

# Conditions for entrepreneurship in Sri Lanka: A Handbook

Edited by Bjørn Willy Åmo



UNIVERSITY OF  
NORDLAND

BODØ GRADUATE SCHOOL OF BUSINESS



University of Ruhuna

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<b>Contents</b>	<b>Page</b>
List of contributors	7
Foreword	17
<b>I - How universities create knowledge</b>	
1 Introduction <i>Åmo, B.W.</i>	21
2 Building capacity in the South: Lessons learnt from a joint Sri Lankan – Norwegian research book project <i>Åmo, B.W.</i>	37
3 A laboratory design for training students in qualitative methodology <i>Sørnes, J.O. and Browning, L.D.</i>	63
<b>II - Entrepreneurs in action</b>	
4 Sri Lankan micro businesses with and without employees: Exploring human capital, perception and business characteristic differences in retail shops <i>Jewanthi, H.A.C., Isaksen, E.J. and Rasmussen, E.</i>	83
5 Challenges faced by SMEs in developing countries adopting ICT: A case study from the hotel industry in Sri Lanka <i>Samantha, R.L., Ganewatta, G.K.H. and Åmo, B.W.</i>	99
6 Challenges facing female entrepreneurs operating in the fish industry: an exploratory study from Sri Lanka <i>Rupasinghe, L.R., Buddhika, S.A. and Åmo, B.W.</i>	115

### **III - Entrepreneurship within established firms**

- 7 Voluntary labour turnover in the textile and clothing manufacturing sector in Sri Lanka: The causes of leaving the employers 143  
*Priyashantha, K.G. and Vinogradov, E.*
- 8 The Impact of owner specific factors on growth of small business: Evidence from Sri Lanka 163  
*Sriyani, G.T.W. and Åmo, B.W.*
- 9 Securing necessary human capital in family businesses after generation changes: The buy or breed dilemma 191  
*Sriyani, G.T.W. and Åmo, B.W.*
- 10 Contingent Just-in-Time (JIT) system implementations: a comparative study from Sri Lanka 215  
*Samadi, M.G.D.S., Ganewatta, G.K.H. and Gårseth-Nesbakk, L.*

### **VI - Budget and finance**

- 11 Does bank ownership matter in performance? Experience and lessons from Sri Lanka 237  
*Wanniarachchige, M.K., Suzuki, Y. and Kjærland, F.*
- 12 Public Sector Accounting Reforms in Two South Asian Countries: A Comparative Study of Nepal and Sri Lanka 257  
*Adhikari, P. and Kuruppu, C.*

## **V - Aquaculture and its environment**

- 13 Mariculture, present trends and future prospects for Sri Lanka 285  
*K.H.M. Ashoka Deepananda*
- 14 Ornamental fishes: trade and transport 315  
*Kiron, W. and Dhanasiri, A*
- 15 A comparative study on quality changes of Arctic shrimp and  
Tropical shrimp during freeze storage 331  
*Alam, N., Sirnes, E. and Solberg, C.*
- 16 Human intervention triggered changes to inlet hydrodynamics  
and tidal flushing of Koggala lagoon, Sri Lanka 347  
*Gunaratne, G.L., Tanaka, N., Priyadarshana, T. and Manatunge, J.*
- 17 Bio-monitoring and assessment of ecological process of  
benthic invertebrate assemblages through pre and post trial-  
impoundment of reservoir 369  
*Takahashi, Y., Asaeda, T., Fujino, T., and Priyadarshana, T.*
- 18 Coarse particulate organic matter exports and characteristics of  
fiber components during different flood events in the second  
order stream 401  
*Fujino, T., Wityi, T., Asaeda, T., Takahashi, Y., and Priyadarshana,  
T.*

## **IV - The interdisciplinary nature of entrepreneurship: Building together**

- 19 The knowledge needed to generate before establishing an  
Aquatic Theme Park in Sri Lanka 421  
*Priyadarshana, T. and Åmo, B.W*  
*With contributions from: Bjørn Willy Åmo, Camilla Risvoll, Chamara Kuruppu, Dorthe Eide, Frode Kjærland, Gihan Muthugala, Hiran Jayewardene, Jagath Manatunge, Konstantin Timoshenko, Nimal Wijerathna, Ove Jakobsen, Thor-Erik Sandberg Hanssen, Tilak Priyadarshana, Tor Geir Kvinen and Øystein Jenssen.*



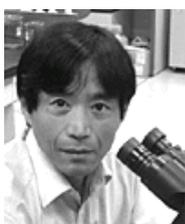
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## Foreword

This book is needed as it helps in translating theories related to entrepreneurship into an understanding of the action on the ground in a developing country influenced by Buddhism. By doing so, the book builds entrepreneurial capacity regarding context and business activities in countries similar to Sri Lanka. The book does this by evidencing a case of co-creation of knowledge involving two universities, University of Nordland, Norway and University of Ruhuna, Sri Lanka. The chapters all relate to how entrepreneurship is conducted, and how the institutional framework in Sri Lanka limits and opens for entrepreneurial opportunities. Together, the chapters evidence the interdisciplinary nature of entrepreneurship.

The book project came into being when The Norwegian Centre for Cooperation in Higher Education (SIU) funded a NUFU cooperation project, “The entrepreneurial university”, as a co-operation between University of Nordland, Norway (UoN) and University of Ruhuna, Sri Lanka (UoR). NUFU is an abbreviation for “The Norwegian Programme for Development, Research and Education”, and its aim is to build research and educational capacity in the south on issues important for the south. SIU is Norway’s official agency for international programmes and measures related to higher education. It is commissioned by several national and international public organisations to administer programmes within all levels of education.

The aim of the book project is to generate new knowledge related to how UoR could facilitate entrepreneurial growth in its region. The NUFU project suggests that exploitations of marine resources could be the content of such an entrepreneurial effort. The studies reported in this book then represent different approaches to an understanding of how the institutional structures hinder or facilitate entrepreneurship in Sri Lanka. The universities involved in the book project hope that the outcome could strengthen our efforts to serve our public responsibilities as knowledge developers and knowledge providers. Universities also have a responsibility to activate knowledge and to help creating viable societies. This we seek to accomplish by doing the research

reported in the book. We also hope that the reader of the book will gain new insights useful in their work.

The teacher in entrepreneurship that would like to offer his students knowledge on the conditions for entrepreneurship in Sri Lanka would find a set of helpful insights. These insights are to some extent also relevant for other developing countries and countries similar to Sri Lanka. The practitioner is also provided support in his strives to understand the limitations and the opportunities that are available in such an environment. The included chapter also offers implication for policy makers seeking to improve the conditions and the institutional framework for entrepreneurship. Aid organizations need to cooperate with the forces shaping the business environment and the findings reported in the book could be helpful in this task. The ones interested in developing joint research between universities in the north (west) and the south (east) are also offered hints for improved practises.

We are grateful for the opportunity offered to us by SIU for to gain more knowledge on conditions for, processes of and results from entrepreneurship activities in Sri Lanka. We would not be able to achieve our accomplishments without the support and guiding from SIU. The contribution from the reviewers is invaluable. Their supporting and constructive critique has enhanced the learning process and improved the papers. I also would like to thank the Vice Chancellor at UoR, the Rector at UoN, the deans at The Faculty of Management and Finance and The Faculty of Fisheries and Marine Sciences & Technology at UoR, and the Deans at Bodø Graduate School of Business and Faculty of Biosciences and Aquaculture at UoN for their assistance. The authors have all worked hard in order to build new competence and share this new knowledge with the readers.

I thank you all for your enthusiasm and effort!

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## **I - How universities create knowledge**



# Chapter 1: Introduction

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**Abstract:** This introduction presents each of the papers included in the book while also providing the rationale for including the given paper in the book. The book reveals conditions for, processes on and outcomes of entrepreneurship in Sri Lanka. Before these issues are addressed, this introduction discusses the theoretical footings for the book. The introduction chapter ends with a discussion on the interdisciplinary nature of entrepreneurship and how this influence entrepreneurship education.

**Key words:** entrepreneurial university, internationalization, co-creation of knowledge, inter-disciplinary nature of entrepreneurship.

## **1 The entrepreneurial university**

Entrepreneurial universities as a phenomenon has received renewed interest. For a university to become entrepreneurial, it must acquire the kind of internal organization that allows it to be in a state of continuous change and adaptiveness, and that allows its members to become more effective (Clarke, 1998). How one could carry this through into realization is still debated. The topic of entrepreneurial universities has been addressed from many angles; as how different national contexts influence on entrepreneurial activities (Dana, 2004), how different national contexts influence pedagogic in entrepreneurship education (Fayolle and Klandt, 2006), how to build a strong entrepreneurial educational program across university faculties (West, Gatewood and Shaver, 2009) and from the point of view of entrepreneurial universities as ecosystems (Fayolle and Kyrö, 2008; Fettes et al., 2010). This book helps toward a deeper understanding on how universities could foster a sustained steady state of change by

displaying a case from Norway and Sri Lanka where universities co-create knowledge in order to stay competitive.

Sporn (1999) describes the entrepreneurial university as a learning university. The author (ibid) claim that in order to stay competitive, universities constantly has to renew their educational programmes in accordance to the need of the society and the student. Kristensen (1999) study, to be found in the same special issue on entrepreneurial universities in Higher Education in Europe as Sporn's (1999) paper, reports from her case that building international alliances could be a route to success for universities seeking rejuvenation. This claim is supported by Zahra and Gilbert (2005) as they point to the increasing globalization of trade. The university has to be mission-centred in this effort toward rejuvenation and build alliances in their effort toward knowledge creation (Zemsky, Wegner and Massy, 2005).

## **2 Internationalization**

There is a great need for internationalization of business education (Doh, 2010). The idea is then that an internationalization of entrepreneurship education would lead to more entrepreneurs daring to take their business internationally (Jones et al., 2008). Wright and Ricks (2004) relate international entrepreneurship to comparisons of entrepreneurial behaviour in multiple countries and cultures. Despite the growing policy and research interest in internationalization of business activities, little attention has been focused on this dimension of entrepreneurship (Zahra and George, 2002). Jones et al. (2008) agrees that little attention has been offered to educational programs related to international entrepreneurship. They argue that this is due to the majority of the recent developments in entrepreneurship education stems from US, where the firms often see the home market as self-sufficiently. The need to address issues as international entrepreneurship is particularly crucial in light of the emergence of small entrepreneurial "born global" firms that are able to take advantage of technological advances to internationalise rapidly (Knight and Cavusgil, 1996).

Jones and Oberst (2003) believe that entrepreneurship "must be taught within the global context; lacking that, graduates will be ill prepared to be internationally competitive" (p. 2). Fernhaber, McDougall and Shepherd (2009) support this view when they argue that international knowledge is a key intangible resource for international entrepreneurship. Their study of 206 ventures suggests that international knowledge may be sourced from alliance partners among others. Zahra and George (2002) point to factors related to the propensity to engage in foreign markets. Their literature review shows that the entrepreneurs foreign work experience and foreign education as well as

the firm's strategy for environmental scanning, all spurs business internationalization. The authors (ibid) conclude that there is much to be gained from conducting comparative analysis of conditions for entrepreneurship. Surely, there are lessons to be learnt by westerners from entrepreneurship in Sri Lanka, India and similar countries (Kundu and Katz, 2000). One reason for the recent success in the Indian computer programming sector is its management practices, low labour cost and a highly skilled workforce (Prashantham, 2004). This book then offers opportunities to study conditions for entrepreneurship as well as examples of enacted entrepreneurship in another developing country, influenced by Buddhist conceptions, namely Sri Lanka.

### **3 Co-creation of knowledge**

Entrepreneurship education has to fit to the cultural and industry context in order to be useful for the graduate and the society (Hytti, 2008). The Global Entrepreneurship Monitor research project clearly indicates that different institutional structures influence entrepreneurial activities differently across countries and that this results in different kinds of entrepreneurial activities (Bosma et al., 2008). Sarasvathy (2001) finds that both entrepreneurship stemming from effectuation and from causation interact with and interpret the business environment. Structuration theory provides some cues on how the environment of the entrepreneurial action influences the actors. Structuration theory puts forward that the actor and the social system co-evolve in an environment where social structures both constrain and enable entrepreneurial activity (Giddens, 1976, 1979). Structuration theory has led to considerations regarding how cues from the environment may influence the entrepreneur's action and how he/she wants to represent these actions.

This implies that knowledge is created as an entrepreneur enters new grounds in his search for profit or gain. Likewise, entrepreneurial universities do create new knowledge in the search for improved footings for education and research. All too often are entrepreneurship education programs or syllabuses copied from a successful university without regard to the context of the copying and the copied university. In the search for educational programs serving the students' need for entrepreneurship skills and the societies' need for entrepreneurs, universities look for best practice in entrepreneurship education at other universities to copy from. Some precautions have to be taken when trying to copy best practice in entrepreneurship education (Åmo, 2011). As there always has to be local adjustments when adopting innovations, the right connotation is translation of innovation instead of transfer of best practice. Likewise, best practice for some implies perfection, or at least being as close to perfection as possible. In the real world there is always room for improvements even for practice that works, even for

practice that works well. Instead of transfer of best practice, what should be is an effort to translate good practice.

The presumption of translating good practice is that what works for one is working for the other. It is well known in innovation research, that there is always a bit invention in the adoption of innovations (Rogers, 1995). An innovation has to be adjusted to the local situation in order to be successful, and the more insightful this adjustment is conducted, the better results the adoption delivers. This implies that when an innovation, as an educational program in entrepreneurship, is to be copied by an institution, some adjustments has to be done. The adjustments needed depend on the purpose of the adoption, the complexity of the innovation, the complexity of the adopting organization and how the environment differs for the copied and the copying institution. This book then offers insight in issues needed to be addressed before a university from Sri Lanka or from other universities in developing countries could successfully translate good practice (that is, good practises as perceived by a western university, based upon theories and practices developed in a Western context) within entrepreneurship education.

The book is an example of co-creation of knowledge related to entrepreneurship. Co-creation is defined as collaboration as a cooperative, inter-organizational relationship that is negotiated in an ongoing communication process, and which relies on neither market nor hierarchical mechanisms of control (Hardy, Phillips and Lawrence, 2003). As the universities involved in the project leading to this book are independent organizations, collaboration best describes their joint efforts toward creating new knowledge (Nonaka et al., 1998; Huxham and Vangen, 2000). Such co-creational actions have to be motivated and orchestrated in order to deliver valuable results (Haga, 2009). Orchestrating is the set of deliberate, purposeful action undertaken by a central actor to create value and extract value from a network (Dhanaraj and Parkhe, 2006). The book discusses how to motivate and orchestrate such actions, and the book displays some of the results stemming from these actions.

#### **4 The inter-disciplinary nature of entrepreneurship**

A while ago entrepreneurship was still not recognized as a separate discipline. Entrepreneurship has long struggled to define its place among the scientific community (Venkataraman, 1997). This is much because it draws heavily from other disciplines such as marketing, organizational development, psychology, strategic management, finance, accounting and culture among others. Entrepreneurship researchers lean on other theoretical field of expertise in their struggle toward understanding business creation

and business renewal. Acs and Audretsch (2003) ask for research that cross-fertilize between adjacent research fields and entrepreneurship, as they argue that this will bring the entrepreneurship domain further. They regard borrowing from other fields as a vehicle for progress in the entrepreneurship domain. Entrepreneurship research is enriched by this influence from other research streams, as Low states it: "A broad range of subjects is the strength of the field" (Low, 2001, p. 21). The authors Ucbasaran, Westhead and Wright (2001) also ask for studies that integrate the inter-disciplinary nature of entrepreneurship.

Not only does entrepreneurship borrow from other research fields. It is also multidimensional in itself. Audretsch, Grilo and Thurik (2007) agree with Wennekers, Uhlaner and Thurik (2002) that entrepreneurship is a multidimensional concept. They argue that "entrepreneurship varies both temporarily and geographically" and that it is "inherently an interdisciplinary subject spanning a broad range of fields, including management, finance, psychology, sociology, economics, political science and geography" (p.3). Neck and Green (2011) further add strategy, law, marketing, accounting, operations and ethics to the list of nearby useful subjects. Network theory and social/cultural theories are yet other subjects that inform entrepreneurship researchers (Amit, Glosten and Muller, 1993). There are a multitude of analytical levels in entrepreneurship research. Audretsch, Grilo and Thurik (2007) go on by stating that entrepreneurship embraces a multitude of analytical levels, these include "the individual, groups, enterprises, geographical locations, industries, countries" (p. 4). Furthermore, entrepreneurship has a variety of costumes. Entrepreneurship embraces start-up of firms (Bosma et al., 2009), corporate entrepreneurship (Burgelman, 1983), social entrepreneurship (Austin, Stevenson and Wei-Skillern, 2006), continued entrepreneurship (Davidsson, 1991), international entrepreneurship (Oviatt, 2005), academic entrepreneurship (Shane, 2004) and entrepreneurship within family firms (Westhead, Cowling, and Howorth, 2001) among others.

By proposing a process model of entrepreneurial venture creation, Bhawe (1994) links other research streams to the business creation activity. The entrepreneur creates a product, market it, attract finance and interact with other actors in the society, and the entrepreneurship student is often asked to prepare a business plan involving many of the before mentioned subjects. This implies that entrepreneurship educators need to be aware how these subjects relate to entrepreneurship. Bhawe (ibid) further stresses the need for empirical process studies of entrepreneurship utilizing a cross section of nearby theoretical frameworks. Luczkiw (2007) suggests another reasons for this interdisciplinary and/or transdisciplinary nature of entrepreneurship. He argues that the

purpose of entrepreneurship education broadens beyond the walls of the business school. Entrepreneurs are found in every sector of the society and relate to much more than just small business owners/managers or self-employed people. Recent developments in entrepreneurship education link entrepreneurship to creativity and being entrepreneurial in one's everyday life. Agents of change and disruption engage in all sorts of activities, hence the field of entrepreneurship is holistic and interdisciplinary in nature. According to Neck and Green (ibid) this quality of entrepreneurship has implications for entrepreneurship education. Modern education in entrepreneurship needs to take account of entrepreneurship being dynamic and cross-disciplinary in nature. The authors (ibid) suggest that students are exposed to different settings where their understanding of entrepreneurship is challenged and broadened. This book adds to our understanding of entrepreneurship as a multidimensional concept linking with many adjacent subjects.

## **5 The content of the book**

The book consists of separate sections. The first section addresses how universities develop knowledge. The second section captures entrepreneurship in action in small and emerging business, while the third section addresses continued entrepreneurship in larger more mature industries. Entrepreneurs depend heavily on finances and infrastructure and support from local and central governments. The fourth section addresses the bank industry and how governments structure their economic activities. The fifth section investigates the conditions for entrepreneurship in an upcoming industry in Sri Lanka, namely aquaculture. The last section evidences the interdisciplinary nature of entrepreneurship by evidencing the complexity of an entrepreneurial endeavour.

### **5.1 Section I - How universities create knowledge**

This section contains five chapters on how universities co-create knowledge and how universities administer their knowledge.

This introduction is the **first** chapter in the book. The introduction discusses how the entrepreneurial university needs to internationalize its range in order to serve its societal purpose and become attractive to the young student. In order to gain knowledge regarding how to do entrepreneurship internationally, universities could form alliances and co-create the necessary inputs to its educational programs. The chapter also argues that the interdisciplinary nature of entrepreneurship necessitates a holistic approach.

In the **second** chapter, “Building capacity in the South: Lessons learnt from a Sri Lankan – Norwegian joint research book project”, *Åmo* presents insights into the process of knowledge co-creation. The purpose of this chapter is to guide others that set forth to orchestrate capacity building by allowing two universities to co-create new knowledge in the form of a book project as the one resulting in the present book. The author presents a number of observations and advises that will assist facilitators interested in providing similar knowledge creation co-operations. The conclusions and suggestions are derived through a case study methodology with elements of action research. The conclusion is that there is a need for goal alignments among the institutions and the individuals involved in such a process. Face-to-face meetings, management involvement together with sufficient funding is vital for success.

*Sørnes* and *Browning* outline a workshop education program for training students in the basics of qualitative methods in their paper “A Laboratory design For Training Students in Qualitative Methodology”. This is the **third** chapter in the book. The authors detail how to teach research students how to excel in collecting and interpreting qualitative data. Some of the Sri Lankan contributors to this book are among the participants of this program. The force of the outlined educational program is that it the students learn by doing and has to reflect of the inherent strengths and weaknesses of these methods. The paper also shows how the outlined educational program has to be adjusted to the students and their background.

This section expands the knowledge base of international entrepreneurship education and provides a framework for other institutions planning or engaged in similar activities by summarizing the efforts of a project developed to co-create knowledge in the area of international entrepreneurship.

## **5.2 Section II - Entrepreneurs at action**

The three chapters in this section address conditions for business start-up as seen from the individual entrepreneur acting in a small firm.

“Sri Lankan micro businesses with and without employees: Exploring human capital, perception and business characteristic differences in retail shops” by *Jewanthi, Isaksen* and *Rasmussen* is the **fourth** chapter in this book. Their paper reports from a survey of 150 small retail businesses exploring which factors are related to increased employment in such businesses. The study identifies several characteristics related to firms having employees and provides empirical data on small firm development in a Sri Lankan context. The findings indicate that both aspects of specific human capital and general

human capital are important when exploring employment size differences. A key finding is the importance of owners' perceptions which may have implications for research and policy related to growth in micro businesses.

The **fifth** chapter in the book, "Challenges faced by SMEs in developing countries adopting ICT: A case study from Sri Lanka", is authored by *Samantha, Ganewatta* and *Åmo*. This paper is designed to reveal and analyze the key challenges faced by SMEs in the hotel industry in a developing country when adopting information communication technologies (ICT). The study uses Rogers (1995) model of adoption of innovations to study adoption and use of ICT. The findings suggest that ICT is perceived as advantageous for the hotel, but the hotels limited access to finance and human capital delimits their capability to exploit advanced ICT. Universities could spur further adoption of ICT by continuing delivering ICT skilled candidates.

*Rupasinghe, Buddhika* and *Åmo* author the **sixth** chapter: "Challenges facing female entrepreneurs operating in the fish industry: an exploratory study from Sri Lanka". This paper investigates conditions for female entrepreneurship in fish industry in developing countries. Women face significant challenges in an industry which has traditionally been gender segregated. Data was collected among 22 female entrepreneurs using focus group interviewees. The findings confirm that there are institutional structures restricting female use and accumulation of capitals in their struggle to run their fishery related self-employing business. This paper offers some political and practical tools to improve the competitive position of the female entrepreneurs.

These chapters discuss how entrepreneurial abilities and human perceptions work together when the individual entrepreneur translate institutional structures into new business ventures. Entrepreneurial opportunities are truly created and acted upon by causation and effectuation.

### **5.3 Section III - Entrepreneurship within established firms**

The "entrepreneurship within established firms" consists of four papers all discussing continued entrepreneurship in larger, more established firms.

The **seventh** chapter in the book is by *Priyashantha* and *Vinogradov* and investigates reasons for the high labour turnover in the textile industry. Their paper is named "Voluntary Labour Turnover in Textile and Clothing Manufacturing Sector in Sri Lanka: The Causes of leaving the Employers". The high turnover reduces work efficiency and hence reduces the profitability and competitiveness of the industry. The authors reveal

fifteen factors that lead to turnover intentions. These fifteen factors were attributed to individual, organizational and environmental levels. The study provides suggestions on how the management of textile factories may address these issues.

Chapter **eight**, “Impact of Owner Specific Factors on Growth of Small Business: Evidence from Sri Lanka” from *Sriyani* and *Åmo* addresses how owner-specific factors links to growth in small and micro sized business in Sri Lanka. A sample of 93 small scale manufacturing businesses from the Southern Province of Sri Lanka was randomly selected. The study reveals that an improvement orientation, industry competence, and management competence are significant related to firm growth while training doesn’t link to firm growth. The findings suggest that formal education now turn more important than on-the-job training for to succeed in the SME sector in Sri Lanka.

*Sriyani* and *Åmo* are also the authors of chapter **nine**: “Securing necessary human capital in family businesses after generation changes: The buy or breed dilemma”. The purpose of this paper is to reveal the strategies family firms undertake in order to secure necessary levels of human capital in their management positions. Family firms goes to length in order to breed their own stock of human capital, but are very reluctant to buy such by hiring non-family members as managers. This study applies a case methodology and derives data from one of the many family businesses located in southern part of Sri Lanka. The paper discusses the strategies a family firm could pursue in order to secure updated and sufficient human capitals.

Chapter **ten** by *Samadi*, *Ganawatta* and *Gårseth-Nesbakk* is titled “Contingent Just-in-Time (JIT) System implementations – a comparative study from Sri Lanka”. The chapter uses contingency theory to study the decision of two firms to utilize Just-In-Time as their management philosophy. The presumption was that firms in less developed parts of the world with less favourable infrastructures are delimited from benefitting JIT technologies. Instead, the findings reported in this case study suggests that firms have the opportunity, in part at least, to construct and/or reshape variables that impinge on their suggested management tools.

The common theme in these chapters researching entrepreneurship within established firms are conditions for continued entrepreneurship. One of the emerging findings is that Sri Lanka is increasingly influenced by the globalization trend. It is no longer sufficient to get business training by working one’s way up the organizational ladder, one also need formal knowledge and international experiences in order to succeed.

## 5.4 Section IV - Budget and finance

This section in the book offers two chapters investigating institutional structures for entrepreneurship in Sri Lanka, exemplified by how the financial markets are working and how the government in Sri Lanka administers its financial resources.

In chapter **eleven**, “Does bank ownership matter in performance? Experience and lessons from Sri Lanka”, *Wanniarachchige, Suzuki and Kjærland* draws upon the experience of the Sri Lankan banking system during the period 2000-2007. This study provides quantitative estimates of revenue-based performance using Data Envelopment Analysis (DEA). The study finds strong evidence to suggest that foreign banks perform better than domestic banks. The findings of the study imply that promotion of foreign bank ownership and creation of public confidence with regard to the credibility of private and foreign banks can be employed as important policy measures to enhance performance.

*Kuruppu and Adhikari* author the **twelfth** chapter in this book. Their chapter is titled “Public Sector Accounting Reforms in Two South Asian Countries: A Comparative Study of Nepal and Sri Lanka”. The authors offer a comparison of two developing countries, Sri Lanka and Nepal, regarding how they react to the pressure to improve their public sector accounting systems. The implications from their study shows that champions for public sector accounting and budgeting reforms need to ensure that the users of these reforms are well trained and educated in order to implement and utilize the reforms.

These two papers show how financial institutions in Sri Lanka have changed. The papers then hints for paths Sri Lanka could take for to further improve vital conditions for entrepreneurial activities. How access to finances and how finances are accounted for colour entrepreneurship.

## 5.5 Section V - Aquaculture and its environment

Six chapters evidence the conditions for entrepreneurship in a given industry, the marine sector.

Chapter **thirteen** “Mariculture, present trends and future prospects for Sri Lanka” by *Deepananda* describes the development in aquaculture of marine species as a world wide industry. He describe in detail the history and the progress made in this industry in the world and Sri Lanka, and suggests future avenues proposed to lead to further prosperity for the Sri Lankan people and the individual entrepreneur engaging in this sector.

“Ornamental fishes – trade and transport” by *Viswanath* and *Dhanasiri* is the **fourteenth** contribution to the book. They discuss the challenges associated with capturing, breeding, transporting and trading of ornamental fish. They point out that ornamental fish trade practices need to be based on better scientific guidelines in order to make the industry a success. In addition, suitable management policies and greater public awareness are necessary to drive the ornamental fish industry forward; with sustainability at the forefront of these developments. They have highlighted ways to advance the industry in Sri Lanka so as to compete in the global market.

The next chapter, chapter **fifteen** by *Alam, Sirnes* and *Solberg*, “Comparative study on quality of Arctic shrimp and Tropic shrimp during freeze storage” investigates under which conditions exporters are able to deliver premium quality for a premium price. They study the quality of shrimps stored at -20°C and at -40°C. This study evidences the importance of a well functional and efficient logistic system when producing marine based food made for export.

Chapter **sixteen**, “Human intervention triggered changes to inlet hydrodynamics and tidal flushing of Koggala lagoon, Sri Lanka” by *Gunaratne, Tanaka, Priyadarshana*, and *Manatunge*, discusses how to restore a hydraulically disturbed lagoon system. They derive an alternative for lagoon management option, suggesting several measurements and techniques in order to secure systematic water exchange with sea that may enhance the biological stability of the lagoon. The ultimate objective of this study is to enhance small scale fishery of the lagoon. Such a management system is of high demand due to increased pressure from people’s exploitation on aquatic systems.

*Takahashi, Asaeda, Fujino*, and *Priyadarshana* author the **seventeenth** chapter of the book: “Bio-monitoring and assessment of ecological process of benthic invertebrate assemblages through pre and post trial-impoundment of reservoir”. This paper identifies the nature of the stress on benthic invertebrates during the period of construction and operation of a dam. They have identified that the stress on benthic components of river ecosystem arises from quantity and quality of seasonal availability of food for organisms. The study reflects that negative impact of dam construction on stream biota could be minimised through long-term monitoring and assessments.

In paper **eighteen**, “Coarse particulate organic matter exports and characteristics of fibre components during different flood events in the second order stream”, the authors *Fujino, Wityi, Asaeda, Takahashi*, and *Priyadarshana* reveal how natural flood events

influence the quality of the exported Coarse Particulate Organic Matter (CPOM). They have identified flood timing and magnitude as the important determinants that affect the quality of CPOM. This study broadens the understanding of ecological processes of streams.

The lesson to be derived from these papers that relate to entrepreneurship is that there are infrastructures present that support new business initiatives within the marine sector. The papers also show that such entrepreneurial initiatives need to take account of the environment and the local regulations in its realization. Green and ethical entrepreneurship is gaining momentum both as a research topic but also as a way to gain comparative advantages. The paper also hints that there are untapped business potentials that could be fuelled by novel research.

## **5.6 Section VI - The interdisciplinary nature of entrepreneurship: Building together**

The end chapter (paper **nineteen**) by *Priyadarshana* and *Åmo* legitimizes the links between the addressed entrepreneurship, management, finance and aquaculture subjects discussed in the book. The last paper discusses some of the challenges related to the realization of an aquatic park implies. The paper clearly shows that entrepreneurship benefits from, and is dependent on a multitude of subjects. The core of entrepreneurship is the enactment of an opportunity and entrepreneurship research try to explain how the entrepreneur discover or create the opportunity. As this paper evidences, the actual exploitation of the opportunity involves other subject areas than just entrepreneurship.

Entrepreneurship has been described as a blossoming field that cuts across several disciplines Acs and Audretsch (2003). This book is an example of such. This anthology consists of joint research informed both from a Western (Norwegian) and an Asian (Sri Lanka) perspective. It is novel in its kind as the papers are truly joint research, almost all paper has a Sri Lankan and a Norwegian contributors. The research is on Sri Lanka, with Sri Lankan data, by Sri Lankans, on Sri Lankan issues for those interested in entrepreneurship, international business, aid and development as well as how independent universities are able to co-create new knowledge. The book helps in translating good practises by highlighting some of the local adjustments that need to be considered when utilizing entrepreneurship theories on the Sri Lanka reality.

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## Chapter 2:

### Building capacity in the South: Lessons learnt from a joint Sri Lankan – Norwegian research book project

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**Abstract:** This chapter offers insights into the process of knowledge co-creation, as well as reflections on how the actions undertaken by the implied parties added to achieving such a goal. The purpose of this chapter is to guide others that set forth to orchestrate capacity building by allowing two universities to co-create new knowledge in the form of a book project as the one resulting in the present book. The purpose of the activities leading to the present book is to build capacity on how to understand and enact entrepreneurship. During this process the project also builds capacity on how to create such capacities. While arranging for this co-creation of knowledge we were also able to reflect on how knowledge could be created and orchestrated in the intersection between two spatially different located universities. This chapter then provides insight on how to co-create such capacities. The conclusions and suggestion are derived through a case study methodology with elements of action research.

**Key words:** collaboration; empowerment; orchestrating; creating knowledge; book project.

#### **1 Introduction – the reasons for the book**

The book project was initiated by a challenge. University of Nordland, Norway (UoN) and the University of Ruhuna, Sri Lanka (UoR) were not able to find a third suitable candidate for a PhD-student position funded by SIU. The Norwegian Centre for Cooperation in Higher Education (SIU) funded a cooperation project, “The entrepreneurial university”, between UoN and UoR where three young staff members from UoR were enabled to

study for a PhD at UoN. Two suitable candidates were located. One PhD student accepted a position at Bodø Graduate School of Business (HHB) at UoN, investigating markets structures for ornamental fish from Sri Lanka, and one PhD student at Faculty of Bioscience and Aquaculture (FBA) at UoN investigating efficient transport methods of ornamental fish from Sri Lanka to Europe. The third position was vacant; hence we had to rethink how we could build research- and educational capacity in the south for the excess funding. As this study shows, a problem can sometimes result in opportunities for alternative cooperation.

The mission of SIU is to promote and facilitate cooperation, standardisation, mobility, and the overcoming of cultural barriers to communication and exchange within the realm of higher education on an international level. SIU is Norway's official agency for international programmes and measures related to higher education. As a part of SIU's work, they offer The Norwegian Programme for Development, Research and Education (NUFU). The NUFU programme supports independent academic cooperation based on initiatives from researchers and institutions in the South and their partners in Norway. The goal of the NUFU programme is to support the development of sustainable capacity and competence for research and research-based higher education in developing countries relevant to national development and poverty reduction, and to contribute to enhanced academic collaboration in the South and between South and North (SIU, 2010). Our NUFU project aims at developing an entrepreneurial region in the southern part of Sri Lanka. It does so by building upon local knowledge and opportunities, where these capacity building efforts are research-driven and research-based. Capacity building does not necessary manifest in a PhD; it can also result itself as published research. As the problem was excess funding and the purpose of the funding was capacity building in the south, we decided to join forces in joint research and publish this research work in a book. This chapter reflects on the choices we made in the work leading to this anthology. The purpose of these reflections is to contribute toward others that in a similar way would like to engage in creating knowledge and building capacity between two countries. How to guide independent individuals in inter-organizational networks toward a prescribed goal is not fully understood yet (Vangen and Huxham, 2003).

In order to deliver education of good quality, HHB finds it important that education is research based (HHB, 2010). This is their motivation behind their north-south cooperation efforts. The ever increasing globalization adds to the interaction among countries. The economical relationships between Sri Lanka and Norway have been strengthened recently (Hillestad et al., 2002; DevFin Advisers, 2009). This implies that the local industry and students at UoN wants an Asian exposure. There is then a need

for generating knowledge regarding Asia and Sri Lanka that relates to educational offerings at UoN. Likewise, as Norwegian and Sri Lankan firms establish links and relationships, this necessitates Sri Lankan knowledge on issues relevant for Sri Lankan businessmen doing business with Norway. The University of Ruhuna is then interested in validating its knowledge and building new knowledge through research, providing its students updated and relevant education (University of Ruhuna, 2010). Hence, the book project fits well with the organizational aims of SIU, UoR and UoN. Even if the overall goals of the three involved institutions are coherent, as reported elsewhere in this chapter, the co-creating process is not straight forward.

The aim of this chapter is to generate new knowledge related to the process of knowledge co-creation. The chapter starts with a section outlining the theoretical framework for understanding collaborative learning and its orchestrating. Then the chosen method is presented. The emerging of the book displays the timetable of the process along with the vehicles used to reach the set milestones. Then we elaborate on the budget and the incentive system used to activate the actors toward the overall goal. The achievements of the book project are then presented together with its experienced limitations. This then give footings to the final section where the reflections are offered as guidelines and advices for others that set forth to orchestrate capacity building by allowing two universities to co-create new knowledge. The research question of this paper is then: How to orchestrate collaborative learning?

## **2 The theoretical framework that guide the insights**

This section expresses the theoretical framework that guided the understanding of the book project which this chapter reports from. The theoretical framework that guided understanding of the emerging book project related to collaboration, empowerment and orchestrating. This chapter contributes to theory by revealing how to develop appropriate forms of co-operation; as such discussions are relatively rare (Nooteboom, 2006). The chapter also briefly discusses the need for research taking account of the social institutions that constitute the business environment. Such insights motivates all situational research, hence it was a strong motivator for the book project as well.

### **2.1 Collaboration, empowerment and orchestrating co-creation of knowledge**

Hardy, Phillips and Lawrence (2003) define collaboration as a cooperative, inter-organizational relationship that is negotiated in an ongoing communication process, and which relies on neither market nor hierarchical mechanisms of control. The term collaborative then describes independent organizations that are working together (Huxham and Vangen, 2000). The advantages of collaboration relates to the synergistic

outcome of the joint activities indicating that the gain could not have been achieved by any organization or individual actor alone (Vangen and Huxham, 2003). The outcome could be a strengthened competitive position as the capability built by the collaborative process is hard to imitate by competitors (Prahalad and Hamel, 1990). One emergent research stream within collaboration research is that of knowledge creation in which the partners jointly develop new knowledge (Nonaka et al., 1998; Hibbert and Huxham, 2005). Multiple forms of values are reported resulting from inter-organizational learning collaborations; individual capacity building, operational value, reputation and relationship building (van Winkelen, 2010). Several obstacles exist in the process of reaping this value. There are inherent difficulties in specifying the goals of the collaborative actions (Eden and Huxham, 2001). As there is a lack of traditional hierarchy other remedies for government has to be put in place in order to manage the collaboration (Vangen and Huxham, 2003). One way of overcoming this problem of management is to develop commitment to the common goal among the participants (Hibbert and Huxham, 2005).

One way of activating this commitment is through empowerment. Empowerment is increased intrinsic motivation (Thomas and Velthouse, 1990). Spreitzer (1995) shows that empowerment manifest itself in four components reflecting the individuals orientation toward a work activity. These components are meaning, competence, self-determination and impact. Meaning is then the fit between the individuals own personal goals and the goals of the work activity as it is perceived by the individual (Brief and Nord, 1990). Competence relates to self-efficacy and describes to what extent the individual feel competent to perform the given work task (Bandura, 1989). Self-determination is the individuals own perception of having autonomy in work behavior (Spector, 1986). Impact is then the extent the individual feel to control the work processes leading to a successful outcome (Thomas and Velthouse, 1990). Kanter (1989) stresses the importance of information in order to be empowered. This is information on how the work contributes toward the goals of the organization (Åmo, 2006) and information on how the organization evaluates the performance of the individual (Lawler, 1992). For the employee to be empowered, there also need to be in place a reward system that acknowledge the contribution from the employee (Lawler, 1986).

Orchestrating can be viewed as a tool to align the individual actions toward a preset goal. Orchestrating is the set of deliberate, purposeful action undertaken by a central actor to create value and extract value from a network (Dhanaraj and Parkhe, 2006). Haga (2009) suggests five main enablers that bring networks into action. These are network management, network infrastructure, training programs, leadership and

processing roles. Network management is the process of building internal resources, relationships and processing roles. Haga (ibid) further define network infrastructure as the organizational tools that structure the way people and organizations cooperate. Training programs are defined as the deliberate efforts set in place to develop skills and knowledge sufficient for the actors to cooperate. Leadership is the involvement of the significant others that define which actions a group finds suitable (Denzin, 1966). Processing roles is the managed processes than governs the links the network have and develops with the external environment.

## **2.2 The need for local embedded knowledge**

There are many evidences that the conditions for entrepreneurship differs among countries (Bosma et al., 2009). Among the causes of these differences are the institutions that humans construct in order to regulate human actions (North, 1994). These constructs and constrains consists of laws, rules, conventions and norms of behaviour. The social institutions provide the rules of the game and define the actor's available modes of action (Scott, 1995). There are a wide variety of ways how people interact with each other and how they expect other to behave in certain situation. Some researchers argue that these norms to a large extent decide societal and economical success (Weber, 1952; Bjerke, 1999). One important issue in institutional theory is how the environment influences over how people organize their businesses (Aldrich, 1999).

Research strives to build common theories describing and predicting human actions. A theory is a statement of relations among concepts within a set of boundaries and constraints where implicit assumptions found the borders of a given theory's usefulness (Dublin, 1969; Bacharach, 1989). Lakatos (1970) argues that the interpretive hard core of a theory is enclosed by a 'protective belt' of supporting explanations. Theories are based on socially constructed notions which take on different meanings in different contexts and spatial and temporal boundaries restrict the empirical generalizability of the theory (Bacharach, 1989). This protective belt is then the explanations related to the spatial and temporal boundaries used to test the borders of the usefulness of the theory itself. There is then an assumption that the differences in culture, social norms and other social institutions will affect the usability of the theory. Hence, there is a need to test generally accepted theories in different local contexts. Applying presumably well functional theories in other contexts stresses the theories and allows deeper understandings on the limitations of a theory.

### **3 The methodology**

In order to reach the derived reflections, a case based participatory action research methodology was utilized. The data was gathered as the book project evolved, and the researcher orchestrating the book project is also presenting the reflections on the dynamics of this process. The book project started as an idea for a possible solution to a dilemma. The dilemma took place in June 2008 when it became evident that we were not able to dress all three promised PhD positions at UoN with young staff from UoR, but had to settle with only two qualified applicants. The available resources had to be transformed from financial capital into human capital (Becker, 1964). The events are still unfolding at the time of writing this chapter, still reviewers are to be called, still authors have to be reminded to revise their papers, still reviewers have to be addressed, and still time limits are stretched.

Action research is an iterative process involving practitioners and researchers acting together in problem solving, action intervention and reflective learning (Avison et al., 1999). Action research often has an intentional design, the researcher structures a process of activities leading to mutual learning as well as it represents an improved route to the initial goal of the activity. This implies an ongoing discussion and negotiation between the researchers and the other participants leading to unforeseen actions and conclusions (Andersen, Boud and Cohen, 2000).

'There is nothing as practical as a good theory' (Lewin, 1951:169). This implies that the proof of a good theory lies in its ability to generate social value, and that theory can and should be generated through practice (Brydon-Miller, Greenwood and Maguire, 2003). Coghlan and Jacobs (2005) claim that it is not enough to explain things, it is also necessary to change them, and to involve others in this change process. Participatory Action Research is a powerful methodology for advancing scientific knowledge as well as for achieving practical objectives (Whyte, 1989). Participatory research is when one or more of the study objects play more active roles than simply those of passive informants. Participatory action research is client-centered research in that it is focused on practical problems important to the client or client organization. The client could be the researcher him or herself, as Whitehead (1994) claims that action research is a systematic form of investigation undertaken by practitioners in order to improve the quality of their own practice. Participatory action research then is a vehicle for practical problem solving and for generating new theory, and for enhancing the skills and competencies of both the researchers and the participants (McKay and Marshall, 2001). Action research is then collaborative; a group of people addressing a social issue (Noffke, 1997).

Inductively oriented knowledge by participatory action research implies reflections on the actions undertaken. A high degree of orderliness is required in preparing for and ensuring completeness and purposefulness in these reflections, while holding on to and purify the emerging research content of each episode of action and involvement (Eden and Huxham, 1996). The reflection undertaken and presented by the involved researcher then has to be made evident for the reader in order to make the analysis convincing. These reflections have to relate to the problem solving method applied and to the research method used as well as on the findings or conclusions of the study (McKay and Marshall, 2001).

A case study provides opportunities to explore and richly describe the existence of a phenomenon (Siggelkow, 2007). Data was collected through document studies, participatory observation, conversation and interviews while facilitating the process leading to the creation of the book. The data elements have been analysed using an interpretive approach guided by the propositions developed in the theoretical section in the paper (Yin, 2003). The internal validity of the conclusions is strengthened by pattern matching in comparing the empirically based pattern with the theoretically predicted one (Trochim, 1989) in a search for alternative explanations.

#### **4 The case: the emerging of the book**

The book started with an approval from SIU. UoN and UoR then arranged a week long visit from UoN to UoR in Sri Lanka. The visit included meeting at institutional level in Ruhuna, Sri Lanka in March 2009 where the details in the book project were discerned. The details of the agreement are displayed in appendix 1. The purpose of the visit was to strengthen the ties between the two institutions and the individuals representing the institutions. Human capital theory prescribes face-to-face meetings as a mean for strengthening human ties (Granovetter, 1973). The visit also allowed guided tours at campus of UoR to be acquainted with the Sri Lankan staffs working conditions, along with their library and computer facilities. The heads of the two institutions addressed the staff in mass meetings informing about the possibilities this book project represent for the staff. A week later, an e-mail explaining the book project and how to participate in it, was sent to all staff members in suitable faculties at UoR. The e-mail expressed the time table for the project and how the staff member could join the book project.

The e-mail expressed that University of Ruhuna has agreed to:

- Encourage staff members to write chapters to the book
- Grant sufficient time to fulfil the writing assignments
- Provide local arrangement for the writing course and the workshop

The research reported in the book is supposed to be joint research between staff at UoR and UoN. As a result of this, most of the papers both have a Norwegian and a Sri Lankan author. We wanted the book to be more than another collection of single authored work on a given topic; we wanted the book to be a vehicle for communication and capacity building. When working together on this research, the Norwegians were invited to know more about the Sri Lankan context regarding their professional interest.

Implementing action based research upon a theoretical understanding of a matter then needs an understanding of how the local context influences the outcomes of the action (Das et al., 2009). The Norwegian gain knowledge on the Sri Lankan context and insights on the usability on theories usually applied in their profession. The Sri Lankan built capacity to do research in their field of professional interest. The research was initiated and propelled by the Sri Lankan counterpart, while the Norwegian counterpart assisted and adjusted the progress ensuring the research quality. Such a methodology allowed the Sri Lankan counterpart to reflect upon the contributions and suggestions made by their Norwegian counterpart. Learning needs action, feedback and reflections (Dewey, 1916; Piaget, 1928; Vygotsky, 1978; Schmidt, Choen-Schotanus and Arends, 2009). The structure for collaboration outlined in the book project allowed for self initiated action, relevant and timely feedback and hopefully it also provided room for reflections and thus learning on how to do research and report it in the format of a paper. Besides contributing towards skills in research and paper writing, the research book project also aimed for creating knowledge useful in the university classroom. A university teacher capable of doing his or her own research, is also more capable of judging the quality and contribution of others research. This implies that their teaching also becomes of higher quality. The involved university teachers are then better able to base their teaching on their own and others research relevant for their teaching.

To kick off the project, an e-mail was sent to all scientific staff at all relevant faculties at UoR. The e-mail referred to the visit and presented the book project, asked for a brief abstract, approximately 3 pages, on their suggested research, delivered before 10<sup>th</sup> May 2009. A template for the abstracts was attached to the inviting e-mail (Appendix 2). The e-mail promised that we would find a Norwegian co-author for each paper. The first meeting then established the project, set forth a timetable and invited the staff members to participate. We received 11 paper ideas from Sri Lanka. The editor of this book then invited all staff at HHB and FBA to participate as coauthors on the suggested papers. This was done by e-mails, as information at mass meetings and as personal invitations.

The next milestone in the project was a week long workshop at UoR in October 2009. The purpose of the second workshop was to ensure knowledge on how to structure a paper, how to do insightful qualitative research, how to analyze qualitative data, how to write a paper and how reviewers read papers. Lectures were delivered on research methodology, research publication and the review process. There were also discussions on how to understand and respond to the comments from the Norwegian counterpart. The Sri Lankan participants were asked to prepare presentation of their research to the others in the group and to the Norwegian professors. Time was also set aside within the workshop for providing comments on how the received three-page abstracts could be developed into full fledged papers. The suggested Norwegian co-writer had commented on the submitted abstracts. The comment consisted on suggestions for how to formulate the research problem, further readings on how to understand and investigate the phenomena, and suggestions on methods to address the problem. These comments were then delivered orally and later on in writing at the presentation by the attending Norwegian professors. In addition to the submitted abstracts, additional 8 paper ideas were presented and commented on. The Norwegian delegation consisted of four persons, two professors focusing on the qualitative research methodology, and two focusing on the paper writing process. The time schedule of the second workshop is displayed in figure 2.1.

Session	Monday	Tuesday	Wednesday	Thursday	Friday
<b>Morning</b>	Welcome speeches Introduction to the workshop	Presentation and discussion of reviews	How to sample qualitative data	Presentation and discussion of text analysis	Presentation of own study
<b>Lunch</b>					
<b>Afternoon</b>	Academic writing How to publish How to review	What is qualitative research	How to analyse qualitative data	Presentation of own study	Presentation of own study
<b>Home work</b>	Review of article		Text analysis		

**Figure 2.1** The time schedule of the second workshop at University of Ruhuna, October 2009.

The Sri Lankan staff members engaged in the book project had at this point of time been provided suggestions and comments on their research. The next step was now to prepare a full length version of their paper (around 5-6000 words) by January 2010. A Norwegian counterpart was found for each of the 30 paper ideas present in January. Their counterpart in Norway was to review and comment on the full length paper. The communication regarding the papers was now directly between the Sri Lankan and the Norwegian counterparts.

We then arranged a workshop at UoR in March 2010 enabling the Norwegian and the Sri Lankan counterpart to meet face to face and discuss their joint paper. This workshop also lasted a week. The Norwegian delegation was then 9 academics co-authoring 25 of the 30 papers scheduled to be discussed at the workshop. The authors were initially given some time to discuss their paper and adjust their presentations. Each paper presentation lasted 30 minutes, allowing a deep discussion on the actualization of the research topic, the theoretical approach to describing how the different element of the problem related to each other, the methodology to use in investigating it, how to analyse the data and which implications to draw from the study. The workshop in Ruhuna in March 2010 then allowed deeper discussions on how to develop the paper. The time schedule of this workshop is displayed in figure 2.2.

Session	Monday	Tuesday	Wednesday	Thursday	Friday
<b>Morning</b>	Welcome speeches Introduction to the workshop	Paper session 1	Paper session 3	Joint sight-seeing	Unscheduled time
<b>Lunch</b>					
<b>Afternoon</b>	Prepare presentations No-SL together	Paper session 2	Group work	Joint sight-seeing	
<b>Social event</b>	Dinner	Dinner	Beach party	Joint sight-seeing	

**Figure 2.2** The time schedule of the third workshop at University of Ruhuna, March 2010.

From this point, there was a joint authorship of the papers. Both the Sri Lankan and the Norwegian counterpart were responsible for developing this paper up to the standards of the book. The authors were provided a template for the papers, describing both content and layout as well as how to arrange the references (see appendix 2.3).

To further enhance capacity building among the participants, we arranged for several review circles on the full papers. The participants were urged to review two or three of the papers they were not involved in as authors. This ensured feedback on how to improve the paper, both regarding the suitable theoretical framework and the practical Sri Lankan implications of the findings. When the paper was accepted by the internal cohort of reviewers, the paper was then examined by reviewers external to the two institutions and to the project to ensure objectivity and rigorousness.

## **5 Budget and incentives**

The book project seeks to create incentives both at institutional level and at the individual level. The incentive for SIU was the human capital capacity built in Sri Lanka regarding research and education related to the purpose of the granted NUFU project. The two universities were interested in the project because of its potential to deliver needed knowledge on conditions for doing business in Europe and Asia respectively. The new gained knowledge would inform and improve their education and teaching of their students.

The staff at UoN and UoR also needed to be motivated toward this effort. To ensure incentives for the scientific staff at UoR a monetary incentive was put in place. A publication in this book is to be honored by an equivalent of 400 € pr chapter. This award will be shared among the Ruhuna staff that authors the chapter. This amounts equal to 1- 1 ½ months salary. This was then in addition to the increase in personal intellectual capital as increased ability to write scientific papers, their increase in knowledge about the subject studied and their increase in reputation as a skilled academic publishing papers. The available budget was not sufficient to support any monetary incentives for the Norwegian co-authors. As engaging in writing papers together with a partner presumed not as skilled as oneself, usually involves more work than writing together with someone more skilled, we decided to add a small incentive for the Norwegians as well. The book project was in need for at least one physical meeting in order to strengthen the ties between the actors. We could either arrange this meeting in Norway or in Sri Lanka. If we were to meet in Norway, all 20-30 Sri Lankan co-writers had to fly to Norway and stay there for a week. Norway is an expensive country to stay in. We concluded that it was less expensive to bring the 8-12 Norwegians to Sri Lanka instead. The trip to Sri Lanka in March 2010 then became the affordable incentive for the Norwegian co-authors. When recruiting Norwegian co-authors we also emphasized the gain in intellectual capital this Norwegian-Sri Lankan research represented.

The costs associated with creating the knowledge recorded in the book included travel and accommodation for 3 workshops in Sri Lanka. There were 16 persons travelling that had to be accommodated for a week each, the costs also included local arrangements by the hosts, the publication reward to the Sri Lankan authors, and the cost of preparing the book. In addition to this, there is all the time devoted by the administration and the scientific staff at both the universities involved in arranging the workshops and conducting and reporting the research. These man-hours are not recorded and do not show in the financial statements of the project, even so, these costs are substantial.

## **6 Success and limitations**

The book speaks for itself; the project is a success as such. Eighteen chapters encompassing substantial scientific achievements can be reported. The book project has provided great opportunities for building relationships between young researchers, its deliveries is within time and budget restrictions and the stakeholders expectations are fulfilled. The research has provided new insights that will inform education, policymakers as well as it will improve practice among future businessmen. Even so, everything can be improved; this section of the chapter provides some suggestions for improvements in processes where research institutions seek to elaborate on each others competences and build further knowledge. The hope is that the good relations between the co-acting institutions and individual researchers will continue to deliver new knowledge and insights beneficial to Sri Lanka and Norway.

By addressing young staff we can expect the built capacity to last longer. On the other hand, engaging more experienced academics would perhaps provide deeper insights that would have a stronger impact on the educational and research trajectory of the involved universities. Incentives engaging also older staff need to be implemented in future co-operating projects in order to reap the full potential of such a project. Older and more experienced staff usually holds more influential positions at the university; hence they are able to allocate additional resources as attention, time and money to the project.

The staff at UoR involved in the book project is mostly young staff, holding a MSc or an equivalent to this, they have a temporary position, and their assignments is mostly related to teaching. The incentive for the Sri Lankan authors includes a monetary publishing reward in addition to the gained knowledge and reputation. The monetary reward is to be paid when the book is published. The many requests for additional time when deadlines were due indicated that they were heavily engaged in giving lectures at their home university, allowing them to allocate little time for the writing project. If they find it hard to secure an income by their ordinary work, then the publishing reward should be an incentive. On the other hand, the reward might have been seen far ahead in time, while the work of writing the paper an immediate action. Maybe some valued the immediate smaller secure reward now from giving lectures higher than the unsecure bigger reward coming at a much later point in time. A suggestion stemming from this insight could be to give some part of a publication reward at the point of handing in the abstract, another piece when the full paper was submitted and the main part at the date of publication. The author of the book is co-authoring many of the chapters in the book, this is as it was difficult to engage full-time-occupied Norwegian colleagues in a risky and

entrepreneurial endeavor as this book represent. The Norwegian participators were younger staff holding a PhD. The incentive for the Norwegian could also be improved. The project did not provide them any compensation for their time. Travelling to exotic Sri Lanka was interesting for a young academic, while an older and more experienced researcher would maybe regard travelling as a burden. This implies that the incentive scheme set up for the Norwegians attracted younger staff not as experienced as some of the older professors reluctant to participate.

One area for improvements that would show itself in enhanced research quality is stretching the process allowing more time for the participants to progress on the activities needed for doing research. The Sri Lankan coauthors was in charge of the writing process at the beginning, and there have been numerous excuses and requests for postponing time limits for handing in abstracts, papers and revised papers. This could be due to them being inexperienced in the academic style of paper writing. The clue would then be to install instruments that secured that the additional time was spent on improving the paper. One remedy to encompass this could be to arrange for another physical meeting between the coauthors from Sri Lanka and Norway. Maybe this meeting could be arranged as a scientific conference where also other researchers than those engaged in the project was invited to attend and present their work. The benefit of another forceful checkpoint regarding progress would then be weighted against the financial cost of arranging such a meeting.

A problem that faces such collaboration is limited access to computer resources in the south, both when writing and editing the document, but also when running statistical and textual analysis. Another issue is access to literature. The Norwegian university can afford access to databases containing literature, while the Sri Lankan does not afford this to the same extent. The copyright agreements do not allow Norwegians to share their access with their Sri Lankan partners, implicating that the Norwegians has to contribute substantially to the theoretical development of the paper. In some occasions books and articles was purchased and sent by post to the Sri Lankan coauthor. Attention from Deans, Rectors or Vice Chancellors is a signal of the importance for the institutions of the project. Such attention has been important in securing the project. These authorities were present at all the meetings and workshops. As the purpose of the workshops was to build relationships between the authors and commitment toward the paper writing process, we intentionally made the workshop programs for one week each. The first meeting established common grounds for the book project. The second meeting was a workshop where the research ideas were discussed in relation to how to do research and how to report in a paper format. The last workshop allowed the

coauthors to meet in person and discuss details regarding their common work. The face-to-face meeting boosted the collaborative writing process.

In order to facilitate rich communication and cooperation on the paper, we arranged the last workshops outside of the university campus area. This was a deliberate design; we wanted to maximize the attention toward the workshop among all participants. Spending time together builds ties. The budget did not allow us to take all the participants away from home to another location. We then arranged half of the second workshop at the university campus. We arranged for long lunches and dinners close to the campus where the co-authors could mingle and talk. The second half of the workshop we stayed at the tourist hotel where the Norwegians lodged. There we arranged beach parties and cricket games in between the academic sessions. We also arranged so that the Norwegians and the Sri Lankans performed folk tunes for each other. All this made it fun to work together and it took away the edge of distance between the co-authors.

## **7 Reflections and advices**

The theoretical framework and the data indicate that in order to orchestrate collaborative learning one needs empowered actors striving to reach a common goal. This is a project where independent organizations join forces on a common project. We see that establishing common goals and communicating these to the actors increases their willingness to invest time and effort in the project. As the organizations are universities and the individual actors are scientific staff, publishing research is one of the measures of personal success. Hence we see that the goals of the project align with the goals of the individuals and there is a good fit between the individuals own personal goals and the goals of the work activity. The project tried to offer means of increasing the individual felt competence in performing the task of writing a scientific paper. Lectures on scientific methods, paper writing, and responding to reviewers were offered along with co-writing together with more skilled academic writers. As the basic research idea stemmed from the Sri Lankan counterpart, they were given a high degree of self-determination. They were able to determine for themselves if they wanted to contribute, define the topic and could decide on how they wanted the paper to progress. As the Norwegian engaged in the paper, the Sri Lankan lost some impact power. The Norwegians had to bring the theory to the table, and had to secure the scientific accuracy and format to the paper. This was intentionally; we wanted the Sri Lankan to learn by riding along on this part. On the basis of the discussion on collaboration, empowerment and orchestrating related to knowledge creation along with the empirical data presented, the following proposition is stated:

*Proposition 1* In order to orchestrate collaborative learning one needs empowered actors striving to reach a preset goal.

This section also presents some advices derived from the process of creating the knowledge materialized as the book you are presently reading. The reflections and advises relates to the process of orchestrating independent actors toward generating new knowledge. Even if the realm of the advices is limited, the hope is that it will stimulate others to engage in seeking knowledge outside their normal harbours (Das et al., 2009).

The co-authors have to meet face to face. In order for the Norwegians to give good advices on which theory that would explain and predict (Bacharach, 1989) a given phenomena, they need to get a good grip of the context where the theory is to be applied. This they get from experiencing Sri Lanka first handed and from deep discussions with their Sri Lankan co-authors. In order for the Sri Lankan to make full use of the advices, there has to be some interaction between the co-authors. This interaction strongly benefits from a rich communication, and rich communication is best facilitated in face to face settings. The content for the discussions would then be how to improve the paper. Arranging two physical meetings between the Sri Lankan and the Norwegian co-authors would have ensured some additional opportunities for interaction between the authors.

Management involvement is crucial. In order to get this involvement and dedication from university leaders, a mutual understanding has to be reached on the goals, means and timelines of the activities of the project. We documented the agreement in a contract describing which party that was to take what action in which timeline. This document was then the guide of the project.

Such a project needs to be allocated sufficient resources. The resources needed are both monetary and related to knowledge. The present project would have benefitted from a budget that allowed two face to face meetings between the authors. Likewise, the project would have benefitted from an engagement from senior professors from both the universities. Finding and persuading reviewers are not always an easy task. The dedication from the university leaders helped in keeping the project members attention on the joint effort: doing good research and summing it up in a paper for the book. The incentive system could be adjusted in a way that kept the income more timely aligned with the effort. On the basis of these reflections, another proposition is stated:

*Proposition 2* In order to achieve efficient processes in orchestrate collaborative learning one needs management attention, physical meetings, reduced lectures, infrastructure arrangements and engage experienced researchers.

It is also necessary to stress the importance of sound methodology and research design. Some of the rejected work is rejected because the writers did not allow their co-authors to interfere on how to gather data and which data that needed to be gathered. One another advice to the co-authors of future joint programs would be to not postpone work; it could end up not being done! Acknowledge the importance of complying with the deadlines! An advice for the orchestrator of such a program is to allow time for reflections among the co-authors. It is action and interaction that brings the actor upwards the learning ladder (Bloom, 1956; Krathwohl, 2002). The best advice is that of doing if fun for all the parties involved. Fun is maybe the best engine for having work done.

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## **Appendix 2.1**

### Agreement

This is an agreement between University of Ruhuna (UoR) and Bodø University College (BUC) on the collaborative research and strengthening further cooperation.

As a part of the NUFU project 10102 between the University of Ruhuna and Bodø University, the University of Ruhuna with the Faculty of Management & Finance and Faculty of Fisheries and Marine Science & Technology together with Graduate School of Business (HHB) of Bodø University College agrees upon a common research project. The research project is parallel to the main PhD education part of the NUFU project.

The purpose of the research project is to enhance the academic capacity building and as a part of that, it was decided to develop programs on academic writing skills among the junior staff at the UoR. The main intention of this writing program is to link academic staff of the UoR and BUC and to strength the cooperation between UoR and BUC further.

Within the research project UoR has to:

- Provide sufficient students to the writing program
- Provide the students with sufficient time to fulfill their course requirements
- Provide local arrangement for the writing course
- Encourage staff members to contribute towards writing papers to a common book
- Provide the writers with sufficient time to fulfill their writing assignments

Within the research project BUC has to:

- Deliver writing courses for junior staff at UoR,
- Facilitate a book that focuses on the entrepreneurial university
- Encourage staff members to contribute toward writing papers to a common book
- Provide the writers with sufficient time to fulfill their writing assignments

The research project (the book project) will be coordinated by the two Deans of respective faculties, Faculty of Management and Finance and Fisheries and Marine Sciences & Technology UoR. As the Faculty of Management and Finance initiated the present NUFU project, the Faculty of Management and Finance will be prioritized in the book project.

The timeline of the project period:

1. Two page paper sketch (May 2009), north counterpart search, north comment (August)
2. Editorial Board select papers based on sketch (June)
3. Chosen projects attend Academic Writing course (November) Joint UiR & UB Diploma
4. 10 page paper handed in to north counterpart (January2010)
5. North counterpart comments paper (February).
5. Workshop in south, paper rewrite (March)
6. Paper goes to Editorial Board ((May)
7. Rewrite period, both south and north contribute
8. Publish the book (September)

For the University of Ruhuna  
Professor Susirith Mendis  
Vice Chancellor, UoR

For Bodø University College  
Dr. Frank Lindberg  
Dean Bodø Graduate School of Business

Mrs. W.M. Indrani  
Dean Faculty of Management and Finance, UoR

Dr. Tilak P D Gamage  
Faculty of Fisheries and Marine Sciences, UoR

Dr. Bjørn Willy Åmo  
Project coordinator

Ruhuna 04 March 2009

## **Appendix 2.2**

Template for abstracts for a chapter to the book project: " Handbook of internationalization of entrepreneurial universities: The case of Norway and Sri Lanka"

There could be several authors of one book chapter, and one author could participate on several book chapters. The following information is needed for each book chapter:

Suggested title of the paper:

Brief outline of the paper (2-5 pages, 1 ½ spacing between lines) - The outline should describe the paper and include the following information:

### **Introduction**

- State the purpose of the study
- State the importance of the study
- What previous research have revealed so far
- State the contribution from your paper
- Your research question

### **Theory**

- Describe the theoretical positioning of your paper

### **Methodology**

- Describe the research method you plan to use when gathering data
- Describe the population and the sample (if possible)

### **Conclusion**

- Which conclusions do you expect to draw
- Why do you expect to reach such conclusions

### **Implications**

- Implications for practice (if available)
- Implications for policy makers (if available)
- Implications for research (if available)
- Suggestions for further research (if available)

References follow the Harvard Reference Citation System

### **Information regarding the author(s)**

E-mail, name, position, education, research interest, publications

## Appendix 2.3

Style guide for chapter to the Ruhuna-Bodø book

### Paper structure

Title

Abstract

Key words

Introduction

Theoretical framework

Often involved hypothesis or prepositions

Methodology applied

Findings

Conclusion

Implications for research and practitioners

References

The **title** should be short, 10-15 words. It should engage an international public, express the subject the paper addresses.

The **abstract** should be 100-150 words, state the general problem to be solved, how it is solved, and the results of your study. Also include how your findings could be helpful in other situations.

4-8 **keywords** highlighting core concepts addressed or used in your study

The first sentence in the **introduction** states the general problem your paper addresses. It goes on to show the present knowledge and explains why there is a gap in our knowledge concerning the problem you are to address. It also explains why this is an important problem to address and what benefits the solution will provide. It ends in research questions – broad termed.

The **theoretical framework** constitutes  $\frac{1}{4}$  -  $\frac{1}{3}$  of your paper. It is a thoroughly discussion on the mental tools you build in order to understand the problem you would like to solve. If you use quantitative methods, the theoretical sections usually ends in testable hypothesis.

The **method** part describes the method you have chosen in this study. You argue for what you have done in such a way that your method is transparent and that the reader trust your findings. Express the weaknesses with your study. Roughly  $\frac{1}{5}$  or  $\frac{1}{6}$  of your paper.

The **findings** describe your findings using the tools (theories or models or mental structures) you made in the theoretical framework part.

The **conclusion** part express how the specific problem is solved and how this solution will help others to solve their problems similar to the problem you solved. Tell the reader how the solution will alter how people should behave, how the government, managers, politicians, etc should change as this new insight on how to act will improve their outcomes. Discuss how the limitations of your study limits the extent of you conclusions and end with suggestions for further research trying to nit the ends that are still loose after your research. This should be ¼ of the paper. If you use a qualitative method, you can express your propositions here.

**References** should be in this format:

- Brunåker, S. and Kurvinen, J. (2006) 'Intrapreneurship, local initiative in organisational change processes', *Leadership & Organisation Development Journal*, Vol. 27, No. 2, pp. 118-132.
- Burnes, B. (2000) *Managing change: A strategic approach to organisational dynamics*, 3<sup>rd</sup> ed., Pearson Education Limited, Harlow, England.
- Pettersen, P., Hanssen, H.H and Olaisen, O.O. (2009) 'This is the chapter title', in Nilsen, N.N. (Eds.): *This is the book title*, pp. 123-132, Publisher, Colombo.

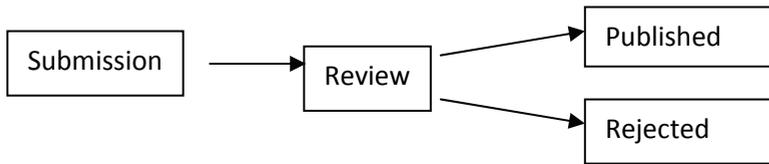
**Tables** and **figures** are inserted where they are referred to in the text.

Tables are named before the table,

**Table 1** The submissions for the book

<b>Number of authors</b>	<b>Number of papers</b>
1	6
2	12
3	10
4	3
Total	31

and figures below the figure.



**Figure 1** The review process

Avoid **footnotes**, it stresses the reader.

Your article has to follow the author's author guidelines from Inderscience publishers, if in doubt, consult their homepage:

<http://www.inderscience.com/www/authorguide.pdf>

Looking forward to your contributions

Bjørn Willy Åmo, editor of the book

Bodø 11/11-09



## Chapter 3:

# A Laboratory design for training students in Qualitative Methodology

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**Abstract:** The purpose of this paper is to outline a workshop education program for training students in the basics of qualitative methods (observation and interviewing) by leading students through a series of exercises that provides them a sense of how they connect and interpret field data. The skill level appropriate for this laboratory is a graduate student or upper division undergraduate in the social and behavioral sciences who has had a series of introductory lectures on the background, purpose, and practice of qualitative methods. A laboratory model for training students in qualitative methods is valuable because it provides an opportunity to experience the basics of qualitative methods in a short period of time.

### 1 A rationale

This paper provides a rationale for training students in participant observation methods through the use of simulations in a workshop/laboratory setting. Because qualitative methodology is a method where the information processing characteristics of the researcher are very much a part of the credibility of the data, the simulations focus on individual differences and styles of data collection and privileges students to record and interpret field data in various ways. Just as we would expect Barbara Czarniawska (2004, 1998) and Erving Goffman (1959) to see different dynamics in a social situation and record different data accordingly—the same premise applies to even the beginning researcher. The questions of what the observer *sees* and the *impact* they have on the

observational setting are key issues for the validity and reliability of qualitative research (Bennett Sandler, 1973). These two questions are addressed from different angles through a series of four continuous exercises on observation and interviewing by:

- a) Exposing researchers to the same data and
- b) Having them write individual field notes and
- c) Sharing the likenesses and dissimilarities in their data.

The training uses a team data collection motif (everyone looking at the same thing at the same time) to show differences in perceptions of the same events and to offer means of developing reliable field notes for future circumstances where team collection is not possible. The key lesson is to learn the subjectivity of field data and to learn to account for it and guard against it when doing research. Note that this workshop on qualitative methods does not directly address the idea of a research question. Instead it follows the Whyte premise that following qualitative methodology, one is often in the field, doing interviews and observations before a specific research question can be clarified (Whyte, 1984). This chapter does not focus on a research problem. Instead, the chapter is about a set of practices that increase the researcher's ability to interview and observe with skill and distinction before and after a research problem is settled on. To capture this evolving practice, we use Taylor and Van Every's phrase "abduction," which refers not to deduction (rationally following procedures) or deduction (a classification of impressions), but a "reconciliation of ideas and experience in the endless quest to resolve our doubts by finding a convincing explanation" (Taylor & Van Every, 2011, p. 20).

The training is not intended to substitute for supervised field experience but is intended to be a sharpening and enhancing addition. The laboratory has its proper impact when it occurs after two or three field observations and interviews have been completed and students have spent five class periods on introductory concepts and reading on qualitative methodology using such texts as Lindlof and Taylor (2010), or Taylor and Bogdan's (1998) texts. The qualitative methods laboratory is designed to operate over a two-day period or over a weekend with session beginning Friday evening from 7-10; sessions two and three running Saturday from 9-12 and 1-6; and session four occurring Sunday from 9-12. This paper outlines the simulations that occur in these time periods including a rationale for the instructions, points to emphasize in discussion, and the role of the instructor in guiding and interpreting these exercises.

## **2 Background and student preparation**

The qualitative methods laboratory is ideally composed of 8 to 12 graduate students (or especially talented upper-division undergraduates) in the social and behavioral sciences in such fields as management, sociology, social work, communication, and psychology. The initial work in the field prior to the laboratory learning mentioned above is to provide students with initial experiences with completing field notes prior to the laboratory. By the time the laboratory takes place, they will ideally have received critiques on two or three sets of field notes and have an idea of the initial interest and natural ability as observers, interviewers and field note writers. The retreat is best held in a lodge-like setting away from the campus to create a temporary subculture with a focus on learning qualitative research methods. The requirement for an off-site location for the laboratory may appear trivial, but it is an important part of the workings of the training program. The retreat is designed to take advantage of extended personal contact and the absence of work and family demands of faculty and students.

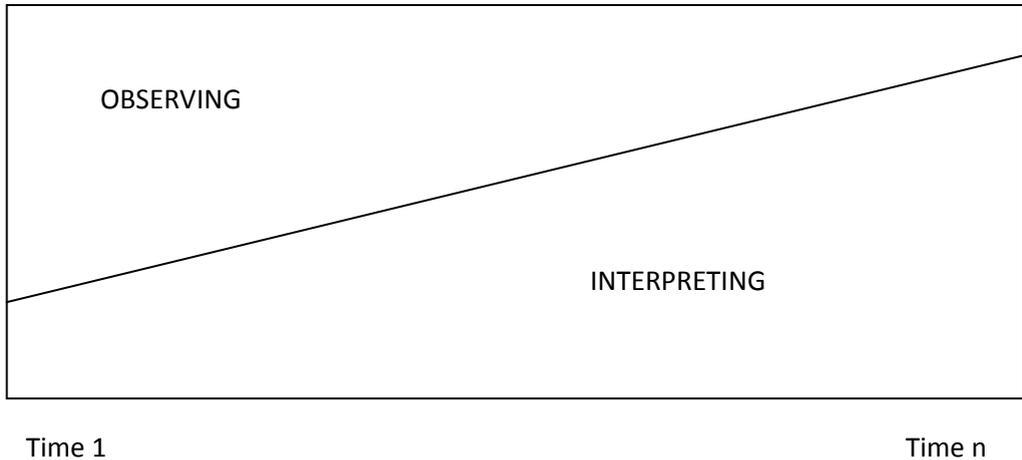
## **3 Session 1. When to observe and when to write**

The introductory session of the retreat focuses on individual perception and information processing involved in observation and note taking. If observation is a synchronic process where many things can be seen simultaneously and note writing is a linear process where words are ordered sequentially, then field note taking produces an overload that is managed by each individual researcher sorting according to preexisting categories or biases. This makes observation a magnified example of selective perception processes, subject to alteration by the cultural conditioning and values of the observer. If note taking is sparked by acts observed and note taking preempts observation when writing is occurring, the data set that makes up the field notes is a product of alternating between observing and writing. The strategies available to the observer to offset selective perception in note taking include continuing to listen while writing notes or using teams of observers who coordinate data collection so nothing is missed. While these strategies help to establish the reliability of the manuscript, they only delay the question of the effect of the observer's values in the collection and interpretation of qualitative data.

According to Rist's scheme (1980), interpretation is the part of the earliest phases of qualitative research and expands in influence as the researcher moves to the final phases on toward manuscript writing. (see figure 3.1). Given that a researcher's attention varies between observing and writing in different phases of qualitative research, the exercise on the values and predispositions of the observer applies to the breadth of issues in qualitative research. Session one focuses on the values of the

observer by looking at the person and social perception application of social psychology to qualitative methodology (Parrott, 2001; Secord & Backman, 1974).

**Figure 3.1** Rist's scheme of observation and interpretation



The selective perceptions of the observer will be directed toward people who are abundant or impoverished on characteristics the observer values (Parrott, 2001; Secord & Backman, 1974). If the observer values intelligence, they will be more attentive to people who seem very smart or very unintelligent. If they value being energetic then they will be more observant of very energetic or very unenergetic people. When an observer has spent extensive time in a setting and has little to say about what has been observed, then it is likely those being observed are *neutral* on the qualities the observer values.

This stock knowledge about person perception is provided as background information to introduce the first exercise. If the observer's values affect what is selectively recorded, then surfacing and addressing those very values is a means of sharpening the observers' awareness of the impact of their point of view on data collection and establishing the norm for acknowledging, in the research report, the relationship—even if stated in a sentence in a footnote—between the observer and the people and setting being observed.

After these points have been introduced in the Friday evening session, the participants are asked to review what they attend to in observations by individually listing six values they use as anchors in their perceptions of people. After they have been given 5-10 minutes to accomplish the list, the participants are directed to share their lists of values

in a 45 minutes leaderless discussion. The instructor is an observer to this exercise, but does not take field notes, intrude or participate in the discussion, and sits apart from the students, after the instructions have been given.

The lack of prescribed leadership structure and the intentional ambiguity about what the discussion of individual values will produce means that the student discussion of values emerges as a social product of group members and can range in infinite directions. In some cases, a participant will initiate a structure for accomplishing the task by suggesting that all members report their most important value first and move sequentially through values until all members views have been heard; others will share the direction of the discussion by validating and identifying with the values of friends or high status participants; others will assume that the purpose of the task is to reach consensus on the existence of common values of the participants and spend much time summarizing likenesses. In some instances variations of the examples of values offered by the instructor to begin the exercise are repeated.

The enactment of any of these different possibilities in the exercise is consistent with the goals of the workshop. The direction the discussion taken by the students in the exercise can range widely and remain effective because its purpose is to produce an event the laboratory participants have in common as a basis for writing field notes and the retreat. At the end of approximately 30 minutes of discussion time or when silence suggests they are finished, the instructor simply states that the participant's next instruction is to write field notes on the happenings that occurred in the group from the time the instructor introduced the discussion until it concluded. This instruction is given between 8:30 and 9 o'clock, which gives the participants an hour or hour and a half to write field notes on the discussion. There is not a formal discussion of the exercise at the end of the evening and participants are left to write field notes at their own pace. Some will be finished in 10 or 20 minutes, others will take the remainder of the entire evening.

#### **4 Session 2. Interviewing to negotiate accounts**

Since a general skill for qualitative research includes both observation and interviewing, an interviewing simulation follows and makes use of the observations completed in session 1. The *act-action* sequence (Harré, 1982; Harré & Secord, 1972) is used to introduce the emphases on the observations from session one's discussion. The communication behaviors of the participants in the discussion are labeled as *acts* that have been recorded and commented on via theoretical memos (Glaser, 1978; Glaser & Strauss, 1967) by the observer. The purpose of the Saturday morning exercise is to develop and present interview questions that capture the meaning that events of the

previous evening's discussion had for participants. The exercise emphasizes Harré and Secord's (1972) philosophical position of:

- a) the actor as a meaning chooser,
- b) the value of theory developed from the particular words of the observer and
- c) the value of agreement between the person being observed and the observer on the meaning of acts.
- d) The meaning of shared standards from which the tactics and strategies of interviewing are completed. (Who among the participants seem to be good at observation and interviewing and what are they doing?)

Prior to the interviewing exercise the workshop participants are given the following guidelines in developing their questions to account for meaning of the previous evening events. First, they are instructed to review their field notes from the previous evening to develop a theoretical interpretation of what happened and what was interesting about what happened. What acts did they observe that are key in understanding the discussion? What expressions of emotion—humor, validation, or disagreement—served as turning points in the discussion? Who said things that affected the direction of the discussion? Who were the major participants at critical points of the discussion? What abstract explanation accounts for the process, and or content of the discussion in exercise one?

Second, students are instructed to develop interview questions that can verify their observer interpretations without disclosing their working theory when the questions are asked. This is presented as the key issue in interviewing. Because of the asymmetrical power relations between interviewer and interviewee, the likelihood of response bias requires special tactics to avoid leading the interviewee toward a preferred statement. Participants are coached on standard interviewing techniques to avoid such biasing:

- a) Ask the interviewee to review what took place at the special point in the discussion: "Stephen, could you describe the sequence of events that took place in the first few minutes following the directions by the instructor?" Such a request for descriptive recall locates the interviewees' response on a portion of data of interest without signaling the meaning assigned by the observer to the event.
- b) Ask interviewees to give their reaction to an event in the discussion: "Anna, what was your reaction when Julie commented in the discussion that all of the men in the group disclosed their values before any of the women did?" This

question is more specific and potentially leading than suggestion a), but still provides a range of responses without overtly making response demand on the interviewee.

- c) Ask more specific questions when the above tactics have not produced specific comments on the observers' interpretation of action. Bias is possible to avoid by including both possible polar ranges of responses for the interviewee to select from: "Johanna, would you say you were annoyed or not bothered at all by the fact that no one asked you what your value statements were until the end of the discussion?" Again, such a question is more specific than a) and b) above but still masks somewhat the interpretations of the observer.

The students are encouraged to use the strategy of moving from general questions causing the interviewees to talk from their own perspective to following with probe questions that tie down the particular inquiries of the researcher. The interviewers are instructed to order their questions beginning with the most oblique, and moving to the most direct as interviewee comfort increases through the exchange with the interviewer. The movement through the interview is also from the descriptive/demographic to more sensitive and potentially rapport shattering questions. The later, more sensitive questions are held until there are few questions, little time, and little to lose in loss of rapport with the interviewee. This progression from general to specific reduces the immediate cost of the interviewee with drawing from direct participation. Interviewers are instructed to continue to attend closely to interviewee comments even after the formal interview is concluded and the notebook is closed. Often times these relax period after formal closure produces a statement that changes the interpretation of the entire interview: "Crucial things often come to the surface at the end of a long conversation. Great truths are said on the door step" (Cioran, 1985)

Workshop participants are given time to prepare questions from a review of their field notes and are reassembled to conduct interviews to verify their accounts of the previous evening. The interviews are conducted in the presence of the full membership of the workshop rather than in the person-to-person format of a standard interview. This means that participants are allowed to see firsthand how each other handles the interview. Frequently, there are one or two students in the class who are especially effective at following the techniques outlined above. The learning that occurs when one student observes another performing successfully and being reinforced by an instructor for that performance is an influential combination of teaching techniques. The open-air interviews also provide data to the research questions they have developed out of the observations. This public access to data economizes on creating meaning (or action in

Harré & Secord's, 1972 terms) out of the previous evenings acts and allows for another form of possible verification of accounts.

The class instructor takes a more active role in this exercise (It is important to announce this change in roles from observer to active participant) in contrast to session one because it is important to critique interviewing style, to show what can be done to improve question asking strategies, and to have students repeat their questions in an improved form as opportunities occur. The use of trial-and-error technique takes advantage of the climate of learning in the qualitative methodology workshop. Interviewees are able to report back to the interviewer the effect their question had on them, the effects of attempts at improvement and, from their perspective as the interviewee, what line of questions would have better uncovered the data that verifies the position of the observer. As the data on interviewing suggest, it is very difficult to avoid asking leading questions (Maier & Sashkin, 1971). This is an important time to reaffirm the goals of non-competitive learning in the workshop and to encourage participants to take the risk to try practices in a setting where the harm to the data or subjects is lessened and the opportunity for sharpening and correcting exists.

This session does not have clear time boundaries because the time use by interviewers tends to be uneven. While it is an objective to surface all participants' accounts of the data and the questions they propose to validate the accounts accuracy, it is more important to follow through on a single observers' attempt to verify a single line of thinking that it is to account for broad coverage. The interview session is a demonstration of what happens when the interviewer takes action to verify an account of an actor's behavior. The important theme of this session is that it provides back stage access for researchers/actors so that both recollections of the event as actors and one's own tracking of research data are possible.

## **5 Session 3. The impact of observers on settings**

This session shifts focus from data collection to the impact of the researchers on the social and political dynamics of the settings they are in. The issues involved regarding the impact of the observer on the research are narrowed to two topics for the purpose of the discussion and exercise: the amount of *similarity* between the researcher and the actor and the *visibility* of the researcher in the research settings. A major problem to be negotiated in the research-actor relations is the difference the researcher and the actor assume about each other. The researcher's seeing the actor as someone different than they is an advantage in observations because qualities taken for granted within an environment are novel and noteworthy to the outsider. The small-scale culture shock of

the observer is parlayed into new information about the setting. Qualitative researchers are often in a privileged position because of their access to people and places of observations and their freedom to ask questions and move about the organization. The people being observed often envy the position of the researcher who seems to have lots of autonomy, nothing to lose in the encounter, and is free to leave the setting when the research is finished.

The subject in the setting tends to see the observer as a person with power. Observers' reports are often treated as official documents and are seen as the last word on the culture being observed. Third party observers have particular power because of their assumed objectivity. The subject sees the observer as a competent expert. Whether researchers are observing organizations, families, or dyadic relationships, the people being observed presume that their observers are experts and know the proper way to make decisions, communicate, and relate to each other. As a result, they believe the observers are, in reality, evaluating their personal competence. The combination of the power given the observer and the assumption they represent the standard for personal effectiveness create caution and compliance among observers that potentially biases the data in qualitative research.

The purpose of exercise three is to recreate these power differences for the laboratory on qualitative methods by replicating the in-group out-group research (Schubert & Sabine, 2002; Sheriff & Sheriff, 1969) with a reorientation toward observer-subject problems outlined above.

To set up as an assumption of differences between observers and subjects the participants in the laboratory are divided into two groups by asking them to respond to a bipolar ten point scale on how they see themselves as field researchers with one end of the continuum representing an *active dimension*, which is described as energetic, assertive, visible behavior and a *passive dimension*, which is described as deliberate, modulate, low profile behavior. After participants have privately selected their place on the scale that represents their general fieldwork demeanor, the instructor divides the class into two equal groups, which are subsequently referred to as the active group and the passive group. Even though the class instructor presents the two alternatives as equally attractive in the description, the creation of in-group cohesion and out-group rejections begins almost immediately.

These two groups take turns observing each other in a decision making situation by first having the passive group discuss the questions that address the value of passiveness,

the category to which they have been assigned. The active group is assigned the task of observing the passive group during this discussion by assigning their team members individual discussants to observe during the exercise. The observers are instructed to write field notes on which to base individual interviews with the discussants after the exercise is completed. These interviews are followed by a presentation of the observations back to the observees on the process of their decision-making. This scheme is repeated with the roles reversed – aggressives as discussants and passives as researchers – before the exercise is debriefed.

The purpose of this exercise is to provide first hand information to the researcher on how it feels to be observed by individuals believed to be different, as a group, from ones' own subculture. What are they writing about me? How do I communicate with people in a discussion who are labeled as I am by an external agent? Should I present a posture that acknowledges or tries to change observers' impression? These are some of the questions the-researcher-turned-subject experiences while attempting to perform as though business-as-usual conditions existed while being observed.

The second objective of this exercise is to give interviewers experience in asking questions of subjects who doubt the objectivity of the researcher and believe the researcher's position is biased toward values that serve the researcher's interest. The structure of this exercise on differences between observer and the person being observed creates a level of tension that engages the participants for the afternoon. By the end of this session, the workshop participants will have completed twelve hours of observations and interviewing since the workshop began.

Session three is usually the most dramatic event of the workshop because of the regularity with which in-group and out-group differences can be created. The discussion of the afternoon session is the most important period of performance for the workshop instructor unless the instructor is able to channel the output of participant energy towards the understanding the implications of the exercise for research/subject relations and diffuse the feelings of competitiveness between the two teams. The conditions of trust as a basis for sharing information about observational ability and the impact of the observer on the setting must be regained at the close of the third session.

The first means of defusing the exercise is sharing the rationale behind the exercise, providing the details of the classic study that surfaced the in-group/out-group dynamics this exercise is based on (Sheriff & Sheriff, 1969). This historical account of how natural intergroup conflict is generated by simply pitting groups against each other usually

allows the participants to depersonalize what was previously an emotional investment in differences. When the review is attached to the feelings of being observed by a team whose values are supposedly different, participants begin to move to a more neutral position. Part of the debriefing is to point out the insignificance of the differences between the two groups based on the numbers used for assignment. Because the extreme positions of one/two and nine/ten are rarely chosen on the active-passive scale, the actual mean scores between the two groups are often minimal especially when the total population is 10-12 people. This makes the *labels* assigned to them by the exercise a critical component in fueling the differences between the groups (Ashforth & Humphrey, 1997). This reference to labeling theory and its influence on terms used in analyzing qualitative data can be highlighted when participants are feeling misrepresented, if not tricked, by the in-group out-group exercise.

The final step in recapturing the feeling of community in the workshop is to consciously emphasize agreement among participants by taking twenty minutes at the end of the afternoon exercise to review the strength at doing qualitative research demonstrated by participants in the workshop. A point is made in this addendum to the afternoon exercise to create agreement just as the previous one was to show the effects of differences. The instruction for this exercise is for workshop participants to communicate, to each other, actions that show their ability. This often includes reviews of interviewing ability shown in the mornings' exercise, of insight offered about the previous evenings' group decision making, of particular comments about the ease of interviewing an out-group member despite the engineered conditions of disagreement. The role of the instructor is to guide this discussion and to comment on members overlooked by their review of each other.

## **6 Session 4. Interviewing for history**

The final session of the workshop has modest goals as participant attention begins to be redirected toward leaving the workshop. The exercise has a combined focus on summary and the interview for recent history – a dimension of qualitative research not yet covered in this workshop. If observations in social settings tend to be a momentary cross-sectional view of the dynamics of relationships, to ask questions on how they got to the present state is a natural research situation.

The simulation to create these dynamics is arranged by dividing the group into even subgroups. Care should be taken at this time to neutralize natural sub-grouping, by separating close friends, as much as possible. The first group is instructed to design a skit to dramatize the principles of qualitative methodology that have been learned over the

weekend. The group is given 30 minutes to prepare and then ten minutes to present it. The second group is assigned the task of developing a research plan to determine what happened in the first group from the time they were given the task until the presentation was made. After the skit is presented, the second group has the opportunity to complete their research plan and feed the results back to group one. By this time in the workshop students have taken a larger role in assessing what they are learning and tracking the effects of data collection styles and techniques and selecting their own level of effort to put into the final exercise. As a result, the instructor takes a neutral leadership style for this exercise and focuses on pulling together experiences from different points in the workshop. While this final exercise is less intense and more ritualistic, there are occasions where the final exercise produces an insight, in dramatic form, out of the skits. A point is made when it is least expected. In still other circumstances, the research group will have decision dynamics that cause them to miss the mark, from the point of view of those being observed, in their feedback on what happened as the skit group went about deciding on what to present.

These qualitative research experiences are designed to give students a series of flash exposures to a set of core issues in qualitative research. It is useful, when time allows, having students list learning at different points in the workshop. They have an extensive set of field notes and memos on their own reaction. Because of the activity level in the workshop, students require a weeks' respite following the workshop to catch up on other work and let the experience sink in. The next task in the course is to translate what was learned at the retreat into observation and interviewing practice. This is done by focusing the students attention on writing a field research report based on data collection that makes use of the skill level attained in the workshop.

## **7 Conclusion: The strengths and weakness of applications across cultures**

The strength of this set of exercises is that they place students in a position to receive direct feedback on their skills at qualitative research. Students are also placed in a position to learn by doing and to learn by the observation of what other students are able to do well that they can mimic in their own observational practice. The limit of this design is that it cannot be presumed to work without modification. For example, the first time the authors implemented the method in Norway, a student from Denmark resisted the personal and emotional components of the first exercise by saying, "You Americans are so quick to express your feelings. You'll find that we are not so quick at making these expressions. It looks shallow to us!" As workshop leaders we were aware that this person's comments did not represent everyone's thoughts, but there was

enough validity to her statement to take it seriously, so we restructured the exercises to give them less of a personal and more of a managerial flavor and the remainder of the workshop worked fine. In another instance, we offered a workshop in the United States comprised of almost equal numbers of Norwegian and American students. As an exercise we showed the 2003 Swedish movie, "Kitchen Stories," an excellent film that showed the limits of intrusive research methods. In the follow-up discussion after the movie, Norwegian students noted the poor job of translating the sub-titles into English and the typical nature of the characters. The American students commented on the quite and taciturn nature of the characters in the movie and the starkness of the Scandinavian winter depicted in the film. In still another application of this design in Sri Lanka, we asked qualitative students to complete a take home exercise by interviewing a manager or professional they knew for the purpose of identifying special problems in arranging Sri Lankan products and services for a global economy. The following day we followed the rudiments of the design outlined in this paper and focused on the differences students encountered while asking questions and gathering data the same research question. In these varied modifications of the laboratory design, we emphasized the theme of individual differences in the application of qualitative methods and how they could learn from each other's practice. The constant of these various applications was how qualitative research is a communication event because it emphasizes what the observer is able to see in the dynamics of humans in natural settings and then communicating what they see in their field notes and writing.

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### Appendix 3.1

First evening:

Exercise One:

Time: one hour

Your task is to select particular events that took place during the exercise that are useful in modeling of explaining the behavior of this group. Please write these up as a field notes (as extensive as possible, 2-4 pages) using direct and paraphrased quotations to support your explanation.

First Morning:

Exercise two:

Time: three hours

Your task at this time is to verify your account by interviewing subjects who participated in significant events you have described. You will all be interviewing each other publicly to allow you to collect information that supports or questions your account and to observe the outcomes of other's questioning strategies.

First afternoon:

Third exercise:

Aggressive Behavior

Passive Behavior

1      2      3      4      5      6      7      8      9

What assumptions do you make about this behavior?

What is your rationale for it?

In what way does it serve your needs?

What impact does it have on your ability as a participant observer?

First afternoon:

Third exercise

Time: five hours

Two groups are differentiated based on their response to the passive-aggressive dimension.

Each group's task is to discuss (in a twenty minute period) questions on how their passiveness or aggressiveness aids them as researchers.

While one group is completing the task, the members of the other group will be observing behavior at the group and individual level of analysis.

As the observing group is completing the task, the members of the other group will be observing behavior at the group and individual level of analysis.

The observing group will have twenty minutes to share their accounts (back stage) and negotiate consensus among themselves on the group and individual behavior they have observed. The observing group will have ten minutes to verify accounts via interviewing the observed group. The observing group will have twenty minutes to share their findings with the observed group in a panel format.

Following this cycle of behaviors and observations, the process is repeated by reversing the roles of observer and those being observed.

Second morning:

Session four:

Time: three hours

Group one

Your task is to develop a presentation-skit, role play, that demonstrates important principles of participant observation. You have thirty minutes to plan the presentation. You will have fifteen-twenty minutes to make the presentation.

Second morning:

Session four:

Group two

You are a research team whose task is to develop a description of what happened in-group one from the time they were given their assignment until it was presented.

You have thirty minutes now to develop a research plan for collecting data. You will have one hour from the end of group one's presentation to collect the data and thirty minutes to make a presentation to them.



## **II - Entrepreneurs in action**



## **Chapter 4:**

# **Sri Lankan micro businesses with and without employees: Exploring human capital, perception and business characteristic differences in retail shops**

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**Abstract:** Micro enterprises stand for a large share of employment in many developing countries. This paper reports from a survey of 150 of small retail businesses in the Matara district in Sri Lanka to explore which factors are related to higher employment in these businesses. Differences in owner's human capital, owner's perceptions and business characteristics were tested between businesses with and without employees. The study identifies several characteristics related to firms having employees and provides empirical data on small firm development in a context that have been scarcely investigated in the literature. The findings indicate that both aspects of specific human capital and general human capital are important when exploring employment size differences. No statistical significant differences were detected with regard to business characteristics. A key finding is the importance of owners' perceptions which may have implications for research and policy related to growth in micro businesses.

**Keywords:** Human capital, perceptions, business characteristics, retail shops, micro businesses, employment.

# 1 Introduction

Businesses are very important for any economy since they are supporting the development and growth of the economy and the standard of living of the people. Among them, micro enterprises are highly important because the large number of such businesses and because medium and large scale businesses often started as small businesses. In particular, micro enterprises have been identified as a major source of employment and income in many development countries (Mead and Liedholm, 1998; Onphanhdala and Suruga, 2010). Doing research in the micro and small business area is important to ensure their existence and understand under what conditions these firms are able to grow. According to Honig (1998) considerable effort is used to promote micro enterprises in developing countries, because it is very difficult to develop large scale business at once in such countries.

Many studies have been done in the small and medium size business environment, but few studies have systematically attempted to examine the micro environment in a developing country. This study will focus on micro enterprises. Micro enterprises have been defined as small businesses employing less than ten persons (e.g. Honig (1998) and Satta (2003)). Among the micro enterprises, this study will look at small retail shops in Sri Lanka operated by one owner manager and hiring no or up to 5 employees. Prior studies in developing countries have found that a large share of microenterprises belong to the retail category (Satta, 2003). Retail shops have been defined in many ways, but simply explained they are the enterprises which sell goods and services for final consumption. Thus retail shops are important for any economy because even though there are large numbers of medium and large scale businesses for producing goods and services, retail shops play the intermediary roles which facilitate the link between producer and final consumer. Therefore, the existence of retail shops is beneficial to the standard of living of the people as well as the progress and growth of the economy.

Although there are thousands of retail shops and they can be found in every village, town or country, these enterprises have been given little attention in the literature. Most of the micro retail shops in Sri Lanka are sole proprietorships with a single person acting as both owner and worker in the enterprise. Studies indicate that one-person enterprises are less efficient than businesses with employees (Mead and Liedholm, 1998). Hence, the performance of the business seems dependent on the owner's characteristics. Different types of characteristics may influence whether retail shops grow or not, related to the human capital and perceptions of the business owners. In addition, firm level characteristics are likely to influence the growth of micro businesses.

Micro businesses in developing countries are often seen to represent an 'informal sector' (Honig, 1998) where little statistical information is available. Most of the Sri Lankan retail shops are not registered or recorded due to several reasons like lack of awareness about the registration process, or they do not want to follow many rules and have to pay the taxes required for registered businesses. Therefore most of the retail shops are informal shops. The entry barriers to start a new retail shop is low, and every year many new shops are started and many are closed down.

Because micro retail businesses belong to the informal sector, identifying growing businesses by using financial information is very difficult. This study is based on the assumption that retail business owners that are able to grow their business are likely to need additional labour. Therefore we use the addition of employees as a proxy to identify businesses that have been able to grow. For a self employed business owner, hiring additional employees is a significant event in the development of the business. In order to do so the business need some financial strength and the business owner face additional administration and risk. As a consequence, it can be assumed that micro businesses that have overcome the hurdle of hiring employees are better able to grow and make a stronger impact on the economy. This study was designed to identify the differences among Sri Lankan retail micro enterprises with and without employees.

Understanding the differences between the Sri Lankan micro enterprises with and without employees is important at three levels. First, the business owners have invested their time and money and may need to grow their business in order to maximize the profit from this investment. Second, knowledge about the factors associated with small business growth is important for understanding some of the mechanisms behind economic development in developing countries. Third, governments can influence and support the development of retail shops by making policies and procedures associated with the growth of these businesses. This study explores the following research question:

*Are there differences between Sri Lankan retail micro enterprises with and without employees with regard to owners' human capital and perceptions as well as firm characteristics?*

The research question will be addressed using a sample of 150 retail shops situated in Matara District in Sri Lanka where the density of micro businesses in the retail sector is high.

## **2 Theoretical framework**

Many factors are associated with the development and growth of new and small businesses. However, the development of retail micro businesses in Sri Lanka is not well documented. This study will explore some variables that are commonly associated with business growth related to both the business owner and the characteristics of the business.

First, human capital theory is often used to explain why some individuals are able to perform better as business owners than others. According to the human capital perspective (see for example Becker, 1993) the business founders' investments in key attributes (e.g. education and training) are linked to competencies and skills that may improve business performance. The human capital framework refers to the individual level of analysis, but could still be useful when exploring business performance. This is in particular related to small businesses where it is reasonable to assume that the owner manager and the business are closely linked (Chandler and Hanks, 1994; Cooper et al., 1994). Within the human capital framework a distinction is often made between general and specific human capital. General human capital includes factors expected to increase an individual's productivity for a wide range of job alternatives (Gimeno et al., 1997), whereas specific human capital includes only factors assumed to be relevant to a specific domain (Westhead et al., 2005). For micro business owners, specific human capital will be related to experience and training of direct relevance to running a small business. While the business owners' level of general and specific human capital are expected to be positively associated with superior business performance, it is likely that some human capital attributes are more important than others.

Second, another stream of research has argued that individual perceptions can influence the performance of small business owners. Both individuals' work satisfaction and growth aspiration may be relevant in this regard. In the context of this study, work satisfaction relates to how satisfied the individuals are with their occupation as micro business owners. Cooper and Artz (1995) argued that satisfaction is a relevant measure of success for the individual entrepreneur. Satisfaction may be associated with small business performance, such as business survival and growth, since satisfaction may be linked to the decision about whether or not to invest additional time and financial resources in the business (Cooper and Artz, 1995). In addition, as Bradley and Roberts (2004) pointed out, work satisfaction may be positively related to productivity. Owner's growth aspirations will in the present study refer to general growth aspirations and employment growth aspirations. There is reason to expect that the past performance of small firms is related to growth aspirations since owners of firms that previously have grown are likely to wish to grow the business in the future (Kolvereid, 1992). In line with

this argument, Kolvereid (1992) detected a significant positive relationship between Norwegian entrepreneurs' growth aspiration and firms' previous growth in terms of turnover and employment.

Third, other factors related to business characteristics, besides the individual business owner, also need to be taken into account. Storey (1994) carried out a review of small business growth studies. Some of the firm-specific characteristics he addressed were: firm age, legal form and size. The findings of the review indicated that young firms grow more rapidly than older firms. Moreover, fast growth is also found to be related to legal form. Limited companies, rather than sole proprietorships and partnerships, grow more rapidly. With regard to firm size, Storey (1994) argued that the findings indicate that the relationship with business growth is rather complex. While small firms seem to grow more rapidly than large ones, the smallest firms are least likely to grow. In the present study differences between one-person firms and firms with employees will be explored with respect to following business characteristics: sales turnover, net profit, type of business, entry mode and business age. While the findings from the Storey (1994) review are not directly comparable with the focus of the present study, the review, nevertheless, indicate the relevance of including business characteristics in a study of micro businesses employment size differences.

### **3 Methods**

Data for this study was collected from 150 micro retail shops owners situated in 10 villages in the Matara District in Sri Lanka. The population of retail shops in the Matara District is approximately 1,100, hence more than 10% of the population of retail shops are included in the sample. Since many of the retail shops are not listed in any register, it was not possible to select firms randomly from a list containing the population of businesses. Nevertheless, efforts were made to select firm according to the sample frame which included four types of retail shops; consumables (foods), stationary, pharmaceuticals and hardware. These four types of retail shops are in part selected because all these types of micro businesses are present in each village in the Matara District.

A questionnaire was constructed in order to obtain information concerning owners' human capital and perceptions as well as firm characteristics. Several of the questions and statements included in the questionnaire was adopted from measures previous used in the entrepreneurship and small business literature. The questionnaire was first written in English and then translated to Sinhala by the first author. To strengthen

content validity, the questionnaire was pre-tested by ten students. The pre-test did not indicate that the questionnaire should go through major revisions.

The business owners were interviewed during the spring 2010 at the location of their retail shops. To assist in data collection, the first author recruited 14 students who had practice in collecting data using questionnaires. The group of 14 students was informed about the purpose of the data collection and the questionnaire was presented to them. They were also instructed about how to conduct the interviews and to give necessary support to the business owners in answering the questionnaire. The first author and the students then conducted the data collection. The data collection covered 10 villages and included 15 retail shop owners in each village. The first author covered three villages and the group of students covered the remaining seven villages. In some cases the retail shop owners were not willing to fill out the questionnaire themselves. If this was the case the interviewers completed the questionnaire according to the business owners' verbal answers. According to Honig (1998), owners of informal sector firms may hesitate to reveal information relating to financial aspects of the business. However, the interviewers explained the purpose for the data collection and did not experience serious problems in getting the business owners to participate.

### **3.1 Sample characteristics and measures**

Table 4.1 includes information about the owner managers' human capital and perception concerning work satisfaction and aspirations. Relevant information about business characteristics is presented in Table 4.2.

### **3.2 General human capital**

As shown in Table 4.1, three variables were selected to measure the individuals' general human capital attributes; gender, age and level of education. The gender variable reveals that approximately 15 percent of the sample is women. The average age is 40.3 years and 55.3 percent reported that the highest level of education is primary education. For further analysis the gender and education variables were operationalized as dummy variables. The gender variable was assigned a value of 1 if the owner is male and a value of 0 if a female is owner. The level of education the variable was given a value of 1 if the respondent reported that the highest level of education is more than primary otherwise the variable was assigned a value of 0.

**Table 4.1** Owner/manager characteristics (n=150)

Characteristics	Percent	Mean	Median
<b>General human capital variables</b>			
Gender			
Male	85.3		
Female	14.7		
Age		40.3	38.5
Education			
Primary education	55.3		
Ordinary level education	19.3		
Advanced level education	15.3		
First degree education	10.0		
<b>Specific human capital variables</b>			
Management experience in years		13.1	12.0
Parents self-employed/business owners			
Yes	20.7		
No	79.3		
Previously owner/manager in another business			
Yes			
No	8.7		
	91.3		
Entrepreneurial training			
Yes	12.7		
No	87.3		
<b>Perceptions</b>			
Work satisfaction (I like doing the things I do at work) <sup>a</sup>		4.9	5.0
Growth aspirations (I want the business to grow in the future) <sup>a</sup>		5.2	5.0
Employment aspirations (I plan to hire additional labour within the next two years) <sup>a</sup>		2.8	3.0

<sup>a</sup> Measured on a seven-point Likert scale where 1 = strongly disagree, 4 = neither agree nor disagree and 7 = strongly agree.

### **3.3 Specific human capital**

As previously discussed, specific human capital are attributes considered to be of specific value to the domain of interest, in this case the management of micro enterprises. Four variables were selected; management experience, parental self-employment, previous ownership experience and entrepreneurial training. The average management experience among business owners is 13.1 years. The parental self-employment variable was operationalized as a dummy variable (0=no, 1=yes), and 20.7 percent of the respondents reported that at least one of their parents are or were self-employed/business owners. The previous business ownership experience variable relates to whether or not the respondents reported to previously have been a manager and owner of another business (0=no and 1=yes). The entrepreneurial training variable was measured by asking the respondents if they have got any entrepreneurial training from a recognized body like the chamber of commerce (0=no, 1=yes). As reported in Table 4.1, 8.7 percent and 12.7 percent respectively, reported to have obtained business ownership experience and entrepreneurial training.

### **3.4 Perceptions of work satisfaction, growth aspiration and employment aspiration**

Table 4.1 also shows the mean and median values of the three owner perception variables. The respondents were asked to indicate the level of disagreement/agreement with each statement on a seven-point Likert scale. The statement concerning work satisfaction was taken from Hmieleski & Corbett (2008). As shown in Table 4.1, on average, the business owners seem to agree rather than disagree with the statement (mean value of 4.9). This indicates a high degree of satisfaction with their work as small business owners. The statements measuring growth and employment aspiration are adopted from Kolvereid (1992). The average values are relatively high for growth aspiration and low for employment aspiration (mean values of 5.2 and 2.8). Hence, while the business owners, on average, seem to wish to grow their businesses while they are relatively negative towards hiring additional employees.

### **3.5 Business characteristics**

Table 4.2 displays information about the business characteristics of the sample of 150 firms. As shown in the table the majority of firms are very small in terms of employment. Approximately 75 percent of the firms (113 respondents) reported they employed only one person including the owner. Moreover, none of the firms had more than five employees. Hence, the sample of firms fit the criteria linked to definition of micro firms (Honig, 1998 & Satta, 2003) implying that they all employ less than ten persons. This

study explores differences between firms with and without employees and uses this employment variable to categorize the firms into firms with and without employees. When the respondents indicated that the firm employed one person including the owner/founder, the firms are considered one-person firms. If the respondent reported that the business employed two or more persons, the firms are considered and labelled firms with employees.

**Table 4.2** Business characteristics (n=150)

Variable	Percent of firms
Number of employees including the founder	
One employee	75.3
2-3 employees	14.7
3-5 employees	10.0
Sales turnover in millions <sup>a</sup> in the last calendar year	
Less than 3	0.0
3 to 5	30.7
5 to 7	34.0
7 to 9	27.3
9 to 15	8.0
Net profit <sup>a</sup> for the last calendar year	
Less than 300,000	21.3
300,000 to 350,000	28.7
350,000 to 400,000	18.7
400,000 to 450,000	26.7
450,000 to 500,000	4.7
Type of business	
Consumables (food)	70.0
Hardware	8.7
Pharmaceuticals	6.7
Stationary	14.7
Entry mode	
Started from scratch	92.0
Purchased	2.7
Inherited	5.3
Business age	
0-1 year	3.3
1-3 years	8.0
3-5 years	8.0
5-10 years	16.7
More than 10 years	64.0

<sup>a</sup>Amount reported in Sri Lanka Rupees (LKR), 100 LKR = approx. 0.71 EUR.

Sales turnover and net profits are measured in broad categories. Several other entrepreneurship and small business studies, such as Chandler and Jansen (1992), have measured aspects of firm performance in a similar way. The questionnaire used in this study included a question concerning the type of the retail business. As shown in Table 4.2, 70 percent of firms are categorized as consumables. For further analyses a dummy variable was created where consumables was denoted a value of 1 and hardware, pharmaceuticals and stationary were assigned a value of 0. With regard to entry mode, 92 percent of the firms reported to have started from scratch and 8 percent were acquisitive entries (purchased or inherited). Once again the variable was transformed to dummy variable where 1 = started from scratch and 0 = purchased or inherited firms. The age of the retail business was measured in broad categories and as shown in Table 4.2, 64 percent of the firms report to be more than 10 years.

#### **4 Findings**

To explore differences between firm without employees (one-person firms) and firms with employees, t-test and chi-square analyses were performed. Cross tabulation and chi-square were employed with regard to the dummy variables, otherwise t-test were performed. Non-parametric Mann-Witney tests were also performed. The results from these tests are not reported here, but they were practically identical with the results of the t-tests presented in Table 4.3.

With regard to the general human capital variables one statistically significant difference between one-person firms and firms with employees was detected. There was a higher representation of business owners with highest education more than primary in the group of one-person firms than in the group with employees ( $p < 0.10$ ). Concerning the specific human capital variables, owners with employees, compared to one-person firms, were more likely to have parents that were or are self-employed ( $p < 0.05$ ) and to have obtained previous business ownership experience ( $p < 0.10$ ). No statistically significant differences between groups were detected with regard to management experience and entrepreneurial training.

**Table 4.3** Differences between firms with and without employees, means, t-test and Chi-square.

Variables	Mean One-person firms	Mean firms with employees	t-Test	Chi-Square
<b>General human capital</b>				
Gender (1=male, 0=female) <sup>a</sup>	0.87	0.81		0.71
Age	39.97	41.49	-0.68	
Education (1=more than primary) <sup>a</sup>	0.49	0.32		2.97*
<b>Specific human capital</b>				
Management experience	12.89	13.57	-0.46	
Parents self-employed <sup>a</sup>	0.16	0.35		6.27**
Previous business ownership experience <sup>a</sup>	0.06	0.16		3.47*
Entrepreneurial training <sup>a</sup>	0.14	0.08		0.93
<b>Individual perceptions</b>				
Work satisfaction	4.84	5.19	-2.40**	
Growth aspirations	5.17	5.11	0.41	
Employment aspirations	2.75	3.11	-1.96*	
<b>Business characteristics</b>				
Sales	3.07	3.30	-1.27	
Profit	2.63	2.70	-0.32	
Type of business (1=consumables) <sup>a</sup>	0.71	0.68		0.13
Entry mode (1=started from scratch) <sup>a</sup>	0.94	0.86		2.03
Business age	4.27	4.37	-0.49	

<sup>a</sup>Dummy variable

\*Significance  $p < 0.1$

\*\*Significance  $p < 0.05$

As shown in Table 4.3, differences in individual perceptions were detected with regard to work satisfaction and employment aspirations but not concerning growth aspirations. Business owners with employees reported significantly stronger work satisfaction ( $p < 0.05$ ) and stronger employment aspiration ( $p < 0.10$ ) than business owners managing one person businesses. Analyses of differences concerning business characteristics (sales

turnover, net profit, type of business, entry mode and business age) indicated no statistically significant differences between the two groups of firms.

A logistic regression analysis was also performed where only those variables that indicated a significant difference at the 0.1 level between firms with and without employees were included. That is, the following independent variables were included; education, parental self-employment, previous business ownership experience, work satisfaction and employment aspiration. The logistic regression model was statistically significant at the 0.01 level. Moreover, the analysis showed some minor differences compared with results of the t-tests and chi-square analysis reported in Table 4.3. Firstly, no significant difference was detected with regard to the previous business ownership experience variable. Second, the impact of the employment aspiration variable increased, moving from the 0.10 to the 0.05 level of statistical significance.

## **5 Conclusions**

This study explores factors associated with differences in employment size within the novel context of micro businesses in the Matara District in Sri Lanka. The sample of 150 retail shops constitute an appropriate and interesting empirical context for exploring human capital, perceptions and firm characteristic differences.

The study found several interesting differences between firms with employees and one-person firms (firms without employees). With respect to the owners' human capital, both aspects of specific human capital and general human capital seem to be important to detect employment size differences. In relation the owners' general human capital, a weak relationship was detected with regard to level of education. A larger proportion of firm owners with employees reported to have low education (primary education) compared with owners of one-person firms. A possible explanation for this finding may be that well educated business owners to a higher degree own part-time businesses and are reluctant to employ others (Isaksen and Kolvereid, 2005). Education is generally assumed to increase expected financial payoff both inside the business as well as for alternative employment (Gimeno et al., 1997). Hence, well educated business owners may, in general, focus parts of their effort toward being paid employees in organizations instead of trying to increase their income employing others in the micro businesses. In line with this finding, Isaksen and Kolvereid (2005) detected a negative relationship between level of education and growth objectives, based on a sample of Norwegian new business founders.

Concerning human capital considered as specific to owning and managing micro businesses, the findings indicated that parental self-employment was significantly related to differences in firm's employment size. The results showed that a significantly higher percentage of firm owners with employees reported that their parents are or were self-employed, compared with owners of one-person firms. Parents may act as role models for their children (Gimeno, et al., 1997). Further, such a background may relate to that children learn business relevant skills throughout their adolescence and that business owners with self-employed parents therefore do not consider employment of others a very difficult hurdle to overcome. Previous business ownership experience was found to be related to firm's employment size in the chi-square analysis ( $p < 0.10$ ). However, the logistic regression analysis failed to confirm this result.

The findings relating to owner perceptions indicate that owners of firms with employees are significantly more satisfied than owners of one-person firms. A possible explanation for this finding is that employing others is associated with increased status and reputation. Work satisfaction can also be related to individuals' optimism concerning the outcomes of the business. Cooper and Artz (1995), based on a sample of North American entrepreneurs, detected that business founders that were more optimistic initially, (when they on average had been in business for 11 months) reported more satisfaction two years later. It is possible that business owners that employ others generally are more optimistic than individuals owning one-person firms. Hence, a manifestation of their optimism may actually be the hiring of additional employees. The results also indicated, even if the relationship is weak, that owners of firms with employees report stronger employment aspiration. This may not be a very surprising result since this group of business owners already have obtained experience in managing employees and may therefore not view hiring additional employees as a very serious challenge.

Somewhat surprising, the results indicate no significant employment size differences with regard to the selected measures of business characteristics. Especially, it might be expected that firms with employees would report significant higher annual sales turnover than one-person firms. The finding may be related to the relatively small sample size and the measurement of sales in broad categories. With respect to the latter issue, it is possible that using more fine grained measures of sales would result in statistically significant differences among the two groups of firms.

This study provides two interesting implications for governments in developing countries seeking to stimulate the growth of micro businesses in the retail sector. It

seems like specific human capital is clearly related to differences in employment size, while the relation with general human capital is more unclear. The results indicate that businesses with employees are more likely to be owned by individuals with primary education and with parents that are or were self-employed. This indicates that the skills that are important to grow the micro businesses are developed through experience and role models rather than formal education. A possible initiative to promote more micro businesses to grow could be to establish business associations or networks of business owners who could learn from each other. The other implication from the study is related to the link between job satisfaction and growth. Although we do not know the mechanism behind the higher level of job satisfaction among business owners with employees, this finding points at the importance of taking individual perceptions into account. Thus, governments seeking to encourage growth among micro businesses need to obtain advice from the business owners and listen to the issues they perceive as important, as a basis for designing policies. These issues are likely to be highly context specific and require further investigations in each context.

The present study has limitations that should be acknowledged. First, the measures used in this study are rather shallow consisting of single items. Second, there is a question whether a representative sample is drawn from the population of retail-shops in the Matara District. Unfortunately, it was not possible to randomly select a sample of micro businesses. There may therefore exist biases that reduce the generalizability of the findings. Third, since this is a cross sectional study that focus on differences between two groups of firms, the direction of the relationships is not considered. For example, there is a question whether work satisfaction is an effect of differences in employment size or it is the other way around (i.e. satisfaction impacts employment size). Future micro business research could utilize longitudinal designs to better ascertain this causality issue. Moreover, future studies may also explore the mechanisms behind job satisfaction in micro businesses in developing countries.

To conclude, the key contributions of this study is related to the novel empirical setting for exploring attributes associated with small firm employment and the finding that owners' perceptions are highly significant. The latter finding extends the majority of existing studies on small business growth which mainly rely on objective measures of characteristics related to the owner, firm or context. This study asserts that perceptions, in particular job satisfaction, may be an important explanation for employment in micro businesses in developing countries.

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## Chapter 5:

# Challenges faced by SMEs in developing countries adopting ICT: A case study from the hotel industry in Sri Lanka

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**Abstract:** This paper is designed to reveal and analyze the key challenges faced by SMEs in the hotel industry in a developing country when adopting information communication technologies (ICT). This will then hint for a set of potential determinates that affect the adoption of ICT and allow suggestions for suitable recommendations to overcome such challenges. The study uses Rogers (1995) model of adoption of innovations to study adoption and use of ICT. The study then contribute by describing the current situation of SMEs in a developing country regarding usage of ICT, as it highlights some of the main challenging factors which impact the adoption and use of ICT in SMEs. The findings suggest that ICT is perceived as advantageous for the hotel, but their limited access to finance and human capital delimits their capability to exploit advanced ICT. Universities could spur further adoption of ICT by continuing delivering ICT skilled candidates.

**Keywords:** ICT, SME, adoption of innovations, developing countries, Sri Lanka, case study.

## **1 Introduction**

In today's increasingly globalized world, using Information Communication Technology (ICT) is very important for ensuring success for Small and Medium Enterprises (SMEs). Business network around the world relies heavily on ICT in their daily work. According to Alam and Noor (2009), ICT is rapidly changing the way enterprises and consumers interact, this shows itself in a more and more globalizing production, rapidly changing consumption patterns, new ways of organizing work, constantly improved business methods and an expanding international trade. Many SMEs use ICT in financing, reporting and sales activities. Both the development of ICT, the shift to a knowledge-based economy and the introduction of easily accessible ICT is increasingly important for SMEs. As a result SMEs are able to reinvigorate their business models, achieve new competitive advantages and by this contribute toward growth of the national economy (UNDP, 2004).

In most of the countries the SME sector is the largest provider of employment, and SMEs contributes substantially to new job creation. Also SMEs is a major source of technological innovation and new product development. SMEs play a particularly important role in developing countries where poverty is most severe. As explained by Gamage (2003), SMEs highly contribute to growth of Gross Domestic Product, as well as SMEs is a major source of employments. SMEs also contribute to uplift on innovations and is stimulating to other business activities in larger business entities. By providing jobs and serving local needs, SMEs then contribute to social development in underdeveloped countries.

SMEs share of the economy is substantially in Sri Lanka, in manufacturing sector 96 per cent of industrial units, 36 per cent of industrial employment and 20 per cent of value added are accountable by the small and medium scale industries in Sri Lanka (Task Force, 2002). A study carried out by the United Nations Development Project (UNDP) estimates that SMEs in Sri Lanka (firms with less than Rs. 16 Million in assets) account for 90 percent of the total number of firms generating 70 percent of employment and account for 55 percent of the Gross Value added by the private sector. (Main Report, SPREAP, 2003). Therefore, In Sri Lanka also, SMEs have gained wide recognition as a major source of employment, income generation, poverty alleviation and regional development over the years. In Sri Lanka SMEs contribution is most beneficial to the economic activity in agriculture, mining, manufacturing, construction and service sector industries. Especially the southern province of Sri Lanka relies heavily on entrepreneurial activities in SMEs.

Although SMEs play an important role in every country, SMEs face a lot of challenges due to the rapidly changing business environment. In many instances, the skills, competencies and resources available to SMEs are not adequate to face the continuous technical change, market uncertainties and the high level of competition. Moreover, as the enterprise grows, entrepreneurs must stay focused to continue to improve their business and its product and services. This as the entrepreneur must have an understanding of the market needs and he should be able to collect and interpret customer feedback properly. In this regard, adopting ICT is a very important technique and SMEs could use ICT in order to grow and to become more innovative. One industry facing increased demand from hard-to-please costumers is the hotel industry. Since the civil war ended in 2009, there has been a sharp rise in tourists arriving in Sri Lanka (Sri Lanka Tourism Development Authority, 2010). As explained by Alam and Noor (2009), the most SMEs today minimize their wastage of time, knowledge and resource due to adopting of ICT for their business activities. According to Alberto and Fernando (2007), SMEs can enhance their business activities using ICT so enabling them to compete and cooperate with large enterprises. Kapurubandara and Lawson (2006) claim that SMEs does not fully benefit from the potential ICT offers, suggesting that SMEs face significant and unique challenges in adopting ICT and e-commerce.

The daily operation of SMEs differs from the operation of large enterprises; effectiveness of ICT management in SMEs is particularly critical (Montazemi, 2006). Most SMEs perceive the integration of ICT into their business operations as risky, complex, time-consuming, and an expensive initiative (NOIE, 2000). According to Kapurubandara and Lawson (2006), there are very few studies about ICT adoption in developing countries. As a developing country, the SMEs in Sri Lanka are not utilizing ICT as much as SMEs in more developing countries are able to. However there is a dearth of data and research about ICT usage of SMEs in developing countries, and especially in a Sri Lankan context. The existing research on ICT in Sri Lanka could be outdated, as their reliability for today's context is become questionable as technology is rapidly changing.

Very limited knowledge is available regarding the challenges SMEs faces related to adoption and use of ICT with regard to the southern province of Sri Lanka. This region is predominantly a rural area and is affected by lacking infrastructure and other problems faced by rural areas of a developing country (Main Report, SPREAP, 2003). On the other hand, a concerted effort was made by the government to speed up the development process in the region during the recent past. With those changes, business environment is rapidly changing and it is important to have updated knowledge on the current situation faced by SMEs adopting and using ICT.

Despite the importance of ICT and emphasis by various governments to encourage SMEs to adopt ICT, it has been reported that SMEs for various reasons have been slow in adopting ICT (Houghton and Winklhofer, 2004). In this context this research is designed to reveal and analyze the key challenges faced by SMEs in the hotel industry situated in developing countries in adopting and using information communication technologies. The research question addressed by this study is how SMEs in the hotel industry in developing countries adopts and utilizes ICT in their business activities. The study will then contribute by describing the current situation of SMEs in a developing country regarding adoption and usage of ICT, to highlight some of the main challenges which impact the adoption and use of ICT in SMEs. This allows some recommendation to overcome such challenges.

## **2 Theoretical framework**

ICT usage in business activities can be effective and efficiently and ensure business success as ICT is usually more accurate and fast than manually routines. ICT has the potential to support many business activities within a firm and could influence its performance; performance such as productivity, profitability, market value, and market share (Laudon and Laudon, 2006). ICT also affects intermediate performance measures such as process efficiency, service quality, cost savings, customer satisfactions, as well as organizational and process flexibility (Alberto and Fernando, 2007). Businesses adopting and using ICT can obtain benefits as it allows quick access and more accuracy to vital information in a competitive environment (Laudon and Laudon, 2006).

There are many examples of benefits from ICT usage for SMEs in their daily business activities. Increased annual profit, more effective employees, improved accuracy and quick customer satisfaction is some of the benefits SMEs can gain by adopting and using ICT. The ICT usage could be computer (web sites, email, database), and communication (telephone and internet) usage. Firms using ICT needs to have personnel who are able to use the ICT in order for the firm to reap these benefits. If the SMEs manages to reap these benefits depends on their ability to recruit ICT skilful graduates (Vanita et al, 2009).

In Sri Lanka there is no official definition of SMEs. The main criteria used are the number of employees, the size of fixed investment and the nature of business and the sector, i.e. formal or informal in which the industry operates (Cooray, 2003). According to Dasanayaka (2009), most definitions categorizes SMEs to have between 10-100 employees and an invested capital between 2 and 25 million Sri Lankan Rupees (17,000 – 224,000 USD). Previous studies have shown that the adoption of ICT by SMEs is still

lower than expected (Yu, 2006; Pavic et al., 2007). Several barriers to ICT adoption have been identified, including: lack of knowledge about the potential in ICT use, a shortage of resources such as finance and expertise, and lack of skills (Utomo, 2001 as quoted in Hashim, 2008). As revealed by Hashim (2008), some studies looked into a broader perspective of internet adoption and found that environmental factors such as government intervention, public administration, and external pressure from competitors, suppliers, and buyers play a key role in the adoption and implementation of ICT, especially in e-commerce. Other studies focused on organizational factors, such as organization support and management support; however, few studies focused on skills and use among the owners.

According to Kapurubandara and Lawson (2006), the same level of ICT adoption is not evident among all SME, suggesting that SMEs face significant and unique challenges in adopting ICT. Kapurubandara and Lawson (2006) have categorized internal and external barriers that impede adoption of ICT by SMEs in developing countries. The internal barriers include owner manager characteristics, firm characteristics, cost and return on investment, and external barriers including infrastructure, social, cultural, political, legal and regulatory factors. Houghton and Winklhofer (2004) have reported a slow response of SMEs relating to adoption of ICT. Shiels et al. (2003) found that characteristics of the firm and industry sector are contributory factors to the adoption and exploitation of ICTs by SMEs. Thus, it is important to understand the barriers that inhibit SMEs in Sri Lanka and how SMEs could overcome these barriers if Sri Lankan SMEs are to take advantage of ICT usage.

When regarding ICT as an innovation, an innovation-decision model developed by Rogers provides a theoretical framework for studying the challenges faced by SMEs in Sri Lanka adopting and using ICT. Rogers' (1995) models have previously been used in developing countries explaining adoption of ICT (Hashim, 2008; Richardson, 2009). An innovation is defined as an idea, practice, or object that is perceived as new by an individual or other unit of adoption (Rogers, 1995, p. 11) while adoption is the decision to make full use of an innovation as the best course of action available (ibid, p. 21). According to Rogers model there are five major factors determining the rate of adoption of an innovation: its relative advantage, its compatibility, its complexity, its observability and its trialability. The relative advantage of the innovation is the degree to which an innovation is perceived as better than the idea it substitutes. Compatibility is the degree to which an innovation is perceived as being consistent with the existing values, past experiences, and needs of potential adopters. Complexity is the degree to which an innovation is perceived as difficult to understand and use, while observability is the

degree to which the results of the use of an innovation are observable to oneself and others. Trialability is the degree to which an innovation can be experimented or practiced in small scale before the adoption is fully implemented.

Kapurubandara and Lawson (2006) find that the cost and return on investment is a vital basis for decision making regarding purchasing and use of ICT, and Rogers (1995) also argues that the relative advantage of the innovation is important in the decision process. Vanita et al. (2009) claim that a SME needs trained personnel in order to reap the benefits of an ICT adoption. This resonates with Rogers claim that the more an innovation is compatible with the present organizational structures, the easier it is to implement the adoption. NOIE (2000) reports that the complexity of ICT is blocking SMEs to integrate ICT into their business operations, this is supported by the finding that complexity was the most prevalent innovation characteristic among Malaysian females adopting and using ICT at their workplace (Azam and Quaddus, 2009). Perceived Complexity was found to be the most significantly related factor affecting e-service adoption in Saudi Arabia (Al-Ghaith, Sanzogni and Sandhu, 2010). Also Uzoka et al (2007) finds that complexity plays a major role in adoption of e-commerce among product/service organizations in both public and private sectors of Botswana. Azam and Quaddus (2009) found that perceived trialability and perceived observability were positive correlated with the adoption intention of e-commerce whereas perceived complexity have negative correlation with the adoption intention of e-commerce among Malaysian SMEs. Their findings on observability is supported by Askar, Usluel and Mumcu (2006) in their study of how Turkish secondary school teachers use ICT. Trialability of an ICT is also previous found to influence the adoption decision in a developing country (Richardson, 2009). Al-Gahtani (2003) found that trialability is important for ICT adoption among Saudi-Arabian employees. Tarofder, Marthandan and Haque (2010) findings suggested that top management support and Trialability play crucial role for diffusing web technologies in supply chains among Malaysian SMEs. Trialability is also found to be vital for adoption of handheld reporting devices for Dutch workers in the installation sector (Verkerk, and der Pijl and van Asperen, 2009).

The 'innovation decision process' is categorized in the steps an individual takes from awareness of an innovation, through the formulation of an attitude to the innovation, on to the decision as to whether to implement, and finally confirmation of this approach. This innovation-decision process includes the two main stages: decision and implementation.

The decision stage is when the individual engages in activities that lead to a choice to adopt or reject the innovation. According to Rogers (1995) this decision is based upon the five above mentioned criteria. The decision leads to an action; implementation or rejection. Implementation occurs when an individual puts an innovation into use, while rejection is the abandoning of the innovation.

### 3 Methodology

A case study is the best approach for taking account of the multi-dimensionality of complex phenomena as innovation (DeBresson, 1996). This research is investigating the challenges to adoption of ICT in SMEs in Matara District, in the south of Sri Lanka. Different countries use different definitions for SMEs. The universally acceptable official definition for SMEs is not available in Sri Lanka as is the case in most developing countries (Dasanayaka, 2009). Thus, in this research, we have adopted the following definition for small scale and medium scale firms as given by the Department of Small Industries, Sri Lanka.

**Table 5.1** Definitions of small and medium sized firms in Sri Lanka

Institution	Criteria	Small Scale	Medium Scale
The Sri Lankan Department of Small Industries	i) Capital investment	Between 2 – 5 million SL. Rupees	Between 5 – 25 million SL. Rupees
	ii) No. of Employees	Between 10 - 49 employees	Between 50 - 100 employees

Source: Dasanayake, 2009.

SMEs in the hotel industry located in Matara district in the southern part of Sri Lanka is considered as the informants in this research. The study is conducted as a qualitative research. The study focuses on hotels, as the tourist industry is increasing rapidly and is competing internationally. As hotels are a part of the tourist industry, hotels has to adapt to the demanding international costumer. This implies using ICT for building costumer relations and for ensuring an efficient and cost effective production. Our research sample consists of two medium scale hotels, one slightly older than the other. A purposive sampling technique was used to select the participants for the study. Kerlinger stated that purposive sampling “is characterized by the use of judgement and a deliberate effort to obtain representative samples by including presumable typical areas or groups in the sample” (Kerlinger, 1964, p. 129). With the purpose of the challenges faced by the SMEs adopting ICT in their business activities, in-depth interview were conducted with representatives from the hotel industry in the Matara district.

Semi-structured interviews were carried out to collect the data. This as semi-structured interview allows addressing research questions and obtains in depth information from the informants on the issues addressed (Yin, 2003). One researcher was handling the sessions while the other was recording the interview on tape. The entire interviews were recorded and converted into text and translated from Sinhala language to English. The open ended questions asked refer to:

- The present situation, what ICT is they currently using for what purpose and what do they achieve by using it.
- If they could wish, what ICT would they want to use for what purpose
- Why do they not do as they wish, what is hindering them in doing so

Data analysis was done with the purpose of identifying the challenges faced by the SMEs hotels in adopting ICT. The interview data was analysed along the theoretical framework in order to reveal the main challenges the SMEs faced when considering adopting ICT. Yin (ibid) suggested that every investigation should have a general analytic strategy, guiding the decision regarding what will be analyzed and for what reason. Among the possible analytic techniques presented is pattern-matching. In general, the analysis will rely on the theoretical framework that led to the case study. Trochim (1989) considered pattern-matching as one of the most desirable strategies for analysis. This technique compares an empirically based pattern with a predicted one. If the patterns match, the internal reliability of the study is enhanced. The judgment of the researcher is therefore required for interpretations.

#### **4 The case**

The Perl Clip Hotel is situated in the Southern part of the country, in the Matara District of Sri Lanka. The hotel is over 12 years old. It is a private firm registered under the Tourist Board in Sri Lanka. The reported capital investment of the hotel totals to about 12 million Sri Lankan rupees (110 000 USD). When the business started, it was just a hiring location for weddings. At that time there were no ICT in use in the business. Pearl Clip has gradually evolved, the next step was to supply meals for the weddings at the house for hire, then it also offered catering for other events, and after this it has step by step improved into a hotel with all usually hotel activities. As the business grew, more and more employees were hired into permanent positions. The staff then included chefs and waiters, and then it gradually improved and grew into a restaurant. According to the present manager of the hotel: “we did hard work to make this into a hotel and a restaurant and make this famous, not only among the local customers but also among its foreign customers”. Currently, there are more than 50 employees who are working at the hotel. They all strive to make the hotel to become a success and such secure their

working place. The goal of the hotel is to be able to offer more than 8 rooms and 5 separate houses to foreigners or other high demanding local customers. The restaurant offers a variety of Sri Lankan traditional foods together with foreign foods. There are many competing suppliers of food around the Matara area which are also able to serve at any celebrations or ceremonies. Recently Pearl Clip have expanded the hotel premises by adding another restaurant and they also hope to build a swimming pool to satisfy the customers' needs and wants. Their ultimate goal is to become a part of the rated star hotel sector in Sri Lanka, and to be regarded as supplying the best service for the customers in the local and the international markets.

The Lalitha hotel is situated near Matara town, Sri Lanka. It is a star class hotel which was established in 2007. It is a private owned hotel registered under the tourist board in Sri Lanka. The mission of the hotel is to provide quality service to satisfy customers' needs and wants. It consists of more than 20 separate rooms in flat house including, conference facilities, a swimming pool facility and a restaurant. Their target customers are the local customers and foreign customers as well. They provide Sri Lankan traditional foods together with more international foods. They have a small tour operating system for arranging travels allowing customers to visit sites of interest in the local area. The manager of the Lalitha hotel said "From the beginning, we had a computer system with software which was used to do our day to day activities, the system are developed by our trained staff members". Currently, they have more than 50 permanent staff members and several temporary staff members. According to the manager; more than 7000 local and foreign customers visit their hotel annually. They claim to have a very effective business network which supplies goods, materials and services; services such as local guides or local transport. They try to become the best hotel in Matara by providing quality services. Their investment are valued to more than fifteen million Sri Lankan rupees (140 000 USD).

## **5 Findings**

The interviews revealed that the two hotels relate to ICT in a similar manner. The both of them only use Microsoft Office and internet facilities together with payment systems. Demanding costumers forces the hotel to adopt certain ICT systems. The hotels use payment systems as international costumers expect to be able to pay that way. Internet is used for advertisements on the web to attract new customers and for chatting or contacting previous costumers. The hotels use many of the applications found in MS office. They use Word for writing letters, Excel for keeping financial records and providing periodical statements, Access for building databases on their relations to costumers and vendors and they use free e-mail access offered by Microsoft or other e-

mail providers. The Pearl Clip manager stated: *“Normally we don't use computerized system for the hotel activities. There is no special package or soft ware. But we mainly use Internet, Email, Web facilities (we provide these facilities for needs of customer such as foreign or local, getting information, communication needs , their entertainment or any other needs), Finger print (mainly used for checking the employee's attendance), Credit card (for most of card holders are customers , suppliers needs), Telephone (internal or outside customer, supplier communications), Microsoft Office (for many day to day hotel activities such as letter writing, bill issuing, and storing data)”*.

The interviewed managers perceive ICT to be advantageous for their hotel. The advantages they see is that it saves time, is more reliant and more cost efficient than doing the same tasks manually. According to the Pearl Clip manager: *“Really, ICT makes our job easier and it enable to us complete tasks quickly and reliably, .... our productivity is increased and the number of customers gradually increased.”* Even so, both hotels reports that they do keep manual records on the side, in case their computer system breaks down. *“We have not faced much trouble due to our computer system because normally we carry out both manual and digital methods, so that the effects or damage to our daily activities are reduced if our ICT systems are down”* (Pearl Clip manager). The managers intentionally keep the complexity of the systems low, the Lalitha hotel has a *“very simple computer system”* and the Pearl Clip hotel has *“no advanced ICT systems”*. The purpose is to keep the purchasing and operating costs as low as possible as they has to *“develop little by little by the income generated by the business”* (Lalitha manager).

Another barrier mentioned is that *“the senior management lack knowledge of ICT, they are used to manual routines”* (Lalitha manager). A simple system is then easier to introduce at the hotel. Both the managers report that the used ICT systems are highly compatible with the organizational structure of the hotel and the competence base of the employees. The hotels recruit young staff, as they usually have some computer training. The staff gets their computer training at universities or in private computer schools, none of the two hotels offered in-house ICT training for their staff. As mentioned by the Pearl Clip manager: *“Since we don't use special software we do not need to train our employees in the use of ICT”*. The only ICT training reported in-house was related to handling of the payment systems.

Both the managers reported that they have personal knowledge on how to use computers and software, as both of them have worked for international hotels operating in Sri Lanka. This implies that the perceived complexity of the adopted ICT systems is low. The managers were themselves used to computers at their previous

workplaces. According to the Lalitha Hotel manager: *“ I have used Hotel Management Systems when I worked at other national and international hotels, then I got more experience with using such systems and I realized the advantages of such systems”*. Likewise, the staff has adequate computer training. The ICT systems they presently uses is common in use also at other workplaces and does not represent much tasks not performed also at other workplaces. The managers and the employees had cooperated in adjusting the system to the routines at the hotel. If anything breaks down, the employees try to mend it. In the case they do not manage to mend it, the manager has to order service personnel from the city.

As the complexity of the systems is low, the managers did not feel an urge for to try the present ICT systems before adopting them. Both managers have for some time considered upgrading their ICT system from Microsoft Office to some Hotel Management System. They both reported that if they were to purchase such a complex system, they were in the need for a test period, as commented by the Pearl Clip manager: *“I have experience with a Hotel Management System and know how to use it and are aware of its advantages. When we are to adopt such system, I think it’s necessary that we try the software first”*. The purpose of the test period would then be to reveal if the employees was able to cope with its complexity and to see if the promised advantages could be realized. They both hesitated to adopt such a system as they feared that the cost would be larger than the benefit from using it,: *“I have an idea about a Hotel Management system, I did some feasible studies and called quotations from more software companies. We hope to adopt such a system in the near future, but, yet we are not able to purchase such a system, because, firstly we have to consider the change in income and expenditure”* (Lalitha Hotel manager).

The observability of the benefits is high. The manager and the staff see that the ICT used actually helps by reducing the time needed for fulfilling the tasks. The ICT usage also makes it possible to serve the costumer in a more timely and efficient way. The Pearl Clip manager commented: *“There are many advantages of using ICT, when we consider email we have good responses from international and local customers. On the other hand, suppliers can directly communicate with us, but few of our suppliers actually use e-mail”*. The time delay makes it difficult to discuss with European customers through phone; both the customers and the staff prefer to communicate by e-mail as this reduces the misunderstandings and the errors. Many of the domestic suppliers do not use e-mail, hence much of these approach the hotel by phone (Lalitha manager).

## 6 Conclusions

The conclusion of this research is that SMEs in the hotel industry in the southern part of Sri Lanka does not use ICT extensively. They find ICT advantageous, but not advantageous enough for adopting it as extensively as SMEs in the hotel industry in the more developed parts of the world does. The ICT the SMEs in the southern part of Sri Lanka use is simple and cheap, and the SMEs are to some extent driven to adoption by a demand from their customers, then mostly from their international customers. Their local subcontractors and their local business contacts are in the same situation, thus they do not demand their local business partner SME to take further use of ICT. There might be a lack of role models when it comes to use of ICT.

Work experience in international hotels provides the hotel managers with acquaintance of ICT systems more specialised for a hotel organization than Microsoft Office offers. Recruiting young people with computer knowledge spurs more use of ICT. Young computer skilled employees are invited to participate in adjusting the ICT to the routines of the hotel. As the employees gets their computer training from universities and private computer classes, government are able to increase the usage of ICT in the SME sector by improving and expanding the availability of computer skilled graduates. Local universities have to respond to this demand for computer skills among its graduates in order to provide the local SMEs such competences.

The main concern for the hotel managers were the profitability of a new ICT. As the managers of SMEs are concerned about the relative advantage of a new ICT device or service, any salesperson would need to address this issue. The hotels have to earn the money before they could spend it, indicating that organizations wanting these hotels to acquire expensive ICT systems probably need to arrange finances as well. A salesperson or any other promoter of ICT then has to relate to the situation and the needs at the hotel, expressing the relative advantages and the possibilities the new ICT offers. When promoting more unfamiliar ICT systems, the promoter need to take more into considerations how the ICT is compatible with the existing organization, maybe allowing a trial period for to make the results and the compatibility of the new ICT visible for the users.

As the data is limited to only two hotels in the southern part of Sri Lanka, the conclusions are not far reaching. Thus, the findings are strengthened by using Rogers (1995) model of adoption of innovations, as this theory is rigorously tested over the years in many other contexts regarding other innovations than ICT. The findings imply that Rogers (1995) model of diffusion of innovations has applicability also in Sri Lanka

regarding the adoption and use of ICT. As the interviews revealed that the hotel managers stressed different aspects of Rogers (1995) model according to how familiar they were to the particular ICT, the study has some theoretical implications as well. When the innovation was perceived as familiar, the relative advantage became more important. While when the ICT was more unfamiliar, the other four elements (compatibility, complexity, trialability and observability) became more important. This indicates that the adopter perceives there to be different types of risks associated with adopting a familiar and an unfamiliar innovation.

Future research may include how familiar the respondent is to the innovation in question when applying Rogers (1995) model of adoption of innovations. Such research may also include other industries than tourist related ones. This allows investigations on how adoptions of ICT innovations are influenced by networks or by other ICT promoters.

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## Chapter 6:

# Challenges facing female entrepreneurs operating in the fish industry: an exploratory study from Sri Lanka

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**Abstract:** This paper investigates conditions for female entrepreneurship in developing countries by examining a case of female necessity entrepreneurship from Sri Lanka. The fish producing industry has traditionally been gender segregated and males and females had their different predefined roles as entrepreneurs in this industry. Recent developments are breaking this protecting wall and restructuring the industry. Women face significant challenges in their new roles in an industry which has traditionally been gender segregated. According to established theory, these challenges relates to institutional structures and a lack of resources as financial, human and social capital. Data was collected among 22 female entrepreneurs using focus group interviewees. The findings confirm that there are institutional structures restricting female use and accumulation of capitals in their struggle to run their fishery related self-employing business. This paper offers some political and practical tools to improve the competitive position of the female entrepreneurs.

**Keywords:** Female entrepreneurship, necessity entrepreneurship, self-employment, developing country, resources, institutional theory, human capital, social capital, financial capital, fishing industry

## **1 Introduction**

Women entrepreneurship is a journey out of poverty and toward equality (Minniti and Arenius, 2003). Many females in developing countries are engaged in necessity entrepreneurship (ibid). Entrepreneurs are argued to be the live wire towards a country's development and advancement of the standard of living of its people (Perera et al., 2007). Self-employment and home-based work have expanded opportunities for female participation on the economy (Minniti and Arenius, 2001). Perera et al. (2007) has identified limited access to technology, information, capitals, as well as perceived few opportunities for growth, non-opaque market forces, and a lack of managerial skills and networking capabilities as seven key challenges facing Sri Lankan entrepreneurs. Allen et al. (2008) argues that countries aiming for a competitive edge is dependent on also investing in female entrepreneurship. Females are more inclined to feed their family, and to share their capitals with others, thus generating more spillover effects to the economy. Throughout the developing world, hundreds of million women are employed in different industries and while many of these women are entrepreneurs, they are often unable to become self sufficient or to adequately support their families through entrepreneurship (Seymour, 2001).

However, Kepler et al. (2007) argued that if male and female entrepreneurs engage in entrepreneurial activity in the same way and with the same resources, then gender would not be an important dimension for entrepreneurship researchers. Other researchers argue that women small business owners face hurdles that men small business owners do not (Das, 1999; Roomi and Parrott, 2008). Allen et al. (2008) show that female entrepreneurship in low-income economies is more necessity driven than male entrepreneurship is. In Southeast Asia, women are a substantial part of the workforce, and many females are starting up businesses. In India, similar to Sri Lanka in many ways, females are only slighter less likely to start a business than are men (9.5% versus 7.5%), but are much less likely to own an established business (8.9% versus 2.2%) (Allen et al., 2008).

There are indications that women face different barriers than men do when performing their role as entrepreneurs (Ljungren, 2005; Allen et al., 2008). Discriminatory attitudes towards women, family responsibilities, cultural barriers, less education and less business experience may be causes for this difference. Microenterprises owned by females are often lacking business information, guidance and access to networks and business support systems (Allen and Truman, 1993). Research on entrepreneurs in developing countries show that the factors associated with success differs between microentrepreneurs in low- and high-technology industries, necessitating research

addressing also female microentrepreneurs running low-technology intensive businesses (Honig, 1998). Moreover, the fish producing industry has traditionally been gender segregated indicating that males do the fishing and that females preserves the catch. Recent developments are breaking this protecting wall, and now males are structuring also the processing part of the fishing industry. This restructuring of the industry is forcing female cooperatives to compete with male owned business entities holding more resources. This study then explores the barriers facing women when participating in the fish-industry in Sri Lanka and what these females do to overcome these challenges.

The rest of the paper is organized as follows: First there is a section displaying the Sri Lankan context. Then the theoretical framework discusses how institutional theory and rescores base theory contribute toward understanding the challenges facing low caste females in a developing country when they struggle to compete in an evolving industry. The methodology section reveal why a case based investigation was carried out. The findings show that the females uses several strategies to overcome the challenges, they diversify, minimize their costs and organize their efforts in order to improve their competitive position. The conclusion section offers insights in how their competitive position could be strengthened by addressing issues both regarding the institutional structures and the resources the females have access to.

## **2 The context**

Sri Lanka is an island on the southern tip of the Indian continent. There are 19.3 million inhabitants in Sri Lanka; most of the people live along the western and southern coast. The GDP per inhabitant is 4.300 USD and the Sri Lankan economy is growing by approximately 6% per year while the population grows with 1% per year.

Matara, which is 160 km south of Colombo (capital of Sri Lanka), is one of the main cities in the southern region. Matara is an ancient commercial city from the colonial time and it is surrounded by small towns such as Welligama, Akurasse, Kamburupitiya, and Dikwella. Matre is close to Galle harbour, Dondra fishery harbour and Koggala free trade zone, all vital to business development in the area. Fishing and tourist related industries are the most popular economic activities in the coastal belt, but growing rice for own consumption is for many still vital for survival. In Matara district, Sri Lanka, there are about 12.700 registered entrepreneurs engaged in various types of business activities. Out of these entrepreneurs, women account for about 30% (Perera et al., 2007). As much as 44% of the population living in the coastal belt is engaged in fishing and fish related industries (Matara district statistic hand book, 2007: p. 3-15). The availability of

appropriate technology and the abundance of raw material (fish) are among the reasons for its popularity.

The main religion in Sri Lanka is Buddhism, Buddhism demand from its worshippers that they should not kill living creatures. This implies that fishing or those involved in fishing are not highly regarded in the Sri Lankan society. Fishing is low-caste. Moreover, fishing is a male dominated industry in Sri Lanka. This indicates that religious aspects will be a major de-motivation for women to engage in fishing, and then especially in direct fishing as this involves killing the fish. This has created a situation where women specialize in fish-related activities such as preservation of fish and selling it in the open markets, while men focus on the fishing. Moreover, the common activities of women who have engaged in fish processing industries are to preserve the fish by salting, sun drying, or preparing "Maldivian fish". Maldivian fish is cured tuna fish. Maldivian fish was traditionally produced in the Maldives, hence the name.

The fish preserving industry is far less developed in Sri Lanka than in more developed countries. The situation is changing very slowly, as the fish industry is moving from labour intensive to capital intensive production methods. Some initiatives have been taken by foreign aid organizations as The Canadian International Development Agency (CIDA) to let poor females take part in this development. One of the aims of a CIDA project is to improve the living conditions in the Matara District and as a mean to achieve this, the project has distributed a number of fish drying machine among the women who are engaged in fish-processing activities. The majority of female entrepreneurs in the fish producing industry are working as sole operators rather than working together in a cooperative. Gandara is one of the areas close to Matara where CIDA operates. The CIDA project promoted marketing clusters for women who are engaged in the fishing industry in these areas. CIDA experiences that female participation in cooperatives is low compared to male participation in cooperatives. The main objective of these cooperatives was basically helping women to reap benefits by developing a mechanism which allows them to work together. These cooperatives were set up to help in marketing their products by developing necessary supporting mechanisms like packaging, brand names and membership in a self-help group. Our research then addresses four such groups, consisting of a total of 22 self-employed females.

### **3 Theoretical framework**

An individual's motive for engaging in entrepreneurship could be divided in two broad categories. Pull factors are perceived characteristics related to the business idea. The attractiveness of the business idea pulls the individual toward starting a business in order to realize the potential of the business idea. Push factors are factors unrelated to the individuals entrepreneurial characteristics, but with the individuals dissatisfaction with their positions. Push factors pushes the individual to start a business (Amit and Muller, 1995). Some label push entrepreneurs as necessity entrepreneurs and pull entrepreneurs as opportunity entrepreneurs. Hence, necessity entrepreneurship is becoming an entrepreneur because you have no better option, and opportunity entrepreneurship, is then an active choice to start a new enterprise based on the perception that an unexploited or underexploited business opportunity exists (Acs, 2006). Opportunity entrepreneurs usually perform better than do push entrepreneurs (Block and Wagner, 2006). There are usually a higher proportion of necessity entrepreneurs in under-developed countries (Allen et al., 2008).

Minitti and Arenius (2001) claims that the relatively high female involvement in necessity entrepreneurship might indicate that self-employment is used as a way to circumvent institutional constraints. Investigations on how the necessity entrepreneur perceives the available recourses and the institutions supporting entrepreneurship are especially important as necessity entrepreneurs are more likely to be influenced by their perception of the obstacles (Bhola et al., 2006). When examining previous literature on entrepreneurship, it appears as some barriers for entrepreneurship are gender related and some are gender-neutral challenges (Roomi, and Parrott, 2008). However, according to Das (1999) and Roomi and Parrott (2008) female small business owners are facing hurdles that male small business owners do not. These hurdles could i.e. relate to less time available for doing business, and fewer resources; such as financial, human and social capital. Females are often dedicating their time to domestic issues, leaving less time for running a business (Loscocco et al, 1991) but self-employment are often attractive to females due to its flexibility (Buttner and Moore, 1997). Tambunan (2009) found that woman entrepreneurs in Asian developing countries are pulled toward entrepreneurship and self employment due to poverty, unemployment and need for additional cash income.

#### **3.1 Institutional theory and entrepreneurship**

Economic behaviour is socially situated and individuals act in a social context embedded in networks of social relations (Granovetter, 1992; Berger and Luckmann, 1996). North (1994) argues that institutions are human constructs that configure human interaction.

These constructs and constraints consist of laws, rules, conventions and norms of behaviour. A common theme in institutional theory is environmental influence over how people organize their businesses (Aldrich, 1999). Gender boundaries associated with agriculture and fishing is rigid (Shaw, 2004). The caste system is another such institutional structure that delimits entrepreneurial opportunities, and activities related to the fishing industry are regarded as low caste work. Hecahavarrua and Reynolds (2009) shows that much of the variance in motivation for entrepreneurship stems from institutional factors. They further argues that in societies as the Sri Lankan, with a very rigid status or prestige rank order of the traditional culture, it is difficult for an individual to pursue upward mobility by entrepreneurship. Institutional theory has been suggested as a suitable frame for understanding how the role females play in contributing toward economic development is shaped (de Bruin, Brush, and Welter, 2007).

The social institutions provide the rules of the game and define the actor's available modes of action (Scott, 1995). In institutional theory the growth of deeply shared meanings among social actors is labelled habituation (Tolbert and Zucker, 1996). Habituation is the rise of patterned problem solving behaviours. Such patterns include how business is performed and which categories of people who are allowed to do what type of activities. Gender based differences in role allocations may be reflected in traditionally attitude of society forbidding females to carry out certain activities (Coltrane, 1992). Female's self-perception is shaped by the institutional structures in which their entrepreneurial actions take place. Singh, Reynolds and Muhammad (2001) find that female micro businesses entrepreneurs in Indonesia are concentrated in traditional and less dynamic markets and in low-income informal sectors where prospects of growth are minimal. When the norms for female participation are delimited, this leads to lower levels of opportunity recognition, thus influencing the extent and fabric of female entrepreneurship (de Bruin, Brush and Welter, 2007).

Studies are showing that family responsibilities affect men and women owned businesses differently (Loscocco and Leicht 1993). Traditional gender role expectations and sexist attitudes in many developing nations make it even more difficult for women to relieve themselves from family responsibilities (Seymour, 2001). This is a barrier for success of female entrepreneurs. When investigating local literature that discussed female entrepreneurship, Aydurai and Sohail (2006) stated the most common problems faced by female business owners in North East of Sri Lanka, were insufficient start-up capital, poor confidence as well as family issues. Women in low-income countries have a strong incentive to create their own work environment that is compatible with child rearing (Minitti and Arenius, 2001).

Moreover, males are able to move more freely in the business society, i.e. in offices of public administration and government agencies, where men relate to women differently than they do to their male colleagues. Due to expectations stemming from religious practices, culture and norms, there are different rules for female and male behaviour delimiting females' opportunity to engage in entrepreneurship (Roomi and Parrott 2008). According to Gregg (1985) female entrepreneurs face three significant problems in launching and operating a business. They are; lack of role models, difficulty in recruiting male employees, and tension between personal lives and their career pursuits. Further, he suggests that such factors create more difficulties for female entrepreneurs than for males.

Stokke (1992) finds that firm productivity in Sri Lanka more depend on sector differences than by scale of operations, indicating that institutional factors are important. There is also a divide between firms addressing the local market and firms addressing a broader market (Stokke, 1994). Small-scale industries addressing only the local market are often caste segmented and use traditional manual labour dependent technology, and are facing increased competition from firms exploiting large scale benefits addressing broader markets. According to Verheul et al. (2001) entrepreneurship influenced by the technological development as the technological development increases the dynamics in the way one does business. Chowdhury's (2007) study from a similar context as Sri Lanka, identified poor transportation facilities, lack of entrepreneurship education, training and financial assistance, the presence of strikes, inadequate law and order regulations, bureaucracy, corruption, lack of adequate investment, lack of government support and assistance, lack of research and development, inadequate information, frequent power failure, inadequate telecommunication services, and lack of technology as the main constraints faced by entrepreneurs in Bangladesh. As Benzing, et al. (2005a) described, other problems facing entrepreneurs in developing and transition economies include a generally weak economy, an inability to hire reliable employees, and too fierce competition. Moreover, small business owners in developing and transition economies often complain about insufficient capital access (Benzing et al, 2005b).

The institutional factors presumed to constrain female entrepreneurship the most is then role expectations, manifesting itself as caste and family responsibilities, and lack of role models and physical infrastructure. Jentoft (1981) suggests that individual actors could organize themselves in groups in order to respond to some of the challenges institutional structures imposes. This leads to a proposition linking institutional structures to the conditions females perceived for entrepreneurship

**Proposition 1:** Institutional factors constrains females ability to start and run businesses related to the fish industry in Sri Lanka

### **3.2 The resource base view of the firm and entrepreneurship**

The resource base view of the firm explain differences in firm performance through differences in the assets and resources the firm has access to (Barney, 1991; Grant, 1991; Audretsch and Monsen, 2008). Research link firm success with resources as the social human and financial capitals the owner/founder have access to (Westhead, Wright and Ucbasaran, 2001). Research has shown that the social capital, human capital and financial capital a person has access to influences on the person's propensity to engage in entrepreneurship. Economic capital is money and funding abilities, human capital is their education and their experiences while social capital lies in the structures of their human relationships. Porter (1985) discusses how individual actors could utilize their capitals or resources in a competition with others. He argue that entrepreneurs could differentiate their offers from the products others offers and in this way exploit a monopolistic position in a niche or try to reduce the costs in order to expand the gap between income and cost. Both of these strategies demand a capability to do so, such a capability builds upon accessible social, human and financial capitals.

**Social capital** refers to the "ability of actors to secure benefits by virtue membership in social networks or other social structures" (Portes, 1998: p. 6). The stock of social capital has been found to correlate with business sales and profit (Davidsson and Honig, 2003). Woman in low income countries have smaller networks and less geographical mobility than men, and their social networks functions differently. Women build strong ties with few, while men build weak ties with many (Minitti and Arenuis, 2001). Individuals can gain direct access to economic resources by exploiting their social capital (Portes, 1998). Allen et al. (2008) shows that paid employment are a fundament for female entrepreneurship in low- and middle-income countries. They suggest that being employed provides the experience, networks, money and ideas as well as self-confidence needed for creating new business. Females starting businesses seeks advices from more people than does males (Greve and Salaff, 2003). Kolvereid, Isaksen and Ottóson (2010) finds that there is an inverted U-shape between number of advices and success in starting a firm. People unsecure of their ability seek too many advices, and people over-confident seeks too few. Networking is not only seeking advices, it is also about seeking business relevant information. Information is playing a critical role in locating market and suppliers. Moreover, Turkey (2004) has found that lack of experience in business relevant fields is a problem for women. His argument is that all stages in entrepreneurship are dependent on relevant experience and information; from

the identification of opportunities to the execution of running a business, and females on average has less business experience than do men. Furthermore, female entrepreneurs spend less time networking than do male entrepreneurs, indicating that females may lose some business opportunities (Verheul and Thurik, 2000). This leads to a proposition linking social capital to the conditions females perceive for entrepreneurship.

**Proposition 2a:** The social capitals females have access to are limiting their ability to start and run businesses related to the fish industry in Sri Lanka

Social capital is often associated with societal status, societal ties and how to relate to other people, while age, gender and level and type of education and business training are often associated with *human capital*. Microentrepreneurs in high-level technological industries are more dependent on formal education than are their low-level technological industry counterpart's (Honig, 1998). Self confidence is very important to ensure success in business, but many self-employed women lack self confidence (Aydurai and Sohail, 2006). This is due to the fact that women feel that they lack education, prior technical training, enough business knowledge, language skill or enough self-esteem (Das, 1999). As a result of poor education, female business owners do not like to deal with banks, suppliers, and clients (Aydurai and Sohail, 2006). Schwartz, as early as 1976 (Swartz, 1976) found that the greatest barriers to female business success were financial discrimination, an inadequate training and business knowledge, and general underestimating of financial and emotional cost of sustaining a business. This is still the case (i.e. Verheul et al., 2004; Lerner and Alomor, 2002). An increase in human capital has to be accompanied by physical means to exploit this new knowledge (Kodithuwakku and Rosa, 2002). A study by Klyuev (2005) recognized that lack of financial resources, insufficient information, inadequate appropriate education and weak markets where the main constraining factors regarding entrepreneurial activities. This leads to a proposition linking human capital to the conditions females perceive for entrepreneurship.

**Proposition 2b:** The human capitals females have access to are limiting their ability to start and run businesses related to the fish industry in Sri Lanka

*Financial capital* is the physical assets or resources that a person could activate. Such financial means refers to start-up capital and other physical means necessary for running the business. The relevance of available financial means has been extensively documented (see i.e. Blanchflower and Oswald, 1998). Females often have less financial

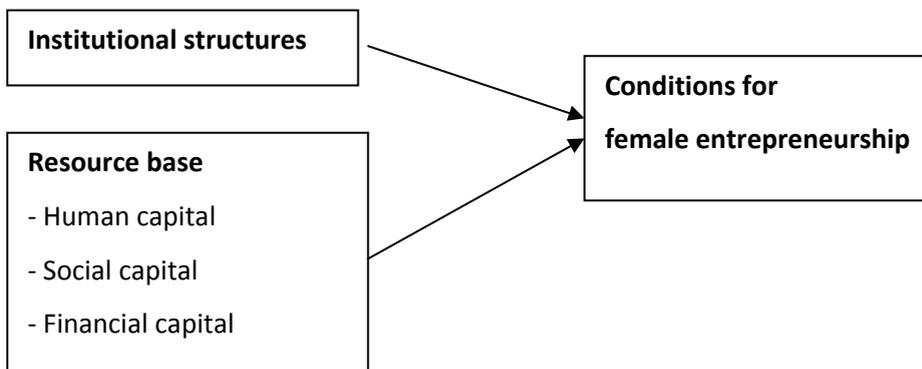
capital of their own to invest in a business or have problems in accessing funds provided by formal financial institutions (Verheul and Thurik, 2001). Women in developing nations have little access to funds, due to the fact that they are concentrated in poor rural communities with few opportunities to borrow money (Seymour, 2001). Further, Seymour (2001) explained that due to discriminatory attitudes of banks and informal lending groups, women still faces problems; even if their repayment rates are higher than men's. As shown in a recent study by Roomi and Parrott (2008) savings and bank loans are the common ways of raising start-up capital by women entrepreneurs. In general, women have lower personal financial assets than men (ibid). This means that for a given opportunity and equally capable individual, women must secure additional resources compared to men in order to exploit the opportunity because they control less capital (Turkey, 2004). Similarly, credit discrimination is one of the major barriers for female entrepreneurship (Charbonneau, 1981; Roomi and Parrott, 2008). Approximately two-thirds of the debt owed by Canadian SMEs comes from informal sources, such as loans from individuals and trade credit from suppliers (Klyuev, 2005). According to Hisrich and Fülöp (1997), insufficient capital, high interest rates, high rates of tax, increasing leasing/renting fees, uncertainty of market sizes, fierce competition, accounts receivable not paid on time, deliveries not on time, poor business moral, increasing prices of raw materials, decreasing purchasing power, few orders, health problems, and family problems are among the most common problems faced by Hungarian female entrepreneurs.

Honig (1998) shows that microentrepreneurs engaging in industries related to low-level technology are more dependent on start capital and loans than are high-level technology. Access to financial means is not sufficient alone for ensuring a transition from survival enterprises to higher values activities (Shaw, 2004). This claim is further supported by de Mel et al. (2008) who find that what distinct owners of micro-enterprises from owners of SMEs are their less human capital and motivation. Microcredit has a larger effect on employment growth in female owned businesses than in male owned businesses, this is particular valid for older females (Kevane and Wydick, 2001). Likewise, small scale manufacturer's benefits more on microcredit than does small scale retailers (Kevane and Wydick, 2001). The most common problems faced by female business owners were lack of sufficient cash flows for day to day operations, insufficient trained labours, fail to deliver stable quality products, fail to find appropriate markets, poor managerial experience, weak confidence and insufficient time allocated to running the business (Das, 1999, Panda, 2002).

Policy makers or aid organizations engaging in improving the living condition of poor under-privileged people need to provide access to financial capital while also improving the stock of human capital the potential entrepreneur possesses (Shaw, 2004). People poor in financial and human capital often start firms that are not competitive, as cost and scale efficiency of the more efficient larger firms outperform these micro survival enterprises. Fishing and livestock are among these industries where the earnings are low for businesses started by people poor in human and financial capital (ibid). Rural poor is particular inhibited by their lack of human and financial capital, as they are inclined to engage in survival activities because the physical and market environment presents few viable alternatives (ibid). DeTienne and Chandler (2007) find that females and males identify different business opportunities as they bear different stocks of human capitals. This leads to a proposition linking financial capital to the conditions females perceive for entrepreneurship.

**Proposition 2c:** The financial capitals females have access to are limiting their ability to start and run businesses related to the fish industry in Sri Lanka

The propositions could be summarised as in figure 6.1. The figure shows that the conditions for female entrepreneurship in Sri Lanka related to the fish processing industry are linked to institutional structures and the resource base the females can access. The most important institutional structures are role expectations, manifesting itself as caste, family responsibilities, and lack of role models and physical infrastructure while the most important resources are human, social and financial capitals.



**Figure 6.1** Conditions for female entrepreneurship

## 4 Methodology

Female entrepreneurs who are engaging in the fish and fish related industries are the target population for this study. This as fish related industries is popular in the costal area of the Matara district. The fishing industry is vital for the economical development of Sri Lanka, and the female participation in these industries has a long tradition. Even so, recently the structure of the industry has changed due to globalization and that new production methods are introduced. This stresses the roles of the females engaged in these industries.

An exploratory case study methodology was chosen as the investigated topic is complex. There are many factors influencing the behaviour of the female entrepreneurs in the fishing industry in Sri Lanka. Likewise, the level of ill-literacy of the local actors does not invite to collect data by standardized survey tools. Case studies are well suited in situations where a contemporary phenomenon is studied in a real life situation and where the boundaries of the phenomena are not clearly evident (Yin, 2003). The study unravels contextual conditions determining available options for female entrepreneurship in traditional industries in developing countries. Several groups of informants were chosen as this would allow richer data to be analysed, this increases the internal validity of the study. The analysis of the statements is guided by the propositions developed in the theoretical section in the paper (Yin, 2003). The internal validity of the conclusions is strengthened by pattern matching in comparing the empirically based pattern with the theoretically predicted one (Trochim, 1989) in a search for alternative explanations than the ones proposed in the propositions.

The sample consists of four collective fishing groups consisting of in total 22 women entrepreneurs. The groups are loosely coupled and the females help each others, but do not share the income of their individual activity. The data was collected by focus group interviews. Purposive sampling technique was employed to select informants for the focused group interviews. Focus groups were addressed as it allows the subjects to elaborate on their situation in a secure environment. Four focus group discussions were held in Dondra and Gandara. Dondra and Gandara were selected as both those electorate are the most important fishing harbours in the Matara District. Each group consisted of 5-6 women entrepreneurs; their age is between 21 and 57, their formal education range from 5 to 12 years of schooling, they are all married and have 1 to 4 children. The females are single entrepreneurs who do there entrepreneurial activities separately but which cooperates loosely when needed. Females associated with cooperative work-groups are selected as organizing is a tool to overcome institutional hindrances to entrepreneurship in the fishing industry (Jentoft, 1981). The interviewed

females are then actively taking steps to improve their situation and are hence able to provide insightful comments regarding the investigated topic. The unit of analysis is the single female entrepreneur.

One researcher chaired the sessions while the other kept records. The entire focus group interview was recorded and at the same time one researcher manually took down notes. A funnel approach was employed where the focus groups were initially presented with general questions regarding the subject and then the conversation moved into more specific questions regarding the problems faced by women entrepreneurs in the fish and fish related industries. The participants were not disturbed when they answered the questions in order to make sure a free flow of ideas. The informants were usually invited to elaborate further on their answers. The focus group interviews lasted about one to one and half hours each.

The groups were assigned numbers from A1 to A4 respectively. Group A1 and A3 lives and works in the Dondra area, while group A2 and A4 are located in the Gandara area. Their husbands are fishermen and some of the husbands have a small fishing boat. After fishing for a night, early in the morning they come to the beach with the fish and sell some of the fish at an auction at the beach. The women process the rest of the fish into Dry fish and Maldive fish. They have all done this type of activities for more than 10-15 years.

**Table 6.1** A description of the four focus groups addressed

<b>Group</b>	<b>Location</b>	<b># of females</b>	<b>Products</b>	<b>Production methods</b>
A1	Dondra	6	Dry fish & Maldive fish	Salting, boiling and drying the fish out in the sun
A2	Gandara	5	Dry fish & Maldive fish	Salting, boiling and drying the fish out in the sun
A3	Dondra	6	Dry fish & Maldive fish & Ambulthiyal & Maldive fish Mix with spices	Salting, boiling and drying the fish out in the sun
A4	Gandara	5	Maldive fish	Salting, boiling

The women in group A1 are preserving the fish by salting, boiling and drying the fish out in the sun. Four out of the five informants in group A2 were using a machine donated by a SIDA project for drying fish. As much as 125 kg of fish can be dried at once within 4 days as Dry fish, likewise it takes 5-6 days for making Maldive fish. The females in group A3 also makes Dry fish, and Maldive fish by sun-drying it, but they also produce “Ambulthiyal” and “Maldive fish Mix with spices”. Group A4 are engaged in making Maldive fish. The descriptive of the groups could be summarized as in table 6.1.

## 5 Findings

The findings indicate that institutional structures influence the abilities of the females to do business. Their position as poor female Buddhists borders their opportunities. Their family responsibility is a major barrier. One young woman who has school children explained her daily workload like this: *“I get up about 4.00 o’clock in the morning, and then have to prepare meals for children who go to school. Then, at around 7.00 o’clock I prepare them for school. After 7.00 I start house keeping, cleaning, washing. After one and half hours, my business activities can be started. Then again around 11.00 I usually start to prepare lunch for my children and husband. So, finding enough time for the business activities is hard due to my family responsibilities. My husband doesn’t have time to support me or my children since he is a fisherman. After coming home he usually gets rest because he has to go to sea again in the night”* (female no. 1, group A1). However, some other women said that they can manage their family responsibilities better since their children are now grown up. The children support their mothers in the household work.

The institutional structures are exposed in many ways; the females also lack market access. The lack is due to the cost of transportation forcing them to sell their product to middle men. As the females in group A1 explained: *“The main problem is getting a good price for our products. Usually, we don’t go to meet customers or vendors, vendors come to our area and buy our products according to their price. We don’t have the opportunity to bargain as there are not many buyers. On the other hand, it is difficult to take our products to the town since we don’t have transportation facilities, if we took a three-wheeler, after paying hire for it, we don’t have profit left. So, we have to sell our products at the village”* (female no. 3 group A1). Lack of transportation facilities is hindering the development of the business. The females in group A4 has to walk for a half and hour to reach the highway for to enter the bus.

The females also report that they lack access to new technology and that this keeps their profit at a low level. *“The other problem is lack of new technology; we make Dry*

*fish and Maldivian fish using traditional methods and sunlight. During some periods we get big quantities of fish, but we don't have enough equipment to boil and dry it. If we have a machine to dry it, we can preserve it and avoid selling at low prices" (female no. 4, group A1). Without this new technology they have to rely on the weather in order to produce their goods. "On the other hand, the weather is another main problem. We use sunlight to dry fish. During the rain period, especially in South East Monsoon, it is very hard to make Dry fish and Maldivian fish, then our income also goes down" (female no. 2, group A1).*

The competition is fierce in the Dry-fish and Maldivian-fish segment. Group A4 also produces Maldivian fish. Finding a market giving good prices was the main problem for this group of women entrepreneurs. As they explained: *"Finding markets is a main problem for us. We usually sell our products in the Gandara, Dikwella and Matara areas. Considerable numbers of people in this area are also engaged in making Maldivian fish and Dry fish. So, the demand for our products is very low" (female no. 1, group A4).*

At the same time as there are a multitude of local producers, these producers also have to compete with imported fish products, especially is the imported original Maldivian-fish popular. Since there are differences in quality between local Maldivian fish and imported Maldivian fish, the demand for the low quality domestic product is low. To make the situation worse almost all the supermarkets are carrying these imported brands. Moreover, supermarkets are reluctant to accept the products made by these micro entrepreneurs due to the variability of quality. *"On the other hand, when comparing with the Maldivian fish imported from the Maldives, the quality of our product is low. Our products low quality is another barrier we have to face when entering the market, plus the imported products have very attractive packaging as well" (female no. 3, group A4).*

The studied females also have challenges related to their meagre resource base. The problems are not solved just by getting access to better technology for producing the Dry fish or the Maldivian fish. As mentioned, group A2 were using a machine for drying fish and it is less resource demanding to produce fish by the machine than by traditional means. The margins are stressed even when using the improved producing technology. For these females their major problems were access to market and the cost of the raw material. As they explained: *"We buy fish from the beach. Fish are very expensive during some periods, especially in the out of season. But at the market, the whole sellers buy our product at very low prices (female no. 5, group A2).*

Group A3 has approached the problem by refining their products, trying to offer a more unique product thus avoiding the fierce competition. Group A3 are producing Dry fish

and Maldivian fish, but they also produce “Ambulthiyal” and “Maldivian fish Mix with spices”. Even if their problems of getting a good enough price for their products were less than for the other groups, they still faced market problems: *“Expanding our markets is a main problem for us. “Ambulthiyal” and “Maldivian fish Mix” have good demand from the local market. But the local market is a limited area”* (female no. 6, group A3).

The females lack access to markets, technology and information. Lack of information about the raw materials, suppliers, customers and technology has prevented these entrepreneurs from moving into new technology and markets: *“Getting information is another problem. Information about the raw materials, suppliers, customers and technology is very important to ensure success for our business. We have heard that certain things we make like “Ambulthiyal” and “Maldivian fish Mix” has a potential in some foreign markets but we don’t know how to address it, simply as we don’t have information on it. Plus we know that there are new preservation methods which provides better quality, but we don’t know how to get access to it”* (female no. 1, group A3).

Their problems are complex and there are many factors restricting the female entrepreneurs. Access to different types of capitals is also among these barriers: *“We do not distribute our products to the other remote areas, that is because of transportation problems and finance problems. Although we need to expand product quantity, we don’t have enough money to do so. It is very difficult to get a loan from the bank since they ask for securities. We don’t have enough properties and what we have is owned by our husband or father. Not only that although we have to pay high return rate, since we are women they think we will escape repaying the loan. That’s why they are asking securities. So, I gave up that idea and shifted to the informal money lender and got some money at a high rate (10% per month)”* (female no. 5, group A3). Finding finance is not easy especially for the women in Sri Lanka. Usually, banks or other formal financial institutes ask for securities or collaterals. In Sri Lanka, men own most of the properties and the goods. So, women fail to find necessary financial requirements to obtain loans from the formal financial institutes. Accordingly, as a solution for the financial problem, entrepreneurs tend to move towards the informal financial sector since there they are not required to provide securities in the same way as in the formal sector. Generally, informal finance can be obtained based on the closeness or the familiarity between the lender and the borrower, and such transactions are not done on solid legal grounds. Therefore, informal lending has been an easy way to overcome the barriers in the short run, and with less time, effort and documents. But, according to the researcher’s knowledge informal lending is not a good way to obtain money since there are no standard interest rates. The interest rates are high. Therefore, obtaining money from

the informal money lenders, they have to pay unnecessary high interest amount and this would cause a decline of their business.

The females perceive organising as helpful in exploiting and building their human capital. Lack of network among suppliers, customers and other organizations is preventing the female entrepreneurs to find a good market. As they pointed out: *“We are doing our business as separate persons, not as group or organization. For example, I make Maldive fish and take it away to the market and sell it there. She also produces and sells it. At the same time, we don’t have a good relationship among us producers. If there were such a relationship present, we would be bargaining together against our vendors and customers. Likewise, we don’t have a good network among fish suppliers, producers, and buyers”* (female no. 2, group A4). They see a potential partial solution to some of their problems. They want to organize in order to cooperate and by this strengthen their market position. The females in group 2 reported that they do this business as a group because the five members of the cooperative have only one drying machine and have to share it. If they developed this cooperation further, they could exploit their pool of human capitals more efficient. The females also reported that they were lacking social capital as access to networks among suppliers and customers: *“Although we are organized as a group we don’t have enough knowledge especially regarding how to handle finance, and how to sell our products. We do not use any promotion strategies to sell our products. We don’t know how to develop and maintain useful networks with our customers and suppliers. Today we sell our products to one wholesaler, and then if another buyer likes to pay a little more, we sell to him. So, we don’t have proper/regular customers. The story about our suppliers is also the same* (female no. 5, group A2).

The studied entrepreneurs don’t have sufficient knowledge about how to run their business successful. What they know, they have learnt gradually by experience. Almost all of them could tell storeys on how they failed and learned from their mistakes. To make the situation worse, most of these women entrepreneurs do not keep accounts. Thus until the business is totally lost, they don’t know whether their making a profit or loss. This may give the result that some of them after a few months realize that they not only have lost all their savings but also that they now have pressing obligations to informal money lenders.

## 6 Conclusions

The objective of this research was to reveal the barriers faced by women entrepreneurs in the fish and fish related industries in the Matara district and how the females coped with their challenges. In order to reach conclusions, the investigation employed focus group interviews among four groups of women entrepreneurs in fish and fish related industries. Based on the focus group discussion, several conclusions are drawn on barriers facing the women entrepreneurs in fish and fish related industries in Matara. Role expectations, market problems, transportation problems, unstable and disadvantageous weather condition, demanding family responsibilities, lack of access to new technology, high cost of raw materials, poor managerial skills, low self confidence, lack of business networks, limited access to financial capital, and poor quality of the produces products were the main problems faced by these women when performing their role as micro entrepreneurs. The efforts the females themselves put up to reply on these challenges were diversification, cost efficiency measures and organizing their forces.

Some institutional factors are blocking the female's opportunities to exploit and expand their capitals, capitals as social, human and financial capitals. As Buddhist females they are expected to behave in certain ways and to not behave in other ways. The gendered roles demand that they spend much of their time taking care of the family. This leaves little time to develop their human and social capitals by taking part in educational programs. Hence, such programs then have to be short and operational.

Societal structures are changeable. Mair and Marti (2009) shows that it is possible to change the societal structures that hinder the economical and social development of certain population groups. Increasing their bargaining power both toward their suppliers and their buyers has the potential to affect their societal position. One subject offered to these female entrepreneurs in an educational program could relate to how these females could organize themselves and their activities in such a way that it increased their bargaining power. In addition to this, knowledge on how to create and maintain co-operatives is another topic useful for the studied females. Moreover, since they do not have strength to compete successfully on their own, co-operative societies have to be established to face the challenges collectively.

Poor infrastructure facilities are common problems for the entrepreneurs in developing countries. As Chowdhury (2007) identified, poor transportation facilities is a problem for the Bangladesh entrepreneurs. The same situation can be seen in Sri Lanka. As Gandara and Dondra are rural areas, the infrastructure facilities are not at a satisfactory level. If

the local government responsible for such facilities could improve these facilities, it could spur more efficient business activities. Such means would reduce the transaction costs for the entrepreneurs and their markets. The females in our study ask for better transportation means. Better and cheaper transportation would give them better access to customers, but it would also potentially pave the way for purchasers buying larger quanta of fish for centralized processing in factories. This would then weaken the position of the females.

As small entrepreneurs in other developing nations (Das, 1999; Panda, 2002; Schwartz 1979), Matara district small women entrepreneurs don't have sufficient managerial experiences. Basic management training program for the small business owners can be offered in order to improve their management skills. Government and other institutes which offer training courses must give their attention on this matter. The Small Business Sections of the Divisional Secretarial Office have already implemented some educational programmes. Minniti and Arenius (2001) argues that policies should create and guarantee the existence of underlying conditions favourable to an entrepreneurial environment than as active promoters of start-up activities. In order to support entrepreneurial efforts among low caste females, these institutions should focus their programmes according to the need of such business owners as the investigated female entrepreneurs. Such programs then have to be provided in small building blocks, offering practical and applicable knowledge. In addition to this, the studied female entrepreneurs do not excel in their sales promotion and advertising efforts. Yet another topic is how to take advantage of different local niches in the market for their products. One group found it lucrative to offer a more processed version of the dry fish, by adding spices and tastes to it. Hence, provided better human capitals they can implement new strategies to find new markets and expand existing markets.

Participating in such short educational programs would also expand the females net of useful contacts. Networking in itself is a critical skill for entrepreneurial success. By this the government can act as a facilitator to build human assets by initiating good networks between the women entrepreneurs and other outside bodies. Dorr (2005) summarises good practises in Europe promoting female entrepreneurship. These include the use of female mentors and advisors, address both groups and individuals, focusing on sectors that can provide females with an adequate income provide modular training opportunities in business relevant subjects and provide access to funding. These measures all address the individual and seek to remedy lacks in capitals, lacks in human, social and financial capitals. Motivated mentors could help in growing human and social capital by giving advice both on how to perform a certain tasks and who to relate to

when a particular problem occur. Mentors could in this way be a channel for needed information.

In the short run, allowing these females to exploit simple machines to increase their productivity is necessary. Introducing new technology and skills to the females is then not enough. As access to capital is a huge problem for these females, access to financial capital has to be arranged as well. Micro credit has been tried with success elsewhere; such instalments could be introduced for this population as well. Further, by educating these women on savings schemes will allow them to draw from their own savings for their ventures. In a longer time frame, Sri Lankan females in the fish industry might have to deal with other challenges as well. Large fishing vessels and trawlers are seeking new seas to fish in. This has affected the traditional way of living for the people living on the coast of i.e. West Africa (Kaczynski and Fluharty, 2002). Such industry restructuring processes are evident in Sri Lanka as well (Chaturvedi, Sakhuja and Rumley, 2009). Moreover, the fish industry is changing very rapidly in developed countries. The use of modern technology for fishing and fish processing is increasing. In the investigated area, the local small scale fish industry is changing slowly. Instead of labour oriented methods, modern technology, new machines is introduced in order to increase both quantity and quality. Skills necessary for handling these new machines also has to be offered to the females. Minniti and Arenius (2001) see a path from necessity entrepreneurship in agriculture and fishing, employment in industry, employment in service industry and then opportunity entrepreneurship. Hence, another path for empowering these females would then be to create more positions for females to be employed in the industry sector. At the same time educational efforts has to put in place to ensure that these females are able to dress these new positions.

This study shows that entrepreneurship is locally embedded and that the opportunities possible to act upon are delimited by societal structures and the available social, human and financial capitals. The propositions were supported by the data. The remedies available for expanding the space of opportunities delimited by societal structures are to organise ones forces. The actors wanting to succeed in entrepreneurship also has to constantly improve their access to resources, or else one will become outperformed by the ones pursuing such strategies. Further research could inform about the practicalities of such small scale building blocks of education for poor female entrepreneurs in developing countries, and how they could overcome the resistance they will meet when they try to improve their business position by organizing their forces (Jentoft, 1981).

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### **III - Entrepreneurship within established firms**



## Chapter 7:

# Voluntary Labour Turnover in the Textile and Clothing Manufacturing Sector in Sri Lanka: The Causes of Leaving the Employers

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**Abstract:** This research focuses on the causes of leaving the garment factories in free trade zones in Sri Lanka. This explorative research is based on 6 qualitative in-depth semi-structured interviews with the aim of gaining a more detailed and comprehensive understanding of the labour turnover issue in Sri Lankan garment industry. The study found that there were fifteen causes of intentions to leave a current employer. These fifteen causes/factors were attributed to individual, organizational and environmental levels. As this study suggests, the employee made the leaving decision depending on the severity of the labour turnover factors and/or external opportunities available in the same industry. There was evidence that the left employees have started as self-employed.

Some particular moments were found to be specific for the context of Sri Lankan garment industry. A specific system of gratuity benefits and social security funds made a contribution to the high level of labour turnover. Sexual harassment appeared to be an important non-economic factor, contributing to leave decisions amongst employees. Low social status, associated with employment in the garment industry further encouraged labour turnover. National culture strongly shaped the carrier paths. Particularly, family traditions, emphasizing the woman's responsibility for childcare and homework, played an important role. While the garment industry mainly employs females, their husbands seemed to influence the leave decision to a large degree.

Based on the research results, some implications for practitioners and policy-makers were suggested. Some avenues for further research were proposed.

**Key words:** Individual Factors, Organizational Factors, Environmental Factors, Intentions to Leave, Labour Turnover, Garment Industry

## 1 Introduction

Success of any organization largely depends on the available resource-base. Arguably, people are the most important resources to any organization, making the most significant contribution to its success. However, when people decide to voluntarily leave an organization, the overall effectiveness of the organization may decrease for several reasons (Hom and Griffeth, 1995). First, the organization loses the knowledge that the departing employee possesses. Second, the organization must spend time, money and resources to select recruits and train the replacements. Therefore, this voluntary employee turnover causes many problems for employers. There is evidence that high levels of voluntary turnover adversely affect business unit performance (McElroy, Morrow and Rude, 2001; Koys, 2001).

Media reports, statements from consultants, and the prior research studies provide evidence that the Clothing and Manufacturing industry (Garment Industry) in Sri Lanka faces a high level of labour turnover. Though reliable island-wide data on labour turnover is not available, information received from the garment industry suggests that the average annual labour turnover is around 15 per cent. The industry needs around 45,000 new recruits per annum to keep up with the present level of operations ([www.ilo.org](http://www.ilo.org)). The garment sector has recorded turnover rates up to 60 per cent for some factories in the Western Province (Kelegama and Epaarachchi, 2001). According to International Labour Organization (ILO) statistics, some companies in the Export Processing Zone (EPZ) have reported a 3 per cent monthly labour turnover, which amounts to one-third of the employees at any given time being 'new'. It is also known that labour turnover does not necessarily mean that all employees leave the industry completely ([www.ilo.org](http://www.ilo.org)). Normally, the leavers leave one factory and join another factory. The Clothing and Manufacturing sector is labour intensive. Therefore, a high level of labour turnover can directly affect the firms in the industry. These firms require smooth functioning of their operations and high level of labour turnover may become dysfunctional. Further, since the *multi-fibre agreement* ended in 2005, the garment factories have to compete with foreign suppliers to sell their products. Garment manufacture has primarily been concentrated on low quality, low value-added, standard garments. As such, the cost-based strategy and productivity improvement are the

dominant strategies in the industry (Gopal Joshi, 2002). When the highly skilled labours leave the organization or the organization experiences some labour shortage, strategies are relatively hard to implement.

The number of studies on Labour turnover in Sri Lankan garment industry is very limited. Understanding the underlying causes of leaving the employer is essential when developing a strategy for reduction of the employee turnover. This research focuses on the causes of leaving the garment plants in Free Trade Zones in Sri Lanka. The research question for this study is:

*What are the main causes for leaving the garment plants in free trade zones in Sri Lanka?*

The findings of this study will be helpful for the policymakers, including the government, Board of Investment (BOI), the government regulatory body for garment manufacturing trade in Sri Lanka, and the respective garment factories to revise the HR policies in order to improve the retention.

## **2 A theoretical framework**

The 'turnover' may be defined as 'voluntary cessation of membership of an organization by an employee of that organization' (Morrell, Loan-Clarke and Wilkinson, 2001). Labour turnover refers to the movement of employees in and out of a business. However, the term is commonly used to refer only to 'wastage' or the number of employees leaving. The term Labour Turnover may be defined as "the analysis of the number of people leaving the organization against a given time period" (Armstrong, 2000).

The applied measures of the turnover are often not sophisticated enough to tell apart cases where employees have chosen to leave, and cases where they have had to leave for reasons out of their control (Morrell, Loan-Clarke and Wilkinson, 2001). However, the simplest measure involves calculating the number of leavers in a period as a percentage of the number employed during the same period. This is known as the 'separation rate' or 'crude wastage rate' (Armstrong, 2000).

There is no universally applicable maximum level beyond which the employee turnover becomes damaging for organization. "Everything depends on the type of labour market in which the companies compete. Where it is easy to find and train new employees quickly at relatively little cost, it is possible to sustain high quality levels of producing products and service provision despite having high turnover rate. By contrast, where skills are relatively scarce, where recruitment is costly or where it takes several weeks to

fill a vacancy, turnover is likely to be problematic from a management point of view” (Chartered Institute of Personnel and Development, 2005, p. 2).

March and Simon (1958) formed probably the first complete theory of labour turnover. Their analysis is based on equilibrium of paying employees. Employees are interested in working and they provide a certain level of contribution to the organization at a certain level of pay. If the equilibrium does not exist, employees feel their contributions are more important than the pay they are receiving. Then they decide to leave the organization. On the other hand, employees may feel that their pay exceeds their contribution. This will cause them to be satisfied and retain in the organization. March and Simon (1958) introduced two relevant concepts: “Perceived desirability of leaving” and “Perceived ease of leaving.” The perceived desirability of leaving is derived from the satisfaction with current job and the perceived possibility of intra-organizational transfer. If the pay levels are high, but the employee is not satisfied, employee may reconsider the perceived desirability of leaving. Perceived ease of leaving is derived from the number of perceived extra-organizational alternatives.

Mobley (1977) developed a sequential model for turnover. He identified job dissatisfaction as leading to thoughts of quitting. Once the employee considers the quitting due to dissatisfaction, the cost of quitting is evaluated. If the cost of quitting is low, then employees start to search for job alternatives. Then he/she evaluates the identified options of job alternatives. This evaluation then leads to the comparison of available options with employee’s current job. If the evaluation results show that the alternatives are more beneficial than the current job, the employee takes the quitting decision. These steps can be figured out as follows (Hunter, 2008):

Job Dissatisfaction ➤ Intentions to Quit ➤ Evaluations of Alternatives ➤  
Comparison ➤ Quit ➤

The Mobley’s (1977) model was tested by Hom et al. in 1984. The study suggested that job satisfaction negatively affected turnover and thoughts of quitting positively affected turnover (Hom et al., 1984). This supported the model suggesting that job satisfaction directly influenced thoughts to quit and thoughts of quitting directly resulted in intent to quit (Rilovick, 2005).

Price (1977) developed a causal model depicting what determinants produced turnover and how these determinants operated (Rilovick, 2005). The model included pay, integration, instrumental communication, formal communication, and centralization as

determinants for job satisfaction. Satisfaction was a mediator and opportunity as a moderator of the relationship between satisfaction and turnover. Decreases in pay, integration, instrumental communication, and formal communication and increases in centralization directly influenced job satisfaction. If the low job satisfaction occurred at the same time that job opportunities outside the organization were numerous, it was predicted that the rate of turnover would be high (Rilovick, 2005).

In 1981, Price's work was refined by Price and Mueller (1981). They included 11 determinants and two intervening variables. The 11 determinants include: opportunity, routinization, participation, instrumental communication, integration, pay, distributive justice, promotional opportunity, professionalism, general training, and kinship responsibility. The two intervening variables were job satisfaction and intent to stay. Seven of the determinants (routinization, participation, instrumental communication, integration, pay, distributive justice, and promotional opportunity) were believed to directly affect job satisfaction; three of the determinants (professionalism, general training, and kinship responsibility) were predicted to directly affect intent to stay; and low job satisfaction and low intentions to stay were believed to increase turnover (Price and Mueller, 1981).

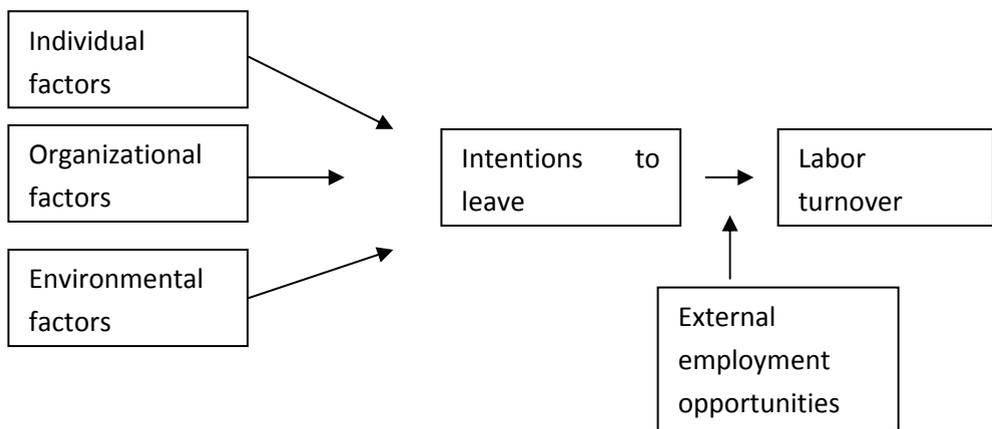
The Jackofsky's (1984) theory explained the U-shaped curvilinear relationship between job performance and turnover. The turnover would be relatively high for both very poor performers and very good performers. Turnover was high for very poor performers primarily due to involuntary turnover and is high for relatively good performers primarily due to voluntary turnover.

Steers and Mowday (1981) predicted that high performance would lead to increased expectation of rewards (promotions, salary growth), which would lead to increased turnover only if those expectations are not met (Mohammad, 2008). Hom and Griffeth (1995) and McLaughlin (1990) argued that the quality of peer group relationships and work environment were related to turnover. Employees would be inclined to leave an organization when experiencing an unpleasant environment and poor relationships with their peers (Mohammad, 2008). Goldsmith (1997), Mohammad (2008), Hom and Griffeth (1995) and Price and Mueller (1986) argued that heavy workload could lead to job stress and burnout, which in turn could lead to turnover. Further, Boxall et al. (2003) found that there were 16 factors that affected leaving the organization in his study (see the table 7.1).

**Table 7.1** Factors that affect leaving the organization

Measure	Indicator
Labour Turnover	Left because of a work-related accident or illness
	Left because unhappy with co-workers
	Left to obtain easier commuting to work
	Left because of a difficult relationship with your supervisor
	Left because the job was not what it was made out to be
	Left because of excessive work demands, asked to do too much work
	Left for promotion elsewhere
	Left because it was an organization that didn't listen to its employees
	Left to work with more up-to-date technology or work methods
	Left for better job security
	Left for better pay elsewhere
	Left for change of career. That is, from one occupation to another
	Left to obtain better balance between work demands and life outside work
	Left for better training opportunities
	Left because management didn't recognise employee merit
	Left for more interesting work elsewhere

According to Gordon Hunter (2008), there were three categories of voluntary turnover factors: individual level factors, organizational level factors and environmental level factors. The conceptual framework is presented in figure 7.1.



**Figure 7.1** Theoretical framework, Source: Gordon Hunter (2008).

At the individual job level, voluntary turnover factors consist of job satisfaction, reward and recognition (Hunter, 2008). Job satisfaction is measured based on the criteria used by Price (1977) which includes pay, integration, instrumental communication, formal communication, and centralization. Reward and recognition refer to competitive monetary compensation, bonuses, profit sharing, stock options, time off, and other perks of the job and have been identified as a factor shaping job satisfaction (Price and Mueller, 1981). At the organizational level, voluntary turnover factors include the workplace environment and career commitment. At the environmental level, factors that initiate turnover intentions are mainly non-work factors, which relate to family/personal concerns (Hunter, 2008).

In the absence of previous research on employee turnover in Sri Lanka, this study will make an attempt to find out which causes for leaving an employer are relevant in this specific context. These causes will be attributed to individual, organizational and environmental levels.

### **3 The context: Garment industry in Sri Lanka**

Many garment factories in Europe as well as in USA have been closed down because the developing countries, characterized by low labour costs, had started the garment factories. The garment industry is labour intensive and does not require large amount of capital and long time to train people and start production. The cloths and fabrics, which are the major inputs, may be obtained at a competitive price from countries all over the world. The developing countries like India, Maldives, Bangladesh and Sri Lanka are engaged in this industry and substantial proportions of these countries' budget come from garment export to Europe and the USA.

The textile garment industry in Sri Lanka has been started in 1960. Today, it has become the largest industry contributing to the Gross Domestic Product (GDP), accounting for 45% of the national exports and 458,165 employment opportunities which is nearly 5% of the total employment in Sri Lanka (data for 2008).

Taking the significance of the industry to the Sri Lankan economy into account, the government introduced free trade zone concept (1978) and preferential tax rates, Infrastructure facilities and constitutional guarantees are also provided for the investors who locate their factories in such zones. The major free trade zones and their employees are depicted in table 7.2.

**Table 7.2** The major export processing zones in Sri Lanka

<b>Name</b>	<b>Katunayake EPZ (K)</b>	<b>Biyagama EPZ (B)</b>	<b>Koggala EPZ (Ko)</b>
Date of inception	1978	1983	1990
Number of enterprises in commercial operation as at April 2008 (K), April 2009 (B), December 2006 (Ko)	85	57	21
Number employed as at February 2008 (K), April 2009 (B), December 2006 (Ko)	50,449	20,798	10,230
Number of enterprises	84	56	21

Sources: Board of Investment official web site, [www.boi.lk/BOI2008/katunayake\\_epz.asp](http://www.boi.lk/BOI2008/katunayake_epz.asp))

#### **4 Method**

In the absence of previous relevant studies in the Sri-Lankan context, this study thought to focus on generating the data based on what the informants tell rather than testing any pre-existing models. This explorative research was based on 6 qualitative in-depth semi-structured interviews with the aim of gaining a more detailed and comprehensive understanding of the labour turnover issue in Sri Lankan garment industry. The informants were the production related employees. The production related employees consisted of sewing machine operators, helpers and quality checkers. Six factories in the Koggala free trade zone situated in southern part of Sri Lanka, were selected and one employee from each factory was selected for the interview, considering the resource limitations such as financial, time etc. The following procedure was adopted for the selection of employees. First, the addresses/ telephone numbers of recently left employees were obtained from the HR departments of each factory. Then, the employees were contacted and the time for a face-to-face in-depth interview was decided. In order to gain fruitful data from the informants, they were given full awareness that the researcher is independent from the respective factories.

During the interviews, all the responses were tape-recorded and written notes were made by a researcher whenever necessary. The data were thereafter transcribed before starting the analysis. The analysis procedure included data reduction, data categorization and combining and connecting the resulting pieces of information. At the data-reduction stage the most relevant reasons for turnover intentions were emphasized and any unnecessary data were eliminated. Thereafter, the identified

labour turnover reasons were attributed to individual, organizational and environmental categories. Finally, the patterns of turnover behaviour were identified based on the labour turnover reasons, intentions to leave, and external opportunities.

## 5 Findings

Based on the in-depth interviews conducted with the left employees, the following factors that lead to turnover intentions were identified (see table 7.3)

**Table 7.3** The major factors that lead to turnover in the Sri Lankan textile industry

### **Individual level factors**

*Pay dissatisfaction*

*Gratuity and ETF entitlements*

### **Organizational level factors**

*Material issues such as allergies, dust related diseases*

*Higher work load*

*Problems with supervisor*

*Sexual harassment*

*No proper grievance handling procedure and there is no opportunity to being heard*

*Working environment (AC -Headache);*

*Unnecessary advice from senior/co-workers*

*Shift work sickness;*

### **Environmental level factors**

*The changing residence due to marriage*

*Husbands objections*

*No one to look after the infants*

*Bad impression towards the Job*

*diseases and sicknesses (Not job related)*

Each factor was further explained in the paragraphs that follow. The quotations supporting the arguments can be found in Appendix 7.1.

### **5.1 Pay dissatisfaction**

Compared to other employees, production employees were paid lower wages. Their wage ranged from LKR 10,000 to LKR 21,000. When comparing to the other job categories in the industry, employees perceived that they were underpaid. The

employees were graded depending on their performance. The performance was determined based on the target completion. It was very difficult to reach the higher performance because the target given was always slightly higher than the achievable level. Therefore, most of the employees interviewed were on average or even low performance level. This implies that they got lower wage. Low wages caused dissatisfaction with the job.

## **5.2 Gratuity and ETF entitlements**

According to Payment of Gratuity Act No.12 of 1983, employee can have gratuity payment - a payment based on the wage which is multiplied by the number of years of service, from the employer when an employee leaves after the completion of continuous working period of 5 years. Similarly, according to the Employee Trust Fund (ETF) Act No. 46 of 1980, all private and semi-governmental sector employers contribute with 3% of the gross salary of their employees monthly to the social security fund called ETF. The payments from this fund can be obtained when an employee leaves from the job. Since the job can be easily obtained from other organizations in the free trade zone, there is a common practice in the industry when employees leave the factory and join another one with the intention of having either ETF-payment or/and Gratuity-payment. When an employee has any financial difficulty, the employee normally considers leaving in order to have ETF or Gratuity benefits. When an employee has completed more than 5 years period, an employee quickly makes the leaving decision. In this study, one employee left in order to get Gratuity entitlements and another one left in order to withdraw the ETF entitlements.

## **5.3 Allergies and dust related diseases**

Work related accidents and illnesses mentioned by Boxall et al. (2003) were amongst the important factors influencing labour turnover amongst the respondents. Chemicals used for printing on fabrics and the dusts of fabrics caused allergies and illnesses, especially diseases like asthma.

## **5.4 Higher work load**

Production employees' performance is determined based on the individual target completion. Normally, target is determined in order to have maximized production efficiency. The respondents perceived that the targets already set were difficult to achieve. In addition they felt that they were like machines after starting the work every day. Even though rest time was set and rest rooms provided by the factory, they perceived that this was not enough. Some of the employees felt that their respective factories had relatively high work load and this caused the intentions to leave. When

employees had external employment opportunity with lower expected work load, the employees made the leaving decision.

### **5.5 Problems with a supervisor**

This is further explained by the factor “Left because of a difficult relationship with your supervisor”, which was used by Boxall et al. (2003). Most supervisors in the garment factory did not maintain the respect for his or her subordinate production workers. This was because of the pressure coming from the top management when the line performance was below the target. The respective supervisor was responsible for each line’s target performance and it was determined by employees’ individual target performance. If there were low performed employees, they were blamed, shouted at and threaten in order to reach the targets. Most supervisors were male and the most production employees were female. When there were defects or failure to reach the targets, the relationship between supervisor and production employee was broken by the supervisors’ threats, verbal attacking, and blaming. Then the employee requested a transfer to another production line. If the employee transfer was not taken place or if there was same problem in a new line the employee has been transferred to, the employee had intentions to leave and made the leaving decision depending on the severity of the relationship problem.

### **5.6 Sexual harassment**

In Sri Lankan garment industry the majority, of the production employees are female. Most of them are within the age-range of 18-30. In a garment factory, there is a high coercive power for the superiors. The sexually harassed employees are powerless, voiceless and they suffer in silence. Most of them have low educational level and have come from far rural areas in the country. Young attractive girls are especially vulnerable to sexual harassment from managers and supervisors. Every employee in a garment sector has dignity and self-esteem. According to the Sri Lankan culture, the woman does not sexually behave with anyone before marriage. If a female employee is sexually harassed or tried to be harassed that becomes a huge social stigma and psychological harm for that employee. Then, the one and only option for that employee is to leave the company. According to the data obtained from the informants, the employee normally intent to leave when there is a sign of sexual harassment by a supervisor or a manager. The actual leaving decision is made when the sexual harassment is of substantial proportions.

### **5.7 No proper grievance handling procedure and there is no opportunity to being heard**

Every garment factory has to keep a grievance handling procedure (section 12.2.1 of the Labor Standards and Employment Relations Manual) which is not functioning properly in some factories. Employee counselor sometimes is not authorized to take respective actions. Even though there is Joint Consultative Committee (JCC), a kind of labor union in garment manufacturing sector, it fails to deal with work related problems like sexual harassment because it affects the dignity and esteem of the victims. When an employee perceives any work related problem, which is not solved during one to four weeks time, employees always consider the same job in another factory in the free trade zone. While intending to leave, if the employee gets an outside employment opportunity and the work related problems still in existence, the employee simply makes the leaving decision from the respective garment factory. It is evident from the statements of respondent 2, 5, and 6, that the leaving decisions are made due to no proper grievance handling procedure and there is no opportunity to be heard.

### **5.8 Working environment (AC -headache)**

Most garment factories are operating in an air conditioned environment. The temperature level inside the factory is about 15-25 degrees of Celsius. It is normally 30-32 degrees of Celsius outside the factory. Employees always suffer from asthma or a headache due to a quick change of the body temperature when they go out from the factory and come in again. This is an organizational cause which leads to intentions to leave the factory. Some employees choose the factories which have not been air conditioned (usually a kind of small factories).

### **5.9 Unnecessary advice from supervisors and co-workers**

Sometimes unnecessary advices are given by supervisor or co-workers. Advises may, for example, concern higher paid job opportunities elsewhere, foreign employment opportunities, etc. An employee gets turnover intentions when they are told such an opportunity. If they get such an opportunity, they normally make the leaving decision.

### **5.10 Shift work sickness**

Sometimes garment factories have to run around the clock when they have high work demands. At these time employees have to work on the nights. Some employees can't work at night-time due to some illnesses and they simply prefer going to another factory which doesn't pursue night shifts. Those employees have intentions to leave when night shifts started and start searching job for opportunities in the same industry. They

normally make the leaving decision as soon as they get new employment opportunity in another factory.

### **5.11 Changing residence due to marriage**

Most of the garment factories have been located in free trade zones. Most employees come to the free trade zones from far rural areas and they are living in company maintained or private dormitories. When the employees get married, especially females, they do not prefer living in dormitories. When expecting the wedding they normally have intentions to leave and find job opportunities in the areas close by to the original residence. Their leaving decision is made when they got just married or one week before the wedding. In this case, some employees permanently retain to their homes after the marriage.

### **5.12 Husband's objections**

Most husbands of the female production employees make objections for working in garment factories due to the bad impression about this job. Females have intentions to leave due to the objections of their husbands and they leave the factory, stay at home, move to another industry, or become self-employed, depending on the severity of the husband's objections.

### **5.13 No one to look after the infants**

Most of garment sector female employees work in factories up to their marriage. When they get married and have children, their main concern is to look after their children. When they are expecting a child, they normally start to intend to leave.

### **5.14 Bad impression about the job**

There is a bad social impression towards the production employees of the garment factories. The production female employees are nick-named as "Juki Girls". The bad impression is mainly due to the low wages, more vulnerability to sexual harassment etc. Most of the Juki Girls come to this industry from poor families and work only for shorter period of time for such purposes as finding income for the dowry. Dowry is a culturally adopted practice when it is a paid in cash or artifacts by the bride's family to the groom's family. When such employees feel that they have sufficient savings for the wedding and the dowry they usually leave the factory.

Thousands of young girls who come from far rural areas find their job as sewing girls in free trade zone. They have not been provided proper residence. Most of them stay at small poorly-maintained rented houses. According to informant 2: *“we are always vulnerable to sexual harassment at roads and in outside rented houses. Outside, men try to grope and snatch girls in those houses to sexual favours”*. They don't have any protection since they are living far away from their homes. There are reported cases about rapes and attempts to snatch girls for commercial sexual trade. This contributes to the bad impression about the job. These concerns are also reflected in secondary sources:

*“The free trade zones themselves are associated with illegal abortion clinics and a thriving commercial sex trade. These social costs are the less discussed aspects of Sri Lanka's largest export trade”* (De Silva. D, <http://www.lawandsocietytrust.org/>).

### **5.15 Diseases and sicknesses (Not job related)**

There are some instances that employees leave due to illnesses that are not job related. For example, informant 2 revealed this issue.

## **6 Conclusions**

The study found that there were fifteen causes of intentions to leave a current employer. These fifteen causes/factors were attributed to individual, organizational and environmental levels. There were two individual factors, eight organizational factors and five environmental factors, influencing the decision to leave a garment factory.

As revealed in this study, the employee made the leaving decision, depending on the severity of the labour turnover factors and/or external opportunities available in the same industry. There was less evidence that the employees moved to other industries. Most of the production employees had low educational qualifications and their skills and knowledge could not be readily applied to another industry. But there was sufficient evidence that the left employees started as self-employed in small tailor shops keeping in a room at their homes and beauty salons with Sari made up activities.

While the major propositions steaming from the existing literature on voluntary labour turnover seem to be confirmed in this study, some particular moments were found to be specific in the context of Sri Lankan garment industry. Particularly, a specific system of Gratuity benefits and social security funds made a contribution to the high level of labour turnover. Sexual harassment appeared to be an important non-economic factor, contributing to leave decisions amongst employees. A low social status, associated with

employment in the garment industry, further encouraged labour turnover. National culture strongly shaped the carrier paths. Particularly, family traditions, emphasizing the woman's responsibility for childcare and homework, played an important role. While the garment industry mainly employed females, their husbands seemed to influence the leave decision to a large degree.

Human Resources department officials in each garment factory exerted their full capacity for the recruitment activities as their firm's labour turnover was high. The results of this study may be used in order to find remedies for the labour turnover and the HR planning activities of respective factories in the industry. Adjustment of management and supervising practices may be one of the most necessary actions. A factory may greatly benefit from the educational and training programs for the production-floor managers. These managers may be trained to treat the employees in some more respectful way. Possibly some pre-selection of supervisors based on their personal characteristics may be useful. Without considerable investments, this intervention may greatly reduce the employee turnover rate. The top-management may also adjust their planning practices in order to take into account the health problems of their employees. Paying attention to the extensive use of air-conditioning may, for example, both reduce the costs and labour turnover and provide some environmental benefits.

On the industry level, the producers may join their efforts in order to improve the overall image of the industry. The identified factors may also be useful for the Board of Investment (BOI) which is the regulatory body for the Sri Lankan garment industry when developing labour standards for the industry. This qualitative study identified the factors and relationships that were important for understanding the voluntary leave decision in a particular context. In the future, researchers may attempt to develop and test empirically the model for voluntary turnover which will be adapted to the context of labour-intensive industries in developing economies. Further, they can test to which extent each individual, organizational or environmental factor affects the leaving decision.

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**Appendix 7.1** Selected quotations.

Identified reason to leave	Respondent/ Statement	Quotation
Pay dissatisfaction	3/1	<p><i>“Sometimes, I am unable to reach the set targets. I feel that the supervisors set targets above my capacity. Since my individual performance is low, I am unable to get a high wage. Sometimes I am able to complete the targets... It depends on the style of the garment producing in the line. Even though I am able to complete targets, there is very little, sometimes it is nothing to save from my monthly wage after paying my boarding rental. ...I was thinking always to leave the job when I was in the factory and I left the factory when I got new job.”</i></p>
Gratuity and ETF Entitlements	1/1	<p><i>“It is useless to have this job; I want to start my own business like a tailor shop in my home. Then there will be no objections from my husband to go to the factory in the Free Trade Zone and I will be able to look after my infants easily...”</i></p>
	4/1	<p><i>“My parents do not have enough money. My father is a farmer and my mother is a house wife. Even though I had my secondary education up to General Certificate of Education, Advance Level (GCE, A/L) I was unable to obtain a job from the government. Therefore I decided to come to work for a garment factory. ...I wanted to collect money to make Gold Jewelleries and dowry for my wedding..... I decided to leave the factory since I felt that I have enough money for my wedding and also my friends told me that I could obtain ETF balance when leaving the factory.”</i></p>
Allergies and dust related diseases	5/1	<p><i>“I was working in the cutting department. I had not any diseases before coming here, now every night I am suffering from asthma and I have to spend much money for that. ....I requested to transfer me in to packing department. .... I was not transferred and I left the factory and I am staying at home until I get a job in a garment factory which is not dealt with clothing dust..... One of my friends had allergy when I was in one factory before coming here, due to chemicals used in printing department.”</i></p>
Higher work load	3/2	<p><i>“I feel that the supervisors set targets above my capacity....and I can’t bear my work load..... we get our wages based on this work load...I got an opportunity to have the same job in another factory in the Zone and I left the factory since I felt that I was under paid for my work load.”</i></p>

Problems with a supervisor	2/1	<i>"My line supervisor was always scolding me, when I made even a small mistake, or absent from working he had a habit of scolding me. But he treated some girls in a good way for the same mistake.....Most of our girls having this type of problem like for me in the garment sector.....Most of them request to transfer in to another departments in such instances. But the management does not behave on employee requests frequently. One day I was scolded badly and after that I didn't go for work for that factor...."</i>
Sexual harassment	2/2	<i>"Some girls in our factory fulfil sexual desires of the superiors....most of the supervisors and managers of our factory are males.... They used to say double meaning things. If we smile or laugh at them they will go on deeper. It is sort of checking us ... If they see a chance they will ...you know... one of my friends left the factory due to the sexual harassment. Every night one supervisor was calling to her and talked about sexual things. He has told to her that he would like to behave sexually with her and forced to come to a hotel room in a particular day. She afraid to complaint this to the management due to the fear of losing her esteem and She told me the incident and left the factory and disconnected the mobile connection."</i>
Working environment (AC-headache)	6/1	<i>"Air Conditioning (AC) was very high in my department. I felt very cold and I couldn't bear it and I was always suffering from headache and sneezing continuously...We always complain that situation. But, AC was not reduced. Therefore I couldn't achieve my daily targets. ...I was searching a factory without AC. Since I was able to find a one that is not AC, So, I decided to leave the company."</i>
Unnecessary advice from supervisors and co-workers	3/3	<i>"When I joined this company my friends and female machine operators told me that this company pays very low salary, limited OT and there was labor exploitation. So, I was searching a good paid job, While, line supervisor told me about the foreign job opportunity. Then I searched about it and I realized that it was a highly paid job. Therefore I decided to leave the company to go abroad. These days I am waiting for my visa."</i>
Shift work sickness	6/2	<i>"I have 6 years experience as a sewing machine operator. During that period I have changed 5 factories and of which 3 factories were left due to night work shifts. Doctors have advised me not to work at nights and normally I prefer to work general shifts. When they start night shifts I requests from the management about my difficulty of working at night. Since they didn't consider my request I was persuaded to find a general shift job. Since I was able to find good job I said good bye to that factory."</i>

Changing residence due to marriage	1/2	<i>"I have been working 3 years as a quality checker and this year I got married. My husband's native place is "Kurunegala." I feel that it is so difficult to make family commitment with this garment job."</i>
Husband's objections	1/3	<i>"My husband's residence is situated in "Kurunegala" (more than 200 Kms to the North from the respondent's working place) and I am working here, staying at a boarding. Before 8 months I got married. My husband's working place is near to his residence. Daily he told me and asked me to come to "Kurunegala", to stay at home, not to work. Because, he doesn't like garment jobs and he condemns production girls since the society's bad perceptions on such girls. ...He persuaded me to leave the factory."</i>
Diseases and sicknesses (Not Job Related)	2/3	<i>"One of my friends who were a helper for me suffered from arthritis from her age 18, therefore she was difficult to help me and having sitting for long hours. She was telling me that she wanted to leave the factory and before 3 months of my leaving she left the factory."</i>

## Chapter 8:

# The Impact of Owner Specific Factors on Growth of Small Business: Evidence from Sri Lanka

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**Abstract:** This article addresses how owner-specific factors links to the level of growth in small and micro sized business in Sri Lanka. Analyzing owner-specific factors on small business growth is paramount due to the small size of the firm and the management structure of the firm. Past research uphold the owner’s personal characteristics and human capital attribution within this research framework. A personal characteristic of improvement orientation and three human capital variables were tested to identify their relationship with firm growth. A sample of 93 small scale manufacturing businesses (SSMBs) from Southern Province of Sri Lanka was randomly selected for this study. The statistical methods used include principal component analysis and multiple regressions. The study reveals that an improvement orientation, industry competence, and management competence are significant related to firm growth while training doesn’t link to firm growth. An improvement orientation of the founder/owner is strongest associated with firm growth.

**Key words:** Business growth; small manufacturing businesses; improvement orientation; human capital.

## 1 Introduction

Do owner-specific factors correlate with the level of growth of small firms? This is the main research question addressed in this research. Generally, growth implies the increase in either employment or sales or profitability or two or all these aspects. In today's world, small scale entrepreneurs (SSEs) tend to play a vital role in economic development and are seen as the means to create jobs for the unemployed (Davidsson et al., 2002). Small businesses account for a significant proportion of world businesses (Morrison et al., 2003). They constitute 95% of all businesses in the United Kingdom (Day, 2000), 96-99% of the total number of enterprises in the Organization for Economic Cooperation and Development (OECD) countries (OECD, 2002). Also in Sri Lanka, small businesses heavily outnumber larger businesses. In 2003/2004, small businesses accounted for 92.4% of the industrial establishments (Department of Census and Statistics, 2006). However, their contribution to total employment and economic growth is substantially lower than in other countries. Therefore, revealing factors associated with growth and survival of SSEs has become important and substantial attention has been given by many countries for upgrading their SSEs. Despite the size of the firm, entrepreneurs bring wealth, prosperity, employment and change to the society in which they are a part of. They change the market, bring new goods and services into existence, and introduce new ways of doing things. As such, focusing on what brings this success in small businesses in whichever country is important. Some key factors are acknowledged to broadly influence the post-entry performance of firms. One is individual-related: the entrepreneur's or business owner-manager's traits, motivation and capacity. Secondly, firm-specific structural factors, such as the age and size of the firms. Finally, environmental forces and phenomena represent a third group that is recognized to explain post-entry performance.

The factors affecting to the success of small businesses may vary from country to country and region to region due to differences in entrepreneurs' behaviour, culture, and macro and micro environments. There is a strong need to focus research attention on the understanding of the owner-specific factors which relates to small firm growth. Due to the small size of the business, it is believed that the owner of those SSEs has to play a vital role for ensuring growth and survival of their business. The term "entrepreneur" is defined in a variety of ways, yet no consensus has been arrived at on the precise skills and abilities that make a person a successful entrepreneur. Entrepreneurial success depends among others on the characteristics of the entrepreneurs (McClelland, 1985). A number of business development organizations exist in Sri Lanka and their purpose is to provide opportunities for the entrepreneur to increase their entrepreneurial ability. Despite their effort, about 90 percent of the Sri

Lankan business start-ups have failed during its first three years from the origin (Gunarathne, 2008). Hence, there is a question about how these owner-specific factors are linked to the success of small firms and a need for further investigation unravelling this complex issue.

Developing the SSE sector is very important to countries where poverty and unemployment are a persisting problem. Since Sri Lanka earned its independence, its successive governments took many steps to develop Sri Lanka's economy. Some recent policy documents issued by the government emphasize the feasibility and implications of achieving more than 8 per cent annual growth targets. A significant weight is put on SSEs on achieving these projected growth targets. When analyzing the present contribution of this sector in the national economy, it is clear that the sector has not achieved the desired level of contribution when comparing with other developed and developing countries in the region (Gamage, 2003). As the national accounts of the Central Bank of Sri Lanka reveal in its annual reports, the 'small' manufacturing sector contributes only little over 1 percent of the country's GDP. The White Paper on National Strategy for the small and medium sized business (SME) Sector Development in Sri Lanka (2002) revealed that 85.4 percent of industrial establishments in Sri Lanka are 'Small', however, this 85 percent of establishments contribute only 20.6 percent of industrial employment and 5.5 percent of industrial value added. The empirical results of the study of post-start-up growth of small businesses (Gunarathne, 2008) showed that only a small proportion of businesses had achieved employment growth and many have failed to contribute to the national level economic goals. Even though the survival and growth of small firms is vital in regional economic development, many small businesses are vulnerable in the period after starting-up. SMEs are vulnerable as they have to cope with changes in the market, fierce competition and new technologies.

This research approaches the development of owner-managers of small firms throughout the entire life cycle of the business rather than limiting itself to the pre-start-up stage or the immediate time after start up. Analyzing how owner-manager specific factors links with the success of the business focusing on small firms definitely will contribute into strengthening the SSEs sector, as such findings and implication could be implemented in new politics supporting the SSE sector. The findings of this research could also be a guide for the facilitators of entrepreneur development.

## **2 Theoretical Framework**

The entrepreneurial literature has identified several factors that influence on the success of small firms, factors such as individual-specific factors, firm-specific factors, and industry-specific factors (Bates, 1990; Baum and et al., 2000). Among those factors, individual-specific factors have been identified as prominent factors (Gimeno et al., 1997; Pennings et al, 1998). As there are few persons involved in a small business with few employees, a special attention is given on individual level analysis when doing research on SMEs. In individual level analysis, personal characteristics, the background of the individual owner, human capital and social capital of the owner has been studied. Also the owner's goals and strategies on behalf of the firm have been used profitably to study the success in these firms. In small businesses, the owner-founder is the manager of the firm and he/she much determines the strategy of the enterprise. As such his/her management decisions, intentions for the business, attributes, attitudes, and aspirations could be intrinsically linked with the growth of the business itself. On the other hand, profit and growth orientation, innovativeness, risk taking ability, and the human capital attributes of the owner such as education level, industrial and managerial experience, prior business ownership make the founder more efficient in organizing the business processes and in attracting customers and investors (Baum et al., 2000).

According to previous research, it can be concluded that many researchers in the entrepreneurship field have focused on owner-specific factors impact on small business growth, namely personal characteristics and human capital (Coleman, 1988; Cooper et al. 1994; Pennings et al, 1998; Bosma et al., 2000; Praag, 2002). Therefore, the literature review section of this paper limits the focus on the empirical findings of the impact of owner manager's personal characteristics and the human capital on small business growth. The personal characteristic discussed is improvement orientation, and the human capitals are business training, industry training and management competence.

### **2.1 Improvement orientation of the owner and small business growth**

Gartner (1988) argues that it is not fruitful to explain business start-up as a function of core human traits and personality, as starting a business is a rare event and personality is a stable personal characteristic (Jennings, Cox and Cooper, 1994). Other manifestations of entrepreneurship than business start-up happen more often and are linked to more dynamic personal characteristics than personality. Past research associate small business growth to elements of owner-manager characteristics. For instance is proactivity (Crant, 1996) associated with intrapreneurship (Campbell, 2000), and entrepreneurial orientation is associated with business performance (Lumpkin,

1996). Also, Stevenson and Jarillo (1990), and Brown and et al. (2001) expressed that high growth tends to be associated with entrepreneurial characteristics. The findings from several studies on small firm success, for example, Burns and Dewhurst, (1996); Haslam-McKenzie and Ryan, (2000); Morrison et al., (2003), suggests that the personal orientation of the owner-manager is associated with small business success.

A personal characteristic, Improvement Orientation, has been suggested as a construct associated with organizational performance (van den Berg and Wilderom, 2004). Rousseau (1990) argues that the degree of improvement orientation in an organization reflects its ambition level. Some findings relate improvement orientation among US business owners to business growth in SMEs (Wolff and Pett, 2006). The findings of Coyle-Shapiro and Morrow (2003) suggest that individual predispositions may play an important role in the degree to which an individual exert a continuous improvement orientation. Early research findings show that an entrepreneur should have several special characteristics that help him to become a successful businessman. For example, an entrepreneur should be a risk taker; he/she should be innovative, self-confident, goal setter, hard worker, and accountable (Siropolis, 1997); entrepreneurs must be persistent, self-confident, creative, and optimistic and independent minded (Holt, 1992); they should be realistic about working hard and driving toward measurable results, tend to have superior conceptual abilities (Welsh and White, 1981); entrepreneurs should have characteristics like self-confidence, task result orientation, be risk taking, exercise leadership, and have a future orientation. Many of the studies have observed significant relationships between owner-managers' psychological characteristics and the success of small business. Other studies have focused on the psychological influences and have investigated how these factors relate to small business growth, among the investigated factors are: need for achievement, internal locus of control; propensity to take risk, tolerance for ambiguity, profit motive and growth orientation, motivations of owner-managers, their attitude and drive, competence, and communication skills (McClelland, 1965; Kets de Vries, 1977; Begley and Boyd, 1987; Abdner, 1988; Filley and Aldag, 1988; Lean, 1998; Morrison et al., 2003).

Inspired by this discussion, Innovation ability, Risk Taking ability, Profit Motive, Growth Orientation, Courage and Dedication, and Self Confidence have been included in a measure of the owner's improvements orientation in this study. An entrepreneur that scores high on these items could be regarded as having an improvement orientation. This leads to a hypothesis on an improvement orientation and firm growth:

**H1** Business owners with higher improvement orientations will experience higher firm growth.

Human capital is a resource. Human capital is created by changes in persons that bring about skills and capabilities that make them able to act in new ways (Coleman, 1988). Prior studies evidenced that the intellectual capital and the talent of an owner manager is central to the success of their business enterprises (Rivette and Kline, 2000). Several arguments support the view that a high level of human capital is related to firm survival and growth (Bruderl et al., 1992; Cooper et al., 1994; Pennings et al., 1998; Bosma et al., 2004; Isaksen, 2006). High level of human capital attributes can reduce outside stakeholder uncertainty. During the venture pre-growth stages, whether or not the stakeholders of a firm provide resources to a firm, such as inputs, credit and finance, information, etc will depend partly on how they view the credentials of founders or owner manager of the small firm. Therefore, it is believed that founder's human capital act as a surrogate indicator of competence and credibility of the founder (Pennings et al., 1998). In attempting to understand SSE success, the human capital attributes of individual entrepreneurs, such as: industrial experience, training, management competence, and educational qualifications are frequently hypothesized to influence business performance.

## **2.2 Industry competence of the owner small business growth**

Some researchers (Bruederl et al., 1992; Cooper et al., 1997) have identified different types of human capital namely: general human capital and industry-specific human capital. According to Cooper et al. (1997), general human capital relates to factors expected to increase the individual's productivity for a wide range of job alternatives where as specific human capital factors are related to the factors which applicable to a specific domain. Bosma et al. (2002), also distinguish between three types of investment in both human and social capital: general, industry-specific and entrepreneurship-specific investment. Bosma et al. (2004) again discussed three categories namely, (1) entrepreneurship specific; (2) industry specific; and (3) general human capital. One type of human capital specified by Cooper et al. (1994) is industry-specific know-how. This type of human capital may play an important role in the understanding of how business is done in a specific context of suppliers, competitors and customers. Bruederl et al. (1992) distinguished between general human capital as years of schooling and years of work experience; and specific human capital as industry specific experience, self-employment experience, and leadership experience.

Owners starting firms in fields where they have specific prior work experience are expected to outperform those lacking such industry-specific work experience (Bruderl et al., 1992). Entrepreneurs who came from similar businesses may bring with them relevant knowledge bases, experience, and relationships that significantly reduce the liability of newness (Cooper et al., 1994). Bringing industry-specific experience to one's new business venture enhances performance; operating one's own firm is hypothesized to enhance further one's industry-specific experience. Praag (2002) commented that success requires knowledge of the industry and the experience gathered through occupation. Bruderl et al., (1992) mentioned that industry specific experience yields knowledge about profitable niches and increases productivity. By applying the resource based view of firms when studying factors leading to competitive advantages, many researchers pointed out that the importance of non-imitable human capital i.e. industry specific human capital (see i.e., Barney, 1991; Bosma et al., 2004). Possessing experience in the same industrial sector as the newly founded business increases the probabilities of success in making profits and in surviving (Bosma et al., 2000). This leads to a hypothesis on industry competence and firm growth:

**H2** The more industry competence the business owner has, the higher firm growth.

### **2.3 Business training of the owner and small business growth**

Bruderl et al., (1992) and Isaksen, (2006) pointed out that entrepreneurs with more diverse skills and competencies are able to organize and manage the production process more efficiently and thereby increasing the productivity and profits, and to have more diversified financial bases, and finally to be able to own more successful ventures. Individuals with higher human capital may benefit from preferential treatments and hence may have better access to critical resources such as financial capital, market information and other networks. The results of Hausman' (2005) study suggest that different facets of human capital attributes possessed by the entrepreneur such as: industry-specific, firm-specific, and innovation-specific factors assist for innovativeness which is considered as very important in order to achieve competitive advantage and also to achieve business success. Dahlqvist et al. (2000) contributes to previous studies by adding yet another category of human capital, this related to hands-on training in businesses. Experience from previous start-ups and previous work training provides the entrepreneur with tacit knowledge about the processes involved in getting a business up and running.

Training is argued to be vital to the performance of females starting their own firm, according to Carter (2000). Cosh, Duncan and Huges (1998) found some evidence for a

link between training provided to employees and firm growth measured in growth in employees and sales, the linkage to profit was more unclear. Despite the received view in policy circles that business training is critical to firm growth, research findings do not clearly demonstrate such a link between training and better business performance, according to Storey and Westhead (1994). Wong et al. (1997) is also critical to previous research on training and firm performance as they claim that where an association between training and firm performance is found, the direction of causality is unclear and the methods used is flawed. Even so, Wong et al. (1997) demonstrate a value of training to the development of UK SMEs. Taking part in training activities are associated with a continuous learning culture and people that participate in training activities could be more innovative (Martocchio and Baldwin, 1997). This paper propose a link between training received by working as an employee for another firm, on the growth of the present firm owned by the person who received the training. This leads to a hypothesis on training and firm growth:

**H3** The more training the business owner has, the higher firm growth.

#### **2.4 Management competence of the owner and small business growth**

Cooper et al. (1994) suggested three categories of human capital, (1) general background; (2) specific industry know-how; and (3) management know-how. Management know-how focuses on the entrepreneur's previous experience with general management tasks. As evidenced by Gimeno and et al., (1997) specific human capital compared with general human capital is more likely to contribute to entrepreneurial success and to superior business performance (e.g. business survival and employment growth). Some studies identified the business owner's level of education, his industrial specific experience, and his management experience to be related to success (Bruederl et al., 1992; Cooper et al., 1997). Bosma et al. (2000) concluded that human capital is especially important for determining survival and profit. Bosma et al., (ibid) further pointed out that management experience is important in determining business success.

Sinha (1996) expressed that managerial skills are an important factor in entrepreneurial success, stressing that it is human factors that make the difference between success and failure. Gill (1985) stated that the market knowledge acquired while in past managerial positions or through prior business ownership becomes useful to achieve high growth rates. Storey (1994) also found a positive relationship between previous management experience and high growth rates. Dobbs and Hamilton (2007) emphasized the positive effect of past experience on small business growth by proposing that owner-managers

with previous experience are more likely to avoid costly mistakes than those with no prior experience. Some researchers have found a positive relationship between previous management experience and business growth (Hambrick and Mason, 1984; Macrae, 1992; Storey, 1994; Dahlquist et al., 1999; Locke, 2004) and growth in employment (Dunkelberg and Cooper, 1982) while other studies have found no relationship between these variables (Kalleberg and Leicht, 1991; Siegel et al., 1993; Birley and Westhead, 1994). This leads to a hypothesis on management competence and firm growth:

**H4** The more management competence the business owner has in terms of industry experience, the higher firm growth.

### **3 Methodology**

The Southern Province of Sri Lanka was selected as the research site because a large portion of the industrial establishments within the Southern Province operates as micro businesses. Hence, it is well suited to study growth in micro businesses. According to the Central Bank Annual Reports in 2004, employments in the manufacturing sector of Southern Province in Sri Lanka was 16.8 percent of total employment and it is very low in comparison with the employments in the agriculture and service sector which records respectively 39.8 percent and 36.0 percent. In 2003, about 97 percent of the industrial establishments in the Southern Province were small and micro scale establishments which employ less than 19 people.

In Sri Lanka, the Manufacturing industries have been categorized differently by different organizations such as Central Bank of Sri Lanka, Department of Census and Statistics (DCS), Provincial Planning Secretariats. For example; the DCS uses 25 industrial categories in their annual survey and Provincial Planning Secretariats use 30 industrial categories. Due to absence of a database of entrepreneurs in Sri Lanka, a convenient sampling method is selected for this study. The researcher contacted several organizations such as District Chamber of Commerce and Industry, Women's Chamber of Commerce, Small Business Development Divisions, Divisional Secretariat Offices, and Agromart Foundation, all which operates in the Matara, Galle, and Hambantota districts in the south of Sri Lanka. A list of Small Scale Manufacturing businesses (SSMBs) from the three districts was prepared. In the sampling frame there were about 1728 SSMBs which employ 5-49 employees operating in the Southern Province (Census of Industry 2003/04, DCS, Sri Lanka). Based on the Definition of SSMBs used in the *White Paper on National Strategy for SME Sector Development in Sri Lanka (2002)*, only small businesses with 5-29 employees and that have been in businesses for at least 36 months were included in the sample. The overall list then includes 1265 such firms, whereof 120 were

selected randomly. The sample then consists of a representative sample of the SSMBs belonging to the 7 largest industries in the region.

A structured questionnaire was distributed among 120 SSMBs, whereof 93 SSMBs of the sample responded the questionnaire satisfactorily. The data was collected via personal interviews. As the researcher needed to ask sensitive and complex questions in order to reveal the reality of conditions for growth among manufacturing SSMBs, a personal interview method was considered as the appropriate data collection method. A structured questionnaire was used as an interview guide (see appendix 8.1). Each interview lasted about a half an hour. The researchers performed a pilot test on 10 of manufacturing SSMBs equal to the sample. A pilot test was conducted in order to test the appropriateness of the questionnaire content, in particular the growth constraints, and to check how the respondents understood the wording on the items. No major changes in the structured questionnaire were needed.

The control variables used in this study is descriptive of the owner; age, gender and education. These variables has been used in previous studies showing a positive relationship between age and small business growth (Westhead et al., 2001; McGee and Sawyer, 2003; Andersson et al., 2004), gender and business survival and growth, (Gimeno et al., 1997) and business growth and the formal education of the founder-owner (Dunkelberg and Cooper, 1982; Johnson, 1993; Storey, 1994; Barringer et al., 2005; Kozan et al., 2006). Type of business is another control variable often used in studies of organizational growth, hence it is included in this study. The industry categorization is that of DCS. All the human capital attributes, except level of education of the owner, are measured in terms of years. Level of education of the owner is revealed by using several interval scales such as: 5 = Up to Grade 5; 8 = Up to Grade 8; 11 = GCE O/L; 13 = GCE A/L; and 17 = University Education or equivalent. The wording of the items used is presented in Appendix 8.1.

Past research on firm growth of Micro and Small Scale Enterprises (MSEs), Small Scale Enterprises (SSEs), and Small and Medium Scale Enterprises (SMEs), used several measures in defining the firm growth (Kickul and et al, 2002; Nicher and Goldmark, 2005). Those include: number of employees, sales turnover, capital investment, expansion of product line, product diversification, market diversification, and duration of business. For this study, firm growth was measured by using a combined measure: employment growth since start up; growth in investment since start up; sales turnover growth since start up; and profit growth since start up. The values on these four items are captured on a ratio scale from 0 to 7 (0 = Extremely insufficient; 4 = Moderate; and 7

= Extremely sufficient). To ensure a good reliability of these measures of growth in sales, profit, investment, and employment, several documentary reports had been investigated at the interview site. Such documents includes; informal financial records, receipts of purchasing of machineries and equipments and a conversation with the owner. The results of the Principal Component Analysis (PCA) of firm growth as reported in Table 8.1 indicate a high congruence among the items used to build the firm growth construct. The value of the KMO measure (.846) and the high eigenvalue (3.056) all indicates that the firm growth measure used in this study is a consistent measure (Hair et al., 1998).

**Table 8.1** Firm growth: Principal component analysis, varimax rotation, n=93

Items	Firm Growth	Extraction
Growth in Investment in the Business	.759	.577
Growth in Sales Revenue	.933	.870
Growth in Profit	.929	.864
Growth in Employment	.863	.746
Eigenvalue		3.056
Variance explained (%)		76.397
KMO		.846

Data were collected relating to owner-specific factors including the improvement orientation of the owner and human capital attributes associated with the owner founder. Both general human capital and entrepreneurial specific human capital attributes have been included in the model. The owner-specific factors have been measured in terms of the perception of the owner manager. For this purpose the researcher has applied ratio scale ranging from 0 to 7 (0 = Very Poor; 4 = Moderate; and 7 = Extremely High).

According to eigenvalues of the Principal Component Analysis reported in Table 2, four factors retained and those include: Improvement orientation (F1), Industry competence (F2), Training (F3), and Management competence (F4). The items: "Innovation ability of the owner", "Risk Taking ability of the owner", "Profit Motive of the owner", "Growth Orientation of the owner", "Courage and Dedication", and "Self Confidence" are all included under the label of "Improvement orientation". "Industry experience", and

“Experience in parental business in similar industry” are the items included under the label of “Industry competence”. Two items: “Years of Industrial Training” and years of “Business Management Training” are included in the “Training” component. The remaining three items that builds component 4 (Managerial competence) are years of “Managerial Experience”, “years of Experience in Parental Business in Non-Similar Industry”, and “years of Prior Work Experience”.

**Table 8.2** Improvement orientation, Industry competence, Management competence and Training variables: Principal component analysis with varimax rotation, n=93

Principal Components, varimax rotation	Improvement orientation	Industry competence	Training	Management competence	Extraction
F1-Innovation ability of the Owner	.810				.668
F1-Risk Taking ability of the Owner	.906				.856
F1-Profit Motive of the Owner	.920				.910
F1-Growth Orientation of the Owner	.935				.895
F1-Courage and Dedication	.951				.930
F1-Self Confidence	.919				.894
F2-Industry Experience		.879			.841
F2-Experience in Parental Business in Similar Industry		.878			.797
F3- Industrial Training			.814		.692
F3-Business Management Training			.739		.646
F4-Managerial Experience				.763	.658
F4-Experiance in Parental Business in Non-Similar Industry				.722	.572
F4-Prior Work Experience				.673	.566
Eigenvalue	5.628	1.885	1.073	1.339	
Variance explained (%)	39.3	13.4	11.1	12.5	76.3
KMO					.846

As displayed in Table 8.2, the four components accounted for 76.3% percent of the total variance. With regard to component loadings, Hair et al., (1998) considered components extractions above the 0.50 level as particularly significant. All component extractions of the model in this study meet this requirement and have the highest loading on the component they are conceptually expected to belong to. Loadings less than 0.3 are suppressed in the table. Improvement orientation has the highest loadings and records the highest eigenvalue (5.6%). Industry competence, Training, and Management competence are noted for eigenvalues of 1.9%, 1.07%, and 1.34% respectively.

**Table 8.3** Descriptive of the respondents in this study, n=93

<b>The sample</b>	<b>Percent</b>
<b>GENDER</b>	
Male	75
Female	25
<b>AGE</b>	
20-29	7.5
30-39	28.0
40-49	27.0
50-76	37.5
<b>EDUCATION</b>	
Up to Grade 5	7.5
Up to Grade 8	4.3
GCE OL	38.7
GCE AL	39.8
University Education	9.7
<b>BUSINESS TYPE</b>	
Food and Beverages	16.1
Jewellery	9.7
Brass and Metal products	4.3
Coir products	16.1
Handicrafts	10.8
Garments	12.9
Shoe and Leather products	17.2
Clay products	12.9

Descriptive of the respondents in this study is shown in Table 8.3. From the sample, 75% are male and 25% are female. The smallest age group in the sample is in that of 20-29 years (7.5%) and the upper age group (50-79) is most represented (37.5%). The males

are older than the females in the sample. The most of SSMBs owners have reached either G.C.E. OL or G.C.E. AL educational level. Only 9.7% have achieved University education or equivalent. Shoe and Leather, Food and Beverages, and Coir are the industries that are most frequently in the sample.

#### **4 Results**

This study includes one dependent variable, and four independent variables. Firm growth is the dependent variable and owner specific factors are the independent variable. Because the dependent variable is represented by metric data (ratio scale) and several independent variables also are represented as metric data, a multiple regression analysis has been used to determine the relationship between the owner specific factors and business success as well as the degree of effect of owner specific factors shows on firm growth (Hair et al., 1998). A Pearson's correlation analysis (see Appendix 2) has been applied to test for multicorrealtions, no indications of multicorrelation were found in the data. The values of skewness and kurtosis show that the variables used are adequately normally distributed (ibid). The VIF values for all the variables are also within the borders of the acceptable for a multiple regression (ibid). The highest VIF value was 1.37.

The overall model is good. The adjusted  $R^2$  is 0.501 while the F value is 12.56 and significant at a 0.00 level, when running the regressions with SPSS version 15. The high adjusted  $R^2$  indicate a good fit for the model, half of the variance in firm growth is explained by Improvement orientation, Industry competence, Management competence and business type along with the control variables.

Regression results as depicted in Table 8.4 shows that an Improvement orientation of the owner manager records the highest relationship with firm growth and that the relationship is positive. This indicates that Improvement orientation is the far most important factor predicting firm growth in Sri Lankan SSMBs. Management competence also contributes positively. Industry competence as measured in this study actually contradicts firm growth. The control variables Gender and Age did not influence firm growth. The analysis further indicates that the food and beverage industry is growing, even when controlled for the other variables. The Pearson's correlation results attached in Appendix 8.1 also indicates that the Improvement orientation and Management competence as measured in this study of the owner is correlated with firm growth. The regressions add to the correlation by also evidencing that the Industry competence is significantly negatively associated with firm growth. Moreover, the regressions indicated that the food and beverage sector is currently growing in Sri Lanka.

**Table 8.4** Regression on Firm growth, n=93

Regression on Firm growth	Std. B
<b>Controls</b>	
Gender (male=1, female =0)	-.075
Age of the Owner	.143
The Owners highest educational level	-.134
Business Type - Food and beverages	.195 **
<b>Hypothesis</b>	
H1: Improvement orientation	.771 ***
H2: Industry competence	-.189 **
H3: Training	.060
H4: Management competence	.215 ***

Note: \*\*\* => p < 0.01, \*\*=> p < 0.05 and \* => p < 0.10

The hypothesis stating that the higher scores on Improvement orientation of the business owner, the higher firm growth, were confirmed. The more improvement oriented the business owner is, the more the firm grows. The second hypothesis, linking industry competence to firm growth was rejected. The link was significant, but the direction of the correlation was opposite to the predicted. This implies that industry competence contradicts firm growth in this sample. The third hypothesis linking the owner's general business training to firm growth was rejected. The link was not significant. The fourth hypothesis was confirmed. The more management competence the business owner has, the higher firm growth there will be. Management competence by the business owner as measured in this study supports growth of the business.

The results suggest that for SSMB firm growth, the firm needs to recognize that a strong improvement orientation of the owner are a critically more important influencer on growth than the other factors tested in this study. The business owner's industry competence and management competence are also good predictors of business growth. However, here we see that training, education, age and gender are not good determinants of firm growth.

## 5 Conclusions

Small business growth deserves an increasing attention among researchers. The social and economic development and the generation of new jobs depend, in a substantial portion, on the entrepreneurial capacity to generate new jobs, new products and processes through a sustainable growth of the business. Hence, the growth of small

businesses is an essential challenge within this framework. In this study, we have addressed the impact of owner-specific factors on the actual growth in small firms. Thereby, the researchers aimed to reveal if there is a significant association between owner-specific factors on small firm growth. The study concludes which factors related to small firm growth and provides some implications for future researchers, small scale entrepreneurs, and policy developers.

Firm growth is measured as several different aspects of firm growth. The measures are relatively consistent regarding firm growth. If the firm reports growth in sales revenues, there is usually also growth in profit, employment and investments, and vice versa. Even if the researcher seeks to verify the growth indicating measures by verifying the provided information with additional data from ledgers and on-site observation, the measures of growth used in this study are self reported measures. This implies a potential for self reporting biases, the owners might want to report good numbers to indicate to the researchers that they are competent players in the business market. This concern is further minimized by allowing the respondents anonymity and the fact that the respondents were randomly selected without prior knowledge to the university or the researchers.

There are other limitations than the measure of growth that should be considered when interpreting the findings of this investigation. Also the owner specific factors are self reported. This is cross sectional study, the direction of the relationship is not considered. We find a link between the owner's improvement orientation, human capital and firm growth. Even if the theoretical framework suggests a causal link between human capital, improvement personality, and firm growth our methodology does not allow any conclusions on causality. Our sample size is low, but the response rate is high. This together with the selection procedure indicates a good representativeness of the registered SSBM sector of southern province in Sri Lanka.

An entrepreneurial personality, industry competence, training, and managerial competence are the four factors that have been tested in this study. The results of this empirical research show the important role of the entrepreneur in developing his/her firm. The needed skills, knowledge and competencies in order to successfully face the challenges in the business world relates to human capital and an improvement orientation of the owner. These tested four variables accounted for slightly more than half of the variance in firms' growth. We find that personality has a unique impact on the growth of the small business. Industry competence and management competence also links strongly to business growth. Therefore, an evaluation of the extent of

entrepreneurial characteristics of the business owner is very important in achieving firm growth.

A greater attention should be given by the entrepreneurs as well as from the Sri Lankan Business Development Service (BDS) providers regarding developing a profit motive, growth orientation, courage and dedication, as well as a risk taking and innovative ability of the entrepreneur. Those BDS providers also need to consider how the training is provided. Training as measured in this study does not contribute to firm growth. Small scale entrepreneurs participating in courses offering business management and technical training specific for their industries, does not perceive higher growth rates than those not participating in such training. Another interpretation of the non-result from training on firm growth is that the long time lag between the training and the result disguises the effects from the training on realized firm growth (Gibb, 1997). Age and gender of the owner as well as the age of the business do not turn out as very important determinants of business growth in this study.

The food and beverage industry are different from the other investigated industries relating to firm growth. Firms in this industry are on the average growing more than firms in other industries. One reason for this firm growth among owners of food and beverage firms could be that Sri Lanka can be considered as a growing economy and more and more locals have income enough to enjoy eating out or buying prefabricated food. There are also more tourists coming to Sri Lanka. Maybe the other industry has to change toward products and a service needed by a wealthier population, as the growth experienced in the Food and Beverages industry are not yet realized by other industries.

There are signs of a worsened situation regarding growth in SSMBs in Sri Lanka. Industry experience contradict firm growth, this implies that the knowledge and competence gained by working in a firm is soon outdated. Maybe the ever globalized world also has reached Sri Lankan SSMBs and they have to constantly innovate in order to stay competitive. If so, learning from old praxis and insisting on prolonging these might contradict innovation and growth.

Even worse is that the results show that the educational level is not influential on firm growth. It might indicate that Sri Lankan SSMBs does not yet benefit from educated managers. The competence gained by working in the industry is not sufficient for growth (it even contradicts growth), therefore, it can be suggested that Sri Lankan SSMBs would benefit from a better adjusted educational offer from Sri Lankan universities.

Universities has to respond to this need, families has to send their young to universities, as working ones way up does not help.

The findings and the conclusions of this study has opened for further research on the relationship between firm growth, educational offers from universities and Business Development Service as well as for industry rejuvenation. This research was not able to pinpoint which university offerings Sri Lankan SSMB would benefit from and how these offerings should be served. The findings suggest that the present offerings are not sufficient and not adjusted to the local needs.

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**PART I**

**Basic Information of the Business/Entrepreneur**

1. The **Location** of the business

(a) In which **District** is your firm located? *(Please tick one box)*

- Galle
- Matara
- Hambantota

(b) Is your business in an **urban or rural** location? *(Please tick one box)*

- Urban
- Rural

2. Type of the business *(Please tick one box)*

- |                         |                          |                       |                          |
|-------------------------|--------------------------|-----------------------|--------------------------|
| Food & Beverages        | <input type="checkbox"/> | Jewelry               | <input type="checkbox"/> |
| Brass & Metal products  | <input type="checkbox"/> | Coir related products | <input type="checkbox"/> |
| Handicrafts             | <input type="checkbox"/> | Garments              | <input type="checkbox"/> |
| Shoe & Leather products | <input type="checkbox"/> | Clay related products | <input type="checkbox"/> |

3. The **ownership** of the business? *(Please tick one box)*

(a) Type of ownership

- Sole Proprietor  Partnership  Other

4. Is the business the main income source? Yes  No

**PART II**  
**Owner-Specific Characteristics**

5. Age of the Owner *(Please tick one box)*

Under 30 years	<input type="checkbox"/>	50-59 years	<input type="checkbox"/>
30-39 years	<input type="checkbox"/>	60 years and over	<input type="checkbox"/>
40-49 years	<input type="checkbox"/>		

6. Educational qualification you have obtained ( please tick the highest qualification)

Up to Grade 5	<input type="checkbox"/>	Up to Grade 8	<input type="checkbox"/>
GCE OL	<input type="checkbox"/>	GCE AL	<input type="checkbox"/>
University Education or higher	<input type="checkbox"/>		

7. Gender of the Owner-Manager    Male        Female   

10.

11. Marital Status of the Owner – Manager

a) Married        Unmarried        Widowed   

b) If married, how many children do you have?   

12.

13. **Entrepreneurial characteristics** do you possess with (The following statements are designed to determine the extent of entrepreneurial characteristics possessed with you. Please tick one box according to the following scales).

**0 = Extremely very Poor;      1 = Very Poor;      2 = Poor;**  
**3 = Slightly poor;      4 = Moderate;      5 = Slightly good;**  
**6 = Good;      7 = Very Good;      8 = Extremely very good**

Entrepreneurial characteristics	0	1	2	3	4	5	6	7	8
(a) Innovation ability of the Owner									
(b) Risk Taking ability of the Owner									
(c) Profit Motive of the Owner									
(d) Growth Orientation of the Owner									
(e) Courage & Dedication									
(f) Self Confidence									

**Human Capital Factors Influencing the Growth of your Business**

*(The following questions are designed to determine the extent of **Human Capital attributes** possessed with you which are considered as important for business growth)*

14. When you start your current business   
 (Please mention the commencing year)

15. (a) What is your **employment** prior to starting the current business? *(you can tick several boxes as appropriate and need to mention the approximate time period in months)*

- Self-Employed/ Prior business ownership .....
- Employed in a Family firm within the same industry as the current business.....
- Employed in a Family firm NOT within the same industry as the current business....
- Employed in a Non-family firm within the same industry as the current business...
- Employed in a Non-family firm NOT within the same industry as the current business
- Unemployed

(b) If you employed prior to starting the current business, what were the positions that you held and the time period in months in such positions

- Managerial position.....
- Clerical grade .....
- Minor grade .....

16. Technical and management trainings you have obtained ( Please indicate the approximate time period in months in the give boxes)

Type of training	Period in months
Technical training	
Computer training	
Record keeping	
Business Management training	

**PART III**

17. Following is a list of statements that may determine the **growth level** of your business. Please rate the extent of growth performance since origin of your business as you perceived relating to each dimension (*Please circle the appropriate number on the 1 to 7 scale for each dimension according to the given guideline*)

**0** **4** **7**

---

**Extremely Insufficient** **Moderate** **Extremely sufficient**

Growth Criteria	0	1	2	3	4	5	6	7
I. The business has experienced considerable growth in the number of full time employees since origin of the business								
II. The business has experienced considerable growth in the number of part time employees since origin of the business								
III. The business has experienced considerable growth in the number of hours spent by family members for the business activities since origin of the business.								
IV. The business has experienced considerable growth in sales volume since origin of the business								
V. The business has experienced considerable growth in sales revenue since origin of the business.								
VI. The business has experienced considerable growth in profits since origin of the business								
VII. The business has experienced considerable increase in Break-Even-Point sales volume since origin of the business								
VIII. The business has experienced considerable growth in investment land and buildings since origin of the business								
IX. The business has experienced considerable growth in investment machinery & equipments since origin of the business								

## Appendix 8.2

	Pearson correlations (n=93)	1	2	3	4	5	6	7	8	9
1	Growth indicators	1								
2	Improvement orientation	.639 (***)	1							
3	Industry competence	-.090	.000	1						
4	Training	.089	.000	.000	1					
5	Management competence	.213 (**)	.000	.000	.000	1				
6	Gender type of the Owner	-.006	.089	-.179 (*)	-.054	.003	1			
7	Age of the Owner	.014	-.077	.376 (***)	.421 (***)	-.135	-.011	1		
8	Education level of the Owner	.109	.307 (***)	-.108	.210(**)	.214 (**)	.052	-.080	1	
9	Business Type - Food and beverages	-.018	-.374 (***)	.087	-.040	.236 (**)	-.116	-.034	-.297 (***)	1
	Skewness	-.048	.137	.961	3.307	1.826	1.191	.280	-.581	1.872
	Kurtosis	-.912	-.604	.981	14.042	8.686	-.596	-.578	1.385	1.538
	VIF values		1.246	1.283	1.371	1.188	1.063	1.568	1.363	1.375

Note: \*\*\* Correlation is significant at the 0.01 level (2-tailed), \*\* Correlation is significant at the 0.05 level (2-tailed), \* Correlation is significant at the 0.10 level (2-tailed).



## Chapter 9:

# Securing necessary human capital in family businesses after generation changes: The buy or breed dilemma

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**Abstract:** After the transference of business leadership from one generation to the next, high failure rates or poor performance has been recorded all over the world. This study seeks to focus attention on this under-researched area of family businesses. It does so in the context of concerns about human capital in the family business. The purpose of this paper is to reveal the strategies family firms undertake in order to secure necessary levels of human capital in their management positions. Family firms go to length in order to breed their own stock of human capital, but are very reluctant to buy such by hiring non-family members as managers. This study applies a case method and derives data from one of the family businesses located in southern part of Sri Lanka. The business is in its third generations and is presently performing poorly.

**Key Words:** Family Business, human capital, business survival, family generations, successor, hired managers, non-family managers

## **1 Introduction**

Family business plays a significant role in the new global economy. Studies in the United States, Canada, Europe, Australia, and Latin America suggest that family firms account for the majority of the businesses and have a major impact on the growth of the national economies (Ibrahim et al., 2001). Regardless of the role for economic development relatively little attention has been given to the family firm's unique and complex challenges. All over the world, high failure rates or poor performance has been recorded after the transference of business leadership from one generation to the next (Ward, 2004). Lack of human capital of the leaders in the succeeding generations is one of the causes for this high failure rate (Morris, Williams, Allen and Avila, 1997). Nevertheless, in spite of the increased attention devoted to the study of family firm performance in intergenerational transitions of business leadership, academic research that attempts to examine the importance of human capital upon success in family firms is still scarce.

The world is changing more and more rapidly, this implies an increasing demand for human capital. A family firm could solve this by developing its own human capital or it could buy human capital (hire an outsider as a manager). There are great differences in the preferences for breed or buy human capital among family firms in different countries (FBN, 2008). In Sri Lanka, the founders of most of the family businesses do not like to pass the management and controlling power to someone outside the family (Sriyani, 2010). This phenomenon is general for many countries. Saito (2008) found that founding families are a prevalent and important class of shareholders and senior managers in Japan. The usual way is to appoint or select a successor from the family members. There are several advantages as well as disadvantages of selecting the successor among the family members. Comparatively with non-family members, a family member has training, skills, flexibility, and motivation specific to the business. It is argued that families may lack necessary skills and abilities due to small labor pool, lack of talent, or inadequate trainings (Dyer, 2006). Business owners assume that their kin is eager to take control over the business when the time will come, but there is a difference between wanting to do it and being good at it. Furthermore, the next generation has to combine wanting to do it and being good at it. Therefore, selection of and preparation of a family member for business ownership is not an easy task. The family firms have to compete with non-family firms, non-family firms which often is managed by persons who have very good knowledge and skills. A good balance between breeding and buying human capital is not present in Sri Lankan family firms (Sriyani, 2010), some of the reasons for this is discussed in this paper.

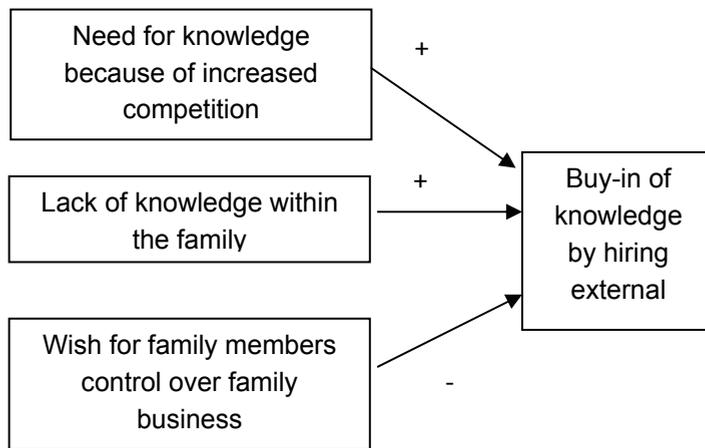
In Sri Lanka, often family-blood descendant is selected as a manager or as the Managing Director of a firm (ibid). Selecting a manager among a small labor pool in a family which may lack talent and necessary skills is definitely a threat to the future of the firm. This successor preference has become a source of firm failure as many of the Sri Lankan family firms (ibid) usually prefer to transfer the business leadership to sons in the family. Daughters are seldom trusted to continue the family firm. This even further limits the talented labor pool of the family. Herein, we examine human capital as a unique resource of family businesses that can lead to increased business performance and survival of the firm. The present study endeavors to reveal the effort done for creating human capital for preparing the children in the family for future business leadership. We selected a family business which is a prominent business in Sri Lanka and reveal how this transition of leadership affects to increase or decrease the performance of the business. Further this study explores the perceptions and comments on the process of human capital creation among the family members who have been appointed as the leaders of the business. The paper also reveals processes leading to hiring outsiders as managers in a family firm. Based on the discussion, some guidelines are offered for family businesses and suggestions are made for future research.

## **2 Theoretical Background**

Family enterprises play a significant but commonly overlooked role in the new global economy. In fact, 175 of *Fortune 500* US companies are family-controlled (Colarossi et al., 2008). Studies in the United States, Canada, Europe, Australia, and Latin America suggest that family firms account for the majority of the businesses and have a major impact on the growth of the national economies (Ibrahim et al., 2001). One measure of their dominance is the proportion of family enterprises to all registered companies; this is estimated to range from 75% in the UK to more than 95% in India, Latin America and Middle East (Cadbury, 2000). In Norway, they account for approximately 2/3 of the number of medium and small enterprises (NHO, 2007) and analogous percentages can be found all around Europe (Mandel, 2008). In Sri Lanka, the total contribution of family businesses to GDP was between 40 to 60 percent (ILO Report, 2000).

As much as 90 percent of businesses started as family businesses (Bowman-Upton, 1991; Cadbury, 2000; Ibrahim et al., 2001; Colarossi et al., 2008). Dunn (1995) emphasized that the return on the government's investment in Scotland and throughout the UK into economic and business development may be improved if Small and Medium Family Enterprises are given special attention. However, most of the researchers show that the performance track record of family firms seems to be poor. Ward (1988) in a study of 200 family firms found that only 13 percent lasted through the third generation.

Even among the survivors, only 3 percent points (out of the 13 percent) grew significantly; 3 percent points stagnated, and 7 percent points declined. Most of the previous research pointed out that, comparatively with non-family businesses, many family businesses have recorded poor performance after the transition occurred from first generation to the succeeding generations. A number of reasons have been revealed for family business failures in all over the world. The studies on family firms from developing countries have mainly focused on China and India (i.e. Bertrand and Schoar, 2006). Some studies of family firms are even related to the Sri Lanka context. For instance, Herath et al. (2006) focuses on corporate culture, Batten and Hettihewa (1999) investigates the operating strategies of small firm while others study the information exchange between Sri Lankan firms and their foreign business network (Kasturiratne and Poole, 2006). This is the first paper that discusses the buy or breed dilemma seen from a Sri Lankan family firm. The family firm has to compensate for the lack of knowledge among its family members while balancing the need for knowledge caused by increased competition with the wish for family members control over the business. These concerns are depicted in figure 9.1 and further explained in the following text.



**Figure 9.1** The links between the business need for knowledge, its ability to suffice the knowledge by internal resources, the wish for control over the strategy and the wealth in the family firm and the need for buying in knowledge by hiring outsiders in powerful positions in the family firm.

In the research literature, family business is defined as a business actively owned and/or managed by one or more member of the same family (Bernard, 1975: p. 42). In other words, a business can be defined as a family business when its ownership and

management are concentrated within a family unit (Davis, 1983: p. 47). Recent research has shown large declines in firm performance around family-CEO appointments (Pérez-González, 2006) which led to significant underperformance of firms controlled by family CEO relative to firms managed by non-family CEOs (Morck and Yeung, 2004; Bennesen et al., 2006; Pérez-González, 2006; Villalonga and Amit, 2006). Furthermore, the impact of the inferior managerial talent can potentially extend beyond family firms, hurting aggregate total factor productivity and economic growth (Morck and Young, 2004; Caselli and Gennaioli, 2006).

Sirmon and Hitt (2003) found that success is tied directly to how well the company manages the five unique resources every family business possesses. The resources examined were human capital, social capital, patient financial capital, survivability capital, and lower costs of governance. These unique resources have been referred to as the "familiness" of the firm. Habbershon and Williams (1999) describe familiness as the unique bundle of resources created by the interaction of family and business. They believed that one resource that can give a firm a competitive advantage is human capital—the skills, abilities, attitudes, and work ethic of those employed by the firm. This paper then focuses on the human capital aspect of success in family firms.

Becker (1993) remarks that the presence of high levels of human capital impacts the quality of business behavior. Higher levels of human capital are associated with stronger performance (Pennings, Lee and Van Witteloostuijn 1998). Several authorities consider that human capital is important because its extraction creates capital accumulation of firms (Edvinsson and Sullivan, 1996). Consequently, human capital (knowledge, abilities and capabilities) provided by the entrepreneur(s) constitutes a key determinant to ensure business success (Chandler and Jansen, 1992; Cooper et al., 1994; Honig, 2001; Peña, 2004). Also Fitz-Enz (2000) argues that human capital is a multifaceted concept, as it encompasses knowledge, skills and technical ability, as well as personal traits such as intelligence, energy, attitude, reliability and commitment. According to the same author human capital also include the ability to learn, including aptitude, imagination and creativity as well as a desire to share information, participate in a team and focus on the goals of the firm.

There are different types of human capitals. Lafuente and Rabiteno (2007) suggested that human capital comprises individual's attributes as formal education, previous labor experience, the presence of partners who might provide additional expertise, and a family tradition of business ownership. Researchers (Peña, 2004; Cooper et al., 1994; Lafuente and Rabiteno (2007) points out that it is widely recognized that formal

education positively impacts the entrepreneur's decision making process increasing the firm's growth opportunities. More educated entrepreneurs have the necessary skills, discipline, motivation, information and self-confidence to attain higher growth rates in their businesses, hence, they are more likely to perceive and exploit business opportunities (Cooper et al., 1994).

Other researchers stress the importance of in-house training in addition to formal education. Living within the family and working within the business from an early age allows family members to develop deep levels of firm-specific tacit knowledge (Zahra et al., 2007). Cabrera-Suarez et al. (2001: p. 39) argue that the "family firm's specific knowledge, as well as the ability to create and transfer it, are considered a key strategic asset that may be positively associated with higher level of performance." As such, knowledge can be seen as an "enabler of longevity," i.e., as contributing to the survival of the family business. Chirico (2008) viewed the knowledge as relevant and actionable information based on experience and education. Actionable information is a significant source of competitive advantage which enables an organization to be innovative and remain competitive in the market. It originates in the heads of individuals and builds on information that is transformed and developed through personal beliefs, values, education and experience (Bender and Fish, 2000). Knowledge has been considered as the enabler of longevity in family business. Consequently, knowledge needs to be created, shared and transferred to generate value over time. This is a major challenge faced by any firm in everyday business life, especially by family firms. It is of vital importance to master this challenge when the new generation has to take over the business from the previous generation (Cabrera-Suarez et al., 2001). In successful multigenerational family firms, hence, the previous and following generation exchange ideas and encourage mutual learning (Handler, 1991; Cabrera-Suarez et al., 2001; Kellermanns and Eddleston, 2004, Venter, Boshof and Maas, 2005). Practical training courses within the family firm allow people to acquire, share and transfer knowledge across generations. In-house training is then important in family firms.

It is also necessary to complement formal education and in-house training by general industry exposure. Bosma et al. (2002) distinguish entrepreneurship specific investments in human capital including experience in business ownership, and experience in activities relevant to business ownership. They exemplify the industry specific investment as work experience from the industry. Chirico (2008) concluded that for the successful operation of the family business, successors need to acquire knowledge from the previous generation while also adding new knowledge gained through education and personal experience from sources within and outside the family firm. Bruederl et al.

(1992) also distinguished between general human capital as years of schooling and specific human capital as years of work experience. According to Cooper et al. (1997), general human capital relates to factors expected to increase the individual's productivity for a wide range of job alternatives whereas specific human capital factors are related to the factors applicable to a specific domain. Conversely, academic courses and practical training courses outside the family firm in schools, universities, other firms, institutions, and so on, allow people to acquire additional or contradicting knowledge and skills which, once brought into the family firm, could be activated in the firm. This experience does not even have to be in the same industry, probably because general business experience is what counts. Cooper et al. (1994) specify initial conditions in terms of four groups of human capital. The first, general human capital concerns knowledge that could lead to higher productivity and access to network resources due to the general background of the entrepreneur. The second, management know-how, focuses on the entrepreneur's previous experience with general management tasks. This is mainly a question of tacit knowledge acquired through vicarious learning or by actually performing management tasks. The third factor, industry-specific know-how, may play an important role in the understanding of "how business is done" in a specific context of suppliers, competitors and customers. This knowledge is mostly tacit and costly to build up if the entrepreneur has no previous experience from the industry where the new business is established. This investigation then differs between three main categories of human capitals; formal education, in-house training and industry experience.

The acknowledgement that there is a rising need for knowledge in order to succeed in business is not new (Johanson and Vahle, 1977). The need has not become less the later year as the globalization of the world is increasing (Lo and Yeung, 1998), and increasing is also the pace of innovation (Hedefjäll, 1997). Because of their improved capacity to innovate are Asian countries facing rapid growth due to increased international trade and increased business relations (Puga, 2010). Hence, there is an amplified need for knowledge when doing business.

According to Becker's (1993) human capital theory, investments in an individual's education and training are like an investment in machineries and equipments. Having access to the right educational qualifications and business knowledge will undoubtedly be an invaluable asset for a company. Sirmon and Hitt (2003) distinguish human capital from other resources as they argue that the primary resource is the family or "inner circle" human capital. When the skill sets of different family members are coordinated as a complementary accumulation of knowledge, with a clear division of labor, the

likelihood of business success improves significantly. Training family members for leadership within the family business is very important. The division of labor makes sure that every one knows that there are certain guidelines that the business adheres to. They (ibid) further pointed out that clearly delineating this unique family resource and leveraging it into a well-coordinated management strategy greatly improves the business's chances of success compared to non-family-owned businesses. Dyer (2006) also claims that one of the most important family assets is human capital. Comparatively with non-family firms, the family has unique training, skills, flexibility, and motivation.

There have been several reasons posited explaining why family firms may have unique human capitals. One of the reasons is the family members in the successive generations are more likely to stay in the firm as they believed that they have particular skills, knowledge or experience that fits with the needs of the business (Levie and Lerner, 2009). The other is that owners of family businesses are more likely to be concerned with transferring the business to the next generation of family members. It is revealed that family business owners may, on average, be less well endowed in human capital terms than non family-business owners. With those perspectives, several researchers have linked the human capital aspect to the success and/or failure of family firms.

Family firms can perform well over time when the new generation is integrated into the family business and the transfer of knowledge from the previous generation to the next takes place (Kellermanns and Eddleston, 2004). Other studies show that intergenerational succession is problematic (Miller, Steier and Breton-Miller, 2003). Understanding how knowledge is accumulated and managed through generations is important given that some studies indicate that only a third of family businesses successfully make the transition from each generation to the next, while only 5% of family firms are still creating value beyond the third generation (The Economist, 2004). Dyer (2006) argues that the family may lack necessary skills and abilities due to the small labor pool, lack of talent, or inadequate training a family may represent. Researchers argue that recurring causes of business failure fall under the general category of "business incompetence" caused by lack of knowledge and management incompetence (Gibb and Webb, 1980; Dun & Bradstreet, 1991; Chirico, 2008). Intergenerational succession is more successful when the heir is better prepared (Morris et al., 1997). Such a preparation includes training (Massis, Chua and Chrisman, 2008). In this respect, Cabrera-Suarez, et al. (2001, p. 39) argue that the "family firm's specific knowledge, as well as the ability to create and transfer it, are considered a key strategic asset that may be positively associated with higher level of performance".

Breeding human capital for use in a family firm, by educating or training family members is a long term strategy. The breeding of human capital ensuring the succession process includes three specific steps. The first step is to prepare the offspring for their leadership roles at an early age, the second is full-time employment and the last is to appoint the offspring to leadership roles in the family business (Stavrou, 1999). The selected family member might not be motivated or skilled to fill the expected position (Venter, Boshoff and Maas, 2005). Another option for a family business to get access to human capital than breeding it among its family members is to hire a manager. The benefits are that the knowledge the hired manager represent is easier to replace when the knowledge is outdated or show it self insufficient. Likewise, when the outside world changes fast, it might be difficult to retrain or educate family members to respond to these dynamic changes. The drawbacks on hiring a manager, as seen from the family point of view, are the increase in controlling costs (Chrisman, Chua, and Litz, 2004). Principal agent theory argues that a the owner bear a cost by providing incentives for a hired manager toward a behavior that benefits the owner, the owner also bears a cost in monitoring the behavior of the hired manager (Jensen and Meckling, 1976). A hired manager and an owner might have different preference for firm growth or for the risks the firms undertakes (Schultze, Lubakin and Dino, 2003). Another drawback with non-family managers is that hired managers often require higher monetary compensations than does family managers (McConaughy, 2000). Even if family firms are reluctant to accept non-family members as manager, they sometimes have to hire outsiders as managers. The larger the family firm is, the more likely it will rely on nonfamily managers because there will not be enough family members willing and able to help manage all aspects of the business (Chua, Chrisman and Sharma, 2003).

To conclude, as suggested by Chirico (2008), knowledge can be depicted as the most important strategic resource of any firm either acquired through education or on the job training or off the job training. The ability to acquire, develop, share, transfer and apply it enables a firm, in this case a family business, to generate higher value of performance over time (Grant, 1996; Cabrera-Suarez et al., 2001; Kellermanns and Eddleston, 2004). This is why, family firms should be more careful in sustaining, maintaining and developing knowledge across generations. This could be achieved by buying or breeding such human capitals.

### **3 Methodology**

One approach to gain a better understanding of the strategies the family firm undertakes to secure necessary levels of human capital is through examining the process of succession from one generation to the next (Fischer et al., 1993; Davis and Harveston, 1998). This research examines human capital as a unique resource of a family business, which managed correctly, can lead to increased business performance and eventually to the survival of the firm. Moreover, case study research excels at bringing an understanding of a complex issue or object and can extend experience or add strength to what is already known through previous research. Case studies emphasize detailed contextual analysis of a limited number of events or conditions and their relationships. Case study research generally answers one or more questions which begin with "how" or "why" (Yin, 1984). The questions are targeted to a limited number of events or conditions and their inter-relationships (Patton, 1980). As the issue of the strategies the family firm undertakes to secure necessary levels of human capital through examining the process of succession from one generation to the next is complex, the case study approach was chosen for this investigation (Patton, 1980; Yin, 1984). The case study analysis undertaken for this study proposes that the failure of family businesses surviving leadership transfer from one generation to the next is due to a lack of concern on the human capital aspect of the succeeding generations of the family.

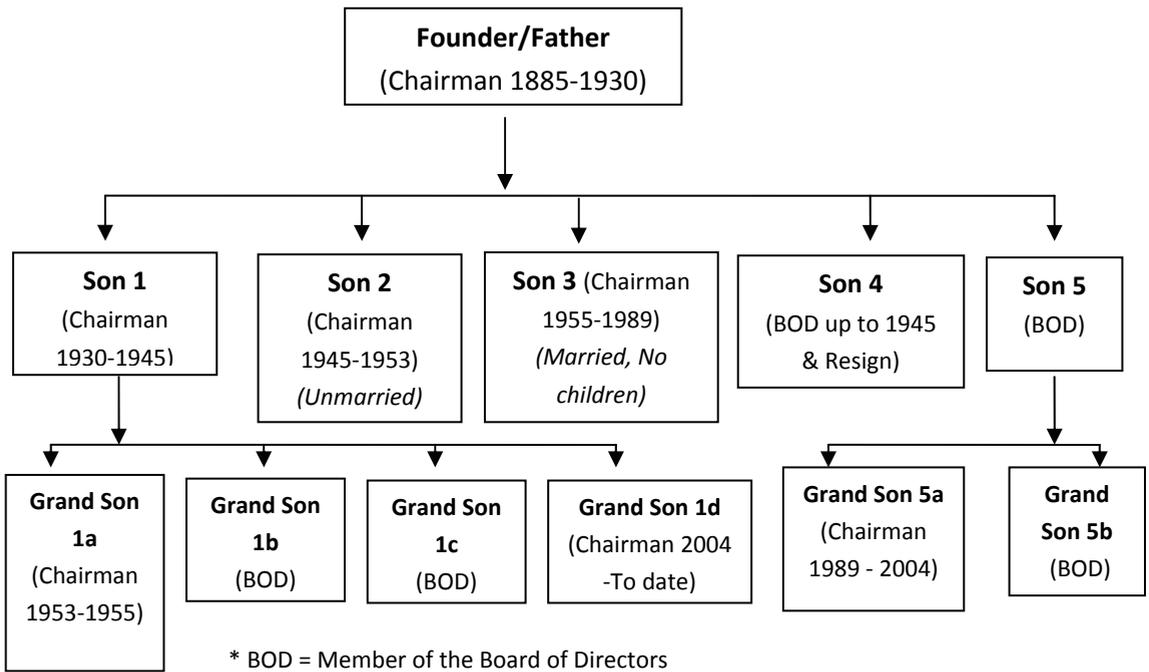
At first, documentary reports about the firm were examined. Secondly, a series of in-depth interviews were arranged with the active family members who represent the third generation. Selected employees at manager and managing director levels, who have been working under the various generations, were also interviewed. The interviews had an average length of one hour. A telephone interview about half an hour has been organized with two family members who are not active in the daily business activities. One of them was a daughter (second generation) and the other was a grand daughter (third generation). Investigation of each generational period was carried out to develop the case history, and identify the human capital creation process and its pros and cons. Finally, critical findings were elaborated relating to the human capital of the successors and the business performance.

Since most of the data were collected in a qualitative form a descriptive analytical tool was applied to elaborate the perceptions, emotions, and comments of the respondents relating to the human capital aspect of the business over the generations. The analysis section of the study includes the followings: Firstly, background information of the case and the succession process of the firm are presented. This is followed by a section which elaborates how the accumulation process of the human capital in the MCA & Sons

Company happened. As revealed by previous researchers, the most important human capital variables in family firms include: education; knowledge; and prior work experience. Therefore the analysis section transcribes the most significant answers given by the family members interviewed on these three dimensions of human capital. This analysis was conducted by actively searching for alternative explanations than those outlined in the theoretical part of the paper (Trochim, 1989). Meanwhile, the performance of the firm is discussed in different perspectives relating to each generation. Previous research on family firms suggests investigating how family members personally experienced and judged the transfer process and its outcomes when investigating success or failure in generational changes in family firms (Handler, 1989, Sharma, 1997, Harvey and Evans, 1995; Venter, Boshoff and Maas, 2005). In light of the problems of missing data for revenues dating back to 1885, we chose to rely on the judgment of the involved family members when reporting success of the family business.

#### **4 Background information of the Case**

MCA & Sons Company (a nickname) is generally considered as one of the most prominent family business located at one of the major cities in the Southern Province of Sri Lanka. The firm was founded as a sole proprietorship in 1885 and produced coconut oil. The people in the area respected the founder because he owned large amounts of coconut and grass lands. Due to the close relationship with the villagers and the suppliers, the coconut land owners even in remote rural areas brought their copra production (dried coconut) to the MCA factory for processing. Due to high supply of copra the mill operated day and night and delivered huge quantities of coconut oil to Colombo. This was the foundation of the firm. After some years the founder transformed it into a limited liability company. The founder of the MCA & Sons Company was a father of five sons and four daughters. The eldest son of the founder has four sons and two daughters and the youngest son has two sons and two daughters. The other sons and daughters of the founder don't have children and this limits the availability of grand sons-in-blood for the management positions of the firm. Altogether the second generation had five sons and third generation has six grandsons who were eligible for potential successors. The notable ethic of this company is, since its origin, is that the role of the wife and daughters is to be silent. Hence, active ownership and management of the firm is dedicated for the sons of the family only. The founder never invited his wife and daughters to take part in owning or managing any activities in the business. This governance practice continues by the successors of the business also up to the present date. Figure 9.2 shows the family tree of the MCA & Sons Company. The figure also indicates who possessed the position as Chairman of the BOD.



**Figure 9.2** Family Tree of the MCA & Sons Company

As elaborated in Figure 2 and Table 1, since 1953 the company didn't follow a chronological order in the family in appointing successors. This shows that even though the founder had a clear succession plan, the leaders in succeeding generations did not follow a predefined succession plan. The family's share of the member in the BOD (Board of Directors) declined down to 50% during the period of 1953 – 1955. As reported by an employed manager of the company (non-family member) with more than 45 years of experience in the company and still is in the same position, the profit of the business start to decline gradually during the period of 1945 – 1955. Moreover, the good relationship the business had with suppliers and customers also gradually declined in that period. However, the firm experienced a remarkable increase in business results during the leadership period run by Son 3. At present, the company operates at sales volumes below the break-even point. The transition points of the business leadership positions and the percentage of family members in the board of directors (BOD) in each transition periods are shown in Table 1. Likewise, table 1 shows the number of managing directors and how many of these were non-family members, but hired help. Table 9.1 also indicates how the different regency eras are referred to by the respondents regarding business results.

**Table 9.1** Transition points of the business leadership positions

<b>Position of the Family</b>	<b>Chairman of the BOD</b>	<b>Family members in the BOD (%)</b>	<b>Managing director</b>	<b>Share of non-family as Directors</b>	<b>Business results</b>
Founder-Father	1885 – 1930	100%	Founder-Father	0/1	Established a successful firm
Son 1	1930 – 1945	100%	Son 1	1/1	Expanded the firm
Son 2	1945 – 1953	80%	Son 2	1/1	Decline of profit
Grand Son 1a	1953 – 1955	50%	Grand Son 1a	1/1	Steep decline
Son 3	1955 – 1989	80%	Son 3	1 / 1	Increase in profit
Grand Son 5a	1989 - 2004	60%	Grand Son 5a	2/2	Stable
Grand Son 5d	2004 – To date	50%	Grand Son 5d	2/2	Firm loses money

## 5 Findings

The family firm undertakes several strategies to secure access to necessary human capitals. The main strategy for the investigated family firm is to breed human capital among its family members. This is in line with the succession process described in the family business literature (Stavrou, 1999). The founder-owner of the family firm prepared his offspring for duties in the family firm. The employed manager comments: *“The founder had given the priority for the family members specially sons-in-blood and grandsons-in-blood when appointing key managers of the company as well as appointing members to the BOD (hired manager).”*

The sons received both in-house training and formal education. *“He provided a good education and business training for the sons in the second generation before they joined as executives and/ or the directors of the company. For example, he trained his eldest son (Son 1) well by appointing him as the manager of one of the business units of the company in 1920. He had given a good education to all of his sons and he included them in his business activities” (hired manager).* The founder even provided the sons with

relevant industry exposure. *“Son 1 was involved in drying coconut produced from lands owned and hired by the company and buying and selling of citronella oil collected from surrounding estates. He had received foreign exposure by following a one year Business Diploma in a foreign country” (Hired manager).* The hired manager further explained that *“the owner founder had given the opportunity to Son 3 to receive foreign business training as well as proper educational and professional qualifications. By receiving a military training, he had become a good leader of the business.”* This training was then provided to all sons of the founder-owner, and consisted of both informal training by in-house work, industry exposure and as formal training at business or management schools.

This view of the family firm’s human capital strategy is consistent with the expression of other respondents as well. The present Chairman of the Company expressed his views as follows: *“Our grand Father (Founder of the business) had raised his children and shaped their personality. He formed positive associations with his children that help them develop their innate abilities to their full potential; to learn from their experiences; and to help them to compensate for their weaknesses. I believed that developing human capital requires close attention, an on-going dialogue and a sense of trust between the child and the parent. Our Grand Father always encouraged us, though we are teenagers, to look for what is happening in the factory. After the school hours, I watched how the oil plant was operating and how my grand Father and my Father dealt with customers and suppliers (Present Chairman).”* The main strategy for the family firm was to breed its own human capital.

The present chairman further explained the importance of human capital for the key managers appointed from the family. Each member of the 2<sup>nd</sup> generation worked with the founder father in a specific given area of the business. Thereby they learnt to make constructive decisions. The sons in the 2<sup>nd</sup> generation then build up their personal skills enabling them to cope with their responsibilities. This high attention toward breeding human capital among family members was not followed by later successors. *However, after the death of our Grand Father, the attention given to participation in business activities has declined gradually because my father (Son 1) hasn’t devoted enough time to form positive relations with us. After my formal education, I hadn’t received a chance to follow a business management course or any other course, courses which I consider could be very helpful for developing my technical and business management skills. During the era of 3<sup>rd</sup> generation, when my brothers had been holding the business leadership, there were no room for intervening in business activities and participating in business decisions. Therefore, acquiring industrial training by working for the business*

was at a poor level” (Present Chairman). The founders focus on breeding human capital has not been followed by all the successors.

By criticizing the human capital level represented by several business leaders in the firm, the Managing Director pointed out that, even though, working outside the family firm and using consultants provides a more detached perspective over how to run and how to introduce changes and innovation in the business, no emphasis in this regard has been given by any of the family business leaders. Business experience gained outside the family business prepares the successor for a wider range of problems than does the family business. Knowledge acquired outside the family firm can be shared and transferred within the family business. The leaders in successive generations failed to introduce modern technologies and the Managing Director believes this failure is due to the lack of concern on improving knowledge by getting outside experiences. The inward focus was the cause for the failure in diversification efforts done by the leaders in the second generation.

The present Managing Director (grand son 5d) reports that he was not provided opportunities for participating in off-the-job training nor was he offered sponsorships to follow any business management courses. Before appointing him as the managing Director of the MCA & Sons’ Company he took the ownership of one of the business earlier owned for the MCA & Sons’ Company. While working as the owner – manager of this firm he has acquired a sufficient level of knowledge and prior work experience and business ownership. In the future, he hope to change some traditions inherited for the MCA & Sons’ Company, for example, opening the business leadership and other employments for females of the business and thereby, he believed, he can improve the performance of the family business.

Even though there are four Grand Daughters (Blood-family members), according to the traditionally and legally accepted regulations of the firm, there is no opportunity to appoint female family member for the business leadership. Daughter in the 2<sup>nd</sup> generation further argued upon the human capital acquisition process over the generations. The grand daughter who was interviewed mentioned that *“In stead of admitting daughters and grand daughters of the family into the business, the fathers in 1<sup>st</sup> and 2<sup>nd</sup> generations try to get them married at an early stage of the daughter’s life.”* All of the female in the family had received either below or ordinary level education. However, the Daughter in the 2<sup>nd</sup> generation reported that she was very interested in joining the business. She hopes that the future leaders of the family business will

introduce changes to the legal structure of the business, allowing the entrance of female family member into the management level of the business.

A second strategy not pursued to a large extent in this family firm is to buy in human capital by hiring outsiders as managers. The first time this happened was in 1955. The hired manager was the son of a very close friend of the founder father. As expressed by the present chairman of the company; *“when recruiting the outsiders to the company the leaders of the company always give the priority for the people who is suggested by the existing employees of the company. The “trust” and dedication to hard work is the two factors being considered when we hire the people to the company for what ever position.”* Later on one other persona has been hired into a managerial position. This happened in 1982 and then this person was appointed as the managing director of the company.

At present the age of the first hired manager of the company is 75 years, he and he now have more than 50 years work experience with this company. He was hired as the assistant for the managing director in the 2<sup>nd</sup> era of the company. He looked after the overall business, an in particular the sales division. Even now he is as enthusiastic about the business as a family member. The present chairman expressed that *“developing the human capital of the two hired members also was prioritized by this company. The first hired manager became a manager as he had proven his capacity at the time of absence the chairman of the company. Before this he received the opportunity for looking after the overall business since he was working as the assistant, and he then became responsible for the long life customers of the company and by this had received the understanding of how to run the business.”* The hired manager was internalized into the management group of the family through in-house training. This was also how the second hired manager got his position. *“And also, the present managing director is non blood family relation and he was also trained by letting him work in several positions of the other business units operating under the MCA & Son’s company but at separate premises for example, cinema hall, stationary shop etc. At present he has sufficient talents and skills to manage the business (Present Chairman).*

This strategy is accepted by the hired managers. The second hired managing director said that *“the present chairman understood that no one was available in the family to be promoted as the successor of the business. So he plans since several years before to assign the future leadership position of the company to myself. With this in mind he promoted me to the managing director position of the company and in the meanwhile he let me work as the manager of some subsidiary business units. During the period of*

*working as the manager of other business units I got the chance to participate in the family councils arranged by the present chairman. This was a very big opportunity for me to identify the extent of the involvement of the family members in the business. Likewise it gave me an opportunity to see how they did their other business related decisions and even how they handled the critical issue of succession planning”.*

## **6 Analysis**

The purpose of this paper is to reveal the strategies family firms undertake in order to secure necessary levels of human capital in their management positions at changes in generations. The MCA & Sons’ Company is a family firm which operates in its third generation and was growing well during the founder’s period. As revealed through the interview with key managers of the company, the founder did a great job of building and maintaining a positive and friendly environment within the family and the business, as well as with other stakeholders. Two of the sons in the 2<sup>nd</sup> generation acquired high levels of education, knowledge, and experience, and the business was profitable during their regency. They also managed to establish a link between the family and the business utilizing other family member human capital for the good of the business. They did not invest enough in younger family members’ human capital to ensure business success by their successors. Hence, all other successors have failed to run the business properly. As a result of this they failed in continuing the growth level achieved by the managers in 1<sup>st</sup> and 2<sup>nd</sup> generations.

All the managing directors have invested in in-house training of other family members. The most commonly applied methods of acquiring human capital was knowledge improvement through on the job training and face-to-face interactions. All the family members and the non-family members interviewed for this study revealed that "working within the family firm," "more generations work closely together" and having "face-to-face interactions" allow family members to create and share their knowledge and information. By involving directly with the old generation via a "learning-by-doing process", children of the succeeding generations have the opportunity to learn the business to know. They learn how to run a family firm, how to be a good "business leader" and, more importantly, all the tricks of the trade related to the business. Therefore, when comparing with the non-family managers, the family managers can easily acquire competencies and skills required for running the business activities and by this achieve competitive advantages. Their learning is directly related to the activities in the firm. Apart from this, family members also represent a high level of emotional involvement toward the business. This interaction has become less evident the later years, as the younger ones complain about them not being included sufficiently into the

business. As shown in this case, failing in investing in family members human capital might cause the firm to be less successful.

The founder provided his sons with a formal education suitable for continuing the business. The grand-sons were also provided formal educations, but they themselves report that they did not see a strong link between their education and their actual or potential role in the family business. Industry training was a vital part of the human capital the founder wanted to build among his potential successors. There is less evidence of such a focus in the later years. The risk of relying only on experiences gained within the family firm is that it might not enable new insights. This family has not paid enough attention to training courses and working outside the family firm. As a result, the relative degree of knowledge has decreased especially in the later generations. In particular, due to lack of knowledge about what is happening at the outside business world, and then in particular, the technological developments in the industry, competitors' strategies, and new business routines may be causes for the decline of the business. Therefore, a successors need to possess off-the job training and foreign exposure. This case reveals that business experiences gained outside the family firm is needed for firm survival.

The founder hired a non-family member as a manager. This person was initially hired as an assistant, and through in-house training and familiarization put in the position as general manager. One of the sons of the founder hired another general manager in order to assist the senior general manager. This person is also provided in-house training and the plan is that this person will replace the senior general manager. This is not a clear cut buy strategy. The family firm does not hire and fire managers as their need for human capital changes, nor do they shop around for good heads and seek new ideas by hiring consultants to solve specific problems. The family firm train outsiders until they are as family members and then they include them in the management family.

These strategies are summarized in table 9.2. Table 9.2 shows that the founder had a strong breed strategy with some elements of a buy strategy. Their sons mainly pursue a breed strategy, with a focus on in-house training. The grand-sons do not have a clear strategy for acquiring and keeping human capital. This contradicts previous research that indicates that later generations do more succession planning than do the first generation (Sonfield and Lussier, 2004).

**Table 9.2** The knowledge management and the knowledge strategy of the succession generations of family business heads

<b>Era</b>	<b>Founder</b>	<b>Sons</b>	<b>Grand-sons</b>
Breed strategy			
In-house training	Much	Much	Some
Formal education	Much	Some	None
Industry exposure	Much	Little	None
Buy strategy	Some	Some	None

## **7 Conclusions and implications**

A family firm needs access to necessary human capital. When the family firm is unable to or unwilling to breed this from family members, it has to hire outsiders representing the needed knowledge. In the case when the family firm needs to buy in knowledge by hiring non-family member in powerful positions, the family needs to establish routines such that the family still keeps the wanted degree of control over the values the family business represents. Legal arrangements could be made to ensure family control over the future direction of the business as well as how the wealth generated by the firm should be distributed.

Figure 1 indicate that when there is a need for knowledge caused by increased competition coupled with a disability to provide this knowledge from the family members, it may lead the family firm to hire outsiders as managers. A wish for control by the family members over the family firm may make the family firm reluctant to hire outsiders as manager. Our analysis of the MCA & Sons Company supports these assumptions. The case results indicate that the more knowledge that is needed in a family business; the more a successful business need to buy in knowledge by hiring a manager. The more competitive the environment is; the more knowledge is needed. The less knowledgeable the family members are able to become, the more the business need to buy in knowledge. The tighter control the family wants over the family business, the less likely is it that the family business relies on hired managers. Based upon the previous theoretical and empirical discussion the paper then derives a set of propositions linking human capital and the presence of hired managers in family firms:

**Proposition 1:** The more knowledge the family firm needs, the more likely is it that the firm engages hired managers.

**Proposition 2:** The less adequate knowledge the family members are able to offer to the family firm, the more likely is it that the firm engages hired managers.

**Proposition 3:** The more the family seeks to control the strategy of the firm and the wealth generated by the firm, the less likely is it that the firm engages hired managers.

Further research is needed in order to suggest means for strengthening older family firm's access to necessary human capitals. This paper shows that some family firms lose their grip on securing necessary levels of human capitals, but now why. This paper shows one strategy pursued in order to secure external human capital while still holding a firm grip on the control of the firm. The strategy is to internalize the externals and make them as a member of the family through in-house training. In our case the results is far from optimal, as the long breed period in this internalization weakens the influence from knowledge on affairs outside the family firm. If the family members in charge of a family firm are not able to respond properly to an increased demand for human capital, the family firm will eventually expire. This paper shows the need within family firms to acknowledge the need for additional human capital, represented by non-family members. The paper also reveals a need for more knowledge on how to administer knowledge represented by others than family members. Universities could prepare their graduates for the challenges of entering family firms as knowledgeable outsiders. Government could arrange legal structures that secure the families their share of the wealth generated by the family firm, as well as legal structures that secure the board of the family firm influence on the strategies of the firm. This has to be balanced by the need for involving the needed knowledge in the making of the business. The outsiders need to be acknowledged for their contribution to the firm.

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## Chapter 10:

# Contingent Just-in-Time (JIT) System implementations: a comparative study from Sri Lanka

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**Abstract:** Just-in-time (JIT) system implementations in the garment manufacturing industry in Sri Lanka are examined in this empirical study. Two cases are studied – one having implemented JIT, whereas the other has not (yet) done it. Data collection methods included observations and interviews. The study relies on a literature review as well as contingency theory. Main findings in the study include the view that JIT seems to be contingent on certain factors, including organizational structure, culture, the environment and technology, where structure and technology seem to dominate. At least some of these factors are very much determined by the firms in question, which contradict points made in contingency theory that firms are often forced to adapt to determining factors beyond their control.

**Keywords:** Just in Time, Implementation, contingency, context, Sri Lanka.

# 1 Introduction

Most firms today find themselves in a highly competitive environment because of globalization and rapid technological developments. To survive, firms typically need to deliver high quality products, have efficient production processes and seek rapid, if not continuous innovations in aforementioned areas. One management technology adopted by firms to cope with aforementioned challenges is called Just in Time (JIT) Systems – for inventory management (Fullerton & McWatters, 2002).

Just in Time ordering or Just in Time inventory management describes a *“manufacturing system where necessary parts to complete finished products are produced or delivered at the assembly site when needed”* (Wafa & Yasin, 1998: 1111). Quality is heavily emphasized in JIT – alongside product scheduling, operating structure and control (Davy, White, Merritt & Gritzmacher, 1992). The main goal is to have no defects or in other words to *“get it right the first time”* (Aghazadeh, 2004). For instance, Flynn, Sakakibara & Schroeder (1995) argued that the use of Total Quality Management (TQM) will improve JIT performance. Successful JIT practices are said to provide a number of advantages – making it attractive for many firms to implement (we elaborate on this in the frame of reference section). The JIT inventory management idea, which is often also referred to as a philosophy (Cook & Rogowski, 1996; Wafa & Yasin, 1998), originated in Asia (especially within Japanese firms), where Toyota is one typical and well-known example (Amasaka, 2007). Over the years, many other firms have followed suit, including many western firms, herein many U.S. firms (Schonberger, 1982; Young, 1992). These firms have been subject to many research studies to learn more about experiences with JIT, herein relating to advantages, challenges and the like. Many of these cases represent *“success”* stories.

However, fewer studies can be found of JIT implementations in other contexts, where the firms endeavoring JIT implementations face other frames of constraints than some of the early JIT movers (i.e. adopters). In particular, less is known about how this managerial tool is being considered or applied in poorer countries with a more fragile infrastructure (herein transportation system) – effectively making JIT more demanding. In such different contexts, there might also be challenges relating to other JIT prerequisites, like the need for having reliable sub-contractors (always delivering on-time), standardized quality measures and well functioning legal systems (that are able to enforce contracts). Conversely, it has been pointed out in the literature that JIT success or opportunities is not reserved for firms in particular industries or locations (Levin, 2004), it is more a question of dedication to the JIT philosophy (Wafa & Yasin, 1998). Nevertheless, *“... small firms may experience different kinds of difficulties and successes related to JIT application”* (Golhar, Stamm & Smith, 1990: 44). On a more theoretical

level, one can also ask whether the same management (control) ideas and systems provide the answer to global competition for firms located in different contexts. Prior studies have namely concluded that JIT implementation is contingent on each firm's unique setting (Storhagen, 1995; Zhu & Meredith, 1995). On this basis one could expect that potential benefits or JIT considerations will differ across firms, especially when examining firms facing potentially different challenges and frames of constraints than many western firms that have been JIT success stories. This led us to formulate the following research question: What JIT considerations are made by firms located in other areas than typically JIT success firms?

We chose Sri Lanka as the empirical context of our inquiry. Specifically, we decided to compare two firms (i.e. plants) in the garment industry in Sri Lanka. This is namely a significant manufacturing sector in the Sri Lankan economy. It is also highly concerned with quality systems and related management practices in order to win customers worldwide. This includes JIT. Nevertheless, the applicability of JIT is somewhat uncertain in the Sri Lankan context, because of fragile and unstable circumstances, tormented by civil war and other challenges for many years. In such a setting it is not given that the JIT philosophy – of waiting until the last possible minute with inventory deliveries – will function equally well.

We continue by outlining our frame of reference (which consists of JIT literature and contingency theory), and the applied method. Our empirical findings are presented jointly with the discussion. The conclusions and suggestions for further research follow subsequently.

## **2 Frame of reference**

In our discussion, we draw insight from contingency theory and related JIT literature. We begin with an introduction to the JIT concept, including related benefits and implementation challenges.

### **2.1 Introduction to the JIT concept**

During the 1960s, Toyota developed the just-in-time (JIT) system in order to streamline its manufacturing operations. Soon after, JIT became popular throughout Japan, and thereafter in the U.S.A. The primary reason behind the high acceptance of JIT in the U.S.A is the significant benefits it brings (Manoochchri, 1988: 23). Moreover, the same author (when, paraphrasing others), pointed out that:

*"... the U.S. manufacturer using JIT can: Reduce inventory and lead time by something like 90 percent, cut labor costs 10 to 30 percent, reduce set-up time by 75 percent, manufacturing and storage space by 50 percent and improve the quality of manufacturing by 75 to 90 percent."*

The objective of JIT is to eliminate waste (Aghazadeh, 2004) by producing an item "just in time" to be sold or used by the next work station, eliminating the need for much inventory (for an additional discussion of how Toyota has been found to apply "new" JIT, see Amasaka, 2007).

*"Proponents of JIT consider inventory the root of many problems in operations. ... As inventory increases, so do associated costs, including the opportunity cost of capital, storage facilities, labor costs, material handling costs, paperwork, sophisticated computerized inventory control system costs, obsolescence costs, and taxes. Even more important is the fact that inventory hides problems of operation, and undiscovered problems cannot be solved... With a very low inventory, any mistake causes a disruption in the operation, attracts attention, and is identified and corrected. This process helps to streamline the operation... In the absence of a large inventory, JIT attempts to minimize sources of uncertainty and/or to design a more flexible system that can better adapt to changes. Hence, the JIT system is quite different from conventional systems, and adoption of JIT requires a major overhaul of the operations system."*  
(Manoochchri, 1988: 23)

Research has shown that the benefits of JIT do not simply materialize without making a serious effort to transform the organization. E.g., Prasad (1995) discussed various problems associated with implementing JIT, including: Improper or inadequate planning, changing market conditions, competing tactics, management problems, operation-related problems and process-related problems. Before an organization can enjoy the fruits of JIT, it must accept JIT as an organizational philosophy, including abolishing all old concepts of managing (Aghazadeh, 2004: 28). Education is a means of establishing employees' commitment (Zhu & Meredith, 1995). This may require the organization to change or modify its operating procedures, production system and in most cases the organizational culture. For instance, plant layouts may have to be adjusted, relations with suppliers and customers have to be modified, quality circles have to be implemented and accurate demand forecasts have to be achieved and maintained (Hobbs, 1997). Moreover, Vickery (1989) stressed the importance of communication and having a logistical planning system, and regarded it as a prerequisite to the implementation success of JIT, especially to overcome (larger) geographical distance.

Moreover, Wafa & Yasin (1998: 1122) concluded that JIT success rest upon certain key factors, including: having the management's support, having cooperative suppliers and formal training programs for workers.

This indicates that JIT implementation and operation is not easily done. In fact, the JIT philosophy rests on several general prerequisites – like the need for having a functioning transportation system, reliable sub-contractors, standardized measures of quality, and a functional legal system – that are able to enforce contracts. Gélinas (1999) presented several more detailed success factors related to JIT implementations and operation – spanning across areas like purchasing management, inventory management, quality management, production management, localization and output, and distribution management. This included various JIT organizational success factors, like: commitment toward JIT, performance evaluation with respect to JIT, research and development, remuneration modes reevaluation, training sessions and the need for acknowledging the legitimacy of suppliers' profitability (Gélinas, 1999). There is also a set of JIT operational success factors, like partnerships with the suppliers, suppliers attitude toward JIT, exclusive and long-term contracts with suppliers, emergency procedures for late deliveries, information accuracy regarding the stocks, preventive maintenance, control visibility, quality of the suppliers, tuning, set-up and repair time minimization as well as distribution network configuration. Concerning the latter, Yasin, Small & Wafa (2003) found for instance that firms which had engaged in improving linkages with suppliers and staff training, prior to implementing JIT, experienced less implementation problems. Many of the issues addressed above concerns how to incorporate JIT thinking and organizing with the firm's supply chain (see also Cook & Rogowski, 1996). In essence, it is about seeking new ways of cutting costs, increasing quality, and enhancing valuable product attributes by working very close with both suppliers and customers (Shank & Govindarajan, 1993).

Furthermore, another important consideration concerns the regular activities of the organization and the availability of human resources. Therefore, more consideration should be given to the need for employee involvement, especially from those in work stations where modifications will be performed (Storhagen, 1995).

## **2.2 Contingency theory and JIT**

Different inventory and management accounting systems (MAS) exist. This invites questions and discussions concerning whether some systems or models are generally better than others. Some researchers have argued against this viewpoint and pointed out that there is no universal and one preferred management accounting and control

system. This view is at the core of contingency theory, as discussed e.g. by Otley (1980) and Chenall (2003). They argue that the question of finding as well as implementing different management accounting and control systems is mostly about considering certain factors that form the particular organization in question. They present various factors which different studies have found to be important when considering the design of management accounting and control systems. Frequently discussed contingency factors or contingent variables include organizational structure, strategy, technology, culture and the particular environment faced by the organization.

To illustrate, *organizational structure* by means of having a hierarchical organization would typically require a more formalized control and reporting system than organizations having flatter organizational structures. The latter group may for instance draw on trust or direct observations to a larger degree than what is possible in more hierarchical organizations with larger span between the top and bottom (i.e. the management and the production). Choice of *strategy* will also in many cases have great impact on the MAS (of which JIT is a part). A classical distinction would be a cost leadership strategy versus a differentiation strategy. Cost leadership normally would demand more attention towards cost accounting systems and internal processes, so as to make sure that costs are kept at the minimum and that the prices charged cover the costs (in the long run). With a differentiation strategy, the MAS must be much more oriented towards the environment – to closely monitor competitors' actions, and ensuring that the products being offered are unique and correspond to customer preferences. In this regard, Yasin, Small & Wafa (1997) found that firms with a differentiation strategy realized significantly more JIT benefits than firms relying on cost leadership as a strategy. *Technology* equally could or should impinge on MAS design. E.g., when product scanning technology became available for retail firms, they quickly interlinked this with inventory monitoring, and many also tied this to automatic placement of new orders when the stock reaches a certain minimum level. Moreover, ICT technology has revolutionized calculative practices in organizations concerning various management accounting matters, including the sharing of information. This is indeed also an important element of JIT and other inter-organizational relationships, namely having the potential to share information across the supply chain (Kraus & Lind, 2007). *Culture* impinges on e.g. the extent and form incentive systems might be an integrated element in an organization's MAS. In some cultures, e.g. those characterized by collectivism, all formal incentive systems may be counterproductive (or absolute). In other cultures, incentive systems may be integrated into MAS, but in some cases at the individual level and in other settings at the group level (for a continued discussion, see Hofstede, 2001). Additionally, Fullerton & McWatters (2002: 730) concluded that “firms

*also must adapt their control system by empowering workers and linking compensation rewards to quality results.”* The *environment* might be divided into the internal and the external environment. An illustration of the latter with respect to MAS would be the frame of constraints provided by authorities or the transportation infrastructure found in certain regions, as well as the degree of order/stability in the region in which the organization is situated. A simple example would be that the more stable a region is, the more stable and fixed can also the MAS be (if ignoring other factors of importance, like aforementioned contingency variables). The more unstable the external environment is, the more difficult it would be e.g. to carry out long-term planning, and the more important it will be to closely monitor the environment for pivotal changes in key areas of relevance to the organization in question.

Elements of contingency theory can also be found in JIT-literature. For instance, Storhagen (1995: 20) concluded that:

*“A known fact, pointed out very clearly in the case studies in Japan, is that implementation is very specific for each company. There are no standard solutions or any use for fixed packages. It is very clear that the implementation of just-in-time must be brought in line with the conditions both within the company and with regard to its environment.”*

Zhu & Meredith (1995) argued the same (see the conclusions). Moreover, there is no definite and quick way for an organization to convert its operations and management system into the JIT philosophy. The existing organizational context and conditions of any firm are directly affected and therefore should be given (prior) consideration when introducing the new system for inventory controlling. Several studies have shown that a successful JIT implementation is a complex process which is directly affected by the organizational culture, working methods, procedures and specially the relationship with vendors. Fullerton & McWatters (2002: 730) concluded that *“firms need a decision-making system that incorporates bottom-up measures, and frequent reports of quality results and vendor reliability.”* Moreover, Yasin, Small & Wafa (1997: 469-470) found that *“firms with differentiation and mixed... business strategies appear to realize significantly more JIT benefits relative to firms with a cost leadership business strategic orientation... the involvement of customers and suppliers in the actual implementation of JIT is essential. ...it appears that firms which do the right things by becoming leaders in their industries, also do well in terms of JIT utilization. Perhaps this may be attributed to an organizational culture that promotes success and excellence in addition to efficiency”*

Selto, Renner & Young (1995) applied contingency theory when studying JIT adoption, and found e.g. that; *“conflicts between operators’ needs for empowerment required by JIT/TQC systems and a management approach better suited to mechanistic work quite probably negate beneficial influences of appropriate controls.”* In effect they pointed out the need for making coherent organizational changes, ensuring e.g. that authority levels are changed accordingly, and that they are backed up with the required information to do the job in the various workgroups.

### **3 Research method**

The research site of the study is the garment manufacturing sector in Sri Lanka, which holds an important role within the Sri Lankan business economy. Additionally, there were ex ante reasons (see the introduction section) suggesting that this industry in Sri Lanka faced other JIT challenges than e.g. many western firms. Still, to accommodate global customers and survive in the global competition, the garment manufacturing industry in Sri Lanka has followed different strategies specially focused on managing the quality of their products. Globally accepted quality criteria and standards were also regarded as a way of achieving higher profitability, via increased productivity. This vitalized the use of JIT in the garment industry.

We identified one plant that decided to implement JIT two years prior to our study, and one plant that has considered JIT, but so far concluded that it can do without JIT. This therefore provided us with an empirical basis to learn more about varied JIT considerations amongst firms in the same industry, and especially to learn why they hitherto have reached different conclusions with respect to JIT implementations.

Data was collected by means of observations and interviews. Observations were made of site visits. Supplementary interviews were made with managerial personnel engaged with quality management, production and operations management and/or procurement and inventory control. The interviews lasted for about one hour and the data was translated before they were analyzed. We continue by describing the case findings deriving from our data collection.

## **4 Findings and discussion based on two Sri Lankan cases**

The case descriptions and discussions are presented as case 1 and case 2, where the first case involves the firm that implemented JIT. With respect to both case firms the aim is to describe and discuss their JIT considerations.

### **4.1 Case 1**

We start by providing background information and move on to describe and discuss stated JIT benefits and implementation barriers, before ending with addressing action taken to overcome some of the JIT barriers.

#### **Background information**

The first case represents data gathered from the Head of Lean Manufacturing Section of a leading garment manufacturing firm in Koggala, in the Southern Province. The firm produces garment products for the global market and is one of the remote plants managed by a cluster located in Colombo. There are 85 employees engaged in the inventory controlling activities, where forty work in raw material stores, twenty five work with production and twenty in finished goods. The firm uses SAP as the Management Information System for their inventory control activities, which is a globally renowned software system. The respondents said that SAP provided them with end to end transparency. Some fractions of the group, to which the plant in question belongs, have been applying JIT manufacturing for over 5 years. The Koggala plant itself has been applying JIT for the last two years and applies it to all aspects of the business.

As discussed under the frame of reference section, technology is a contingent MAS variable and is becoming more and more important. The use of SAP seems to be an important technology which provides the firm with the required overview it needs when organizing the production according to the principles of JIT. This makes communication easier, which is very important when geographical dispersion becomes an issue (Vickery, 1989). The latter seems namely to be a challenge for the plant, partly because it is a part of a cluster of plants organized under one firm, but also since it serves customers at distant places. This makes it pivotal to organize and coordinate productions across plants in the group, and jointly making sure the production is aligned with customer preferences for clothing, which is known to be volatile and driven by low margins (Bruce, Daly & Towers, 2004).

#### **Experienced JIT changes and benefits**

The firm has experienced many JIT benefits, several of which are similar to those reported in the JIT literature (see introduction and the frame of reference section).

These are described below. Before that however, the firm underwent various changes in its effort to convert the organization into a JIT organization. For instance, each plant was set up with a lean core team (indicating organizational structure being an important contingent MAS and JIT variable, see e.g. Chenhall, 2003). The initiative was driven from the chairman and downwards. The later is in line with recommendations in research literature, emphasizing the importance of having top level management that is dedicated to JIT (Wafa & Yasin, 1998). A lot of training and education was given to the lean core teams in all plants in the group (which is another key point addressed in JIT literature, see e.g. Gélina, 1999; Wafa & Yasin, 1998). Also, continuous audits helped to set proper standards. There were also focused project teams working on designated lean initiatives. This resulted in an empowered work force that thinks differently, e.g., by applying Kaizen thinking (this is frequently pointed to as being a critical element, see Fullerton & McWatters, 2002; Selto et al., 1995). The work force therefore became committed to the ideas of continuous improvement and error proofing by team members on the job. This helped to reduce work load. For instance; the raw materials have been reduced by setting up production control units in each plant and the in house inventory of production stocks have been minimized by setting up smaller manufacturing cells (in short this underlines the importance of relating to organizational structure as a JIT contingent variable). In the finished-goods stores, frequent deliveries are organized by getting the customers involved in the process (which is a typical JIT supply chain focus, Yasin et al., 2003). Combined, these factors mean that less capital is being tied up in the production. According to a respondent:

*“It also increases our productivity by improving the effectiveness of the production process and by enhancing the quality of the work.”*

Furthermore, cross functional multi-skilled work teams have also improved the moral and motivation of the workforce via JIT implementation. Achieving lower inventory costs and levels are a typical JIT goal (Manoochehri, 1988). The case material, concerning staff training and boosting motivation as well as employee commitment, resembles the need for focusing on – and changing, the culture, or at least being aware of culture as an contingent variable (as argued by Chenhall, 2003; Otley, 1980).

When we asked about compatibility issues (whether the JIT system matched with the culture, work habits and existing norms in the organization), the interview data show the following: Previously introduced ideas/ previous experience with JIT were gathered through the group of firms (to which the plant in question belongs) that was already following this concept. As for the JIT system itself, it was not regarded as very complex. The organization unit understood the system through the group’s experiences. One reason for this was the organized training sessions that were provided for the managers

in the system. Through them, other employees became well informed and trained. Additionally, the employees gained knowledge by observing JIT implementations in their member plants. From this, the benefits of JIT implementation became more easily attainable. This suggests that organizational learning (see, March, 1991) within the overall organizational structure was important. This furthermore points in the direction of organization structure as being an important contingency variable. This was partly due to the benchmarking across different plants, but perhaps even more via the opportunity to enjoy benefits of scale by learning from other plants in the group.

Before applying the JIT system, the plant used to have a centralized cutting centre with a work in process (WIP) of fifteen hrs per line, for each of its twenty-five lines. Right now the cutting is decentralized and the WIP is reduced to six hrs per line. This has reduced inventory levels, and therefore a large waste factor. This has also reduced fabric related defects in sewing lines (shrinkage). Also the manufacturing units' production flow has been reduced to a single PC flow. Low inventory levels help to reduce additional transport related work, including, loading and unloading. At the same time the capital tied up in raw material is reduced, whereby working capital requirements have dropped. Shorter lead times improved the cash flow since the frequency of payments from customers increased. Combined, these matters point to ways in which technology (for instance via the use of PCs) can aid in increasing plant layout efficiency and structure. One thereby gains typical JIT benefits, like reduced waste and increased quality (Aghazadeh, 2004). Moreover, plant layout efficiency and restructuring are acknowledged as being important in JIT systems (Hobbs, 1997).

### **JIT implementation barriers**

Despite the aforementioned perceived and/or experienced JIT benefits, the plant did encounter some barriers when implementing JIT. Some related to infrastructure. E.g., organizational logistic layouts had to be modified. Also, the general infrastructure of the country is not logistically easy (transportation is difficult and there are challenges relating to import legislations). Another matter relates to the maintenance of equipment and layout arrangements. JIT also proved difficult with respect to some critical external relationships. For instance, it was not straightforward to align the suppliers to the JIT framework. Nor are the relationships flexible enough. In relation to the customers, it was found difficult to provide accurate forecasts. As for the employees; changes needed to be made concerning general working habits, as well as the mindset of the employees. The respondents experienced also certain political, legal and regulatory barriers. These included e.g. government policies and practices on export and import. Also, the unstable economic climate in the country was found to make it more challenging to apply a JIT

system. Moreover, some pointed to instability as a problem, where regulations tended to change in tandem with the government shifts.

Aforementioned findings relate directly to reasoning in contingency theory and JIT literature (e.g. Storhagen, 1995) regarding ways in which the environment provides certain factors that condition, in part at least, what management accounting tools (herein inventory) to apply. This also relates to the way in which they may be applied or be expected to function. Some of the aforementioned environmental factors could not be easily changed by the firm. Instead, it managed to adapt to them, thereby making JIT doable. So then, what did they do to overcome the JIT challenges?

### **Action taken to overcome JIT challenges**

To overcome some of the challenges encountered, the plant management considered different strategies, like increasing the involvement of team members in lean projects and sharing the benefits of practicing lean production with the teams. Another suggestion was to reward the teams, either financially or otherwise so as to improve the job satisfaction. These strategies are well-known in JIT literature (see e.g. Bruce et al., 2004; Fullerton & McWatters, 2002).

One decided to endorse certain practices to maintain a friendly environment for JIT within the organization. One such factor was to ensure commitment from the top management for the structural and organizational changes. Also, supplier integration-meetings are held on a regular basis. Certain procedural steps were also taken, including process audits, to maintain sustainability of the implemented lean practices. Moreover, mechanisms in place are being reviewed in order to come up with structured solutions to avoid repetitive mistakes. Additionally, it was seen as important to have the opportunity to test different things, and fail without being blamed. What is mentioned above reinforces the earlier points made about management (and culture) orientation, and the need to emphasize the supplier relation (Gélinas, 1999; Wafa & Yasin, 1998). The plant management was therefore aware of the importance of the supplier relation and reworked it actively.

The question then is how to understand the second case, which hitherto has not yet implemented JIT, despite being in the same industry.

## **4.2 Case 2 – the organization which did not implement a JIT system**

The description and discussion of the second case follows the same structure as case one, where we start with background information and move on to reflect on various JIT

perceptions (relating to both perceived benefits and implementation barriers). We then end by pointing out some expectations of change, as provided by the respondent.

### **Background information**

The second case is a member plant of a group of firms (herein various member plants) competing in the garment industry. The main plant, which is located in Colombo, has a central cutting division. The cut pieces are delivered to the member plants to be processed into final garments. The studied Koggala Plant does therefore not maintain a huge inventory stock. As per the production requirements, it receives lots (deliveries) of cut pieces regularly, typically once or twice a week. As a whole the group of plants is connected with a centralized computer system for controlling and handling the inventory throughout the cluster (i.e. the group). Hence, also the Koggala plant is familiar with the current computer system for record keeping and forecasting purposes. Through this system they are also able to manage the inventory level in a good manner (according to themselves). Consequently they do not consider it essential to convert the existing system into a JIT system. Nevertheless, the cutting division in the central plant in the group does apply a JIT system for its inventory management.

Again, just like in the first case, this shows the importance of technology as a contingent factor, shaping the firm's inventory handling (as argued in the literature, e.g. by Otley, 1980). In the second case, an acceptable technology was already in place, making it less pressing to implement a JIT system, partially because some of the reported benefits in JIT literature (as e.g. by McLachlin, 1997) were already achieved. This also seems to represent a kind of satisficing management view (where well-functioning and acceptable solutions are in focus, rather than (only) optimum solutions (March & Simon, 1993).

### **JIT perceptions**

The respondent elaborated on the choice of inventory system in the Koggala plant. It turned out that the respondent had been working within the industry for many years and was fully aware of the relative advantages of a JIT system. He did in fact acknowledge many of them. He stated for instance that *"JIT enables a smooth flow of the work at the production process, JIT helps to reduce the unwanted stock / inventory and thereby maintain a comfortable work environment which is not overcrowded, JIT enables a smooth cash flow / a small amount of money is invested for inventory, JIT increases our productivity, JIT improves the effectiveness of the production process, JIT enhances the quality of the work."*

When having this kind of a belief in JIT one can ask why the respondent (and his firm) nevertheless has not yet attempted to implement a JIT system.

### **Perceived implementation barriers**

The respondent did nevertheless point to certain key factors, which make it difficult to implement a JIT system in his plant. These factors included e.g. that the firm's existing capacity and the context did not coincide with JIT. Specifically, the working culture, the attitudes of the people, and the existing inventory controlling and raw material handling layouts, were considered to be incompatible with a JIT system. These factors suggest that the respondent was uncertain about critical JIT elements, like employee commitment (Zhu & Meredith, 1995). Moreover, based on the experiences from the external organizations (in the same group), it seemed too complex to convert to a JIT system; especially when considering that so many organizational changes are needed. Nonetheless, the respondent expressed no (direct) negative attitude towards JIT, but implied that his organization is not flexible enough to transcend JIT implementation barriers. Another main reason for not targeting a JIT implementation was that it seemed to bring about a too complex set of activities that could destabilize the organization in the short and the long run.

The reasons provided by the respondent in terms of why JIT has not yet been embarked on illuminate once more the apparent importance of certain contingent variables. The most outstanding ones seem to be complexity and required work culture associated with the JIT system, but also the way in which this is perceived to mismatch the organizational culture in the respondent's firm. If this is so, it also raises some difficulties about discussing culture as a contingent variable (see Chenhall, 2003; Otley, 1980), because culture is often perceived to relate to the national rather than the local country level (Hofstede, 2001). Still, the respondent's comment, about the firm finding itself in a difficult context when it comes to implementing a JIT system, falls within the core of a contingency theoretical argument of the organization's current choice of inventory system. It also seems that many of the aforementioned reasons provided can be related to the firm's environment, where the firm is different in one important area from the firm described in case 1. Case 2 namely belongs to a group of firms which have described JIT as challenging, whereas the Case 1 plant experienced the opposite. In that way, the firms' environments, especially the part made up of other plants in the same group, seem to play an important role in persuading a firm/plant whether or not to implement JIT. Consequently, organizational structure (regarding e.g. how plants are organized into a group) appears as being a very important JIT contingency variable.

Nonetheless, at the end of the interview, the respondent in Case 2 mentioned that the plant's "yes" or "no" to JIT had not formally been made and that they in fact expected this to change soon (see below).

### **Expected changes in responsibility, work tasks and organizational structure**

As of yet the plant (i.e. Case 2) does not have a JIT system, nor has it made any attempts at implementing one. At the same time though, they found it likely that they in the near future would be nominated by the group to take the role as a central cutting plant for the cluster of plants (to which the Case 2 plant belongs). When this will be carried out they will consider JIT as being a good inventory handling system for them.

Consequently, when relating this to the frame of reference; it appears that technology arises as one of the most important factors to consider when it comes to JIT implementation, alongside organizational structure. Hitherto, the plant (portrayed as Case 2) has had a technology (i.e. software system) that has provided it with JIT-like benefits. Yet, the cutting station function is clearly important. Organizational structure refers in part to the system thinking within the group, especially the position that the cutting plant has within the overall group structure, but also the way in which the priorities seem to change when changes are made to the organizational structure. In relation to the latter, consider e.g. what happened when the respondent anticipated the plant (i.e. Case 2) to become a new cutting plant (i.e. a new cutting hub) in the group's overall production system. Then suddenly, JIT appeared as a natural choice.

## **5 Conclusion**

The purpose of this study was to learn more about JIT considerations made by firms in the garment industry in Sri Lanka.

We learned that the kind of JIT attributes which our two case plants found attractive were basically very much similar to typical JIT benefits that are advocated in JIT literature. Examples include lower inventory levels, better product quality, a quicker production process, and related to this, also lower working capital needs. One also experienced a change in work culture, which is also promulgated as necessary in JIT literature. Our main findings suggest that JIT implementation in the two cases in question is much contingent on a set of variables. Several examples have been identified and discussed; including technology, the environment, organizational structure and culture. Still, the two most important ones seem nevertheless to be the plants' technologies and organizational structures. This also refers to the plants' position within their group, and the way this seems to play an important role in persuading a plant

whether or not to implement JIT. That is, the decision of whether or not to implement JIT seemed to be quite sensitive to the experience made by other plants in the same group and the duties given to each plant.

We see some implications from our findings. One important one would be that some of the identified and discussed contingency variables are very much determined by the firms in question. This contradicts points made in contingency theory that firms are often forced to adapt to determining factors beyond their control. For instance, with reference to JIT implementations in many western firms, one could reasonable have argued or believed that contingency theory (see e.g. Chenhall, 2003; Otley, 1980) would proclaim that Sri Lankan firms, facing different circumstances and contingencies, will in fact need different management tools and control systems than their western counterparts. However, our findings do not fully support this view. Firstly, one firm has implemented JIT, whereas the other has not (yet) done it. Secondly, one could ex ante have expected the two firms to be facing more or less the same contingent variables, and hence end up with the same conclusion regarding JIT implementation. However, this was not what we found. This suggests that firms do have greater rooms of flexibility and maneuverability than frequently said to be case (at least in traditional contingency based studies). Instead, it seems that firms have the opportunity, in part at least, to construct and/or reshape variables that impinge on their suggested management accounting tools. Two illustrative examples would be organizational design and technology. Basically, the firms can achieve different things by modifying either of the two.

A somewhat surprising finding in our study is nevertheless the way that case 1, which is applying JIT, has managed to obtain several JIT benefits despite facing various challenges (e.g. relating to environmental instability). One could namely have expected that these challenges would make JIT impossible. There are different ways of interpreting this, which is beyond this paper to sort out (due to lack of sufficient data details about this matter). It might e.g. be caused by post-rationalizing of JIT benefits by case 1, since it is always tempting to justify decisions and actions that have already been undertaken (Feldman & March, 1981). Alternatively, some of the contingency variables and JIT benefits are dominating some of the challenges that may be posed by other factors, which in total makes it net beneficial to undertake JIT (even in challenging settings like those faced by Sri Lankan firms). However, this is a matter for future studies to investigate in greater detail. There are also certain other limitations to our study, which bring forward some additional suggestions for further research. For instance, we focused on employees closest to the inventory handling and the production process. It

might be that other perspectives would have yielded additional insight. Moreover, it would be relevant to gather data from suppliers and customers to see what perspectives and experiences they have in relation to firms that have implemented JIT in this industry. Furthermore, it would be promising if future studies could carry out more case studies and subsequently surveys, targeting many more firms in the garment industry. Then we will see if the same understanding remains when it comes to JIT benefits and the importance of contingency variables in this industry.

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## **VI - Budget and finance**



## Chapter 11:

# Does bank ownership matter in performance? Experience and lessons from Sri Lanka

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**Abstract:** Theoretical predictions concerning the ownership-performance relationship remain ambiguous. Despite substantial changes in ownership in the Sri Lankan banking system less has been done to analyze performance differences amongst various ownership groups. Drawing upon the experience of the Sri Lankan banking system during the period 2000-2007, this study first provides quantitative estimates of revenue-based performance using Data Envelopment Analysis (DEA). Secondly, it evaluates the influence of ownership on performance using regression techniques. The study finds strong evidence to suggest that foreign banks perform better than domestic banks. Moreover, the evidence suggests that state-owned banks perform better than domestic private banks though this evidence is weak. Furthermore, all domestic banks have experienced substantial performance gains in recent years. The findings of the study imply that promotion of foreign bank ownership and creation of public confidence with regard to the credibility of private and foreign banks can be employed as important policy measures to enhance performance.

**Keywords:** bank performance; DEA; ownership; revenue based efficiency; DEA; Sri Lanka

## 1 Introduction

The foundation of the ownership-performance argument stems from the principal-agent framework, public choice theory and property rights views. Due mainly to its practical as well as its theoretical importance, the relationship between ownership characteristics and the performance of financial institutions in general and banks in particular has become the subject matter for numerous studies in recent decades (Yildirim and Philippatos 2007). However, existing literature provides conflicting predictions regarding the ownership-performance relationship. While some researchers argue that state-owned banks perform relatively better than their private counterparts (Sathye 2003) and domestic banks perform better than foreign banks (See Chang et al. 1998, De Young and Nolle 1996, Lensink and Naaborg 2007), some argue the contrary (see Bhattacharyya et al. 1997, Clarke et al. 2002, Demirguc-Kunt and Huizinga 1999). In contrast, some authors state that the influence of ownership is different in developing countries to that of developed countries (see Demirguc-Kunt and Huizinga 1999). However, less has been done to investigate the ownership-performance relation in developing countries. Particularly, a study that quantitatively assesses the impact of ownership on efficiency of Sri Lankan banks cannot be found in the internationally available literature despite drastic changes having occurred in its financial system in recent decades.

Sri Lanka is historically characterized as a country with a banking sector dominated by state-owned banks. Its financial system has been subjected to a series of reforms with the initiation of economic and financial reforms since the late 1970's (Edirisuriya 2007) and further intensified since the early 1990's. Promotion of private ownership in the financial system has been a prominent characteristic of financial reforms. Therefore, numerous private and foreign banks have entered the banking system; meanwhile state-owned banks have taken steps in restructuring their operations and in increasing efficiency. Statistics published in the annual reports of Central Bank of Sri Lanka (CBSL) suggest that these reforms have resulted in a 12 percent decrease in the share of the banking sector assets held by state-owned banks during the past decade. In contrast, the respective shares of domestic private banks and foreign banks have increased by 7.3 percent and 4.5 percent. As a consequence of the reforms, the current financial system in Sri Lanka encompasses most of the institutional elements of a modern banking system and remains resilient (Asian Development Bank 2005). Interestingly, the Sri Lankan financial system remained substantially resilient during the US subprime crisis. Moreover, with the ending of the three decade long civil war in 2009, Sri Lanka achieved remarkable development on various fronts and has recently attracted widespread attention.

The ambiguity in the existing literature and the lack of substantial amount of studies in the Sri Lankan context provide important rationales for investigating the ownership-performance relationship in Sri Lanka. Owing to Sri Lanka's regional importance, steady economic growth during recent decades and the nature of the financial system reforms to a large extent resembling those of neighboring countries (and possibly with those of many other developing countries), this study will have significant implications on banking literature and on developing countries. This study hypothesizes that bank ownership exerts a significant influence on the performance of banks and attempts to assess the nature and extent of ownership effect. To this end, the study first estimates the efficiency of banks using the revenue-based approach with Data Envelopment Analysis (DEA) and then uses second stage regressions to assess the ownership effect. This study prevails over the majority of previous studies mainly due to improvements achieved in the field of methodology.

The main contributions of this study are threefold. First, the study provides quantitative assessments of the efficiency of Sri Lankan banks where such evidence still remains substantially missing. Second, the study provides new developing country evidence regarding the ownership-efficiency and implications for policy readily applicable in other developing countries with similar characteristics, particularly within the region. Third, the findings of the study will provide an insight for policymakers and bankers concerning the nature of required future institutional reforms to mitigate performance lags in the banking system. Limiting the performance measurement of banks to merely one indicator and the exclusion of the financial crisis period, 2008-2009, may be identified as limitations of this research. For instance, during a financial crisis, banks with more exposure to foreign markets may become more "distressed". Moreover, the banks with more clients who depend on the fluctuations of foreign markets may also face higher difficulties, i.e. increased bad loans, during a crisis. Thus, the performance variations identified in this study may be temporally changed during such a global economic downturn.

The discussion in the paper is organized into five sections. Section 2 provides an illustrative review of related literature on ownership-performance debate. Section 3 discusses the methodology and models used in the study while Section 4 discusses the results and findings. Finally, Section 5 concludes the paper with a discussion about the implications of the findings.

## **2 Review of Related Literature**

The ownership-performance debate, on the one hand, stems from the arguments in the principle-agent framework and public choice theory. Accordingly, the management actions are constrained by capital market discipline and consequently play a role in determining the performance of firms (Altunbas et al. 2001). Hence state-owned enterprises are expected to perform poorly compared to private enterprises - due to political influences faced by management and the lack of capital market discipline. Superior monitoring mechanisms in private capital markets push management more towards the achievement of owners' objectives where such mechanisms are not clearly observable in the case of state-owned enterprises and monitoring mechanisms of the government (Figueira et al. 2009). Thus, based on such arguments, there emerged a wave of deregulation and privatization in many developing countries in which financial systems were formerly owned and managed (most of the time) entirely by governments with strict regulatory controls. Such initiatives expected increased competition and capital market discipline to force managers to make their financial institutions more efficient by altering their operating mechanisms and production technologies.

On the other hand, property rights approach also attempt to emphasize the importance of ownership in the determination of performance (Starr 1988). It argues that ownership affects the extent to which the costs and benefits are accrued more directly to the responsible individuals, based on the ability to transfer their respective shares of ownership. In contrast to owners of private enterprises and owners of state enterprises, the general public is unable to transfer its shares of ownership. This inhibits inexpensive detection and rectification of ineffective management actions contributing to poor performance in state-owned enterprises (Davies 1977). Thus, the property rights view also supports deregulation and privatization as private ownership seems to enhance performance.

Though a great deal of the literature supports these arguments, the majority of this literature is based on studies conducted on non-financial firms particularly operating in non-competitive contexts (Altunbas et al. 2001). Moreover, the majority of studies conducted on financial institutions have focused on developed countries in Europe or US and Australia, where comprehensive data sets are available. The performance of the banking systems in developing countries, particularly in Asia, has been less researched despite radical financial system reforms taken place during the 1970's and 1980's (Ataullah et al. 2004, Figueira et al. 2009, Clarke et al. 2002, Sathye 2003). On the other hand, despite the extent of the literature, different studies provide contradictory evidence on the ownership-performance relationship. The following discussion gives an

illustrative review of findings of selected previous studies on developing country context. Some of the methodological issues pertaining to previous studies are discussed under Section 3.

Numerous studies have pointed out that foreign banks are relatively more efficient than domestic banks, particularly in developing countries (Clarke et al. 2002, Demirguc-Kunt and Huizinga 1999, Sathye 2003 etc.). This argument is based on the fact that foreign banks in developing countries are endowed with cutting edge technologies which are inaccessible to domestic banks. For instance, Sathye (2003) suggests that privately owned banks are still in their expansionary stage in which they have to incur higher fixed costs thus needing time to realize the benefits. Demirguc-Kunt and Huizinga (1999) state that foreign banks in developing countries perform better due mainly to their technological edge. Foreign banks' ability to extend their branch network within metropolitan areas rather than towards rural areas can also contribute to the higher performance of foreign banks (Bhattacharyya et al. 1997).

However, contrasting evidence to the above view is also available. For instance, in an industrialized country context, Chang et al. (1998), De Young and Nolle (1996) and Micco et al. (2007) state that foreign banks perform less efficiently than their domestic counterparts. In a developing country context, Bhattacharyya et al. (1997) state that state-owned Indian commercial banks are the most efficient followed by foreign and private banks respectively. Lack of understanding of domestic markets and local clients of the host country may sometimes hinder foreign banks from achieving higher performance levels (De Young and Nolle 1996). Moreover, De Young and Nolle (1996) observe higher input efficiencies of foreign banks due to high proportions of costly inputs as compared to domestic banks. Supporting these arguments, Altunbas et al. (2001) also state that public and mutually owned banks have a slight advantage regarding raising funds at a lower cost - compared to privately owned banks. However, as foreign banks acquire more experience in doing business with local clients they may surpass the performance of domestic banks in developing countries. For example the findings of Bhattacharyya et al. (1997) and Figueira et al. (2009) imply that foreign banks have experienced substantial efficiency gains during recent years in their respective countries.

The evidence denying any ownership effect is also only sparsely available. For example, Micco et al. (2007) state that not only is the link between ownership and performance in industrial countries weak, but also the performance of foreign and domestic private

banks is not significantly different in developing countries. Figueira et al. (2009) also denies any significant influence of ownership in Latin-America during his study period. In the context of Sri Lanka, Seelanatha (2010) has made an attempt to investigate the performance of Sri Lankan banks measured in terms of DEA technical and scale efficiencies during the period 1984-2004. He considers only local commercial banks, and neglects specialized and foreign banks. Further his unbalanced panel of data raises concerns about the validity of relative efficiency scores generated by DEA. Additionally, Wanniarachchige and Suzuki (2010) have assessed the cost efficiency (DEA) of Sri Lankan banks and the effect of competition on performance. Perera et al. (2006) also limit their study to estimation of competition in the banking system. None of these studies have attempted to explore the influence of ownership on performance.

The illustrative evidence provided in this section not only reveals the lack of literature about Sri Lanka, but also provides some important implications with regard to future ownership-performance research. First, the ownership effect is not a static one. Thus, even though once it was found that a particular ownership type performs better than other ownership types, there is no guarantee that this remains the same over different periods of time. Second, the relationship is influenced by many other exogenous variables as well as ownership. The stage of financial sector development seems to be one such important factor influencing the effect of ownership. Finally, findings are highly sensitive to the measures of performance and the methodologies adopted in assessing the performance.

### **3 Methodology**

It has been common practice in literature to estimate bank efficiency using financial ratios such as return on investment, return on equity, and interest margin etc. However, these financial ratios tend only to capture certain aspects of performance. Estimation of true performance, in contrast, requires a broader perspective and thus, necessitates advanced techniques. To overcome the limitations associated with narrowly focused financial ratios as measures of performance, this study first estimates bank performance in terms of revenue efficiency using Data Envelopment Analysis (DEA). Second, efficiency scores are regressed with a series of explanatory variables using a second-stage regression to estimate the ownership impact on efficiency. The study is based on the hypothesis that ownership has a significant influence on the determination of the level of efficiency of banks. To ensure the robustness of the regression model, performance differences among state-owned, private and foreign banks were reinvestigated using one-way analysis of variance (ANOVA) and non-parametric Kruskal-Wallis test.

Though the Sri Lankan banking system contains 35 banks, 5 banks were dropped due to their non-existence during the entire period of study. Thus, the analysis is based on bank-level financial statement data on a balanced panel of 30 banks in Sri Lanka over a period of 8 years from 2000 to 2007. However, the data regarding 6 regional development banks was consolidated on an annual basis to form a single unit as these banks operate in relatively separate geographical regions while sharing common operating conditions. Thus, the total number of banks amounts to 26. These 26 banks are composed of 5 state-owned banks, 11 domestic private banks and 10 foreign banks. Furthermore, except for 5 specialized banks the rest of the 21 banks studied are commercial banks. Two separate models are assessed by dividing the study period into 2 four-year sub-periods (i.e. 2000-2003 and 2004-2007) in a dynamic sense to see whether performance variations are changing.

### **3.1 Performance of banks**

A comprehensive and commonly accepted performance measure for financial institutions such as banks does not exist in the literature. Instead, different researchers have attempted to estimate the performance of banks using financial ratios and other productivity measures. Different measures focus on different aspects of performance and thus have their own pros and cons. Along with X-efficiency literature, the performance in this study takes the form of profit/revenue-based efficiency, as first suggested by Berger and Mester (1997), and followed up by other authors such as Hadad et al. (2008) and Drake et al. (2009).

Efficiency measurement can be conducted based either on econometric or mathematical programming approaches (Worthington 2000). DEA and Stochastic Frontier Approach (SFA) are two techniques widely used to estimate efficiency, while the distribution-free approach, the free disposal hull approach and the thick frontier approach have also been frequently used in estimating the efficiency of banks (Berger and Mester 1997). Econometric approaches such as SFA require prior specification of the functional form and estimate the absolute efficiency which can be decomposed into inefficiencies and statistical noise. However, mathematical programming approaches such as DEA do not require prior specification of the functional form and measure the relative efficiencies in which total deviation from the efficient frontier is identified as inefficiency.

DEA is a non-parametric approach first proposed by Charnes et al. (1978) under the assumption of Constant Returns to Scale (Cooper et al. 2006) later extended and applied by various authors (Coelli 1996). DEA uses piece-wise linear technology to establish an

efficient frontier using mathematical programming techniques. Thus, this is a valuable benchmarking technique in which the efficiencies of Decision Making Units (DMU's) are estimated in relation to the efficient frontier. The efficiency scores generated by DEA ranges between 0 and 1 where, 1 represent best practice "cutting edge" DMU's and lesser scores represent relative inefficiencies.

Due to its ability to deal with multiple outputs and inputs together with its flexibility in the specification of the functional form, DEA has emerged as a leading tool for measuring the efficiency of financial institutions (Colwell and Davis 1992). Further, unit-invariance and adaptability with small samples can also be considered as merits of DEA over other parametric approaches (Avkiran 1999). However, DEA attributes all deviations from the frontier to inefficiencies. This may result in over- or under-estimation of efficiencies. Further, DEA efficiencies can be severely affected by outliers and measurement errors. These two factors can be considered critical limitations of DEA (Figueira et al. 2009).

Amongst various DEA models, this study adopts the Slack Based Model (SBM), first proposed by Tone (2001), as this specifically incorporates slacks in its inefficiency analysis. Thus, under this approach, a given DMU is efficient only if it is neither associated with input excesses nor output shortages. This approach is expected better to discriminate efficient DMU's from inefficient ones and generate better outcomes compared to standard DEA approaches such as CCR or BCC. Furthermore, SBM efficiency scores do not exceed efficiency scores generated by CCR and BCC models.

Banks are typically associated with multiple inputs and multiple outputs though there is no straightforward approach for identification. The literature provides two commonly adopted approaches in identifying inputs and outputs of banks: the production approach and the intermediation approach (see Freixas and Rochet 1997). Most DEA models in banking studies have adopted the intermediation approach (Sathye 2003). This study adopts the intermediation approach as this is closely aligned with the financial intermediation process of banks. Moreover, this study takes the form of the profit/revenue-based approach, taking into consideration the arguments of Berger and Mester (1997). This type of revenue-maximizing approach is expected to offer a better picture of bank efficiency as it more comprehensively describes the goals of managers and owners (Berger and Mester 2003, Drake et al. 2009, Hadad et al. 2008).

Furthermore, the study draws upon the specifications of Hadad et al. (2008) and Drake et al. (2009), regarding inputs and outputs. For example, Hadad et al. (2008) have identified net interest income, net trading income and net off-balance sheet income as

outputs, whereas employment expenses, non-employment expenses and provisions for losses on earning assets are reckoned as inputs. Similarly Drake et al. (2009) identifies net interest income, other operating income and net commissions, fee and trading income as outputs while non-interest expenses, other operating expenses and provisions are reckoned to be inputs. However, as interest expenses are directly related to deposits which become an input under intermediation approach, it may be more appropriate to treat interest expenses as a separate input variable rather than using it to calculate net-interest income. Thus, this study separately considers interest expenses as an input and interest income as an output rather than taking net-interest income as an output. Further, instead of considering provision to be a separate input, this study includes provisions together with other operating expenses. At the same time all incomes other than interest income are pooled together as non-interest income.

Summing up then, this study identifies interest income and non-interest income as *outputs* and interest expenses, employment costs and other operating expenses as *inputs*. All these variables are measured in Sri Lankan Rupees (millions). By design, this DEA model avoids certain major limitations associated with DEA models in the majority of previous developing country studies. First, some studies have included flow variables together with stock variables in their DEA models. For further examples see the models of Bhattacharyya et al. (1997), Saha and Ravisankar (2000), Sathye (2003), and Kumar and Gulati (2009). Flow variables measure amounts during a particular time period while stock variables measure amounts at a particular point in time. Thus, such models tend to give a wrong picture regarding performance. Second, most of the studies are confined to narrow and too historical time spans. For example, Atallah et al. (2004) and Bhattacharyya et al. (1997) limit their observation to the 1988-98 and 1986-91 time periods respectively. Saha and Ravisankar (2000) limit themselves to a narrow 4- year period (1992-95). Figueira et al. (2009) limit their study to a single year, 2001. Such historical and narrow time spans render findings less robust and irrelevant in the current context. Third, the majority of studies have based analysis on the production approach while the intermediation approach remains more appropriate in modeling financial institutions.

### **3.2 Regression Model**

To assess the influence of ownership characteristics on efficiency, this study employs the following regression model which also includes a series of control variables. The relationship is, first, assessed for the entire eight year period ranging from 2000 to 2007, and then for two sub-periods namely from 2000 to 2003 and from 2004 to 2007 respectively. The analyses on two sub-periods expect to capture performance variations

in a dynamic context. Independent and dependent variables represent averages for each period under consideration.

$$EFF_{it} = \alpha + \beta_1 SP_{it} + \beta_2 DF_{it} + \beta_3 CS_{it} + \beta_4 BCHR_{it} + \beta_5 LTA_{it} + \beta_6 MP_{it} + \varepsilon_{it} \quad (1)$$

Where *EFF* denotes SBM efficiency scores obtained using DEA whereas *i* indexes banks and *t* indexes time. *SP* and *DF* are dummy variables representing ownership characteristics. *SP* takes the value 0 if the bank is state-owned and 1 if private-owned. *DF* takes the value 1 if the bank is foreign-owned and 0 if domestically owned. Classification of banks as state-owned, domestic private and foreign banks was done based on the categorization of CBSL. *CS* is a dummy variable to differentiate between commercial banks and specialized banks by which it takes the value 1 if the bank is a commercial bank and 0 if the bank is a specialized bank. Further, *BCHR* is included to capture the operational characteristics of the bank. Micco et al. (2007) measures this by dividing non-interest income by way of total assets. However, it may be more appropriate to measure the importance of non-interest income relative to interest income in order to get a clearer understanding of the focus of the bank on other activities than lending. Thus, in this study, *BCHR* represents the ratio of non-interest income to interest income. The higher the ratio of non-interest income, the higher will be the involvement of the bank in trading and off-balance-sheet activities. Following the approaches of Berger et al. (2005) and Micco et al. (2007) this study includes *LTA* and *MP* to capture scale effects of banks where *LTA* denotes the logarithm of total assets of the particular bank and *MP* denotes relative the market power of each bank estimated in terms of its market share of total assets. Finally,  $\beta$  denotes regression coefficients,  $\varepsilon$  denotes the random error and  $\alpha$  denotes the intercept.

#### 4 Findings and Discussion

The banking system in Sri Lanka accounts for around 70 percent of the assets in the financial system during 2000-2007 (FSSR 2007, CBSL 2000). In other words, banking assets relative to GDP remained as high as 70 percent whereas the market capitalization of the equity market relative to GDP remained around 23 percent by the end of 2007 (CBSL 2008). Thus, in Sri Lanka where the equity markets have not yet fully developed and the public awareness of equity markets remains critically low, the banks have a crucial role to play in mobilizing and intermediating funds for investment projects. The CBSL acts as the sole regulator in the Sri Lankan banking system which currently consists of 22 commercial banks and 13 specialized banks totaling 35 banks. Among these, 12 are state-owned whereas the number of domestic private banks and foreign banks amounts to 12 and 11 respectively. Commercial banks hold the lions' share of around 70 percent

of banking system assets. Furthermore, three large state-owned banks account for around 56 percent of the deposits mobilized by the banking system in the recent years, though their share is gradually decreasing.

Table 1

Descriptive statistics of DEA efficiency scores across banks during 2000-2007

Bank	Mean	Std. Deviation	Minimum	Maximum	N
DMU01	0.525	0.070	0.414	0.640	8
DMU02	0.919	0.150	0.671	1.000	8
DMU03	0.558	0.050	0.477	0.617	8
DMU04	0.953	0.088	0.797	1.000	8
DMU05	0.900	0.192	0.445	1.000	8
DMU06	0.364	0.317	0.054	1.000	8
DMU07	0.709	0.201	0.464	1.000	8
DMU08	0.449	0.051	0.372	0.518	8
DMU09	0.909	0.189	0.475	1.000	8
DMU10	1.000	0.000	1.000	1.000	8
DMU11	0.805	0.234	0.396	1.000	8
DMU12	0.849	0.137	0.654	1.000	8
DMU13	0.261	0.185	0.001	0.507	8
DMU14	0.810	0.359	0.107	1.000	8
DMU15	0.444	0.055	0.373	0.530	8
DMU16	0.405	0.079	0.283	0.475	8
DMU17	0.341	0.084	0.252	0.506	8
DMU18	0.812	0.262	0.411	1.000	8
DMU19	0.819	0.335	0.252	1.000	8
DMU20	0.492	0.051	0.405	0.559	8
DMU21	0.962	0.107	0.698	1.000	8
DMU22	0.763	0.091	0.669	0.885	8
DMU23	0.230	0.061	0.137	0.305	8
DMU24	0.433	0.070	0.332	0.536	8
DMU25	0.784	0.401	0.103	1.000	8
DMU26	0.318	0.069	0.219	0.396	8

Note: Bank names were coded to preserve data confidentiality

Even though the operations of all banks are relatively similar, the two state-owned development-oriented financial institutions (Housing Development & Finance Corporation and State Mortgage & Investment Bank) do have a slightly different focus. For example, these two institutions are mainly involved in fulfilling long-term development financial requirements of the entities not adequately serviced by commercial banks and also servicing other long-term financial needs for agricultural, housing and construction sectors. Furthermore, being the largest specialized bank, the state-owned National Savings Bank is also primarily concerned with the savings of small

scale savers while the majority of its funds are invested in government securities. For example, as of 2007 nearly 74 percent of its funds have been invested in government financial instruments.

As specified in section 3, the SBM model of DEA was used to estimate bank efficiency during each period. Table 1 depicts summarized statistics of DEA efficiency scores. Bank names were coded in order to preserve data confidentiality. The table shows that 14 banks have recorded full efficiency in at least one of periods (i.e. maximum score=1). Moreover, DMU10 has been characterized as fully efficient during all the periods (i.e. minimum score is 1). More importantly, DMU 10 is a foreign bank. DMU 6, 14, 19, and 25 have recorded full efficiency scores in certain periods while recording significantly low efficiency scores in certain other periods. This has possibly resulted from the changes in reference sets used by DEA to evaluate the relative efficiency of these DMU's.

Table 2  
Descriptive statistics of Regression variables during 2000-2007

Symbol	Definition	Mean	S.D.	Min	Max	CV (%)
EFF	DEA efficiency scores which vary between 0 and 1	.647	.249	.230	1.000	38
SP	Dummy variable, Equals one if the banks is privately owned	.769	.430	.000	1.000	-
DF	Dummy variable, Equals one if the banks is foreign owned	.385	.496	.000	1.000	-
CS	Dummy variable, Equals one if the banks is a commercial bank	.808	.402	.000	1.000	-
BCHR	Importance of non-interest income relative to interest income	.239	.172	.016	.871	72
LTA	Log of total assets	4.316	.679	3.228	5.466	16
MP	Market share in terms of assets	.038	.053	.001	.195	138

Number of observations are 26

Second stage regression is used to assess the impact of ownership on efficiency. The group of other explanatory variables accounts for the other bank specific characteristics. Table 2 summarizes the regression variables and related descriptive statistics together with the coefficient of variances for continuous variables. This shows huge disparities of relative sizes (MP) of banks and their involvement in activities other than lending (BCHR). Similarly, a significant efficiency variation can also be observed amongst banks - as reflected in the coefficient of variance for EFF. This can largely be attributed to two specialized banks which have recorded very low efficiency scores throughout the study period. These two banks are either focused on development activities or micro-financing

activities as their main business activities, and the profit maximization motive is less prominent.

Regression results have been illustrated in Table 3. Model A, assesses the impact during the whole eight-year period, whereas model B and C assess the impact in two sub-periods (2000-2003 and 2004-2007) separately dynamically to assess the changes in efficiency and ownership impact. All three models are statistically significant according to the *F*-test and are capable of explaining 80.1, 78.4 and 77.0 percent of the efficiency variation of banks respectively.

Table 3  
Model Estimation: OLS regression results

	Model A		Model B		Model C	
	$\beta$	Std. Error	$\beta$	Std. Error	$\beta$	Std. Error
$\alpha$	0.036	(0.312)	0.181	(0.314)	0.130	(0.324)
SP	-0.166	(0.107)	-0.277	(0.137) *	-0.066	(0.105)
DF	0.484	(0.082) ***	0.463	(0.114) ***	0.444	(0.074) ***
CS	-0.251	(0.094) **	-0.360	(0.114) ***	-0.123	(0.094)
BCHR	0.185	(0.223)	0.278	(0.272)	0.135	(0.172)
LTA	0.183	(0.081) **	0.202	(0.083) **	0.111	(0.082)
MP	-1.868	(1.204)	-2.266	(1.272) *	-1.125	(1.263)
R Sq.	80.1		78.4		77.0	
F-test	13.901 ***		11.520 ***		10.580 ***	

Model A estimates the relationship during 2000-2007 whereas Model B is for 2000-2003 and Model C is for 2004-2007. SP, DF and CS are dummy variables taking a value of one for private banks, foreign banks and commercial banks respectively. BCHR measures the bank characteristic, LTA measures size effect of banks and MP measures relative market power. Standard errors are in parentheses.

\*\*\* Significant at 1%, \*\* Significant at 5%, \* Significant at 10%.

Model A does not provide statistically significant evidence of a performance difference between state-owned banks and private banks. However, the results of model B suggest that state-owned banks perform better than private banks during the period 2000-2003. These findings partially indicate the presence of special customer preferences for the state-owned banks or the presence of special protective cover from the government towards state-owned banks creating a low-risk perception in customers' minds. Perera et al. (2006) also indicate that Sri Lankan customers prefer low-risk banks. However, in terms of cost efficiencies, these banks cannot be considered as efficient, due to the presence of higher employment ratios, lack of technological edge and other inefficiencies prevailing in the operating systems (Edirisuriya 2007, Asian Development Bank 2005). But, these banks have been able to generate higher revenues, possibly due to their ability to maintain lower deposit rates and higher lending rates resulting from higher confidence from the general public in their credibility. However, results of model

C indicate that such differences are gradually disappearing with the expansion of private sector banking activities and resulting efficiency gains. Thus, as far as the whole eight-year period is concerned, noticeable performance difference does not exist between state-owned and private banks, due mainly to gradual performance gains acquired by private banks stretching into the second sub-period.

All three models show that the coefficient for DF is positive and significant at a 1 percent level. Thus, the study finds strong evidence to suggest that foreign banks are relatively more efficient than their domestic counterparts. This can be attributed in part to the fact that most foreign banks operate in metropolitan areas where they can maintain a higher level of profitability with very low investment on fixed assets needed to extend the branch network. In contrast, the state-owned banks have a widespread branch network which is costly to maintain. Moreover, the use of advanced technologies might also have influenced foreign banks in becoming more efficient. The advantages for foreign banks of having a technological edge may offset other inefficiencies they may face (such as a lack of understanding of local markets and costly inputs). Hence the view that foreign banks perform more poorly than domestic banks is less plausible in a developing country context. However, when comparing the coefficients in model B and C, it can be observed that the magnitude of the coefficient has decreased slightly in the second sub-period relative as opposed to the first sub-period, indicating an efficiency improvement of domestic banks - possibly due to gradual implementation of the latest technology.

Furthermore, Model A suggests that commercial banks have performed less well than specialized banks on average during the period 2000-2007. This indicates that the relatively concentrated activities of specialized banks have helped them achieve higher efficiency than commercial banks which are exposed to higher levels of risks. Nevertheless, the significance of this difference is much higher during the first sub-period; the difference is not statistically significant during the second sub-period. This is also an indication of the efficiency gains of commercial banks with implementation of modern technologies and the acquisition of more experience in commercial banking activities - given the continuous improvements in the financial system infrastructure in Sri Lanka.

The focus of banks on activities other than lending, as denoted by BCHR, does not seem to influence statistically significantly efficiency. As indicated by LTA, evidence is available, in Model A and B, to suggest that larger banks have performed better than smaller banks - hence the prevalence of economies of scale in the Sri Lankan banking system. Again this impact is also not statistically significant during the second sub-period

as indicated by model C indicating the achievement of operationally efficient scales by the majority of the banks during the period 2004-2007.

One of the interesting findings is that, the relative market power (MP) measured in terms of market share of total assets has a negative influence on the efficiency, though this is not statistically significant (significant at 10 percent level in model B). However, this variable needs additional care in interpretation, as it has a high degree of association with ownership. For instance, the largest 3 banks were state-owned while the remaining two state-owned banks were also ranked within the largest 15 banks. Only 3 foreign banks could be found within the largest 15 banks where the majority consisted of private domestic banks. Thus, this variable also indirectly indicates the higher efficiency of foreign banks relative to domestic banks, rather than the influence of relative market power.

To ensure the robustness of the regression model, two alternative analyses were performed on the same data. First, one-way analysis of variances (ANOVA) was conducted to evaluate the performance differences amongst different ownership groups with and without equal variances assumption (i.e. Dunnett's C). Second, the nonparametric Kuruskal-Wallis test was also performed to evaluate performance differences. Both techniques provided results highly consistent with each other and with the regression results. ANOVA tests for all three periods provide evidence to suggest that foreign banks perform better than domestic private banks, though performance differences between foreign and state-owned banks were not statistically significant. Furthermore, statistically significant performance difference could not be observed between state-owned and private banks. Moreover, Kuruskal-Wallis tests reveal that foreign banks perform better than domestic banks during the period 2000-2007, as well as during two sub-periods. In contrast, evidence does not suggest a significant performance difference between state-owned and private banks in any time period. As the primary concern of this study is to evaluate the influence of ownership on performance, results for other control variables were not assessed in these alternative analyses.

## **5 Conclusions and Implications**

The participation of domestic private banks and foreign banks has been increased, together with a series of financial reforms that have substantially reshaped the banking system in Sri Lanka in the recent past. However, a substantial amount of studies has not been conducted to assess the performance differences amongst different ownership groups. Moreover, the literature provides ambiguous predictions regarding the

ownership-performance relationship, while fewer studies have focused on developing countries. Thus, an attempt is made in this study to empirically examine performance differences amongst various banks under different ownerships. The study employs DEA frontier estimation technique using the slack based model (SBM) in order to estimate the efficiency variations amongst 26 Sri Lankan Banks taking a revenue/profit approach first suggested by Berger and Mester (1997). Second-stage regressions were primarily used to estimate the influence of various ownership characteristics on efficiency variations.

The findings suggest that foreign ownership contributes positively to the improvement of revenue efficiencies. The results are highly consistent with the findings of Sathye (2003), Bhattacharyya et al. (1997) and Clarke et al. (2002) in which they also found foreign banks to be the most efficient. However, it should be noted that foreign banks in Sri Lanka mainly operate in metropolitan areas and their branch network is not extensive. This seems to be a common characteristic of many of the developing countries (Bhattacharyya et al. 1997). Further, domestic banks are still in the process of integrating the latest technology into their operations. Thus, foreign banks' concentration on profitable metropolitan areas and state of the art technology may help them experience higher level of cost efficiencies - allowing them in turn to be more profitable. However, unarguably the competitive pressure created by foreign banks has forced domestic banks to be more efficient as is evident from the decreased magnetite of coefficient in the second sub-period. There is also an aspect that state-owned banks have a different mission than private banks.

The overall findings do not indicate a significant performance difference between state-owned banks and private banks. However, state-owned banks have outperformed private banks during the first sub-period. These results suggest that private banks have gradually experienced performance gains such that performance variations across them have faded away and are not visible in the second sub-period. Consistent with Altunbas et al. (2001) this study observes certain cost and profit advantages for state-owned banks. Being strongly attached to the government, they are able to build a higher level of credibility regarding the stability of the bank and the safety of deposits which consequently facilitates attracting large amount of deposits at a relatively lower cost. The resulting performance gains of state-owned banks may offset or in some cases override the performance gains of private banks' better management resulting from capital market discipline. This kind of performance gain for state-owned banks may be reinforced during a financial crisis where customers may switch their deposits from private banks to safer state-owned banks.

As also suggested by Sathye (2003) with regard to Indian private banks, the majority of Sri Lankan private banks are still in their expansion stage. With the gradual deregulation of the financial system since the 1990's and with continuous developments in the financial system infrastructure, private banks are gaining market shares, popularity and credibility while also improving their operating mechanisms. For example, indications of scale advantage in the first sub-period are no longer available in the second sub-period signaling performance gains for small banks. These can be identified as the main reasons for the disappearance of a performance difference between state-owned and private banks.

The findings of this study have two important policy implications. First, the promotion of private ownership is not a sufficient condition, though it is a *necessary* condition in improving the efficiency of the banking system. Even though more private banks are allowed, they do not have sufficient capacity to penetrate into the market due to their scale and accessible technology. Relatively new private banks face more credibility issues. Hence, state-owned banks with long experience and widespread branch networks tend to retain a healthy portion of deposits. Thus, the promotion of foreign ownership will be an important policy measure in enhancing performance. This can be done either by allowing more foreign banks or by promoting joint ventures with foreign banks. In terms of technology absorption and domestic financial stability the latter seems to be more appropriate for Sri Lanka. It will enhance the financial strength of domestic banks while facilitating the transfer of advanced technology and management skills.

Second, combined with the first point, it might be appropriate to introduce a mechanism to enhance the credibility of domestic private and foreign banks. Undue favor of the customers towards state-owned banks observable in the market have covered the inefficiencies of state-owned banks. And this also creates space for domestic private banks to remain inefficient (Asian Development Bank 2005). This mainly happens because the general rate of interest in the market is largely influenced by the rates offered by large state-owned banks (particularly the National Savings Bank). Relatively high spreads set by these banks to offset their operating inefficiencies enable private banks to earn large profits. These high profits de-motivate private banks in further improving their operating conditions. A mandatory deposit insurance scheme might come forward as an appropriate "candidate" amongst possible policy measures in order to improve the credibility of private banks. Further, continuous improvements on prudential regulations and the financial system infrastructure and public awareness will also contribute towards a credible private bank sector. Such developments can improve

the monitoring of financial institutions by the central bank while improving the transparency of banking affairs. These reforms can help create a better impression with regard to the safety of private and foreign banks and hence improve their attractiveness. In addition, the resulting pressure will induce state-owned banks to clear up their inefficiencies.

Even though this study suggests some factors as enabling state-owned banks to score relatively higher efficiency scores, a comprehensive firm level of empirical investigation still remains missing. Moreover, the extent and causes of customer preference towards state-owned banks have not yet been empirically tested, particularly in the Sri Lankan context. In some cases the preference of customers for state-owned banks may have occurred due to their long existence in the market and familiarity - rather than additional safety perceptions. However, lack of empirical investigations prevents practitioners from taking the necessary actions. Moreover, the influence of recent global financial crisis on Sri Lankan bank performance has not been explored in this study. These areas remain interesting areas to be empirically explored in the future.

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## Chapter 12:

# Public Sector Accounting Reforms in Two South Asian Countries: A Comparative Study of Nepal and Sri Lanka

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**Abstract:** Many developing countries have endeavoured to introduce public sector accounting reforms. However, little research has so far been devoted to studying the ongoing public sector reforms covering accounting and budgeting reforms in developing nations. Moreover, albeit comparative studies on this subject matter have increased in recent years, the latter is confined within the purview of developed nations. Given this lack of knowledge along with the paucity of comparative research covering developing nations, the present paper aims at tracing and, in so doing, comparing the forces behind public sector accounting reforms in two developing countries, namely Nepal and Sri Lanka. The findings of the study suggest that reforms in both countries have been much affected by overseas developments, reflecting the NPM and NPFM trends.

**Keywords:** Accrual accounting; Institutional forces; Nepal; Sri Lanka

### 1 Introduction

The public sector worldwide has been experiencing changes under the banner of New Public Management (NPM) since the last three decades (Cortes, 2006; Lambert and Lapsley, 2006; Lapsley, 2009). Studies demonstrate that a growing number of countries have, in recent years, introduced cost improvement programs, performance indicators,

financial management information systems, financial targets, delegated budgets, and resource allocation rules, to name but a few, as part of NPM reforms (Arrington and Watkins, 2007; Groot, 1999; Pettersen, 1999). However, the transformation of the accounting system from being cash to accrual based has been the most discussed and debated issue within the theme of NPM reforms- a phenomenon also referred to as New Public Financial Management (NPFM) (Guthrie *et al.*, 1998; 1999).

Indeed, a number of reasons have been given to explain the widespread dissemination of NPM and NPFM ideas across countries ranging from a consequence of financial crisis to increasing public debts to a global trend (Czarniawska and Sevón, 1996; Hyndman and McGeough, 2008; Sahlin-Andersson, 2001). In the context of developing countries, NPM and NPFM ideas have been envisaged, particularly by international organizations namely the World Bank, the Asian Development Bank, and the IMF, as a means of initiating structural changes, mainly privatization (Mimba *et al.*, 2007). The adoption of NPM and NPFM ideas has therefore become a precondition for many developing nations ensuring external funding and expert knowledge (Chan, 2005).

Mimba *et al.*, (2007) state that many developing countries have already initiated NPM and NPFM reforms and some are in the process of reforming their public sectors. However, it is striking that little research has so far been devoted to studying the ongoing public sector reforms covering accounting and budgeting reforms in developing nations (Bourmistrov and Mellemvik, 2005; Chan, 1996). Moreover, albeit comparative studies on this subject matter have increased in recent years (see e.g. Guthrie, 1998; Pina and Torres, 2003; Sahlin-Andersson, 2001) the latter is confined within the purview of developed nations. Calls have been made to promote comparative studies between developing nations on this topic so as to reflect the varied paths and attitudes towards public sector reforms in different contexts (Chan, 2000; Timoshenko and Adhikari, 2010).

Given this lack of knowledge along with the paucity of comparative research covering developing nations, the present paper aims at tracing and, in so doing, comparing the forces behind public sector accounting reforms in two developing countries, namely Nepal and Sri Lanka. The study is particularly focused on giving a better understanding of the underlying reasons for public sector accounting changes in these two countries. The changes of political landscape in the early 1970s of Sri Lanka and the emergence of Nepal in world politics at the beginning of the 1950s have motivated us to trace public sector reforms, particularly accounting changes in these two countries, from the mid-twentieth century until recent times.

The paper draws on an institutional perspective in that it deals with how organizational changes are shaped by exogenous and endogenous forces (see e.g. DiMaggio and Powell, 1983; Meyer and Rowan, 1977). The extent literature relies upon institutional theory to shed light on the role of accounting practices and other public sector reforms in maintaining the appearance of legitimacy (Modell, 2009). Moreover, many of these studies covering the case of developed nations have demonstrated how countries strive to embed the generally accepted accounting rules and practices in their formal structures without considering the relevancy of such rules and practices in their particular context (Carpenter and Feroz, 2001; Connolly and Hyndman, 2011). With some exceptions (Adhikari and Mellemvik, 2010a) there is, however, a lack of studies attempting to present the comparative analysis of public sector accounting reforms in developing nations using the institutional lenses. This study therefore intends a contribution to institutional theory by presenting the case of two developing nations.

Nepal and Sri Lanka are worth exploring as they represent a group of developing nations, which have experienced similar ethnic and political conflicts in the past decades. Both countries, located on the South-Asia subcontinent, are dependent to a large extent on international aid and loans for development activities. As a percentage of GDP Sri Lankan government foreign debt stood at 36.5% and its dependence on foreign financing sources to cover the budget deficit is 5.1% of GDP in 2009 (see Central Bank of Sri Lanka, 2010). Similarly, Nepal received average international aid worth of 5% of GNI in 2008/2009. The financial deficits of the country stood at about 5% of GDP and the total external debt at about 29% of GDP (MoF, 2010). This dependency on international resources means that both countries are exposed to pressure by international organizations, namely the World Bank, the International Monetary Fund, and the Asian Development Bank for structural changes in the provision of services (Haque, 2001). Based on these similarities, one could assume that the institutionalization of accounting changes and other public sector reforms in Nepal and Sri Lanka are likely to be very similar.

The remainder of this paper is structured as follows: the next section introduces our theoretical framework explaining accounting changes. This is followed by a discussion of public sector reforms, particularly accounting and budgeting reforms in Nepal and Sri Lanka respectively, from the 1960's and 1970's up to recent times. Section Four compares and discusses reforms in Nepal and Sri Lanka in the light of the theory applied. Following this, concluding remarks are incorporated. Finally, implications of this are presented.

## 2 Theoretical Framework

There are many ways of understanding how accounting rules and practices become an institution. Two ways of constructing a particular institution are worth looking at more closely. Firstly, organizations on a number of occasions formulate institutions by learning from their experience. March (1991) defines this mode of creating institutions 'a way of learning through exploration and exploitation of own experience'. Next, institutions can also be seen as a result of the interconnection between organizations and their operating environments (Meyer and Rowan, 1977; DiMaggio and Powell, 1983).

Institutional approaches, particularly the so-called 'new institutionalism' propagated by Meyer and Rowan (1977) and DiMaggio and Powell (1983), emphasize that organizations endeavour to adopt socially accredited systems, procedures, practices, and structures that are assumed legitimate in society regardless of their appropriateness (Carpenter and Feroz, 2001; DiMaggio and Powell, 1983; Palmer *et al.*, 1993). The search for legitimacy has often proved more important than rational decision-making processes (Connolly *et al.*, 2009; Gold, 1999). Meyer and Rowan (1977) further argue that the incorporation of institutionalized rules and practices in their formal structures also provides organizations with a means of protecting them from having their conduct questioned. The concept of decoupling, which demonstrates the extent to which the rules and practices adopted from the external environment are distinct from actual organizational practices, has therefore become a central issue in institutional theory.

DiMaggio and Powell (1983) state that legitimated structures, processes, procedures and practices are exported to organizations, i.e. through coercive, mimetic, or normative pressures or by the cumulative pressures of two or all of them. These three institutional pressures have provided a theoretical setting for a number of studies attempting to explore the interconnection between public sector changes, particularly accounting reforms and the context in which changes take place (Adhikari and Mellemvik, 2009; Adhikari and Mellemvik, 2010a; Carmona and Macias, 2001; Carpenter and Feroz, 2001; Carmona and Donoso, 2004; Timoshenko and Adhikari, 2010).

The coercive pressure consists of both the formal pressure imposed through legislation and informal pressures exerted on organizations by other organizations due to fiscal stress and the situation of resource dependency (Connolly *et al.*, 2009). The main argument is that the organizations providing the resources critical for the existence of

another organization gain the opportunity to exercise authority or power over such a dependent organization (DiMaggio and Powell, 1983; Mizruchi and Fein, 1999). DiMaggio and Powell (1983) argue that reforms imposed by coercive pressures tend to be of a rather ceremonial nature. The mimetic pressure, resulting from uncertainties, leads organizations to model themselves on similar organizations regarded as successful or legitimate organizations (Covaleski and Dirsmith, 1988; Hassan, 2005). Ribeiro and Scapens (2006) demonstrated the role of consultants in promoting mimetic changes. Normative isomorphism implies that organizations endeavour to adopt the systems, practices, and procedures widely propagated by professional bodies. This also means that normative pressure is linked to professionalization - the collective struggle of professional bodies, consultants, and experts to determine the appropriate conditions and methods for adhering to their standards (see e.g. Carpenter and Feroz, 2001; Dillard *et al.*, 2004; DiMaggio and Powell, 1983; Fein and Mizruchi, 1999; Jacobs and Jones, 2009; Levitt and Nass, 1989; Palmer *et al.*, 1993).

Studies have applied the idea of an institutional perspective to exhibit the role and influence of international monetary institutions in the dissemination and execution of public sector reforms in developing countries (Adhikari and Mellemvik, 2010a; Timoshenko and Adhikari, 2009; Timoshenko and Adhikari, 2010). These studies pinpoint to the fact that the political survival of a government in developing countries very much depends upon its ability to bargain with these external institutions and their requirements. While the lower bargaining power of the government is likely to exert a higher degree of institutional pressures, the higher bargaining power is expected to reduce the degree of institutional pressures in pursuing public sector reforms. This paper intends to add knowledge to these studies by exploring the influence of international monetary institutions in the public sector reforms of Nepal and Sri Lanka.

### **3 Research Method**

This is a descriptive case study seeking to examine and compare public sector reforms, particularly central government accounting reforms in Nepal and Sri Lanka starting from their beginning in the 1960s (Nepal) and 70s (Sri Lanka). Moreover, we have attempted to assemble accounting and budgeting changes in Nepal and Sri Lanka, respectively into three successive periods in order to achieve the goals of this study. Our choice for this is due to the identified patterns of continuity and change in accounting and budgeting reforms in both the countries. Also, by bracketing the time period, we have striven to study what pressures have forced Nepal and Sri Lanka to initiate accounting and budgeting changes overtime and what has remained unchanged and what has altered.

The empirical evidence presented in this paper is mainly drawn from a collection of official documents issued by the governments of Nepal and Sri Lanka respectively, accounting and budgeting regulations and procedures in both countries, and reports issued by international organizations, particularly the World Bank, the Asian Development Bank, and the International Monetary Fund. These reports include, amongst other things, the World Bank's Country Financial Accountability Assessment of both countries, a Comparison of Public Sector Accounting and Auditing in Nepal and Sri Lanka with International Standards, the ADB's Nepal Public Financial Management Assessment and the Diagnostic Study of Accounting and Auditing Practices in Sri Lanka.

It is also worth mentioning that a variety of other secondary sources such as textbooks, articles, and websites dealing with public sector accounting in both countries has been widely accessed for the purposes of this study in order to solidify the level of precision. Moreover, observation of government accounting practices both in Nepal and Sri Lanka during our regular visits to these countries and informal talks with government officials, academics, and professional accountants have not only contributed to enriching the empirical evidence, but also to ensuring the relevance and validity of the secondary sources applied. Five visits were made to Nepal in the period from 2003 to 2009, whereas four visits to Sri Lanka took place from 2006 to 2009. Informal conversations were held with professional accountants, representing the Institute of Chartered Accountants, and senior government officials and accountants from the Ministry of Finance in both the countries.

Nevertheless, this paper does have some limitations regarding scope, as it is confined to covering accounting developments purely at the central level of Nepalese and Sri Lankan governments. Moreover, it is also worth mentioning that, being a comparative case study of two south Asian countries, this study may reflect more similarities in the process of reforming public sector accounting and budgeting than differences. The results derived from this study may not be transferable to public sector accounting reforms in other developing countries in Africa, Latin America, and Asia.

#### **4 Public Sector Accounting Changes in Nepal and Sri Lanka**

This section endeavors to cover public sector accounting reforms in Nepal and Sri Lanka since the beginning of the 1960s and 1970s respectively. In doing so, the section demonstrates what types of accounting changes have been proposed in these two countries and the efforts undertaken to implement these accounting changes. This section starts with the case of Nepal, followed by describing accounting reforms in Sri Lanka.

## 4.1 The Case of Nepal

### *Initiation of Accounting Changes*

The cash basis accounting system was introduced and institutionalized in the government of Nepal in the 1960s. The UN and the USAID participated in this reform process and emphasized the importance of cash accounting to achieve greater control over budgetary allocations, especially those expenditures sponsored by donors and international organizations in the form of development grants and aid (Adhikari and Mellemevik, 2009). They offered the government both resources and expertise to conduct training to government officers and accountants, who were unacquainted with cash principles. More than 4000 government officials were given accounting knowledge during the 1960s making it possible to institutionalize the cash accounting system across the country (Donnalley, 1967).

Along with cash accounting, the UN and the USAID had also envisaged the importance of program and performance budgeting (hereafter, PPB). The PPB was in fact seen as a means of executing the development budget - largely consisting of foreign aid and grants. In the budget speech of 1969, the Prime Minister implicitly hinted at the government's plan to introduce the PPB system (Waldman, 1970). International organizations were assured that the projects included in the development budget would be examined closely in order to determine their economic feasibility and the benefits likely to accrue to the nation. Moreover, a commitment was formed with a view to strengthening the administrative and technical capacity of the concerned departments in implementing the development projects.

Nepal could not, however, execute the plan to introduce PPB as intended. Waldman (1970, p. 2), the USAID advisor appointed to help implement the PPB in the Ministry of Food and Agriculture, cited the implementation difficulties in the following way: "This new budgeting technique (PPB) was imposed upon an existing management and administrative system reflecting the traditional society's bureaucratic outlook characterized by an over-concern for propriety of expenditure." The implementation of PPB remained therefore largely ceremonial with no impacts on the selection and reporting of programs and projects.

### *The Emergence of Accrual Accounting Ideas*

Accounting and budgeting reforms embarked on in the 1970s were mainly intended to facilitate the implementation of PPB. At the outset, attempts were made to decentralize financial administration. The line ministries were empowered by being awarded delegated authority to disburse the allocated budgets to their subordinate agencies and

consolidate their budget reports. Moreover a new norm was enacted in 1981, i.e. 'procedures for operating government's incomes and expenditures' with a view to strengthening ongoing efforts towards financial decentralization. The norm resulted in the expansion of the services of the FCGO at regional level by establishing 'District Treasury and Controller Office (DTCO)', in all seventy-five districts.

Notably, the DTCO's, which functioned under the auspices of the FCGO, introduced a change in the existing financial hierarchy by establishing a link between the line ministries and the spending units in budgeting and reporting (Shrestha, 2000). They started to transfer allocated budgets to the district offices concerned, thereby limiting the role of ministries in the budget release process. Moreover, the offices introduced a trend of preparing consolidated district reports having carried out internal audits of all district accounts. All in all, the operation of the DTCOs envisaged improvements in budget implementation and control at distinct levels and created optimism for re-introduction of PPB (Sharma, 1996).

In 1985, this renewed focus on PPB resulted in the introduction of a new set of financial administration regulations, mandating all government agencies to evaluate and analyze the potential costs and benefits of each development project and program under consideration (Sharma, 1996). There were also concerns about changes in other important financial disciplines, for instance accounting and reporting, so as to ease the process of implementing PPB. The prevailing cash accounting was claimed to be inadequate in terms of identifying the full costs of development projects.

In 1987, a government accounting and auditing improvement project was set up by the Financial Comptroller General Office (FCGO, 1988). A main goal of the project was to initiate reforms in public finance in order to provide favorable conditions for the implementation of PPB (AGO, 1989). The team proposed a new accrual accounting manual comprising accounting codes, classifications, and formats and then submitted this to the government. In 1989, the government announced the launch of new accounting codes underpinning the accrual principle in some development projects. However, lack of resources, professional expertise, and technical competence forced the government to halt experimentation with the new accounting system after just a few months.

### *New Waves of Reforms*

Notably, the political change of 1990 provided the country with a fresh and candid impetus to initiate public finance reforms. Initially reforms in Nepal were very focused

on reinforcing budget implementation. The budget norms were revisited in order to enforce government entities to demonstrate the accounts and the goals achieved from previous spending. Despite these reform attempts, the country, however, witnessed by the end of the 1990s a large reduction in international grants and aid. The main reason was the country's failure to demonstrate improvements in resource mobilization and public service delivery. Notably, international organizations pinpointed two major weaknesses in Nepalese public finance (World Bank, 2002; Asian Development Bank, 2005). Firstly, selection of development projects was seen as rather 'donor driven' diverting from local requirements (NDF, 2004). Next, there was a lack of concentration on the results and outcomes of development projects and programs.

At the outset of the new century, a series of joint studies were conducted in cooperation with international organizations in areas such as public accountability and procurement administration to find and select the necessary public finance reform measures (Timoshenko and Adhikari, 2010). In 2002, as recommended by these studies, the government introduced a number of NPM techniques, including the medium-term expenditure framework (MTEF) and performance-oriented reporting. The implementation of the MTEF was considered important to estimate resources over the medium term, at least for three years, and allocate them in the prioritized projects and programs. Development programs and projects were included in the MTEF by categorizing them into three groups, i.e. priority 1 programs/projects, priority 2 programs/projects, and priority 3 projects/programs on accounts of their intended contributions to national development (NPC, 2002). This classification of projects and programs was meant to help the Ministry of Finance make estimates and ensure the provision of adequate expenditures for the accomplishment of the projects and programs in question. The introduction of performance-oriented reporting was seen as being important in order to demonstrate the results and achievements of those projects and programs incorporated in the MTEF.

In the field of accounting a major recommendation was to adopt accounting standards and develop a road map for a transition towards the accrual basis of accounting (World Bank, 2002). The main argument was that it would be difficult to ensure the effective implementation of the MTEF and performance-oriented reporting without improvements in accounting. In 2005, the government attempted to address accounting sector reform by formulating a high-level public expenditure committee consisting of government officials and professional accountants. The majority of the committee members were in favour of improving the performance of existing cash accounting, albeit there were significant pressures from professional accountants to shift away from

cash to accruals (Adhikari and Mellemlvik, 2008). However, consensus was reached between government officials and professional accountants, representing the Institute of Chartered Accountants and the Accounting Standards Board to advance the accounting reforms by introducing the cash basis IPSAS at the outset and moving towards the accrual basis in a step-by-step approach. The main idea was that the adoption of the cash basis standards would help the country to enhance its capacity and enable it to acquire resources to be able to surmount the implementation barriers of accruals gradually (ADB, 2005; IMF, 2007).

In 2007, the government authorized the Accounting Standard Board, an autonomous body to pronounce standards for enterprises, to develop Nepal Public Sector Accounting Standards in line with the cash basis IPSAS. Interestingly enough, the Board was asked to learn from the experience of Sri Lanka in developing and adopting the cash basis accounting standards. The World Bank (2007, p.5) recommended: "The government of Nepal could form a core team to make a study visit to Sri Lanka and then apply possible changes in the existing accounting system". In 2009, the Accounting Standards Board submitted the draft of Nepal public sector accounting standards corresponding to the cash basis IPSAS to the Ministry of Finance for approval (Adhikari and Mellemlvik, 2010b). The Board has clarified that it has used the Sri Lankan accounting system as a model while drafting the standards (Guragain, 2008). The Financial Comptroller General Office has been attempting to prepare the annual accounts for the fiscal year 2010/2011 in accordance with the cash basis Nepal public sector accounting standard corresponding to the cash basis IPSAS (Adhikari and Mellemlvik, 2010b).

## **4.2 The Case of Sri Lanka**

### *An Emphasis on Budgeting*

The power of Sri Lankan government was straddled between the United National Party (UNP) and the Sri Lanka Freedom Party (SLFP). A SLFP headed alliance enjoyed a two-thirds majority in the House of Representatives in 1970. In the first budget speech of this government, they emphasized the necessity of establishing a socialist society (Athukorala and Jayasuriya, 1994). A new Constitution was introduced in 1972 whilst presenting a five-year development plan to pursue a six percent annual economic growth from 1972 to 1976. Budget estimates for three ministries, i.e. education, health and finance were drafted in accordance to PPB in 1971 (see Treasury, 1971). The UN rendered technical support in this respect (see Dean, 1986). Sixteen more ministries embraced this budgeting model in 1973 (Treasury, 1972). The budget estimates for the whole country for the year 1974 were presented in accordance to PPB (Treasury, 1973; Kuruppu et al., 2010).

The standard terms in PPB were *Program, Project and Object*. Instead of these, Sri Lanka used *Vote, Sub-head and Items* respectively as prescribed in the parliamentary standing orders. In 1974, the parliamentary standing orders were amended to use the three standard words associated with PPB. A lecture series consisting of three sessions organized by the Institute of Chartered Accountants in the 1960s appeared to be a significant milestone in the country (see Dean, 1986). Articles published by Sri Lankan scholars have also extended their assistance to popularize the PPB approach (see Balakrishnan, 1973; Kuruppu, 2010).

The power of government shifted to the UNP in 1977, and a new Constitution was enacted in 1978. This government embarked on liberal economic reforms and the IMF granted financial assistance. Nevertheless budgeting or accounting reforms were not endeavored. In 1994, the SLFP led alliance obtained the power of government and did not oppose the market-oriented economic policy. A project to computerize accounting systems in ministries and departments was initiated in 1995 (Kuruppu, 2010). The ADB provided financial and technical assistance to implement this project. The ADB again sponsored a public expenditure management system project from 2000 to 2002 (see General Treasury, 2000). The purpose of this project was to improve planning and budgeting processes in the government. Computerization of public expenditure information system and Medium Term Expenditure Framework (MTEF) were a part of this project. Nevertheless, neither conventional cash-based accounting, inherited from the Britain nor the PPB approach was changed until the end of 2002.

#### *Professional Arguments for Accrual Basis*

Accounting and auditing professionals criticized the incompatibility of PPB and cash-based accounting from the 1980s. In 1980, the then Auditor General (henceforth AG) of the island expressed skepticism over the use of cash-based accounting together with PPB<sup>i</sup> (see Wijayasuriya, 1997a). Wijayasuriya was the AG from October, 1971 to May, 1983. His main argument was that cash accounting does not facilitate analysing inefficiency and wastages. He recommended adopting accrual accounting to the central government of Sri Lanka. This appeared to be the first occasion whereby the necessity of changing the basis for the central government accounting has been emphasised by a native (Kuruppu, 2010).

The IMF residential advisor to the Ministry of Finance, Thomas criticised the use of a cash-based accounting system with a focus on compliance and stewardship<sup>ii</sup> (see Thomas, 1998). The central government accounting system should rather be intent on generating accurate cost information. Nevertheless he also stated that accrual

accounting as used in the business sector is not appropriate to accomplish governments' expectations as governments would not wish to make profit. Accordingly, he proposed to adopt modified accrual accounting. ZBB and performance budgeting were also discussed. His discussion probably represents the first endeavour to bring the notion of modified accrual accounting up for discussions in the island (Kuruppu, 2010). Likewise, ZBB was presented as a futuristic budgeting technique by a chartered accountant working as a financial consultant (see Senanayake, 1998). Moreover, an administrative reform committee viewed ZBB as a budgeting approach not permitting administrators to add a margin to the existing budget and submit to Parliament, whilst seeking funds to meet expenditure in the ensuing year (see Kuruppu, 2010).

Wijayasuriya again argued in favour of adopting accrual accounting (see Wijayasuriya, 1997b). He emphasized the inability of cash basis accounting to contribute to economic development and the importance of designing accounts and financial statements to mirror a fair view of resource utilization in the government sector. Wijayasuriya further stated that accrual-based accounting would make PPB meaningful. A similar view was propagated by Sivagnanasuntharam (1997). The use of cash-based financial reporting by central governments would exhibit only a fragmentary list of cash receipts and disbursements. Activities of modern government are not simple and the impact from present financial commitments to the future is very broad. Cash-based accounting is no longer appropriate, he argued.

As described by an ADB consultant in Sri Lanka, substantial amounts of liabilities and assets were not included in the balance sheet prepared as per cash-based accounting (see Sivagnanasuntharam, 1998; ADB, 2002). Financial statements prepared in accordance with accrual accounting would avoid such deficiencies. A UN technical advisor to Sri Lanka also emphasised the importance of presenting financial statements in a comprehensible manner to ordinary people and media (Benett, 1998). In 2003, the necessity of using generally accepted accounting methods for governmental operations was discussed at a conference.<sup>iii</sup> It was also argued that the accounting system should pinpoint activities hindering the achievement of objectives of ministries and departments. The cash-based accounting system in the island appeared to be unable to do this task (see Kuruppu, 2010).

#### *Towards the Direction of IPSASs*

The UNP and its alliance came into power in December, 2001 with the budget deficit of the country standing at 141,102 million Rupees. Unemployment, a deepening budget deficit and the problem of declining foreign assets were amongst other issues

emphasised in the election campaign. Following their victory in the election, the UNP headed government initiated budgetary reforms. One of the ministers, Charitha Rathwatthe resigned from his ministerial position in order to become secretary to the Ministry of Finance. Using his administrative authority, all ministries, provincial councils, and departments and statutory boards were ordered to ensure rational allocation of public resources in accordance with zero-base budgeting (ZBB) from 2003.<sup>iv</sup>

An officer from the Sri Lankan accountants' service became the Director General (DG) of the State Accounts Department (SAD) from January, 2001 to the middle of 2005 (see General Treasury, 2001). A management training unit had been established within this department by July, 2001 to provide training to its administrative staff in addition to foreign training opportunities. Likewise, this department took initiatives to organize lectures for its staff on emerging themes. In 2003, the SAD prepared the consolidated financial statements of central government on the IPSAS cash basis as a partial shift to modified accrual accounting (see SAD, 2003). This can be seen as an endeavour to gain legitimacy from international financial institutions (see Kuruppu, 2010). The WB (2007) admired the country's financial statements for the year 2002 being in accordance with the IPSAS cash basis.

This afore mentioned endeavour represented the first effort to change the conventional format of preparing financial statements inherited from the country's colonial master, the Britain. Generally Accepted Accounting Principles (GAAPs) for the cash basis of accounting were also used to prepare financial statements (see SAD, 2003; 2004; 2005). The SAD stated that additional information about assets and liabilities, and domestic and foreign debts etc. are disclosed from 2003. The AG in his report, however, argued that such information forms an integral part of the financial statements of the government. And similar information was disclosed using the previous format (see SAD, 2003; 2004; 2005).

The MTEF was used from the beginning of 2004. The SLFP and its alliance came to power in November, 2004 and a civil servant was appointed to the post of secretary in the Ministry of Finance. He had completed a Bachelor Degree in economics at a Sri Lankan University and had obtained a Doctoral Degree from an American University in the field of development economics (Kuruppu, 2010). Similarly, a chartered accountant working in the department of AG became the Director General of SAD in the middle of 2005. The new secretary to the ministry endeavoured to prepare budget estimates in accordance with performance budgeting and the MTEF from 2006 (see National Budget Circular

120\2005). The ADB got involved in assisting the Treasury to determine performance measures.

The SAD provided a comprehensive overview of the financial position, financial performance, and cash inflows and outflows- including accounting policies as from 2006. Financial statements for the year of 2005 were prepared in compliance with GAAPs. And the guidance given in Sri Lanka Accounting Standards (SLASs) and IPSASs were also considered (see SAD, 2006; 2007; 2008). The WB (2007) acknowledged the disclosure of additional information and viewed the effort as a move towards accrual accounting. Information on moveable assets was disclosed in the notes to financial statements from 2007 (see SAD, 2007; 2008). The AG accepted that the SAD presents financial statements in accordance to SLASs and IPSASs (see SAD, 2006; 2007; 2008).

In 2009, The Public Sector Accounting Standards Committee (PSASC) of the Institute of Chartered Accountants presented its first exposure draft of Sri Lankan Public Sector Accounting Standards (SLPSASs) on the accrual basis of accounting. The President of the Institute of Chartered Accountants revealed that this institute had endeavoured to articulate SLPSASs in order to avoid losing its membership at the IFAC.<sup>v</sup> PSASC consists of representatives nominated by the Ministry of Finance and members of the Institute of Chartered Accountants. The current Chairman of the committee is the AG of the country. This committee drafted and presented four standards corresponding to IPSASs 1, 2, 3 and 5. Albeit this shows that the introduction of accrual accounting has now become a key reform item on the agenda in Sri Lanka, the committee admits that the government will decide when to produce financial statements in accordance with SLPSASs.

## **5 Discussion**

This study of public sector reforms in Nepal and Sri Lanka has demonstrated a number of interesting points - both similarities and differences. These two countries have initiated reforms at more or less the same period of time by following the similar ideas, namely the cash basis of accounting and PPB. Notably, the use of cash accounting and PPB in developing countries was the key financial reform agenda of the UN and the US in the 1950s and 60s (UN, 1965). This means that reform ideas in both countries seemed to be much influenced by the international trends of the time and international consultants were involved in disseminating reform ideas in both Nepal and Sri Lanka.

The empirical evidence shows that the adoption of PPB in Nepal and Sri Lanka was guided by different motives. The main concern in Nepal was to improve the

effectiveness of development budgets funded mainly by foreign grants and aid. On the other hand, the ambiguities involved in founding a socialist society had seemingly convinced Sri Lanka to embed PPB and to provide parliamentary legitimacy by amending the standing orders. Another striking difference between them was probably Nepal's failure and Sri Lanka's success in the introduction of the PPB model. The incorporation of the PPB format had proved unsuccessful in reflecting any significant changes in Nepalese public administration. PPB was attempted institutionalized in the existing administrative system - characterized by the traditional mentality of controlling cash, lack of knowledge and understanding of PPB techniques, and financial centralization (Waldman, 1970). It was in fact this failure to institutionalize PPB which provided the country with a fresh impetus for continuing public sector reforms. The public sector reforms embarked on in Nepal in the 1970s and 1980s were, therefore, mainly focused on creating a favourable environment for the re-introduction of PPB. On other hand, the technical support of the UN, the availability of trained bureaucrats, and the involvement of professional accountants contributed to the successful institutionalization of PPB in Sri Lanka. The country also introduced the standard terms and headings associated with PPB in order to make it locally adjustable. The PPB approach has been in practice in Sri Lanka until recently, except for a few years in the new millennium in which it was replaced by the zero-based budgeting model. The case of Sri Lanka exhibits that colonial experience led the country to inherit and develop knowledge, administrative structures, and professionalism that were crucial, not only for PPB but also for other sound budgeting and accounting techniques.

What is striking is that the ideas of accrual accounting appeared in these two South Asian countries at approximately the same period of time, namely at the end of the 1980s and for the same reasons, i.e. to introduce and implement the PPB. In fact, the IFAC had started discussing the need of accrual accounting for central government in the 1980s, making the accrual basis of accounting a global agenda (see e.g. IFAC, 1996). Indeed, donors and international organizations were influential in disseminating the accrual ideas in both countries. However, in the context of Sri Lanka, professional accountants and some bureaucrats were also involved in a discussion favouring the accrual concept. Many Sri Lankan accountants and bureaucrats were seemingly aware of the notion of accrual accounting compared to their Nepalese counterparts, as they had the opportunity to achieve education and training in accounting both within the country and in the UK during the colonial period. Indeed, the Nepalese bureaucrats were deprived of such education and training opportunities undermining their participation in the reform process. In the context of Nepal, we can only see the involvement of

bureaucrats and professional accountants in accounting reforms just recently, particularly when making decisions on the adoption of cash basis accounting.

The empirical evidence underlines the point that despite much talk about accrual accounting, budgetary reforms in fact took precedence over accounting changes in Nepal. Concerns regarding accounting changes were raised latter, particularly in the first few years of the new century, in order to sustain and improve the effectiveness of the newly introduced budgeting and reporting measures, mainly the MTEF and performance reporting. This also means that accounting changes had become more a supporting tool for sustaining the newly adopted budgeting and reporting measures. In contrast, the Sri Lankan case envisages that the country had placed more or less equal emphasis on budgeting and accounting reforms, particularly from 2003. As is the case of Nepal, increasing budget deficits had forced Sri Lanka to introduce budgetary techniques such as ZBB and the MTEF during the first few years of the new millennium. However, unlike Nepal, the state accounts department had also endeavoured to improve the functioning of its cash accounting by complying with the requirements laid down in the cash basis IPSAS. Moreover, the adoption of accrual accounting was emphasized in order to advance changes in the budgetary process. In this regard, accounting reforms in Sri Lanka appeared to be the fundamental infrastructure aiming to drive changes in the budgeting system.

This study of Nepal and Sri Lanka also demonstrates that both countries seem to have been persuaded, to varying extents, by the intended benefits of accrual accounting and IPSASs. As in the case of other countries (Connolly and Hyndman, 2011), accrual accounting has been envisaged in both the countries as a means of providing new and, arguably, comprehensive information for financial decision making and control. While Sri Lanka has already embarked on a move towards accruals by issuing the accrual basis standards corresponding to IPSASs, Nepal has considered the adoption of cash basis IPSAS as a mean of improving its ability to implement accruals in the future. The availability of a well-trained bureaucracy and accounting profession, and fundamental infrastructure necessary for introduction of accrual accounting (IFAC, 2003) are probably the reasons why Sri Lanka seems to be ahead of Nepal in initiating accrual accounting reforms.

All in all, the pattern of institutionalizing public sector accounting reforms in both countries reflects more similarities than differences. Representing the status of developing nations lacking necessary financial resources means that it is not easy for the policy makers in these two countries to defy the reform agenda propagated

internationally. It is evident from our findings that some of the reform ideas have been relinquished by both countries after a while because they were either harder to introduce or use than originally thought (for example PPB in the context of Nepal and ZBB in the case of Sri Lanka) or have been superseded by new ideas (for example, the cash basis of IPSAS in Nepal and performance budgeting in Sri Lanka). This development in Nepal and Sri Lanka is seemingly in line with the underlying ideas of new institutionalism emphasizing changes as a means of securing external legitimacy.

As stated previously, conditions of fiscal stress and resource dependency have often been cited as two primary factors giving rise to the potency of coercive pressures (Carpenter and Feroz, 2001). These two factors are likely to enforce organizations to accept the rules, practices, and structures considered legitimate by exogenous forces. In this regard, we cannot deny the presence of coercive pressures in facilitating accounting and budgeting changes in Nepal and Sri Lanka over time. We can argue that despite reform ideas more reflecting the characteristics of normative and mimetic pressures as they are evolved by means of education and recommendations and through consultancies and workshops, they have in fact acted more coercively in both countries. The ceremonial acceptance of many reform ideas such as PPB in the context of Nepal and zero-based budget in the case of Sri Lanka provides evidence that both countries have used these internationally disseminated ideas as a strategy for securing financial assistance from their funding agencies such as the WB, IMF and ADB.

Referring to institutional literature, two or more institutional pressures are likely to operate simultaneously, making it difficult to determine the potency of individual institutional pressure at one given time (DiMaggio and Powell, 1983; Mizuchi and Fein, 1999; Carpenter and Feroz, 2001). It is evident from our findings that the coercive and normative institutional pressures exerted by international organizations have been more influential in facilitating reforms in Nepal, whereas the case of Sri Lanka reflects more or less the interplay of all three forces. What is striking in comparing these two countries is perhaps the active presence of normative processes within Sri Lanka. Unlike Sri Lanka, the case of Nepal shows that the country has rarely experienced any pressure from professional accountants, bureaucrats, and other internal forces in proceeding public sector reforms until recently. The existence of a skilful and well-trained bureaucracy encouraging mimetic changes (see e.g. DiMaggio and Powell, 1983) has probably helped Sri Lanka embark on a move towards the accrual basis of accounting ahead of Nepal.

## **6 Conclusions**

The present paper has sought to explore the accounting and budget reforms in the public sectors of Nepal and Sri Lanka by examining the potent institutional forces at work. Our study demonstrates that the reforms in both countries have been much affected by overseas developments, reflecting the NPM and NPFM trends. In this regard, our study can be seen as an extension to previous research demonstrating the role of international organizations in the dissemination of public sector reform ideas, particularly accounting reforms, in developing countries (Annisette, 2004; Torres, 2004; Chan, 2005; Mimba *et al.*, 2007; Adhikari and Mellempvik, 2010).

Interestingly, reforms in Nepal seem to be mainly driven by two forms of institutional pressures exerted by international organizations: normative and coercive whereas, in Sri Lanka, the coercive form of changes emerge to some extent together with the normative and mimetic nature of reforms. In the context of Sri Lanka, normative pressures appear to have been exerted from wider sources, including both exogenous and endogenous forces. However, the mimetic nature of influence for changes is seemingly growing in the island. This provides a reasonable and convincing argument for why Sri Lanka seems to be ahead in initiating and implementing the public sector reforms, including accounting reforms - as compared to Nepal.

The issuance of accounting standards for government entities corresponding to the accrual basis of IPSASs means that Sri Lanka has already embarked on a move towards the accrual basis of accounting. This stands in sharp contrast to the Nepalese case lacking trained accountants and bureaucrats at government level. In fact, the ideas of accruals have brought about divided views in Nepal, leading the country to compromise on the cash basis IPSAS. However, it is worth mentioning that our analysis is limited, it being a case study of two South Asian countries. The results may therefore not necessarily reflect the scenario in other developing countries in Africa, Latin America, and Asia. The paper underlines the need of comparative studies between other developing countries, in order to further our understanding of how public sector reforms are being shaped in other similar contexts and the role of international organizations in public sector reforms.

## **7 Implications**

The NPM and NPFM paradigms increasingly impact on accounting and budgeting practices in the government sector. Nevertheless, scholars have expressed scepticism on this trend (Lapsley *et al.*, 2009). Our findings also point some interesting issues that policy makers and international institutions need to take into account whilst introducing

accrual accounting and rational budgeting approaches in developing countries. It is important to have well-trained and educated administrators in the public sector to import accounting and budgeting practices used by profit-oriented institutions. The dearth of this sort of administrators in Nepal has hindered most of its reform endeavours. As a result, our findings pinpoint that it is utmost essential to recruit professional accountants to the government sector before embarking on accounting and budgeting reforms. Similarly, the bureaucracy should be given opportunities to enhance their skills and knowledge by attending national and international training programmes in order to endure reforms successfully. Moreover, this study shows that reforms initiated in the absence of administrators' consent are likely to be failed or short lived. This appears to be a reason for the failure of PPB in Nepal and the deinstitutionalization of ZBB in Sri Lanka with the change of administrative leadership in the Treasury. Therefore, the involvement of administrators in reforms discussions and decision making has to be permitted so as to materialize reforms and to remain them effective even after the change of governing leaders.

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<sup>i</sup> The Inauguration Ceremony of IPFDA at Hotel Janaki in Sri Lanka, 28<sup>th</sup> to 31<sup>st</sup> March, 1980.

<sup>ii</sup> A Seminar on Budgetary Management and Expenditure Control at Sri Lanka Institute of Development Administration, 28<sup>th</sup> March, 1997.

<sup>iii</sup> IPFDA, "National Conference on Government Accounting", at Hotel Gladari in Sri Lanka, 23<sup>rd</sup> to 24<sup>th</sup> June, 2003.

<sup>iv</sup> National Budget Circular No. 97 issued on 11<sup>th</sup> March 2002.

<sup>v</sup> Workshop on Sri Lanka Public Sector Accounting Standards Exposure Drafts at Hotel Galadari in Colombo on 15<sup>th</sup> June 2009.

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## **V - Aquaculture and its environment**



## Chapter 13:

# Mariculture, present trends and future prospects for Sri Lanka

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**Abstract:** Over the past few decades mariculture, which is the managed cultivation of aquatic species in coastal waters, has become a growing industry worldwide and an increasingly prominent topic for discussion. An extensive literature review of published articles was carried out to assess global mariculture and its present trends, and to discuss various types of promising approaches that have been undertaken to overcome the problems associated with global mariculture. In addition, the development of mariculture in Sri Lanka was similarly reviewed as a case study. Though a few species of mollusks, crustaceans, fishes and seaweeds play a major role in global mariculture, mariculture production has continuously increased during the past few decades, and the industry accounted for 54% of the world aquaculture production in 2004. Disease, the major cause of economic loss in the mariculture industry, is being minimized through Best Management Practices (BMPs). Moreover, environmental impacts from the industry have been minimized either at the planning stage or during operations. In addition to the governing directives, a new concept, i.e. the creation of Marine Protected Areas (MPAs) adjacent to the mariculture installations, is being introduced to alleviate the pressure on wild biota. Organic mariculture is a modern trend in global mariculture, and integrated mariculture is supposed to lead the industry towards a sustainable future. The feasibility of offshore mariculture has already been established, and new technologies and research innovations have become vital factors in the further expansion of offshore mariculture. New innovations are constantly improving, and further mariculture development based on these improvements will be notably more

positive in the future, which will help to meet the ever increasing global demand. Accordingly, with such trends in global mariculture, there are indications that the Sri Lankan mariculture industry will take advantage of the expansion of coastal aquaculture, making use of the available technologies and innovations.

**Keywords:** mariculture, review, trends, mariculture commodities, sustainable future

## **1 Introduction**

The global seafood supply has doubled over the last three decades and is currently about 130 million tonnes per year (Jensen et al., 2007). Most natural sea stocks are being overexploited and many of them are close to reaching maximum sustainable yields and many others have already reached it (Fernandez-Pato, 1989). Since the mid 1990's, fish production from capture fisheries has been constant at about 90 million tons per year (Jensen et al., 2007) and the ability to obtain fish from capture fisheries have simply exceeded the capacity of marine ecosystems to provide them. World seafood demand is expected to increase to about 180 million tons within the next three decades, primarily due to growing world population and increased per capita consumption (Jensen et al., 2007). Therefore, there is a clear need for increased aquaculture production to meet global demand for seafood and to alleviate pressure on wild populations which have been diminished due to over fishing, pollution and habitat destruction. Mariculture is a type of aquaculture defined as the managed cultivation of aquatic species in coastal waters (Pillay, 1990). In a broad sense, mariculture includes the rearing of marine organisms for food and other products such as fish meal, culture media or nutrient agar, pharmaceuticals, jewelries (cultured pearls) and cosmetics, in a process in which at least one phase of growth is under the control of human beings, either in their natural environment or in sea water, ponds or raceways. Mariculture production worldwide is growing, and it seems that growth is set to continue. The need to increase production from mariculture is driving the industry towards more intensive practices and the inputs used and the degree of management practices vary greatly in different regions depending on the availability of resources and technology (Islam, 2005). Increased knowledge and development of new methods within marine biotechnology have resulted in important breakthroughs for the industry and further important advances within this sector will continue.

Mariculture is a significant socio-economic activity, especially for rural communities, contributing to livelihoods, food security and poverty alleviation through income generation, employment, services, use of local resources and diversified farming

practices. However, mariculture on an industrial scale may pose several threats to marine and coastal biological diversity due to, for example, wide scale destruction and degradation of natural habitats, nutrients and antibiotics in marine wastes, intentional or un-intentional releases of alien or living modified organisms resulting from modern biotechnology, transmission of disease to wild stocks and displacement of local and indigenous communities. In addition, one of the major environmental issues in the 19th century is the discharge of nutrient rich water from land-based aquaculture systems to coastal waters (Jagatheesan et al., 2006). Several studies have shown that increased nutrients affect phytoplankton, zooplankton and bacterial communities (Chopin et al., 2001), macro algal growth and diversity, epiphyte diversity (Chopin et al., 1999), benthic fauna (Nunes and Parsons, 1998) and fish mortality (Jones et al., 1982; Croomey et al., 2000; Brooks et al., 2002). Impacts to wild biota and environment in present mariculture is being minimized by introducing new concepts and techniques such as marine protected areas (MPAs), integrated mariculture, organic mariculture and re-circulatory aquaculture systems (RAS), and by governing the industry through national and international conventions (Read and Fernandes, 2003). To ensure the health and enhance the good quality production in future, several approaches are currently applied and being introduced (Lotz, 1997; Pruder, 2004). Applying BMPs at least to a certain limit to overwhelm the consequences for marine ecosystems, the global mariculture industry has achieved a significant growth in past decades (FAO, 2007) and become an increasingly prominent topic for discussion. In addition, all technical and research innovations are being used to develop the industry to ensure growing demand, as seafood is the only alternative that can be produced on a large scale to face the challenges of the 21st century (Nammalwar, 1997). The purpose of this article is to provide a concise, rather than comprehensive overview of global mariculture and a discussion of what kinds of promising approaches to be undertaken, that may help in overcoming problems associated with global mariculture. Special attention is paid to discuss the present trends in the mariculture industry in Sri Lanka.

## **2 The historical Development**

The history of mariculture goes back over 4 millennia in time. In ancient Rome, grey mullet were cultivated in coastal marine lagoons. It is also known that about 4000 years ago, the people of China grew fish in shallow water ponds artificially separated from the sea (FAO, 2006), and Chinese oyster farming was recorded as early as the Han dynasty, 206 B.C. – 220 A.D. (Hishamunda and Subasinghe, 2003). Mariculture on plant commodities in China has gone back to about 1000 years ago, cultivating seaweed called glue weed, *Gloiopeltis furcata* (Tseng, 1993). About 300 years ago, red algae *Prophyra* locally called “nori” has been farmed in Tokyo bay (Korringa, 1976). Other examples of

early mariculture practices include the Japanese culturing oysters for pearls; the Greeks and Romans rearing eels and the Europeans cultivating oysters (Bondad-Reantaso et al., 2005). The long term experience of mariculture was held by Japan, China, France, Italy, Norway and United Kingdom (FAO, 2006). Mariculture highly developed over the past 3 decades and aquaculture including mariculture has seen a worldwide expansion over the past 20 years (Naylor et al., 2000).

### **3 The importance of Mariculture products**

Mariculture products are directly used for human consumption. They may be eaten fresh, frozen, canned or preserved or as food additives. Consumption of fish and shellfish give several advantages: (a) low in calories, (b) excellent source of protein, (c) low in fat, (d) source of polyunsaturated fatty acids and (e) source of minerals and vitamins (Ayub et al., 2006). Consumption of omega-3 fatty acid from seafood products have been shown to prevent or ameliorate certain types of diseases such as coronary heart disease and stroke, autoimmune disorders, cancers of colon, prostate and breasts, hypertension and rheumatoid arthritis (Flick, 2004). In addition to population growth, domestic sea food consumption is expected to continuously increase in the future, due to greater emphasize on eating sea food as part of a healthy diet. It has, therefore, been estimated that the U.S. seafood market alone will require an additional 1.8 million Mt of sea food by 2020 (MATF, 2007). Fish and other mariculture organisms are used to prepare fish meals and oil sources for medical and cosmetic industries. Sponge aquaculture is also still the most reliable and least expensive option available for the production of sponge biomass to provide metabolites (Duckworth et al., 1997; Munro et al., 1999; Duckworth, 2001). Sponges have been known as a marine source for obtaining materials with great curative potential (Pronzato et al., 2000), and recognized as the source of numerous bioactive compounds with pharmaceutical potential (Garson, 1994; Munro et al., 1994). Extracted compounds have shown anticancer, anti-inflammatory, antibacterial and antiviral properties (Faulkner, 2001; Mayer and Hamann, 2002; Proksch et al., 2002). Compounds from *Dysidea avara* are discussed as an anti-HIV agent (Faulkner, 2001). Seaweeds form a very important part of the human diet in Japan, China and other Asian countries, providing proteins, vitamins and other minerals. Moreover, many areas of the world use seaweed biomass as animal fodder, fertilizer or as an energy source, rather than for human consumption (Gellenbeck and Chapman, 1983). The products from mucilages and chemical constituents of algal cell wall are widely used. These polysaccharides: phycocolloids such as agars, carrageenans from red algae and alginates from brown algae are commercially very important (Gellenbeck and Chapman, 1983). Agars extracted from *Gelidium* are used mainly in microbiology, while *Gracilaria* agars are used in foods. Carrageenans are widely used as

thickeners in dairy products, while alginates serves as thickening agent in products ranging from salad dressing to coating in paper manufacture. Seaweeds are used to prepare food additives, rubber /textile products, adhesives and pharmaceuticals and for industrial uses. Some other products are; seaweed based air freshener (Seamoy), fruit-flavoured candy-gel (fruit cubes), pastilles (Euginto), menthol ointment (Ginhawn), seaweed based fertilizers and liquid soap/ shampoo. In addition to food value and such products presently being produced, future research findings revealing the importance of derivatives from marine commodities will trigger future mariculture towards a more diversified industry to reach future demand.

#### **4 Geographical distribution of mariculture activities**

Global mariculture activities are not evenly distributed. Bulk of the tropical mariculture activities are concentrated along the tropical belt of South and South-East Asian nations, in the Indian and Pacific oceans and along the Pacific coast of the South American continent. On the other hand, very little or no mariculture activities are conducted along the coastal belt of the African continent (De Silva, 1998). Development of mariculture in South American countries such as Ecuador and Peru has been observed recently (De Silva, 1998). However, better developed mariculture industries have been found in North America (USA and Canada), in countries of European Union and in Mediterranean countries. For instance, Atlantic salmon in Scotland, Norway and Ireland; sea bass and seabream (*Sparus aurata*) in the Mediterranean and mussels (*Mytilus edulis*) in Ireland, Spain and France (Read and Fernandes, 2003). Traditionally, seaweed culture has been confined to subtropics or temperate inshore waters of countries in which sea weeds is part of the regular cuisine, such as Japan and Korea. Increasing world demand by the colloid industries for alginates and carrageenans and the development of their processing technology have also triggered the expansion of seaweed culture into tropical waters such as the Philippines, Indonesia and Ecuador, in the past 15 years or so (De Silva, 1998).

#### **5 Mariculture operations**

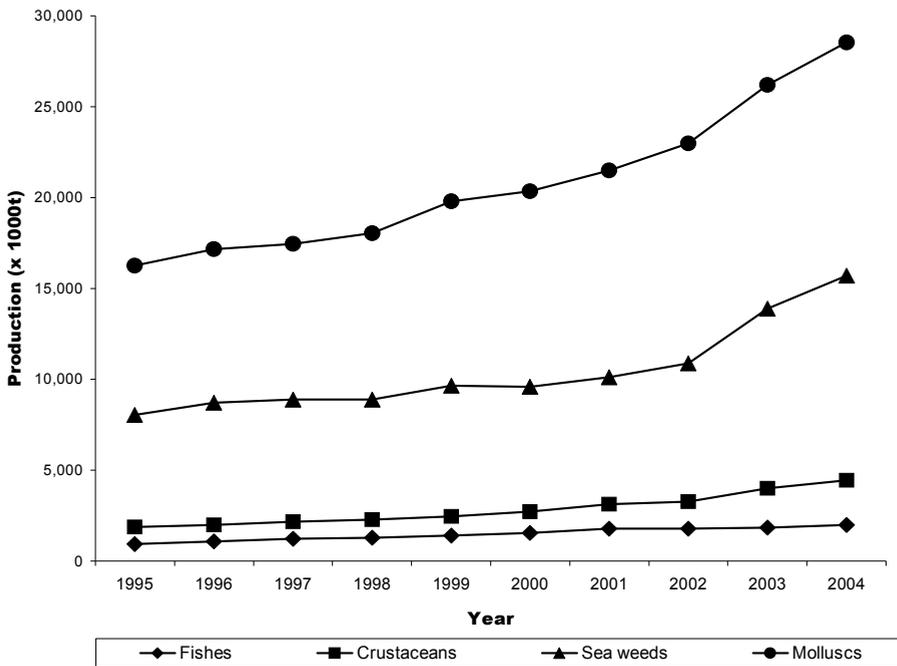
Modern mariculture operations comprises of small scale backyard ponds and hatcheries to large scale commercial operations. Also, management varies from family level to cooperate ownerships (Bondad-Reantaso et al., 2005). In finfish and shellfish mariculture operations, four main types of structures: floating cages, net enclosures, earthen ponds and constant water circulation systems are in popular use at present. Floating cages are used for culture purposes in open oceans or large sheltered bays where other structures are not practicable. Net enclosures barricading off large areas of sheltered bays are being tried on a commercial scale in some countries. Supplementary

feeding which require higher running cost, in addition to the capital outlay is essential to floating cages and net enclosures. Earthen ponds are widely used in developing countries in the East where tidal range is adequate to impound the pond. On the contrary, constant water circulatory units and large cement structures require continuous pumping of water in large quantities. This system requires high capital outlay, and is popular in some developed countries where a high price can be obtained from the end product (Sivalingam, 1981). Mariculture practices in tropics mainly take place on land-based ponds, which draw sea water through natural inlet canals and in shallow bays (De Silva, 1998; Clarke and Beveridge, 1989). For the above operations, three main methods: extensive, semi intensive and intensive culture methods are being practiced. Extensive mariculture involves the farming of finfish or shell fish in natural habitats with no supplementary food added. In semi intensive systems, fertilizers (organic or inorganic) are added to increase the primary production within the pond, and in turn increase the harvest. Intensive farming of marine finfish, commonly practiced in cages/pens or ponds, involves the supply of high quality artificial food and medication. Intensive larviculture of marine fish in South-East Asia is done in concrete or canvas tanks (Pechmanee, 1997; Duray et al., 1997). Finfish mariculture have become more intensive over the last 15 years due mainly to the introduction of new technologies, improvement of feed technology, improved understanding of biology of the farmed species and increased demand (DeVoe, 1994). Commercially, modern mariculture is usually practiced as large monocultures (Troell et al., 2003). Global molluscan culture is being conducted as bottom, pole, rack, raft or long line culture systems (Bondad-Reantaso et al., 2005). Two basic types of mariculture systems have been operated in seaweed culture. That is, semi closed systems where tanks or ponds are used as culture vessels and open ocean systems where structures are placed in coastal waters to anchor the algae. Presently, open ocean systems are most successful and are operating in Japan and China for growth of algae for human consumption (Gellenbeck and Chapman, 1983). The most inexpensive design would be one using naturally occurring embayment and areas of relatively calm water that are easily accessible to workers and machinery (Gellenbeck and Chapman, 1983). But, due to the high demand and lack of this type of coastal area, present sea weed culture is being forced to the open ocean systems. The water current and storm conditions of open ocean waters requires quite sturdy and consequently expensive equipment. Most promising system in modern mariculture, especially in developed countries is the Recirculatory Aquaculture System (RAS) that has a bio-filter (Gutierrez-Wing and Malone, 2006). It is playing an important role in the production of healthy, properly sized fingerlings for stock out in net-pens or ponds (Fielder and Allan, 1997) and in ornamental mariculture. Studies have confirmed that better food conversions are

achievable with RAS which means less wastes are generated by feed (Lorosordo et al., 1998). RAS has, therefore, been identified as one of the main research areas in aquaculture, and one of the proposed areas for the European Union (Martin, 2002).

## 6 Main Organismic groups in Mariculture and global production characteristics

The four basic commodity groups, commercially cultured in global mariculture with production of one million tonnes or more in 2004, the latest year for FAO statistics made available are seaweeds (red algae and brown algae), mollusks (oysters, mussels, scallops, pectons, clams, cockles and arkshells), crustaceans (shrimps and prawns) and fin fishes (salmons, trouts and smelts), and they alone contributed 88.6% for total mariculture production (FAO, 2007). According to FAO statistics, the global mariculture production of the aforementioned commodity groups and their increasing trend over the past decade are illustrated in figure 13.1.



**Figure 13.1** World mariculture commodity groups and their production from 1996 to 2004.

The production data over the past 10 years clearly shows the development of mariculture practices with increasing global demand. Of the world faunal mariculture commodities, a higher production has been achieved through giant pacific oyster

(*Crassostrea gigas*) and pacific oyster (*Carassius carassius*) in 2004, while the highest market price has been obtained for shrimp, *Penaeus vannamei* that comes to the third position in production rather than high productive two species of oysters (FAO, 2007). The top ten faunal species in production and total revenue obtained from them are summarized in table 13.1. Marine finfish culture is dominated by Atlantic salmon (*Salmo salar*) lead by Norway, then Chile, United Kingdom, Canada and Ireland. Other economically important marine fish are gilthead seabream (*Sparus aurata*), sea bass (*Dicentrarchus labrax*) and turbot (*Scophthalmus maximus*) in countries such as Greece, Italy, France, Spain, and Portugal, and yellowtail (*Serola quinqueradiata*), ayu (*Plecoglossus altivelis*), flounder (*Paralichthys olivaceus*) and seabream (*Pagrus major*) in Japan (Toranzo et al., 2005).

**Table 13.1** Top ten faunal mariculture producers and their revenues in 2004. The percentage contribution of each species to global mariculture production and revenue are in parenthesis (Source: FAO, 2007).

Commodity group	Species	Production (tons)	Revenue (US\$' 000)
Molluscs (Oyster)	<i>Crassostrea gigas</i> (Giant pacific oyster)	4429337 (13.8%)	2693147 (7.5%)
Molluscs (Oyster)	<i>Carassius carassius</i> (Pacific oyster)	1949758 (6.1%)	1371772 (3.8%)
Crustacean (Shrimp)	<i>Penaeus vannamei</i> (Western white shrimp)	1386382 (4.3%)	4899457 (13.7%)
Fish	<i>Salmo salar</i> (Salmon)	1244637 (3.9%)	4085052 (11.5%)
Molluscs (Scallop)	<i>Patinopecten yessoensis</i> (Yesso scallop)	1126159 (3.5%)	1418302 (4.0%)
Crustacean (Shrimp)	<i>Penaeus monodon</i> (Giant tiger prawn)	721793 (2.2%)	3376178 (9.5%)
Molluscs (Clam)	<i>Sinonovacula constricta</i> (Razor Clam)	676391 (2.1%)	507491 (1.4%)
Molluscs (Mussel)	<i>Mytilus edulis</i> (Common mussel)	526987 (1.6%)	422698 (1.2%)
Molluscs (Cockle)	<i>Anadara granosa</i> (Blood cockle)	474239 (1.5%)	434694 (1.2%)
Molluscs (Mussel)	<i>Perna viridis</i> (Green mussel)	322234 (1.0%)	24944 (0.1%)

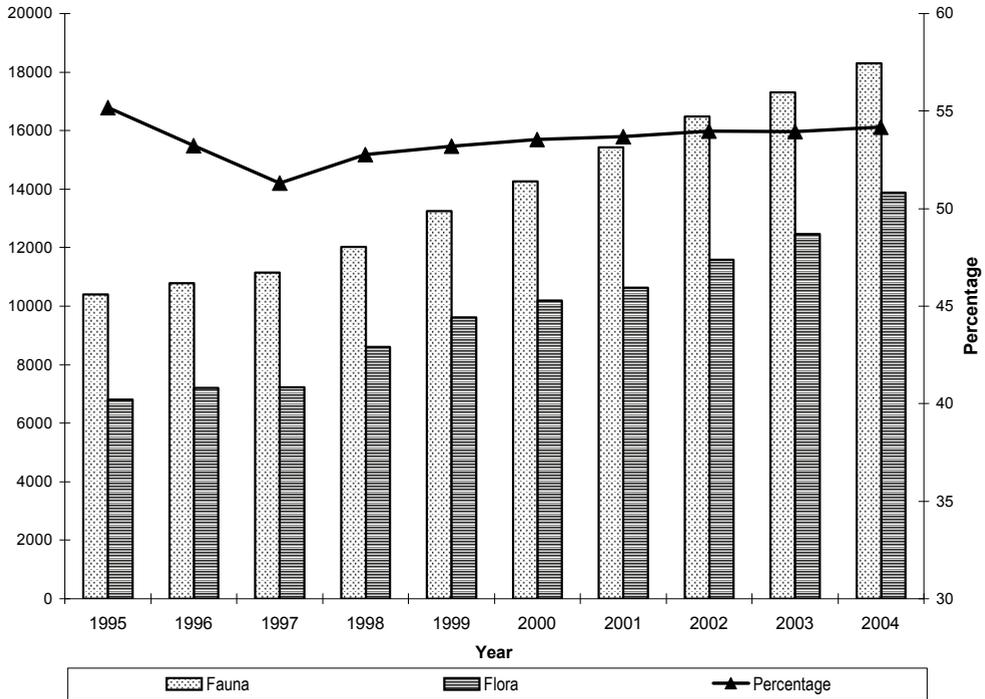
\* The other mariculture species not listed here are less than 200000 tonnes in production

Demand for seaweeds has increased due to its food value and its usage for different products. In addition, the demand for sea weed products primarily from the growing food processing industry has been increasing steadily over the years. Of the seaweeds,

brown seaweed and red seaweed have given the highest production in 2004 (values: 7194316t and 4067028t, respectively) and valued at 16% of total mariculture earnings (FAO, 2007). The species contributing to higher seaweed production are mainly a red algae, *Prophyra* marketed as nori and brown algae mostly *Laminaria* marketed as kombu, wakame etc. (Gellenbeck and Chapman, 1983). Besides *Laminaria* and *Porphyra*, several other seaweeds such as brown algae: *Undaria pinnatifida* and *Hizikia fusiformis*; red algae: *Gloiopeltis furcata*, *Gracilaria* sp, *Eucheuma gelatinae* and *Gelidium amansii* have been cultured. In recent years, two micro algae: *Dunaliella salina* (green algae) and *Spirulina platensis* (blue green algae) have been cultivated (Tseng, 1993). Seaweed culture is considered as causing least environmental degradation, leading to most acceptable to community groups of diverse interest and views. Moreover, it offers other advantages to small scale farmers in initial processes and in harvesting where post harvest losses are negligible (De Silva, 1998). All mariculture production over the world have been achieved by culturing a few species. Due to increasing demand and market value for marine commodities, scientists have been introducing new species to acquire higher production. A likely trend in future marine aquaculture, whether it is in near shore or offshore waters, will be a diversification in cultured species (MATF, 2007). Salmon is still playing a major role in finfish mariculture industry, and research is already underway on several other species, including cod, halibut, cobia, snapper, pompano and tuna (MATF, 2007). Several new varieties of species have already been introduced and researches using modern technology are being carried out to introduce new species. However, to increase accessibility of seafood to economically depressed people, aquaculture development must be based on relevant species, choices and sound technologies more relevant to developing countries (Naylor et al., 2000; Williams et al., 2000; Hambrey et al., 2001).

Global mariculture production in 2004 was estimated to 32,183,140 t, worth an estimated thousand US\$ 35,682,194. In terms of monetary values (FAO, 2007), contribution from the mariculture industry to world aquaculture has increased over the years, and its contribution has oscillated between 51% and 55% during 1995 to 2004 (FAO, 2007). Of the total mariculture production in 2004, mariculture floral commodities have given 13,882,177 t, while faunal commodities have given a production of 18,300,963 t. Both figures show an increasing trend over the past decades (FAO, 2007). The total mariculture production of faunal and floral commodities and their overall contribution to the world aquaculture from 1995 to 2004 are depicted in figure 13.2. These continuous increasing trends in mariculture is due mainly to most countries have increased mariculture dramatically in recent years and even some East African countries have initiated their mariculture activities in the recent past. These overall trends have

been enhanced by declines in capture fisheries and an increase in public demand for cultured finfish and shellfishes (Fernandes et al., 2000), due to the fact that mariculture production in 2004 accounted for 54% of world aquaculture production (FAO, 2007).



**Figure 13.2** World mariculture productions of floral and faunal commodities, together with percentage contribution of mariculture to global aquaculture production, from 1995 to 2004.

## 7 Threat to mariculture

The greatest threat to world mariculture is pathogenic diseases which cause significant economic losses to the industry. For instance, in Ecuador alone, white spot syndrome virus (WSSV) was responsible for an estimated 53% decline in shrimp production from 1998 to 2000, resulting in a loss of US\$ 516 millions export revenue (Rosenberry, 2000). The clearest way to ensure the continuous growth of mariculture is the control and eradication of pathogens from the industry. Therefore, good management practices are often being used to keep disease under control and reduce the loss. Provision of high quality feeds, effective stocking density, avoidance of stresses, careful handling, proper monitoring and employment of well-trained personal are the primary precautions commonly used in mariculture operations to ensure good health. Studies conducted

using fish, oysters and shrimp have proven that the use of probiotics in hatchery and grow out facilities is beneficial in helping to maintain a healthy environment (Browdy, 1998; Moriarty, 1998). Several commercial probiotics products are currently used in mariculture to treat the culture water prior to and during stocking. In addition, ozone applications have been extensively used as a means of disinfection and general disease control in relatively small hatchery systems and experimental intensive fish production systems (Schoor, 2003). As a biological control agent, cleaner wrasse (Labridae sp.) is being stocked with commercially farmed salmon to reduce the fish lice (Tully et al., 1996; Treasurer, 2002; Wall, 2005). Disinfectants, antifoulants and veterinary medicines are presently used to control external and internal parasites or microbial infections in European mariculture. Medicines include antibiotics, anaesthetics, ectoparasiticides, endoparasiticides and vaccines (Costello et al., 2001). To overcome the disease hazard; specific pathogen free and genetically improved stocks, biosecure systems including enclosed, reduced water exchange and increased water re-used culture systems, biosecure management practices, and co-operative industry wide disease control strategies have been employed in mariculture industries throughout the world to resume the growth in production in future (Lotz, 1997).

## **8 Problems of scale**

Recent intensified mariculture operations have placed tremendous pressure on wild fauna of coastal systems. In one aspect, the conversion of coastal ecosystems to aquaculture ponds destroys nursery areas that support ocean fisheries (Naylor et al., 1998). On the other hand, marine ornamental fish farms and many mariculture farms in Asia stock wild-caught juveniles rather than hatchery reared post larvae derived from brood stock (Primavera, 2006). Million tonnes of small pelagic fish each year are used to make fish food. In addition, accidental escapes and even purposeful releases create “biological pollution” with irreversible and unpredictable ecological impact (Naylor et al., 2001). Aquaculture structures mimic the natural floating objects which are used as natural habitats by over 300 species of fish, jellyfish and seaweeds over the world (Castro et al., 2002) and are highly attractive habitats for many species of wild fish (Dempster et al., 2004). Several authors (Dempster et al., 2002 and 2004; Thetmeyer et al., 2003; Boyra et al., 2004; Tuya et al., 2006; Carss, 1990; Bjordal and Skar, 1992; Brehmer et al., 2003) have observed these widespread phenomena across the globe. Likewise, mussel farms also aggregate wild fish (Brehmer et al., 2003). These aggregated wild fish fauna attract the commercially important higher predators such as large pelagic fish, rays and dolphins to fish farms (Dempster et al., 2002; 2005; Boyra et al., 2004), therefore, subjecting them to heavy fishing pressure (Dempster et al., 2006). In response to this impact on wild fauna, several efforts have been undertaken to minimize the

impacts. The development of marine ornamental fish aquaculture is an area of much research interest. Techniques for farming sea horses, ornamental shrimps and a wide variety of coral reef fishes are under development and should offer a potentially lucrative and more environmentally sound alternative to wild-caught marine aquarium species in the near future (MATF, 2007). In addition, high values associated with fingerlings and marine ornamentals will also promote the adoption of RAS. Also, research is being conducted to develop non-living alternatives to phytoplankton and zooplankton feeds used in mariculture hatcheries (Wikfors, 2004). Prohibiting fishing around coastal aquaculture sites worldwide will protect many thousand tons of adult spawning stock of wild fish vulnerable to fishing (Dempster et al., 2006). Furthermore, creating Marine Protected Areas (MPAs) around coastal aquaculture installations is a recent concept to conserve habitat and biodiversity (Dempster et al., 2002 & 2005).

Negative impacts of mariculture on the environment are widespread. The potential impacts are wide-ranging from aesthetic aspects to direct pollution problems. Marine aquaculture operations and associated infrastructure can impact on scenic rural areas (Read and Fernandes, 2003). Environmental impacts of mariculture are mainly caused by releasing chemicals, antibiotics & waste; habitat modification through making space for farms; and building up of nutrient and sediment beneath farms. The quality and quantity of waste from aquaculture depends mainly on culture system characteristics, cultivated species, feed quality and management (Iwama, 1991). Therefore, environmental impacts depend very much on species, culture method, stocking density, feed type, hydrography of the site and husbandry practices (Wu, 1995). Different species release wastes of different quality and quantity, but generally most of the nutrients added through feed are released to the environment. For instance, 70-75% of nitrogen and phosphorous nutrient given with feed for Salmon and 77-94% of those for shrimps are released to the environment (Troell et al., 2003). In general, some 85% of phosphorous, 80-88% of carbon and 52-95% nitrogen input into marine fish culture as feed may be lost into environment through feed wastage, fish excretion, feces production and respiration (Wu, 1995). Several authors (Jones et al., 1982; Croomey et al., 2000; Brooks et al., 2002) have confirmed that excessive nitrogen caused by marine fish farming activities leads to eutrophication of the ecosystem and mortality to fish. Coastal ecosystems have the ability to reduce the waste to certain extent. Several authors (Dempster et al., 2005; Vita et al., 2004) have shown that the aggregated fishes near fish farms reduced the impacts of farms on the sea bed by eating food lost from the cages, thereby reducing 80% of waste. However, this natural purification has a limit and cannot exceed the maximum capacity of the environment. Therefore, in response to the environmental impacts from modern mariculture operations, several measures have to be taken to

minimize the problems to the environment. Keeping stocking density and pollution loading under carrying capacity of water, marine fish culture have become a sustainable industry (Wu, 1995). Feed wastage have been reduced by increasing the stability and reducing the sinking rate of feed and providing the fish with an optimal size of feed at different stages of development (Wu, 1995). The environmental impact of mariculture within the European Union (EU) are regulated and managed by various European Commissions (EC) Directives and international conventions. International conventions directly relevant to the environmental impacts of aquaculture are OSPAR Convention for the protection of the marine environment of the North East Atlantic, the Helsinki Convention (HELCOM) for the protection of the marine environment of the Baltic Sea area and the Barcelona Convention for the protection of the Mediterranean Sea against pollution (Read and Fernandes, 2003).

To ensure the increase of mariculture from the present status, different techniques are used to minimize the nutrients loading from mariculture systems to coastal ecosystems. One presently used technique is harvesting the pollution by clearing (extracting) organisms known as integrated mariculture. Most studies have confirmed that discharge from land based and open water fish and shrimp culture operations are suitable for intensive production of seaweed, thereby reducing the environmental impacts derived from the high load of nutrients contained in their effluents (Santos, 2006). The rapid expansion of intensive mariculture systems and the concern for negative effects on the environment from such practices have, during the 1990's, renewed and increased research into the development of seaweed based integrated techniques (Troell et al., 1997; Neori and Shpigel, 1999; Jimenez del Rio et al., 1996). Resultant seaweed biomass regarded as a by-product can be used for direct consumption (human or animal) or for the extraction of phycocolloids. Additional arrangements for integrated mariculture include possible increased income, social benefits and diversified productions (Buschmann et al., 1996; Troell et al., 1997). Therefore, integrating seaweed cultivation systems into fish or shrimp farms is likely to be one of the most cost effective and sustainable solutions available to producers (Santos, 2006). Neori and others (2000) conclude that these nutrient rich-scavenging systems are bound to play a major role in the sustainable growth of aquaculture. On a global scale, mariculture of extractive organisms already removes a significant fraction of nutrient from the world ocean (Troell et al., 2003). Until present, most commonly used biofilters are green seaweeds, genus *Ulva*, and red seaweed, *Gracilaria* (Santos, 2006). The present goal of researchers is to test and develop high-value seaweed biofilters and to improve tank culture success for established seaweed species to reduce the undesirable effect of intensive fish mariculture (Santos, 2006). Therefore, present studies on integrated seaweed

mariculture mainly focused on tank cultures (mainly fish based systems), pond cultures (fish and shrimp based systems) and open water systems (mainly fish systems). Several studies in open systems, focusing seaweeds (Troell et al., 1997; Chopin et al., 1999) and bivalves (Troell and Norberg, 1998; Taylor et al., 1992; Stirling and Okumus, 1995) as biofilters, have been conducted. In addition to the seaweeds, though small-scale and family based operations, mangrove friendly aquaculture technology are adopted in mangrove conservation and restoration sites in Vietnam. At present day, similar integration is being practiced in the traditional *gei wai* ponds in Hong Kong, *aquasilviculture* in Philippines, and *silvofisheries* in Indonesia (Primavera, 2006). Future mariculture technologies could attain sustainability by integrating waste generation (feed) and cleaning (extractive) organisms in each form. Genetic engineering and selection of nitrifying and denitrifying bacteria are suggested as contributing significantly to enclosed, recirculating marine culture system in the future (Lyndon, 1999).

## **9 Present trends and future prospects**

Present conventional farming relies on high stocking density, antibiotics, fertilizers, exotic and even genetically modified species and so on, leading to a destruction of the natural balance of the coastal ecosystems. Today an ever increasing number of people in European countries, especially Germany, are looking to avoid additives and are taking an interest in “natural” products with traceable ingredients. In response to the negative environmental and social consequences of modern farming methods, organic farming systems have been initiated. Organic certification is a process of claim; hence organic standards regulate the practices and material used to produce the product (Brisler and Kapuscinski, 2000). Since the early 1990’s the retail market for organic farming in developed countries has grown about 20% annually, due to increasing consumer demand. Due to absence of regional/ international standards for organic farming, individual member states and private/ non-governmental certifying agents developed and set their own specific organic aquaculture standards and accreditation bodies. To address these issues, the International Federation of Organic Agriculture Movements (IFOAM) drafted basic Standards for Organic Aquaculture Production (Scialabba and Hattam, 2002). A pioneering private certifying body actively engaged in the promotion and development of organic aquaculture in Europe and globally is Naturland which is a non profit association of organic farmers based in Germany that had been formulating standards for organic aquaculture since 1996 (Scialabba and Hattam, 2002), and had begun to work in developing nations to develop organic aquaculture as a viable economic alternative (Global Envision, 2004). As farmed shrimps represent the single most valuable internationally traded aquaculture commodity worldwide, Naturland initiated their pilot project for organic shrimp farm in Ecuador, and since then other

countries have shown interest for organic farming (Scialabba and Hattam, 2002; Cuoco, 2005). As of May 2004, 6 certified farms, 4 packing plants and laboratories where larvae are raised by organic methods are in existence (Cuoco, 2005). A recent study commissioned by the Seafood Choices Alliance, in partnership with Global Environmental Conservation Organization (WWF), Greenpeace, the Marine Conservation Society (UK) and the North Sea foundation (The Netherlands) reveals that 86% of consumers would prefer to buy seafood labeled as environmentally responsible (WWF, 2007). Due to high demand and market in developed countries and in Europe, certain numbers of conventional farms over the world, especially in developing countries, have been converting into organic farms. For instance, In January, 2007, Indian Marine Product Export Development Authority (MPEDA) signed a memorandum of understanding with the Swiss Import Promotion Program (SIPPO) for aid in the certification and marketing of organic farmed shrimp (SNI, 2007). European seafood professionals say that organic farming is good for the ocean, good for business, and good for consumers (WWF, 2007). Since 1998, organic food sales across Europe have doubled (Global Envision, 2004), and organic aquaculture and agriculture are the two fastest growing sectors in American agriculture today (Brister and Kapuscinski, 2000). Consumers in Italy, Spain, Germany, the United Kingdom and France spent a total of US\$ 9.6 billion on organic food. In Germany alone, the organic market has reached US\$ 3.8 billion, more than France and the United Kingdom (Global Envision, 2004). Although no official statistical data are available concerning the global production of certified organic aquaculture products, it is estimated that total production in 2000 was only about 5000 Mt., primarily from European countries. This modest quantity represent about 0.01% of global aquaculture production or about 0.25% total European aquaculture production (Scialabba and Hattam, 2002). Little or no production data is available for countries outside Europe. New Zealand is the largest producer outside Europe. Non European countries which are actively trying to develop their organic aquaculture production industries using national or private standards include Canada (salmonids), Chile (salmonids), Ecuador (shrimp), Indonesia (shrimp), New Zealand (mussel), Peru (shrimp), Vietnam (shrimp), the United States (non-species specific) and Australia (Scialabba and Hattam, 2002). Based on current estimates of certified organic aquaculture production and an anticipated compound annual growth rate of 30% from 2001 to 2010, 20% from 2011 to 2020, and 10% from 2021 to 2030, it is estimated that production will increase 240 fold from 5000 t to 120,000 t by 2030 (Scialabba and Hattam, 2002). The organic aquaculture sector can successfully co-exist with other food production sectors, such as organic food and nutrient resources. Therefore, the present trends in organic mariculture have long term prospects. Growing awareness concerning environmental pollution and safety of aquatic products for human consumption, demand for organic

mariculture products will increase in Europe, North America in the west and Australia, Japan and Singapore in the east. There is no doubt that present increasing trend in organic mariculture production will increase further in future.

Mariculture is flourishing along coastlines in many countries. Considering high environmental impacts and making it available of free up spaces for other purposes such as shipping, recreation & residential land use by reclamation, mariculture is being forced into offshore area. The water properties experienced offshore give a higher flux of oxygen through net structures and more stable water temperatures. Sea lice infestations of fish are lower in offshore locations, which contribute to higher quality of product (Svealv, 1988). Muir (2000) emphasized that movement of mariculture from sheltered and near shore locations to genuine offshore systems would require a number of essential transformations, i.e., from essentially human-sensory oriented systems to machine oriented systems and/ or from modest scale systems (varying degree of artisanal/ local fabrication) to large highly engineered systems. The common experience of most operators in offshore aquaculture is that offshore production carries considerable risk, and the criteria for success and conditions which are environmentally, technically and financially challenging are yet poorly defined (Willinsky and Huguenin, 1996; Muir, 2000). Due to high demand and availability of technology, the United States is turning to the open ocean for mariculture expansion, under the jurisdiction of the federal government (Stokstad, 2007). The Hawaii Offshore Aquaculture Project (HOARP) was initiated in 1999 and has successfully demonstrated the feasibility of offshore mariculture. Applying the results of HOARP, high-valued pacific threadfin (*Polydactylus sexfilis*) have been raised in the first commercially operated offshore fish farm in the United States and marketed with production reaching approximately 4,000,000 kg in 2004 (Yoza et al., 2007). In addition, to implement the legislation for ensuring the offshore mariculture in the United States, the National Oceanic and Atmospheric Administration (NOAA) drafted a bill. On 8th June 2005, the Commerce Committee co-chairmen & senators introduced the National Offshore Aquaculture Act of 2005 (S. 1195). NOAA justifies this move on several grounds: increasing demand for sea food, ocean waters being over fished and state regulations limits the near shore fish farming (Naylor, 2006). In addition, the availability of high technology and the largest Exclusive Economic Zone (EEZ) in the world, United State can easily move towards open ocean farming (Naylor, 2006). But it is problematic to other nations which do not have high technology, lack of capital, lack of technical expertise and wide EEZ. Due to lacks of specific environmental standards, opponents criticized this offshore aquaculture legislation. That is, without clear legal standards for environment and resource protection, marine fisheries and ecosystems are vulnerable to further decline (Naylor,

2006). The bill was criticized before a senate committee and two key senators are expected to reintroduce the bill revised by NOAA (Stokstad, 2007). Technical and research innovations are being introduced and being developed to expand the offshore mariculture in future. The economic pressure for automation and consolidation are especially great for offshore mariculture because the energy and labor cost associated with feeding and facility maintenance increased with distance from shore. If future offshore locations are significantly more expensive to develop, the potential for expansion may be limited.

Mariculture is an emerging industrial sector which requires continuous research with scientific and technical development, and innovations. Concerning the regulations for a well-managed industry, researchers and entrepreneurs are currently developing technologies needed for mariculture (Goudey, 2006). The development of the mariculture sector is the only solution for increasing demand. Therefore, different methods are being presently used for enhancing the productivity. Applications of biotechnology have brought the mariculture industry closer to achieving the growing demand of the world. To increase the production: growth enhancement through introduction of additional growth hormones (GH) genes; control of reproductive activity through administration of brain hormones; increased resistant of fish to pathogens through the use of DNA vaccines and antimicrobial agents; are being used in modern mariculture (Melamed et al., 2002). The implementation of principles and methods of molecular biology and genetics in the near future can be used to create new species to achieve high production. Scientists have already developed a way of obtaining diploid (all female) young flounder and marine cabbage giving a production yield of 20% higher than natural kinds (FAO, 2006). Increasing world demand for ornamental fish have opened new markets for new varieties with novel shapes and colors which can be supplied through the use of transgenics (Melamed et al., 2002). Effectiveness of mariculture has been achieved by creation of artificial reefs on the sea bottom, for which old marine construction vehicles, old automobile bodies, and even scrapped aircraft fuselages have been used. On their surfaces, seaweed develops, which in turn, creates favorable conditions for fish spawning, and reliable shelter for young fish (FAO, 2006). At Present mariculture is being forced into the open sea where strong winds and waves are challenging sea-cage design. A harsh environment and long distances to shore encourage a complete systems solution with high degree of remote monitoring and automation (Jensen et al., 2007). Therefore, open sea mariculture highly depends on the application of new technologies form cage construction to harvesting (Neyts and Sunde, 2006). Concerning mismatching of present structures used in offshore mariculture, Jensen and others (2007) introduced the concept of using tensegrity to build

aquaculture installations. Increased technology is likely to increase the production in the future, but the fact that technology depends heavily on petroleum is an important factor. From the recent past, increased petroleum prices will induce a return to traditional methods with consequent decrease in productivity. Therefore, research and new innovations are vital for future development of offshore mariculture. In order to solve the unmet needs of mariculture, National Aquaculture Centre for Technology Research is being planned to be established in Norway. Norwegian scientists are hoping that the centre will provide a meeting place for technology and biology and will form the basis of a joint European full-scale research centre for aquaculture technology and engineering (Neyts and Sunde, 2006).

## **10 Mariculture development and future prospects in Sri Lanka**

Being an island, Sri Lanka has a coastline of 1760 km which consists of mangroves, shallow lagoons, bays and shallow areas of which several areas can be used for the mariculture industry. Sri Lanka aquaculture industry did not develop in the past due to a lack of practical tradition and religious beliefs of the people until the mid 80's, with the introduction of the shrimp farming by the government. Until then, the export industry was mostly based on the exploitation from available coastal marine resources. For instance, seaweeds, *Gracilaria edulis* and *Gracilaria verrucosa* from natural stocks were exported from Sri Lanka as early as 1820 (Lundsor, 2004). Limited supply of natural stocks was seen as a limitation for improving the living standards of the families engaged in harvesting. With the increasing demand for export of sea food products especially penaeid shrimps, people moved towards the brackish water aquaculture as a lucrative income generating activity.

Sri Lanka has rich marine algal flora along its coastal belt, and implementation of seaweed farming has been found to be a sustainable activity, both environmentally and socially. In 2001, an effort was made by the National Aquatic Resources Research Agency (NARA) and the Export Development Board (EDB) to survey the potential seaweed resources and cultivation areas along the coast of Sri Lanka, with the purpose to upgrade the living standards of the people. During the survey, *Gracilaria edulis* and *G. verrucosa* were identified as potential species for cultivation, although other species present in coastal areas were also of economic importance. The areas identified for cultivation of sea weeds were lagoon areas in Puttalam, Negombo, Chilaw and Rekawa. Lundsor (2004) proposed that the southern coast of Sri Lanka from Bundala sanctuary to Hikkaduwa was suitable for seaweed farming. The Ruhuna University is currently involved in seaweed research to assist the rural coastal fishers and presently, people are

becoming aware of sea weed farming as a livelihood for rural fishers with excellent future prospectus for the Sri Lanka mariculture industry.

Only a few species contribute to the mariculture industry in Sri Lanka. Shrimps are the most important commodity at present and shrimp farming is the most lucrative commercial aquaculture activity in Sri Lanka. The shrimp farming industry in Sri Lanka originally commenced in Batticaloa in the Eastern coast, in late 1970's. Due to civil unrest over the past three decades, farming activities were abandoned and the shrimp aquaculture industry for the export trade was shifted in the early 1980's to the North Western coastal belt, and finally concentrated in that area, from Madampe to Puttalam covering a farm area of more than 4500 hectare. *Pennaeus monodon* was the most commonly used species for farming. The industry recorded its peak economic performance in the year 2000, earning LKR 5041 millions as foreign exchange. Unfortunately, there was a fall (LKR 2359 millions in 2004) due to the sudden spread of the white spot disease (Weerakoon, 2007). Several farms were abandoned and the industry demanded a multi-faceted approach to overcome many problems associated with it. The National Aquaculture Development Authority (NAQDA) of Sri Lanka established in 1999 introduced a comprehensive strategy that addressed various issues simultaneously, to control the disease spread and upgrade the industry again. NAQDA along with the Fisheries Ministry of the Wayamba Provincial Council spearheaded a comprehensive program for control of the disease spread and to rehabilitate the shrimp farming industry in North Western Province (NWP) in early 2004. Amidst stiff opposition from the stake holders, NAQDA introduced the 'Crop Calendar' which came into effect in the year 2004, resulting in the effective control of the disease spread among the shrimp farms. The Sri Lanka Aquaculture Development Alliance (SLADA) established in mid 2004, comprising various stake holders of the shrimp farming industry from shrimp feed importers, hatchery operators, equipment importers and sea food exporters extended their assistance in implementing this control mechanism.

One drawback of this practice was that the total quantity of processed shrimp exported from the country dropped from 2400 Mt in 2004 to 1800 Mt in 2005. However, this draw back was only a temporary one, and at present, the 'White spot' disease is effectively controlled and sustainable shrimp production and shrimp producing areas have been reestablished. To regulate and monitor the industry and for its betterment, a Shrimp Farm Monitoring and Extension Unit (SFM & EU) initiated by NAQDA was established in 2004. This unit monitored the activities of shrimp hatcheries and shrimp farms regularly. Officers of the SFE & EU implemented regulations and control immediately on receiving information about disease occurrences in shrimp farms.

NAQDA also formulated, 'Best Management Practices' (BMPs) for shrimp farm management, hatchery management, brood stock collection, chemical and feed import and transport & maintenance of brood stock with the concurrence of NARA, shrimp industry stakeholders, the Department of Animal Production and Health, Coastal Environmental Authority of the North Western Provincial Council (NWPC), the Faculty of Veterinary Science, Sri Lanka Standard Institute (SLSI), Quality Control Unit of the Department of Fisheries and Aquatic Resources and the University of Wayamba (Weerakoon, 2007).

With the gradual increase in production of farmed shrimp as the result of the rehabilitation work, prospects for shrimp farming is still good in Sri Lanka. Due to its inherent profitability and high return on investment and as livelihood development activities, shrimp farming is now being expanded to the coastal areas of the Eastern Province of Sri Lanka, with the conclusion of the civil war in 2009. To facilitate this expansion, NAQDA planned and implemented a project on development of infrastructure facilities for shrimp farming in Vakara in the Eastern coast, mainly to create livelihoods to coastal communities affected by the Tsunami in 2004. The project was funded by the Post Tsunami Coastal Rehabilitation and Resource Management Program (IFAD) (Aquaculture News, 2009). To train coastal communities on sustainable shrimp farming in this expanding province, NAQDA also planned and established a demonstration shrimp farm in Batticaloa and also disseminated Best Management Practices (BMPs) formulated for sustainable development of shrimp farming. This model shrimp farm project worth LKR 10.5 million was constructed in Manmunai North, Putur with funding from IFAD (Aquaculture News, 2009). NAQDA also prepared a zonal plan for the development of shrimp farming in the Batticaloa District to indicate suitable areas to construct shrimp farms and hatcheries (Aquaculture News, 2008) followed by the establishment of a bio-secure shrimp hatchery at Puthukudirippu in Batticaloa to supply the post larvae for existing and for stock enhancement of the Batticaloa lagoon farms (Aquaculture News, 2006). The shrimp farming industry in Sri Lanka has now entered a new phase of its development with some shrimp farmers already implementing organic shrimp farming. Other shrimp farmers have also indicated their willingness to engage in organic shrimp farming thus leading by example. With the planned shrimp farming activities in the East and the development of the industry, Sri Lanka could act as a role model for *P. monodon* farming in the region.

In addition, shrimp farmers are being encouraged by NAQDA to carry out alternate cropping, using fish varieties such as milk fish, grouper and tilapia. Milkfish fingerlings so produced have been marketed to long line Tuna fishing vessels, both local and foreign,

as there is a growing demand for milk fish juveniles as live bait for the Tuna fishery. There are also farmers who have engaged in polyculture of milkfish with shrimp aquaculture. Some farmers grow milk fish in sedimentation tanks where farm effluents are discharged, in order to control plankton growth (Aquaculture news, 2006). Due to increased demand, NAQDA and Aqua Lanka Hatcheries (Pvt) Ltd implemented a joint venture partnership agreement in 2005, to establish a milkfish hatchery in Negombo for the production of milkfish seed (Aquaculture News, 2006).

Apart from shrimp farming, the other most promising mariculture commodity is sea bass. Sea bass culture was commenced in Negombo lagoon in 2006 as a livelihood development project under the Coastal Resource Management Project (CRMP) funded by the Asian Development Bank (ADB). Under this project, Aqua Lanka Hatcheries (Pvt) Ltd commenced operations with 68 cages in Negombo lagoon, in collaboration with the fisher community. NAQDA is also planning to install 1500 cages among 550 families in Trincomalee District with the assistance of USAID. Sea bass cage culture was commenced in the Negombo lagoon with the fisher community in 2009 under the initiation of NAQDA. This project directly helped to reduce the fishing pressure in the lagoon and generate income as an alternative livelihood activity (Aquaculture News, 2009).

Sea horse culture is another promising mariculture activity in Sri Lanka with its expansion program for the ornamental fish export industry. NAQDA commenced sea horse culture & breeding research using *Hippocampus kuda*, species living around the coast of Sri Lanka. However, the project was unsuccessful due to low productivity of the species. Currently, Aqua Marine (Pvt) Ltd has established a farm in Pitipana for sea horse culture, using hybrid species which is more productive. NAQDA has trained shrimp hatchery owners on sea horse breeding to utilize the shrimp hatcheries which are not functioning at present and to make them aware of the foreign exchange income generation potential with sea horse breeding for export (Aquaculture News, 2009).

The other most promising commodity in Sri Lanka mariculture industry is sea cucumber and mussel culture. NAQDA has commenced a pilot project in Mannar for fattening sea cucumber and presently there are farms managed by the private sector in Kilinochchi to fatten sea cucumber using pens. A project on brown muscle culture was conducted during 1995-1996 in Rumassala bay, Galle, under the support of Southern Province Rural Development Project (SPRDP) (Wanninayake, 1998). Currently there are two ongoing projects managed by NARA on Green muscles, *Perna perdis* and edible Oyster culture at Thambalagamuwa bay in the Trincomalee District. NAQDA has also commenced an

Oyster farming project in Arippu in the Mannar district. Moreover, a project on pearl oyster culture is to be implemented very soon by the NARA at Thambalagamuwa bay with community participation. Considering high demand, NAQDA have conducted an experimental trial lobster fattening at Valaipadu Divisional secretary division of Poonakery in Killinochchi District (Aquaculture News, 2010).

Knowledge of mariculture in Sri Lanka is limited. With the current economic development in the country after the civil war, the authorities have identified the importance of aquaculture to enhance the economy of the country. Several initiatives have been taken to disseminate knowledge among the community on this industry. To educate students at the graduate level, several universities have introduced courses related to aquaculture. The Ruhuna University is the first University in Sri Lanka to establish a dedicated Faculty, Fisheries and Marine Sciences & Technology to produce graduates with theoretical and practical knowledge on aquaculture to be engaged in future aquaculture ventures of this expanding industry.

## **11 Conclusion**

Mariculture is a significant socio-economic activity and its conspicuous development and expansion is observed mainly during the past few decades. Though different species and techniques are used in global mariculture activities, a significant production is only being achieved through a few species. Global mariculture production is growing continuously with demand and its contribution to world aquaculture is over 50% during the few past decades and the trend is set to be continuous. Statistics clearly show that, global mariculture is in the mollusk era at present, as suggested by Tseng (1993) for Chinese mariculture. It appears that seaweed culture may take the lead in the future. Diseases, the major threat to modern mariculture is being kept under control, using good management practices. Direct and indirect impacts on environment are the major concerns in mariculture practices. Hence, there is a need to minimize the main environmental problems derived from mariculture operations, either at the planning stage or during culture operations. Several measures have already been undertaken by governments worldwide (national and international directives) and new concepts, viz. creation of MPAs are being introduced to alleviate the pressure on wild biota adjacent to the mariculture installations. Organic mariculture the fastest growing modern trend in aquaculture and integrated mariculture is supposed to be an environmentally friendly promising technique in modern mariculture. The feasibility of offshore mariculture has been already established, but facing problems hindering further expansion. Research is vital to introduce new species giving high production and to develop new technologies to solve future problems in global mariculture. It appears that many of the innovations

are becoming better with the possibility to expand offshore mariculture becoming notably more positive in the future. The present trend in technology development clearly shows that the industry will have a promising future for supplying increasing demand for fish. Therefore, future seafood demand will, however, be achieved through mariculture development and this seems to be better off with new innovations and technology and employing best management practices. It is essential therefore, that researchers, governments and all other stakeholders involved in the industry should work together for future plans in this direction to be realized and to achieve the future demand for food.

Sri Lanka has a vast potential to develop coastal aquaculture industry as a livelihood improvement of coastal aquatic resource users. Sri Lanka coastline studded with 158,000 ha of bays, lagoons and estuaries are mostly suitable for various kinds of mariculture practices. As the major mariculture commodity, shrimps exported from Sri Lanka have a high demand from buyers, due to its quality and taste. In addition, there is a huge potential to culture sea bass in abandoned shrimp farms, and sea bass has an extremely high demand within the European Union. Mariculture projects launched so far in the country with community participation have shown a high success and expected to achieve high production, thereby increasing the export market potential. Water quality parameters are favorable for culturing many economically important fish such as sea bass, milk fish and grouper etc. in Sri Lanka. It is a well known fact that the location of the country provides easy access to many major markets around the globe, facilitating export of fresh and good quality products. Therefore, Sri Lanka mariculture sector is being developed now with available resources after the conclusion of the civil war and with the BMP's. It is evident that, with the expansion of global mariculture industry, the present trend in mariculture sector development in Sri Lanka will contribute to meet future demand for food thus ensuring livelihoods and food security for the citizens.

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# Chapter 14:

## Ornamental fishes: trade and transport

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**Abstract** The ornamental fish trade has flourished during the past five decades. Both marine and freshwater fish are currently traded, though the former are high-value species and generally captured from wild. Culture of ornamental fish, particularly marine species, helps to avoid undue exploitation of natural populations as well as to protect their ecosystems. Training of the personnel involved in the value chain is inevitable to tackle several of the issues that plague the industry. The success of trade also depends on holding and transport of animals under optimum conditions to their final destination. Greater concerted efforts to implement the right policies at governmental levels and increased awareness on appropriate procedures at all steps of the trade would entail the success of the ornamental fish industry. Though Sri Lanka has a tradition in ornamental fish trade, the industry needs to be revitalised through governmental support and technological advancement.

**Keywords:** Ornamental fishes; wild fish; cultured fish; natural habitat; trade; value chain; transport; packing density; water quality; fish welfare; effective management, Sri Lanka.

## 1. Introduction

Watching ornamental aquatic animals in their artificial habitats set either in the confines of a home or in a public place is an activity preferred by the masses to relax. The aesthetic value of ornamental fish was recognized even by the ancient civilizations of Egypt and Rome (Fosså, 1981). Today this has become a very popular hobby that requires a large number of live animals. Both marine and freshwater fishes are bought by aquarists around the world. It has been reported that around 1, 500 marine ornamental fish species (Wabnitz *et al.*, 2003) and more than 4000 fresh water species (Whittington and Chong, 2007) are being traded internationally every year. EU veterinary data collected over a period of 3 months in 2007 showed that over 58 million ornamental fish were imported into 23 European Union Member States and Norway (UNEPWCMP, 2007). United States of America and Europe together buy over half of the 30 million marine fishes collected from the reefs (Wood, 2001). The freshwater types that are traded could be presumed to be much higher in numbers than the saltwater types as the number of species and the countries that are involved in this business are far more numerous than those for marine fish.

Goldfish are considered as the first domesticated ornamental fish species; Chinese initiated the culture of these fishes during the first half of the first millennium (Fosså, 1981). The interest in aquarium fish hobby developed during the 19<sup>th</sup> and 20<sup>th</sup> century in Europe and North America. Freshwater species like goldfish, common carp, paradise fish, chanchito, Siamese fighting fish, and guppy were the popular varieties (Fosså, 1981).

Ornamental fish trade is expanding year by year as there is a continuous increase in the number of fish hobbyists. However, several challenges need to be tackled to safeguard, among other things, the health and quality of the “wet pets” reaching these hobbyists (Roberts, 2010). The issues are destruction of the natural environment, extirpation of the wild marine stock, unnecessary use of chemicals, post-harvest morbidity and mortality, lack of proper breeding techniques for marine species, spread of diseases, improper health management during transportation, release of pets to the wild, inadequacy of qualified staff at the distribution and retail level in the value chain, and lack of communication within the industry (Bruckner, 2005; Miller-Morgan, 2010).

According to the World Wildlife Fund (WWF), the global sale value of ornamental animals, primarily fish, is estimated to be 900 million USD, 90% of which is obtained through trading of freshwater varieties. Now many countries around the world compete in trading of these highly valuable “wet pets” which are in huge demand. The history of

this industry began as early as in 1920 when South Asian countries, mainly India and Sri Lanka, started exporting freshwater ornamental fish by passenger or cargo steamers (Ekaratne, 2000; Tekriwal and Rao, 1999). Sri Lanka has a marine ornamental fish trading history dating back to 1930s (Wijesekara and Yakupitiyage, 2001). At present, European Union, Japan, Australia and USA imports ornamental fish from Sri Lanka through 25 companies operating in the island country (Ekaratne, 2000; Thilakaratne *et al.*, 2003; Whittington and Chong, 2007; Yu, 2001). Sri Lanka secured approximately 1% of the world export value of ornamental fish in 2009 (<http://www.naqda.gov.lk/>; <http://www.wwf.org>) through the export of farm-raised, wild-caught and captive-bred marine as well as freshwater ornamental fish and other aquatic species. Now trade of ornamental fish from this country has become a lucrative business that includes exporters, small-scale breeders, out growers, collectors and retailers and the successful relationship among them is vital for the progress of the industry (Weerakoon and Senaratne, 2005).

Sri Lanka, can harness the wealth of its vast coastal areas through the expansion of the ornamental fish industry. Alongside, if the industry supports the low income rural population, it will largely contribute to the economy of the country as it can produce considerable income per unit area and earn substantial amount of foreign exchange (Wijesekara and Yakupitiyage, 2001). With the establishment of the National Aquaculture Development Authority of Sri Lanka (NAQDA; <http://www.naqda.gov.lk/>) in 1999, the government started getting directly involved in the development, promotion and extension of ornamental fish and aquatic plants sector (Weerakoon and Senaratne, 2005). In addition, National Aquatic Resources Research and Development Agency (NARA; <http://www.nara.ac.lk/>) and universities play important roles in improving the industry through research and technology development. Besides creating an institutional framework within the country, cooperation among different sectors is imperative for the success of the industry. Proper transfer of technology and knowledge to the people in the value chain (Weerakoon and Senaratne, 2005; Wijesekara and Yakupitiyage, 2001) would enable the industry to contribute to the national income.

## **2. Major aquatic animals in trade**

Listed in tables 1 and 2 are some of the prominent marine and freshwater aquatic animals that are currently traded. Almost 90% of the freshwater fish species that are traded are cultured. In contrast, the marine varieties are harvested mainly from the coral reefs of tropical regions (Inskipp, 2003; Wood, 2001). As larvae of marine ornamental fishes thrive abundantly (90 times more than the adults) in nature, they could be preferentially collected over the adults that should be left to breed (Lecchini *et*

al., 2006). Once these larvae are collected, they are transferred to the breeding centres, to be grown to marketable sizes. The bottlenecks in the artificial rearing of marine fishes

**Table 1.** Popularly traded marine ornamental aquatic animals

<b>Common name</b>	<b>Scientific name</b>
<b><i>Invertebrates</i></b>	
Cleaner shrimp	<i>Lysmata grabhami</i>
Mantis shrimp	<i>Odontodactylus scyllarus</i>
Peppermint shrimp	<i>Rhynchocinetes uritai</i>
Fire shrimp	<i>Lysmata debelius</i>
Banded coral shrimp	<i>Stenopus hispidus</i>
Atlantic anemone	<i>Condylactis passiflora</i>
Yellow trumpet anemone	<i>Parazoanthus axinellae</i>
Delicate sea anemone	<i>Heteractis malu</i>
Magnificent sea anemone	<i>Heteractis magnifica</i>
Red fromia starfish	<i>Fromia elegans</i>
Long spine urchin	<i>Diadema antillarum</i>
Blue ring octopus	<i>Hapalochlaena maculosa</i>
Turban snail	<i>Turbo castaneus</i>
<b><i>Fishes</i></b>	
Flame angelfish	<i>Centropyge loriculus</i>
Speculum butterflyfish	<i>Chaetodon speculum</i>
Clown fish	<i>Amphiprion ocellaris</i>
Blue green damselfish	<i>Chromis viridis</i>
Domino damselfish	<i>Dascyllus trimaculatus</i>
Sapphire devil	<i>Chrysiptera cyanea</i>
Goldtail demoiselle	<i>Chrysiptera parasema</i>
Yellow sailfin tang	<i>Zebrasoma flavescens</i>
Bluestreak cleaner wrasse	<i>Labroides dimidiatus</i>
Convict surgeonfish	<i>Acanthurus triostegus</i>
Blue surgeonfish	<i>Paracanthurus hepatus</i>
Sea goldie	<i>Pseudanthias squamipinnis</i>
Starry triggerfish	<i>Abalistes stellaris</i>

\*Adapted from Global Marine Aquarium Database; Bruckner, 2005; Inskipp, 2003

are – the small size of larvae, the unavailability of suitable live feeds for first-feeding and the inadequate knowledge on diseases and their control (Tlustý, 2002). Overcoming

some of these hurdles certain marine species such as marine angelfish, clownfish, gobies, dottybacks, blennies, seahorses and selected shrimp species are being cultured (Bell *et al.*, 2009; Schiemer, 2001; Tucker, 1998). On the other hand, breeding and culture techniques of the common freshwater ornamental fishes are well established in several countries including Sri Lanka.

**Table 2.** Selected freshwater ornamental fishes traded in Europe\*

<b>Common name</b>	<b>Scientific name</b>
Guppy	<i>Poecilia reticulata</i>
Koi carp	<i>Cyprinus carpio carpio</i>
Platy	<i>Xiphophorus maculatus</i>
Sword tail	<i>Xiphophorus helleri</i>
Goldfish	<i>Carassius auratus</i>
Angel	<i>Pterophyllum scalare</i>
Molly	<i>Poecilia sphenops</i>
Neon tetra	<i>Paracheirodon innesi</i>
Barb	<i>Puntius tetrazona</i>
Kissing gourami	<i>Helostoma temminkii</i>
Siamese fighter	<i>Betta splendens</i>

\*Adapted from Ornamental Aquatic Trade Association, National Aquaculture Development Authority of Sri Lanka

### **3. The importance of culturing ornamental fishes**

The merits of farming these high-value non-food fishes have been pointed out by Tlusty (2002). It is recognized that ornamental fish farming will: i) contribute to the GDP of a country, ii) provide sustainable livelihood to the rural poor, iii) prevent over-harvesting and destruction of natural habitats, thereby conserving the wild stock, iv) provide high quality 'domesticated' fish that are already trained on artificial feeds and v) help the development of new strains through breeding. To sustain this valuable business, particularly of the marine species, it is important to consider the impact on their ecosystems too. The destruction of fish habitats using explosives, electro fishing devices, chemical poisons and toxicants are jeopardising the sustainability of the industry (Gopakumar and Ignatius, 2005). Due to the dependence on the wild population, adequate measures should be in place for responsible harvest techniques and quotas. If not, the removal of these organisms from their surroundings may lead to an overexploitation of the species being collected, disruption of the food chain in the ecosystem, reproductive failure and habitat alteration (UNEPWCMP, 2007). On the other hand, from an animal welfare perspective, when a fish is removed from its natural

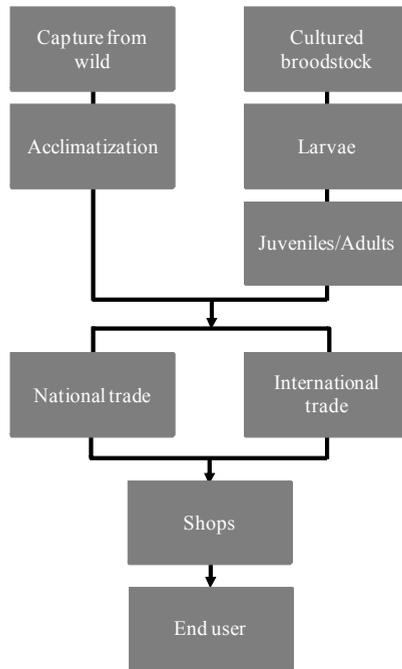
habitat and reared in the artificial environment, the conditions may not be optimal for their health and survival. The major limitations would be due to differences in water quality, temperature, pH, oxygen, photoperiod and food (Jordan, 2007; Livengood and Chapman, 2007). Therefore, the industry should consider the welfare of the organism maintained in captivity, give attention to habitat conservation, adopt eco-friendly collection methods, and avoid relentless overharvesting and chemical usage. Several ornamental fish trading organizations functioning globally addresses some of the above mentioned issues. One of them is Marine Aquarium Council (MAC; <http://www.aquariumcouncil.org/>) which promotes sustainability through the development and deployment of best practices and standards. They provide certification for those engaged in the collection and care of marine ornamentals, set on voluntary standards and an eco-labeling system for the marine aquarium trade. These standards are established for four main areas, i) ecosystem and fishery management, ii) collection, fishing and holding, iii) handling, husbandry and transport, and iv) mariculture and aquaculture management. Moreover organizations such as Ornamental Aquatic Trade Association (OATA; <http://www.ornamentalfish.org/>), Ornamental Fish International (OFI; <http://www.ofish.org>) and International Air Transport Associations (IATA; <http://www.iata.org/>) are also actively engaged in both development of the industry and making ornamental fish trade sustainable.

The culture of ornamental fish is the viable alternative to their harvest from the wild. This has been successfully carried out for several of the freshwater species listed in table 1. Closed tanks, ponds and cages in ponds are used to culture ornamental fishes (Tamaru *et al.*, 1997). Asian countries lead in the breeding of ornamental species. It should also be noted that majority of the wild-caught marine aquarium fish comes from the archipelagoes of Indonesia, the Philippines, Sri Lanka, the Maldives and Central Pacific Island (Livengood and Chapman, 2007). Therefore these countries could be the logical areas where the culture of marine ornamental fish could be developed.

#### **4. Value chain in ornamental fish trade**

Ornamental fish trade involves several stages that are outlined in figure 1. The first step is the production of the species of interest or its capture from the wild. In the former case, the captive broodfish are used to produce the young ones. In the latter case, the animals, mainly the marine fishes are captured live from their natural habitats and transported to the culture centres, where they are kept prior to their shipment. The animals when ready for the market are then prepared for transportation - a key component in the value chain. The quality of transportation is vital in ensuring the successful delivery of the animals to their destinations - national or international. The

international trade is carried out by exporters, transporters (airline) and wholesale importers. Exporters use fish from their own operating farms and/or from independent suppliers such as collectors, breeders or middlemen/brokers. Transporters, especially air carriers and freight forwarding agents, play major roles in the success of international ornamental fish transport. If the duration of international transport is long it would need appropriate measures to secure the delivery of live healthy animals. Importers are mainly large whole sale companies which supply to other small wholesale companies or directly to the retail market. Retailers can be small pet shops or large specialized shops dedicated to the ornamental fish sales. Through the retailers fishes are directly delivered to the end user.



**Figure 1** Value chain in ornamental fish trade

## 5. Transportation of fish – a critical step in the value chain

The success of ornamental fish trade mainly depends on the quality of live fish that is delivered to the final destination. Therefore, elaborate and adequate steps are needed to prepare the fish for transportation. The fish which are collected from the wild are transferred to the farm, graded and held for a period of time to acclimatize them prior to transportation (Cole *et al.*, 1999; Crosby *et al.*, 2005c). In the case of cultured fish, they are harvested from the ponds using traps and seine nets (Crosby *et al.*, 2005b). The

fish are quality-checked by visual inspection to assess several features such as size, body condition, color, fin development, sex, scale loss, eye damage and indicators of health. Grading of fish according to size is carried out generally by hand or by using a mechanical grader (Crosby *et al.*, 2005a). Preparation of fish for transportation also involves conditioning them before packing. This is done in three stages - prophylactic treatment, feed deprivation and prepackaging (Cole *et al.*, 1999; Crosby *et al.*, 2005c; Lim *et al.*, 2003; Teo *et al.*, 1989). Prophylactic treatment is normally done on fish infested with external parasites or other pathogens (Cole *et al.*, 1999; Crosby *et al.*, 2005c; Lim *et al.*, 2003). Depending on the size of the fish, they are starved for one to three days prior to transport (Cole *et al.*, 1999; Lim *et al.*, 2003) to ensure good water quality throughout the transport period, by reducing the risk of defecating in the shipping bags. Pre-packaging and storing under 22-23°C help the fish to get acclimatized to the package conditions (Cole *et al.*, 1999; Lim *et al.*, 2003).

The welfare of the animals should also be ascertained by visual inspection and if necessary, through a health examination while aiming to deliver quality products at the final destination. Crude handling, undesirable water quality and high packing densities lead to morbidity and mortality of the transported fish (Inskipp, 2003). During the movement of fishes from the exporting country to the destination, handling occurs before and after shipment, as the boxes are not repacked during the journey (Davenport, 1996). Even so, a significant number of imports are repacked at a tranship facility before moving on to their final destination (Miller-Morgan, personal communication). Therefore, handling, packing densities and water quality are the important aspects that require due consideration during transport. Table 3 outlines the recommendations for these parameters given by Ornamental Aquatic Trade Association (<http://www.ornamentalfish.org/association/code/Code.pdf>).

Transportation of ornamental fish to the destination markets often involves both land and air shipment. As a general practice, fish are first packed in polythene bags charged with pure oxygen and these bags are then enclosed in styrofoam boxes. Some traders place heat or cold packs in these boxes to regulate the internal temperature. Water quality stabilizers including pH buffers, zeolite (to remove ammonia), activated carbon (to absorb carbon dioxide) are also used by some exporters (Cole *et al.*, 1999). However, ensuring suitable conditions for the well-being of animals within these bags is challenging. High freight cost is the main factor that determines the volume of water being used in the bags. Existing packaging systems use very high fish loading densities to keep freight cost low. Fish densities in the packages depend on several factors including the size of the fish and the duration of transport. For smaller fish and longer transport

duration lower densities are preferred, while for larger fish and smaller duration higher densities could be considered (Cole *et al.*, 1999; Lim *et al.*, 2003). Rare, expensive and delicate fishes are packed at lesser densities.

Parameters such as concentration of unionized ammonia, nitrite, nitrate, dissolved oxygen and pH affect the quality of water. If fish are stocked at densities higher than the recommended levels, the quality of water will be compromised due to the accumulation of fish metabolic wastes (Lim *et al.*, 2003; Wohr *et al.*, 2005). Ammonia, if accumulated in body become extremely toxic and can lead to the death of fish (Ip *et al.*, 2001; Randall and Tsui, 2002). Adequate supply of oxygen is an important factor as the fish uses more oxygen during transport than under normal circumstances (Froese, 1988). Therefore the current practice is to charge three quarters of the bags with pure oxygen and one quarter with water (Chow *et al.*, 1994; Froese, 1988; Lim *et al.*, 2003; Teo *et al.*, 1989). However, an evaluation performed at the Rhein-Main-Airport, Frankfurt, Germany on thousand shipments of ornamental fishes that travelled for up to forty-two hours revealed that 41% of shipments had transport bags with less oxygen and dead ornamental fish (Wohr *et al.*, 2005). On the other hand, production of carbon dioxide by fish during transport results in low pH and other harmful effects on fish. Further, high levels of ammonia or carbon dioxide can be lethal to fish transported in closed systems (Paterson *et al.*, 2003).

**Table 3.** OATA recommended conditions for ornamental fish transport

<b>Parameters</b>	<b>Cold water species</b>	<b>Tropical freshwater species</b>	<b>Tropical marine species</b>
Stocking-density (kg fish/l)	8	1.5 (size ≤ 5cm) 2.5 (size > 5cm)	1 (size ≤ 5cm) 2 (size > 5cm)
Water quality (mg/l)			
Free ammonia	≤ 0.02	≤ 0.02	≤ 0.01
Nitrite	≤ 0.2	≤ 0.2	≤ 0.125
Dissolved oxygen	≥ 6	≥ 6	≥ 5.5
Nitrate	≤ 50	≤ 50	≤ 100

Undesirable water quality, high stocking density, pre-transportation procedures including capture, harvest, post-handling, packing, and transportation itself are stressful to fish (Bendhack and Urbinati, 2009; Miller-Morgan, personal communication). Alleviating this stress is very important, from a fish welfare perspective. Scientific studies have revealed that confinement and ammonia levels are major stressors during transportation (Hur *et al.*, 2007; Jeney *et al.*, 1992). Fish are capable of responding to

the different stress factors using their adaptive mechanisms to maintain the homeostatic state (Barton, 2002). In order to mitigate stress related to transportation, application of salt, calcium ion, anaesthetics and probiotics to the transport water has been attempted (Bendhack and Urbinati, 2009; Carneiro and Urbinati, 2001; Forsberg *et al.*, 2001; Gomes *et al.*, 2006, 2008; Hasan and Bart, 2007; Mazik *et al.*, 1991; Robertson *et al.*, 1988). The beneficial effect of salt was found to vary with the fish species and the concentration of salt used. Calcium ion did not have any notable effect in reducing stress. Studies have also indicated that anaesthesia can control stress to certain extent. However, probiotic application (*Bacillus subtilis*, *Bacillus licheniformes*, *Lactobacillus acidophilus* and *Saccharomyces cerevisiae* along with essential nutrients) was found to be efficient in reducing stress during transport (Gomes *et al.*, 2008, 2009). It is hypothesized that the ammonia toxicity in transporting systems could be effectively managed by the addition of nitrifying bacterial consortia. This is being tested in the project “Developing an entrepreneurial university based on local opportunities and knowledge” funded by Norwegian Centre for International Cooperation in Higher Education. The project is part of the bilateral cooperation between University of Nordland, Norway and University of Ruhuna, Sri Lanka. A component of this project aims to create scientific knowledge and technology required for the successful transport of ornamental fish. Such an approach will help in developing effective practical solutions to support local entrepreneurs. One of the studies has found that addition of nitrifying bacteria could effectively control ammonia accumulation in ornamental fish transport units (Dhanasiri *et al.*, 2011).

## **6. Proactive measures to tackle issues facing the industry**

To avoid the destruction of natural habitats of ornamental fishes, strategies for conservation such as limited access to fishery, fixed quotas, size limits, creation of marine reserves and temporary closures could be adopted (Gopakumar and Ignatius, 2005). These measures directly prevent overharvest of the wild stock. The use of cyanide that destroys the habitat of the target fish species as well as of other organisms should be discouraged. ‘Nature-friendly’ techniques such as the use of crest net for larval collection and the use of recommended levels of clove oil instead of cyanide should be preferred (Cunha and Rosa, 2006; Erdmann, 1999; Lecchini *et al.*, 2006; LeGore *et al.*, 2005; Robertson and Smith-Vaniz, 2010). Thus proper standards and methods for collection could be implemented, though further refinements are necessary.

On the other hand, improved collection and handling procedures, appropriate stocking densities and ideal water quality conditions during transport are important to move fish

successfully to their destinations. An often disregarded, but vital aspect to the trade is the need to screen for pathogens prior to and after transport. Proper quarantine and disease screening measures would help to restrict the transboundary spread of pathogens through the animals that are transported. Office International des Epizooties (OIE; <http://www.oie.int/> - the world organization for animal health in which most of the ornamental fish exporting countries are members) is engaged in preventing spread of diseases through ornamental fish trade. Assurance from the veterinary service of the exporting countries stating that the fishes are free from certain diseases listed by the OIE is required by many importing countries. EU import legislation (EU import Directive 2006/88; [http://ec.europa.eu/food/animal/liveanimals/aquaculture/index\\_en.htm](http://ec.europa.eu/food/animal/liveanimals/aquaculture/index_en.htm)) is applicable for ornamental fish trade with EU. In the case of Sri Lanka, quality assurance certification pertaining to the health of fish is done by the Department of Animal Quarantine, the documentation of which accompanies each shipment.

Thus only through governmental legislations and coordinated efforts of authorized bodies and industry trade organizations can any country effectively manage ornamental fish trade. The awareness on marine conservation, eco-friendly harvest techniques and the importance of fish care are taught by many non-profit organizations like LEAD project (<http://www.lead.org/page/5>) and MAC. The contribution of such efforts towards educating the personnel in the value chain is immense. Besides this, there is a need to properly organize the industry, both at national and international levels to tackle several of the issues. It is also important that aquarium hobbyists are aware of sources of their pet organisms and have adequate knowledge on animal care. Readers are encouraged to refer to a recently published book on ornamental fish health as well as the ornamental fish international book series (Roberts, 2010; <http://www.ofish.org/about/shop>).

Hence further scientific advances, suitable management practices, apt policies, and greater public awareness are necessary to drive the ornamental fish industry forward; with sustainability at the forefront of these developments.

## **7. Recommendations for successful ornamental fish trade - Sri Lankan context**

Ornamental fish industry plays an important role in the economy of Sri Lanka, both by securing foreign currency and by creating jobs. Year round favorable climate, ideal geographic location, expandable resources and international reputation for quality fish supplies are strengths of the country's ornamental fish industry (Wijesekara and Yakupitiyage, 2001). As mentioned earlier, this country exports wild-caught, capture-

bred and farm-raised aquatic animals to different parts of the world. But to become a leading ornamental fish trading country the following issues need to be addressed:

- *Breeding of endemic fish species / production of new varieties*  
Sri Lanka has a wide variety of endemic fresh-, brackish- and marine fish species. To attract the international hobbyist, breeding of endemic fish species without endangering the wild stock is essential. But these species that are very rare are subjected to excessive exploitation (Weerakoon and Senaratne, 2005). Ornamental fish breeding centers under NAQDA is currently engaged in research and development of endemic species, including breeding in captivity. It has been suggested that the development of new strains by hybridization of local endemic species with genetically compatible exotic species would be a good strategy to attract international market as well as to conserve wild stocks (Weerakoon and Senaratne, 2005). The challenge is to produce large quantities of high quality animals. Breeding of high value marine species can definitely bring success to the industry besides avoiding the destruction of natural stocks and their habitats.
- *Research and technology development*  
In Sri Lanka, small scales out growers involved in ornamental fish industry do not have the capacity to conduct their own research and are therefore dependent on the commercial growers and exporters or the government organizations for technology and trade (Weerakoon and Senaratne, 2005; Wijesekara and Yakupitiyage, 2001). Presently government institutions and universities contribute to advancing ornamental fish industry. NAQDA assists the farmers in disease diagnosis, provides advice on fish health, supplies quality ornamental fish brood stock and parent stock of ornamental aquatic plants. The organization also conducts research on ornamental fish farming and aquatic plant culturing. These initiatives are still far from enabling the country to have a lead in the competitive global market and calls for further concerted efforts in research and development.
- *Training and supporting entrepreneurs*  
Transfer of proper technology to the persons involved in the industry is vital for the success of Sri Lankan ornamental fish trade. As previously mentioned, government institutions and Export Development Board of Sri Lanka (EDB; <http://www.srilankabusiness.com/>) have been conducting training programs for the entrepreneurs and employees involved in ornamental fish trade on various

aspects including farming as well as marketing. NAQDA organizes ornamental fish and aquatic plant exhibitions to bring together all the sectors involved in ornamental fish trade, including overseas buyers. Moreover some organizations like Association of Live Tropical Fish Exporters of Sri Lanka are educating divers to develop diving skills in collecting animals without endangering their habitats. However, small scale farmers need both financial and educational support.

- *Increased facilities for air transportation*

For the success and profitability of the business, it is important that live fish reaches the final destination with minimum delays. For enhancing the share of Sri Lanka in global ornamental fish trade, the national airline should provide efficient and cost-effective logistic support.

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## Chapter 15:

### A comparative study on quality changes of Arctic shrimp and Tropical shrimp during freeze storage

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**Abstract:** North Atlantic Shrimp (*Pandalus borealis*) and Black Tiger shrimp (*Penaeus monodon*) were stored at -20 °C and -40 °C for 0, 2, 4 and 6 months and the chemical, physical, sensory and fatty acid content changes were investigated. Drip loss, water, protein, fat, ash, TVN, pH were measured with standard methods at FBA (Faculty of Biosciences and Aquaculture, Bodø University College, Norway) Laboratory, Texture was done with TA-XT2 Texture Analyzer and Color analysis was done with Minolta Chroma meter 300, shrimp muscle histology was studied, the fatty acid profile was determined with GC (Gas Chromatography), sensory analysis was done as triangle test.

During the study drip loss was higher at -20 °C storage and that resulted in a drier shrimp and prawn as the storage time increased. There was also an increase in pH, TVN and ash content in the samples and that was higher in -20 °C than -40 °C stored samples. Texture was firmer and color was whiter at -40 °C storage than at -20 °C

storage. Due to larger size the shear force was higher in Tiger shrimp than in Atlantic shrimp, but in both species shear force increased during freeze storage at -40 °C and decreased during storage at -20 °C. In -20 °C stored samples larger ice crystals formed between the muscles. The PUFA content was relatively more stable at -40 °C stored samples than that stored at -20 °C. EPA, DHA contents remained high in the -40 °C stored samples. During the study the PUFA content was almost double in Atlantic Shrimp than Tiger Shrimp. The sensory panel found difference between the -20 °C and -40 °C stored Atlantic shrimp samples after 2 months.

**Keywords:** Shrimp, freeze storage, drip loss, shear force, PUFA.

## 1 Introduction

Shrimps in international trade are regarded as one of the most valuable products from the sea. As like other seafood products shrimps serve as important sources of nutrients and is an excellent source of protein (Feliz, *et al.*, 2002). Additionally, shrimp consists highly unsaturated fatty acids (HUFA) such as Eicosapentaenoic Acid (20:5n3, EPA) and Docosahexaenoic Acid (22:6n3, DHA) which are cardio-protective (Feliz, *et al.*, 2002) and maintain healthy function of brain and retina (Simpson, *et al.*, 1998). Norway is one of the leading countries to produce and export North Atlantic shrimp worldwide. The export value for shrimp is 0.9 – 1.3 billion NOK yearly ([www.seafood-norway.com](http://www.seafood-norway.com)). Black Tiger Shrimp has become global commodity with increasing prospects for export from Bangladesh, Thailand and other developing countries. Frozen-raw and cooked shrimp are particularly valuable export crop in Bangladesh generating substantial revenues and foreign exchange, earning in excess of \$360 million annually and accounting for 4.9 percent of total exports (USAID, 2006).

Inappropriate transport or freeze storage of shrimp can adversely affect the quality parameters. Its quality, however, often falls far short due to processing and storage techniques. Chemical composition is one of the important parameter of shrimp muscle that changes due to various storage temperature and time. The water and protein content of prawn found to be decreased during ice storage; where as ash and fat content increased (Kamal, *et al.*, 2000; Rahman and Driscoll, 1994). TVB-N is found to be increased with the lapse of storage on ice (Kamal, *et al.*, 2000). The amounts of C20:4, C20:5 and C22:6 decreased as the storage time increased in *Parapenaeus fissures* (Shye, *et al.*, 1988). During long period of storage different types of physiochemical changes occur in shrimps and results in lost of its appeal to consumers than a fresh one. Studies on freeze storage revealed that long time storage of shrimps made the final products unacceptable to customers (Angel, *et al.*, 1981). Lower temperature can inhibit the

growth of bacteria and extend the shelf life of shrimp, but the texture of shrimp becomes soft (Li, *et al.*, 2002). Usually the sensory qualities of shrimp during storage changes due to biochemical changes (Antony, *et al.*, 2002) and it exaggerates due to the bacterial types and quality during storage (Anwar, *et al.*, 1988). Experiments confirmed that the storage temperature is very important in storing of shrimps, and in storing at a temperature of -25 °C the quality was much better than at a temperature of -16 °C (Karsti and Hakvaag, 1961). Little information regarding either the chemical, physical, and fatty acids profile comparison of Arctic and Tropical shrimps has been reported on long term freeze storage at low temperatures like -20 °C and -40 °C. So, it is important to know more about the freeze storage and how it affects the quality parameters in shrimps to produce more quality product to sustain the global business. Bearing all these practical conditions in mind the present study has designed to assess the quality comparison of frozen peeled North Atlantic Shrimp (*Pandalus borealis*) and Black Tiger Shrimp (*Penaeus monodon*) in different periods of storage at low freezing temperatures.

## **2 Materials and Methods**

### **2.1 Sample collection and preservation**

The study was conducted at the Seafood quality Laboratory of the Faculty of Biosciences and Aquaculture, Bodø University College from January 2007-April 2008. Frozen peeled North Atlantic Shrimp (*Pandalus borealis*) samples were supplied from a Norwegian processor. Frozen peeled Black Tiger Shrimp (*Penaeus monodon*) samples were collected from Bangladesh through a Norwegian importer. The lead time to collect the samples was 15 days, which includes harvesting, processing, freight from Bangladesh to Norway and inside Norway. During this experiment samples were collected from a single batch and stored in the freezer. Each type of samples was divided into two treatment groups of -20 °C and -40 °C, packed in airtight food grade poly bags and then stored in cryo boxes with lid on top in the freezer at -20 °C and -40 °C for 2, 4 and 6 months. Samples on the day of delivery were treated as control or 0 months and went through lab analysis. During laboratory analysis one bag has been taken from the freezer and analysis was done as quadruplicates. So, these were not true replicates during the study.

### **2.2 Thawing of samples and Drip Loss**

The samples were thawed overnight in a natural fabricated mesh to runoff the water through the bottom and the mesh was covered by aluminium foil to avoid drying out of the shrimps. Drip loss was estimated by measuring the percent loss of water from the shrimp during the thawing process with the following formula (AOAC, 1995).

% Drip Loss = (weight of frozen shrimp-weight of thawed shrimp) / weight of frozen shrimp X 100

### **2.3 Analysis of water and ash**

Water and ash were measured with quadruplicate samples and the average value was taken. Five grams of accurately (0.0001g) weighed homogenized samples were taken in porcelain cup and were dried at 105 °C for 12 hours and after that the samples were cooled in a desiccator and weighed. The water content was calculated with the following formula.

Water content (%) = [ (wet weight-dry weight)/wet weight] X 100

The same dried samples were burned at 540 °C for 12 hours and then cooled in a desiccator and weighed. The ash content was calculated with the following formula.

Ash content (%) = [ash weight/ wet weight] X 100

### **2.4 Analysis of protein**

Protein was also analyzed in quadruplicate samples by Kjeldahl procedure with a Kjeltac 2300 (Foss Analytical AB, Höganäs, Sweden) and the average was taken. 1.0 gram of homogenized samples were weighed in nitrogen free paper. Samples were then placed in Kjeldahl tubes along with 2 pieces of Kjeltabs and 15 ml of concentrated sulphuric acid was added to each sample. The samples were digested at 420 °C for 45 minutes and then kept still to get cooled. After cooling the tubes, 75 ml of distilled water was added and then the samples were analyzed in a Kjeltac to directly determine the protein percentage values.

### **2.5 Analysis of fat**

Fat was extracted from quadruplicate samples by ethyl acetate and the average value was taken. 10.0 grams of homogenized sample were mixed with 20±0.5 g dehydrated sodium sulphate (Na<sub>2</sub>SO<sub>4</sub>), mixed well and transferred to 100 ml bottles with tight fitting lids. The bottles were then filled with 50±0.1 ml ethyl acetate and samples were extracted for one hour on shaking table. The extracted solvent was then filtered through "Black band filter" and was evaporated in glass cups on waterbed. The glass cups were then dried at 105-110 °C in 15-20 minutes, cooled in a desiccator and weighed. The fat content was calculated by the following formula 1 and converted into percentage afterwards.

Formula 15.1.

$$\text{Fat content} = \frac{10300 \times \text{gm fat}}{(40 - 2.17 \times \text{gm fat}) \times \text{gm sample weight}}$$

## 2.6 TVN (Total Volatile Nitrogen) and pH Analysis

TVN was analyzed by a Kjeltec 2300 (Foss Analytical AB, Höganäs, Sweden) with 4 replications and the average value was taken. 10.0 grams of homogenized sample was taken along with 50 ml distilled water, 3 ml antifoam agent (20% silicon), 1 g MgO and put into a Kjeltec 2300 with DD1 program to determine ml titrant used during distillation. The following formula was used to calculate the mg TVN/100 g sample.

$$\text{Mg TVN/100g Sample} = \frac{\text{ml titrant} \times M \times 14.01 \times 100}{\text{Weight of sample}}$$

Where M is the molarity of the used HCl solution

The pH of the grounded samples was measured by a digital pH meter.

## 2.7 Colour analysis

The L, a\*, b\* (L-lightness, a\*-redness and b\*- yellowness) values were analyzed to determine the colour of the samples with Minolta Chroma meter 300. North Atlantic Shrimps were blended in a food processor and placed in the lens plate and 6 measurements of L, a\*, b\* values were taken by putting the measuring sensor on the lens in circulatory order and the average value was taken. In Black Tiger Shrimp colour were measured on the surface and average of the 6 measurements was taken.

## 2.8 Texture analysis

Texture analysis of the shrimp muscles was conducted by TA-XT2 Texture Analyzer to measure the shear resistance (kg). Where Pre-test, Test and Post test speeds were 2, 1, 2 mm/sec respectively with 90% Distance, 100g Force and 10sec Time.

## 2.9 Fatty Acid Analysis

The fatty acid profiles of the shrimps were determined with GC (Gas Chromatography) in quadruplicate samples. 1.0 gram of homogenized sample was weighed for each

replication. Then the lipid was extracted following the (Blight and Dyer, 1959) method by extracting with  $\text{CHCl}_3$ , MeOH and water (2:2:1.8) over night at 4 °C with C 21:0 (1.0 mg C 21:0/g sample) as internal standard. After centrifugation the lower phase was taken and evaporated with  $\text{N}_2$ . The sample was then hydrolyzed with 0.5 M NaOH in MeOH and then esterified with 10%  $\text{BF}_3$  in MeOH according to (Metcalf, *et al.*, 1966) but the extraction was performed with hexane instead of petroleum ether. The samples were loaded with an auto sampler adapted to GC (Agilent 6890). A 10m, internal diameter 0.1 mm capillary column (Agilent 127-2222, DB-25 Integrator) with a split injector,  $\text{H}_2$  as mobile phase and a flame ionization detector was used. Initial temperature was 90 °C in 4 minute and then temperature was raised with 30 °C per minute to 165 °C then with 3 °C per minute until it reaches to 225 °C. HP chemstation (Rev. A. 09.03. 1417) was used for data analysis.

### 3 Results

Table 15.1 shows a higher initial drip loss (13.2%) in Black Tiger shrimp (BTS) than in North Atlantic shrimp (NAS) (7.3%). Drip loss was higher in BTS throughout the freeze storage than in NAS. After 6 months drip loss was 17.0% and 12.2% in BTS and NAS respectively at -20 °C and 16.0% and 10.0% at -40 °C. NAS had higher water content than BTS throughout the storage period. Initial water content was 83.3% in NAS and 81.0% in BTS. At the end of 6 months water content was higher in both groups at -40 °C storage than -20 °C. Protein content was 14.1% in NAS and 17.1% in BTS . In NAS protein increased after six months to 15.3% at -20 °C and 14.9% at -40 °C. In BTS it was 19.9% at -20 °C and 18.6% at -40 °C. Initial Ash content was 2.12% in NAS and 1.74% in BTS . Increase in ash was more in NAS than in BTS and higher content was at -20 °C than -40 °C in both species. There was higher pH and TVN in NAS than in BTS throughout the storage period. Initial TVN value was 5.8 (mg/100 g) in BTS and 8.7 (mg/100 g) in NAS. Shear Force increased at -40 °C storage while it decreased at -20 °C in both the species during six months of storage. In general shear force in BTS muscle was higher than that of NAS muscle.

**Table 15.1** Chemical and physical parameters in North Atlantic Shrimp during freeze storage

Samples	Drip Loss (%)	Water (%)	Protein (%)	Fat (%)	PH	TVN (mg/100g)	Ash (%)	Shear Force (Kg)	L	a*	b*
<i>NAS,Control</i>	7.32	83.35	14.1	0.42	7.23	8.18	2.12	0.88	61.09	-0.94	4.50
NAS,2M-20	9.52	82.83	14.3	0.39	7.35	8.75	2.46	0.88	61.13	-0.65	4.29
NAS,2M-40	9.25	83.09	14.4	0.41	7.31	8.49	2.22	0.92	61.16	-0.17	4.81
NAS,4M-20	9.95	82.04	14.7	0.39	7.62	9.25	2.88	0.86	61.09	0.13	6.30
NAS,4M-40	9.38	82.46	14.7	0.40	7.47	8.80	2.56	0.95	61.16	-0.37	5.51
NAS,6M-20	12.15	81.15	15.3	0.35	7.90	9.62	3.22	0.84	61.10	-0.39	5.90
NAS,6M-40	9.95	81.86	14.9	0.38	7.61	9.05	2.86	0.98	61.19	0.01	6.96
<i>BTS,control</i>	13.18	81.00	17.1	0.30	6.32	5.82	1.74	1.08	62.13	1.86	7.40
BTS,2M-20	14.62	80.52	17.5	0.28	6.45	5.91	1.94	1.09	61.96	1.67	7.41
BTS,2M-40	14.33	80.79	17.2	0.29	6.40	5.88	1.90	1.14	62.01	1.76	7.4
BTS,4M-20	15.85	79.32	18.3	0.28	6.66	6.59	2.10	1.04	61.46	1.36	7.31
BTS,4M-40	15.01	80.19	17.5	0.29	6.50	6.01	1.99	1.19	61.92	1.65	7.35
BTS,6M-20	17.00	78.00	19.9	0.27	6.92	8.20	2.73	1.00	61.00	1.05	7.29
BTS,6M-40	16.02	79.15	18.6	0.28	6.61	7.50	2.32	1.30	61.80	1.30	7.30

NAS= North Atlantic Shrimp, BTS= Black Tiger Shrimp

Table 15.2 shows the percentage of major fatty acids found in North Atlantic shrimp and their change during the course of freeze storage. Major fatty acid was PUFA and rest were SFA and MUFA at almost equal quantity.

**Table 15.2** Percentage of major fatty acids of total fatty Acids in North Atlantic Shrimp (NAS) during freeze storage

Samples	C16:0	C16:1n7	C18:1n11/9	C18:1n7	C20:5n3	C22:6n3
NAS,Control	17.0	5.1	12.1	7.5	24.1	19.4
NAS,2M-20	16.9	6.3	12.5	7.3	23.7	17.4
NAS,4M-20	19.6	7.0	13.6	7.6	22.5	15.1
NAS,6M-20	20.0	8.8	14.6	7.6	21.0	14.9
NAS,2M-40	17.0	7.1	12.6	7.4	24.1	18.4
NAS,4M-40	18.2	7.1	13.7	7.6	24.0	18.0
NAS,6M-40	19.2	8.7	14.8	7.6	23.9	17.8

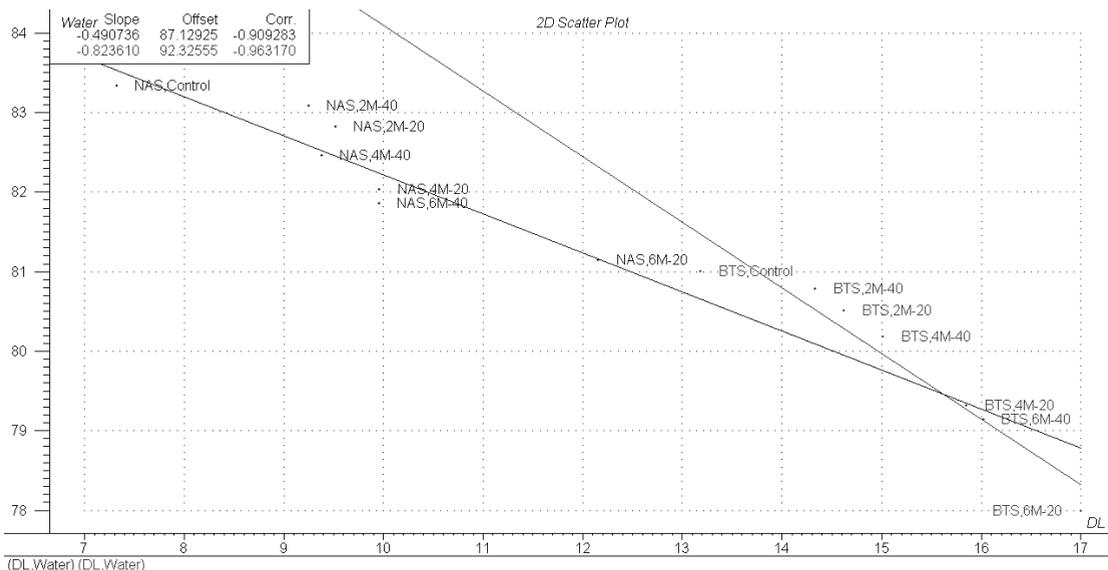
Table 15.3 shows the percentage of major fatty acids found in Black tiger shrimp and there changes during the course of freezing. Major fatty acids were SFA and MUFA and the rest were PUFA.

**Table 15.3** Percentage of major fatty acids of total fatty Acids in Black Tiger Shrimp (BTS) during freeze storage

Samples	C16:0	C18:0	C18:1n7	C18:2n6	C20:4n6	C20:5n3	C22:6n3
BTS,control	17.7	10.1	14.7	11.1	9.1	13.3	8.1
BTS,2M-20	18.0	10.2	14.8	11.1	9.0	12.3	8.6
BTS,4M-20	18.3	10.2	14.9	10.8	8.7	11.3	7.7
BTS,6M-20	18.5	10.3	14.9	10.7	8.3	10.3	7.8
BTS,2M-40	17.9	10.1	14.8	11.1	9.1	12.7	8.9
BTS,4M-40	18.0	10.1	14.8	11.0	9.0	12.0	8.10
BTS,6M-40	18.2	10.2	14.8	10.9	8.7	11.2	7.6

## 4 Discussion

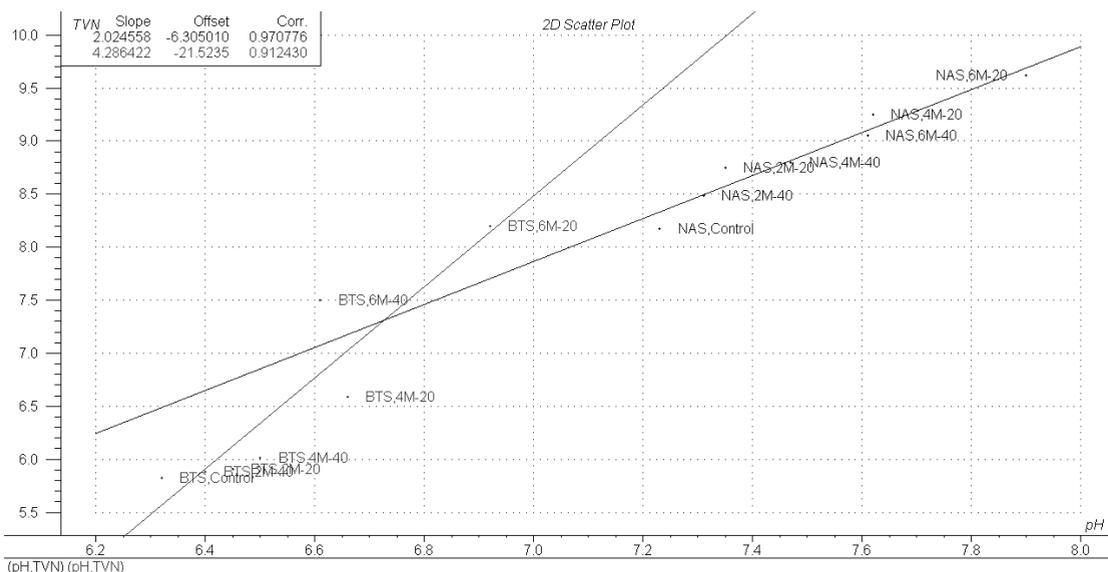
Drip loss during thawing shrimp in other sense is loss of money in terms of water. Some part of the drip loss was obviously from glazing as its necessary in shrimp processing. The other reason for drip loss may be due to cavity ice formation; which resulted in product desiccation as moisture comes out from shrimp as ice (Nickerson and Karel, 1975). Higher drip loss in Black Tiger Shrimp (BTS) resulted in decreased water content and made it much drier (Figure 15.1) than North Atlantic Shrimp (NAS). Retaining higher water content in NAS than BTS during the freeze storage may be due to lesser drip loss. Drip loss also resulted in decreased fat content and increased protein & ash content; this change was higher at -20 °C than -40 °C. Formation of larger ice crystals at -20 °C may be another reason for higher drip loss.



NAS= North Atlantic Shrimp, BTS= Black Tiger Shrimp, DL= Drip Loss

**Figure 15.1** Correlation between drip loss (DL) and water quantity in North Atlantic Shrimp (NAS) and Black Tiger Shrimp (BTS) during freeze storage

Protein content in NAS in the present study is lower than the value (17.4%) found in the study by (Zeng, *et al.*, 2005). Protein content of BTS was similar to 17.7 % found by (Boonsumrej, *et al.*, 2007). Variation of protein content may be due to physiological and environmental reasons. In both shrimp and prawn the protein percentage increases gradually during storage, this could be due to the loss of water and the meat became more concentrated. In this study fat content of both ready peeled frozen NAS and BTS was from 0.30% - 0.42% which is similar to the fat content (0.35%) of frozen shrimp found by (Cadun, *et al.*, 2005). In both samples ash content were higher because of added salt during processing. Previous studies observed ash content of *Pandalus borealis* was 2.04 (Simpson, *et al.*, 1998), which was similar to the values of 1.85 (Gordon and Roberts, 1977) and 2.49% (Amer, *et al.*, 1991). In marine fish, TVN values of 15–20 mg N/100 g treated as good quality and 50 mg N/ 100 g as poor quality (Conell, 1995). But in this study TVN content of both shrimp samples ranged from 8-14 mg N/100g from start up to 6 months of storage, which surely indicates excellent quality than TVN values (33.5 mg/100 g) found in previous studies by (Zeng, *et al.*, 2005). During freeze storage, BTS had lower TVN than NAS, but the rate of increase was higher in BTS during storage (Fig 2). A higher pH in NAS than in BTS resulted in coordination with higher TVN value.

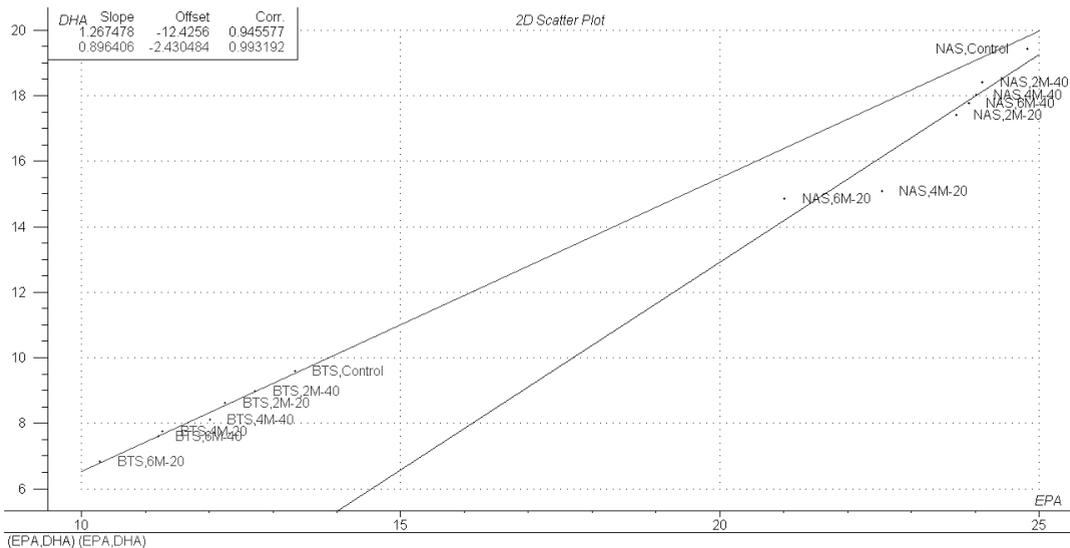


NAS= North Atlantic Shrimp, BTS= Black Tiger Shrimp

**Figure 15.2** Correlation between pH and TVN in North Atlantic Shrimp (NAS) and Black Tiger Shrimp (BTS) during freeze storage

Both the samples had close pH values during the freeze storage and there was an increase in pH and it was slightly more in -20 °C than -40 °C. Similar trend of increase in pH during ice storage had seen by (Shamshad, *et al.*, 1990) and (Sergio and Crawford, 1973). Comparatively high pH in both samples may be explained due to seasonal variation and catching condition or procedure. Usually shrimp muscle gets tougher during frozen storage (Noomhorm and Vongsawasdi, 1998; Webb, *et al.*, 1975) and this relates with the present study values from -40 °C but in case of -20 °C storage shrimp muscle had lower shear force i.e., muscle structure got soft. This may be due to freezing damage due to larger ice crystal formation at -20 °C. In general NAS muscle had lower shear force than BTS muscle, as BTS was bigger in size.

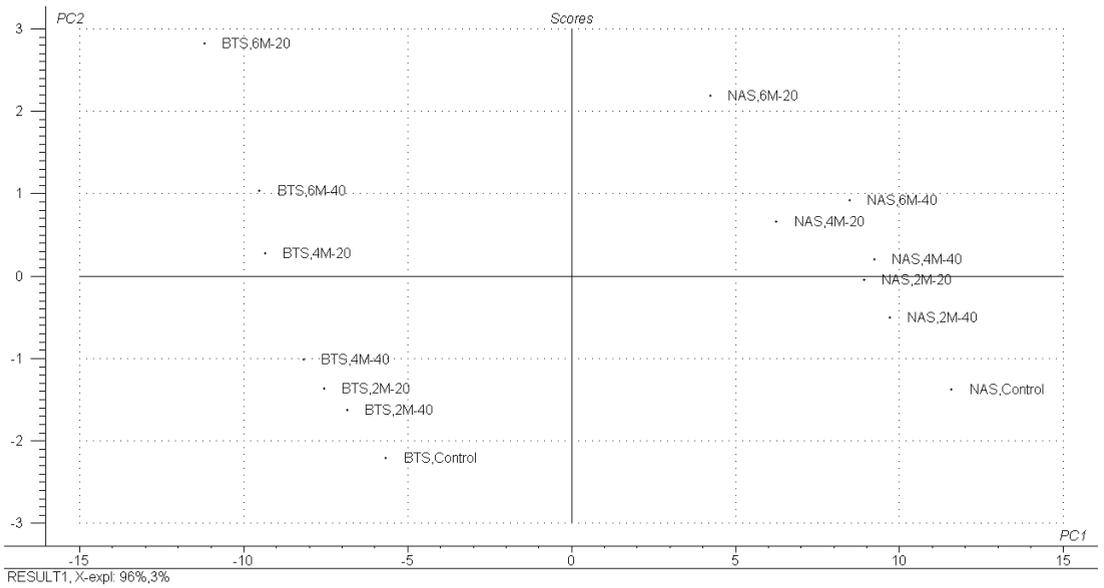
Figure 15.3 shows the change in EPA and DHA in both NAS (North Atlantic Shrimp) and BTS (Black Tiger shrimp) during six month of freeze storage. The decrease was higher in BTS than NAS throughout the storage. Fatty acid composition of North Atlantic Shrimp (NAS) was dominated by polyunsaturated fatty acids (49.9%) mainly EPA (Eicosapentaenoic Acid 20:5n-3) and DHA (Docosahexanoic Acid 22:6n-3).



**Figure 15.3** Change of EPA and DHA content in North Atlantic Shrimp (NAS) and Black Tiger Shrimp (BTS) during freeze storage

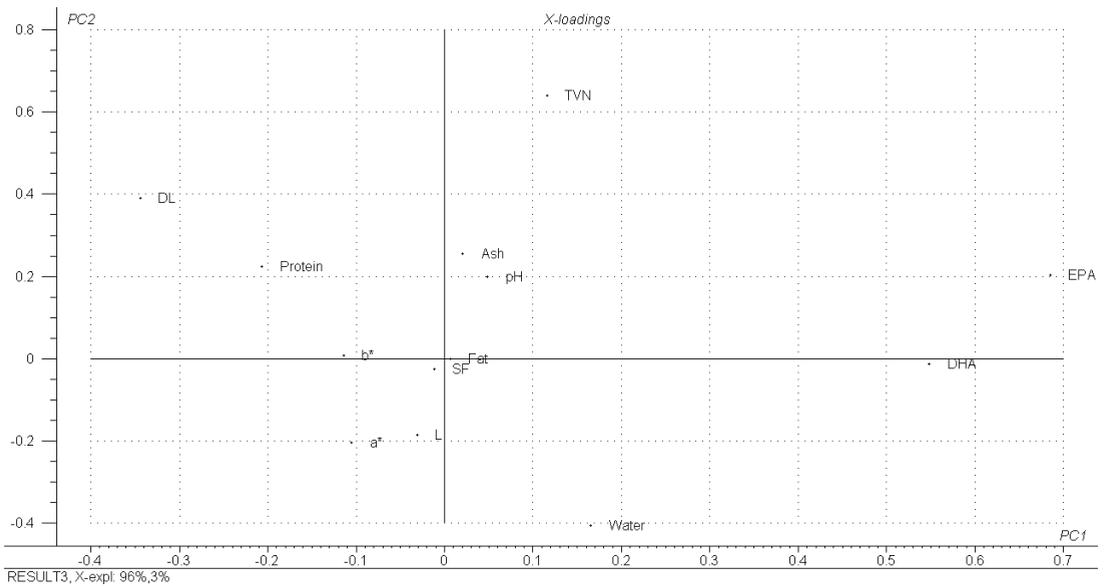
The total amount of EPA and DHA in NAS was 44% of total fatty acid when the total fat content was only 0.4%. The total amount of EPA and DHA in BTS was 23% of total fatty acid when the total fat content was only 0.3%. These values are more similar with previous studies where PUFA content of *Pandalus borealis* was 42.1%-48.4% (Rosa and Nunes, 2004). In NAS the major proportion of fatty acids were PUFA, MUFA and then SFA respectively. (Yanar and Celik, 2006) found 16:0, 18:0, 18:1, 16:1, 20:4, 20:5 n-3 and 22:6 n-3 the most available fatty acids in marine shrimp, which is very similar to NAS fatty acid profile. Reduction in fatty acids during freeze storage is a usual trend as nutrients keep on deteriorating during freezing and it relates to the previous studies on shrimp freezing. Reddy, *et al.*, (1981) found a decrease in the fatty acids during 6 months storage at -18 °C. Higher value of EPA, DHA at -40 °C than -20 °C reveals the benefit of low temperature freezing during long time storage.

Score plot in figure 15.4 shows North Atlantic Shrimp (NAS) and Black Tiger Shrimp (BTS) are differentiated in to PC1 and PC2. In the sample plot the variations amongst the samples were 99% explained.



**Figure 15.4** Score Plot of PC1 and PC2

Figure 15.5 shows the major difference between BTS and NAS indicating high drip loss, protein, shear force and low fat, EPA & DHA content in BTS and higher water, pH & TVN content in the NAS. EPA and DHA were more stable in NAS



**Figure 15.5** Loading Plot of PC1 and PC2

The PC2 show the changes due to storage temperature and time. The drip loss, protein, ash, TVN, pH increased during the storage especially for the -20 °C samples. This explains maximum changes in quality were at -20 °C than at -40 °C. Maximum changes from the controls of all samples were after 6 months at -20 °C. In the loading plot the variations amongst the variables were 99% explained.

## 5 Conclusion

To get a longer shelf life it is better to store shrimps at -40 °C but for short-term storage for domestic consumption -20 °C may be useful. Freezing at -40 °C preserves the quality of peeled frozen shrimp, especially the beneficial fatty acids like EPA and DHA. During this study it was found that freezing at -40 °C resulted in less drip loss. Freeze storage at -20 °C results in softer texture and at -40 °C storage results in a firmer shrimp.

Frozen peeled North Atlantic Shrimp contains double the quantity of beneficial EPA and DHA than Frozen peeled Black Tiger Shrimp. Drip loss during thawing was 5.8% higher in Black Tiger Shrimp than Atlantic Shrimp and which resulted in a drier product. Qualitative and quantitative changes were almost similar in raw, peeled frozen and manually cooked Tiger shrimp during freeze storage. There were limited researches on the fatty acid profile of shrimp during freeze storage, so this study will assist to the future research.

This study shows that shrimps are undergoing rapid quality degradation if they are frozen and stored at -20 °C. Freeze storage at -40 °C will maintain the quality attributes for considerably longer times. There are no differences in the freezing equipment as long as the temperature is above -40 °C. Below this temperature other cooling media is necessary strongly increasing the price for the freezer. Using standard freezing equipment, the increase in the cost for freeze storage is low. Storage at -40 °C has therefore become standard for high quality products of fatty species as salmon and herring and should also be used for expensive products such as shrimps.

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## Chapter 16:

# Human intervention triggered changes to inlet hydrodynamics and tidal flushing of Koggala lagoon, Sri Lanka

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**Abstract:** Hydrodynamic model applications related to hydrodynamics of lagoon inlet and flushing properties of the Koggala lagoon, Sri Lanka are described in this research work. The hydrodynamic modeling study was carried out for two scenarios of Koggala lagoon namely; 1) Existing situation (Koggala Scenario 1 – KS1) and 2) Future scenario with respect to proposed groyne interventions for the mouth width of 20m (Koggala Scenario 2 – KS2) with the aim of minimizing the seawater intrusion and subsequently improve lagoon ecosystem. Numerical simulation results showed existing salting factor

for the lagoon is 0.68 and for 20m opening is 0.54. This shows the mouth width can be reduced up to 20m in order to obtain a slating factor close to 0.5, which indicates the predominant influence of fresh water which in turn leads lagoon to a fresh water ecosystem. In quantifying the tidal flushing of Koggala lagoon, the concept of flushing half-life ( $T_{50\%}$  hours) was adapted as the optimum measure of flushing time. Flushing half-life was calculated for the same two scenarios KS1 and KS2. The flushing half-life ranges from 9hours to 37hours (1.5 days) for KS1 while it ranges from 12hours to 72hours (3days) for KS2. Flushing half-life suggests that the exchange rate between the lagoon and the ocean is controlled by the balance between the fresh water inflow and the sea water inflow. Evacuation factor was assessed as a measure of tidal flushing efficiency and results showed KS2 has an improved efficiency than KS1 with the narrow opening. Applications of hydrodynamic model and flushing half-life presented in this article can be used to help guide management and policy making for coastal environment of Koggala lagoon, Sri Lanka in future.

**Key words:** Coastal lagoons, Lagoon morphometry, Numerical modeling

## 1 Introduction

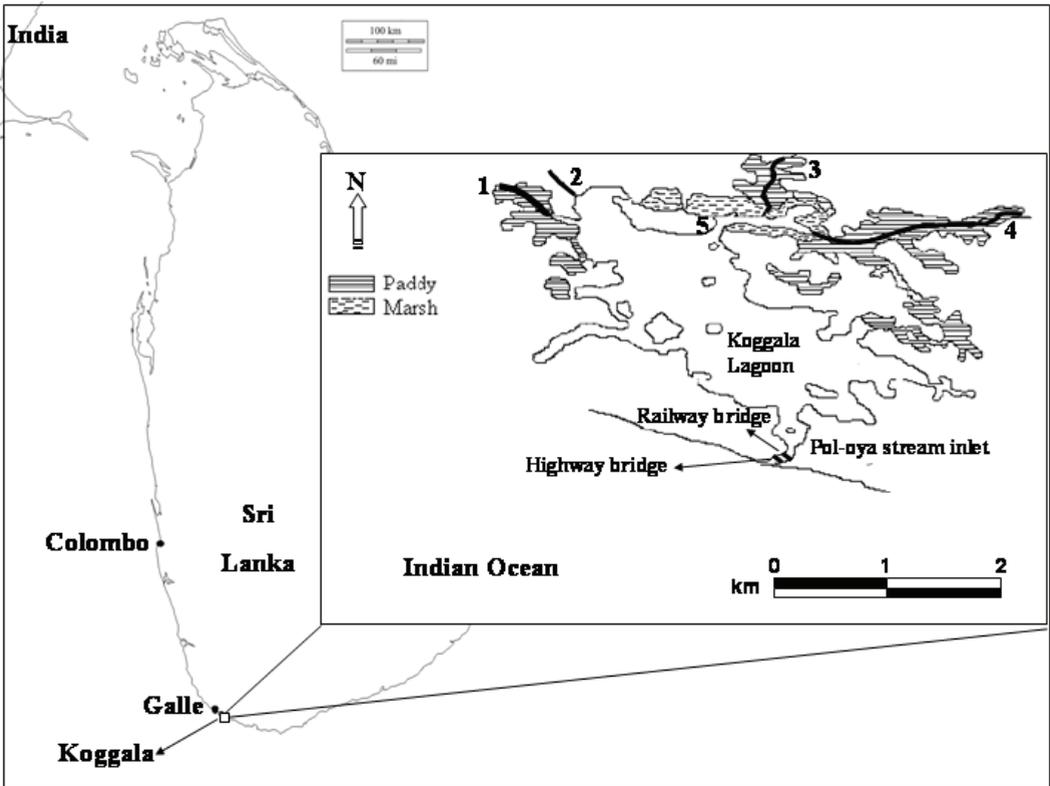
Koggala lagoon is a costal lagoon located ( $5^{\circ} 58' - 6^{\circ} 20' N$  and  $80^{\circ} 17' - 80^{\circ} 22' E$ ) on the southern coast of Sri Lanka (SL) about 110km south from trade capital Colombo and approximately 10km away from southern capital Galle (CEA 1995) (Fig. 16.1). Coastal lagoons are areas of relatively shallow water, usually oriented parallel to the sea that have been partly or wholly sealed off from the sea by the deposition of spits or barriers (Colombo 1977; Phelger 1969). Coastal zones are currently experiencing intense and sustained environmental pressures from a range of natural, semi-natural and anthropogenic drivers (Mitsch and Gosselink 2000). Over the past two decades industrialization, urbanization, and deforestation have led to wetland loss in Koggala lagoon area, resulting in the extinction of countless species and the alteration of the relationship of coastal wetlands with the regional environment (Gunaratne et al. 2010). Physical processes in coastal lagoons are influenced by winds, tides and morphometry. Lagoon inlet morphometry controls the exchange of water including the dissolved and suspended matters that it contains, and in turn determines flushing time (Miller et al. 1990). At the inlet of the Koggala lagoon there was a naturally built sand bar perpendicular to the lagoon mouth which controlled the seawater intrusion into the lagoon (Fig. 16.2a). With the opening of the lagoon mouth during the rainy season, rapid outflow of water has begun. However, the flow of seawater into the lagoon during the monsoon and high tides ceased the formation of sand bar again in the dry season. This

natural dynamic rhythm caused high seasonal variations in most of the physical and chemical properties of lagoon water (Priyadarshana et al. 2007). Coastal lagoons are considered to be the estuary type most sensitive to human interventions (Boyd et al. 1992). Human interventions in coastal lagoons are frequent and many of these systems are maintained through regular dredging of the inlets, while many others have artificial structures, such as jetties, groynes and guiding walls, to prevent inlet migration or closure (Oliveira et al. 2006).

## **2 Theoretical framework**

Objectives of this study are to analyze quantitatively the adverse contribution of the existing groyne structure, caused by intensification of the seawater through the large mouth opening and to evaluate the restoration possibility with proposing groyne structural interventions. An effort has taken to analyze the tidal flushing of the lagoon using some hydrological parameters of the lagoon.

An engineering solution was proposed with a redesign of existing groyne structure by Priyadarshana et al. (2007) but it was not hydro-dynamically simulated and investigated. In this paper two dimensional (2D) hydrodynamic models are discussed in quantifying sea water inflow volumes and predict hydraulic parameters (e.g., water velocity in the lagoon mouth), aiming at reaching better decisions with regard to lagoon restoration design and management actions for improvement of environmental conditions and aquaculture. Accurate hydraulic and hydrologic designs reduce restoration design risks. Coastal erosion and coastal defense activities have changed the morphometry of the lagoon inlet since 1992. A foreign contractor for the coastal defense work damaged the natural protective seaward sandbar by unplanned sand removal (CEA 1995). After the removal of the natural sand bar, its formation shifted towards landward side. Breaching the sand bar became increasingly difficult and erosion close to the highway bridge posed a risk to the bridge. Along with the sand movement, sedimentation occurs in certain area of lagoon mouth. Southern Provincial Council built a rubble mound groyne system (old and new groyne) as a remedial action in order to protect the bridge from the wave attack and to minimize erosion (Fig. 16.2b) (Gunaratne et al. 2010; Priyadarshana et al. 2007). The groyne system provoked concern over local resource users and environmentalists as it pushed the lagoon towards saline conditions, avoiding inlet throat closure while permanently open lagoon inlet throat to the sea (Priyadarshana et al. 2007). In other words it adversely affects on reduction of the fish production in the lagoon, growth of invasive species in the lagoon, destruction of mangroves, loss of alternative livelihoods in the area and salinization of paddy fields (Gunaratne 2010; Priyadarshana et al., 2007).



**Figure 16.1** Map of Koggala lagoon with the locations of outlet and major freshwater inflows; Suburb marsh and paddy field areas are shown in different shaded patterns (Modified from CEA, 1995)



**Figure 16.2** a) Satellite image of Koggala lagoon outlet with sand bar and manually cut opening in 1985 (Source: Coast Conservation Department, SL); b) Satellite image of lagoon outlet with the existing groyne structures.

Since groyne constructed in 2005 (new groyne) was not captured in the image, it was included externally for the figure. Sand deposited areas are encircled by dotted lines (Modified from Google earth, accessed January 2009)

### **3 Methodology applied**

#### **3.1 Study site description**

Koggala lagoon is enriched with several freshwater streams connected at the far end, and the seaward end has a narrow outlet named 'Pol-oya', a narrow 300m long canal connects the lagoon with the sea (Fig. 16.1). The waterway area of the Koggala lagoon, estimated approximately as 7.27km<sup>2</sup> measuring 4.8km in length and 2km in width. The water depth ranges from 1.0m to 3.7m with a mean depth of 1.29m (Gunaratne 2010; Silva 1996). Hydro-catchment of the lagoon outlet is about 55km<sup>2</sup>, out of this amount about 15% consists of lagoon area. It is estimated to have further 15% of paddy fields or low lying areas (Priyadarshana et al. 2007). Various land use practices exist around this wetland, which mainly includes small-scale fishing industry within lagoon and paddy cultivation close to the landward end of the lagoon (Amarasinghe 1998). The Koggala Export Processing Zone, largely focused on textile manufacturing is located within the catchment area of the lagoon.

Koggala is located in the wet zone on the southern coast of SL and therefore experiences a mean annual rainfall of between 2,000 to 2,500mm with the heaviest rainfall in the months of May and October (IWMI 2006). It receives rain during the southwest monsoon and during the first and second monsoon periods. The temperature in the area ranges between 15°C and 28°C (IWMI 2006).

#### **3.2 Inlet Hydrodynamics**

Physical processes of the lagoon are influenced by structural interventions. To get a full understanding of the complex reality of physical processes is sometimes difficult with field observations thus a model provides a simplified abstract view. To reproduce the water circulation in the lagoon, a two-dimensional (2D) hydrodynamic model was developed and used. The basic equations included in the hydrodynamic model are the conservation of fluid mass equation and momentum equations (Reynolds equation). The equations are first developed in three dimensions. By depth averaged integration, the equations are reduced into two dimensional equations which are suitable for the

shallow depth estuaries or lagoon when compares with long length tides. The basic governing equations in Cartesian coordinate are shown as follows:

Continuity equation:

$$\frac{\partial h}{\partial t} + \frac{\partial M}{\partial x} + \frac{\partial N}{\partial y} = 0 \quad (1)$$

Momentum equations in x and y directions:

$$\frac{\partial M}{\partial t} + \frac{\partial Mu}{\partial x} + \frac{\partial Mv}{\partial y} = -gh \frac{\partial Z_s}{\partial x} - \frac{\tau_{0x}}{\rho} - \frac{f_x}{\rho} + \frac{\partial}{\partial x}(-\overline{u'^2}h) + \frac{\partial}{\partial y}(-\overline{u'v'}h) \quad (2)$$

$$\frac{\partial N}{\partial t} + \frac{\partial Nu}{\partial x} + \frac{\partial Nv}{\partial y} = -gh \frac{\partial Z_s}{\partial y} - \frac{\tau_{0y}}{\rho} - \frac{f_y}{\rho} + \frac{\partial}{\partial x}(-\overline{u'v'}h) + \frac{\partial}{\partial y}(-\overline{v'^2}h) \quad (3)$$

where  $t$  is the time;  $h$  is the water depth;  $u$  and  $v$  are the depth-averaged velocities in  $x$  and  $y$  directions, respectively;  $M=uh$  and  $N=vh$  are the flux in  $x$  and  $y$  directions, respectively;  $\tau_x$  and  $\tau_y$  are the bed shear stress in  $x$  and  $y$  directions, respectively;  $f_x$  and  $f_y$  are the drag forces per unit area in  $x$  and  $y$  directions, respectively (in this simulation,  $f_x$  and  $f_y=0$ , as there are no mangrove in the calculated region);  $-\overline{u'^2}$ ,  $-\overline{u'v'}$ , and  $-\overline{v'^2}$  are depth-averaged Reynolds stresses;  $g$  is the gravitational acceleration,  $h$  is the water depth,  $\rho$  is the fluid density; and  $Z_s$  is the water level.

For grid transformation from the Cartesian coordinates to generalized coordinate system, the method by Hosoda et al. (1996) was applied. Reynolds stress term was calculated by the same method with Hosoda (2002). The applicability of the developed model was validated for river flow (Tanaka and Yagisawa, 2009). Finite volume method was used to solve the partial differential equations.

### *Model set up*

The area covered for modelling was only the lagoon mouth area (Fig 3a); approximately 80 X 400 m with 9 X 30 orthogonal grids. Since the accuracy of computed results depended on the computing grid, the grid was fine enough to represent the shoreline configuration and yielded accurate results. Considering the layout constraints and computational time, the grid size is fixed around 10 m. The depth averaged two dimensional hydrodynamic model was developed to describe the current and flow pattern in the lagoon mouth area for existing and proposed scenarios with structural interventions. The input data to the model mainly comprises the following: (1) Bathymetry data adapted from Gunaratne (2010); (2) tide elevation time series at down stream; (3) Fresh water inflow rate at upstream. The model was determined to run for period of six hours (half tide cycle in semi diurnal tide) with a time step of 0.2 s.

The Universal Transverse Mercator (UTM) coordinate system was used in plotting graphs for hydrodynamic models.

### 3.3 Salting Factor

Salting factor is an indicator that shows, to what extent are lagoon waters under the influence of the sea. Salting factor ( $F_s$ ) is the ratio of average annual seawater inflow ( $Q_{inflow}$ ) and total inflow can be expressed as follows (Eq. 4) (Chubarenko et al. 2005).

$$F_s = \frac{Q_{inflow}}{(Q_{inflow} + Q)} \quad (4)$$

$$\text{where } Q = Q_{stream} + Q_{runoff} + Q_{prc} - Q_{evp} \quad (5)$$

$Q$  is total annual fresh water contribution,  $Q_{stream}$  is annual average stream flow,  $Q_{runoff}$  is annual average runoff volume from catchment area to the lagoon,  $Q_{prc}$  is annual average precipitation volume from lagoon and  $Q_{evp}$  is annual average evaporation water loss from lagoon.  $Q_{inflow}$ ,  $Q_{stream}$ ,  $Q_{runoff}$ ,  $Q_{prc}$  and  $Q_{evp}$  were adapted from Gunaratne (2010) as shown in Table 16.1.

If the  $F_s \leq 0.5$  then it predominantly influenced by freshwater inflow while  $0.5 < F_s \leq 1$  then it is predominantly influenced by seawater.  $F_s > 1$  it shows the hyper-saline situation where lagoon salinity is greater than seawater salinity.

**Table 16.1** Annual average contributions of identified main hydrological parameters for Koggala lagoon (Time span 2007 Jan to 2008 Nov). (+)Signs denote all the inflows to the lagoon and (-) signs denote all outflows from the lagoon. (Source: Gunaratne 2010)

<i>Hydrological parameters</i>	<i>Contribution</i>	
Annual average precipitation volume ( $Q_{prc}$ )	+ 0.53	$m^3 s^{-1}$
Annual average evaporation water loss from lagoon ( $Q_{evp}$ )	- 0.26	$m^3 s^{-1}$
Annual average stream water inflow rate ( $Q_{stream} + Q_{runoff}$ )	+ 9.48	$m^3 s^{-1}$
Annual average seawater inflow ( $Q_{inflow}$ )	+ 21.64	$m^3 s^{-1}$

### 3.4 Flushing time

Officer (1980) defines the turnover time or flushing time for a lagoon as the mean time a particle of a conservative substance spends in a given volume. Salt and fresh water are usually considered conservative substances in estuarine hydrodynamics.

In quantifying the flushing of Koggala lagoon, the concept of flushing half-life ( $T_{50\%}$  hours) was adapted as the optimum measure of flushing time. Flushing half-life defines as the time that it takes to replace half of the lagoon water volume and this definition is based on a rather restrictive assumption, i.e. it is assumed that complete mixing occurs rapidly compared to flushing half time (Knoppers et al. 1991). Assuming first order kinetics, if  $V$  denotes the volume of water in the lagoon,  $t$  time, and  $k$  a rate constant, it is expressed

$$\frac{dV}{dt} = -kV \quad (6)$$

(Pritchard, 1961) which can be integrated from  $t = 0$  when the lagoon volume was  $V_0$ , to a new time,  $T_{50\%}$ , when the total water volume is the same but only 50% of the original water parcels remain inside the lagoon, or when  $V_{new}/V_0 = 0.50$ . It follows that

$$T_{50\%} = 0.69/k \quad (7)$$

Flushing in coastal lagoons depends on a combination of factors of varying importance. Most important factors are tidal exchange ( $Q_T$ ), runoffs from streams and catchments ( $Q_R$ ), and the difference between rainfall and evaporation ( $Q_E$ ).

The tidal prism represents the new tidal water entering the lagoon every flooding tide. It is assumed that this water did not exit from the lagoon during the previous ebb tide. Since the lagoon's tide is semidiurnal, tidal exchange ( $Q_T$ ) can be expressed by Eq. 8.

$$Q_T = A_W \cdot \Delta h \left[ \frac{24.00}{12.42} \right] \quad (8)$$

where  $\Delta h$  is the mean tidal range and  $A_W$ , is the waterway area of the lagoon.  $A_W$  does not change appreciably between high and low tides because of the small tidal ranges, but are often appreciably different seasonally as a result of the runoff conditions.  $A_W$  was adapted from existing literature. Tidal range for existing condition (KS1) is 0.24m and for the restricted mouth condition (KS2) is 0.1m as modeled by Priyadarshana et al. (2007).

Total daily runoff ( $Q_R$ ) was calculated as the sum of stream water inflows and volumetric catchment runoff values for the daily basis.  $Q_R$  ( $Q_{runoff} + Q_{stream}$ ) was adapted from Gunaratne (2010).

Contribution of difference of rainfall and evaporation ( $Q_E$ ) were calculated as expressed by Eq. 9.

$$Q_E = A_L \cdot \frac{(r - e)}{30} \quad (9)$$

where  $r$  is the monthly rainfall and  $e$  is the monthly constant evaporation. Monthly rainfall data were gathered from Galle rain gauge station 2007 and 2008. Monthly constant evaporation of 120 mm was adapted from Priyadarshana et al. (2007). The absolute sign is necessitated by the fact that both rainfall and evaporation contribute positively to the flushing of the lagoon. Whereas excess rainfall mixes and exits through the canal, evaporation is lost through the surface but is replaced by new water entering from the entrance canal.

The rate constant  $k$  represents the fraction of lagoon water volume replaced each day as a result of tidal exchange, freshwater runoff, and the rainfall-evaporation balance, and  $k$  is expressed by Eq. 10.

$$k = \frac{Q_T + Q_R + Q_E}{V} \quad (10)$$

Flushing half life was calculated for two scenarios of Koggala lagoon; KS1 and KS2. For both scenarios same  $Q_R$  and  $Q_E$  values were used with two different  $Q_T$  values. Different lagoon mouth widths made two different tidal ranges and that provided two different  $Q_T$  values.

### 3.5 Evacuation factor

The evacuation factor is provides a relative measure of the ‘tidal flushing efficiency’ of a lagoon (Haines et al. 2006). This dimensionless factor is defined as:

$$EF = \frac{Sf \cdot TPR}{(1 - ECI)} \quad (11)$$

where,  $EF$  is evacuation factor,  $Sf$  is shape function,  $TPR$  is tidal prism ratio and  $ECI$  is entrance closure index.

The measure of the individual lagoon shape relative to the ‘typical’ lagoon shape has been given the term ‘shape function’ ( $Sf$ ). Lagoons with a shape equal to the typical shape are assigned a  $Sf$  value of unity. Lagoons with more circular in shape are given  $Sf$

values greater than unity, while lagoons that are more linear are given Sf values less than unity. Sf value was adapted from Gunaratne 2010.

The tidal prism ratio (TPR) is defined as ratio of total volume of lagoon at high tide and inter-tidal volume (Dyer 1997). The TPR provides a rudimentary indication of the degree of tidal mixing of an estuary, as it compares the volume of the incoming marine water with the resident volume of the waterway. In reality, the tidal range is variable and dependent on the condition of the entrance channel and shoals (Haines et al. 2006).

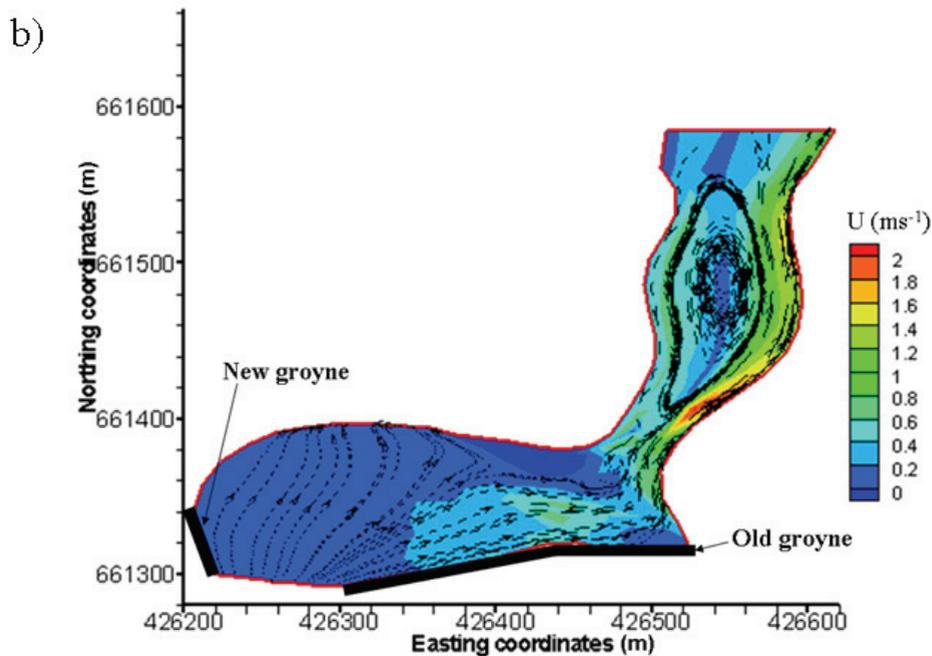
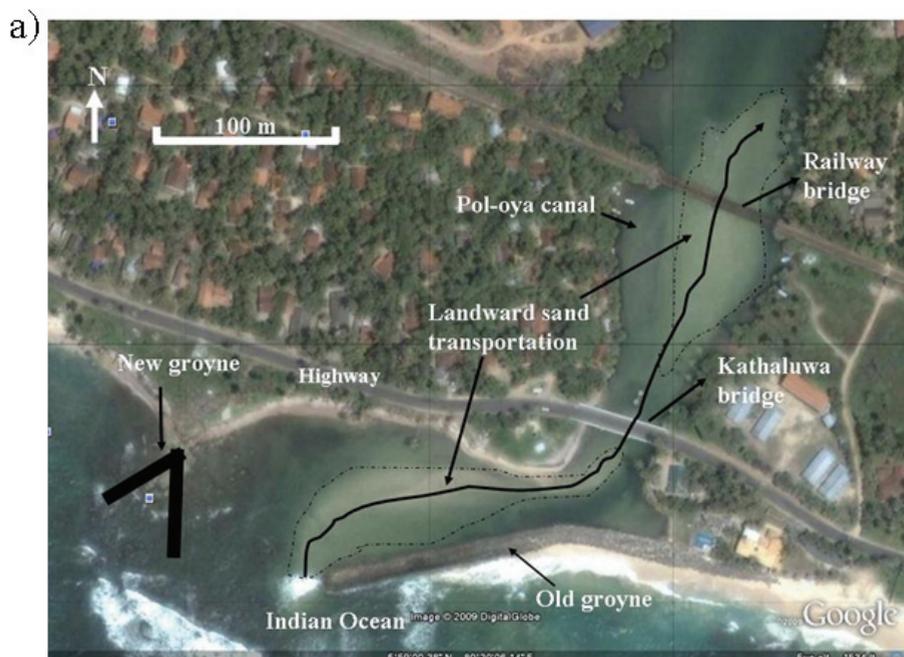
The term “ECI” was adapted from Haines et al. (2006) and it is defined as the proportion of time that the entrance of a lagoon is closed. The ECI is calculated over a long-term period, and as such, represents typical, averaged entrance conditions. The ECI values for Koggala lagoon KS1 and KS2 scenarios were determined using historical aerial photography interpretation, existing literature and interviews with villagers. The accuracy of the indices relates to their method of determination, which ultimately is a function of the availability of long-term information on lagoon conditions. ECI values are considered approximate, and can potentially vary on decadal scales due to dominant meteorological conditions. Future climate change may also influence long-term lagoon conditions, and thus may modify ECI values in time.

## **4 Findings**

### **4.1 Inlet Hydrodynamics**

Simulations were carried out for existing scenario (KS1 scenario) where mouth width was 85.5m (Fig. 16.3a). Fig. 16.3b shows the velocity behavior with stream line elaboration of the lagoon mouth for existing situation for high tide. Time duration was six hours for the calculation. Simulations were carried out for flood tide during the rainy season (May 2009) at spring tide where increased sea water inflows occur.

As Priyadarshana et al. (2007) proposed, groynes should be redesigned in order to minimize the seawater intrusion while reducing inland sediment transportation (Fig. 16.4a). Only this may help to restoration of lagoon’s fresh water ecology, with relatively high fresh water inflows. Simulations were carried out for 20m mouth opening (KS2 scenario). In both scenarios all conditions are same other than the mouth width. Fig. 16.4b shows the stream line elaboration with flow velocity behavior for lagoon mouth 20m opening with the proposed rubble mound groyne interventions with respect to existing groyne structures.

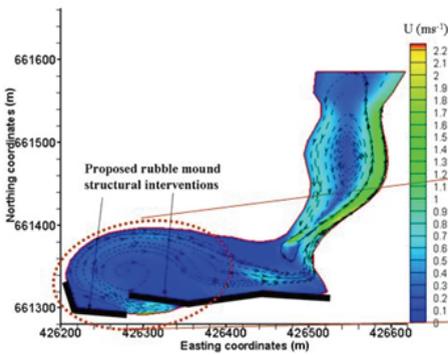


**Figure 16.3** a) Satellite image of lagoon mouth area covered for modeling (Modified from Google Earth); b) Simulated stream line elaboration with flow velocity behavior for lagoon mouth in existing groyne structures.

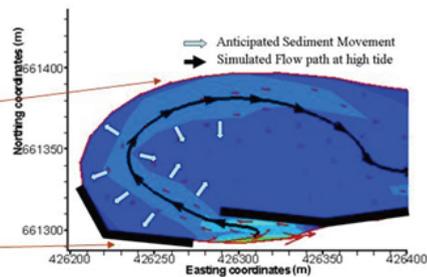
a)



b)



c)

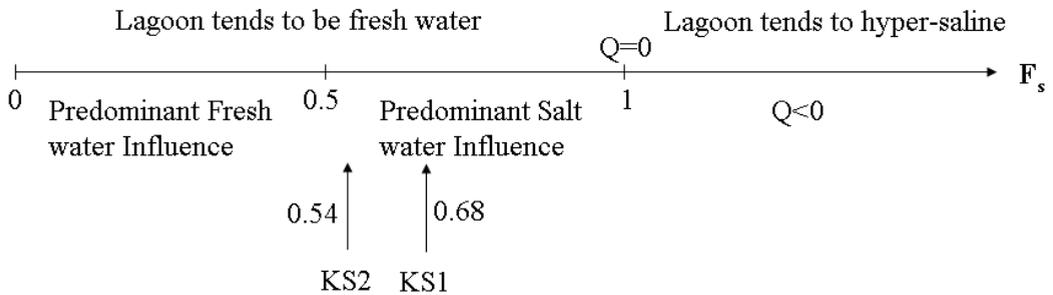


**Figure 16.4** a) Satellite image of Koggala lagoon mouth with proposed structural intervention (20m mouth opening) with respect to existing structures (Source:Priyadarshana et al. 2007); b) Simulated stream line elaboration with flow velocity behavior for 20m mouth opening with the proposed rubble mound groyne interventions with respect to existing groyne structures at high tide in May, 2009; c) Anticipated sediment movements at lagoon mouth with respect to proposed structural interventions. Directions of simulated flow path and anticipated sediment movements are displayed by two types of arrows. Flow path simulation is for high tide in May 2009.

Besides the predominant fresh water influence, with the proposed structural intervention, favorable sediments movement can be expected. During the first dry period after the construction of proposed groyne structures, it is expected that a shoal will build upon the lee side of the main structure. It will strengthen with time as some amount of east west moving long-shore sediments now by-pass the main structure. During high tide when the flow is towards the lagoon, inflow speeds are lower on these shoals and sediment deposition takes place there. There will be no sediment to carry further towards the inner channel. Sediment accumulation will be strengthened by the ebb flow driven sand coming out from the inner parts of the outlet channel. Anticipated sediment movement pattern is shown in the Fig. 16.4c. This type of flow characteristics might help to deposit sand with the time, at lagoon entrance due to the curvature behavior of the flow.

#### 4.2 Salting Factor

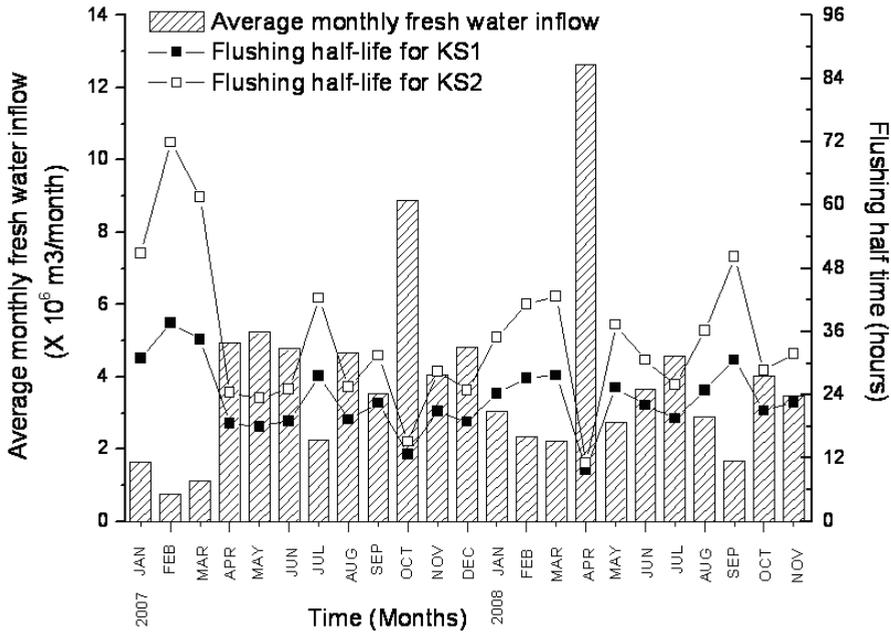
Seawater inflow is higher than freshwater inflow through out the studied time period. Lagoon has a salting factor of 0.68 and it is predominantly influenced by seawater. When the lagoon mouth opening reduced up to 20m, modeled results showed corresponding salting factors as 0.54 (Fig. 16.5).



**Figure 16.5** Main gradations of salting factor and its annual average values for two Scenarios (KS1 & KS2) of Koggala lagoon, Sri Lanka

#### 4.3 Flushing time

Flushing half-life results for Koggala lagoon for two scenarios KS1 and KS2 for year 2007 and 2008 is illustrated in Fig. 16.6. For KS1 flushing half-life ranges from 9hours to 37hours (1.5 days) while it ranges from 12hours to 72hours (3days) for KS2.



**Figure 16.6** Flushing half-life and average monthly fresh water inflow of Koggala Lagoon from Year 2007 January to year 2008 November for KS1 and KS2 scenarios

There is an inverse relationship between freshwater (FW) input flushing half life ( $T_{50\%}$ ) given by the expression

$$T_{50\%} = 39.27e^{-0.149(FW)}, r^2 = 0.96 \quad (12)$$

for KS2, whereas for KS3 the relationship is

$$T_{50\%} = 78.28e^{-0.247(FW)}, r^2 = 0.95 \quad (13)$$

Regression analysis was done with Origin 6.1 shows the data fits to the first order exponential decay curve. No extrapolations for very large fresh water inputs can be made using the above expressions. The exponential empirical equations (Eq. 12 and Eq. 13) show good statistical correlations between flushing half-life and fresh water flow for both scenarios ( $r^2 = 0.96$  and  $r^2 = 0.95$ ) in Koggala lagoon. The exponential expressions result in a freshwater volume which at first increases then unreasonably decreases as  $Q$  increases.

#### 4.4 Evacuation factor

For evacuation factor, the least value of 17 (dimensionless) was attained by existing situation (KS1) compared to proposed scenario (KS2) value of 40.77 for Koggala lagoon.

KS1 is considered to represent the least tidal flushing while KS2 is considered to represent the improved tidal flushing among the two scenarios of the lagoon.

## 5 Discussion

### 5.1 Ecological Impact

Sensitive freshwater floral species have disappeared from the lagoon after the construction of groyne at the lagoon mouth with high saline intrusion (Priyadarshana et al, 2007). Further, previous literature has mentioned that the presence of a zonation of aquatic plants in undisturbed areas which do not observe present, typical gradation from emergent to submerged, from bank starting from *Cyperaceae* and grasses give away water lilies (*Nymphaeaceae*) and then to form a submerged vegetation comprising, *Ceratophyllum* and *Potamogeton* like species. Species like *Lemna* and *Nymphoides aurantiaca* are sensitive freshwater species that are intolerable to salinity and has been recorded in Koggala lagoon before 1995 (CEA, 1995). It has been reported that *Najas marina* and *Salvinia molesta* as common floating plants but recently both species have completely disappeared. Species previously limited to the lagoon mouth have invaded into the inner part of the lagoon. Invasion of sea grass species into the inner part of the lagoon indicate that the lagoon salinity has increased. This indicates that the lagoon water quality change from freshwater to saline has impacted the ecology of the lagoon. Since aquatic plants and associated vegetation provide food and habitats for the variety of aquatic organisms, including fish and crustacean species, loss of vegetation may have influenced the species composition of fish in the lagoon. Specially, littoral vegetation comprised with *Typha angustifolia* and *Phragmites karka* which have not been recorded recently in the lagoon. Both species make littoral refuge for many small fish species to avoid from predation. Therefore, destruction of habitats due to loss of littoral plant species creates a direct impact on the active fauna in the lagoon.

According to previous records it has been observed that some prawn species, like *Caradina nilotica*, *Macrobrachium rosenbergi*, *Metapenaeus dobsoni* and *Penaeus indicus*, were present in abundance in the lagoon. Out of the four species *Caradina nilotica*, *Macrobrachium rosenbergi*, the freshwater species have been record very rarely in recent observations. Species like *Metapenaeus elegance*, *Penaeus indicus*, *Penaeus monodon* and *Penaeus semisulcatus* which are mostly brackish water species were too recorded in sparse (Priyadarshana et al, 2007).

As the lagoon environment changed from fresh to saline, composition of the species dominated by the lagoon earlier has changed and some of the present day species like *Protunus pelagicus* and *Crassostrea medrasensis* are invasive species. Especially areas that are inhabited by *Crassostrea medrasensis* are difficult for fishing due to their sharp shells. Also in terms of fisheries, invasion of some species has forced shifting of the lagoon to a less productive one.

## 5.2 Inlet Hydrodynamics

Flow through lagoon mouth can play a vital role in exchange process and the flushing characteristics of lagoons, both of which impact the water quality and lagoon ecology (Sanford et al., 1992). Unplanned sand removal and prevailing groyne structure have been obstructing in playing this role, in Koggala lagoon. Before the sand bar removal, lagoon was an intermittently closed with the natural sand bar formation in dry season. This sand bar consisted of two parts: a permanent portion (approximately 150m length) running parallel to the coast and a temporary portion. Water used to flush away through this temporary portion when the lagoon water level exceeded about 0.7m above the mean sea level during the rainy season. Often the sand bar breach was triggered by farmers manually digging the sand bar. Subsequent to this sand bar breaching, the water level of the lagoon and the riparian coastline receded and inundation of the inland marshes and paddy field ceased (Gunaratne et al. 2010; Priyadarshana et al. 2007). In our modification we also focus in implementing a similar condition close to earlier natural situation with narrow mouth at the outlet. Opening size of 20m was proposed subsequently. Priyadarshana et al. (2007) showed, using some hydrographs for 10-years return period of flood, the restricted outlet opening with 20m heads up the lagoon to 0.63m mean sea level (MSL). This is 0.4m above the spring-high tide level of the lagoon under existing conditions. No significant impact is expected due to an inundation height of 0.4m (maximum) at low lying areas around the periphery of the lagoon. At its peak, the inundation height is more than 0.3m above the high tide level lasts about 12 hours and this occurs only once in 10 years. Flood level can be further reduced if the bed level of the sand bar erodes beyond the assumed -0.5m MSL. According to the corresponding discharge at restricted mouth, flow velocity is around  $2 \text{ ms}^{-1}$ . With these high velocities, sand bar breach has high possibility to be eroded and actual inundation levels should therefore be lower than the above predictions. Before the removal of sand bar, Koggala used to be a freshwater lagoon ( $F_3 \leq 0.5$ ) where salinity ranged from 3 -15 psu (Silva 1996) and the current salinity level is around 25 psu. Numerical simulations showed for the mouth width of 20m, lagoon will be contributed with a comparatively less sea water influx with respect to the existing situation.

### 5.3 Flushing time

The flushing half-life shown in Fig. 6 suggests that the exchange rate between the lagoon and the ocean is controlled by the balance between the fresh water inflow and the flow of sea water entering from the adjacent coastal zone. In KS1, lagoon was permanently open to the sea with the sand bar removal and that brought large amount of sea water into the lagoon. But with the restricted lagoon mouth situation in KS2 resulted less amount of sea water intrusion with respect to current situation. That may be the reason of slightly high flushing half life of KS2 than KS1. The smallest flushing half-life occurred in April 2008 when the fresh water inflow was substantially high for both KS1 and KS2 (9hours and 12hours respectively). In April 2008, it reduced the gap to a minimum of KS1 and KS2 (3hours) with less sea water intrusion with respect to high fresh water inflow. It shows the lowest flushing half life at the highest fresh water inflow in the month of April in 2008. The largest flushing half-life occurred in February 2007 due to extremely low precipitation conditions with the high sea water inflow for both scenarios (37hours for KS1 and 72hours for KS2). Also in February 2007, it increased the gap to a maximum of KS1 and KS2 (35hours) with less fresh water flow with respect to high sea water inflow. Flushing half life of Koggala lagoon was very small comparing with other tropical lagoons in the world due to its regular sea water intrusion due to the permanent mouth opening. Flushing half-life was presented in hours in order identify its variation noticeably with its minute magnitudes.

Further existing scenario (KS1) adversely affects the productivity and shelter facilities, with emerging unfavorable conditions in nursery areas of nektonic crustaceans and fishes due to prevailing estuarine conditions. Due to this relatively high flushing efficiency fish productivity has been drastically decreased in lagoon while having exceptionally high crustaceans and fish productivity at the lagoon mouth.

### 5.4 Evacuation Factor

Lagoons with relatively large evacuation factor values indicate poor tidal flushing efficiency, consequently unable to physically evacuate pollutants and other external loads from the lagoon water. Thus, lagoon systems with larger evacuation factors are considered to be more sensitive, or vulnerable to external loads.

The accuracy of the evacuation factor values essentially relates to the accuracy of the adopted tidal prism ratio (*TPR*) value. The *TPR* is influenced by both the waterway area and the waterway volume, which are both variable in lagoon (dependent on water levels at the time of determination).

Accuracy relates further to  $S_f$  which is a measure of waterway shape. Relatively linear lagoons are assigned as 'displacement-dominated' lagoons because catchment runoff that enters the lagoon tends to push out, or displace, the resident water in the system. Following significant catchment runoff, the water quality of a displacement-dominated lagoon, starting in the upstream extremities of the waterway, can quickly reflect the quality of the inflowing runoff rather than the antecedent conditions in the lagoon prior to the event. Relatively circular lagoons have been assigned the new term 'mixing-dominated' lagoons. Catchment runoff that enters a mixing-dominated lagoon tends to become assimilated with the resident water of the lagoon prior to discharge to the ocean (if the entrance is open) (Haines et al. 2006). Koggala lagoon falls under the category of displacement-dominated lagoon due to its relatively linear shape.

Change of  $E_{CI}$  will change the Evacuation Factor of a lagoon. The main reason for the assumed smaller value for KS2 was sand bar removal and subsequent groyne constructions at lagoon mouth. In KS2,  $E_{CI}$  becomes relatively larger than KS1 when narrowing the outlet width. Entrance conditions of coastal lagoons are dependent on a number of factors relating to the dominant coastal and catchment processes (Roy et al. 2001), as well as geomorphic features of the entrance and coastline, such as headlands, offshore reefs, and the presence of shallow rock underlying the entrance. The reason for the relatively higher evacuation factor in KS2 scenario is its relatively higher  $E_{CI}$  value.

## **5.5 Management Implications**

As a direct consequence of large-scale sand removal in 1992, the lagoon was permanently opened to the sea. This caused a series of problems due to the influx of salt water, which resulted in an increase in the salinity levels of the lagoon and surrounding areas. Some of the problems included the increased sandiness of the lagoon bed due to the influx brought in at high tide, the abandoning of paddy lands, decline in fish productivity in the lagoon and the destruction of some mangrove species particularly *Sonneratia casiolearis*. Additionally, the high salinity of the lagoon water makes it unsuitable for human consumption and other domestic activities. Fishing practices are also unregulated and thus lead to overexploitation of the valuable resources. The growth of invasive plant species within the lagoon (i.e. *Salvinia molesta*) has led to a decrease in other species naturally found in the area. The ease with which foreign investors are allowed to purchase land has led to large scale clearing of mangroves for construction purposes. Mangroves have also been destroyed due to the discharge of effluents into the lagoon. Unauthorized filling and encroachment of the lagoon boundary and land erosion leading to sedimentation in the lagoon are further threats to the wetland area. The landing of seaplanes in the lagoon is known to affect

the bird populations, and cause erosion of the lagoon banks due to the large waves created during landings. “Madol Duwa-island” a famous tourist attraction spot is threatened by irresponsible waste disposal by tourists. Urgent actions have to be taken to mitigate existing threats by all stake holders of the lagoon.

## 6 Conclusion

After the constructions of groynes the sand accumulation pattern changed seizing the periodical formation of the sand bars across the lagoon mouth. Lagoon has become more saline lagoon with a salting factor of 0.68 in existing situation (Koggala Scenario 1 – KS1). This indicates that lagoon presently influenced by seawater largely. Numerical simulations of 2D unsteady flow model reveal, narrowing the mouth while reducing mouth width up to 20m (Koggala Scenario 2 – KS2), maintaining the salting factor ( $F_s$ ) of 0.54 may result a lagoon, predominantly influenced by freshwater. Besides proposed mouth opening of 20m would be sufficient to discharge a flood with 10 years return period smoothly. Simulated results supported the proposed rubble mound structures in the lagoon restoration in reducing sea water intrusion. Further anticipated sand accumulation patterns will lead to intermittent closure of lagoon with the time as its previous conditions before sand bar removal. Therefore the proposed rubble mound structure switches the lagoon closer to its natural conditions.

Flushing half-life results for Koggala lagoon for two scenarios KS1 and KS2 for year 2007 and 2008 is illustrated in Fig. 6. For KS1 flushing half-life ranges from 9hours to 37hours (1.5 days) while it ranges from 12hours to 72hours (3days) for KS2. Flushing half-life discussed in this study for two scenarios, 1) existing situation (KS1) (KS1); 2) future scenario with respect to proposed groyne interventions for the mouth width of 20m (KS2) of Koggala lagoon never exceeds three days. Flushing half life has been increased approximately by 1.5 days in KS2 compared to KS1. Which indicates reduction of flushing of lagoon water with the introduction of propose groyne structure.

Existing conditions of the lagoon with very high flushing efficiency lead the restricted Koggala lagoon to estuarine conditions. The relatively small size of waterway area and the large volume of water carried out by streams together with catchment runoffs discharging into it result in a very short flushing half-life. The results obtained for the flushing half-life suggest that the exchange rate between the lagoon and the ocean is also controlled by the fresh water input. The empirical regression equations (Eq. 12 and Eq. 13) also show that flushing half-life may significantly increase if freshwater reduction occurs in the low flow conditions. The evacuation factor values for two scenarios reveal higher tidal flushing efficiency with decreased natural sensitivity in KS2 than KS1. All the

assessments can be a tool for restoration of Koggala lagoon and can help the decision makers to take the correct decisions.

### **Acknowledgement**

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## Chapter 17:

# Bio-monitoring and assessment of ecological process of benthic invertebrate assemblages through pre and post trial-impoundment of reservoir

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**Abstract:** Monthly environmental and bio-monitoring, such as water chemistry, organic matter transport, epilithic and suspended phytoplankton, and invertebrate communities, were carried out both at the upstream and the downstream of a reservoir for more than three years including the pre trial-impoundment period. The water temperature difference between the downstream and the upstream substantially increased with increasing volume of the impoundment. CPOM transport at the downstream became lower than that of the upstream even with one day of a retention period of the impoundment. Although FPOM transport was not different much between two sites, the origin and its quality were changed. Invertebrate classes of Ephemeroptera, Stenopsychidae and Hydropsychidae substantially enhanced immediately after the impoundment started, while Tipulidae was declined. It was evident that the trial impoundment has had a substantial effect on the downstream biota from the periods of low volume of water.

**Keywords:** dam construction, trial-impoundment, invertebrate community, organic matter flows, upstream and downstream environment.

## **1 Introduction**

Dam construction has large impacts on the downstream environments (Ana & Graciela 1999, Dominique & Philippe 1998, Pozo et al.1997, Bushaw-Newton et al. 2002, Keith et al. 2002, Yiguang & Geoff 1996). These impacts can be categorized into three levels (Petts, 1984). The first-order effects include changes of water quality, sediment load and flow regime. Then, the second-order effects, such as changes to channel-cross section, bed-sediment movement and periphyton production. The third-order effects are changes to macroinvertebrate communities and other biota come into act.

The construction of a large concrete dam takes a longer period and consists of various stages, such as the surveying of the site, the construction of the temporal channel to be used during the construction of the dam body, the trial-impoundment of the reservoir etc. In these series of different construction stages, some of impacts are imposed on the downstream and become particularly prominent after the impoundment started. Various kinds of mitigation works can be conducted after completion of the construction. However, if the environment has shifted too much, it is not possible to bring the environment back to its initial stage or restore even after removing impact. Therefore, it is vital to make clear quick and slow impacts, particularly during the impoundment process for the implementation of effective mitigations.

In Japan, the trial-impoundment has to be carried out to investigate the safety of the dam body and surrounding slopes of the reservoir before commission of the dam. There are various restrictions in the operation. The control system is amalgamated to the Ministry of Land, Infrastructure, Transport and Tourism (MLIT), such that the rising speed of the water level must be maintained to less than 1 m per day during the trial impoundment, and if some troubles occur, water must be kept as the current level or drawn down to the suitable level at descending speed of 1 m per day. Similar systems are used in depending on the operational restrictions, hydrological conditions concerning the reservoir, such as the retention period of the impoundment, and the inflow and outflow relations, differ. Associated with the hydrological difference the downstream impacts are different. In this report, impacts on the downstream during the trial-impoundment were described when a large concrete dam was constructed.

After the commencement of construction, particularly at the time of the impoundment started downstream environment started to alter (Bushaw-Newton et al., 2002). This study is therefore aimed to elucidate the alteration of the downstream condition along with the impoundment stages. This indicates that, although the present modification of the downstream environment is very distinct after completion of the dam, that modified environment is not a sudden event. It was started gradually and continued with the construction process of the dam in its different stages.

## 2 Theoretical framework

Takizawa Dam is a multipurpose dam which was constructed and commissioned by Japan Water Agency in 2008. It is located in the downstream side of Nakatsu river in the Ara river basin, covering 108.6 km<sup>2</sup> in catchment area (Figure 17.1, Photo 17.1). The capacity of reservoir is  $63 \times 10^6 \text{ m}^3$  which is relatively small in capacity compared to the other reservoir in Japan. After indentifying the location, construction of dam was started in 1997 and the temporary channel under the dam body was completed in 1999. Then, all river flows was introduced into the channel until the trial-impoundment of reservoir started on October 1<sup>st</sup> 2005, with the completion of the concrete dam body (Photo 17.2a).

Then, the inflow water was stored at the rate of less than 1 m of daily increment of the water level, together with 0.5 m<sup>3</sup>/s minimal flow into the downstream. After a month during the trial-impoundment, part of storage was discharged to drawdown the water level,



for the landslides protection measures. During the trial-impoundment, water level was lowered two days, on November 5<sup>th</sup> in 2005 and on 1<sup>st</sup> May in 2007 respectively and outflow water was released from the mid to surface layer of the reservoir, depending on the water level.

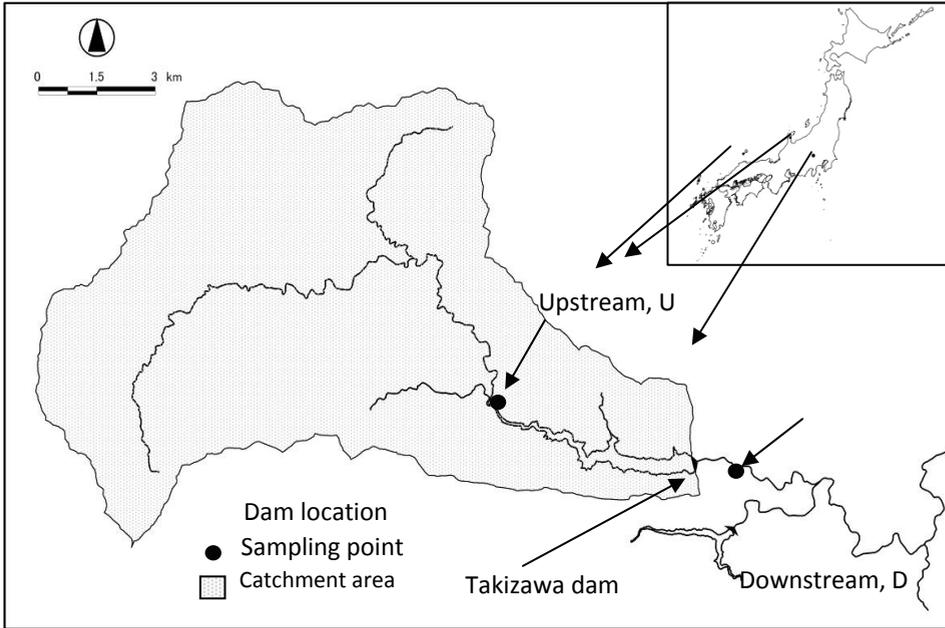
**Photo 17.1** Bird's eye view of the Takizawa Dam



**Photo 17.2a** Before the trial-impoundment of Takizawa dam

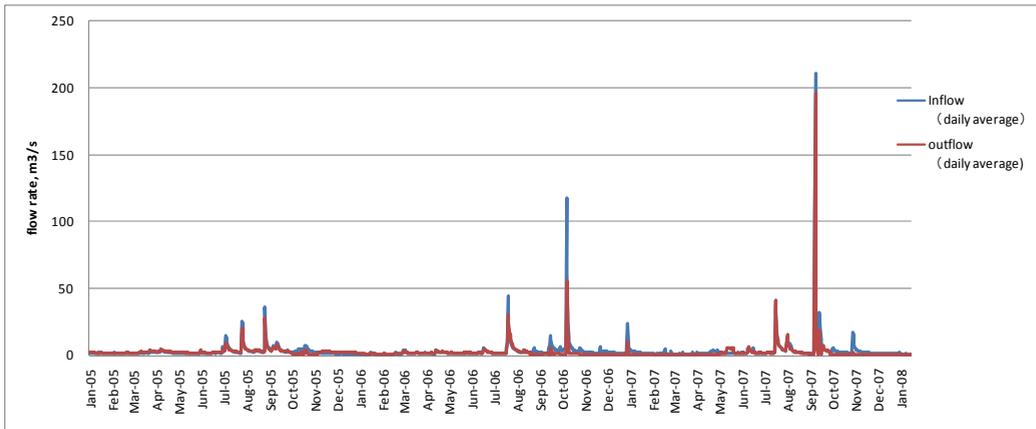


**Photo 17.2b** After the trial-impoundment Takizawa dam

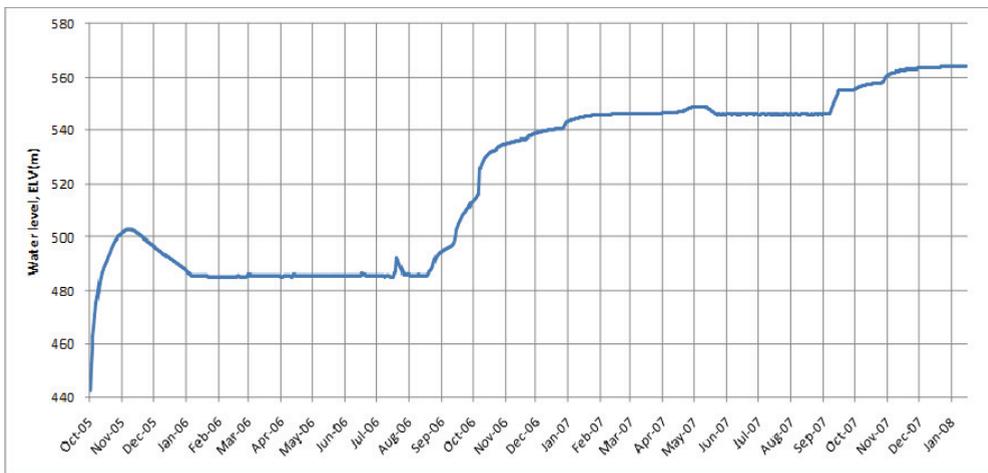


**Figure 17.1** Location of the upstream and downstream sampling stations in the catchment of Nakatsu river.

Figure 17.2 shows the inflow and outflow rates measured at the upstream and the downstream data recording stations. Figure 17.3 shows the monthly variations of stored water level in the reservoir. The retention time of water started to increase gradually from October 1<sup>st</sup> in 2005 with filling of reservoir for a period of one month and reached to a maximum of 10 days, then was reduced to one day due to the discharge of water from November 5<sup>th</sup> in 2006. It again started to increased from August 18<sup>th</sup> in 2006 by filling up of inflow water up to 20 days, however, was again declined for the other landslides protection work until Aug 30<sup>th</sup> in 2007, thereafter the trial-impoundment was resumed and the reservoir was completely filled on March 30<sup>th</sup> in 2008 (Photo 17.2b).



**Figure 17.2** The daily discharge in the upstream and the downstream site



**Figure 17.3** Water level near the dam site of the reservoir during the trial-impoundment.

The Nakatu river channel is formed in the riffle-pool sequence for both the upstream and downstream sites. In upstream site, the substratum mainly composed of sand and coarse gravel (<75 mm, Photo 17.3a), where as in downstream contained cobbles and large boulders (>75 mm, Photo 17.3b). The stream width increases towards the downstream, ranging from 10 m to 35 m. The streamside vegetation density is getting decreased towards the downstream.

If any change of water quality and quantity of river will alter the ecological processes and ultimately will transform to its compositional changes of organisms varying long-term stability. The processes of transformation only could identify through long term bio-monitoring and assessment programmes. Larger retention times of water due to

dam construction may affect the quality and quantity of CPOM and FPOM that will alter ecological processors. Therefore, it can be hypothesized that CPOM and FPOM changes possibly will be predictable through macroinvertebrate population shifts.



**Photo 17.3.** River bed consisted of sand and coarse gravel in riffles of the upstream site



**Photo 17.3b** River bed consisted of cobbles and large boulders in riffles of the downstream site

### **3 Methods**

An intensive investigation was carried out from April 2005, before starting of trial-impoundment and continued up to March 2008, where the water level was reached to

its full capacity. At both stream sites, measuring of physical characteristics, sampling of river water, suspended organic matter, periphyton on the bed stone, and invertebrate community were carried out monthly (Photo 17.4a-d) while some components were measure four times in a year since 2004.



**Photo 17.4a** Water sampling and in situ measurement of water quality



**Photo 17.4b** Suspended particulate organic matter (CPOM, FPOM) sampling



**Photo 17.4c** Sampling epilithic chlorophyll-a for periphyton biomass



**Photo 17.4d** Invertebrate community sampling

Flow velocity and water depth of the sampling sites were measured by instruments, and water temperature (WT), pH, dissolved oxygen (DO), and electric conductivity (EC) were measured by a multiple probe water quality meter (WQC-20A, TOA-DKK). Water samples (2L) were collected using an automatic sample collector and stored in a cooling box until carry to Saitama University Environmental Laboratory. Then, those samples were used to analyze nutrient components and dissolved organic matter concentration variations. Epilithic mat sampling (of 50 mm x 50 mm areas) were employed at five spots both in riffles and pools, following Steinman and Lambert (1996). Course particulate organic matter (CPOM) and fine particulate organic matter (FPOM) were trapped for 10 minutes by 50 cm half round net with either 1.0 mm mesh size or 0.1 mm mesh size, respectively, together with the inflow velocity measured at the entrance of the net. Then, measurements were converted to the concentration in  $\text{gDW}/\text{m}^3$  (gram dry weight per cubic meter) with the measured inflow velocity and discharge data.

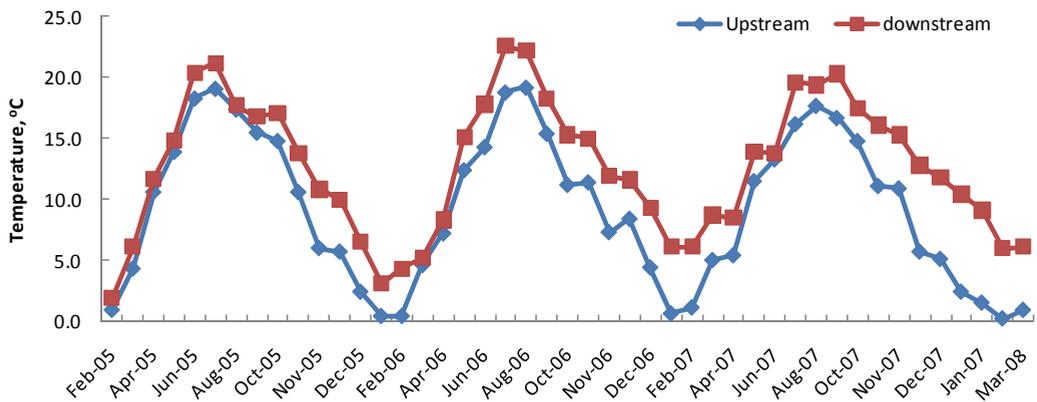
Invertebrate community was sampled from three 50 cm by 50 cm quadrates, which were randomly taken both in riffles and pools. Invertebrates were collected into a net located at the downstream of the disturbed bottom sediments at first, then each bed cobbles were carefully brushed in front of the net (Hauer & Resh 1996). Collected samples were preserved in 95 % acetone solution until sorting was conducted. All individuals were identified as to at least their family level (Kawai & Tanida 2002).

Macroinvertebrate composition was checked against the environmental variables (EC, periphyton, phytoplankton, CPOM, FPOM, discharge, velocity, water depth, water temperature as quantitative, and upstream, downstream, riffles and pools as nominal) by canonical correspondence analysis using CANOCO ver.4.5. Monthly means for the predominant taxa were used in the analyses. Separate analyses were done for spring-summer data set of before and after the trial-impoundment.

## 4 Results

### 4.1 Stream Water chemistry

After the trial-impoundment started, the downstream temperature was always about two degrees higher than that of the upstream site in spring and summer. In autumn and winter, the difference gradually increased up to 8 degrees on 30<sup>th</sup> February 2008, when the retention period was approximately 700 days, nearly same as the period of the operation after completion of the project (Figure 17.4). The high outflow temperature is obviously due to the release of mid-to-surface warmed layer of water, while inflow temperature is naturally low. The temperature difference is larger with the increasing the storage of water. It was significantly correlated to the volume of impoundment ( $p < 0.001$ , linear regression  $F = 27.05$ ).



**Figure 17.4** Temperature variations in the upstream (blue) and the downstream (red) site

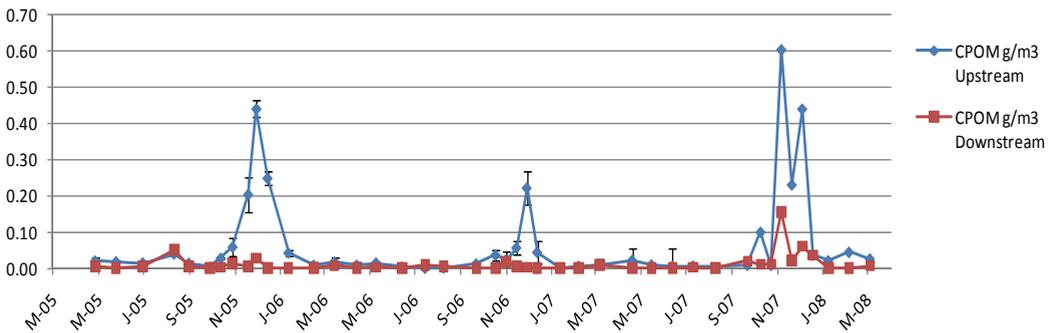
Other stream water chemistry, such as pH, DO, and conductivity was almost constant through a year and there were no significant differences between upstream and downstream for pH and conductivity. Dissolved oxygen was relatively lower at downstream due to relatively warmer water temperature. Nitrate was the main nutrient component for dissolved nitrogen both in upstream and downstream and was 0.639 mg-N/L. It is attributed due to the atmospheric deposition from the nearby Tokyo metropolitan area (Tabayashi & Yamamuro, 2008). On the other hand, averaged soluble phosphorous concentration was less than 0.016 mg-P/L, so that phosphorous is limiting factor for primary production (Table 17.1).

**Table 17.1** Dissolved nitrogen and phosphorous concentration in downstream site

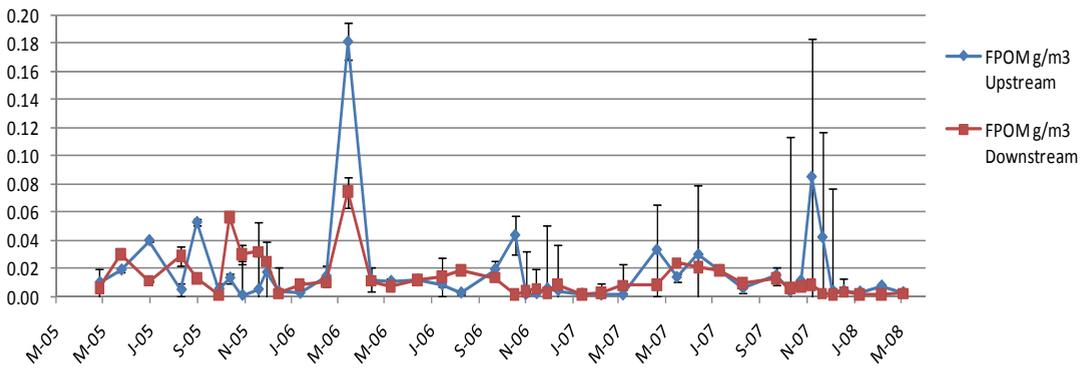
Parameters		pH	DO (mg/L)	EC (mS/m)	NH <sub>4</sub> -N (mg/L)	NO <sub>3</sub> -N (mg/L)	PO <sub>4</sub> -P (mg/L)
Before impoundment	Ave.	8.1	10.5	30.4	0.006	0.611	0.009
	Max.	8.4	16.4	40.3	0.014	0.846	0.011
	Min.	7.5	8.5	10.8	0.002	0.443	0.006
After impoundment	Ave.	8.1	9.3	25.5	0.023	0.639	0.016
	Max.	8.3	14.5	35.0	0.050	0.841	0.091
	Min.	7.6	8.4	10.5	0.006	0.511	0.001

#### 4.2 Organic matter transport

Figure 17.5 and 17.6 show the concentration of CPOM and FPOM at the upstream and the downstream sites, respectively. The CPOM concentration was generally high in November and December because of the seasonal litter falls, while was low in January and February especially at the downstream site due to lowest discharge around 1 m<sup>3</sup>/s. The ratio of the downstream CPOM concentration to the upstream value was relatively (0.3 times) high before the starting impoundment, however, after starting the impoundment, it was declined to less than 0.1 except for July and August in 2006. Then, it reached around 0.01-0.001 in the litter fall periods.



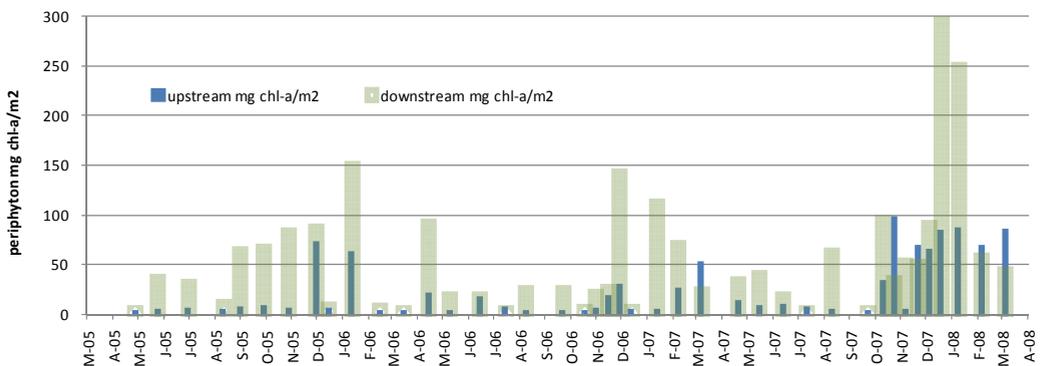
**Figure 17.5** The variations of CPOM in the upstream (blue) and the downstream (red) of Nakatsu river



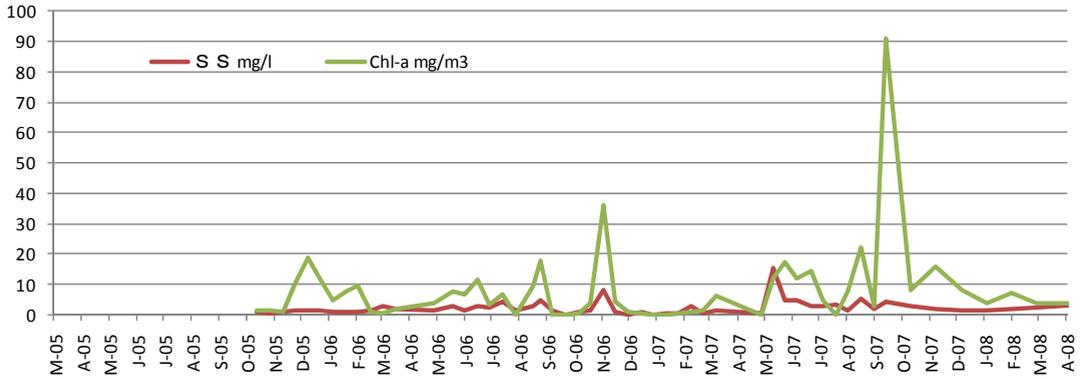
**Figure 17.6** The variations of FPOM in the upstream (blue) and the downstream (red) of Nakatsu river

The FPOM concentration in the downstream was similar or larger than that of the upstream. The ratio of the downstream to the upstream FPOM fluxes was between 0.1 and 10 and was larger than that of CPOM ( $p < 0.001$ , paired sample  $t$ -test). The ratio did not change much after starting the impoundment (ns, least-significant difference).

The amount of chlorophyll- $a$  in the epilithic mat is shown in Figure 17.7. Epilithic chlorophyll- $a$  was generally more abundant in winter from November to March than in summer ( $p < 0.001$ ,  $t$ -test). Compared with the upstream site, the downstream site almost always kept higher values ( $p < 0.001$ , paired sample  $t$ -test), however, after the largest flood on September 7<sup>th</sup> 2007, the amount of chlorophyll- $a$  was continuously high through winter at the downstream. At downstream, flowing phytoplankton was significantly detected after impoundment (Figure 17.8). It is considered that phytoplankton was supplied from a reservoir.



**Figure 7.17** The variations of epilithic chlorophyll- $a$  at the upstream (blue) and downstream (green) of Nakatsu river.



**Figure 17.8** The variations of suspended solid (red) and phytoplankton as chl-a content (green) in water at the downstream.

Table 17.2 shows the number of taxa and average individuals per 1 m<sup>2</sup> found in upstream and downstream. Table 3 shows the list of major insect species and their population of Rhyacophilidae, Stenopsychidae, Hydropsychidae, Chironomidae, and Chloroperlidae, obtained from the quadrats in the upstream and the downstream sites. Upstream population were dominated by Chloroperlidae while the downstream by Baetidae family.

**Table 17.2** List of dominant macro-invertebrates

family	the rate of population (%)	
	upstream	downstream
Ameletidae	0.00	0.05
Baetidae	13.51	19.96
Isonychiidae	0.00	0.99
Heptageniidae	14.47	5.06
Potamanthidae	0.00	0.00
Polymitarcidae	0.00	0.01
Leptophlebiidae	0.30	2.32
Ephemeridae	0.14	1.61
Ephemerellidae	7.51	12.18
Caenidae	0.06	0.02
Gomphidae	0.02	0.01
Taeniopterygidae	11.98	0.01
Nemouridae	1.81	0.32
Capniidae	0.67	0.00
Perlodidae	1.38	0.49
Perlidae	3.97	2.32
Chloroperlidae	22.52	3.57
Leuctridae	0.17	0.00
Corydalidae	0.03	0.27
Scirtidae	0.00	0.03
Noteridae	0.11	0.34
Gyrinidae	0.01	0.05
Psephenidae	0.04	0.47
Elmidae	0.00	0.03
Tipulidae	0.85	5.62
Nymphomyiidae	0.00	0.03
Blephariceridae	0.16	0.02
Psychodidae	0.00	0.00
Simuliidae	0.26	4.40
Ceratopogonidae	0.31	0.22
Chironomidae	9.60	16.61
Athericidae	1.53	0.78
Empididae	0.00	0.04
Glossosomatidae	0.18	0.41
Rhyacophiliidae	1.04	4.40
Stenopsychidae	0.11	7.65
Sericostomatidae	0.00	0.04
Polycentropodidae	0.03	0.11
Goeridae	0.02	0.02
Hydropsychidae	3.63	8.27
Limnephilidae	0.11	0.05
Leptoceridae	0.23	0.24
Lepidostomatidae	3.20	0.69
Psychomyidae	0.03	0.26

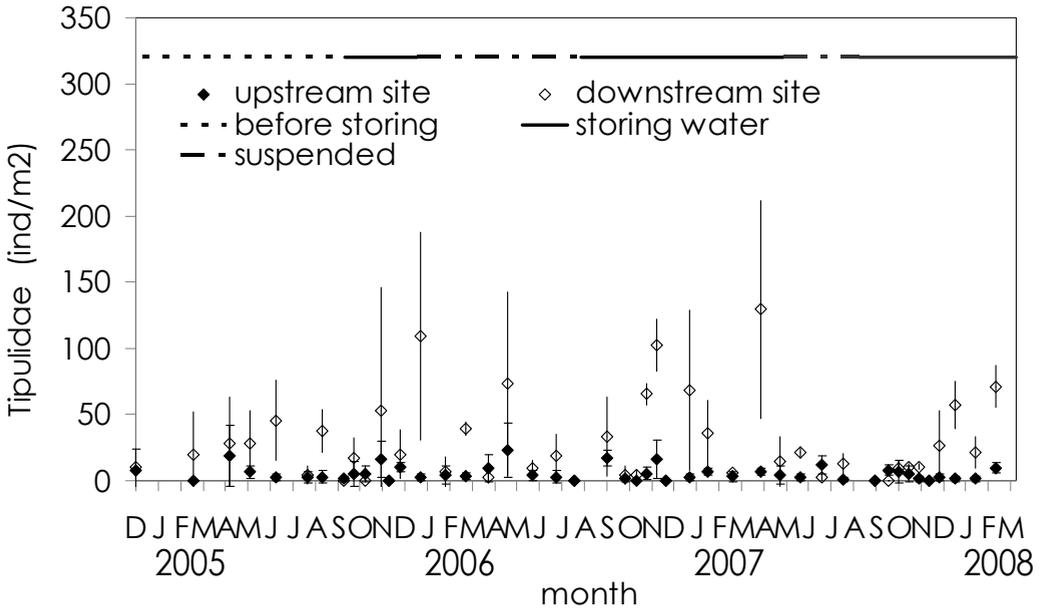
**Table 17.3** The number of taxa (upper), and average individuals (lower) per 1 m<sup>2</sup> found in upstream (US) and downstream (DS)

	2004 - 2005			2005 - 2006			2006 - 2007		
	Winter	Spring	Summer	Winter	Spring	Summer	Winter	Spring	Summer
US	20	17	19	31	55	21	26	38	-
	231	211	130	936	1354	217	1163	842	-
DS	25	30	34	41	66	33	33	46	-
	336	605	314	1581	2060	546	2486	3263	-

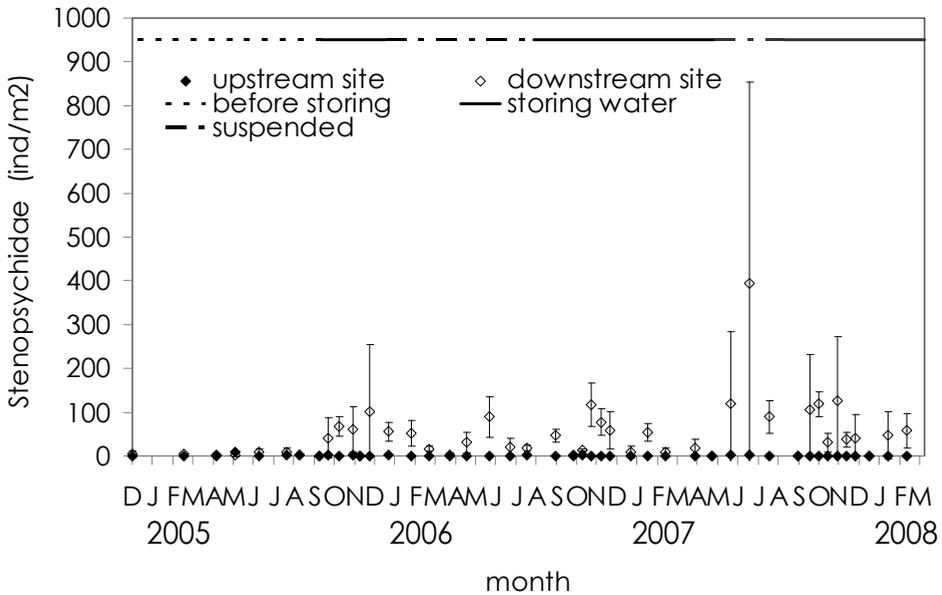
Figure 17.9 (a) to (d) show densities of dominant taxa of benthic macro-invertebrates. Tipulidae, although not occurring in the upstream, was far abundant in the downstream until December 2006, slightly later than the beginning of the impoundment. Thereafter, however, it gradually declined and did not occur after summer in 2007.

There was almost no Stenopsychidae until September 2005 both in the upstream and the downstream, while its density enhanced in the downstream immediately after the impoundment had started (Mann-Whitney U-test,  $p < 0.001$ ), although almost no Stenopsychidae was sampled in the upstream. Differently from other taxa, the density of Perlidae did not change much either in the upstream or in the downstream (Mann-Whitney U-test, ns).

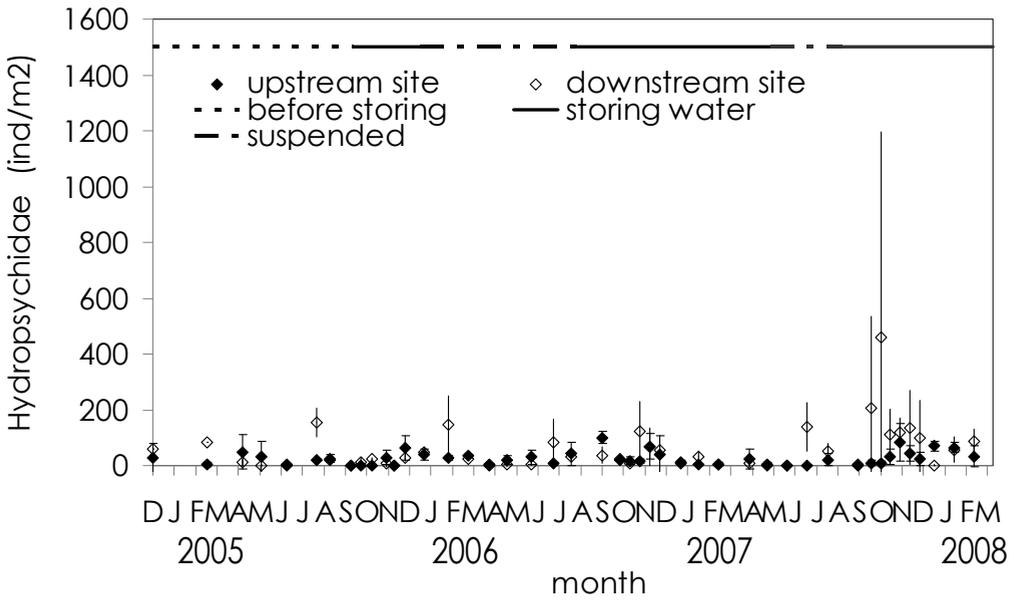
The density of Hydropsychidae normally became high from October to December when litter fall was abundant. Before the downstream discharge was regulated much, Hydropsychidae density was at most 20 ind/m<sup>2</sup>. Subjected to the regulation of the downstream discharge, however, it enhanced up to 40 ind/m<sup>2</sup>. After the large flood in September 2007, it remarkably increased and peaked at 120 ind/m<sup>2</sup> in October 2007. The same trend was seen in the density of Chironomidae. In 2006 and 2007, it peaked with 850 to 1,000 ind/m<sup>2</sup> in October to November. However, in 2008, it amounted up to 1,350 ind/m<sup>2</sup> when impoundment volume was about 63 million m<sup>3</sup> and the downstream discharge was not regulated much.



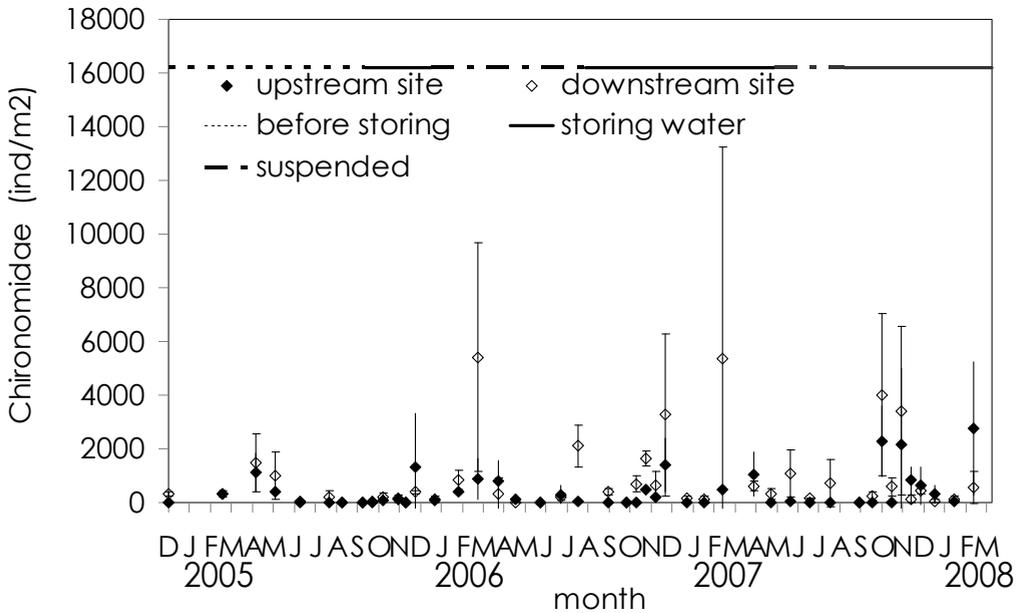
**Figure 17.9a** The density variations of dominant taxa, Tipulidae



**Figure 17.9b** The density variations of dominant taxa, Stenopsychidae



**Figure 17.9c** The density variations of dominant taxa, Hydropsychidae



**Figure 17.9d** The density variations of dominant taxa, Chironomidae

## **5 Discussion**

### **5.1 CPOM and FPOM**

CPOM flux was substantially declined in the downstream even from the early stage of impoundment (retention period ~ one day). Although small sized CPOM is not trapped in the small impoundment, large floating litters are easily trapped even by a small impoundment. Thus this difference is likely attributed to the trap of litters of large POM. However, during two to three months after the large flood in June 2006 and September 2007, the downstream values became more or less similar to the upstream levels (July 2006 and September 2007). This is probably due to a large amount of litters were trapped in the impoundment during the flood, they were gradually decomposed afterwards. At the same time, however, a part of them were also washed away into the downstream, increasing CPOM flux there. With increasing volume of the impoundment, more fraction of suspended loads were settled and trapped by the reservoir even during floods even though similar amount of water to the inflow was discharged from the impoundment. Therefore, the ratio between the inflow and the outflow fluxes gradually declined with increasing impoundment volume.

### **5.2 Epilithic chlorophyll-a**

Chlorophyll *a* contents in periphytic algal mats are dislodged during floods subjected to strong shear stress during the high flow (Perterson & Stevenson, 1992; Asaeda & Son, 2000, & 2001), the removal by clashing suspended sediment (Horner *et al.*, 1990, Grant *et al.*, 1986) and scouring of the surface bed materials. Thus, the reduction of flood volumes due to the dam construction may affect the amount of Chlorophyll *a* in the downstream. Epilithic Chlorophyll *a* concentration is relatively high in general even in the upstream, such as 50 mg/m<sup>2</sup> in winter throughout the observed three years. While, in the downstream it was continuously more than twice as high as that of the upstream, such as more than 100 mg/m<sup>2</sup> in winter time.

Differently from other reports, the downstream values did not increase much even after the impoundment was started. The impoundment speed was restricted as 1m of daily increment of water level and the surplus inflow volume was discharged into the downstream, thus the regulation level was too small, although suspended sediments were likely settled. It seems therefore that the reduction of suspended load does not enhance the epilithic biomass. Similar results are reported in the observation at the downstream of the hydroelectric dam.

### 5.3 Invertebrates

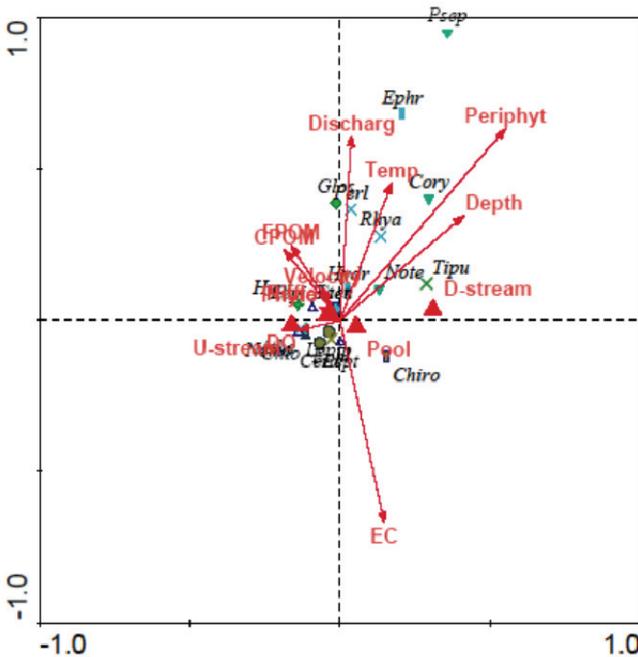
Differently from other factors, invertebrate communities altered relatively largely associated with the impoundment. No Stenopsychidae had appeared both in the upstream and the downstream before October, 2005, when the impoundment had started, however, the density of Stenopsychidae remarkably enhanced in the downstream, thereafter. Then, it almost continuously kept the high population, especially after the September 2007 flood. In contrast, the upstream remained uncolonized even after the large flood. Hydropsychidae, relatively low in density before both in the upstream and the downstream, had an increasing trend after October, 2005. The enhancement of net-spinning species is often reported in the downstream of dams (Fjellheim *et al.* 1993), which is considered as linked to the increase in POM fluxes (Boon, 1987). In the present case, the increase in epilithic chlorophyll *a* after the impoundment likely enhanced these taxa.

In the present results, however, POM fluxes into the downstream were apparently declined with the longer retention time of water and the impoundment did not alter periphytic algal biomass much. Similar results are also reported elsewhere; the extension of the retention time reduces downstream fluxes of CPOM (Cortes *et al.* 1998).

With high periphytic algal biomass of the river, the amount of organic matters may not restrict the colonization of these collectors even in the original condition. However, transportation of fine sediments that fill interstitial spaces and the occurrence of unstable substrata associated with discharge variability reduces species richness (Cobb *et al.* 1992). Thus, the reduction by the impoundment increases habitats in the interstitial spaces of stable bed sediments. In addition, the reduction of infrequent flood volumes reduces the flushing risk of both bed sediments and biota, thus, eventually enhances the biomass although it is only for limited taxa.

The ordination diagram and figure caption list are shown in Figure 17.10 and Table 17.4. Table 17.5a shows canonical coefficients that define the ordination axes as linear combination of the environmental variables and Table 17.5b indicates the inter set correlations which are the correlation coefficients between the environmental variables and these axes for pre trial- impoundment. The position and separation of the points for upstream and downstream along the first axis is that species with positive scores (that lie on the right hand site of the diagram) on the first axis is usually found in downstream of the dam. Although all points were plotted around the origin of coordinate, the species (family name) Psephenidae, Ephemeridae, Corydalidae, Rhyacophilidae, Tipulidae,

Noteridae, Chironomidae were largely found in downstream. The two classes of sites, upstream and downstream, thus have already differed in macroinvertebrate composition. The variation explained by the first two axes of ordination diagram, is 56%.



**Figure 17.10** Ordination diagram by CCA before the trial-impoundment (2005 Apr-Sep)

SPECIES		ENV. VARIABLES	NOMINAL ENV. VARIABLES
△ Sh	■ Fc(Det)	→	▲
◆ Sc(Her)	● Gc(Det)		
◆ Br(Her)	● Fc+Gc(Det, Alg)		
× Br, Pr	■ Fc, Gc(Det, Alg)		
× Pr	× Gc, Pr		
▲ Fc+Gc+Sc+Pr	▼ unknown		

**Table 17.4** List of species and functional feeding group (FFG) used in CCA (for Figures 10-12) \* Det: Detritus, Alg: Algae, Her: Herbivorous

Caption: Species	FFG(caption)
Baet: Baetidae	Grazer (Br (Her*))
Ison: Isonychiidae	Filterer, Gatherer, (Fc, Gc (Det, Alg*))
Hept: Heptageniidae	Scraper (Sc (Her*))
Lepto: Leptophebiidae	Gatherer, Collector (Gc)
Ephr: Ephemeridae	Gatherer, Collector, Predator (Gc, Pr)
Ephl: Ephemerellidae	Predator (Pr)
Nemo: Nemouridae	Shredder (Sh)

Perl: Perlidae	Predator (Pr)
Chlo: Chloroperlidae	Gatherer,Collector+ Scraper+ Predator (Gc+Sc+Pr)
Cory: Corydalidae	Predator (Pr)
Note: Noteridae	Predator (Pr)
Psep: Psephenidae	Scraper (Sc)
Tipu: Tipulidae	Grazer, Predator (Br, Pr)
Simu: Simuliidae	Gatherer,Collector (Gc)
Cera: Ceratopogonidae	Gatherer,Collector, Predator (Gc, Pr)
Chiro: Chironomidae	Filterer, Gatherer, (Fc, Gc (Det, Alg*))
Athe: Athericidae	Predator (Pr)
Glos: Glossosomatidae	Scraper (Sc)
Rhya: Rhyacophilidae	Predator (Pr)
Sten: Stenopchidae	Filterer+Gatherer (Fc+Gc (Det, Alg*))
Hydr: Hydropsychidae	Filter feeder (Fc (Det*))
Lept: Leptoceridae	Shredder (Sh)
Lepi: Lepidostomatidae	Shredder (Sh)

**Table 17.5a** Canonical coefficients of ordination diagram for 2005 April-September

	<b>Variable</b>	<b>Axis 1</b>	<b>Axis 2</b>
1	Discharge	-0.5823	-0.9490
2	Temp	0.0964	0.6946
3	EC	-0.3920	-0.9575
4	DO	-0.9364	-0.8364
5	Depth	0.0808	-0.1843
6	Velocity	-0.7480	0.0691
7	CPOM	-0.5115	-0.3348
8	FPOM	0.2822	0.3368
9	Periphyt	0.0766	1.1456
10	Phyto	0.0231	-0.3632
11	Riffle	-0.1368	0.0887
12	Pool	0.0000	0.0000
13	U-stream	-0.7781	0.6583
14	D-stream	0.0000	0.0000

**Table 17.5b** Inter-set correlation of environmental variables with ordination axes for 2005 April-September

	<b>Variable</b>	<b>Axis 1</b>	<b>Axis 2</b>
1	Discharge	0.0371	05861
2	Temp	0.1667	0.4363
3	EC	0.1434	-0.6433
4	DO	-0.1344	-0.0326
5	Depth	0.4000	0.3324
6	Velocity	-0.0563	0.1015
7	CPOM	-0.1800	0.2226
8	FPOM	-0.1579	0.2379
9	Periphyt	0.0563	0.6079
10	Phyto	0.0668	0.0429
11	Riffle	-0.1944	0.0777
12	Pool	0.1944	-0.0777
13	U-stream	-0.9214	0.0970
14	D-stream	0.9214	0.0970

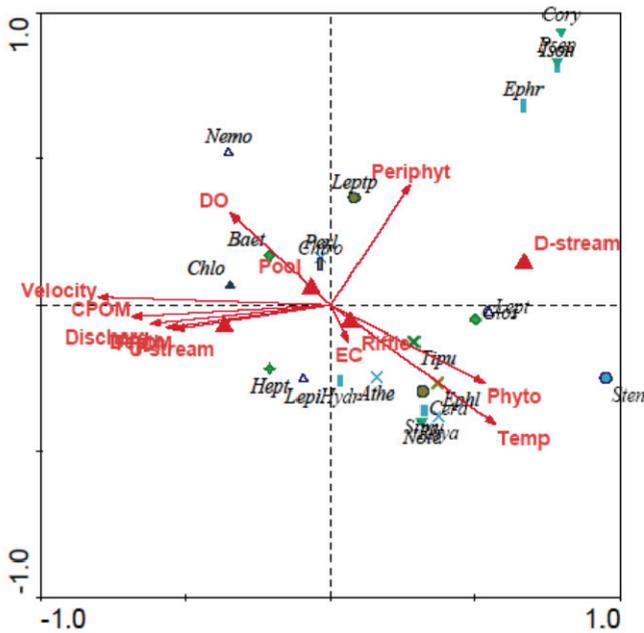
**Table 17.5c** Ranking of environmental variables by their effects on species composition for 2005 April-September (eigenvalue, probability, F-value )

Variable	$\lambda$	P	F-value
Periphyton	0.20	0.002	3.79
EC	0.14	0.004	2.78
Depth	0.12	0.004	2.55
Phytoplankton	0.07	0.054	1.81
CPOM	0.08	0.040	2.01
Temp	0.07	0.032	2.02

The species points and the arrows form a biplot. The species points can be projected on to the axis. The order of the projection points correspond approximately to the ranking of the weighted averages of the species with respect to the environmental variable. The weighted average indicates the position of the species' distribution along the environmental variable, and thus the projection point of a species indicates this position (ter Braak 1995). Table 5c shows the ranking of environmental variables in their importance for determining the species composition and their significance level of effect. Here, the location, upstream, downstream and riffle, pool were not considered as predictor variables so as to know which measured environmental variables could

account for species composition between upstream and downstream. Periphyton, EC and water depth well explained the species composition and their effect is statistically significant. Thus, they might seem to be found in high abundance of periphyton in downstream, where was more light receiving availability with the wider channel and less riparian vegetation, and larger sediment substratum periphyton abundance was relatively higher. These are not happened by the trial-impoundment, but the geomorphological characteristics for each site. By projecting the species points on the arrow periphyton, it can be inferred that the species Psephenidae, Ephemerillidae, Corydalidae, Rhyacophilidae, Tipulidae, Noteridae, Chironomidae of all the displayed species have the highest weighted averages for periphyton. But the functional feeding group of Rhyacophilidae, Tipulidae, Corydalidae, is predator. This is because Chironomidae is very common predaceous insect (Wallace & Webster 1996).

Table 17.5a and 17.5b show the canonical coefficients and the inter set correlation of ordination diagram for 2006 spring and summer as post trial-impoundment, respectively. The ordination diagram is shown in Figure 17.11. From the inter set correlation, the first axis is mainly the upstream site and the downstream site. The second axis is poorly correlated with the periphyton. The position and separation of the points for the upstream site and the downstream site along the first axis is that species with positive scores on the first axis is usually found in the downstream site. The two classes of sites clearly differ in macroinvertebrate composition. Stenopsychidae, Corydalidae, Psephenidae, Isonychidae, Ephemeridae, Glossostomatidae, Tipulidae, Leptophlebiae, Rhyacophilidae, Ephemerillidae, Noteridae, Ceratopogonidae, Simulidae, Athericidae are largely found in the downstream site. Nemouridae, Chloroperlidae, Baetidae, Heptagyniidae and Lepidostomatidae are largely found in the upstream site. Hydropsychidae was averagely found in both sites. The variation explained by the first two axes of ordination diagram, is about 60%. Table 17.5c shows the ranking of environmental variables in their importance for determining the species composition and their significance level of effect. The measured environmental variables, velocity, temperature, DO, phytoplankton, and FPOM significantly effect on species composition. The measured environmental variables which influence on species composition is different pre and post trial-impoundment. Regulating the river water might increase the change in temperature and flowing phytoplankton from the reservoir. Some species (Stenopsychidae, Isonychidae, Leptophlebiae, Ephemerillidae, Ceratopogonidae, Simulidae, Athericidae) at the downstream site, which are of collectors (filtering and gathering) in the function feeding groups, are found higher population than the pre trial-impoundment.



**Figure 17.11** Ordination diagram by CCA after the trial-impoundment (2006 Apr-Sep)



**Table 17.6a** Canonical coefficients of ordination diagram for 2006 April-September

	Variable	Axis 1	Axis 2
1	Discharge	-0.6410	-2.0736
2	Temp	-1.1388	0.5934
3	EC	0.0924	0.3065
4	DO	-0.2378	1.4473
5	Depth	-0.0165	-0.0410
6	Velocity	0.7803	0.3168
7	CPOM	-5.3252	6.2200
8	FPOM	4.7834	-4.3538
9	Periphyt	-1.8104	1.1987
11	Phyto	-0.6283	0.2649
13	Riffle	-0.0342	-0.1828
14	Pool	0.0000	0.0000
15	U-stream	-1.7520	-0.6445
16	D-stream	0.0000	0.0000

**Table 17.6b** Inter-set correlation of environmental variables with ordination axes for 2006 April-September

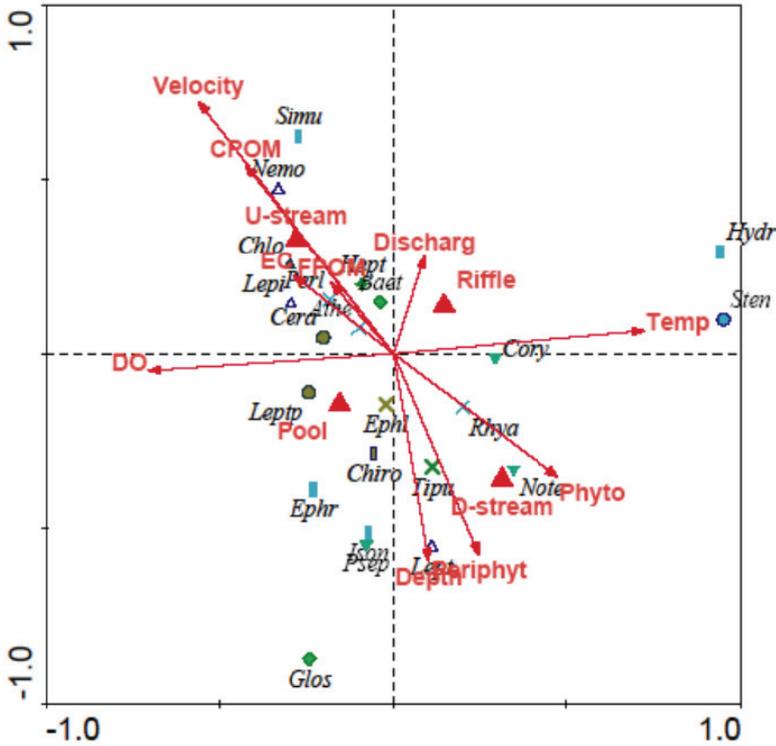
	<b>Variable</b>	<b>Axis 1</b>	<b>Axis 2</b>
1	Discharge	-0.6060	-0.0630
2	Temp	0.5558	-0.3961
3	EC	0.0612	-0.1229
4	DO	-0.3384	0.3036
5	Depth	-0.5508	-0.0771
6	Velocity	-0.7831	0.0271
7	CPOM	-0.6716	-0.0395
8	FPOM	-0.5275	-0.0829
9	Periphyt	0.2691	0.3990
11	Phyto	0.5202	-0.2592
13	Riffle	0.1189	-0.1004
14	Pool	-0.1189	0.1004
15	U-stream	-0.8569	-0.1781
16	D-stream	0.8569	0.1781

**Table 17.6c** Ranking of environmental variables by their effects on species composition for 2006 April-September (eigenvalue, probability, F-value )

Variable	$\lambda$	P	F-value
Velocity	0.22	0.002	4.16
Phytoplankton	0.11	0.006	2.43
Temp	0.12	0.006	2.62
DO	0.08	0.038	1.93
FPOM	0.12	0.002	3.28

Table 17.6a and 17.6b show the canonical coefficients and the inter-set correlation of the ordination diagram for 2007 spring and summer. Its ordination diagram is in Figure 17.12. The first axis is mainly temperature and the second axis is correlated with the velocity according to the inter-set correlation. The variation explained by the first two axes of ordination diagram, is about 50%. The species composition is not much different with that of 2006 spring and summer with the exception of Hydropsychidae species which were found in higher population at downstream sites. Table 17.6c shows the ranking of environmental variables in their importance for determining the species composition and their significance level of effect. The measured environmental

variables, temperature, velocity, CPOM, and discharge are the main factors of species composition.



**Figure 17.12** Ordination diagram by CCA after the trial-impoundment (2007 Apr-Sep)



**Table 17.7a** Canonical coefficients of ordination diagram for 2007 April-September

	Variable	Axis 1	Axis 2
1	Discharge	-2.3291	1.2626
2	Temp	4.1402	-2.1566
3	EC	-0.4866	0.9617
4	DO	2.1543	-2.6993
5	Depth	-0.0621	0.2344
6	Velocity	-2.5664	-1.2735
7	CPOM	2.3346	0.4657
8	FPOM	0.3509	-1.0763
9	Periphyton	-0.0342	-0.0609
11	Phytoplankton	0.3585	0.5785
13	Riffle	0.1391	0.4337
14	Pool	0.0000	0.0000
15	U-stream	1.6194	2.1570
16	D-stream	0.0000	0.0000

**Table 17.7b** Inter-set correlation of environmental variables with ordination axes for 2007 April-September

	Variable	Axis 1	Axis 2
1	Discharge	0.0862	0.2741
2	Temp	0.6954	0.0661
3	EC	-0.2754	0.2203
4	DO	-0.6792	-0.0472
5	Depth	0.0982	-0.5820
6	Velocity	-0.5416	0.7110
7	CPOM	-0.4112	0.5332
8	FPOM	-0.1722	0.1986
9	Periphyton	0.2376	-0.5660
11	Phytoplankton	0.4552	-0.3472
13	Riffle	0.2955	0.2852
14	Pool	0.2955	-0.2852
15	U-stream	-0.5847	0.6900
16	D-stream	0.5947	-0.6900

**Table 17.7c** Ranking of environmental variables by their effects on species composition for 2007 April-September ( eigenvalue, probability, F-value )

Variable	$\lambda$	P	F-value
Temp	0.26	0.002	5.18
Velocity	0.20	0.002	4.80
CPOM	0.12	0.006	3.36
Discharge	0.11	0.008	3.33

It can be noticed by CCA that the distributions and abundances of invertebrate community in the upstream site and the downstream site depend on many environmental gradients. There are many complex interactions between physical, structural, and food resource variables that the species respond in different ways. After the trial-impoundment, abundance of some species of collectors was relatively higher in the downstream. This was an evident in case of large body size filtering collectors, *Stenopsyche marmorata* (Stenopsychidae), and *Isonychia japonica* (Isonychidae). The reason seems to be the supply of organic seston in large amounts to the downstream from the reservoir. Simultaneously, the post period truncate the transportation of coarse detritus required by shredders (Lepidostomatidae). As food source, suspended phytoplankton has much influence in the downstream site. The arrow length, which relates its potential influence, of suspended phytoplankton in the ordination diagram for the pre trial-impoundment was significantly short. The influence of water temperature was significant after the trial-impoundment and was remarkably high in 2007 spring-summer. Retention of large quantity of water by the reservoir and subsequent lengthy retention periods could be the reasons for this observation.

## 6 Concluding Remarks

As a mitigation work, settling ponds are often constructed in the river channel to eliminate sediment load to the downstream (Doeg et al. 1987). The present results indicate that the even a small volume of impoundment of a setting reservoir seems to have a substantial effects on the downstream condition. The alteration of the downstream biota is started, particularly for invertebrate communities, even with small impoundment of several days of retention period in the trial impoundment.

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## Chapter 18:

### Coarse particulate organic matter exports and characteristics of fiber components during different flood events in the second order stream

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**Abstract:** Quantity and quality of exported coarse particulate organic matter (CPOM) was investigated in Nakatsugawa River, the second order stream in Saitama Prefecture, Japan during 5 flood events occurred between July 2005 and September 2007. Peak discharge was ranged from  $33.60 \text{ m}^3 \text{ s}^{-1}$  in winter to  $720.43 \text{ m}^3 \text{ s}^{-1}$  in autumn. Average drift density was ranged from  $0.21 \text{ g m}^{-3}$ ,  $1.52 \text{ g m}^{-3}$  and  $2.84 \text{ g m}^{-3}$  (dry weight) for winter, summer and autumn flood, respectively. Drift density was weakly correlated

with discharge ( $r = 0.36$ ,  $P < 0.05$ ). However, lignin contents in leaf was higher in flood magnitude, and correlated with discharge ( $r = 0.560$ ,  $P < 0.01$ ). Inversely, soluble organics was negatively correlated with discharge ( $r = -0.535$ ,  $P < 0.01$ ). Based on the quality, exported CPOM was significantly different among the flood events as classified by the discriminant analysis. Flood timing and magnitude are highly affected the quantity and the quality of exported CPOM.

**Keywords:** CPOM, flood, drift density, fiber components

## 1 Introduction

Magnitude and quality of the exported allochthonous coarse particulate organic matter (CPOM) for different flood events was studied in a second order stream. In this study we had the opportunity to investigate CPOM that exported during high discharge from several flood events in a mountainous woodland streams including from a catastrophic flood in September 2007. Collection of CPOM in different seasonal floods allowed us to make a comparison between them in gaining robust information concerning its quantity as well as the quality in relation to flood timing and magnitude. Understanding of decomposition process of particulate organic matter (POM) is important to manage water quality of the above dam or reservoirs. Quality of drift materials by floods should be analyzed as characteristics of carbohydrate control decomposition rate of materials deeply influence on the dynamics of nutrient release.

## 2 Theoretical framework

In stream food web, organic matter play a substantial part as it is the main carbon source and major energetic resource for the heterotrophic community in the system providing a large portion of the fixed carbon (Vannote et al., 1980). Woodland stream ecosystem has been considered as an allochthonic organic matter-dependent system. Allochthonous CPOM (>1mm) plays an important role of energetic resource for stream ecosystems (Cummins, 1974; Hall et al., 2000), and both its quantitative and qualitative evaluations are important to understand of the ecology of rivers. CPOM that enters stream is transported downstream by the unidirectional flow of the river, with very few mechanisms for upstream movement. The retentive capacity of streams for CPOM is a function of hydrologic, substrate related and riparian features (Speaker et al. 1984).

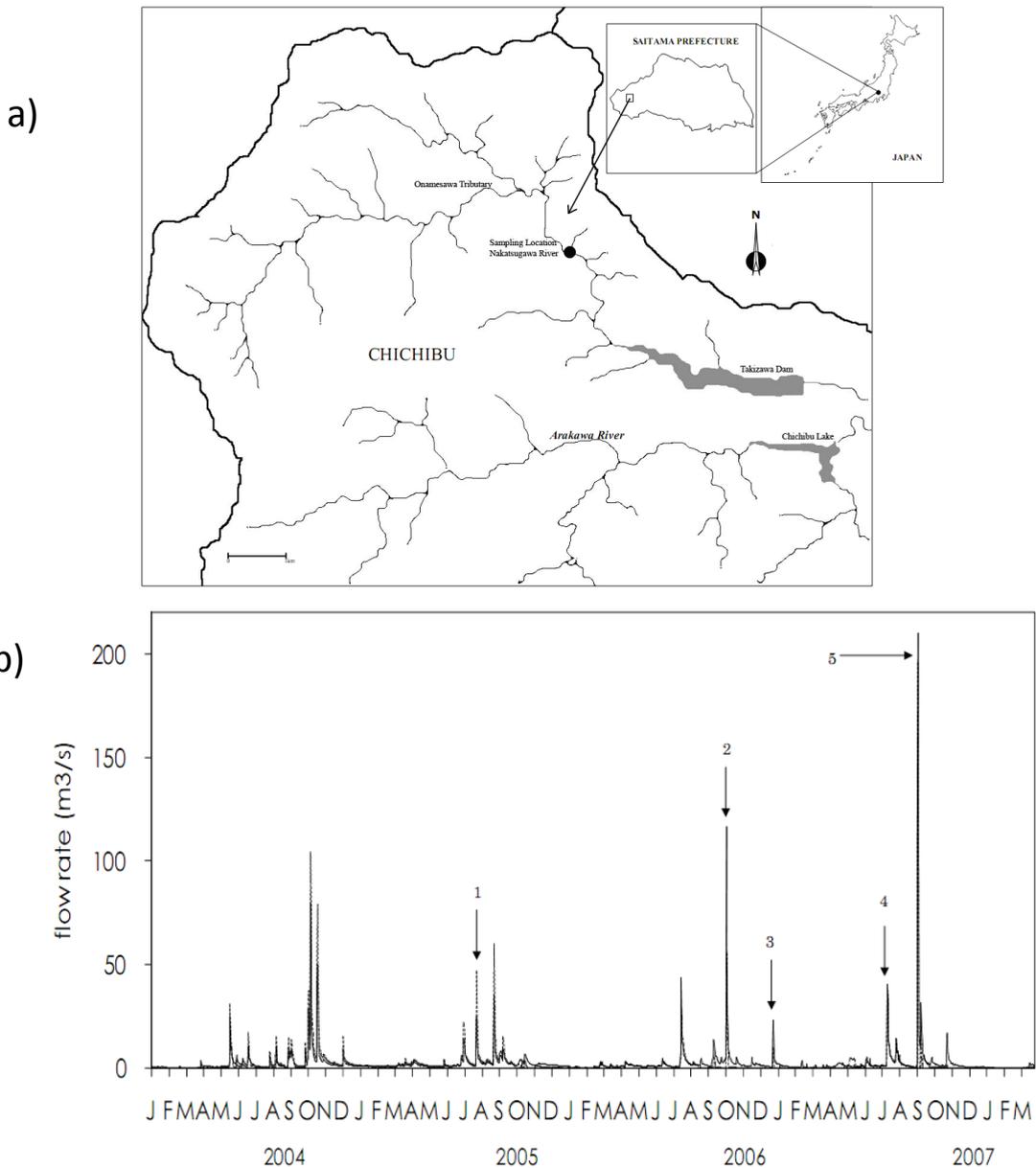
The fate of CPOM is controlled by two concurrent factors: breakdown and downstream transport (Webster et al., 1999). Study about organic matter transport in stream mostly carried out under ordinary water levels or base flow condition. However, regardless of an unambiguously different discharge magnitude, little is known both of CPOM drift and

its quality during flood events due to field sampling being quite dangerous (Tockner and Waringer, 1997). Under the influence of climate change, both magnitude and frequency of this hydrological event is getting unpredictable. A link between CPOM input and its storage in any reach of stream would be affected by such hydrological events. To understand dynamics of organic matter budget, it is necessary to collect the data and information during flood event as much as possible. Interruptions in river flow by dams affect detrital pathways in various ways. Much of the seston may be retained in a reservoir, reducing transport of food detritivores downstream (Goldman & Kimmel, 1978). Short and Ward (1980) found that leaf litter breakdown was faster in regulated river.

### **3 Methods**

#### **3.1 Site description**

The study was conducted at Nakatsugawa River branch of Arakawa River (35°59'10.67"N, 138°50'7.33"E), a third-order river situated in the mountainous area of Chichibu City, in the westernmost-part of Saitama Prefecture, Central Japan (Figure 18.1). Mean daily flow is  $1.9 \text{ m}^3 \text{ s}^{-1}$  measured in upstream of Takizawa Dam. Lowest discharge of Nakatsugawa River is recorded as low as  $0.3 \text{ m}^3 \text{ s}^{-1}$  in winter and reaches maximum discharge during summer due to precipitation. The mean annual temperature in the area is around  $10.9^\circ\text{C}$  at 770m above sea level. In summer, maximum mean monthly temperature is  $22.5^\circ\text{C}$  in August and minimum of  $0.4^\circ\text{C}$  in January. The annual precipitation is about 1400–1500mm (The Tokyo University Forests, 2009).



**Figure 18.1.** (a) Map of study site; showing sampling point in Nakatsugawa River upstream site of Takizawa Dam. (b) Hydrograph of Nakatsugawa River 2004 – 2007; arrows indicate the flood events investigated in this study – 1) July 2005, 2) October 2006, 3) December 2006, 4) July 2007, and 5) September 2007.

### 3.2 CPOM drift density measurement

Sampling was conducted in flood event occurred on July 2005, October 2006, December 2006, July 2007 and September 2007. Drift density was measured by collecting CPOM

for every two hours-interval and lasted for 5 to 180 second during the flood. Sampling device is made from nylon sifting cloth (mesh-size =1.0mm) with approximately 50 cm long and a front opening 50 cm in diameter. Samples were kept in the polyethylene plastic bags, labelled and stored in cool-box during transported to laboratory. Samples were dried at 50°C for at least 48 hours to a constant weight, weighed and sieved to separate grain-size into large particulate matter (LPM; >2mm; 2~1mm) and fine particulate matter (FPM; 1mm~500µm; 500~250µm). Subsamples were weighed, combusted at 550°C for 2 hours in muffle furnace and reweighed to determine ash free dry mass (AFDM) (Benfield, 1996). CPOM amount was determined by multiplying percent AFDM to the dry weight of LPM. Calculation of CPOM drift density was adopted from formulae used by Smock (1996) for macroinvertebrates (equation 18.1):

$$\text{CPOM Drift density} \left( \frac{\text{g}}{\text{m}^3} \right) = \frac{D \times W}{t \times H \times W \times v}$$

(18.1)

where  $DW$  represents dry weight (g);  $t$ , duration of net was set in stream (h);  $H$ , mean height of water column in the net mouth (m);  $W$ , net width (m); and  $v$ , mean water velocity at the net mouth ( $\text{m s}^{-1}$ ).

### 3.3 Leaf composition analyses

CPOM samples were grained and sieved using stainless steel sieve to pass 500µm mesh-size to analyse the total carbon and the total nitrogen by CN corder (MT-5, Yanako, Japan).

The neutral detergent fiber (NDF), acid detergent fiber (ADF), and lignin were determined sequentially with a filter bag system (ANKOM® F57, Ankom Technology, Fairport, NY) and digested in ANKOM Fiber Analyzer 220 (Ankom Technology, Fairport, NY). Hemicellulose was calculated as the difference between NDF (hemicellulose, cellulose and lignin) and ADF (cellulose and lignin). Cellulose was represented by the weight lost by ADF residue in 72%  $\text{H}_2\text{SO}_4$  for 3 hours (Van Soest and Robertson, 1980). The remaining sample weight in the bag estimated as lignin. Alpha amylase and sodium sulphite were used in NDF step.

### 3.4 Microbial respiration rate

Microbial respiration rate was determined by adapting the method used by Yoshimura *et al.* (2008). CPOM samples were ground using a grinder/mill to get particle size of around 0.5cm in diameter. Stream water was filtered using Advantec 0.45µm-pore size membrane filters. Around 30 - 100 mg of ground samples were transferred into Winkler

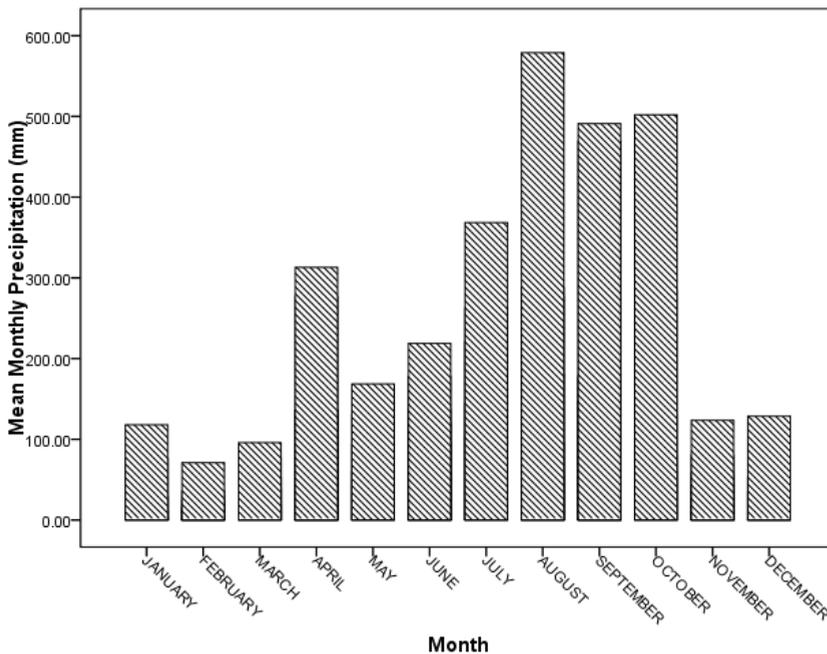
bottles and filled with filtered stream water until completely full to avoid bubble formation. All bottles were then incubated in the dark at 20°C for 24 hours. Oxygen concentration was measured before and after the incubation with YSI 5000 oxygen meter. After subtracting O<sub>2</sub> consumption in the control bottle containing only filtered stream water, respiration rates were standardized by the particulate organic carbon placed in each bottle. Microbial respiration of the CPOM is expressed as mg O<sub>2</sub> per g carbon per hour (mg O<sub>2</sub> g<sup>-1</sup>C h<sup>-1</sup>).

### 3.5 Statistical analysis

Flood events were grouped into three categories representing the associated season when it occurred, i.e., winter flood, summer flood and autumn flood. Discriminant analysis was used to classify CPOM of these flood groups using SYSTAT<sup>®</sup> version 11 for Windows<sup>®</sup> with fiber component as predictor variables. In addition, differences among the parameters measured, including total carbon, total nitrogen and total phosphorus were tested using analysis of variance (one-way ANOVA) and followed by Tukey's HSD (Honestly Significant Difference) Post hoc test to determine the differences between flood events. Correlation between all parameters and discharge was tested using *Pearson product-moment correlation coefficient*.

## 4 Results

Flood in Nakatsugawa River occur due to high precipitation rate in this region, especially in summer and autumn (Figure 18.2). Precipitation rate recorded from Chichibu monitoring station shows that precipitation is high in July to October, with peaked in August. Winter flood is rare to happen as precipitation rate during this period is low.



**Figure 18.2.** Average of monthly precipitation of Chichibu, Saitama Prefecture (1999 - 2008) (Japan Meteorological Agency, 2009)

#### 4.1 Grain size analysis

Particulate matter transported during flood includes many fractions of organic matter and non-organic matter. The organic fraction such as leaves, twigs, barks and many other detritus were found in notable amount. Most of non organic matter fraction comprised of sand and small stones. Materials that >2mm consist of leaves and woody debris, while that of 2-1mm size is mainly comprised of fragmented and unidentifiable leaves, bark fragments, small branches and small stones. In winter sample, seston was mainly comprised of large particulate matter (LPM) in form of leaves. Grain size distribution shows that materials >5mm was dominant fraction among the samples. Proportion of LPM in the December sample was high ranged between 96 - 99% of the total sample. Transported materials during July 2007 flood was mainly consisted of decayed leaves materials with grain size >2mm. This fraction was dominant in all samples with proportion range from 48% to 78%. Amount of LPM in term of leaves was relatively little found in July 2005. Our data show that LPM percentage was higher before the peak discharge. When peak discharge comes, the amount of SPM increased considerably in seston transports. Same pattern was observed from both summer floods in this study, either July 2005 or July 2007.

Seston of autumn flood samples were mainly comprised of twigs and fragmented plant parts. Grain size was dominated by 1-500 $\mu\text{m}$  fraction for both floods to almost 60% of the total sample. In October 2006 flood, LPM was relatively lower compare to SPM. Particulate matter >2mm size fraction only contribute 7.9% to 17.3% of the total sample. While in September 2007 flood, >2mm fraction was higher at the beginning of the flood to about 40%, however, the proportion was fluctuatively change over the sampling period. Percentage of the ~2mm size during peak discharge was only 12-18%, while the 1-500  $\mu\text{m}$  fractions reached high portion at that time.

#### 4.2 CPOM Drift density

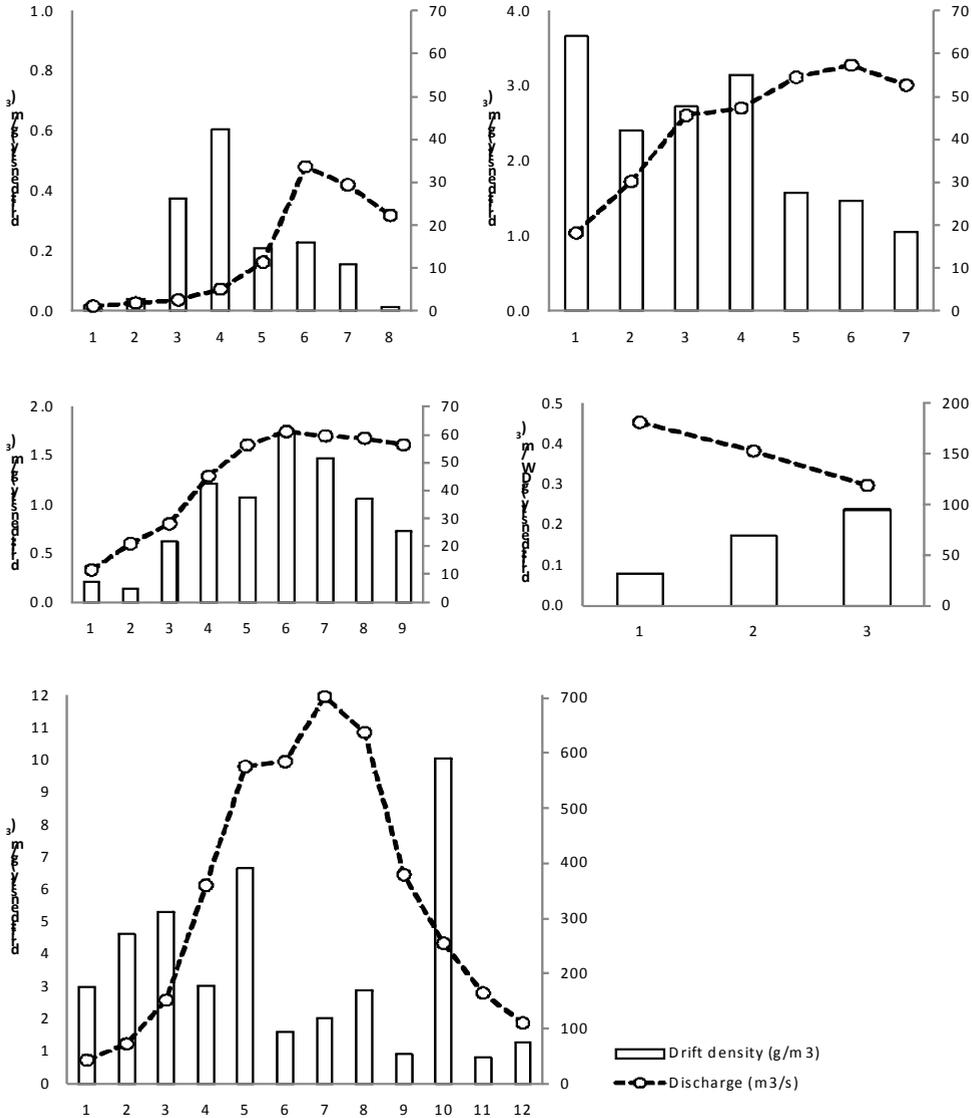
CPOM drift density of flood is the lowest in winter flood, then increasing in summer flood and finally reaches the highest density in autumn flood. CPOM drift density of December 2006 flood was ranged from 0.01 to 0.60  $\text{g m}^{-3}$  with average is 0.21  $\text{g m}^{-3}$  with the highest drift density was observed before the discharge reaches its peak. Drift was dominated by large particulate matter (LPM) which is ranged from 96-99% of the total sample. CPOM was transported in large amount when discharge was still below 10  $\text{m}^{-3}\text{s}^{-1}$  and continuously decreasing as water flow getting higher. Average drift density during summer flood was 1.52  $\text{g m}^{-3}$  with range was from 0.21  $\text{g m}^{-3}$  to 3.66  $\text{g m}^{-3}$ . Drifts in summer were also dominated by LPM which reached up to 91% in July 2007. However, in July 2005, during the peak discharge, drift was dominated by small particulate matter (SPM) to more than 60%. In autumn, September 2007, LPM dominated the drifts during rising limb of the flood, whereas in October 2006, only 36-47% of drift were categorized as LPM.

Average drift density of CPOM in autumn is 2.84  $\text{g m}^{-3}$  with highest drift was found during September 2007 as high as 10.07  $\text{g m}^{-3}$ . Figure 18.3 and Figure18.4 show CPOM drift density of each flood and averaged value of seasonal-grouped-based. Our data shows that CPOM drift density was significantly correlated with flood discharge ( $r = 0.36$ ;  $P < 0.05$ ), and the relationship among them follows power equation (Figure 18.5).

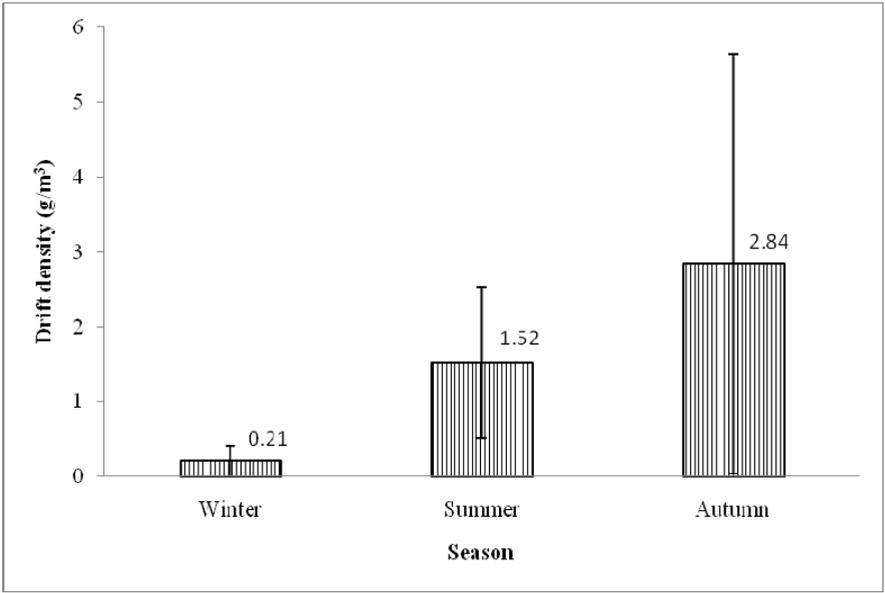
#### 4.3 Chemical parameters

C and N content of the CPOM were generally high (30 – 34.9) and significantly differed among flood events (ANOVA, 2,36 d.f.,  $P < 0.01$ ) with that of autumn flood being the highest (Table 18.1). CPOM of autumn flood significantly lower in C and N compared to two other floods (Tukey's HSD,  $P < 0.05$ ). C and N content show decreasing value from winter to autumn which correspond to the increasing flood magnitude. On the other hand, decreasing value of C and N in CPOM is followed by increasing in C:N ratio as the discharge increase. A high C:N ratio signals a poor diet and indicating a high cellulose

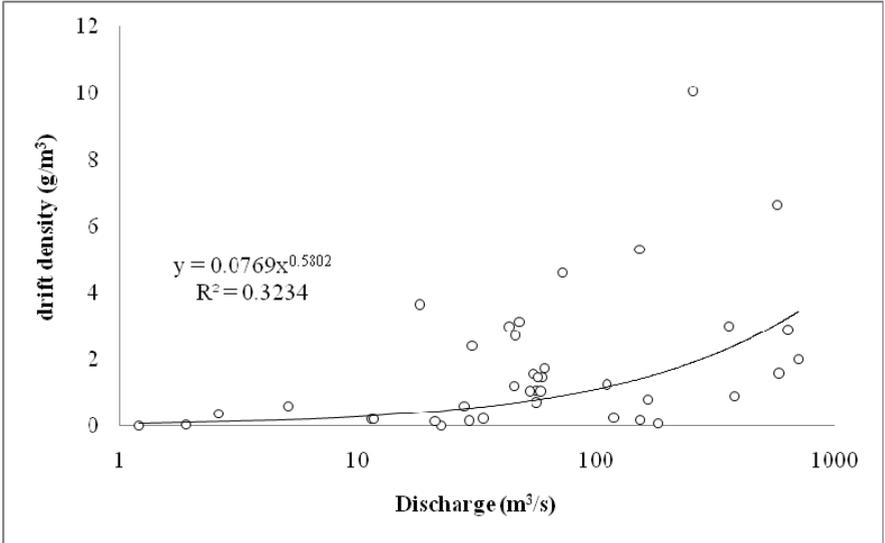
and lignin content and a low protein content. In general, for animal utilization, C:N ratio should be less than 17 (Allan and Castillo, 2007). Two-tailed Pearson correlation analysis shows that discharge is negatively correlated with C ( $r = -0.448, P=0.004$ ) and N ( $r = -0.560, P<0.001$ ), but positively correlated with C:N ratio ( $r = 0.523, P = 0.001$ ).



**Figure 18.3.** CPOM drift density (g dry weight m<sup>-3</sup>) against discharge during flood in Nakatsugawa River. Discharge was measured in m<sup>3</sup> s<sup>-1</sup> (secondary y-axis). The x-axis shows number of sample collected during flood.



**Figure 18.4.** Average of CPOM drift density in flood events in Nakatsugawa River. Flood events were grouped based on the season when the flood occurred.



**Figure 18.5.** Relationship between CPOM drift density (g dry weight m<sup>-3</sup>) and discharge during flood events in Nakatsugawa River, Saitama Prefecture, Japan. Discharge data (x-axis) are plotted on logarithmic scale.

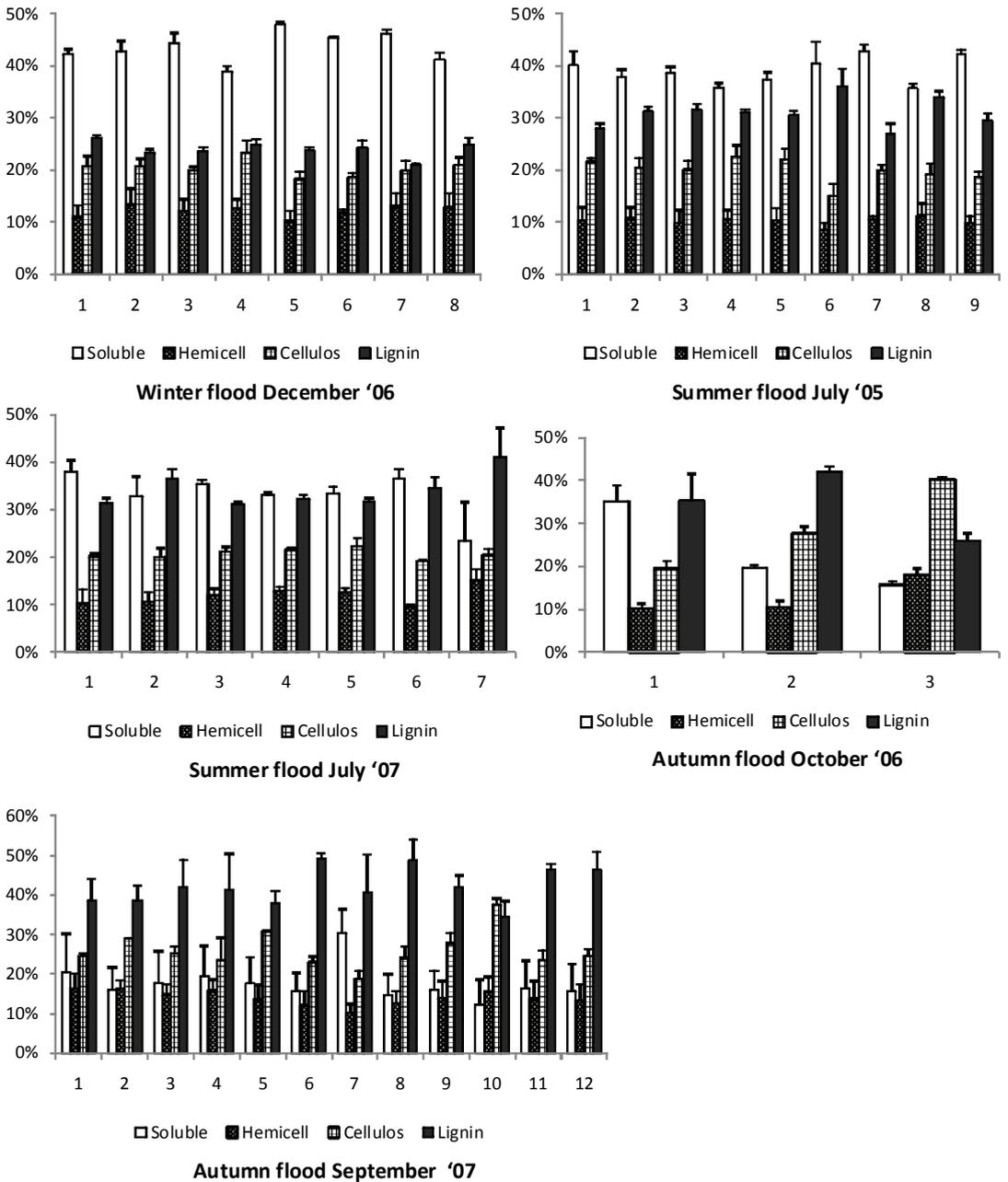
**Table 18.1.** Quality of exported CPOM collected during flood events in Nakatsugawa River between July 2005 and September 2007. Samples were grouped in seasons corresponding to the timing when the flood occurred. Number of samples for each flood is shown in bracket next to header. Significant difference among flood CPOM (Tukey's HSD) denoted with different lower-case letters. Column of Anova shows value of F-statistic and its significance.

Quality Parameters	Winter (n=8)		Summer (n=16)		Autumn (n=15)		ANOVA	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	F <sub>2,36</sub>	p-value
Soluble organics (%)	43.6	±2.9a	36.5	±4.6b	19.8	±7.0c	61.156	<0.001
Hemicellulose (%)	12.1	±1.1a,b	10.9	±1.6b	14.0	±2.4a	10.031	<0.001
Cellulose (%)	20.3	±1.6b	20.3	±1.8b	26.5	±6.0a	11.182	<0.001
Lignin (%)	24.0	±1.5c	32.3	±3.5b	39.7	±5.7a	36.473	<0.001
Carbon (%)	41.2	±1.8a	39.2	±3.8a	29.1	±11.1b	9.966	<0.001
Nitrogen (%)	1.4	±0.1a	1.3	±0.2a	0.8	±0.3b	17.22	<0.001
Total phosphorus (%)	0.1	±0.02a	0.04	±0.01a,b	0.04	±0.01b	3.143	0.055
C:N	30.5	±1.5b	30.0	±5.1b	34.9	±4.2a	5.835	0.006

S.D. indicate standard deviation

#### 4.4 Fiber components

In winter flood (December '06), CPOM contains high soluble organics and low lignin which was dominated by relatively new shed leaves due to previous falling season. Lignin content is roughly half of soluble organics content, while hemicellulose takes only small portion in the biomass. High soluble organics was also found in summer floods (July '05 and July '07), but lignin content was higher compared to the winters. As for floods occurred during autumn i.e., October 2006 and September 2007, we found that CPOM was dominated by lignin suggesting that mostly of the CPOM underwent later stage of decomposition (Figure 18.6).

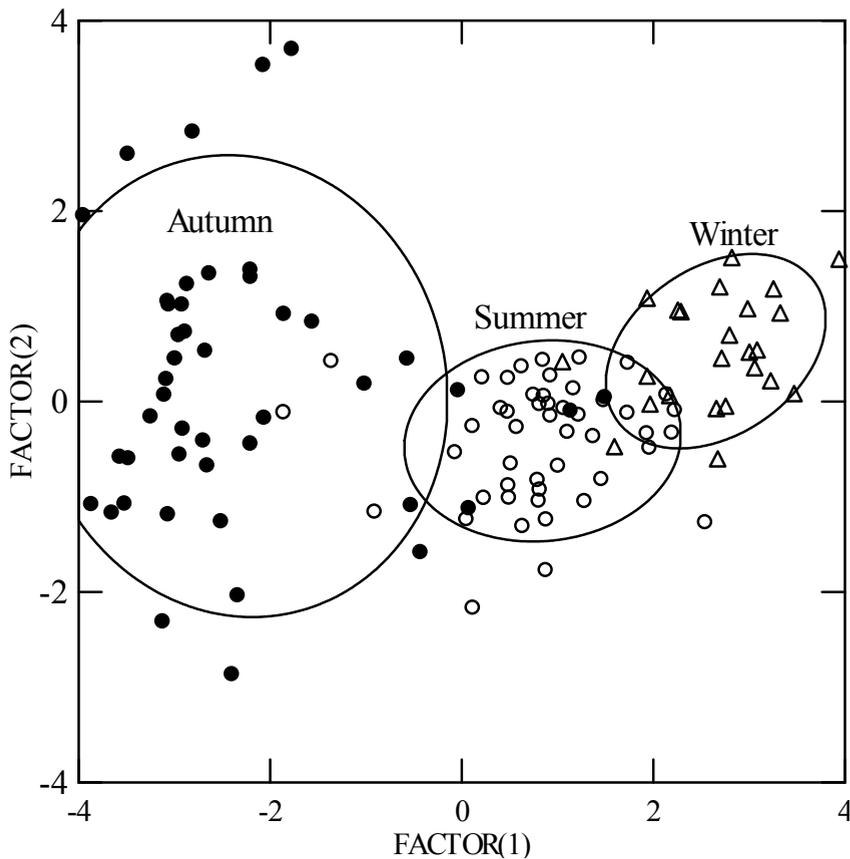


**Figure 18.6.** Fiber components of CPOM collected during floods in Nakatsugawa River. The x-axis indicates number of sample. Low lignin content was found in winter flood December '06, but on the contrary, high lignin CPOM found in autumn flood September '07 and October '06. In summer flood, lignin and soluble organics have almost same ratios.

All fiber components are significantly different among the three floods. We found that soluble organics and lignin of the CPOM were significantly different among floods and it might be related with flood magnitude. Soluble organics was negatively correlated with the discharge ( $r = -0.535$ ,  $P < 0.01$ ), conversely, positive correlation was shown by lignin ( $r = 0.560$ ,  $P < 0.01$ ). Hemicellulose and cellulose are likely not correlated with discharge. Soluble organics of autumn flood was significantly different with that of winter and summer flood (Tukey's HSD,  $P < 0.001$ ). Moreover, lignin content of the CPOM was also significantly different among all floods (Tukey's HSD,  $P < 0.001$ ). In winter and summer, soluble organics content also differed significantly at  $P = 0.012$ . On the other hand, during winter and summer flood, CPOM did not show difference either in hemicellulose ( $P = 0.340$ ), or in cellulose ( $P = 1.000$ ). However, we found significant difference of both cellulose and hemicellulose between the summers and the autumns (Table 18.1). Classification showed a clear result of the overall differences in fiber components of the CPOM. Three groups (centroids) of CPOM were recognized to have different quality of fiber components (Figure 18.7).

#### **4.5 Microbial respiration rates**

Oxygen consumption of the exported CPOM showing a decreasing trend from winter to autumn with range from  $0.35 \text{ mg O}_2 \text{ g}^{-1}\text{C h}^{-1}$  to  $0.10 \text{ mg O}_2 \text{ g}^{-1}\text{C h}^{-1}$ . Low microbial respiration in CPOM of autumn flood was due to high content of lignin which is refractory compound. In contrast, CPOM in winter flood seems to have lower lignin and high soluble organics which contain more less-refractory compound (including nutrient) which preferred by stream microbial community.



**Figure 18.7.** Plot of the first two axes of discriminant analysis on fiber components of CPOM under flood condition showing three groups/centroids of CPOM classified based on season.

## 5 Discussions

Our results show that CPOM drift density was high during rising discharge and decreasing prior to peak discharge. This is consistent with that reported by Bilby and Likens (1979) in their study which show high seston concentrations with rising flows with concentrations decreasing prior to peak discharge. The high drift density was high before the peak flow indicating that large amount of CPOM was already accumulated in the stream channel before flood came as benthic organic matter. High accumulation of CPOM in stream channel was apparently caused by wind-blow. CPOM from riparian forest floor was blown away by high wind velocity or run-off and then became accumulated in the channel.

Drift density of summer floods show different pattern. In July 2005, there was only little amount of CPOM transported in the beginning of the flood, whereas in July 2007 drift

density was highest at initial flood discharge. This difference is expected to be associated with occurrence of the last flood. Before flood in July 2005 occurred, a previous flood was happened in June 2005 (as seen in the hydrograph). CPOM in the forest floor and channel were probably transported in notable amount during the event. Hence, when the flood came in July 2005, only small amount of CPOM was available in the forest floor and river bank due to short period of CPOM accumulation. As in July 2007, CPOM accumulation period was started from January 2007 as CPOM of winter 2006 was already transported by December 2006 flood. Therefore, there was 6 months period for CPOM to accumulate in forest floor or streambed. CPOM that already accumulated will be directly transported from the beginning of the rising discharge. High drift density at the beginning of sampling was caused by first flush-effect, i.e. CPOM that already accumulated in river bank and streambed flushed away by the first high flow. CPOM drift density of flood is the lowest in winter flood, then increasing in summer flood and finally reaches the highest density in autumn flood. Regression analysis give result that CPOM drift density has correlation with discharge of seasonal floods. Good correlation between organic matter and discharge in flood was also reported in study of Liaw and MacCrimmon (1977).

The quality of exported CPOM during flood was found to be different significantly among floods. The high discharge of autumn flood transported large amount of CPOM to downstream which ultimately contribute to organic matter input of the stream. Furthermore, high discharge is likely to give large impact on the quality of CPOM inputs to downstream. Our fibre analysis results shows that in autumn flood of which the discharge is highest the CPOM contains poor-nutrient indicated by high lignin and lower soluble organics content. As demonstrated by Mathuriau and Chauvet (2002), leaf chemistry explained differences in decomposition of leaf litter of two terrestrial species in Andean stream. Additionally, differences in leaf chemistry and structure result in wide variation in breakdown rates (Webster and Benfield, 1986). Leaves with high initial nutrient concentration decompose more rapidly than leaves of lower nutrient content as demonstrated by Kaushik and Hynes (1971) who found positive relationship between initial N concentration and rapidly of breakdown. In addition, Richardson et al. (2004) found that breakdown rate is positively correlated with initial N concentration, but negatively correlated with C:N ratio. Nitrogen typically increases as a percent of remaining dry mass and sometimes increases in absolute terms as well. Therefore, because protein complexed to lignin and cellulose is very resistant to breakdown, N compounds remain while other leaf constituents are lost, resulting in a relative increase (Allan and Castillo, 2007). High C:N ratio in autumn flood shows that CPOM transported during this flood has low nitrogen content. Nitrogen can be found in plant, or in this

term in CPOM, as protein or other forms. During decomposition, bacterial community will refer to colonize the higher organic matter that contains more nitrogen. Thus, in decomposed leaves litter nitrogen content expected to be low. However, some study reported that during decomposition process nitrogen content is high due to the bacterial biomass accumulation. Comparing C:P ratio of CPOM between all floods, we can see that C:P ratio of summer CPOM is higher than the others, as much as 1122.60. Uptake and sorption of phosphorus on to organic matter is primarily due to biotic mechanisms such as incorporation by microbes (Gregory, 1978; Elwood *et al.*, 1981). Furthermore, study by D'Angelo (1990) showed that CPOM quality influenced phosphorus uptake. Referring to those studies, results of this study is still relevant to support that high microbial activity found in summer flood CPOM.

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**IV - The interdisciplinary nature of entrepreneurship:  
Building together**



## Chapter 19:

# The Knowledge Needed to Generate Before Establishing an Aquatic Theme Park in Sri Lanka

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**Abstract:** This paper shows the inter-disciplinary nature of entrepreneurship by exemplifying a much need entrepreneurial spin-off from the University of Ruhuna: The Aquatic Theme Park. The paper reveals some of the considerations that are needed to be accounted for when the theme park is realized. Different authors contribute with ideas on which thoughts should be made when such a task should be accomplished.

## **1 Introduction**

The oldest theme park, Bakken, was opened for public in 1583, at Klampenborg, north of Copenhagen, Denmark. The concept of theme parks took new momentum in the 1950s in the United States. This as world's fairs and expositions were influenced by development of the theme park industry (Adams, 1991). Recently theme parks have incorporated conceptual and operational breakthroughs that have successively

incorporated other kind of leisure facilities and educational activities. The Faculty of Fisheries and Marine Sciences Technology (Faculty of FMST) of University of Ruhuna has a vision of an 'Aquatic Theme Park' that could be located next to its main campus along the narrow coastal belt. In general, theme parks are cultural creations and are leisure facilities due to their mass, artificial and consumerist nature (Adams, 1991). Presently, in Sri Lanka, there is no such a mass scale theme park available. Though generally theme parks are for leisure, the proposed theme park is associated with facilities for aquatic research, academic meetings, conducting different level of awareness programmes for schools in addition to offering entertainment and adventure.

Establishment of a theme park is a multi step process that normally begins with a theme design, followed by a feasibility study which will determine the size and investment level required for to serve a particular market (Hester, 1985). The next step is considered as concept development where the design of the park with its architectural models is constructed. This is then followed by an investment analysis. In the long run, the sustainability and health of the theme park is directly associated with the setup of the business and the quality of the service provided while keeping the balance among ecological, economic, and social values (Hart, 1999).

In the concept of the project, 'Aquatic Theme Park' proposed by the Faculty of FMST of University of Ruhuna comprises of five separate sections: Marine Aquarium, Freshwater Aquarium, Aquatic and Natural History Museum, Research & Education Center and a Water Park. The reason for the inclusion of marine and freshwater aquariums is to provide some educational aspects while the Research and Education Center approaches the higher learning and research arena. Other than common leisure facilities that is normally available in theme park industry, in the proposed project it is expected to provide more weight on aquatic research in order to improve the sustainable use of the vast aquatic resources of the country. Therefore, it is expected that the proposed project will have a great impact on the public concern over aquatic environments, its fauna and flora. Public awareness on aquatic literacy would then be accomplished. In addition, it is expected to alleviate the professional job demand in the aquatic sector, especially for graduates from the Faculty of FMST. Also, the proposed project will have a positive influence on the tourism industry in the area. These identified demands will jointly lead to a betterment of the local economy and the economy in the other areas of the country as well.

Establishing such an extensive research, education, learning and leisure environment is not straight forward. Successful realization of the vision involves numerous disciplines.

This involves pedagogic didactics, marketing, entrepreneurship, organization, architecture, aquatic sciences, networking, nature preservation, auditing, public governance, transport and logistics, financing, and tourism among others. This chapter addresses some of the research challenges linked to the proposed project of the University of Ruhuna in its efforts to establish an Aquatic Theme Park.

The outline of the chapter is given as follows. First, the context of the vision of the Aquatic Theme Park is presented. The Sri Lankan local context are described related to the marine associated industries and the tourist industry in particular. Then a brief history description of the purpose and mission of the University of Ruhuna is presented. The envisioned park is then described along its purposes and goals. Some of the challenges required to realization of the project are then discussed from different theoretical angles. These discussions follow a certain scheme. It includes sections explaining why the project needed research before implanting, how the project could be understood, and a linkage between the general theory and the specific case. At this stage, the research problems which needed to be addressed and the methods to be applied are identified. Also, the chapter includes a section expressing what is needed to know regarding the situation before such a study could be done. The chapter is summarized in the end with reflections on how to take this project to its next step forward to its realization.

## **2 Sri Lanka and the local context**

Sri Lanka is a lower middle-income country (World Bank, 2009). The main economic sectors of the country are tourism, tea export, apparel, textile, production of rice and other agricultural goods. In addition to these economic sectors, overseas employment contributes highly to foreign exchange. Tourism is one of the main industries in Sri Lanka and the major tourist attractions are focused around the islands famous beaches located in the southern and eastern parts of the country, ancient heritage sites are located in the interior of the country and lush green resorts are located in the mountainous regions of the country. The island progress with an economy of \$39.6 billion (2008 estimate) (\$91.87 billion (PPP) estimate), and a per capita GDP of about \$4,300 (PPP), facing strong growth rates in recent years.

Education wise, Sri Lanka is one of the best performing countries in South Asia. However, it faces major challenges in improving learning outcomes in general education, making public higher education more responsive to local and global needs, and keeping its education system functioning efficiently (World Bank, 2009).

The only theme park presently in Sri Lanka, 'Leisure World' is located in the Seethawaka, nearly 40 km away from Colombo along the Rathnapura road. The proposed concept of 'Aquatic Theme Park' differs significantly from this Leisure World, as the present park focus on entertainment, while the intended new park in the south also include an aspect of education.

### **3 The role of the University in support of developing the Southern Region**

Matara historically belongs to the area called Ruhana, one of the three kingdoms in Sri Lanka. In 1978, the University of Ruhuna was established in Matara. Currently, the University of Ruhuna constitutes of seven faculties, namely Agriculture, Engineering, Fisheries and Marine Sciences & Technology, Humanities & Social Sciences, Management & Finance, Medicine and Faculty of Science. Across the seven faculties in 2008, the total number of student account to 7825, recording its fast growth during the past three decades.

The vision of the University of Ruhuna is to be an internationally respected, outstanding academic center, committed to rigorous scholarship, academic freedom, sound moral values and social responsibility. The mission of the University is to produce internationally, accredited, outstanding graduates who are innovative, analytical and adaptable with a life long love of learning, and contribute to the advancement of knowledge and enrichment of educational, cultural, economic and natural environments of the people in the region it serves (University of Ruhuna, 2010).

The goals of the institution shape the future direction of its activities. The educational offers is necessarily a compromise among the needs of several 'stakeholder'; the needs of society, which expects a graduate of a university to be a responsible, ethical, broadly educated citizen, capable of well-informed participation in civic society. The prime responsibility of the University of Ruhuna is to influence the way of future desired state of affairs. In other words the goals of University of Ruhuna serve the function of translating skilled students into active citizens. Education for sustainable development is a learning process based on the ideas and principles that underlie sustainability and is concerned with all levels and types of education. On the other hand University of Ruhuna as the intellectual thrust of the region bears the responsibility of assisting to a sustainable utilization of regional and national resources.

## **4 Visualization of the Aquatic Theme Park**

The Faculty of Fisheries and Marine Sciences & Technology of University of Ruhuna has been proposed (FMST, 2010) to establish a Aquatic Theme Park close to the University main campus at Wellamadama. The theme park will be situated facing the sea at one side and on the other side it will be facing a small lagoon, Dondra Lagoon and the main highways that link to the cities of Matara and Hambantota. Therefore geographically the proposed site is ideal for such a project as the most of the scenic features and water bodies are located close by.

The main objectives of this project are to:

- Provide an opportunity to offer a ‘marine park’ to the people in Sri Lanka as presently there is no comparable marine park located in the island. Therefore, this will give a good opportunity to the people in Sri Lanka to gain an excitement over marine organisms and ecosystems.
- Provide an excellent opportunity to enhance public interest on aquatic environmental education, especially among the primary and secondary education sector.
- Provide an opportunity to gather experts in sectors of marine and freshwater aquatic research by facilitating an aquatic education center.
- Enhance the new sector for cutting edge research in Sri Lanka as there is no facility currently available for studying marine and freshwater ecosystems.
- Provide an opportunity to study the history of aquatic sciences and aquatic tradition in Sri Lanka.
- Provide jobs related to the sector that could be undertaken by the graduates qualified from the Faculty of Fishers and Marine Sciences & Technology.
- Enhance the local tourism industry.

## **5 Components of the project**

The project proposes five separate components, and a brief description of each component is given below. Attractions that could be incorporated into each component are given in Figure 19.1.

- Marine Aquarium
- Freshwater Aquarium
- Marine and Freshwater Museum
- Research and Education Center
- Water Park

### **5.1 Marine Aquarium**

A marine aquarium is an aquarium which keeps marine plants and animals in a controlled environment. Maintenance of marine aquaria is relatively difficult and different from its freshwater counterpart because of the fundamental differences in the constitution of saltwater and the resulting differences in the adaptation of its inhabitants. A stable marine aquarium requires more equipment than freshwater systems, and generally requires more stringent water quality monitoring. However, the inhabitants of saltwater aquariums are usually much more spectacular than freshwater species.

### **5.2 Freshwater Aquarium**

Freshwater fish comes in a large variety of species, and from many different geographical regions. A freshwater aquarium could be arranged to keep fish in different combinations of species and in different kinds of aquatic environments. A community aquarium refers to the mixing of fish and plants from different geographical areas with an emphasis on the color and hardiness of the specimens. A biotope aquarium is an aquarium that is designed to simulate a natural habitat, with the fish, plants, and furnishings all representative of a particular place in nature. Because only species that are found together in the nature are allowed in a true biotope aquarium, these tanks are more challenging and less common than the other themes.

### **5.3 Marine and Freshwater Museum**

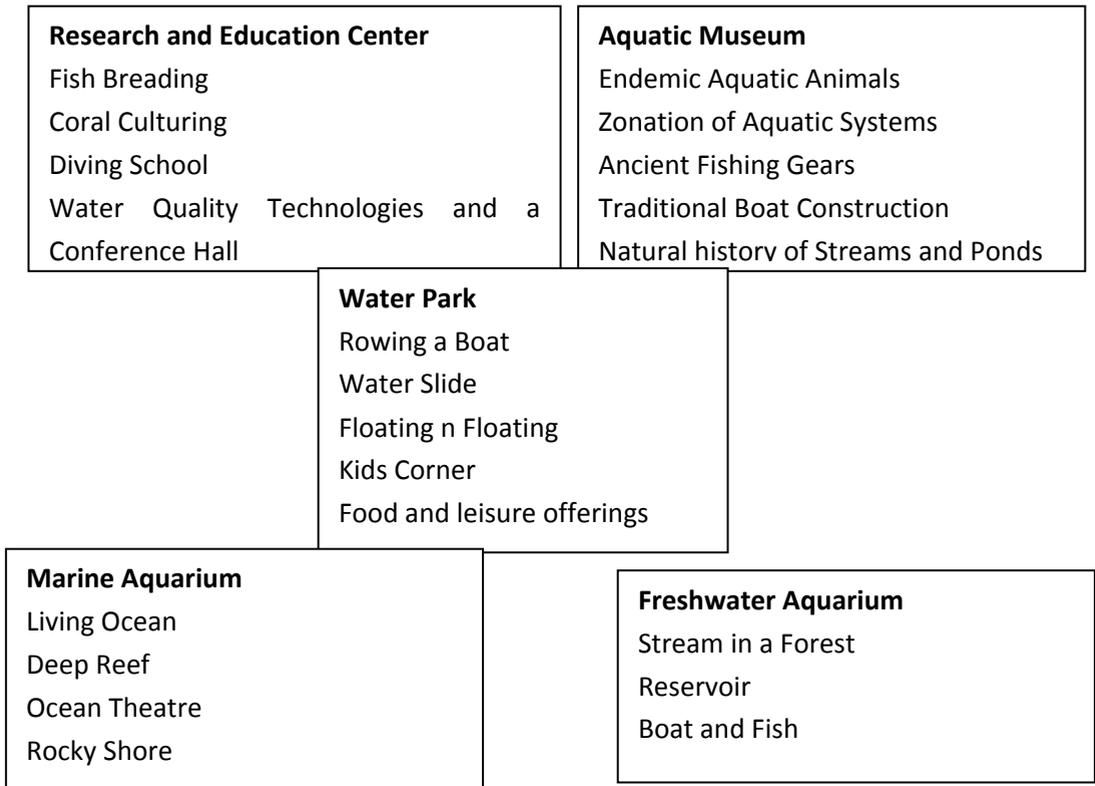
A museum is a place which houses a collection of artifacts that could collect and care for objects of scientific, artistic, or historical importance and make them available for public viewing through exhibits that may be permanent or temporary. Artifacts related to fishery, traditional fishing gears, the irrigation history of Sri Lanka and marine archeological artifacts would be some of the items that could be displayed at the museum. This would also allow research related to the local traditional fish industry and the influence this industry have had on the development of the Sri Lankan society.

### **5.4 Research and Education Center**

The proposed Research Station and Education Center will serve as a hub to the people in Sri Lanka who engage in aquatic research. This facility could also be a place to hold academic meetings and conferences related to the aquatic research. Also, the site could serve as a training center for diving; it could be a place where school kids in all ages could engage in learning about the marine and freshwater life of Sri Lanka.

## 6 The Water Park

This park is a common leisure facility where the general public can enjoy in a pastoral setting. The park may consist of booths, restaurants, entertainment, displays and some “rides” such as rollercoaster or water slides with the features that are currently applied in adventure attractions. Figure 19.1 displays the five components of the proposed Aquatic Theme Park.



**Figure 19.1** The five components of the proposed Aquatic Theme Park

When materializing this vision, it is wise to learn from others experiences and relevant research, this in order to avoid their mistakes (Spencer, 1995) and translate their success (McKercher, Ho and Cros, 2004). Some of the areas for knowledge transfer that could be identified are operational audits, commercial statistics, client characteristics, site geography, equipment manufacture, safety and insurance, public transportation, recreation ecology, educational aspects, adventure destination marketing, amenity migration and lifestyle. The environmental impacts of outdoor recreation have received some attention, and much of this is directly applicable in large scale commercial tourism (Wight, 1993).

## **7 Architectural Concerns**

In June 1996, the Second UN Conference on Human Settlement (Habitat II) in Istanbul put forward ways of applying sustainable principles in buildings. Leisure has become a central focus in the lives of modern day. Many seek leisure and increasingly see it as a central element contributing to the quality of their lives. Also, many increasingly define their leisure interests and pursuits. Leisure has become a major force in the contemporary society with powerful social, cultural, and economic implications for how we live our lives. Scale and effectiveness of the presentation determines the strength of the leisure ones expects. The proposed project requires an understanding of the nature of the leisure of a wider audience in terms of age and education level. Therefore we need to understand and analyze how visitor emotions in a theme park environment influence their satisfaction and behavioral intentions.

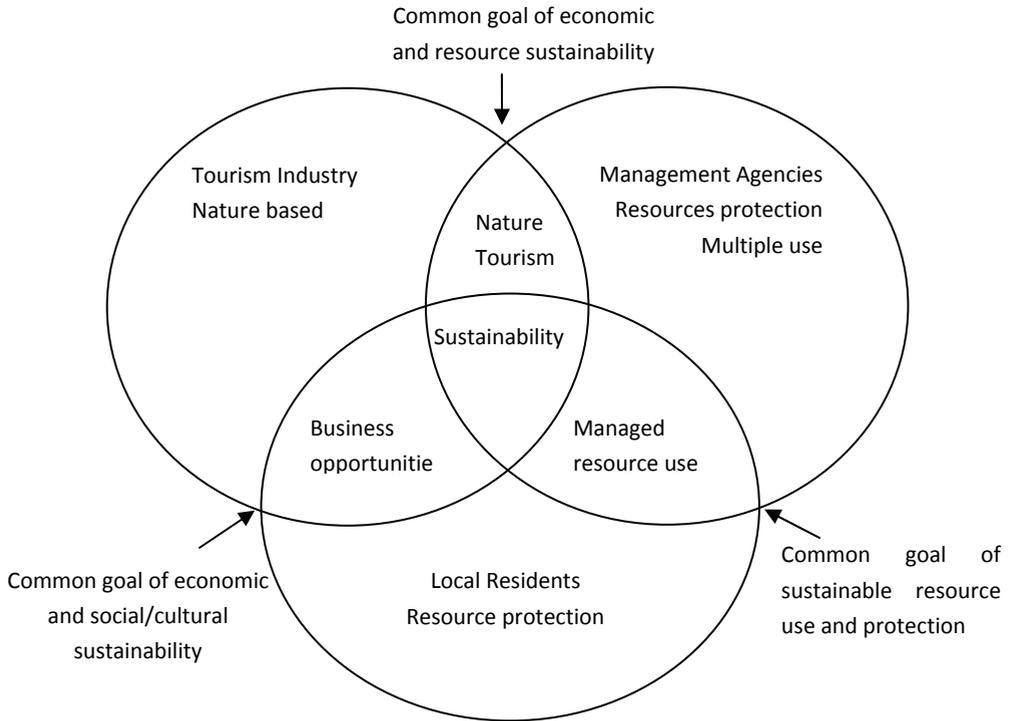
## **8 Impact on the local economy**

Many rural coastal communities face challenges in maintaining stable local economies and depend on recreation and tourism as a basis for economic viability. Local residents often find that nature-based recreational opportunities, and the local characteristics related to attractive and livable communities, are marketed to tourists. Residents can identify positive and negative impacts of tourism in their communities (Harrill, 2004; Andereck et al., 2005). Tourism planning and development can physically alter places of personal value to residents (Hester 1985), damaging the unique appeal of individual communities for both residents and visitors.

Sustainable development has become a vehicle around the globe for expressing the need to depart from present dominant models of development which appear unable to balance the needs of people and the planet in the pursuit of prosperity (Wight, 1993). Since sustainability is more of an ethical question (Wight, 1993) than a technical one, an important step is to understand the meanings the three groups assign to the concept. The extent to which the goals of sustainability can be attained is largely dependent (as a necessary but not sufficient condition) on the extent to which goals and indicators of progress are shared among the three groups (Figure 19.2). The tourism industry itself is a powerful influence on the establishment of these meanings. In many situations, it promotes and develops different tourism products with little involvement from the other two groups. Thus, a logical first step is to identify the meaning the industry places on sustainability.

In communities that depend on natural resources for place meanings and tourism, the limits of ecological processes to renew natural resources establish the parameters of

sustainability. Sustainable tourism meets the above definition of sustainability and uses a public participation process to inform planning and management decisions (Ioannides, 2001). Figure 19.2 shows the major participants in tourism development and their shared goals and opportunities for social, natural resource, and economic sustainability.



**Figure 19.2** Major participants in tourism development and their shared goals and opportunities for social, natural resource, and economic sustainability

## 9 Some of the challenges to be faced

This section presents the views of researchers and practitioners on the challenges of realization of Aquatic Theme Park that might encounter. The contributors argues why there might be a certain challenge, how the problem could be understood and suggest actions for mastering the challenge.

First the mission and purpose of the Aquatic Park is detailed. Then dean at FMST, Tilak Priyadarshana, elaborates on the challenges facing the Faculty, Faculty of Fisheries and Marine Sciences & Technology when serving the need of the region in knowledge and research. This further expresses the purpose of the proposed Aquatic Theme Park. Then, Ove Jacobsen stresses that the theme park in addition to be economical sustainable,

need to be ecological sustainable in order to serve its purpose and for to be aligned with its mission.

Some of the challenges relate to the physical shaping of the park. A young Sri Lankan architect, Gihan Muthugula, suggests a physical outline of the park. Some of the treats mentioned by Gihan Muthugula are further discussed by Camilla Risvoll. She discusses how the park could be arranged in order to reduce the effect of climate changes. Nimal Wijerathna contributes by pointing to the management challenges of handling a security system preventing damages due to potential natural disasters.

This then leads to a section on how the business activities within the park could be arranged and how to attract funding for its realization. The Aquatic Theme Park consists of many different activities with different purposes. Dorte Eide shows some of the challenges related to innovation management related to creating the theme park into a coherent expression with a tourist appeal. The researchers, Konstantin Timoshenko and Chamara Kuruppu elaborates on how the different activities could be organized in order to fit their particular part of the overall mission. Jagath Manatunge raises the issue of human relation management of the employees at the park. Hiran Jayewardene discusses how such an initiative could be funded and sustained over time. He also raises the issue on how these activities should be legitimately arranged. This leads to a need for a business plan convincing funders and other actors that this is a sound investment and that they should devote their time, resources and devotion to its realizations (Bjørn Willy Åmo). Frode Kjærland further discusses how the risks associated with the park could be handled, and by such provide a solution to some of the problems raised.

Øystein Jensen displays the challenges associated with getting attention for its multiple activities, attention from paying customers. These customers are both tourists, locals seeking amusements; school classes seeking education and entertainment, researchers seeking new knowledge and other stakeholders who also have their legitimate claims in the activities at the theme park. The challenges related to engaging the customer in the creation of the amusement – educational interaction is discussed by Tor Geir Kvinen. Thor-Erik Sandberg Hanssen directs our attention to the logistics of getting the customer to the park. The chapter ends with a proposed map toward a realization of the vision.

## 9.1 Challenges as seen from the 21st Century Education Objectives – Marine and Aquatic Science Literacy

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### ***Obligations to marine and aquatic science literacy***

The scene is now set for an accelerated drive for a development of Sri Lanka by improving the economy, bringing prosperity to its people and becoming the new 'Wonder of Asia'. In the coming decades, the general public will be required ever more often to understand complex environmental issues, evaluate proposed aquatic environmental plans, and understand how individual decisions affect the aquatic environment at local to global scales (Fortner and Mayer, 1989). This has been emphasized by the UNESCO statement in *Educating for a Sustainable Future: A transdisciplinary vision for concerted action* in 1997 (Weenen, 2000) as '*It is widely agreed that education is the most effective means that society possesses for confronting the challenges of the future. Indeed, education will shape the world of tomorrow*'.

Society must recognize that intellectual creativity is essential to excellence in science (Jacobson and Wilensky, 2006) and that excellence in science is essential to most effective and cost-efficient management of our resources in general and in particular to management of aquatic resources (Fortner and Mayer, 1989). Thus it is of fundamental importance to ensure that higher quality education on ecological issues raises the aquatic environmental literacy of the general public (Fortner and Mayer, 1989). Therefore, a scientifically literate, environmentally responsible population is vital if Sri Lanka is to be competitive in the world economy and at the same time conserve natural resources and protect its environment.

Natural resources literacy has been emphasized by the United Nations Conference on the Human Environment in 1972: Principal 2: '*The natural resources of the earth, including ....., water, ....., flora and fauna and especially representative samples of natural ecosystems, must be safeguarded for the benefit of present and future generations through careful planning or management, as appropriate.*' And in particular to marine science literacy following provisions has been provided under the Law of the Sea Convention in 1982. Part 14 Development and Transfer of Marine Technology, Section III - National and Regional Marine Scientific and Technological Centres, Article 275 – Establishment of National Centres '*..... particularly in developing coastal states, of national marine scientific and technological research centers and the strengthening of existing national centers, in order to stimulate and advance the conduct of marine*

*scientific research by developing coastal states and to enhance their national capabilities to utilize and preserve their marine resources for the economic benefit.'*

Article 276 – Establishment of Regional Centres. 'States in coordination with the competent international organisations, the Authority and national marine scientific and technological research institutions, shall promote the establishment of regional marine scientific and technological research centres, particularly in developing states, in order to stimulate and advance the conduct of marine scientific research by developing states and foster the transfer of marine technology.'

In particular to marine resources, Sri Lanka is endowed with 42 coastal lagoons and exclusive economic zone of 8 times of the terrestrial land mass. The aim of establishing Faculty of Fisheries and Marine Sciences and Technology was to produce scholars to help the country's economic development through sustainable utilization of inland and marine aquatic resources. One of the major challenges facing Sri Lanka present is instilling scientific environmental principles and literacy in the decision-making public while developing highly trained, technologically capable personnel (Tilakaratna and Gunasena, 2000). The advent of new viewpoints, vantages and perspectives is one of the most important challenges to higher education (Jacobson and Wilensky, 2006). Fostering important facilities requires a diversification of learning opportunities in addition to the school and university level as conventional educational methods are no longer adequate for the real needs of tomorrow.

### ***The role of the Aquatic Park as an Aquatic Education Center***

An education in moral and ethics is needed to achieve global environmental sustainability by changing people's attitude to nature and the environment (Mayer and Tokuyama, 2002). The proposed Research and Education Center, Aquatic Museum, Freshwater and Marine Aquariums all support the education of our nation's future marine scientists and aquatic resources professionals by offering an opportunity to develop their research and analytical skills by assisting the Faculty academics. They are thus better prepared to assume prominent positions in which they may direct the responsible use, sustainable development and conservation of marine and aquatic resources. The proposed Research and Education center may provide a suite of opportunities and programs to accomplish this through its support of a wide range of experiential internships, fellowships, team-based research courses, interdisciplinary courses and programs, and traditional research assistantships that broaden the experiences of undergraduate and graduate students alike. At this most opportune moment for Sri Lanka it is imperative that the country recognize the importance of

science, technology and innovation in propelling Sri Lanka towards the ‘Asian Rising’. Therefore scientific capability within the county has to be of world standard in the areas that Sri Lanka has the competitive edge, so that goods and services developed will be able to compete with those from other countries.

The Research and Education Center may carry out education more explicitly in its strategic thinking, looking at ways to develop innovative, imaginative approaches and technologies for the delivery of education; to consistently assess education efforts to ensure accomplishment of project objectives; to secure sufficient resources to accomplish the task, and to engage in partnerships with other science education stakeholders and work closely with other educators in more productive and focused collaborations. As a national duty, the identification of scientific projects, and the provision of facilities and scientific know-how to carry out projects can be entrusted to Research and Education Center. Such activities will provide extensive support to help current and future teachers to advance their scientific skills, develop interesting and engaging scientific opportunities for school-aged students both in and outside the classroom, and contribute to the continuing professional development of future scientists, policy makers and resource managers.

**Table 19.1** Categories of interest and types of programmes can be provided through Research and Education Center attached to the Theme Park

Category of interest	Type of programme	Type of support
School students	Lectures, workshops, field excursions	Stewardships
Undergraduates	Interdisciplinary courses and programs, team based research courses	Internships, research assistantships
Researchers	Advance research related to freshwater and marine fields	Fellowships
Public and Private Sector Officers	Workshops, lectures	Relevant institutions
General Public	Aquatic science information, awareness programmes, parent-and-child programs, field trips, instructional and informative CDs, and television and radio programmes	Sponsorships

If, as expected, the coastal population continues its rapid increase in the coming decades, so will conflicts over the use of land access to the country's marine and aquatic resources. One way of alleviating these conflicts is through informal public education. The public is fascinated with marine and aquatic natural areas and processes. In recognition of this interest, Research and Education Center in collaboration with the museum, aquaria and environmental education facilities and natural sites, can deliver aquatic science information to the public through lifelong learning experiences, including workshops, parent-and-child programs, field excursions, lectures, instructional and informative CDs, and television and radio programmes.

The educational objectives of the proposed project could be achieved by engaging all stakeholders, integration of local experiences and traditional knowledge. Therefore before establishing, a multidisciplinary team is needed to develop a shared vision of the desired objectives of the proposed theme park.

## 9.2 Challenges as seen from the field of Ecological Economics - Energy and Materials

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Ecological economics is a trans-disciplinary field of academic research that aims to address the interdependence and co-evolution of human economics and natural ecosystems over time and space. The research questions include the study of the metabolism of the society, that is, the study of the flows of energy and materials that enter and exit the economic system. Ecological insights are used to explain and understand economic phenomena in a holistic, contextual, value-sensitive, and eco-centric manner.

Ecological economics goes beyond conventional conceptions of scientific disciplines and attempts to integrate and synthesize many different disciplinary perspectives in order to achieve an ecologically and economically sustainable world. The socio-cultural and ethical dimensions of economic development and change are integrated in the analysis. It is necessary to move beyond the simple recognition of biophysical limits to economic growth, in order to explore how objectives traditionally associated with growth can be reconciled with concerns for environmental quality and quality of life.

From this perspective a commodity in the shelf in the supermarket or a tourist product may be understood and interpreted in a radically different way due to the holistic frame of references. Some of the premises behind this reasoning are as follows. Main stream economics is to a high extent interwoven in a mechanic ontology. Most people (and economists) are not even reflecting on this. The mechanistic worldview is taken for granted and regarded as natural. Massive activities of modern marketing are contributing to this shallow mechanical worldview. Reflection on marketing may be one way to make individuals responsible for their actions and products, which is an important ethical premise. In fact when brands as Adidas and McDonald have been challenged due to unethical acts connected to their production of their branded products, there have been efforts to correct the behavior. What we need is a balance – marketing within limits – not transgressing natural limits of prudent behavior.

The danger with a narrow product concept is that we focus upon the external and shallow external attributes to things and forgets that the core, the essential thing may be inside and part of a much larger picture than what a snapshot allows. We need another way to look beneath the surface. The essence is to discover that everything is

connected to everything else. This perspective may be contrasted with an individual as a "homo consumens", focusing upon fulfilling his immediate wants.

Taylor's (1985) concept, weak and strong evaluations, illuminates this argumentation. Based upon strong evaluations the person includes information in an extended perspective. From the perspective of weak evaluations, questions concerning societal and environmental responsibility will not be raised because the customers may act in an opportunistic way. We will address the question how it is possible to market and communicate the benefits and symbolic values of a tourist product without compromising environmental sustainability and cultural resilience. In the perspective of ecological economics the extended product includes all the direct and indirect activities and processes that are necessary to produce, transport, store, use, and recycle the product.

In the perspective of ecological economics – "meeting needs profitably" is important, but it should be done in a holistic and responsible sense. The challenge is to develop a marketing strategy of goods and services within limits that do not threaten deep cultural and environmental values. The final purpose with economic activity is to enable everybody to flourish, which means that the ultimate objective is to fulfill our capacity as individuals in a resilient society within the limits of the natural ecosystems.

### **9.3 Challenges as seen from the field of Architecture – Conceptual Design**

#### **Approach**

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The main objective of the project is to offer awareness to people about the importance of marine and fresh water environments, via providing increased research facilities to those educated in the relevant field and making it accessible for the public, providing recreational and educational facilities for both locals and foreigners. Also it is necessary to make the project into a profitable investment generating employment and boosting the local economy which would directly or indirectly add to national revenue. The site is located adjoining the university premises, in the Sothern province of Sri Lanka, in a sub-urban area, recognized as a mixed development zone.

#### ***Client's objectives***

The main objective of the client is to provide an opportunity for locals to experience a 'Marine Park' as presently there is no comparable marine park located in the country. Therefore, the park immense potential to gather excitement over marine and freshwater flora and fauna enhancing public interest should be realized. Secondly, another challenge is to provide an excellent opportunity for aquatic environmental education especially among the primary and secondary education sector. The third objective is to provide jobs related to the sector that could be undertaken by the graduates qualified from the Faculty of Fishers and Marine Sciences & Technology equipping the relevant sector of research in Sri Lanka a good tool to accomplish their mission, as there is no such facility currently available for aquatic related education. Further, the park should provide an opportunity to study the history of aquatic sciences in Sri Lanka and in the world context.

#### ***Users***

##### ***Primary user***

The primary uses of the facility would be the general public, including school children, and local and foreign tourists.

##### ***Secondary users***

Expected secondary users of the facility are undergraduates and researchers from the Faculty of Fisheries and Marine Sciences & Technology, and marine archeological and biological explorers who are interested in the field. In addition, other government and non government organizations that may have a potential of engaging in partnerships with the Theme Park in many ways will also use the park. Some of the potential

government institutions are National Aquatic Resources Research and Development Agency (NARA), Sri Lanka Marine Archeological Unit, National Aquaculture Development Authority (NAQDA), Department of Wildlife, Central Environmental Authority (CEA), Department of Coast Conservation (CCD) and Marine Environment Protection Authority (MEPA).

### SWOT analysis (Strengths, Weaknesses, Opportunities and Threats) (**Andrew, 1971**)

#### Strengths of the project:

- Facing the sea – making an attractive, live space
- Ease of access from Galle road and the beach front
- Site topography which is ideal for such development
- Dramatic panoramic vistas unique to the site
- Sea front with a potential for development
- Flow of tourists (both local and foreign) along the Galle road
- Matara being the provincial and the district capital
- Rich biological diversity in the adjoining sea and the deep Dondra lagoon
- Location of close proximity to the fisheries harbor

#### Weakness of the project:

- The technical infrastructure is non-present
- Some developable lands are encumbered by unauthorized access along the shore
- Lack of pedestrian spaces and open gathering spaces close to the site
- Lack of people knowledgeable on marine biology

#### Opportunities of the project:

- Travelling groups through Matara is an opportunity for the park
- Integration of people from different social status and social hierarchy

Total development may increase the income of the surround low income communities  
Underutilized lands which has a greater potential for development as public gathering places providing recreational activities  
Availability of developable vacant lands and naturally scenic areas in the periphery

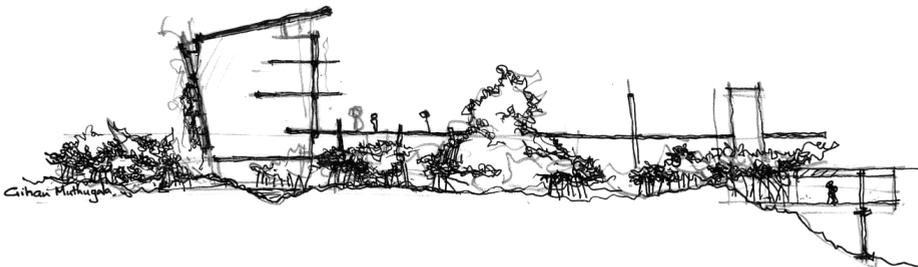
#### Threats to the project:

- Political issues
- Threats on Archeological and Biological sites of surround
- Effects of natural disasters such as Tsunami



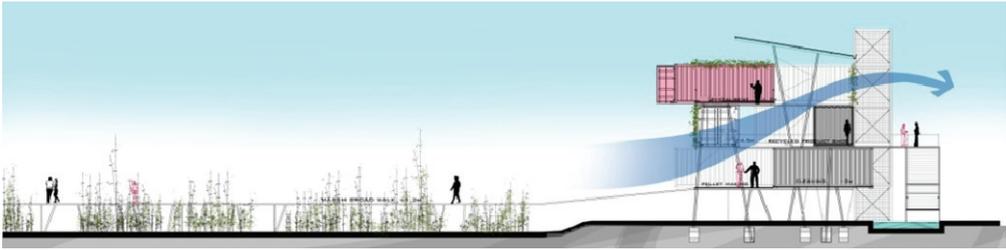
**Figure 19.3** Sketch of a section indicating the friendliness to the environment

The sensitive ecological structure of the marine and fresh water habitats of the lagoon and sea, ask for a design solution that has concern and respect for these environments. The design is approached in this sense as a mix of architecture and landscape (Figure 19.3 and 19.4). The almost non-buildings shall sit on ground upon stilts and touch the earth lightly.



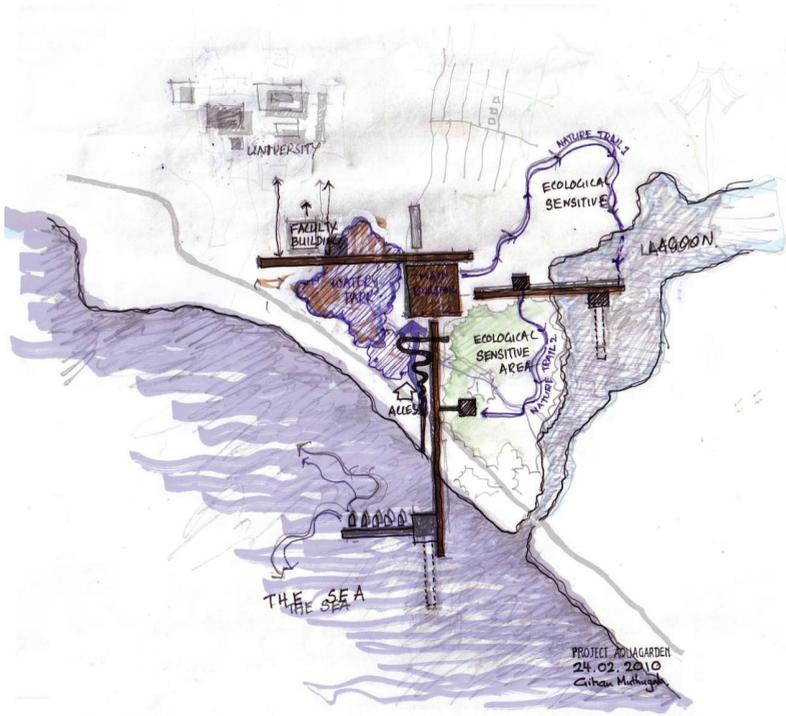
**Figure 19.4** Design with less harm to the environment would be the best approach

Structures would be supported upon stilts with minimal impact on existing ground conditions and the relevant eco-systems. Architecture of such a place as the aquatic theme park should essentially be eco-friendly and present adequate social cultural surrounding. In order to ensure the survival of the wetland ecosystem of the proposed location, an active catalyst balancing value addition, development and preservation is injected. The recreational education facility includes a removable building on high ground at the edge of shallow marsh, decks and a café on the shallow marsh at the edge of the lake and a marsh broad walk connecting the two elements. The main building is primarily an education facility and the promotion centre emphasis is on minimal impact on site, the in-situ work is reduced and the building is of component-based (container



**Figure 19.5** Health and wellbeing supported by architecture

units) construction. The term ecology pertains broadly to interrelation between organisms and their environments. From its early roots in biology, the ecological paradigm has evolved several disciplines (e.g. sociology, physiology, economics and public health) to provide a general framework for understanding the nature of people's transaction with their physical and social-cultural surroundings (Catalano and Dooley, 1983). The energy efficient venture shall use alternative energy sources such as wind and wave energy to an optimum degree. This will also become an exemplary system for those who visit the park.



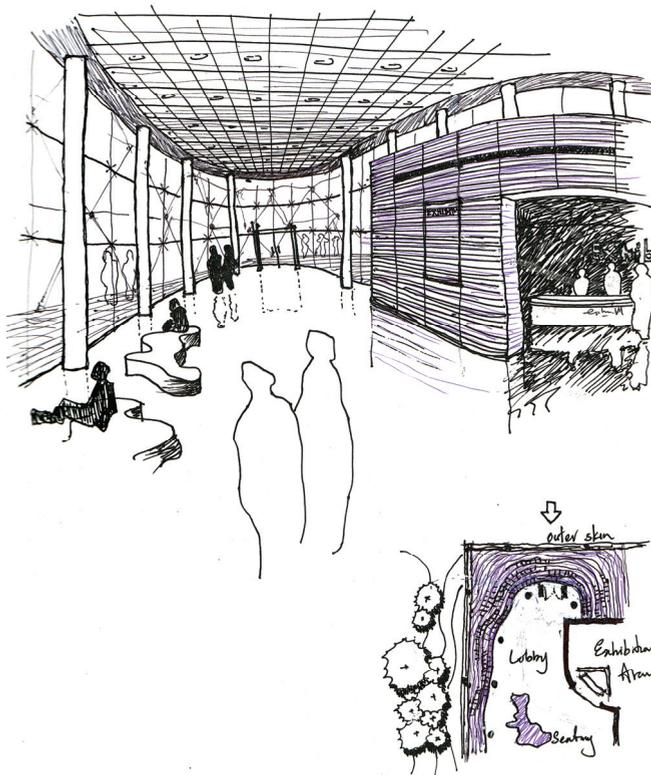
**Figure 19.6** Architect's Conceptual Sketch

### *The architectural solution*

We suggest using robust materials, modular assembly and the use of steel to afflict minimal damage to site during construction. A fragmented steel grid, detailed to age gracefully and that would mix with the greenery of site becoming a part of the existing natural structure.

### *Block A: Public stimuli*

This section would include entrance foyer, main lobby, museum, gallery spaces, office spaces for the administration, service areas, waiting areas, exhibition area, visitor centre, conference hall and a cafeteria.



**Figure 19.7** View of the main lobby - Public stimuli

Appropriate design and construction can reduce the environmental impact of buildings over the buildings entire life cycle. 'Green Architecture' which is a form of environmentally sensitive design and construction could be applied wherever possible in the project. The focus of the concept is on maintaining harmony with the natural features and resources surrounding the building site. It also uses materials that are sustainably grown or recycled, with a preference for materials from renewable

resources. The environmental performance of a building is a result of a sequence of decisions like the choice of the building site, design choices, occupant's behavior, etc. (Polster et al., 1996).

*Block B: Intermediate pause*

This section would be containing facility and storage space, demonstration and discussion rooms, and small galleries.

*Block C: Oceanic stage*

The main components of this would be a pier with water related entertainment activities, under water investigation activities, educational activities, boat yard and co functions, lecture rooms for university students, research facilities, and labs.

*Block D: Water Park*

Display diving pool, Auditorium, multi functional spaces for exhibitions and workshops, library space, meeting rooms, children's play area, restaurants, shopping areas would be found in this section.



**Figure 19.8** Part of the Water Park

#### **9.4 Challenges as seen from the field of Environmental and Climate Change: Measures of Vulnerability, Adaptation and Disaster Mitigation**

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The development of a multi-purpose Aquatic Park in Southern Sri Lanka could create a multitude of opportunities in terms of local and national knowledge and awareness of aquatic environments, job opportunities, tourism, and hence boost the local economy. However there are a number of critical issues that must be raised in regards to the physical, biological and social conditions of a project of such dimension. Recent research has proved that South Asia is among the continents/regions that most acutely will suffer effects of climate change on natural resources along the coast (WorldFish Centre, 2010). Impacts include increased risk of hazard events such as storms, cyclones, and floods. Slower changes that may occur include rising sea levels and sea acidification (IPCC, 2007). Such changes will likely effect low lying areas and coral reefs along the coastal shores. As the proposed Aquatic Park is to be built at the University grounds which is situated near the coast, it is crucial to acknowledge the risks of changing climatic and/or environmental conditions. Any settlement along the coastal belt of southern Sri Lanka is vulnerable to natural calamities (De Silva and Yama, 2007). Thus, it is important to examine what aspects of the physical, biological and social dimensions are at risk.

##### ***Research needs***

When deciding upon locations of the particular buildings, such as near the lagoon, wetland or the coastline, as well as what types of species to integrate in the Park, the vulnerability context within these conditions needs to be acknowledged. The chosen species in the aquariums or the Research Centre for instance, will determine levels of vulnerability to changing conditions. Certain species may be more resilient to flooding for instance, such as species endemic to the area. Coral bleaching as a consequence of changing temperatures may result in increased vulnerability for fish feeding on the corals, which is a potential scenario that should be integrated in a management plan. Another example of changing conditions that can impact on any life inside the Aquatic Park is erosion caused by flooding, cyclones or increased intensity of e.g. the South-West monsoon rains. Erosion can have detrimental impacts on buildings as well as flora and fauna.

Thus, the design of the Aquatic Park should be in accordance with the uncertainties that exist due to changing environmental and climatic conditions. Building an Aquatic Park close to the coastline provides a risk regarding changes in environmental conditions. The

presence and distribution of flora and fauna may be affected and such changes will provide serious threats to ecosystems and people's wellbeing (Anisimov et al., 2007). A Park of this scale may take many forms, however with the impending environmental and climatic changes in mind; three potential design solutions are briefly outlined below:

- 1) Building very robust constructions that can resist floods and potential tsunamis. One major drawback with this solution will be the high costs of building such solid buildings.
- 2) The second option is to build less robust constructions that will not resist extreme weather conditions; however the costs of rebuilding will be minimized.
- 3) A third option is a combination of the above, which is a multiple approach that adapts to the specific context. For example, any permanent buildings of high value (aquarium, museum, potential gene banks etc.) should be built on higher ground, with further distance to the sea or the buffers surrounding it. These buildings would need a structurally strong core that can provide flood protection. The open low lying, more vulnerable areas such as the lagoon and near the sea could provide avenues for open-deck displays of aquatic life etc.

The third approach would most likely provide the best alternative as it has the potential of creating a diverse environment that harmonize with the natural surroundings. Simultaneously it seeks to reduce the vulnerability of both the social and natural environment. Further research on the social and physical vulnerability dimensions of both the coast and lagoon ecosystem could provide valuable insight in order to ensure that all aspects are carefully thought through and catered for.

### ***A knowledge based approach***

Attention to both the social and ecological dimensions of the coastal environment would contribute to a more integrated and broader comprehension of the underlying vulnerabilities in the coastal zone at stake. Dolan and Walker (2003) note that coastal environments' susceptibility to climate induced risks can be assessed either by using a physical sensitivity index or a more integrative approach where biophysical and human systems are not examined in isolation. It may be wise to emphasize such an integrative approach, as it is important to not merely give attention to the physical forcing and impacts of climate and environmental change, but also examine preexisting social vulnerability (Dolan and Walker, 2003). In order to obtain a locally relevant understanding of the vulnerability context, the communities adjacent to the proposed Aquatic Park should be incorporated in the planning process. Coastal people relying on natural resource use for their livelihoods have experienced climatic fluctuations over the years, hence have their own adaptation strategies based on traditional knowledge and

experience. Particularly, local people in this region have first hands experience in dealing with change, as they to varying degrees engaged in recovery activities in the tsunami aftermath (De Silva and Yamao, 2007). Moreover, those with local 'day-to-day' knowledge of the aquatic resource ecology and ecosystems may better detect subtle changes in the environment, which by others may be overlooked (Fenton and Beeden, 2006). It is important to acknowledge this knowledge as an asset that can be integrated with scientific knowledge. Berkes et al. (2003) point out the importance of including local/traditional knowledge as key for diversity, as well as obtaining a broader array of information and approaches for improved management. Anisimov et al. (2007) point to communication and participation among multiple stakeholder groups as crucial in order for this to be possible, thus it may be fruitful to incorporate local knowledge into environmental/ climate change planning and preparedness in regard to the proposed Aquatic Park project. Participation of players outside the University, but adjacent to the proposed Aquatic Park, such as the community, government officials, local partners etc. may be possible important components in the planning process. An emphasis of such community involvement in the planning process may provide valuable insights into local changes in ecological processes, thus offer detailed knowledge that may supplement the more broad-scale view of scientific research (Nakashima, 2008).

## 9.5 Challenges as seen from the field of Disaster Mitigation - Management

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### ***Possible coastal physical environmental related impacts due to the Marine Park:***

Structures related to the marine structure can change the wave and current environment at the vicinity and is reported to have altered the sediment regime and environment; however there is no evidence of long-term damage (Fletcher et al., 2007). Construction activities can cause some change to the hydrodynamic flow, the magnitude and type of its effect will be related to the overall size of the introduced intervention compared to the overall size of the system. These hydrodynamic changes may lead to gradual readjustments in the shoreline due to the changes in sediment transport mechanism. In the areas where the sand supply is restricted by the marine structure, beach erosion will occur and beach accretion will take place where sand out flow is restricted. This may be harmful for the marine structure itself and the surrounding beach. Nearby stream outlet can be adversely affected if sand tends to accumulate and close the outlet. The proposed site is a highly eroding beach at present, and if any further erosion aggravating construction will put the nearby highway in danger.

***Possible disaster scenarios and mitigatory measures:*** Possible disaster scenarios are tsunamis, storm surges and flooding underwater chambers. While it is impossible to eliminate the risk of tsunamis, storm surges or flooding underwater chambers, it is possible to reduce the vulnerability of the facility and its occupants and thereby reducing the magnitude of the disaster. A proper early warning system and an evacuation plan can almost 100% reduce the disasters due to tsunami and storm surges. Early warning system should be connected to the island wide tsunami and other coastal disaster early warning system managed by the Disaster Management Center of Sri Lanka. It should be in working order 100% of the time. An evacuation plan should be prepared and tested. Evacuation routes and safe refuge areas should be identified and there should be a mechanism to make sure that all the occupants will be using them in case of a tsunami or a storm surge. In order to avoid a failure in the water proofing mechanisms in the underwater chambers leading to disastrous situations, the design itself should be incorporated with safety mechanisms such as failure detecting sensors, damage minimizing and life saving mechanisms. Further, it is essential that all the safety features and equipment are properly functioning before the facility is open for public. Employees should be properly trained to handle a panicked crowd in an emergency situation.

## 9.6 Challenges as seen from the field of Theme park innovation

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The realization and success of the Aquatic Park depends on, and involves, innovation. Why? What kinds of innovations? How can they take place? This is the focus of this section.

A simplified definition of innovation is: the development and implementation of something new or significantly improved. Schumpeter (1934) defined innovations as new combinations of resources (e.g. knowledge), into new products, new processes, new organizing, and/or new markets. Since Aquatic Park does not exist yet many innovations must take place, but it is not so only during the start up phase. Continual innovations are considered critical for experience based industries, including tourism, since people often are seeking something new, and since the tourism sector is very global and competitive (Fuglesang, et. al., 2009). What innovations can mean in service and experience sectors are still not fully understood, as much of the theory about innovation origin from more traditional manufacturing industries with physical products, where patents are usual, and where R&D (research & development) budgets and staff is more usual (Okumus, 2004; Sundbo, 2008). Service and experience sectors are seldom characterized by such, they are rather more intangible and innovations more behavioral and human involving. In this area much more research are needed. So far innovations are often tried measured (e.g. EIS, 2008) by variables that ask about characteristics from manufacturing, and often one build on the four innovation types of the Oslo Manual (2005). As a starting point we suggests using these four main types of innovation types, i.e. product innovations (goods, services, experiences), process innovations (technology/methods for production or distribution), organizational innovations (structure, culture, management, quality, efficiency) and marked innovations (sales methods, design, packaging, marketing, markets). Starting out with this model does not mean one should end out with it; rather one should be open for further types both in research and practice. Research from service and experience suggest that innovation often are complex since the types seems intertwined; and innovations often are incremental and part of the everyday life.

Product and marked innovations are the two main innovation types that the project group should work on first. However one can argue they should first explore and make decisions about the business model and the main concept(s) since that will frame the innovations and operations within each of the four types. A first more basic decision is

then: what should be the more overall idea and approach of the theme park? Should it mainly focus on the marine research and use more traditional presentations of it in the forms of facts? If so, one can argue it means taking a rather traditional product focus. Such an approach can partly be altered by building different services as secondary products around the core. A rather different approach is to use the marine research (knowledge) as well as animals and plants as the main theme and resources, and then develop and produce different types of experiences. For example, instead of just looking at aquariums and texts telling about what kinds of animals and plants there are and where they live, one could also try to use new technology and make experience products where the customers can be more involved through their senses, emotions, cognitions, body and through interacting with things and others. That could mean to see the park as part of the experience economy. Value creation and economy have in many societies and sectors developed from a focus on the value of basic resources and products, via service, to experiences (Gustafsson & Johanson, 2003 p. 9). The experience economy was first proposed by Pine and Gilmore (1999). Its origin from the fact that an increasing number of people, not least in western countries, have satisfied their basic needs (food, water, sleep, safety), have the house filled with physical things, and have a work involving too little physical variation and a high degree of technical and rational dominance. People therefore more often seek meaningful experiences in their holidays and leisure time; they do not have the same need as physical hardworking labours to relax their body on a beach. They rather want to be physical active, feel 'alive' as a whole bodily and sensing being. This has opened up for new trades, enterprises and 'products'. Proverbs illustrating this are such as "Less is more" and "hunting for something new". One example is when people prioritize one or two small gourmet chocolate pieces instead of one big cheaper one; or when they take shorter holidays filled with varied experiences rather than taking three weeks on the beach at Grand Canarias. Customers more often seek to fill their holidays and leisure time with activities that includes experiences that not only are meaningful in the movement, but can add value in their development of the narratives about themselves (identity, personal branding). Industries that have chosen the strategy of concentrating on attractive experiences more often use storytelling both in the experience product and in the marketing (Mossberg, 2008; Eide & Mossberg, 2011). (More about the experience economy see the section of Kvinen, and partly also Jensen). Such industries recognize the importance of developing packages of activities, products and services, and often such packaging cannot be done by one single enterprises alone, rather it calls upon relations-with different other stakeholders and different types of formal and informal networks (i.e. organizational and perhaps process innovations).

If deciding to work in accordance to the experience approach then many further decisions and innovations should be made. The theme of the park seems centered on water environments, animals, plants and perhaps also humans' traditions and interactions with the salt and fresh water environments. One can argue that the concept development of the park should use the theme as an overall framing of different elements involved. Mossberg & Johansen (2008, p. 37) illustrate such a framing in a model that is customer focused and assumes that experiences are subjective and holistic processes. The visitor, other visitors and the staff are social dimensions that interact and exists in the experience rooms (contexts), where different kinds of products are provided (e.g. food, drinks, souvenirs, experience activities). All parts influence on the theme that the company tries to mediate and organize for, which also influence on the perceptions of the visitors and the branding of the firm. The contexts can be inside or outside (e.g. the landscape). Some parts of the elements take place in the front stage where visitors are interacting or observing, while other parts take place in the backstage. The model can be expanded with further elements. The main point of such more holistic models is that companies like Aquatic theme park not only should decide on what should be their core products and customers, and what kinds of logics to be used when developing these core products; they also should decide upon if they are to develop a more holistic business model and concepts or just focusing on the core products and let the rest be more random. One example of a theme park that continually innovates and does so in a very consistent way is the theme and theater park of Astrid Lindgren's world where children between 3-9 years are the main target group (Eide, 2011). There the core products are strongly built on, and involve, stories from Lindgren's books, and her values celebrating playfulness. The theme and stories are in the center and they have developed four main pillars being the core product, i.e. playfulness, theater, encountering and environment (inside and outside e.g. architecture, decoration). This makes up their core concept model, which is then expanded with secondary products. Examples of secondary products are food, shops, parking, marketing, staff and economy. When producing and innovating they argue that also the secondary products should be consistent with the core products and idea. One example of that is that they have decided to skip all the hamburgers and chips which they earned lots of money on, and instead they have chosen only to sell food that are consistent with the local traditions and the stories in the literature of Lindgren. Other examples are how they are changing the architecture and decorations, or what kinds of souvenirs they are selling. They are not looking only at one part; they try to create more holistic experiences.

The project group of Aquatic theme park should explore not only if and how to innovate, produce and sell experiences, but also if they want to do so in a more holistic way with consistent concepts. For example what kinds of food and souvenirs are then consistent with the theme? How can staff like tour guides use storytelling, and perhaps even dramaturgy? How can they involve visitors in different ways so that this park becomes something else than a more traditional aquarium? How can the park try to create positive ripple effects in the local environment and cooperate with locals in the innovations and running of the park? A theme park should also explore ways of developing the organizing, culture and human resources in a way that support and not reduces the quality of the core and secondary products. The park will probably need a sufficiently loose coupling to the university so that it can operate as a competitive and innovative theme park, and at the same time have the benefits of being owned by the university. How to make sure that all the different staff are at a high quality and highly motivated? How to organize and manage so the different functions operate as a multidisciplinary team where the work of each part is valued equally and integrated positively in the work environment as well as in innovations and developments? It seems critical that the developers study other parks in order to learn.

In addition they should consider involving potential users of the park in order to get ideas and knowledge useful for the innovations and the running of the park. User-involved innovations are increasing where real or potential users are becoming interactive or integrated co-designers (Mannervik & Ramirez, 2006). One example of involving potential visitors in innovations before opening a park is the Wizarding World of Harry Potter. This is a theme park that involved fans of the Potter stories both before and after the opening, and in doing so ICT was important. After the opening of the park the visitors have put their own videos on YouTube, and different stories and evaluations of the park by using social media. These examples from the Potter theme park include at least product innovations and market innovations through user driven/involved innovation processes.

There has been a move from Schumpeter I model (focus on entrepreneurs) of innovation, via Schumpeter II model where innovations took place mainly by R&D departments/organizations and involving the management, to more open involving models, sometimes called the Schumpeter III model (Fuglsang, 2008). This third alternative has also been termed an empowered careful approach involving most of the people in the firm (Fuglsang, 2008; Sundbo, 2008, p. 44): "Innovation processes in services are generally characterized by a dual organization of innovation: Innovation come top-down, but mostly it comes from the bottom upwards". The third alternative

also includes a move from mainly intra-organizational focus toward more open and holistic frames focusing on interactions within and across organizations, networks and/or regions seek to combine internal and external ideas and experiences (Newell, Robertson, Scarbrough & Swan, 2009; Chesbrough, 2011). Studies show the importance for innovation and learning of being part of both local and regional/non-local networks (Sørensen, 2008; Rønningen, 2009).

One can argue that Aquatic theme park has one vital advantage compared to most other theme parks, and that is the resources and processes related to scientific knowledge in regards of marine disciplines. However, if not including a strong market orientation with focus on service and experiences, the park might not be seen as accessible and interesting for more ordinary people. The strengths can turn into a weakness. The knowledge and nature resources should be transformed and innovated into a business model, concepts and packages that fit into the target groups' needs, dreams and expectations if to create value. The visitors are a vital existential grounding for the park, if one does not incorporate that the park can become a financial disaster before it has opened. In these aspects the disciplines and staff of the business school of the university can contribute with vital knowledge and research.

## 9.7 Challenges as seen from the field of Management Accounting – Decentralization Revisited

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The University of Ruhuna is a Sri Lankan national university. National universities in the country are provided the funds through the decentralized budget and considered semi-governmental organizations. Akin to other public sector institutions, this university is, thus, obliged to follow and implement the public sector reforms propagated by the central government. Efforts to launch New Public Management reforms have been adopted in the island since the 1970's (Kuruppu, 2010). Amongst those, the reforms have entailed initiatives for performance measurement. At present, performance budgeting is the approach used by the central government. As an organization funded by the government, it would be impossible to turn a blind eye on the necessity of performance measurement. It is, therefore, vital to establish organizational structures that enable to account individual units \ sections for their performance. Based on the above mentioned, the objective of this short note is to cast light on those issues that can potentially be taken into consideration at the inception of brainstorming concerned with the proposed Aquatic Park.

The development of the Aquatic Park in Sri-Lanka is thought to encompass diverse and complex activities. Can these activities be centrally controlled within the existing hierarchical system of Sri Lankan universities? The administrative system appears to delay the decision-making process. This may have negative impacts on the management of units like the Aquatic Theme Park as it is intended to entertain the tourists. This makes it hardly possible for any but the smallest unit / section of the park to be controlled centrally. That is why at least some degree of decentralization may be vital to reap the benefits from the specialized information and response flexibility of those who are in charge of each unit / section of the Aquatic Park. Decentralization may also conserve the scarce time of the Aquatic Park's top managers. As the classical literature on decentralization suggests (see e.g. Kaplan and Atkinson, 1998; Atkinson et al., 2001), there are five different types of decentralized units depending on the difficulty of measuring outputs and the discretion or responsibility given to the local manager. These five are standard cost centers, revenue centers, discretionary expense centers, profit centers, and investment centers.

Standard cost centers can be established whenever outputs can be well-specified and easily measured. Employees in these centers control costs but do not control revenues or investment level. Marketing departments are often organized as revenue centers with the aim of meeting goals in sales revenue. Employees in these centers control revenues but do not control either the manufacturing or the acquisition costs of the product or service they sell. Discretionary expense centers are deemed suitable for units that generate outputs that are not measurable in financial terms or for units where there is no clear-cut relationship between resources acquired (inputs) and results achieved (outputs). A much greater degree of decentralization occurs when operating units are given discretion both for acquiring inputs and for selling their outputs. Such units can be established either as profit or investment centers. Profit centers are those units in which managers control both the revenues and the costs of the product or service they deliver. Investment centers are those units in which managers control revenues, costs, as well as the level of investment. The latter is like an independent business.

It seems to us that the proposed five separate units / sections of the Aquatic Park differ somehow in the ease with which their outputs can be measured and in the discretion given to the section managers for acquiring inputs and choosing the type and mix of outputs. In illustration of this, the proposed Research and Education Center can be, perhaps, better organized as a discretionary expense center. Since its output is rather difficult to measure in financial terms, one is unable to determine precisely whether it is operating efficiently or not. This makes it necessary to control this section by monitoring the amount of resources provided to it – spending, people and equipment – rather than by the outcomes this sections achieves. More likely than that, the control process for this center will involve ensuring that the quality and the level of service of the center have been maintained. In turn, the Water Park is deemed to represent a different type of unit. If section managers can make decisions about which entertainments to offer, how to make them functioning, the quality level, and the size of the fee, the Water Park is then a profit center. And profit may be the single best performance measure for this section, providing a short-run indicator of how well its managers are creating value from the resources at their disposal and the input factors they acquire.

## **9.8 Challenges as seen from the field of Management – Organizational Behavior, Motivation and Incentives**

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Organizations represent constant interaction between structure and process. To get an assignment accomplished in an organization, we need to define who does what. Structures refer to organizational shapes, definitions and rules. It is what binds an organization together. Process is the sequence of activity in the system. All organizations including universities or theme parks are made up of people who chose to work in it primarily because it enables them to satisfy at least some of their personal needs. Virtually everybody works, plays or is educated in an organization. Attempt must be made to define what an organization is. Ede (2000), defines organization as a system of consciously coordinated activities which are deliberately structured for the purpose of realizing specific goals. Dale (1978), views organization thus: “Whenever several people are working together for a common end, there must be some form of organization: that is, the task must be divided among them and the work of the group must be coordinated. Dividing the work and arranging for coordination make up the process of organization and once that is completed, the group may be described as an organization.” Organization of a university and theme park performs different coordinated activities and structure and purpose of realizing goals are totally different.

According to Unachukwu (1997), the more complex an organization is, the more difficult it is to coordinate activities, predict events or phenomena and attain set objectives maximally. The complexity of organization in a theme park is more than that of a university and the coordinated activities are difficult in nature. When viewing organizational behavior as the systematic study of the nature of organizations; how they begin, how they develop and their effects on individual members are totally different for a university and a theme park. It is also a systematic attempt to understand the behavior of people in an organization; not just human behavior but structural behavior, elements behavior, systems behavior and even policy behavior. Thus for staff in a particular department of the university to function efficiently and effectively, the particular staff member must understand the nature of the people he is working with and be able to interpret their behaviors. Organizational behavior follows the principle of human behavior: People in an organization are governed by the same psychological mechanisms both on the job and outside the job. This present university organizational behavior is not tuned for an organization like a theme park; a theme park is more diverse in its coordinated activities.

To motivate a worker therefore is to propel, impel and energize him into action that will lead eventually to the achievement of organizational goals. Thus motivation is primarily concerned with spending effort towards a goal. Leavitt (1972) provided a motivation model stemming from three basic premises: (i) Behavior is caused: The things we do, do not just happen. There always underlying factors, (ii) Behavior is directed: In the ultimate sense, there is no aimless behavior and (iii) Behavior is motivated: Underlying what we do are motives and drives which provide us with the energy to attain goals or at least to move in the direction of goals. These three premises help a lot in understanding the behavior of workers in an organization.

Decision Making, Communication, Leadership and Conflict are a few examples of the many processes that take place within an organization. Ocho (1997) aptly suggests that human beings in an organization need to be constantly motivated for adequate production and commitment. Basically, the Chief Human Resource Manager deals with human beings at various levels. Administration at all levels involves effective planning, organizing, supervising, controlling and evaluating. It is therefore the Chief Human Resource Manager's duty to co-ordinate all activities in the registry to meet the university's mission and mandate. Attempt has been made to understand the meaning of human resource management as the understanding of human behaviors, their needs, aspiration in an organization and developing strategies to accomplish these needs and aspirations. Knowing that if these needs are neglected, it could lead to failure in achieving set goals for the university system. Consequently, the primary responsibility of the Registrar of a university is to ensure that the university goals are meet, in a situation human resources are utilized and managed effectively and efficiently.

## 9.9 Challenges as seen from the field of Management – Conceptual Management Plan

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The proposed Ruhuna Aquagarden development is envisaged as a service facility for general public awareness, education and recreation. Funds for its development will be mobilized primarily through the state sector. We then assume that the initial capital outlay for this undertaking is mobilized through the public sector with governmental resources and/or foreign aid components, with or without counterpart funding. One of the principal challenges of embarking on such ventures is sustenance in the long-term. Unless there is pledge of long-term funding for recurrent expenses, there will be the danger of gradual deterioration of facilities and perhaps eventual collapse. In this context, the prospect of a self-sustaining venture is attractive.

A thematic development with multiple characteristics and attractions would have a natural appeal for both domestic as well as foreign tourists. This is interesting especially given the gradual revival of both aspects and the Government's commitment to a dramatic increase in numbers of visitors to the country. The prospect of revenue generation is always attractive. However, governmental regulations pertaining to the proceeds of such undertakings and the propriety of retaining such revenue for upkeep etc. must be considered in the light of the applicable regimes. The Aqua garden will be constructed on University land and managed by University staff. The University would naturally seek to retain control over such an enterprise. So also, in terms of management, there is a great attraction for flexibility outside of the governmental sector that will greatly facilitate efficient management. Such a framework may be devised through a number of legal arrangements. A simple corporate structure would provide the necessary framework for long-term management. Its composition would presumably assure control to the University and perhaps provide for participation of specialists and/or representatives of interested/participating organizations as the University may consider appropriate.

## 9.10 Challenges as seen from the field of Entrepreneurship – The Business Plan

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**Actualization:** Investors and others usually want to see a convincing business plan before they opt to invest their resources in a business idea.

**The general model:** One of the key issues faced by entrepreneurs is to convince potential resource providers of the viability of the business idea (Foo, Wong, and Ong, 2005). A business plan is a document that describes the current state and the presupposed future of an organization (Honig and Karlsson, 2004). Studies show that entrepreneurs tend to produce business plans to conform to institutional pressure, this as a business plan could be regarded as a way to communicate legitimacy to central stakeholders. Different types of investors look at business plans from different perspectives and need different types of information for their decision (Mason and Stark, 2004). One drawback with a written and communicated business plan is that it locks the actors to a promised path, making it difficult to respond to new opportunities (Honig and Karlsson, 2004). Some investors like this lock-in as it ensures their investment while other investors might want to involve themselves in the development of the project, thus allowing deviations from the original plan (Mason and Stark, 2004).

Resources could be defined as those tangible and intangible assets that are tied semi-permanently to the organization (Caves, 1980). Four conditions need to be in place for a firm to enjoy sustained above-normal returns. The resources has to be unevenly distributed and the firm have to have exclusive access to resources allowing Richardian or monopoly rents, the resources have to be acquired under reduced competition, there has to be imperfect mobility of the resources in hand, and the favorable situation has to be maintained (Peteraf, 1993). According to Grant (1991), resources have to be durable, difficult to identify and understand, not freely transferable, and hard to replicate for consisting a strategic capability. The main challenge for firms is then to identify resource gaps and to position itself in order to acquire the needed resources (Grant, 1991).

A firm could be regarded as a nexus of contracts where different stakeholders offer resources to the firm and want benefits in return for their services (Jensen and Mecling, 1976). Stakeholders are the 'holders' who have 'stakes' and that are interacting with an organization (Näsi, 1994). Freeman (1984: 46) defines a stakeholder as "any group or individual who can affect or is affected by the achievements of a corporation's purpose". The stakeholders provide resources to the organization, and expect some rewards in

return for this effort (Freeman, 1984). An organization can only exist as long as this exchange is present (Näsi, 1994). This implies that an organization has to acknowledge the needs of outside stakeholders in order to get access to resources. It also has to relate to stakeholders inside its own borders, as an organization is a coalition of the purposeful activity and decision making of various stakeholders (Cyert and March, 1963). Stakeholder theory enables an understanding of which individuals or groups an organization depends on for ensuring success (Carroll, 1994).

***Linking the general model to this specific case:*** The Aquatic Park then need to describe the resources it needs access to, who the central stakeholders gate-keeping these resources are and what benefits such a park might provide these stakeholders in return. It also needs to describe how this situation could be sustained as the project evolves.

***Research problems:*** What we need to know regarding the Aquatic Park is how the business plan should be prepared and presented in order to resonate with the potential stakeholders that the park need to link with in order to get access to the necessary resources.

***Toward a methodology:*** This could be conducted as a case study. The case study would then investigate who the central stakeholders are, what kind of information they need and how they would like this information to be presented in order to evaluate if they are able to offer their resources to the project. As the study has to be done before the park is materialized, it will investigate the stakeholder's expectations and needs.

***How the findings would be helpful:*** When knowing what kind of information the stakeholders want and how they want it, it would be easier to prepare such information.

***Prerequisites:*** The idea of the park has to be developed and materialized so that one knows the type and size of the resources needed. The needed resources and the outcomes of the project have to be specified. This allows a bargain between the funders of the park and the investors on what resources should be offered and what benefits to expect. This investment does not only include finances, it also includes other resources as land, knowledge, reputation, time, personal devotion, network and physical assets.

## 9.11 Challenges as seen from the field of Finance – Investment and Options

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Investing in new ventures like an aquatic park in southern Sri Lanka involves a high level of uncertainty as well as a considerable risk of failure. Hence, before a decision to implement a project is taken, there is need to establish its viability and to economically justify the proposal. In this regard, feasibility studies need to be carried out. This involves in-depth collection and analysis of data of many kinds, including market demand, estimation of capital and operating costs and financial analysis. Venture capital investing is characterized by high variability in the outcomes. Such investment decisions are complicated by a general lack of quantifiable financial and market data for early-stage ventures, and investment decisions remain hostage to unanticipated factors as market shifts and general financial cycles.

The different possible financial resources for this project, public as well as private, are not addressed here. However, there are aspects from quite recent research that enable to reduce some risk factors and hence, reduce the capital cost and increase the feasibility of the project.

### ***Real options***

Traditional capital budgeting techniques have to some extent failed in describing actual aggregate investor behavior (Schwartz and Trigeorgis, 2001). Real options are legitimate as tools for handling and quantifying flexibility. This holds relevance because the future will always remain uncertain. As new information is revealed, management can adjust and respond to this new information. A number of scientists have criticized traditional NPV/DCF (net present value / discounted cash flow) analysis for ignoring flexibility (Berkovitch and Israel, 2004; Brennan and Schwartz, 1986; Kulatilaka, 1993; Myers, 1987). There are several option features that may be relevant in the case of the Sri Lankan aquatic park.

### ***Option to expand / option to contract***

If the investment turns out positive, this can lead to an upscaling. The initial investment of e.g. one part of the aquatic park serves as an entrance to incremental upgrading of the other parts when more information is revealed. Correspondingly, some parts of the park can be designed in a way that output can be contracted in the future.

### ***Option to defer***

To be able to postpone an investment before final commitment represents value for an investor (Dixit and Pindyck, 1994; Ingersoll and Ross, 1992; McDonald and Siegel, 1986). When the environment is uncertain this kind of option must be considered.

### ***Option to abandon***

An investor has also the option to close down a project during its life. This option is known as an abandonment option. Abandonment options, which are the right to sell the cash flows over the remainder of the project's life for some salvage value, resemble options. If the market value of the project is lower than the value of the invested assets, this would be a put option with an exercise price equal to the value of the sold assets. This real option variant is elaborated on by Myers and Majd (1990). This exit possibility may be a factor in the overall assessment of the aquatic park.

Therefore, in order to avoid myopic decisions concerning the aquatic park, one can follow an option-like approach and separate the project into different stages, in order to postpone parts of the investment decisions when more information is available. This could lead to investments in a phased manner, starting with a one part of the aquatic part and subsequently add other parts of the park in a progressive manner when more information is revealed. If the project is presented as one unit, it would seemingly represent high risk and consequently high capital cost which would call for an extremely high cash flow to yield profitability (positive net present value).

By applying the option-like approach as describes here, one would duplicate what is done in a number of projects in other industries, especially within the energy sector (oil, gas, electricity). The key aspect is to reduce risk and hence, the capital cost which may be of great importance in making the project of the aquatic park feasible.

## 9.12 Challenges seen from the field of Tourism - The Aquatic Park as a Visitor Attraction

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The development of the Aquatic Park is clearly based on a multi-purpose idea. Beside the educational and research aspects one of the purposes is to construct a site that can create some future income and contribute to the development of the Ruhuna region as a destination. This means that the Park will need to operate towards different target groups simultaneously. As will be illustrated by referring to existing research on visitor attractions there might be several synergetic effects in the combining of the different purposes.

Visitor attractions can initially be understood as a collection of resources, for example cultural or natural resources, that represent a basis for tourist experience (Middleton and Clarke, 2001; Pearce, 1991). By managed tourist attractions the main focus is on the appealing visitor experiences created by the management of some permanent destination resources (Middleton and Clarke, 2001; Pearce, 1991). Gunn (1979) states that "Attractions are physical place settings for experiences" (p.67), however, if perceived as products, attractions need to be designed, developed and managed to create such experiences.

The way a visitor attraction is to be designed and managed and what type of experience one should offer is depending on the main purposes of the attraction and the goals of the different stakeholders. Leask (2010) argues that "Identifying the factors that contribute to the effective management of VAs [visitor attractions] depends very much on the nature of the resource on which the product is based, the management objectives and the consumer" (p. 161). For the realization of visitor attractions Leask (2010) emphasizes the need for collaboration among key players and "establishing a network of attractions with lobbying power to push for policy support..." (p. 161), for example, for increased access to funding resources. This also goes for the cooperation between actors with different types of competencies and specializations.

Moreover, Leask (2010) points at the significance of several contextual factors for the positioning of attractions, such as location and distance from the visitor flows (Prideaux, 2002). Prideaux, Allan, Brian, Anna and Stephen (2008) contrast the scale of periphery in terms of access and location and the uniqueness of the attraction. Location barriers in peripheral areas can be linked to transport, costs and access, such as time to travel from

origin to the attraction, the fare costs and the costs of comfort and compare these factors with the scale or size and the viability of the attraction. Weidenfeld, Butler and Williams (2010), on the other hand, discuss the density of attractions in the region and the advantages of a critical mass of tourism attractions creating a synergy of appeal and a complementary relationship between them (Buhalis, 2000). Many attractions, such as illustrated by the hypothetical attraction of Aquatic Park, cannot benefit on such synergies and should thus need to compensate for location disadvantages relative to visitor markets and the lack of complementary attractions, such as by active networking and trying to develop some type of wider cluster of competencies and service offerings for visitors.

When looking into the nature of experiences of visitors at attractions some illustrative relevant findings can be presented. Initially it can be referred to the studies of Poria, Reichel and Biran (2006) who state that the more participants perceive the site as a part of their own heritage, the more they will be interested in the visit. This indicates the management need to discriminate in the interpretation approaches for different visitor segments based on their attachment to the sites and the associated themes. As many tourist studies have focused on the visitors' satisfaction by the visits on tourist sites, Nowacki (2009) stresses the importance of focusing on their behavioral intentions, that is, their wish to revisit, to talk positive of the attractions or to pay a given price. He states that the service provider's (the owner or management) performance through sources of information (information boards, panels and orientation signs) and exhibitions have greatest positive influence on behavioral intentions, in particular life exhibitions that allow for interactions with the visitors.

During recent years a development in the direction of hybridization and increased attention to "edutainment", historical representations of heritage attractions seem to have taken place world-wide and the a new form of "edutainment heritage tourist attraction" have been formed (Hertzman, Anderson, and Rowley, 2008). However, as visitors, on the one hand, can appreciate the inherent educational and entertainment value of, for example, historical representations, they can, on the other hand, also be actively and critically engaged and are able to state their own preferences (Alexandros and Jaffry, 2005). Based on a study of a heritage village in Scotland, Beeho and Prentice (1997) found that as the experiences gained by the visitors are emotional (such as provoking, enjoyable educational experiences) the main benefits were still the beneficial learning experiences. Additionally, attractions can be perceived as important sites of social activities and emotional experiences (Hertzman, et al., 2008).

Generally it is not an exaggeration to argue that amusement and theme parks, not at least based on the Walt Disney World tradition, have had a considerable importance as schools of practice and of adopting more entertainment and market oriented presentation approaches for other types of visitor attractions, such as cultural, historic and nature-based heritage attractions (Wanhill, 2002). An example of an internationally operating “entertainment business groups” is Merlin Entertainment (the world’s second biggest theme-park business group), who during recent years have expanded their thematic fields of operation by the combination of heritage-orientation and fiction, including many sea-based attractions (London SEA LIFE Aquarium, sea life and seal sanctuaries). The use of advanced technology, dramaturgy and storytelling beside the appreciation of a number of multi-disciplinary skills are of central importance within by the creation of such experiences. To some extent such presentation techniques have also been used at aquariums with links to research institutions in Norway, such as at The Institute of Marine Research in Bergen and The Polarium by The Norwegian Polar Institute in Tromsø.

Within ecotourism there has been an increased awareness how to use new and more advanced interpretation techniques within ecotourism-related sites (Moscardo, 2003; Weaver, 2008). Examples could also include ocean-based educational tourist trips, for example whale watching and tours to the Great Barrier Reefs (though the various effects will depend on the conduct of the operators). As an example of a study with a visitor experience focus, Reichel, Uriely and Shani (2008) did a case study among visitors on what was defined as a ecotourism site (World of Salt – a former salt mine in Canada) where the management had developed interactive simulative mining experiences for visitors. The respondents in this study expressed preferences for an integrative approach combining concepts associated with both natural and artificial sites and stated “clear preferences for the development of sites with appropriate infrastructure and themed simulations that preserve local nature and culture” (p. 23). The most favored choice among different interpretative approaches at the site was the discrete category of combined natural and artificial elements.

One of the conclusions from the illustrations of the research literature on visitor attractions is that there does not need to be a contradiction between developing educational, entertaining and meaningful experiences at visitor sites as well as to combine this with support of conservation. This would, however, require the will and abilities to combine multi-disciplinary competences and skills in an optimal way. Such competences can, on the one hand, be research-based marine-biologic competence, and, on the other, professional competence on presentations and pedagogic

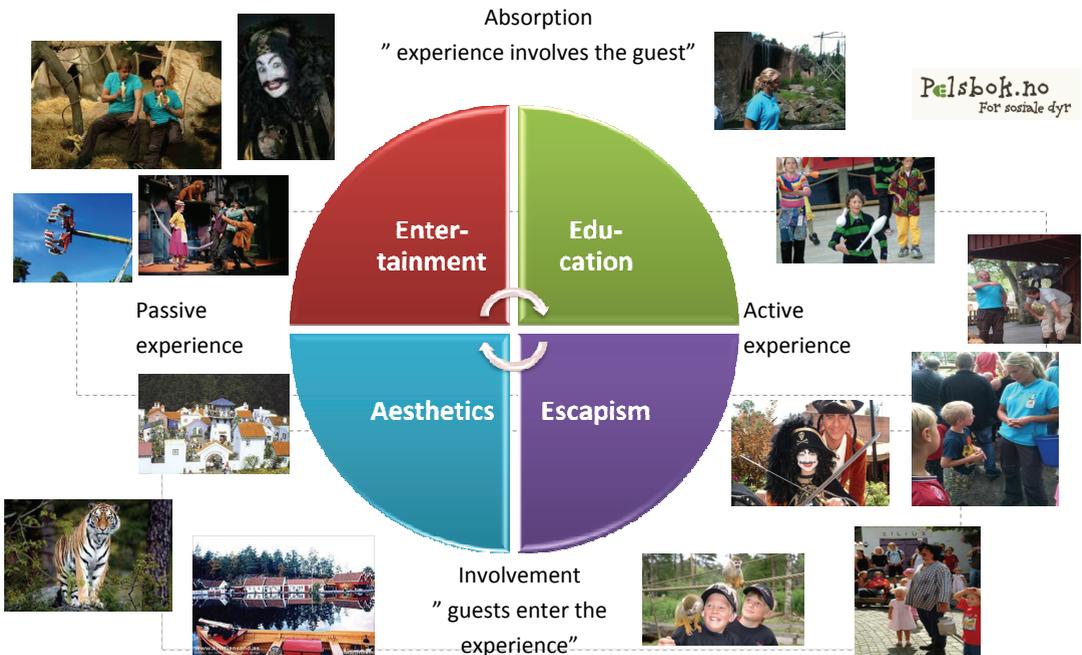
approaches. Additionally, competence on management, service and marketing will also be needed beside the provision of necessary financial means. Finally, if developing the Aquatic Park partially into a visitor attraction, the most critical contextual factors, in particular location-specific factors (access to markets, visitor flows, complementary services and resources), need to be addressed. To be able to do that, cooperative networks between different internal (regional) stakeholders and external stakeholders need to be developed. Basically, it should be possible to develop the Aquatic Park into a multi-purpose institution with different offerings to various target groups and to profit on the combination of competences, skill and other resources that such an institution could make use of and generate. Depending on the point of departure, such a development project still needs time, coordination capabilities and, not at least, political will.

### 9.13 Challenges as seen from the field of Experience Economy and Co-creation

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#### **Experience Economy**

In their ledger of experience economy, Joseph Pine II and James H. Gilmore (1999) uses the concept of escapism. Escapism means that the customer steps into the experience and is actively participating. Employees will, through their interaction with the customer obtain involvement and active participation from customers. Pine and Gilmore (1999) shows how the experience can be seen through two axes. The customer's degree of participation (active or passive) as well as the customer's degree of involvement (absorbent or engaging). The main challenge as seen from this perspective is then how employees can meet with guests and create involvement and active participation at adventure and theme parks.



**Figure 19.9** The experience realms in Kristiansand Zoo: Inspired by Pine and Gilmore, 1999: p. 30

Users can be involved as participants or observers (Abelson, 1976). The model of experience areas shows the variations between active to passive participation, and

absorption of active involvement (Pine and Gilmore, 1999). In adventure and theme parks, there will be elements of all parts of such a model. For example, adventure and theme parks have an element of aesthetics, where users or guests consider beautiful buildings, animals, attractions, etc. Entertainment can be theatre or plays where guests are passive spectators of the performances. Employees, or information on the objects observed can educate on animals, buildings, plants, and other items in the park.

Escapism is created through involvement and active participation where the user steps into the experience. Escapism gives the user control and motivation through self-perceived ability to master the situation (Bandura, 1986). At the same time, through their own active participation, users have to take control and manage on their own. This creates empathy, empowerment and involvement for the user. Other example of escapism is when the user is participating in plays, and the opportunity to perform with animals, or otherwise the chance there are in which users can manage their own experiences as a participant.

### ***Experience Design Theory***

Most design aims to modify emotions so that they give pleasure, joy and fun. Most design is based on the following historical phases (Jantzen and Jensen, 2006):

Feature (c. 1920-1975): The product will technically have the right features. The product should be practical in terms of specifications. For example to travel by air brings you fast from *a* to *b*.

- Ease of use (about 1975-1995): The product should be easy to use. Focus is on the interface between user and technology. For example an aircraft should be comfortable for passengers.
- Most proximity (approximately 1995): The product must be fun to use. The product will provide emotional ties with the user through the sensual and present benefits for the individual user. For example to travel by air is relaxing.

Functionality and usability are due to assumptions. If the product does not work technically, or the product is unavailable, the experience will be unsatisfactory. Proximity merely provides weak emotional ties to the product. Most design should also engage the costumer with the product through joy or annoyance, pride or shamed, as well as safety or anxiety.

Most design is about challenging existing experiences and self-images through:

- Viewing new perspectives on established preferences
- Giving the consumer a tastes of the unknown

To refine and expand individual valorizing (from German *Verwertung*: increase in the value and efficacy) and paying the way for other stories about life experience (Jantzen and Jensen, 2006). The main purpose of co-creation is to enable provision of increase in value increase through an active involvement of the users. Most design aims to modify emotions so that they give pleasure, joy and fun. This can be achieved by making the visitor active, engaging and co-responsible for creating experiences. Active, engaging and co-responsible people in at adventure and theme parks would be a good starting point for co-creation and user involved innovation.

### ***Co-creation***

Prahalad and Ramaswamy (2004) have in their book, *The Future of Competition: Co-creation Unique Value with Customers* (2004), a special focus on co-creation of value. Co-creation goes significantly further than just being customer oriented. According to Prahalad and Ramaswamy (2004) co-creation are values created in collaboration between the business and private individuals and external groups in order to develop new products and concepts. Work previously undertaken by business leaders and employees will now be partially outsourced to users. Customers contribute increasingly with time, resources and effort to the service production. According to Zeithaml and Bitner (2000), customers must be regarded as part of the organization. In most industries, there are increasing uses of self-service and user involvement. This is partly due to new technological opportunities, but also due to desire from businesses and customers to participate. Illustrated by the number of orders of e-commerce, self-check on aircraft and banking where customer have become their "own bank manager". The benefit for the company in this is "free" and creative labor. Clients are also more involved and they manage their own experience.

Thus the companies have a greater responsibility for the user by directing the user's behavior and user's responsibility for participating in the service (Bowen, 2000). The company, employees and the customer's role must then be actively defined by the organization. An interesting question is whether users have the will (motivation), and sufficient ability (competence) to participate in service production. Responsibility and empowerment must permeate the organization, management, employees and customers (Bowen, 2000). There must be made a distribution of information, benefits, knowledge and power between management, employees and users in business activity.

Prahalad and Ramaswamy (2004) believe future businesses, with users, must in cooperation create personal experiences that result in a unique value for each individual and business. collaboration with users requires that the business adopts four basic

assumptions (Prahalad and Ramaswamy, 2004). The business can partner with users by using the four building blocks dialogue, access, risk assessment and transparency.

Dialogue is a tool for listening to users. At the same time it means to understand users' needs and how users understand the experience. Dialogue creates loyalty and helps the company to focus on what users and the company considers interesting. For the sake of dialogue forums, arenas and tools must be created to give business users and opportunities to communicate with each other. Through interaction and dialogue the business can learn from the users and vice versa. Access is the second building block. It is achieved by making information available so that necessary dialogue can take place. If users do not have access to information, it will be impossible to do co-creation. Risk is the possibility that the product or service can harm the users, business and the environment. Uncertainty is a more appropriate term than risk (Karlsen and Gottschalk, 2008). Co-creation involves risk, but also increased opportunities for creating new experiences. When developing new experiences, risk is minimized and opportunities maximized. Openness is the last building block. There must be transparency between the company and users. This is a challenge for companies. How can companies share information so that it gets converted into useful knowledge? If there is openness and sharing of knowledge, users will come with their dreams and provide useful ideas for themselves and for the business.

All industries are experiencing increasing levels of customer orientation. Not just an adaptation to customer needs, but also a development in cooperation with the client in order to expand and develop new experiences. Co-creation is a tool to create value in collaboration between industry and users (Prahalad and Ramaswamy, 2004). Work previously undertaken by business leaders and employees is increasingly being performed by the users. A user generated experience will contribute to the adaptation of users' needs. This can be done by inspiration through user-generated content from other media such as Wikipedia, Facebook, etc. In addition to user-generated content, businesses can make user-driven innovation of new experiences. This may be the expansion of existing experience or the development of new types of experiences. Co-creation could be an answer, and one of several methods for user-generated content and user-driven innovation. Alternatively; Co-creation serves as the conceptual or collective term for user-generated content and user-driven innovation.

## 9.14 Challenges as seen from the field of Logistics - Customer Access

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**Actualization:** The tourism system consists of three main components; the tourism product (supply), the tourism market (demand) and transport (Lamb and Davidson, 1996). The purpose of transport is to connect demand and supply. Without transport, it is impossible to reach a destination. Hence, transport is a prerequisite for most kinds of tourism.

**The general model:** Traditionally, transport has been considered a cost, both in time and money (Prideaux, 2000). Consequently, tourists would weigh the desire to reach a destination against the cost of getting there. However, transport can also add value to the tourism experience and become an attraction in itself. Such value can, for example, be added through the scenery the visitors are transported through, the history of the area the transport goes through or the use of “innovative” transport modes.

Lumsdon and Page (2004) divided tourism travelling into two categories; transport for tourism and transport as tourism. These categories were placed at the extremes of a continuum on which transport solutions were allocated according to their intrinsic value as a tourism experience. Transport solutions with high intrinsic value were exemplified by walking, cycling, historic railway, kayak and balloon, while taxi, city-bus and metro were used to illustrate transport solutions with low intrinsic value as tourism experience.

The degree to which value is added through transport, can affect the amount of time tourists are willing to travel in order to reach a destination. As such, the degree to which different transport solutions are available can impact the potential market size of a tourist attraction.

Linking the general model to this specific case:

A decision must be made on whether to offer low cost transport solutions, with short travel times, or solutions with high intrinsic value as tourism experiences. This decision determines what kind of infrastructure is needed and can affect the ripple effects of the project.

**Research problems:** Which transport solutions should be made available for an individual who wants to visit the Aquatic Park?

What kind of infrastructure does each of these solutions require?

***Toward a methodology:*** Research problem 1: A literature review will provide an overview of available transport solutions and a benchmark study can reveal how similar destinations have solved the issue. Together with a study of existing infrastructure and how the people in Sri Lanka traditionally travel, the literature review and benchmark study will be used to generate recommendations.

Research question 2: The required infrastructure will depend on the chosen transport solutions and a literature review will provide the specific infrastructure requirements of each transport solution.

***How the findings would be helpful:*** Transport is essential for a successful tourism destination. Thus, first class transport infrastructure will, *ceteris paribus*, be beneficial for the Aquatic Park and increase the likelihood that it can become a commercial success.

## **10 A roadmap to the Realization of the Vision of the Aquatic Theme Park**

These discussions show the trans-disciplinary nature of entrepreneurship. Even so, these discussions do not cover the complete picture; there are still subjects that need to be addressed. Regarding the mission and purpose, how to make a synergic interplay between the five parts of the park is not addressed yet. Likewise, regarding the physical outlining of the park, aspects as accessibility for disabled persons, health and safety issues for those working there as well as for visitors, and issues as maintenance costs and operating expenses are not addressed yet. Still more on issues related to the internal organization of the activities in the park needs to be highlighted. I.e. is not recruitment and human relations management addressed in the previous discussion. Likewise is there still issues not dealt with regarding how the park relates to its customers. One of its main customers is the research community, and the construction of the planned research lab is a substantial challenge, both related to funding, operation, staffing and scientific focus. Some of the pedagogical aspects of involving school classes from different levels are not handled by the contributing authors. Furthermore, there will be political disputes on content, localization, size, and timing of this project both at the university, in the local community, regionally and nationally. The champions for this project also have to take notice of such influencers on the trajectory of the project.

The establishment of an Aquatic Theme Park is a challenge in many ways not only to the juvenile faculty, Faculty of FMST, but also to the mature university where it belongs, University of Ruhuna. The project addresses a massive audience; a general public for leisure, school children for educational and awareness programmes, undergraduates for their research, researchers for cutting edge technology applications, officials and managers from relevant government and private sector organizations for different training programmes. In the same manner it is a multi-function service center and a mass scale pleasure and arousal providing system which influence satisfaction and behavioral intensions. Expectation of the counter is to utilize the marine and aquatic resources sustainably to the development of the Sri Lankan economy in the long run. Literacy of its people is an important parameter that needs to develop before aquatic resources could be sustainably managed. The proposed project could be given the responsibility of improving skills of the aquatic literacy population.

The challenges of living in a contemporary society are reflected in the rate of change, complexity, and interconnectedness of our lives. As Hesselbein and Cohen (1999) have written, "Times of great change are always times of great anxiety – but also of great opportunity and hope. That reality has led to an extraordinary hunger for new insights and understandings in all institutions in our society". The expectation of University of Ruhuna is to expand and diverse its services and challenge, the role of a convention university in a developing society, and to enhance the living conditions.

The proposed project has a potential to fulfill at least some of the requirements stakeholders expects University of Ruhuna to deliver. The hope of the contributors is that the thorough discussion on the prerequisites of the success of such an initiative may convince the 'doers' that the project is doable. Sri Lanka, Ruhuna, Matre and University of Ruhuna needs this project.

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"I was very happy when NUFU supported our joint effort to cooperatively build; "the entrepreneurial university". Today, entrepreneurship is a major goal for countries world wide to achieve economic growth. In order to facilitate such development, universities must educate creative candidates, research must investigate innovative action, and HEIs must turn entrepreneurial as well as pursuing academic excellence. This publication reflects a step in this direction. I am really proud to read the result of our joint work, and I know that researchers in Norway and Sri Lanka have learned a lot by joining their resources across cultures."



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**Frank Lindberg, Dean Bodø Graduate School of Business,  
University of Nordland**



"The North-South co-operation that developed between the University of Ruhuna and the Bodø Graduate School of Business, University of Nordland has set an example for such relationships. This project to publish research papers with joint authorship was an excellent idea. The effort has produced a lasting document with papers on management and entrepreneurship in fields as diverse as business characteristics of retail shops to ornamental fish and aquaculture. This needs to be just a springboard to greater achievements in joint research and collaboration between our institutions. The cross-cultural understanding this has created has been significant."



**Prof. Susirith Mendis, Vice-Chancellor,  
University of Ruhuna**

University of Ruhuna