Water Governance Performance Assessment in Songkhla Lake Basin, Thailand

Peter Emmanuel Cookey

A Thesis Submitted in Fulfillment of the Requirements for the Degree of Doctor of Philosophy in Environmental Management

Prince of Songkla University

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Major Program	Environmental Management

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Major Program	Environmental Management
Academic Year	2016

ABSTRACT

This comprehensive lake basin water governance performance assessment study was carried out at the Songkhla Lake Basin, Thailand to examine and analyze the existing relevant and related legislations governing water and natural resources. It also examined and analyzed key actors involved in planning and implementation of programmes for management and governance as well as identified, examined and analyzed key governance performance indicators. The research employed both qualitative and quantitative research methodologies with strong elements of the case study research design approach. The combination of the research approaches facilitated the comprehensive and multidimensional assessment of the complex socio-ecological system and dynamics of the water governance system of the SLB. In order to address the core objectives of this study, series of assessment tools for lake basin water governance performance were developed based on the Adaptive Integrated Lake Basin Management (AILBM), a diagnostic and prescriptive analytical framework. The frameworks were tested on the SLB. As part of the measure for determination of the performance status of the SLB, a critical examination of the water governance challenges were carried out including an assessment of the SLB's local people perceptions of water governance performance. Text mining tools were also used to quantitatively determine the institutional fit of water governance institutions, and were designed to support the qualitative analysis, while the Lake Basin Water Governance Performance Composite Index (LBWGPCI) framework was developed to test and evaluate the overall performance of the SLB's water governance. Data derived from text mining were able to show some degree of challenges in the institutions and the reasons for weak enforcement and compliance. Institutional priorities were identified and compared to management response to

issues concerning the SLB. The general assessment for degree of recognition and involvement of institutions, overlaps, gaps, institutional priorities and response to resource management clearly showed the fit status of institutions of water governance in the SLB. The results of the local people perceptions assessment and the critical analysis of governance highlighted key issues impacting the effective functioning of the governance of the Basin, which include: fragmented institutions, weak coordination, unclear allocation of roles, responsibilities and weak capacities for enforcement and compliance, coupled with lack of adequate integration between the formal and informal institutions. The Lake Basin Water Governance Performance Composite Index (LBWGPCI) indicated a below average performance and required high priority, urgent and critical actions for the improvement of water governance performance. To achieve sustainable governance and wise use of natural resources of the SLB, the study proposes that future governance reviews and reforms should be based on the principles of AILBM framework that support the establishment of a single formal management and policy harmonization organization, with roles and responsibilities clearly defined and functions clearly delineated with appropriate management responses. Conflict resolutions between the Songkhla Lake actors should not overlook the perceptions of the local communities.

Keywords: Lake basin, Governance, Management, Adaptive Integrated Lake Basin Management, Text Mining, Composite Index, Indicator, Performance

หัวข้อวิทยานิพนธ์ ความสามารถในการกำกับดูแลน้ำในลุ่มน้ำทะเลสาบสงขลา ประเทศไทย
นักศึกษา **Mr. Peter Emmanuel Cookey**
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บทคัดย่อ

การศึกษาการประเมินผลการกำกับดูแลน้ำในทะเลสาบนี้ ได้ศึกษาในพื้นที่ลุ่มน้ำทะเลสาบสงขลาประเทศไทย เพื่อตรวจสอบและวิเคราะห์กฎหมายที่เกี่ยวข้องและสัมพันธ์กับการกำกับดูแลทรัพยากรน้ำและทรัพยากรธรรมชาติ นอกจากนี้ยังมีการตรวจสอบและวิเคราะห์บุคคลสำคัญที่เกี่ยวข้องในการวางแผนและดำเนินการสำหรับการจัดการและการกำกับดูแลเช่นเดียวกับการระบุการตรวจสอบและวิเคราะห์ตัวชี้วัดประสิทธิภาพการกำกับดูแลที่สำคัญ ระเบียบวิธีการวิจัยทั้งวิธีการวิจัยเชิงปริมาณและคุณภาพและการใช้กรณีศึกษาได้ถูกนำมาใช้ในงานวิจัยนี้การใช้ระเบียบวิธีการวิจัยทั้งสองแบบกัน การประเมินหลายมิติของระบบสังคมที่ซับซ้อนนิเวศและพลวัตของระบบการกำกับดูแลน้ำในลุ่มน้ำทะเลสาบสงขลานั้น เพื่อที่จะดำเนินการตามวัตถุประสงค์หลักของการวิจัยนี้ การวิเคราะห์ วินิจฉัยและการออกแบบชุดของเครื่องมือในการประเมินความสามารถสำหรับการกำกับดูแลน้ำในลุ่มน้ำทะเลสาบซึ่งขึ้นอยู่กับการปรับตัวแบบบูรณาการในการบริหารจัดการลุ่มน้ำทะเลสาบ (AILBM) ซึ่งได้รับการพัฒนาและทดสอบในลุ่มน้ำทะเลสาบสงขลา โดยในส่วนหนึ่งของการวัดสำหรับการประเมินความสามารถของลุ่มน้ำทะเลสาบสงขลานั้น มีการตรวจสอบการกำกับดูแลน้ำ ด้วยการประเมินจากประชากรในลุ่มน้ำทะเลสาบสงขลาในการรับรู้

เรื่องการกำกับดูแลน้ำ เครื่องมือเหมืองข้อมูล (Text mining tools) ถูกนำมาใช้ในการระบุสถาบันที่เหมาะสมสำหรับการกำกับดูแลน้ำ ซึ่งถูกออกแบบมาเพื่อสนับสนุนการวิเคราะห์เชิงคุณภาพ ขณะที่กรอบของดัชนีรวมของความสามารถในการกำกับดูแลลุ่มน้ำทะเลสาบ (LBWGPCI) ถูกพัฒนาเพื่อทดสอบและประเมินประสิทธิภาพโดยรวมในการกำกับดูแลน้ำของลุ่มน้ำทะเลสาบสงขลาข้อมูลที่ได้มาจากการทำเหมืองข้อมูลนั้น สามารถที่จะแสดงระดับของความท้าทายบางอย่างในสถาบันและสาเหตุของการบังคับใช้กฎหมายและการปฏิบัติตามที่อ่อนแอ ลำดับความสำคัญของสถาบันถูกจัดลำดับและถูกเปรียบเทียบในกรณีเมื่อมีปัญหาเกิดขึ้นและมีการดำเนินการจัดการกับปัญหาที่เกี่ยวข้องกับทะเลสาบสงขลา การประเมินระดับของการรับรู้และการมีส่วนร่วมของสถาบัน, การทำงานซ้ำซ้อน, ช่องว่าง, ลำดับความสำคัญของสถาบันและการตอบสนองต่อการจัดการทรัพยากรอย่างชัดเจนแสดงให้เห็นสถานะที่เหมาะสมของสถาบันที่กำกับดูแลน้ำในลุ่มน้ำทะเลสาบสงขลา ผลที่ได้จากการประเมินการรับรู้ของคนในท้องถิ่นและการวิเคราะห์ปัจจัยหลักที่มีผลกระทบต่อการทำงานที่มีประสิทธิภาพในการกำกับดูแลลุ่มน้ำทะเลสาบนั้นคือ: การแยกส่วนของสถาบัน การประสานงานที่ไม่มีประสิทธิภาพ การแบ่งหน้าที่กันไม่ชัดเจน การที่ไม่สามารถบังคับใช้และการปฏิบัติตามได้ ควบคู่ไปกับการขาดการบูรณาการอย่างเพียงพอระหว่างสถาบันที่เป็นทางการและไม่เป็นทางการ ดัชนีรวมของความสามารถในการกำกับดูแลน้ำในลุ่มน้ำทะเลสาบ (LBWGPCI) ชี้ให้เห็นว่ามีความสามารถต่ำและต้องการให้มีการลำดับความสำคัญและเร่งให้มีการดำเนินการในการปรับปรุงผลการดำเนินงานการกำกับดูแลน้ำเพื่อให้บรรลุถึงการกำกับดูแลอย่างยั่งยืนและการใช้งานทรัพยากรธรรมชาติที่ชาญฉลาดของลุ่มน้ำทะเลสาบสงขลา จากการศึกษาเสนอให้การทบทวนและปรับปรุงการกำกับดูแลในอนาคตนั้นควรเป็นไปตามหลักการของ AILBM ที่สนับสนุนการจัดตั้งสถาบันเดียวในการจัดการและประสาน

นโยบาย โดยมีบทบาทและความรับผิดชอบที่ชัดเจนและมีการปฏิบัติตามการจัดการที่เหมาะสม มติความขัดแย้งระหว่างผู้ที่กำกับดูแลทะเลสาบสงขลาไม่ควรมองข้ามการรับรู้ของชุมชนท้องถิ่น

คำสำคัญ: ลุ่มน้ำทะเลสาบสงขลา, ลุ่มน้ำทะเลสาบ, การจัดการ, คำสำคัญ: ลุ่มน้ำทะเลสาบสงขลา, ลุ่มน้ำทะเลสาบ, จัดการ, การวินิจฉัย, การกำหนด, การกำกับดูแล, กรอบแนวคิด, สถาบัน, การทำเหมืองข้อความที่ทับซ้อนกัน, ช่องว่าง, สถาบันที่เหมาะสม, การตอบสนองต่อการจัดการ, ความหนาแน่นและความถี่, กระจายอำนาจ, การบังคับใช้, การรับรู้, การมีส่วนร่วมของประชาชน, คนในท้องถิ่น, ผู้มีส่วนได้เสีย, การบังคับใช้, การปฏิบัติตาม, การปรับตัว, การบูรณาการ, ดัชนีรวม, ตัวชี้วัด, ความสามารถ

ACKNOWLEDGEMENT

I wish to express my sincere gratitude to my advisor, Asst. Prof. Dr Rotchanatch Darnswasdi and co-advisor, Assoc. Prof. Chatchai Ratanachai for their constant support, constructive revisions and incredible contributions that made this research worthwhile.

I wish to express my gratitude to the Songkhla Lake Basin Research Projects, supported by the Office of the Natural Resources and Environmental Policy and Planning (ONEP) and the Faculty of Environmental Management, Prince of Songkhla University and Faculty of Environmental Management Graduate Research Fund of the Prince of Songkhla University. I must not forget the immense support from the ongoing National Research Council of Thailand (NRCT) research project on the governance in natural resources and environmental management in Songkhla Lake Basin (SLB). I dare say that without all these funding support it would have been very difficult to undertake this study. I am truly grateful.

I cannot also forget to thank Dr. Manop Pormchana of the Faculty of Law, Asst. Prof. Apirada Thadadech, Head of Department of Computer Science, Dr. Noodchanath Kongchauy of Department of Mathematics and Statistics, Prince of Songkla University for their assistance in the course of this work. My appreciation also goes to Dr. Oleg Shipin of School of Environment, Natural Resources and Development, Asian Institute of Technology (AIT), Bangkok and Engr. Jibok Chatterjee of International Medical Corps, India for your various suggestions and advice on how to improve the quality of this research.

My appreciation also goes to the staff and management of Rivers State College of Health Science and Technology, Port Harcourt, Rivers State, Nigeria for their support and understanding in granting and ensuring that I had a trouble free study period. I also appreciate the Director and lecturers of the School of Environmental Health of Rivers State College of Health Science and Technology for their cooperation, which made a great deal of difference in my study.

My sincere love and appreciation goes to my lovely wife, Mayowa Abiodun Peter-Cookey, who played the critical role of my chief proof-reader and gave me a better philosophical insight into critical thinking and logical reasoning. In fact, she

was my sound board, despite her health challenges she was always willing to clean-up my manuscripts. Thank you a great deal and you are indeed a help-meet.

My appreciation goes to my family Dame Caroline Cookey, Pastor and Pastor (Mrs.) Sunny Cookey, Elizabeth Cookey, Rev. Simeon Cookey, Dorcas and Uduak all my precious nieces and nephews. I will not forget my very wonderful parents-in-law, Sir and Lady M. A. Olubobokun, Mr and Mrs. Aina, Pastor Debbie King, Mr. and Mrs. Toba Olubobokun, Okiki Olubobokun and the rest of the clan. How will I forget to mention Mr. and Mrs. Emem Mkpah and the clan of Exxon Mobil, Eket, Nigeria for all your spiritual and financial support which made my journey lighter.

I want to also thank the teaching and non-teaching staff of the Faculty of Environmental Management, Prince of Songkla University, Hat Yai Campus as well as my colleagues and friends, especially the PhD students who were very supportive in breaking all the language barriers for me and ensure that I had a very smooth research experience. I want to say a very big thank you to you all, especially the staff of Songkla Lake Basin Research Centre (SLBRC) and Centre for Earth System Environment and Adaptation for Sustainability (ESAS), Faculty of Environmental Management: Ms. Bechawan, Salamah Manundawee, Pimpaka Sribaiboon, Sutawan Sathianwiriya, Mrs. Sasipatch Punsawat, Siriporn Bunwora, Komgrit Janchum, Rattanaporn Siriarayaporn, Thitima Srichai, Sarunya Tongkunkaew, Natwaree Srisuwan, Jettawan Krutaraniyom and Jutarat Boonrat you all made my stay in this programme very fruitful.

My appreciation also goes to members of the HIM church Hat Yai, Thailand for all their supports especially the Family Fellowship Groups as well as members of the Life Gate Power Church, Port Harcourt, Nigeria.

To everyone, I say thank you.

Peter Emmanuel Cookey

CONTENTS

LISTS OF TABLES

List of Tables

LIST OF FIGURES/ILLUSTRATIONS

List of Figures

LIST OF ABBREVIATIONS AND SYMBOLS

ABBREVIATIONS/ SYMBOLS	MEANING
AD	Agency Density
ADM	Agency Document Matrix
AM	Adaptive Management
AGM	Adaptive Governance Management
AILBM	Adaptive Integrated Lake Basin Management
AO	Agency Overlap
BOD	Biochemical Oxygen Demand
CEHSM	Centre of Excellence for Hazardous Substances Management
CSO	Civil Society Organization
CBO	Community Based Organizations
CFP	Commercial Forest Plantation Act
DEQP	Department of Environmental Quality Promotion
DNWP	Department of National Park, Wildlife and Plant Conservation
DMCR	Department of Marine and Coastal Resources
DOF	Department of Fisheries
DOPA	Department of Provincial Administration
DLA	Department of Local Administration
DDPM	Department of Disaster Prevention and Mitigation
DWR	Department of Water Resources
DGW	Department of Groundwater Resources
ESEAS	Centre of Study for Earth System Environment and Adaptation for Sustainability
ECNE	The Enhancement and Conservation of National Environmental Quality Act
FAC	Factory Act
FA	Fisheries Act
FDD	Field Dykes and Ditches Act
FTW	Right to Fish in Thai Waters Act
GEF	Global Environment Facility
GWP	Global Water Partnership
HS	Hazardous Substance Act
ILBM	Integrated Lake Basin Management
ILEC	International Lake Environment Committee
IG	Institutional Gap
IP	Institutional Priority
IRRM	Institutional Response to Resource Management
IWRM	Integrated Water Resources Management
LBG	Lake Basin Governance
LBMI	Lake Basin Management Initiative
LBWGPCI	Lake Basin Water Governance Performance Composite Index
LD	Land Development Act
LOA	Local Administrative Organization
MONRE	Ministry of Natural Resources and the Environment
MOAC	Ministry of Agriculture and Cooperatives

MOI	Ministry of Interior
MI	Ministry of Industry
MOT	Ministry of Transportation
MRLDC	Mountain-River-Lake Development Commission
MPH	Ministry of Public Health
MAO	Municipality Administrative Organization
MMP	Merchant Marine Promotion Act
MS	Marine Salvage Act
NR	National Reserved Forest Act
NWRC	National Water Resources Committee
NESDP	National Economic and Social Development Plans
NTW	Navigation in Thai Waters Act
NP	National Park Act
OECD	Organization for Economic Cooperation and Development
OI	Overlap Index
OIG	Overall Institutional Gaps
ONEP	Office of Natural Resources and Environmental Policy and Planning
PCD	Pollution Control Department
PAO	Provincial Administrative Organization
PH	Public Health Act
PI	People Irrigation Act
PPD	Plans and Process of Decentralization to Local Government Organization Act
RCSE	Research Centre for Sustainability and Environment
RFD	Royal Forest Department
RID	Royal Irrigation Department
SO	Statutory Overlap
RBC	River Basin Committee
SLB	Songkhla Lake Basin
SLBDC	Songkhla Lake Basin Development Committee
SLBC	Songkhla Lake Basin Committee
SLBKB	Songkhla Lake Basin Knowledge Bank
SI	State Irrigation Act
T	Term
TA	Tambon Council and Tambon Administrative Authority Act
TAO	Tambon Administrative Organizations
Topic	Tc
TDM	Term Document Matrix
WAR	Wild Animal Reservation and Protection Act
WLsSLB	Water Laws relevant to Songkhla Lake Basin
WUA	Water Users Association
UNEP	United Nation Environment Programme
USEPA	United State Environmental Protection Agency

CHAPTER ONE

INTRODUCTION

1.1 Background

Measuring governance performance is often complex because often times we do not know what and how to measure; much like measuring the immeasurable (Bohringer and Jochem 2007). Comprehensive water governance performance assessment is today's priority and are important diagnostic tools guiding policy reforms, monitoring progress and ensuring that water resources are sustainably managed (Mercer and Christensen 2011). Performance assessments guide the designs of effective policy interventions by helping to identify where changes are needed and what actions can make them happen (UNDP 2013, Cap-Net and UNESCO-IHE 2008) as well as play key roles in the evaluation of water management policies and the comparison of alternative policies (Sandoval-Solis et al. 2011, Simons 2000). Other benefits of governance performance assessment include but not limited to: identification of specific institutional weaknesses and priority areas for reform; provision of information on the underlying institutional structure; and creation of benchmarks for future monitoring activities (Kaufmann et al. 2002).

In the broader water sector, governance performance assessment arises to avoid poor resources management, inappropriate institutions, bureaucratic inertia, insufficient capacity and shortage of new investments undermining the effective governance of water and related natural resources (Allan 2000, Rogers and Hall 2003). Performance assessment become very necessary in lake basin governance with regards to institutional fragmentation and outmoded legal instruments, inadequate coordination, stakeholders disconnectedness and apathy, weak enforcement and over emphasis of institutions on resources utilization and exploitation (Jetoo et al. 2014, Bakker and Cook 2011, Camacho 2008, Flaherty et al. 2011, Hall 2006). This challenge of governance systems is its focused on resources utilization and maximization, which is responsible for the crisis of the world's lakes such as over-utilization, water quality deterioration, siltation, acidification, contamination,

eutrophication, and the complete collapse of aquatic ecosystems in extreme cases (World Bank, 1997, 2005, ILEC, 2005, 2007, RCSE and ILEC. 2014, Jingsong and Yushu, 1997). A survey of 217 lakes by the International Lake Environment Committee (ILEC) shows increased levels of eutrophication over the past 50 years in a large number of the world's lakes (UNEP, 2005).

There is need for a change i.e. shift in the strategy for Lake Basin Governance (LBG); and addressing these challenges will require some performance measurement systems, processes, metrics and tools that will be able to evaluate, control, learn and improve governance performance of lake basins (Behn 2003). It becomes very necessary that sound governance performance assessments should enable the comparing of evaluation results of water governance among basin organizations, benchmarking, diagnosing an existing problem, informing programming, reviewing and identifying trends and potential gaps, monitoring and bridging the supply and the demand side of governance (UNDP 2013).

The early approaches of water governance performance assessments were based more on the 'traditional' focus of determining efficiency and effectiveness, which derived its influence from public accounting (Cap-Net and UNESCO-IHE 2008, Metawie and Gilman 2005). But, the main challenge of the efficiency and effectiveness based performance evaluation, especially as it applies to natural resources (water) governance, is the problem of attribution, which deals with examining the extent to which actions/activities of natural resources management (input) can be attributed to specific improvement in the socio-ecological system (outcome) (Lane 2000), as well as the complex and uncertain conditions of natural resources. This often makes linking the means (input) to the end (output) quite difficult. To this effect, in order to capture the essence of the natural resources in any performance assessment, emphasis now lies on the values, characteristics and the purpose of the performance assessment; the identification of the attributes the system shared and the development of new performance measurement frameworks that will address the needs and expectation of the stakeholders (Johnsen 2000).

The notion of governance takes account of the different actors and networks that help formulate and implement water policies. Governance sets the rules with which management operates (Pahl-wostl et al. 2012), and the policy choices to balance

competing interests about who is entitled to what services, how services are provided, who pays and how competing interests are balanced as well as decisions about how water resources are protected (Moriarty et al. 2007). On the other hand, water governance is the range of political, social, economic and administrative systems that are in place to develop and manage water resources, and the delivery of water services, at different levels of society (Rogers & Hall, 2003). It encompasses laws, regulations and institutions that relate to government policies and actions (Saleth 2010); as well as constitutes institutional settings within which the water sector operates. In summary, governance is the interaction of laws and other norms, institutions, and processes through which a society exercises powers and responsibilities to make and implement decisions (affecting lakes and their basin resources as well as their users) and to hold decision makers and implementers accountable (Moore, 2010).

There are sparse researches on the concept of lake basin governance. Several studies reveal that lakes have not received sufficient attention in the global water policy and governance discourse (World Bank, 1997, 2005 and ILEC 2005) and also show the derelict of information on Lake Basin governance (Ballatore and Muhandiki 2001, Cosgrove and Rijsberman 2000). Even though some may argue that lake systems are part of the river basins, but several studies have shown that most researches on river basin governance really do not take cognizance of the lake basins and their peculiar fundamental characteristics of long retention time, complex dynamic response and their integrating nature (World Bank, 1997, 2005, ILEC, 2005, 2007, RCSE and ILEC. 2014).

Several initiatives have being developed for the purposes of measurement of the broader water governance performance ranging from policies and programmes (and often incorporate efforts of multiple organizations), organizational and individual performance (Shah et al. 2001) and the process-oriented approach of performance indicators (Hooper 2006) as well as measurement from the perspective of the user/stakeholder, the benchmarking exercise (NARBO 2008, Kaplan and Norton 1992) and the Dublin principles as a benchmark for performance (WMO 1992). However, there are very few documented initiatives on performance measurement of lake basin governance. The earliest one was the use of indicator framework for the evaluation of operational programmes in transboundary lake basins (Duda (2002). The

most prominent is the Integrated Lake Basin Management (ILBM) governance indicators, the outcome of the Global Environment Facility (GEF) project of the Lake Basin Management Initiative (LBMI) (World Bank 2005, ILEC 2005, ILEC 2011); and indicators for the assessments of Lake Malawi Basin using the ILBM framework (Chidammodzi and Muhandiki 2015). Consequently, this work seeks to develop a multidimensional governance framework analytical tool to assess the performance of water governance for lake basins in general and tested in the Songkhla Lake Basin, Thailand.

The lake basin water governance performance assessment parameters and the methodologies used in this thesis are summarized in Table 4.2 and form the thematic issues as reflected in the 9 chapters of this work. These key components were used in the diagnosis and prescriptive assessment of the water governance performance status of the SLB and used it to make prescriptive empirically based recommendations. Institutional systems in general terms, measure the effectiveness of the policy and legal and enforcement strategies for management of the resource system. Management systems measure the effectiveness of the resource management structures and strategies; the interactive systems take a look at the effectiveness of public, local communities and stakeholders in Basin resources management; information system assess the quality, content, reliability, types and how the information is accessed and shared among the formal and informal actors and adaptive systems measure the system's capacity to adapt to changing conditions as well as the reduction of vulnerability of the system to actual or expected future change.

1.2 Problem statement

Despite the advances in the science of limnology, the governance of lake basins has remains a big challenge (Bakker et al. 2008; Rogers and Hall 2003, Ballatore and Muhamdiki). Governance is essentially about addressing linkages and processes between and within organizations and social groups involved in decision-making, both horizontally and vertically (Rogers and Hall 2003), as well as such processes of making choices, decisions and trade-offs (Folke, et al 2005, Tropp, 2007, Pahl-Wostl, 2009). But, measuring governance is a much bigger challenge, especially when the lake basins possess important national economic values, such as water for hydropower

and irrigation, which often creates dominant sectoral institutions at the expense of those with potential coordinating responsibilities. Another confounding problem with measuring lake basin governance performance is the fact that water resources, agriculture and environmental management institutions often do not understand the complementary nature of their responsibilities and do not often work together (ILEC 2005, World Bank 2005). An even greater challenge is the multi-dimensional character of lake basin governance as well as its conceptual definitional challenges (Kaufmann et al. 2002, UNDESA 2007).

The difficulty in assessing water governance for lake basins stems from the different variables and complex dynamic nature of the socio-ecological system of lake basins. Sound assessment of water governance performance will depend on the choice of the scope, function of interests, types of previous studies available, at what levels and how to measure the performance of the institutions and to define performance and where to measure (Wieriks 2011). To provide a consistent and objective assessment the framework developed should be able to target more than one type of source of information and data and possibly triangulate in a more rigorous way. Therefore, improvement in the performance of the governance systems of lake basins will require a thorough assessment to distill the main obstacles and proffer solutions for the sustainable management of the resource systems of the basins (Figure 1.1).

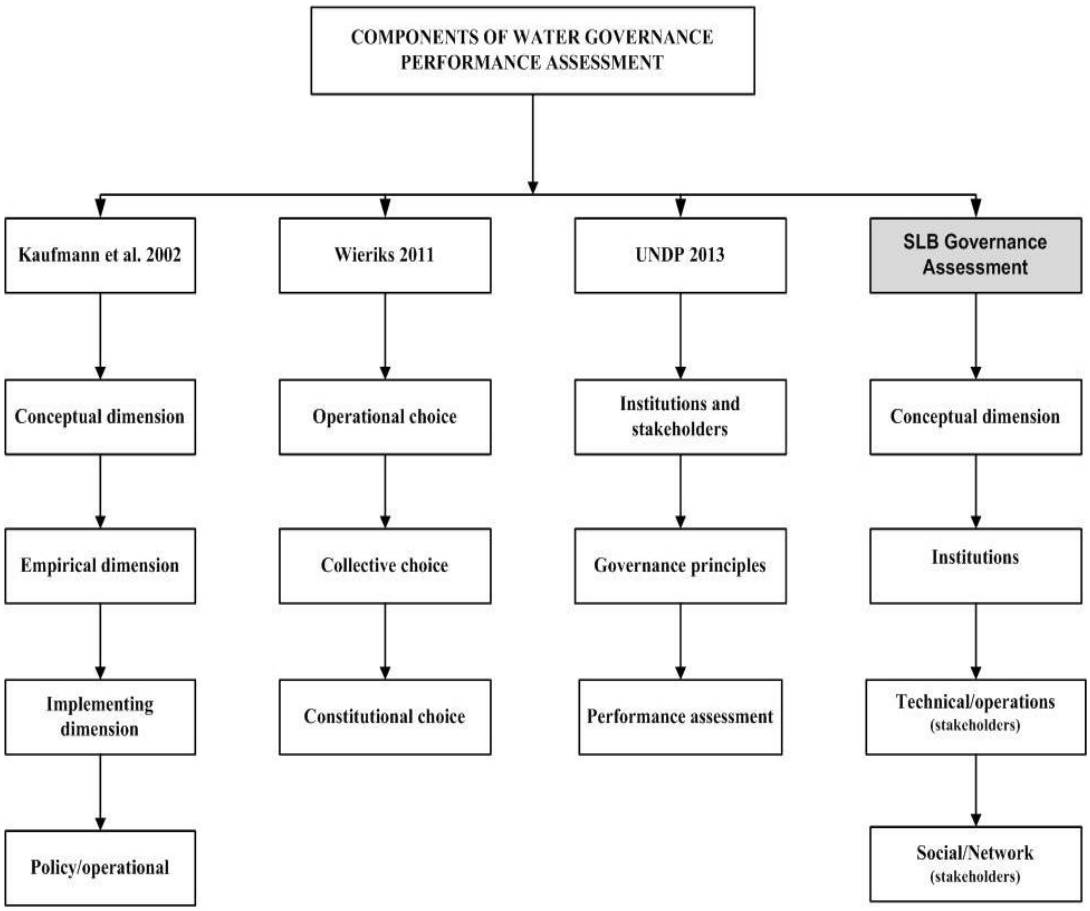

Figure 1.1: Literature mapping of components of water governance performance assessment

Since no blueprint exists for measurement of governance performance, Kaufmann et al. (2002) recommended a fourfold component framework for designing and implementing a governance assessment: the conceptual dimension, the empirical dimension, the implementing dimension and the policy/operational focus. Contributing to the issues of adequate framework for assessment of water governance, Wieriks (2011) developed a framework of three components: operational choice, which includes day to day actions within a framework of rules and institutions; collective choice, which deals with situations of joint decision making on policies and other collective arrangement, structuring behaviours at the operational level and the constitutional choice that deals on the processes of collective and joint decision making about rules and principles guiding the first two choices. Also, UNDP (2013) identified three components to contextualize assessment of water governance: institutions and stakeholders, which assess and analyze particular water institutions

and stakeholders; governance principles focuses on transparency, accountability and participation, and performance assessment, which focuses on institutions, stakeholders and institutions as well as the impact of particular water related functions.

For this work, we developed a four-component lake basin governance assessment framework tool based on the work of Kaufmann et al. (2002). In this work, we introduced a conceptual framework dimension created to design and implement governance assessment for lake basins; with well-defined and clear-cut objectives and variables to study its links with the specific characteristics of lake basins (Figure 1.2).

The conceptual dimension of this work is based on the Adaptive Integrated Lake Basin Management (AILBM) developed in this research work. AILBM is a diagnostic and prescriptive conceptual framework for the assessment of governance of lake basins. The uniqueness of this framework is hinged on a two-pronged analytical set up – diagnostic and prescriptive – to highlight challenges and problematic issues requiring urgent attention (that is diagnosing what is wrong from the symptoms as well as prescribing solutions that are futuristic with quick remedies). The diagnostic answers the how and why questions, which give more insight into the governance structure of the lake basin (Walker 2012), while the prescriptive answers the question 'what should be done to make lake basin governance and institutions better equipped to take advantage of the future? (Rose Technologies 2013) (See chapter 3).

The second is the empirical dimension, which focuses on the specific characteristics of the research tools, field works and data gathering instruments for lake basin governance assessments. At the empirical level, the assessment looks at the governance of the lake basin from three strategic and systematic perspectives of technical/operations, social/network and institutional assessments.

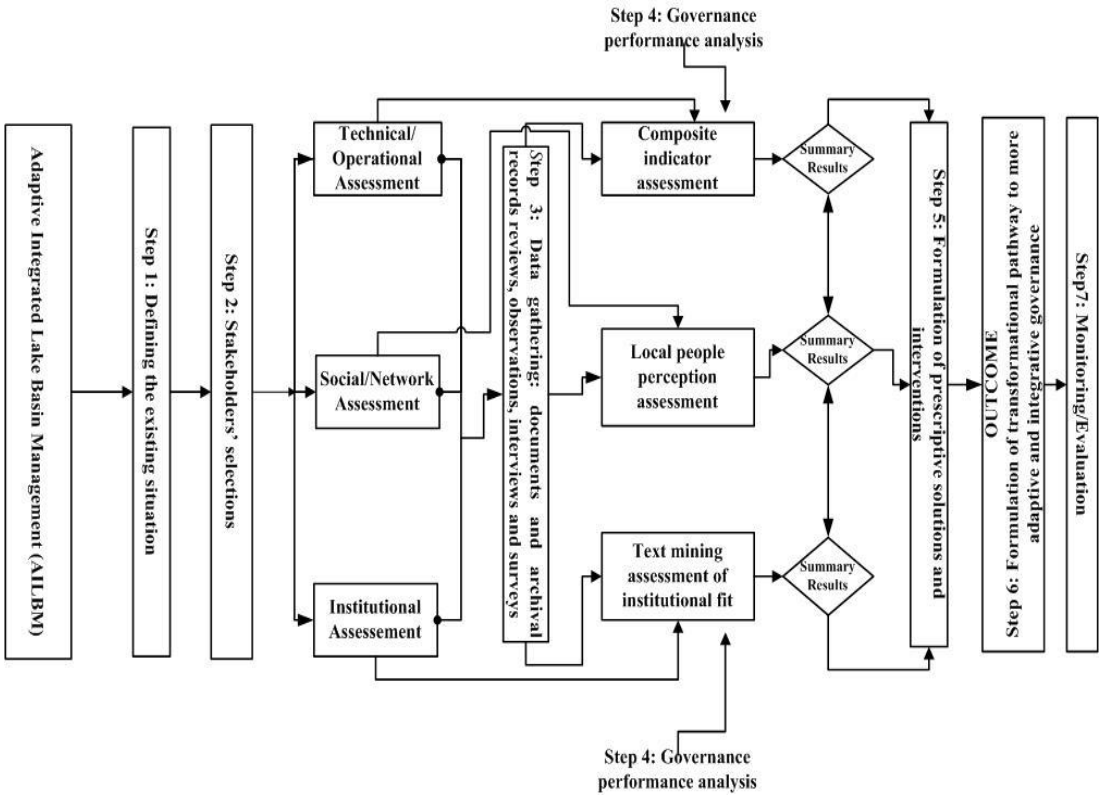

Figure 1.2: Multidimensional AILBM governance performance assessment process

The third pillar is the implementing dimension, which relates to the objectives of the assessment and entails the use of participatory processes in the administration of the tools for assessment/evaluation, data gathering, computation and analysis to obtain the overall governance performance status of the lake basins. The actual activities of the implementation dimension focused on the development of qualitative and quantitative tools, and analysis for the assessment of governance performance in the Songkhla Lake Basin (SLB).

The fourth pillar is the policy and operational aspect, which focused on the need for potential use of the data generated from the evaluation process. It entails the provision of the information that acts as feedback into a broader policy arena for the enhancement and improvement of Lake Basin Governance (LBG). The key, therefore, is the gathering of data that allows the identification of priority areas of reforms and improvement of governance performance for lake basins.

1.3 Research Motivation

Lakes and their basins comprise more than 90% of the readily available liquid freshwater on the surface of the earth and are key components of the global water resource systems and that is why it is so sad to see the deteriorating state they are falling into mostly caused by governance and management failure. However, in spite of the degrading state of the world's lakes, they still provide important socio-ecological functions such as storing water and supporting significant aquatic biodiversity. This has not been enough, though, to get lake basins included in global water discourse (Ballatore and Muhamdiki, 2001). Also, the current global IWRM implementation neglects critical issues about lakes, making finding a fit governance system for lakes globally like a camel passing through the eye of a needle. All of these helped to fuel the current crisis of the world's lakes and no part of the world is immune to the grave misuse of such valuable resource.

For instance, more than 80 percent of the Scandinavian lakes are acidified (Jorgensen 1997). A national baseline study of lakes in the United States of America shows that more than 44 percent of the nation's lakes are not in good biological conditions and 20 percent of these lakes have a high phosphorus and nitrogen concentration (USEPA 2009). African lakes are major sources of natural disasters, tropical diseases and pandemics (UNEP 2006). Asia's Aral Sea has shrunk by more than 72 percent (World Bank 1997). In China, between the period of the 1950s to 1980s, 543 big and middle-sized natural lakes and many little ones with areas of less than 1 km^2 have vanished (Jingsong and Yushu, 1997). According to Ratanachai and Sutiwipakorn (2006), there is serious evidence of overexploitation of the rich natural resources and environment of Songkhla Lake Basin (SLB) for various economic activities and with no reasonable effort to properly conserve and rehabilitate them.

These prompt the following questions: 'why are the lakes suffering from deterioration and degradation globally despite advances in science and technology? And why do the persisting problems threaten their existence in spite of several interventions for the management and protection of lakes from these stresses?' Ballatore and Muhamdiki, (2001) noted that although scientific knowledge about the causes and effects of stresses on lakes is available, the effective management policies (*governance-mine*) have lagged behind; in most cases, the value of lakes have not been

fully considered by policymakers. OECD (2011) re-enforced that the current water "crisis" is not a crisis of scarcity, but a crisis of mismanagement, with strong public governance features. It was these governance challenges of the world's lakes that prompted me to undertake this PhD research and I sought to understand governance and management systems of lakes in order to assess their performance so as to expose the core issues militating against the sustainable management and governance of the socio-ecological systems called lakes. Also, I chose to use the Songkhla Lake Basin as my case study because of its unique boast as the only lake basin in Thailand.

Also, my experiences over the years made me even more curious and confident in my study. I spent the past 20 years working in the field of environment, public health, water supply, sanitation and sustainable development. During this time, I was involved with various activities towards strengthening environment, water and sanitation related issues in Nigeria and globally; some of which include being a member of the National Technical Committee on Environmental Management Systems (TC-EMS): Standard Organization of Nigeria (SON); member of the Water Resources and Waste Management Subcommittees of the Greater Port Harcourt Development Committee, Rivers State, Nigeria; Coordinator, Rivers State Water and Sanitation Sector Reforms, which developed policies, legislation and regulations for the sector (enacted into law in 2012) and was also instrumental in the State obtaining a World bank/African Development Bank facility for urban water supply and sanitation reform projects; National Coordinator, EarthWatch Conference on Water and Sanitation (The Nigerian Water and Sanitation Forum) as well as the publisher of the EarthWatch Magazine (the nation's foremost environment and development magazine) for twelve years. Also, my membership of some professional associations gave good support, for example: Climate Change Network of Nigeria (CNN), Nigerian Institute of Safety Professional (NISP) and Nigerian Environmental Society (NES); and globally, as a member of the Steering Committee (SC) of Water Supply and Sanitation Collaborative Council (WSSCC) in Geneva, representing Northern, Middle and Western Africa for 7 years; member of the International Water Stewardship Standard Development Committee (ISDC) of the Alliance for Water Stewardship (AWS) New York that developed the Global Water Stewardship Standard; member of the Nigerian Water Partnership/West African Water Partnership and Global Water

Partnership (of the IWRM fame); member Water Integrity Network (WIN) Germany; Gender & Water Alliance (GWA) Netherlands; Water Footprint Network (WFN) Netherlands; World Toilet Organization (WTO) Singapore and member, Specialist Group management committee of the International Water Association (IWA); among others.

In the course of my work, I have come to realize that governance and management of our water resources is a really great challenge and this prompted the radical change of my focus from science and technology (as was the case in my previous studies), to governance and management. This is my first full blown policy research and you will still see the interplay of my previous experiences and studies ranging from the fields of public health, pharmacology and physiology, microbiology, environmental management, environmental science and sustainable technology, and environmental engineering management come to hand to help distill my understanding of these complex issues. Given the concern outlined above, the motivation for the research presented in this thesis was reinforced by the following facts:

I. Lack of standardized and suitable framework for assessment of lake basin governance performance
II. Few rigorous quantitative approaches for the analysis of institutions of lake basin governance apart from the quantitative analysis of gaps and fragmentation by Ekstrom and Young (2009).
III. Absence of standardized Lake Basin Water Governance Performance Composite Index (LBWGPCI) to test and evaluate the performance of water governance for lake basins.

1.4 Scope

Lakes are important freshwater ecosystems that perform many essential functions for human development, hydrological cycles and for the preservation of biodiversity (ILEC 2005). There are more than 8 million lakes larger than a hectare in the world (Meyback 1995), and they make up about 90 percent of the liquid freshwater on the earth's surface. The basic ability of lakes to retain, store, clean and evenly provide water makes them critical elements of the water cycle (Lehner and Doll 2004). Lakes are traditionally under-valued resources of human society and nowhere in the world

has lake management and governance been totally a successful activity (Thomas, et al. 1996, Repetto 1987). However, management and governance are often confused together to mean the same words. Management refers to the activities of analyzing and monitoring, developing and implementing measures to keep the state of a resource within desirable bounds, while governance takes into account the different actors and networks that help formulate and implement policy and/or policy instruments (Pahl-Wostl 2009).

Several scholars have noted that governance is a fundamental challenge for the achievement of sustainability of the world's lakes and is often ignored in the management plans of most lake basins (Peters, 1996). Therefore, the scope of this work shall be limited to the exploration of the critical elements of the AILBM diagnostic and prescriptive conceptual framework for the assessment of water governance performance of lake basins and their application in the SLB. The key elements of the AILBM conceptual framework include: sector, stressors, actors, resource systems, resource management systems, institutions, adaptability, collaboration, resilience, decentralization, integration and participation.

This study was restricted to the three main provinces of the Songkhla Lake Basin. The level of analysis were detailed and in-depth interviews with experts, professionals and community leaders, water governance performance index survey of relevant government organizations at the provincial, municipalities, local and community levels. The investigation was designed to assess and tease out general views, perceptions and responses about the focus of this research as well as determine the overall status of water governance performance in the SLB.

1.5 Objectives and research questions

The study presented in this thesis investigated the complex water governance performance of Songkhla Lake Basin (SLB) in great detail by deploying the qualitative and quantitative research tools in order to reveal and distill the main factors militating against improved governance performance in the case study area and make recommendations. This is because finding ways to govern the SLB and its resource systems in a sustainable manner has become very difficult. One of the central

objectives was to critically carry out an assessment of the performance of water governance systems in Songkhla Lake Basin (SLB).

A case study approach based on mixed method research systems was adopted, especially for the analysis of the complex socio-ecological systems of the SLB. Also, the research objectives required a framework specifically designed for the assessment of governance performance for lake basins to scientifically, ecologically and socially capture the peculiar characters and qualities of lake basin governance and management systems. It was for this reason that the AILBM framework, developed with diagnostic and prescriptive features, was employed to assess the governance system of the SLB. Table 1.1 contains four topics and the corresponding research questions addressed in the study.

Research topic 1 served as a conceptual and theoretical construction for a diagnostic and prescriptive assessment of water governance of the SLB. The AILBM conceptual framework is drawn from a combination of organizational management (adaptive) and governance (integrated) frameworks designed to ensure that the governance of lake basins is integrative and adaptive in order to enable the synergistic linkages, inter-connectivity, collaboration and interactions between processes and actors in lake basins to ensure sustainable governance (chapter 3).

Research topic 2a explored the 12 SLB sub-basins communities and other stakeholders' perceptions on water governance performance of the lake basin, which served as useful measurement barometer for citizen involvement and participation in governance; and **Research topic 2b** critically examines water governance challenges in the Songkhla Lake Basin (SLB) with the aim of evaluating and analysing policies, legislations, regulations, institutions and actors in the Lake Basin. The mixed method research was used here to tease out the actual underlining challenges of the SLB governance and management systems.

Research topic 3a assessed institutional fit of SLB governance and management instruments quantitatively by using text mining analysis. The results of this study further buttressed the need for institutional reforms based on the AILBM. The general assessment of degree of recognition and involvement of institutions, overlaps, gaps, institutional priorities and response to resource management clearly depicted the institutional fit status of the SLB governance instruments; and **Research topic 3b** uses

text mining to evaluate the integrative and adaptive elements of water resources institutions in the SLB. The results were able to show some very interesting patterns like being able to determine the capacity of the existing institutions to support the element of integrative and adaptive resource management.

Table 1.1: Research topics and questions addressed in the study

Research Topic 1: Conceptual framework development for assessment of lake basin governance performance	
1	How can the assessment of lake basin water governance performance be improved?
Research Topic 2a: Basin communities governance perception analysis Research Topic 2b: Critical analysis of formal and informal governance actors	
2	Who (individuals, groups, formal and informal institutions) are the key actors in implementing water governance programmes in this lake basins? What are their roles in the governance of lake basins?
Research Topic 3a: Institutional fit analysis Research Topic 3b: Analysis of integrative and adaptive capacity of institutions	
3	What are the existing legal and policies instruments governing water in Songkhla Lake Basin? How 'fit-for-purpose' are these instruments?
Research Topic 4: Governance performance composite indicators analysis	
4	What is the status of critical water governance performance indicators in the case study lake basin?

Research topic 4 developed the Lake Basin Water Governance Performance Composite Index (LBWGPCI) framework to test and evaluate the performance of water governance for lake basins using the Songkhla Lake Basin (SLB), Thailand as a case study. The (LBWGPCI) integrates a range of water resources and environmental related indicators to provide a holistic profile of lake basin key water governance and management issues. The purpose of this work was to identify, examine and analyze key lake basin water governance performance indicators and test them on the SLB, as well as make appropriate recommendations for improvement.

These research questions were addressed separately in chapters 3 – 8 of this thesis. Hence, for each of the questions, the introduction, background, methodology, research findings, discussion and conclusion are addressed separately. As this is a thesis-by-papers, each of these chapters can be read independently without prior knowledge of the others.

1.6 Overall research design

Figure 1.3 summarizes the overall design of the research that is presented in this thesis. This research employed both qualitative and quantitative research methodologies. In other words, it is a mixed or integrative study (Tashakkori and Teddie 2003) with strong elements of case study research design approach (Yin, 2009). The combination of the research approaches facilitated the comprehensive and multidimensional assessment of the complex socio-ecological dynamics of the water governance performance of the SLB. This ensured that the issue is not explored through one lens, but rather a variety of lenses that allowed for multiple facets of the phenomenon to be revealed and understood.

The main objective of the thesis is to assess water governance performance in Songkhla Lake Basin with particular attention on the evaluation and analysis of the policies, legislations, regulations and institutions (formal and informal), users of the resource of the Basin and through extensive in-depth interviews with major stakeholders who are in one-way or the other related to the governance or use directly or indirectly. The aim was to critically determine the current governance system, status, performance and level of institutional fit in the case study area.

The experts and professional groups engaged in this study were drawn from water and natural resources, legal practitioners and from the broader field of environmental science and management specifically from the three main provinces within the definition of Songkhla Lake Basin. They included government ministries and agencies that have one responsibility or the other with water resources, provincials, municipalities, districts and sub-districts administrative organizations, relevant committees, as well as, regional offices of the national relevant ministries and agencies, politicians and legal practitioners, administrators, consultants, international, national and local development organizations within the lake basins as may be

possible, water supply, forestry, research and nature conservation, except in extreme cases, where interviews were conducted with experts outside the institutions and organizations within the boundaries of Songkhla Lake Basin.

Stakeholder's interview survey was designed to generate data on which broad generalizations could be made on the governance and management in the twelve (12) sub-basins of the Songkhla Lake Basin. The tools focused on using the broader stakeholder groups within the SLB to assess governance status and progress. Also, a deliberate attempt was made to include various water user groups in the stakeholders' survey and interviews on the lake basins, including farmers, fishers, as well as the non-governmental and community based organizations. Also, various actors, i.e. women, men, rich, poor, local and traditional authorities, individuals or groups' were interrogated to find out their contributions and perceptions to current water governance performance in the lake basin.

The analysis conducted to answer the research questions consist of literature review in the form of comprehensive and multidimensional analysis of all resource governance and management systems of the SLB. The SLB was chosen because it is the largest lagoon system as well as the only lake basin in Thailand, and is currently challenged with myriad of socio-ecological and institutional issues (Christensen, and Boon-Long, 1994, Wongbandit 1995, 2005, Sukhsri 1999, Neef 2008, Kanjina 2008, Tippayawong et al. 2012). Our analysis focused on the assessment of water governance performance in the SLB.

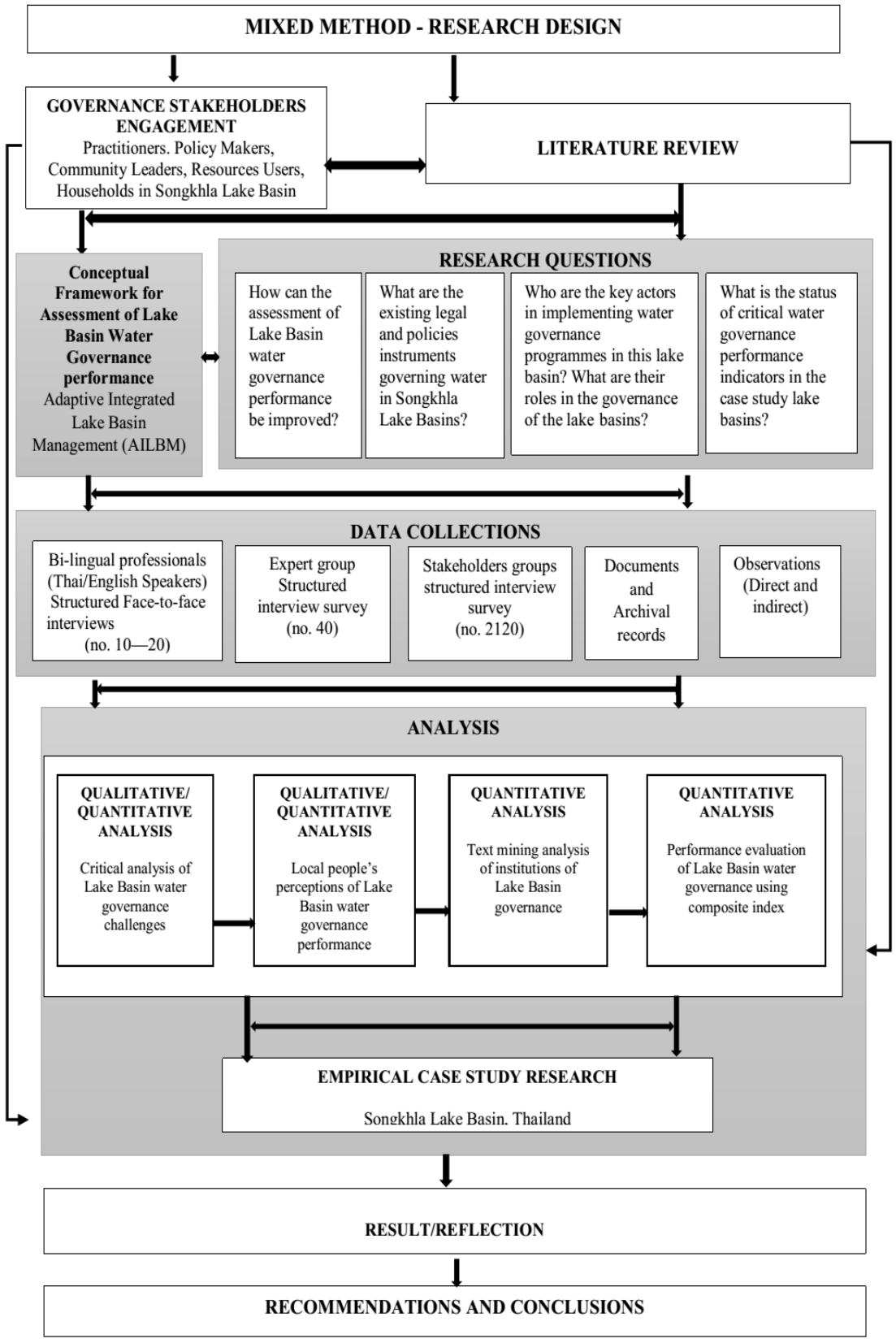

Figure 1.3: Flowchart of the overall research design

1.7 Contributions

This thesis makes significant contributions in the discourse of lake basin management and governance. The main contributions are outlined below and reflected upon in chapter 9. The main contributions are:

I. A procedure was developed for the assessment of lake basin governance performance and proposed governance approaches for the enhancement and improvement. The AILBM framework provides the basis for the new way of thinking in the assessment and proffering solutions to numerous lake basin governance challenges.

II. The introduction of a new quantitative parameter for institutional analysis, which is the 'institutional priority'. We were able to quantitatively analyze sets of institutions related/relevant to lake basin water resources management and governance using text mining to highlight the priorities of the institutions. This is the first time institutional priority was measured quantitatively. The quantitative measure of priorities of institutions will help to illustrate if the laws under review encourage resource utilization and exploitation over conservation/sustainability.

III. The research also developed quantitative determination of the response of the existing institutions to lake basin resource management and the level of recognition they give to resource management, as well as the system to quantitatively measure the integrative and adaptive capacity of water resource institutions. This is another new perspective added to the use of text mining analysis. This parameter helps in the full understanding of institutional fit of lake basin governance instruments and also which actors have more property rights and ownership. Other parameters quantitatively determined were: gaps and overlaps.

IV. The development of the Lake Basin Water Governance Performance Composite Index (LBWGPCI) to test and evaluate the performance of water governance for lake basins. This is also novel in lake basin governance and management because unlike other lake basin water governance performance indices, the LBWGPCI is comprehensive, peculiar, contextual and adaptable. It also measures actual governance performance and expresses the linkages between

performance, implementation and sustainability, and it clearly detects symptoms of problematic concerns, while pinpointing trouble spots for decision-makers. It was tested on the SLB to determine the overall governance performance status of the socio-ecological system.

1.8 Research Outcome: SLB Transformation Pathway to sustainability

In a complex socio-ecological system like the SLB, innovation, adaptation and transformation are seen as ongoing requirements for resilience (Gunderson and Holling 2002, Folke 2006). The adaptive dynamics of the SLB's system has undergone the three phases of Holling (1986) adaptive cycle, that is: exploitation, conservation, release and is currently in the last phase of reorganization. The on-going reorganization focussed on certain desire results will require well-guided and coordinated transformation process towards change, in particular, by convening all stakeholders around a common vision, mobilizing social capital, redesigning flow of political authority and resources, challenging technical and legal frameworks and by encouraging integration of local knowledge with experimentation and new scientific frameworks (Westley et al. 2013). These, experts believe, are necessary elements for successful transformation and this study has shown that all the above listed criteria are present in the SLB either directly or indirectly for transformation.

The major outcome of this work is the realization that the SLB is at the threshold of transformation to more adaptive and integrative governance despite the current challenges of the socio-ecological system's exposure to negative impacts on the environmental quality and resource sustainability of the Basin (but this is reversible) (Turner et al. 1990, Hamilton et al, 2004). Transformative change can occur as a result of ecological crisis, as evidenced in the SLB, resulting in unforeseen ecosystem changes and shifts in the socio-economics of the system, impacting negatively on social values, natural resources and management systems (Scheffet et al 2003, Westle et al 2013), which has also led to economic and political changes (Aberbach and Christensen 2001). The key requirement for this transition is the development of well thought-out pathways and strategies to direct a transformational change, especially for the networks and knowledge systems in the Basin as well as

leadership structures that have emerged in the transition of the SLB over time (Olsson et al 2006).

Transformation is the capacity of people in a socio-ecological system to create a new system when ecological, political, social or economic conditions make the existing system untenable through the agency of the actors to manage resilience (Walker et al. 2004). They are not the products of a single individual's vision and steering, rather, they require systemic shifts in institutions, management routines and resource flow (Westley and Antadze 2010, Olsson and Galaz 2012). Institutional reforms, financial investment, stakeholders' participation and research are indispensable requirements for transformation toward sustainable water management and governance (Halbe et al. 2013). The governance of the SLB has arrived at a crossroad and evidence reveals that the sails are pointing towards the need for change; and so we propose a transformation process for the SLB.

There are good number of knowledge networks already existing in the SLB that could play key roles in a transformation agenda for the SLB. Some of them are: Songkhla Lake Basin Research Centre (SLBRC), Centre of Study for Earth System Environment and Adaptation for Sustainability (ESEAS), Songkhla Lake Basin Knowledge Bank (SLBKB), Centre of Excellence for Hazardous Substances Management (HSM) of the Faculty of Environmental Management of the Prince of Songkla University as well as other sister faculties, educational, research institutions and organizations in the SLB. Others include: community based and indigenous groups, local governance by lake basin communities and others currently involved in finding solutions for the SLB as well as the public and private sector actors. These groups have played key roles in the generation of new knowledge and synthesing existing knowledge for development of strategies for transition to sustainable governance and wise use of the resource system of the Basin. There are also various forms and levels of leadership in the SLB, even though they are currently running their own show, they are willing to support any initiative that will improve the SLB.

Also, clearly visible is the Thai constitutional provision of 1997 for the decentralization of natural resources management to local administrative structures, the enactment of various laws which strengthen local administrative organizations roles in resource governance (Figure 5.1) as well as the current political will of the

central government and LAOs willingness to support the SLB's transformational processes and activities. These create wide windows of opportunity. This local administrative reform is in line with most researchers who have stated that complex socio-ecological systems cannot be governed by top-down, command and control forms of management associated with conventional ideas of leadership (Wheatley 1994, Gunderson et al. 1995, Holling and Meffe 1996, Greanleaf 2002). Also, tendering full decentralization as the only solution is viewed as naïve and increasingly challenged (Ostrom 2005). Moving forward, Anderson and Ostrom (2008) propose a polycentric view, which considers the relationships among multiple authorities with overlapping jurisdictions. Each unit exercises independence to establish, change and enforce rules within a circumscribed domain of authority for a specified geographical area (Cleaver 2000, Ostrom 2005). The current governance system of the SLB can be said to be largely polycentric and just needs some kind of streamlining and better coordination.

Other windows of opportunity are the various development plans for the sustainability of the SLB which include: Master Plan for Songkhla Lake Basin (2017-2036), Climate Change Adaptation Plan for Songkhla Lake Basin, Strategic Plan for Biodiversity (2011-2020) as well as the Pilot Projects in climate sensitive areas for climate change adaptation, on-going governance in natural resources and environmental management supported by the National Research Council of Thailand (NRCT), SLB on-going projects supported by the Office of the Natural Resources Planning and Policy (ONEP), Department of Water Resources (DWR), Royal Irrigation Department (RID), just to mention but a few. Therefore, these indicate that SLB actors are ready to transform to a more adaptive and integrative governance and management system (Figure 1.4). However, such transformation process must be owned by the people and driven by government for it to be effective and successful. It is important to point out that government in this context is the only one with the power required to drive this process towards achieving the desire change.

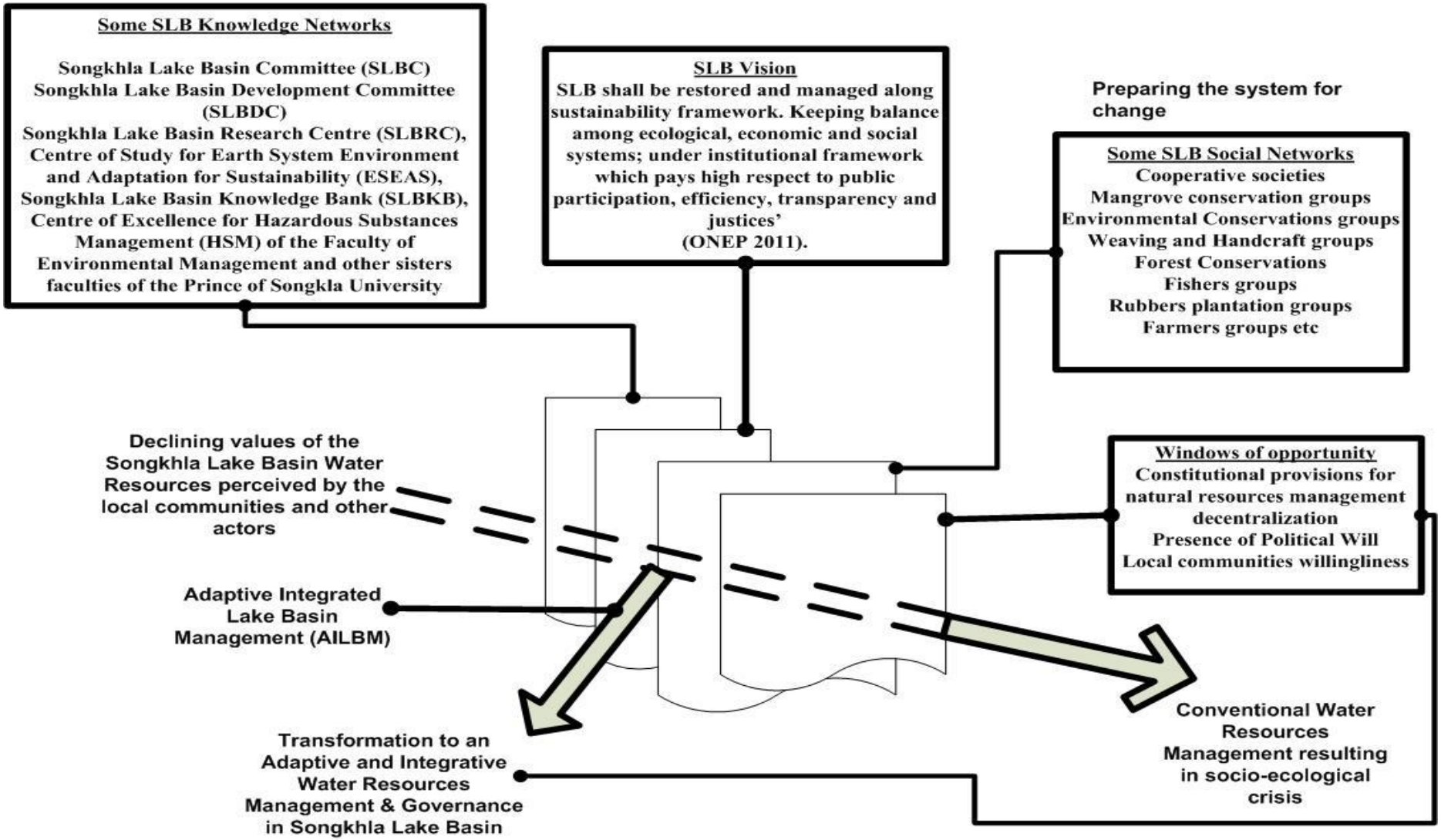

Figure 1.4: Transformation towards adaptive and integrative governance of the SLB

The AILBM encourages the synthesis and transfer of knowledge between scientists, policy-makers, engineers and the local lake basin communities. It also ensures that the evaluation of socio-ecological systems like lake basins is not reduced to over-simplification because it is designed to be comprehensive and dynamic enough to capture the complexities of the socio-ecological system. It facilitates assessments of socio-ecological systems to determine the readiness for transformation of the governance systems into a more adaptive and integrative system. This is because it assesses governance performance to determine the management and governance status quo as well as design the pathway to overcome the detected barriers.

The AILBM supports the design and implementation of transformation processes towards sustainable water governance and wise use of other natural resources of the lake basin. The application of the AILBM framework in the SLB brought to the fore the urgent need for transformative governance towards adaptive and integrative paradigms. Findings revealed that governance performance is below average; institutions are not fit for purpose; the local people are not happy with the governance of the Basin, but they are willing to support any viable intervention of government; too many government actors oversee the Basin, conflicts exist between/among users, between and among government actors, between users and regulators; evidence of a looming sanitation crisis, and a general agreement that urgent change is needed in the SLB's governance system. Specific recommendations have been made (Chapters 3-8) at the end of each chapter in this report. There is also a detailed synthesis of these recommendations in Chapter 9.

The application of the AILBM on the SLB was based on a diagnosis and prescriptive assessment which produced empirically-based prescriptive recommendations for desire changes. AILBM is designed to investigate desired changes comprehensively and determine the required action towards achieving a synergy for these changes to occur. Therefore, outcome shall be the development/design of transformation pathway towards more integrative and adaptive water management and governance system that can be measured by change in knowledge, actions and conditions (USDA 2015).

This transformation pathway can also be extended to include all the sectors in the SLB. The desired results shall include institutional review, increased knowledge, infrastructural improvement, improved collaboration and participation of stakeholders as well as local people involvement. This transformation pathway shall be drawn from the SLB vision statement: 'SLB shall be restored and managed along sustainability framework. Keeping balance among ecological, economic and social systems; under institutional framework, which pays high respect to public participation, efficiency, transparency and justice' (ONEP 2011). We suggest that the transformation process arise from a reconceptualization of this SLB vision to reflect the adaptive and integrative character of socio-ecological systems' governance and the peculiar complex and dynamic nature of lake basins.

The transformation process we propose shall include three major prescriptive actions. The first prescriptive action will be two separate roundtables (technical and institutional review). The institutional review roundtable discussion is recommended under the supervision of the Ministry of Natural Resources and Environment (MONRE) and should include participation from the key ministries, centralized-deconcentrated departments, SLB committees as well as other non-state actors identified in Table 4.2. Others shall include Ministry of Justice and the other relevant ministries in the SLB, as well as members of the National Economic, Social & Development Board and Parliament, legal, social, economic, natural resources, engineers and lake basin management experts. The technical roundtable discussion also under the supervision of the Ministry of Natural Resources and Environment (MONRE) should include all the above as well as all stakeholders, especially the local communities. The roundtables should determine the pace for strategies for the transformation process of the SLB that will be synergistic and coordinate all actors.

The second prescriptive action shall be a coalition of formal and informal actors (i.e. all stakeholders) in one platform perhaps called the people transformation platform to compile the results of these roundtables with best-practice from lake basins as well as findings from research on the SLB. This should then lead to the establishment of a formal management and policy harmonization organization with mandates drawn from an

adaptive and integrative Songkhla Lake Basin Development Roadmap produced by the platform members.

The third prescriptive action is an international and national partner development conference for the SLB. This conference shall involve relevant government agencies and ministries, international development partners, multilateral donor agencies, development banks, embassies, industry, national research institutes, national funding agencies, academia, lake basin managers and the local people. This conference will be designed with the aim to draw financial, technical and knowledge assistance for the re-development and reorganization of the SLB towards adaptive and integrative capacity. The objective of this conference, therefore, will be to identify and match partners with projects, programmes and researches that have being earmarked in the 'Songkhla Lake Basin Development Roadmap'. This conference shall also include technical and academic presentations and discussions on all aspects of the SLB. The outcome of this would be the identification and confirmation of donor funding and assistance pathway. This will then lead to the execution of the transformative process for the SLB towards an adaptive and integrated lake basin management and governance. It is important to point out that this is a dynamic system, which will always be reviewed per time using the AILBM framework in order to remain adaptive (Figure 1.5).

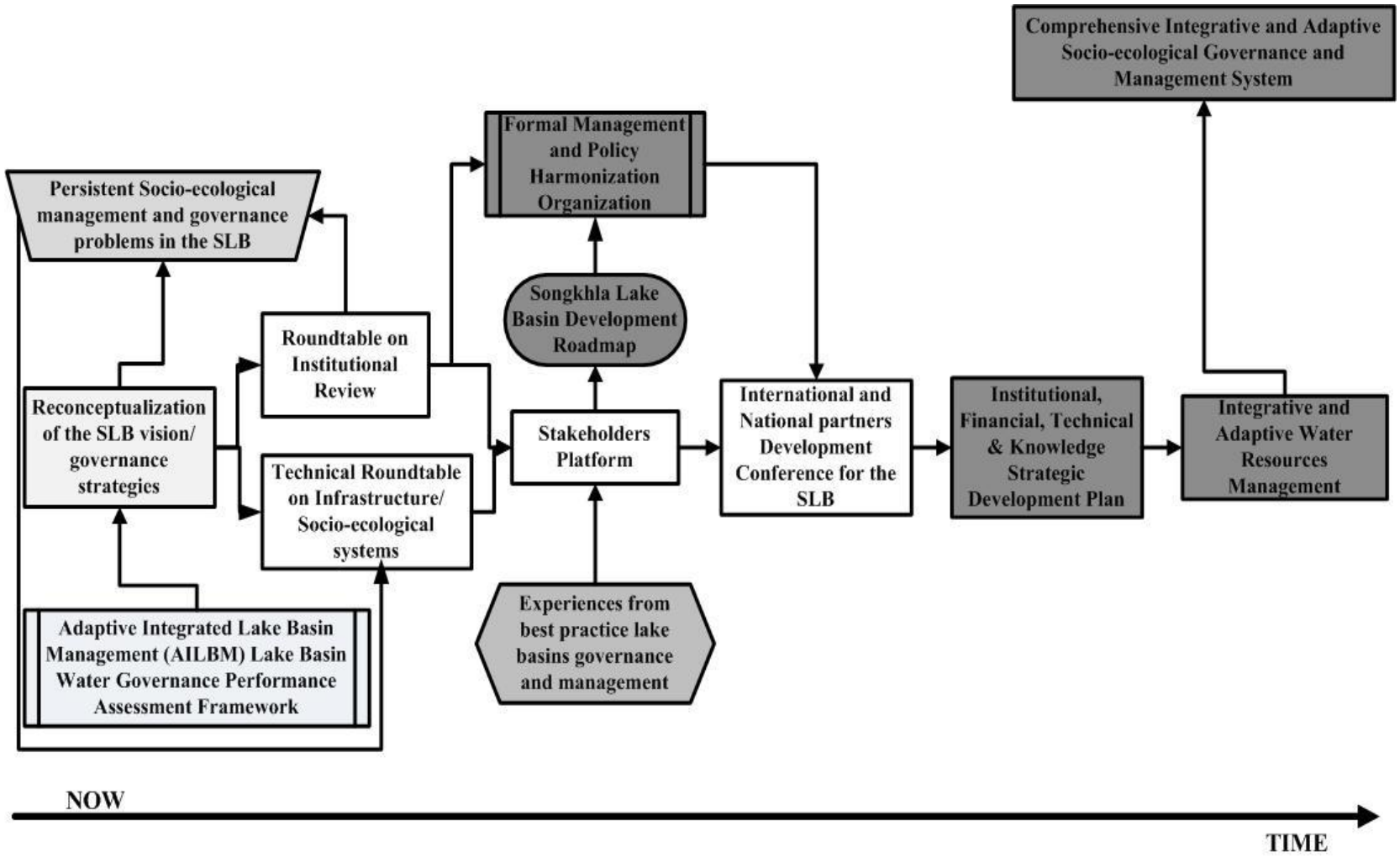

Figure: 1.5: Possible transformation pathway towards adaptive and integrative Songkhla Lake Basin water resources management and governance linked to the comprehensive integrative and adaptive socio-ecological system governance

1.9 Thesis structure

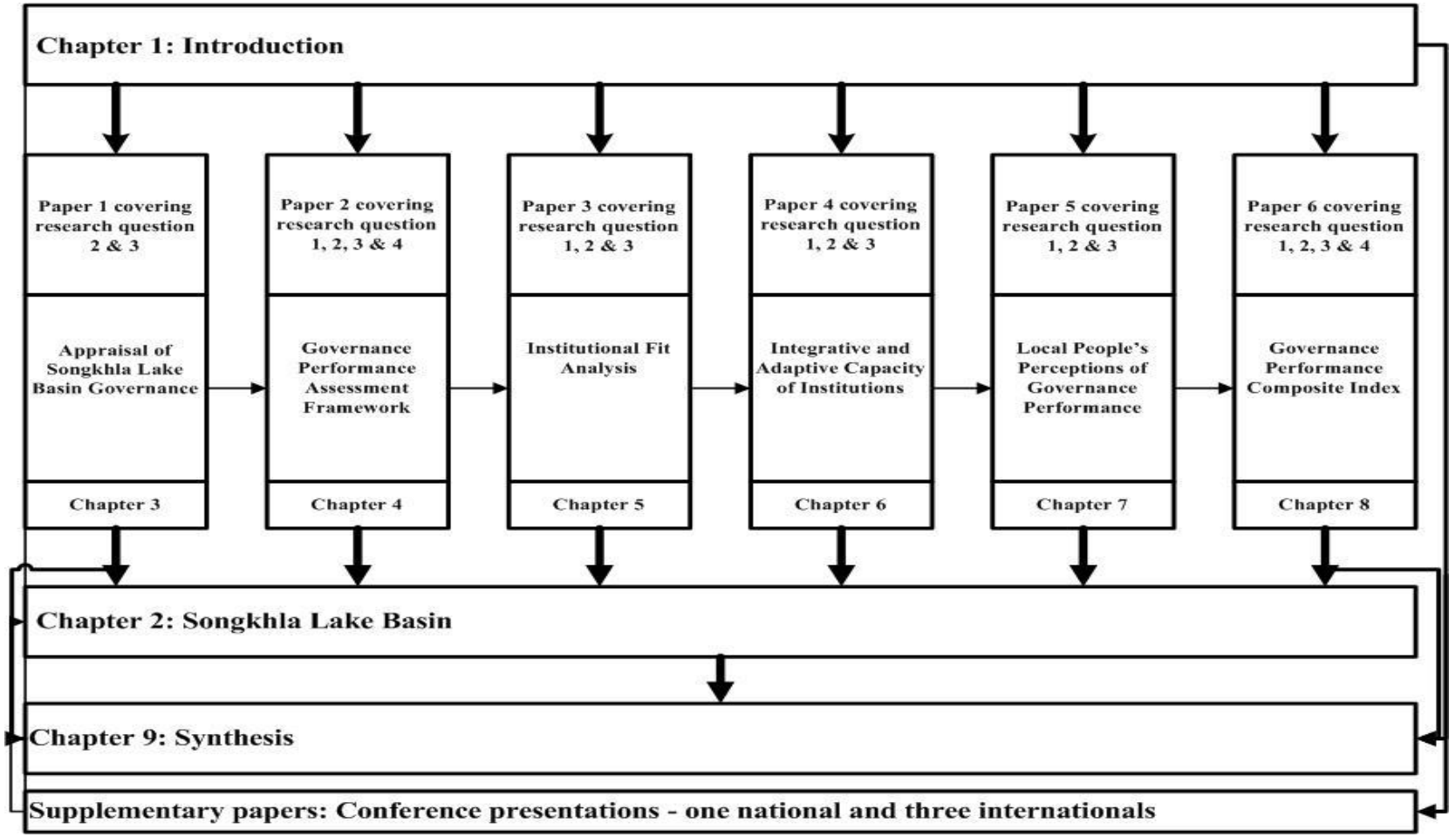

Figure 1.6: Thesis structure

CHAPTER TWO

SONGKHLA LAKE BASIN

2.1 Physical and ecological aspects

The Songkhla Lake Basin (SLB) is the only natural and largest lagoon in Thailand (ONEP, 2011) and the only lake basin in the country. The water environment in Songkhla Lake is a unique combination of marine, brackish and freshwater ecosystems, and it has semi-closed estuaries with the sea mouth in Thale Sap Songkhla, one of its lagoonal features. Furthermore, the ecosystem ranges from tropical rainforest in upstream watershed (basin) areas to the sea through complex water channels (sea mouth and several water gates) with tidal influences and negative impacts of human activities (Iwasaki and Shaw 2010).

The SLB has an area of 8,020 Km^2 in southern Thailand with a population of 1.7 million people (NSO 2012). It spans through three provinces of Southern Thailand: Phattalung, Songkhla and Nakhon Si Thammarat and consists of 12 sub-basins. The lake is bounded by Banthad Mountain which lies in the north-south direction and to the south is Sangala Kiri Mountain. The higher grounds of the two mountains are covered with rainforests, constituting an upstream portion of the catchment area. In the north-south of the Basin parallel to the mountain are undulating plains alternating with low hills. In the east is a large flat plain, mostly made up of paddy rice farms. North of the lake is a large wetland called ‘Phru Kuan Kreng’and in the east between the lake and the sea is a large flat plain. The SLB consists of both land and water areas. The water area covers approximately 12.5% (1,040 Km^2); a complex ecosystem rich in biodiversity with multitude of flora and fauna species. Songkhla Lake is Thailand’s largest freshwater ecosystem consists of four sections, forming three shallow basins connected to each other and to the sea by relatively narrow deep channels (Emsong 1997).

This complex ecosystem is rich in biodiversity with multitude of flora and fauna species and is one of the two lagoons in the world that has endangered species of the Irrawady dolphin. It is a highly diverse and rich ecosystem providing fishery resources all year round (Pornpinatepong 2010). The Lake also serves as an important nursery ground for many economically important species of fish, crabs and shrimps (Choonhapran, et al., 1996 and Mabuntham 2002). There were about 450 fish and 30 shrimp species in 2002 in the Lake (Pornpinatepong 2010), Fishery resources in the Lake are not well managed, as evidenced by the increased use of prohibited equipment and illegal fishing methods. Some studies have noted that there is no more space left for fishing traps and at 2003, more than 29,604 standing traps were counted in the Lake (Choonhapran, et al., 1996 and Mahuntham 2002).

The major economic activity in the Basin include; rubber plantations, paddy rice farms, fruit tree orchards, fishery, aquaculture and animal husbandry with a high attractive tourism potential. Land use pattern in the SLB has undergone significant changes during the past few decades, following socio-economic and demographic changes. According to ONEP (2013), majority of the SLB land, about two-thirds of the Basin area, is used for agriculture, with 60% and 30% used for rubber plantations and paddy rice respectively. Second land use category is forest, which occupies 13.7% of the Basin area, most of which is the rainforest covering upstream area on the hillsides; the remaining areas are mangrove and peat swamp forests. Other land use categories are natural water body, 12.5% of the Basin area and residential area, 2.6% (Tanavud et al., 2000) (Figure 2.1).

2.2 Water Resources Aspect

The Basin is rich with abundant surface and groundwater resources. The annual rainfall in the Basin is approximately 2,000mm (DANCED and MOSTE, 1999). Songkhla Lake is the main surface water resource in the Basin and is the largest lake in Thailand with a sediment rate of 1.0mm yr^{-1} (Tanavud et al. 2000). There are more than 100 streams of all sizes that drain the Basin into the lagoon (Lesaca, 1977). The Lake is a lagoonal system that connects to the Gulf of Thailand at the Thale Sap Songkhla through

a narrow channel outlet and is subject to seasonal fluctuations in salinity (Lesaca, 1977, Tanavud, et al, 2001). The Lake is 1.5 - 2 meters deep (ONEP 2011) and covers an area of approximately 1,042 km^2, consisting of four interconnected lake ecosystems. The northernmost basin, Thale Noi, is a freshwater swamp of approximately 1.0–1.5m depth. Thale-Noi hosts the largest wetland and waterfowl reserve, and is the first world Ramsar site in Thailand. Connected to Thale Noi on the south is Klong Nang Rium, a huge fresh to brackish water basin. On the north of the SLB is Thale Luang and on the south is Thale Sap with depth of 1.3 – 2.4 m. Thale Sap is connected on the south by a long narrow channel, approximately 8m depth, between Pak Payoon and Pak Ror.

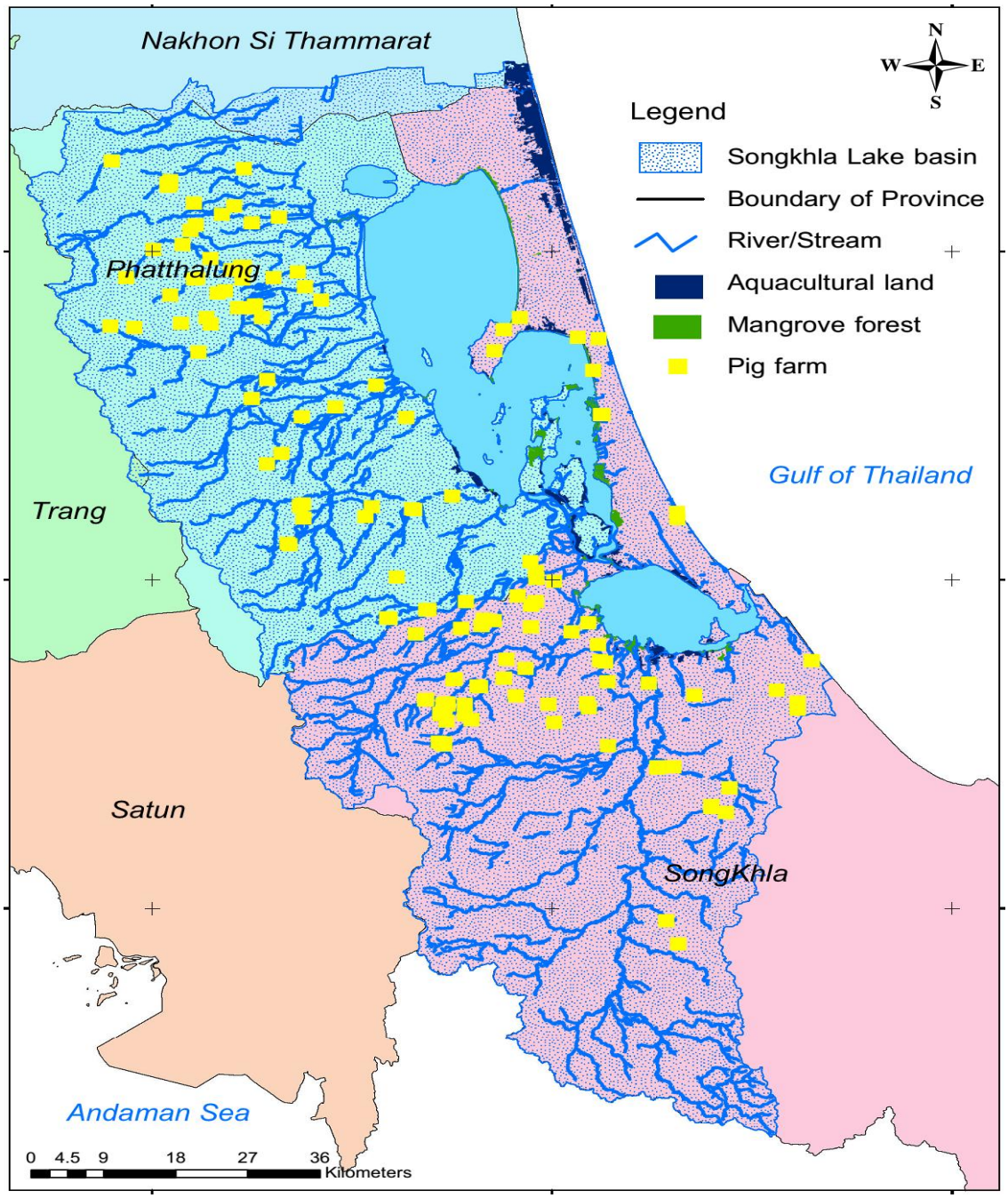

Figure 2.1: Map of Songkhla Lake Basin

Farther south of the Basin is the brackish and marine water, Thale Sap Songkla, 1.0 – 1.5 m depth. The systems finally open to the sea through a narrow channel near Songkhla town, approximately 8m depth (ONEP 2011, NEDECO 1972, Tanavud, et al. 2001,

NESDB and NEB 1985, Lesaca, 1977, Tanavud, et al, 2001, (Ratanachai and Sutiwipakorn 2005).

The estimated mean total surface runoff from several hundreds of smaller rivers and streams in the Basin is 5,500 million m^3, which can drop to 2,000 million m^3 in dry seasons. Total annual inflow from streams to the entire lake system is 5,200,000m^3 (Thimakorn and Vongvisessomjai, 1979) and an average run-off of 4,896m^3 with a storage capacity of 28 cubic meter (WWAP, 2007). The total volume is stored in the Songkhla Lake at a mean sea level of 1,600 million m^3, increases to 3,800 million m^3 when the lake level reaches 1.5 m MSL (Taylor & Sons 1985). Water levels in the system fluctuate each year both in response to seasonal variations in sea level and rainfall, maximum during northeast monsoon in December (+0.27 m MSL) and minimum in August (-0.35 m MSL) (Emsong 1997). The system exhibits a mixing path of freshwater up-stream and salt down-stream, via complicated topography. Narrow channels connect Thale Sap and Thale Sap Songkhla, which restricts attenuates tidal oscillation from a range of 250-600 mm (neap/spring) at the sea entrance to only 30-40 mm at the northern part of Thale Sap. Some amounts of irrigation water are pumped from the Thale Luang at the Ranod pumping station to feed the rice fields and the amount varies depending on the salinity level. The four major potential sources of groundwater resources are: shallow sand aquifers, deep gravel aquifers, rock aquifers and meta sediment aquifers in the SLB (NESDB and ONEB 1985, RFD 1994). Groundwater extraction from Hat Yai Basin alone is estimated at approximately 35 million cubic meters per year or approximately 96,000 cubic meters per day of groundwater (Ratanachai and Sutiwipakorn, 2006).

2.3 Impact of Human Pressure Aspect

The past few decades have evidenced overexploitation of the rich natural resources and serious environmental pollution resulting from human and industrial activities in the SLB. This has resulted in the deterioration of the valuable natural resource base of the Lakes system at a rate never seen before in history, causing depletion of biodiversity, devastation of life supporting systems, deterioration of water quality, depletion of fishery resource, shortage of fresh water in dry seasons, plus social conflicts

in water and other natural resources use (Ratanachai and Sutiwipakorn 2006) (Figure 2.2).

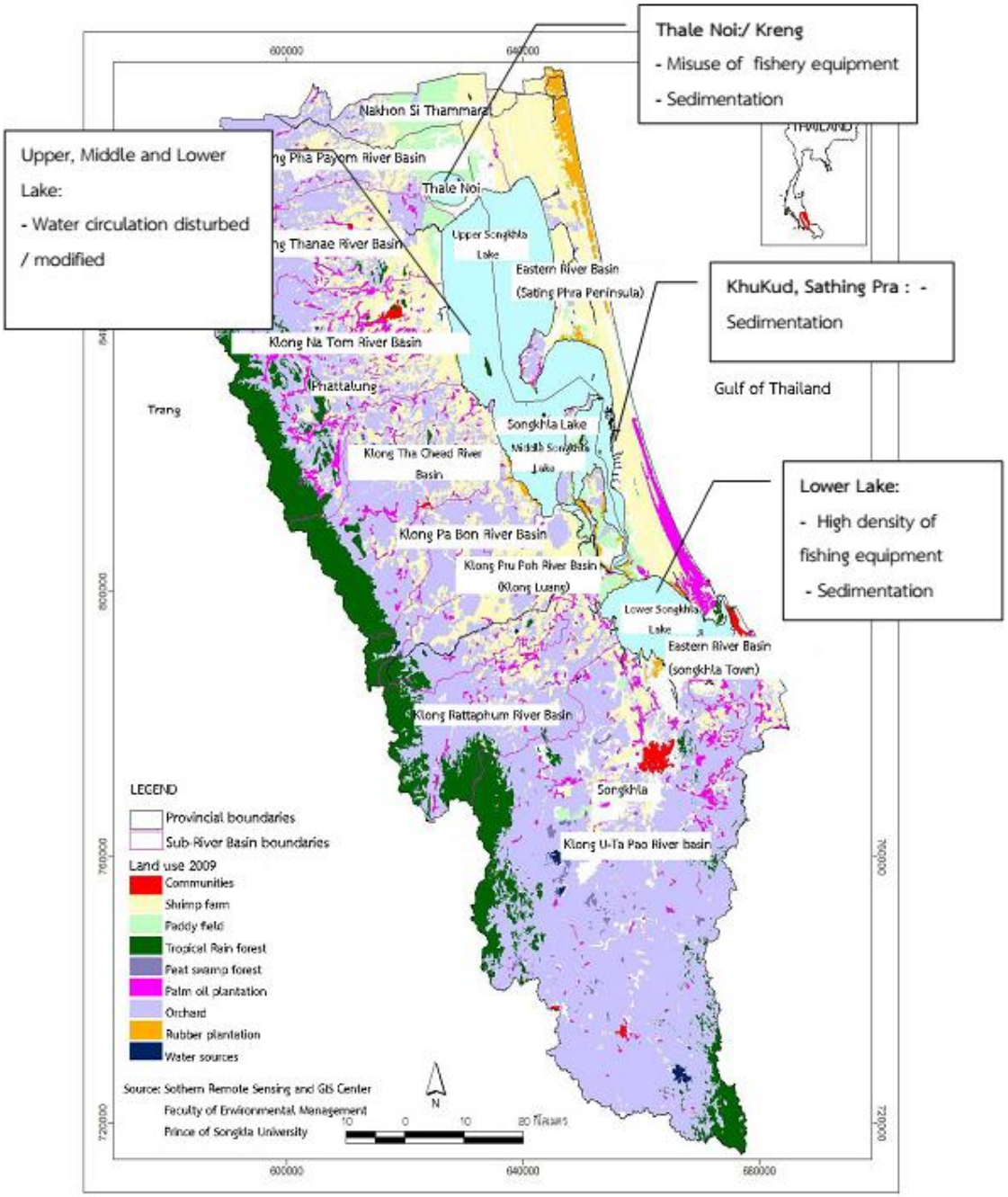

Figure 2.2: Major causes of fishery degradation in the SLB, Source: ONEP 2005

Water pollution is a burning issue in the Lake, but the cause depends on location: wastewater from factories causes damage to livelihood in Thale Sap and Thale Sap Songkhla: pesticides and fertilizers from paddy fields are responsible for the pollution at Thale Luang; and the local people in Thale Noi suffer mainly from household sewage (Iwasaki and Shaw, 2010).

Fishery resources in the Lake are not well managed, which induced a large number of fishery resources to be overexploited. This is evidenced by the increased use of prohibited equipment and illegal fishing methods. Some studies have noted that there is no more space left for fishing traps in the Lake (Choonhapran, et al., 1996 and Mahuntham 2002). The semi-permanent installations of fishing equipment in the water undermined access to limited fishing grounds while causing damage to juvenile fishery resources (Iwasaki and Shaw, 2010). There are reported cases of over-extraction of freshwater from the Lake and groundwater per year (Ratanachai and Sutiwipakorn, 2006). Wetland and Peat Swamp forests have also suffered from severe encroachments by surrounding settlements, as well as by other socio-economic developmental activities. This has resulted in accelerated deterioration of the swamp (ONEP, 2013).

There are insufficient solid wastes and wastewater management facilities in the SLB, which further contribute to the pollution problems of the Lake (Ratanachai and Sutiwipakorn, 2006); only two central wastewater treatment plants and sanitary landfills exist. They are located at Hat Yai and Songkhla and service just about 7percent of the Basin population. The main sources of this wastewater are human activities from households and industries, and deforestation of the catchment area. Industrial water pollution originates mainly from rubber and food industries, shrimp farms, pig farms, tourism as well as from the human communities around the Lake (Pornpinatepong, 2010).

This has led to nutrient enrichment in the Lake areas causing water quality degradation (Ratanachai and Sutiwipakorn, 2006, TSPR, 2010). Songkhla Lake is one example of a tropical shallow lake facing critical water quality deterioration (Chesoh and Lim, 2008). There is also increasing concerns about the possibility of the negative effect of climate change on the Songkhla Lake Basin, especially as it relates to irregular rainfall, abnormal storms and floods (ONEP, 2013) (Figure 2.3).

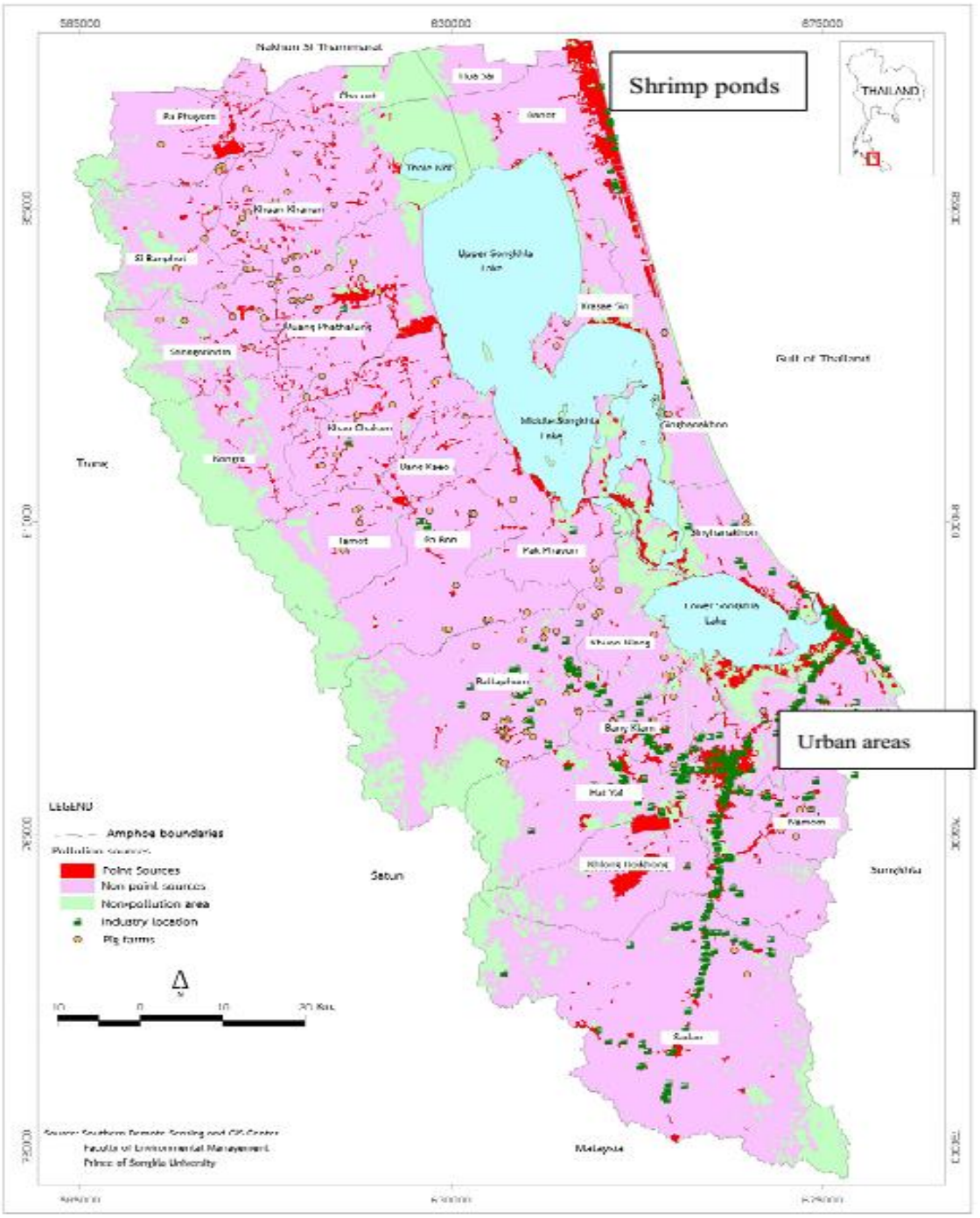

Figure 2.3: Sources of waste water in Songkhla lake basin
Source: ONEP 2005

CHAPTER THREE

APPRAISAL OF SONGKHLA LAKE BASIN GOVERNANCE

This chapter is adapted from:

Cookey, P. E., Darnswadi, R. and Ratanachai, C., Critical Analysis of Water Governance Challenges in Songkhla Lake Basin, Thailand. Paper submitted for publication: Lake & Reserv.: Res. and Manag.

Abstract

The article examines water governance challenges in the Songkhla Lake Basin (SLB) with the aim of evaluating and analysing policies, legislations, regulations, institutions and actors responsible for the current state of the Lake Basin. This study adopted three methodological approaches of review of literatures, face-to-face expert interviews and field survey to investigate governance challenges confronting the Basin. The study identified six major governance challenges that combined to produce current barriers to sustainable governance, resulting in depletion and deterioration of the resource system in the Basin. Moving forward will require the pursuit of better resource management and governance systems, which will require the establishment of a coordinating and policy harmonization committee to promote coherent actions among the formal and informal actors in the Basin as well as review existing water resources and related governance instruments and make them appropriate, adequate and relevant to the SLB.

3.1 Introduction

The laws governing water resources and other natural resources of the Songkhla Lake Basin (SLB) in Thailand are derived directly or indirectly from some basic legal texts, traditional and customary laws and/or from special laws regulating one or more uses of water. There are at least 28 to 48 water related legislations in Thailand (Sukhsri, 1999, Biltonen et al. 2001, Biltonen 2011), and more than 30 national departments in 9 ministries as well as 7 national committees (UN-Water/WWAP, 2007). A single law may regulate more than one aspect of use (Sukhsri, 1999, UN-Water/WWAP, 2007). For instance, the ownership and the right to use water resources are contained in the Civil and Commercial Code of 1923, which regulates issues apart from water resources (KOT, 1923). Also, there is no umbrella legislation linking these laws and codes (UN-Water/WWAP, 2007). Water governance in Thailand and indeed in the SLB is centralized, multilevel, traditional top-down and mainly commands and control regime (Neef 2008, Kanjina 2008, Sukhsri 1999, Christensen and Boon-Long 1994) (table 3.1). Public participation was a missing ingredient in the Thai natural resources management laws, which included water resources, until 1975 when it was first recognized in the National Environmental Quality Act (KOT-NEQA 1975); and in 1997 it was properly highlighted in the Royal Thai Government Constitution (KOT 1997) following the provision of the 7th National Socio-Economic Development Plan (1992-1996).

Subsequently, governance documents have included the need to involve all stakeholders in plans and implementation. The actual turning point in the management of natural resources in the country however, was the introduction of the decentralization policy into natural resources management in the 1997 Constitution (KOT, 1997) and the National Water Resources Management Policy formulated in 2000 (Wongbandit 2005; Hirsch et al. 2005; WWAP, 2007; Sethaputra et al. 2001, Tan-Kim-Yong, et al. 2003).

The National Development Plans (NP), which set the direction for the development pattern of the country, is another vital policy instrument for natural resources management. The aim of the first development plan (1962-1966) on water management was to respond to the demand for water in agricultural and other economic activities by emphasizing supply-side (Sethaputra et al. 2001). From 2007 – 2011 the Plan continued

to emphasize the rehabilitation of natural resources and the environment by strengthening environmental management and increasing local and community participation.

Table 3.1: Summary of some related water legislations applicable to the SLB

Key legal provisions	**Legal Instrument**	**Provisions**
Right to water as a fundamental principle	Constitution of the Kingdom of Thailand 2007	Section 85 (4) the state shall provide the plan to manage water resources and other natural resources systematically for public interest,
National water vision of sufficient water quality good for all users in 2025	National Water Policy, 2000	Set the philosophy and goal of water management
Ownership and right to use water	Civil and Commercial Code, 1923 Conservation of Public Water Supply Canals Act, 1913 Eradication of Water Hyacinths Act, 1913 Municipality Act, 1933 Conservation of Canals Act, 1903 Maintenance of Canals Act, 1904 People's Irrigation Act, 1939 State Irrigation Act, 1942 Fisheries Act, 1954	Set national rule and principle for water usages
Agricultural Uses of Water Resources	People's Irrigation Act, 1939 State Irrigation Act, 1942 Control of Weirs and Dikes Act, 1934 Conservation of Canals Act, 1903 Dikes and Ditches Act, 1941 Agricultural Land Development Act, 1974 Land Reform for Agriculture Act , 1975	Govern the use and distribution of water for agricultural purposes including fishing
Water Supply and	Municipality Act, 1933	Empowers the

Sanitation		Municipalities to provide water and sanitation services
	Provincial Waterworks Authority Act, 1979	Empowers the public enterprise under the supervision of Ministry of Interior to provides water supply services at a commercial rate in the Provinces
	The Conservation of Canals Act, 1903	Prohibits the dumping of waste and garbage into waterways, or canals or ditches
	Sanitation Act, 1952	Empowers sanitation districts to provide water supply and sanitation services
	Public Health Act, 1934	Empowers local authorities to control domestic water supply and sanitation services
Water Quality and Pollution Control	State Irrigation Act, 1942	prohibits dumping of waste into any irrigation waterway
	Conservation of Water Supply Canals Act , 1903	prohibits the discharge of filth, carcasses or garbage into canals
	The Building Control Act, 1936	Empowers local authorities to issue by-laws to control sanitation in buildings and specifications for the construction of storm-water and wastewater drainage systems.
	The Factories Act, 1942	Empowers the Ministry of Industry to control and regulate the discharge of effluents from factories
	The Groundwater Act, 1976	Prohibits the overexploitation and contamination of groundwater quality.
	Enhancement and Conservation of the Quality of the National	Empowers National Environmental Board

	Environment Act, 1992	(ONEB) for protection, conservation and environmental quality
	Navigation in Thai Water Act, 1913	Provides for the controlling of water pollution in the canals
	Water Hyacinth Eradication Act, 1913	Empowers the people to collectively eradicate water hyacinth in their environment
	National Park Act, 1961	Control water pollution within the national park and ensure that no degeneration of the natural water
	Mineral Act, 1967	Provide for the control of water pollution in the mining area
	Petroleum Act, 1971	Provide for the control of water pollution within exploration, production and refining company area
	Artesian Water Act, 1977	Provides for the regulation of groundwater usage and control of pollution
Marine and Coastal Protected Areas	National Park Act, 1961 National Forest Reserve Act, 1964, Wildlife Conservation Act, 1992, Fisheries Act, 1942	Provide for the control and regulation of activities in the marine and coastal environment

Doungsuwan et al., (2013) noted that even though the direction of development has changed since National Development Plan eight (NP8) (1997-2001), the development under these plans continue to negatively impact the Songkhla Lake Basin (SLB) because much focus is on resource utilization.

Songkhla Lake Basin (SLB) is a prime example of an endangered lake burdened with unfocussed governance system. It is fast losing its essence and drastic and quick measures are needed to remedy the current downward trend. Faced with physical challenges like land deforestation and water pollution caused by land use changes and shrimp farming expansion, the Basin is deteriorating so fast, it's definitely at a high risk

(Ratanachai and Sutiwipakorn 2006, ONEP 2013).This is compounded by a wide range of water resources development and management problems, coastal zone management issues, and water shortage affecting water supply and agriculture in the entire area (GWP 2012). The Basin, and its lakes, is further burden with over-exploitation of its rich natural resources, and serious environmental pollution resulting from human and industrial activities, as well as biodiversity depletion including fishery resources, water quality deterioration, devastation of the ecosystem and social conflicts for water and other resources use (Ratanachai and Sutiwipakorn 2006, Pornpinatepong 2010, Chesoh and Lim 2008, ONEP 2013).

In order to properly visualize the SLB governance situation, a brief presentation of the Thailand general governance system is required. Public administration in Thailand is centralized with three administrative systems: central, local administrations and local autonomy. Interestingly, policy formulation is solely the responsibility of the central government; the area specific knowledge is consolidated at the regional level, local inter-ministerial coordination takes place at the provincial level and the physical implementation takes place at the district level (EMSONG 1999). The central government delegates many of its services to its branch offices under the principle of de-concentration and ensures strict control and supervision through the Ministry of Interior (MOI). The de-concentration principle means that central government ministries and departments delegate their authority to their line agencies to operate and perform some responsibilities at the provincial, district, sub-district and village levels under the supervision of the provincial governor with assigned officials from central administrative agencies (KOT, 1991, Rangsiyokrit 2003, Nagari et al. 2008).

The main national water resources agency is the Department of Water Resources (DWR), which operates through mandates from the Office of the Prime Minister's Regulations on National Water Resources Management (1989, 2002 and 2007) as the Draft National Water Resources Act has not being passed. The 2002 Regulation states that water resources are to be managed using the river basin as territorial and administrative units with committees as management organizations (DWR 2006). At the national level, is the National Water Resources Committee (NWRC) (formally under the

Prime Minister's Office, but now administered and hosted by the DWR). Some experts believe that this singular action of transfer of NWRC to DWR could further weaken the mandate of the NWRC. The deconcentrated regional office of the DWR is responsible for the 25 main river basins, which include Songkhla Lake Basin (SLB) and act as their secretariats (DWR, 2006, Kanjina, 2008).

The Thailand River Basin Committees (RBCs) is a technical implementation of the concept of Integrated Water Resources Management (IWRM); however, Simachaya and Yolthantham (2006) argue that in Thailand, there is no integrated water management approach because water management is separated between the quantity and quality due to agency responsibilities and their respective regulations. Also, the other challenges facing Thailand from the implementation of the IWRM are, the assumption that water is an open access resources and lack of sound water allocation principles has pose barriers to effective and efficient water governance. Just as the existence of too many responsible agencies with overlapping mandates and high fragmentation, acute battles for supremacy, vested interests and lack of sectoral integration, weak coordination and enforcement, uneven water infrastructures as well as focus on exploitation has increased inefficiency in management (World Bank 2011). All these have created governance challenges for basins like the SLB in Thailand, resulting in real turbulent physical and socio-economic problems in the Basin. The purpose of this chapter is to critically analyze the impact of these governance challenges on the SLB in order to contribute to body of knowledge on lake basin governance by providing policy makers with information and possible guidelines for sustainable governance and wise use of Basin resources. The chapter shall critically explore the why and how of Thailand's water governance challenges on the SLB as well as assess the impact of the policies, legislations, regulations and institutions that create these challenges.

4.2 The Institutional Context of Songkhla Lake Basin (SLB)

The study identified 19 sets of Thailand national laws that were relevant and related to water governance in SLB. These laws can be summarized under the following themes: marine, environment, fishery, irrigation, forestry/land and local administrative laws. The

general characteristics of these laws are the fact that there are fraught with fragmentation with overlapping responsibilities and filled with a lot of gaps and only the Fisheries Act made provisions as regards the prohibitions of use of dangerous fishing gears in the Songkhla Lake. However, it was also observed that the most abused laws were the fisheries related legislation because of lack of enforcement (Pornpinatepong 2010) (see table 3.1 for details of the relevant laws in the SLB). The direct management and governance of the SLB are the responsibilities of provincial/districts offices of the central government ministries and centralized-deconcentrated departments under the direct supervision of the provincial governors. Water resources management in the SLB is complicated with gaps and overlaps because of many government agencies and private parties involved in the development and exploitation of the surface and ground water resources; it is directly coordinated from 6 central government ministries and more than 13 centralized-deconcentrated departments (agencies) with various related and relevant roles (Table 3.2).

The centralized-deconcentrated departments constitute the permanent building blocks of the SLB's administrative and governance systems and are the main vertical decision-making bodies. By the policy of deconcentration the ministries and the departments delegate their responsibilities to the SLB provincial and district offices under the direct supervision of the 3 provincial governors (Phattalung, Songkhla and Nakhon Si Thammarat) and about 33 District Chiefs appointed by the Ministry of Interior (MOI) approved from the Cabinet.

Table 3.2: Institutional fragmentation: multiple competing mandates of centralized ministries and deconcentrated departments actors in the SLB.

Actors	**Mandates**	**Main concern**
Central government actors		
Departments supervise by the Ministry of Natural Resources and the Environment (MONRE)		
Ministry of Natural Resources and the Environment (MONRE)	Responsible for the protection of clean and safe air, land and water to ensure healthy communities, ecosystem protection and sustainable development	Drinking water quality and environment
Department of Water Resources (DWR)	Oversee the development and management of groundwater resources in the lake Basin and host the National Water Resources Committee (NWRC) and supervises the Songkhla Lake Basin Committee (SLBC)	Ground water quality and quantity
Department of Groundwater (DGW)	Responsible for groundwater resource management in the basin.	Water quality and quantity
Pollution Control Department (PCD)	Control, prevent, reduce pollution and conserve the environment of the lake basin.	Water quality
Office of the Natural Resources and Environmental Policy and Planning (ONEP)	Responsible for environmental policy and planning for the enhancement and conservation of the environment and supervises the Songkhla Lake Basin Development Committee (SLBDC)	Water quality and environment
Department of Environmental Quality Promotion (DEQP)	Supporting environmental research, providing training courses and general environmental awareness	Conservation and environmental quality
Royal Forest Department (RFD)	Responsible for the sustainable development and management of forest resources	Impact of forest activities on aquatic ecosystem
Department of National Park, Wildlife and Plant	Responsible for the supervision of the protected areas in the Basin e.g. Ramsar site at Kuan Si Sian within the Thale Noi Non-hunting area in Songkhla, Phattalung, Nakorn Sri thammarat	Biodiversity, recreation and ecosystems

Conservation (DNWP)	Province.	
Department of Marine and Coastal Resources (RDMCR)	Responsible for the conservation and restoration of marine natural resources and sustainable use in the Basin.	Fisheries and aquatic resources
Departments supervise by the Ministry of Agriculture and Cooperatives (MOAC)		
Ministry of Agriculture and Cooperatives (MOAC)	Responsible for Irrigation development for the purpose of improvement and growth of agricultural sector of the economy.	Agriculture and food
Royal Irrigation Department (RID)	Responsible for the management of irrigation-water resources and infrastructure development and protection of water resources and catchments management	Water quality and quantity
Department of Fisheries (DOF)	Responsible for licensing of fishing gear, fish farming, shrimp farming, mariculture and fisheries research.	Fisheries and aquatic resources
Departments supervise by the Ministry of Interior		
The Ministry of Interior	Supervises the Local Administrative Organizations systems	Supervises LAOs and PWA water supply and sanitation services
Department of Provincial Administration (DOPA)	Responsible for the supervision of the Provincial Administrative Organizations (PAO)	Supervises PAOs water supply and sanitation services
Department of Local Administration (DLA)	Responsible for the supervision of the Tambons Administrative Organizations (TAO) and Municipal Administrative Organizations (MAO)	Supervises TAOs and MAOs water supply, sanitation and wastewater treatment services
Department of Disaster Prevention and Mitigation	The agency is responsible for management of all water related disasters and emergencies.	Emergency response

(DDPM)		
Provincial Waterworks Authority (PWA)	The State enterprises responsible for domestic water supply in the SLB with facilities located at Hat Yai, Songkhla, Phatthalung, Sadao, Patong, Plangla and Cha-uat.	Drinking water supply
Basin actors		
The Songkhla Lake Basin Development Committee (SLBDC)	An inter-agency coordinating body established by ONEP to formulate policies for conservation and restoration of natural resources and environment of the Basin.	Natural resources conservation
The Songkhla Lake Basin Committee (SLBC)	IWRM agency established by DWR as a coordinating body for water resources management in SLB	Water quality and quantity
Provincial administration	Represents the deconcentrated public administration system with the broadest representation from the centralized-departments and where they can be coordinate by the MOI through the provincial governor with assigned officials from central administrative agencies	Drinking water supply, sanitation and wastewater
District administration	The next level of deconcentration basically a miniature of the provincial set-up with sector staff appointed by the centralized-departments coordinate by the MOI through the District Chief	Drinking water supply, sanitation and wastewater
Local administration	This is the autonomous administrative authority of the people in each administrative locality. Namely: Provincial Administrative Organizations (PAO), Municipal Administrative Organizations (MAO), Tambons Administrative Organizations (TAO) and Sanitation Districts (SD)	Drinking water supply, sanitation and wastewater
Water Users Associations (WUA)	Legally registered association with the Ministry of Interior to collaborate with the Royal Irrigation Department (RID) in the issues of irrigation.	Water quality and quantity
Civil Society Organizations	Several	Natural resources, saving and loans

The Provincial Governors are responsible for coordinating the activities of the staff posted to the provincial level by the respective central-deconcentrated departments (EMSONG 1999). The 6 most dominant ministries in terms of water resources governance and management in the SLB are the Ministry of Agriculture and Cooperatives (MOAC), the Ministry of Natural Resources and Environment (MONRE), Ministry of Industry (MI), Ministry of Interior (MOI), Ministry of Transport (MOT) and Ministry of Public Health. The mandates of the centralized-deconcentrated departments are presented in table 3.2 (Bamroongrugsa 1998, ONEP 1997, 2005, 2008, 2011, KOT, 1991, Nagari et al. 2008, Kongthong and Ratanachai, 2012). There is lack of cooperation and stiff rivalries among the departments in the ministries and from the deconcentrated departments' offices under the supervision of the provincial governors (Thomas and WAC 2005). There is a stronger vertical chain of command within individual departments than the horizontal interactions among field staff from the other departments, which impact negatively on coordination in the provinces and districts.

To add to this confusion, two Basin management committees were established for the SLB: Songkhla Lake Basin Development Committee (SLBDC) established in 1993 as an inter-agency coordinating body by the Office of Natural Resources and Environmental Policy and Planning (ONEP) with mandates to formulate policies for conservation and restoration of natural resources and environment of the Basin; and Songkhla Lake Basin Committee (SLBC) established in 2007 as a coordinating body for integrated water resources management in the Basin by the Department of Water Resources (DWR) (Uraiwong, 2013), charged with the responsibility of developing basin-specific programs in close consultation with stakeholders. SLBC has three working groups: integrated river basin planning, information and public relations; and participation (DWR, 2006). The working groups provide advice regarding water resource management, coordinate basin activities with other government agencies, determine the priority and allocation as well as monitoring and evaluation of programmes and interventions in the Basin (DWR 2006, Kanjina 2008, and ONEP 2011). These committees are neither decision-making nor collegial bodies providing a negotiation forum for equal partners and do not have budgets

of their own. They are more reactive than proactive, and more remedial than conserving; and also have conflicting mandates.

At the local level, the Local Administrative Organization (LAOs) hierarchy centres on career staff that have long managed government administrations at provincial and district levels under the authority of the Ministry of Interior's Department of Local Administration (DLA). The LAOs are responsible for the provision and maintenance of local infrastructure and their leaders are elected by the people within their jurisdictions. There are three types of these local administrative bodies: Provincial Administrative Organization (PAO), Municipality Administrative Organization (MAO) and Tambon Administrative Organization (TAO); including the Sanitation Districts established by the MOI at the suggestion of the Provincial Governor with recommendations from the District Authorities.

Complementing the LAOs are active civil society organizations involved in development activities in the Basin. One of the major actors are the Water Users Association, which partner with Royal Irrigation Department (RID) on irrigation; Songkhla Lake Basin Board (SLB Board), (figure 3.1) an active entrepreneurial civil society organization, Tambon Ta-Hin Community Council which conducts advocacy programmes against illegal fisheries activities and Ruk Thale Noi Fisherfolk Society which is responsible for stopping illegal fishing, natural resources restoration, etc., (Kongthong and Ratanachai, 2012). There are also numerous cooperatives and thrifts societies, mangrove protection groups, weaving and environmental protection and conservation of elephants groups, actively involved in the conservation and protection activities of the SLB, but not necessarily in the governance.

3.3 Methodology

To achieve this objective we developed a methodology based on three approaches to assess the institutional and governance challenges of the SLB. The first phase involved a review of literature regarding governance and in particular on management and governance of lake basins, which enabled us to identify the principles and concepts of lake basin governance. This was followed by face-to-face interviews of 20 experts

selected among the communities' leadership as well as professionals in the private and public sectors. This was designed to collect in-depth information on the mode of governance operations for proper understanding of the structure and dynamics of decision making in the Basin. The third approach, central to this paper, focused on field surveys undertaken to cover the three provinces of the SLB, 25 districts (amphoe) and 200 (sub-districts) tambons.

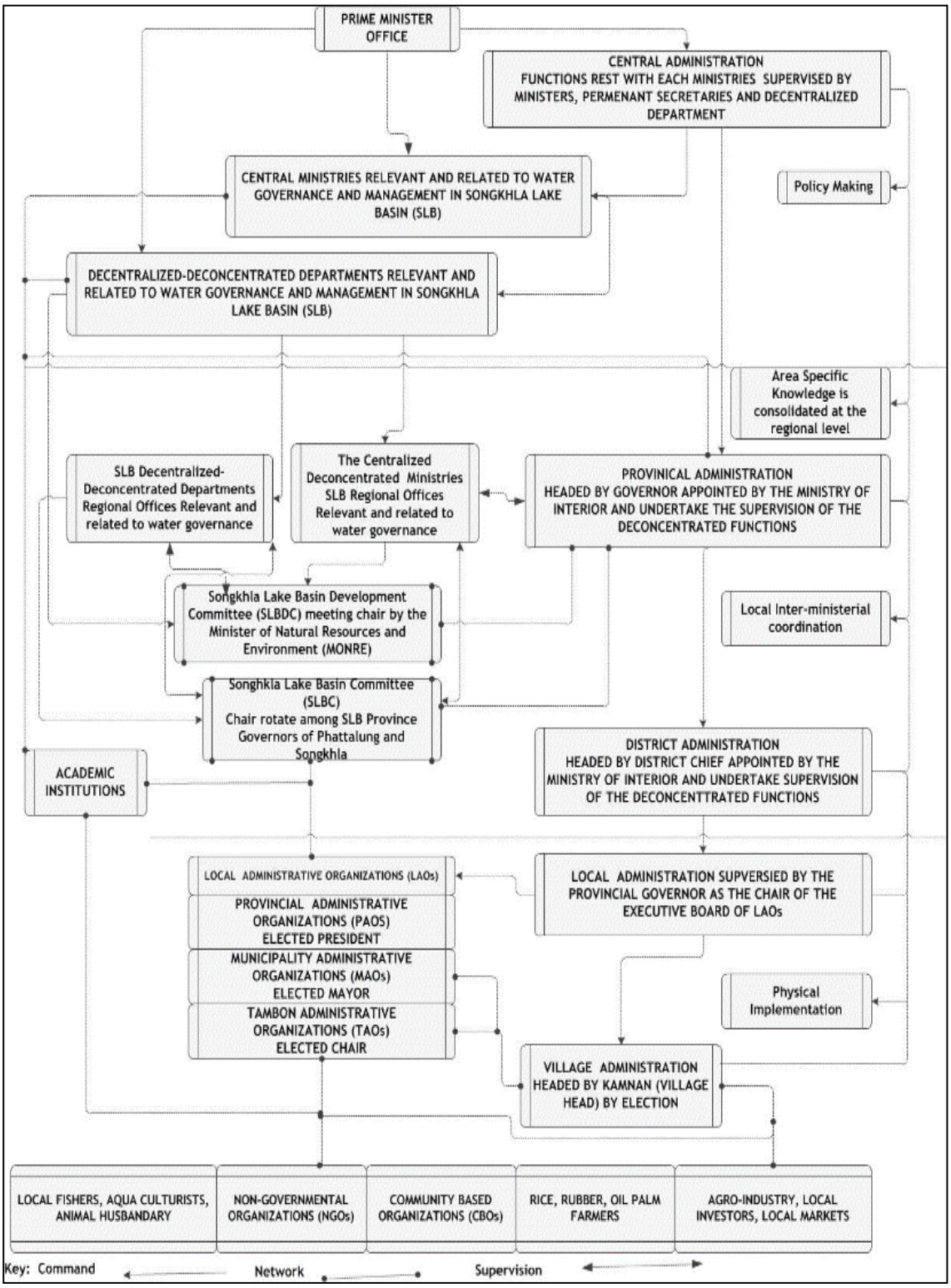

Figure 3.1: Institutional actors, top-down policy approach and project implementation in the SLB

The surveys were conducted between the periods of April to June 2014 by a team of six field research assistants. A total of 2000 households were randomly selected and administered with questionnaires. The response rate during the survey were 100 percent, which might be due to the fact that the enumerators were experienced researchers and were familiar with the Thai language and community setting. The questionnaires consisted of 50 questions and were divided into four sections: socio-economic, livelihood assessment, resource governance and stakeholder perception surveys. For analysis, the interview data were organized using a thematic approach and the survey data were entered and analyzed using simple descriptive statistics with the help of Excel Statistical packages. Frequencies and percentages were calculated to facilitate the drawing up of inferences related to the SLB governance.

3.4 Results

3.4.1 Institutional fragmentations, gaps and outmoded legal instruments

The first and most significant governance challenge is institutional fragmentation in the SLB. A review of the 19 core sets of laws relevant and related to water governance in the SLB revealed that no specific and comprehensive legal framework exists that address the core challenges of sustainable management and governance of water resources in the SLB. The results indicated that there were serious institutional fragmentations and gaps within the 6 main centralized ministries and the 13 deconcentrated departments involved in the governance of the SLB. Also, the results revealed that water overlapped (fragmentation) all through the 19 laws reviewed and all the 19 reviewed agencies had mandates covering all aspects of water issues. This shows a high fragmentation of water issues in the relevant laws and agencies, indicating duplication of responsibilities, which may lead to conflict in the Basin. Our findings showed that the Ministry of Agriculture and Cooperatives (MOAC) and her departments had the highest responsibility over water resources management and governance.

It should be noted that the MOAC are major users of water (more than 57% of the 109.3 billion m^3 in 2006) (DEQP 2008) and as such should not have an overriding

influence above the regulators, i.e. the Ministry of Natural Resource and Environment (MONRE), as is the case in the SLB. This is an issue of grave concern. The most interesting aspect of the results showed that the DWR, the main government focal point for water resources management and governance is not established by any Act of Parliament. The Thai National Water law (which talked about the DWR) is still in draft form, although the DWR has regulations with which they operate. However, regulations are supposed to be drawn from an Act of Parliament (i.e. institutions/laws), commonly issued by the Minister (Administrative Court of Thailand 2013). Also, the establishment of two Management Basin Committees in the SLB by two government departments of the same ministry really goes to show the degree of institutional fragmentation in the Basin. The Songkhla Lake Basin Development Committee (SLBDC) established by the Office of Natural Resources and Environmental Policy and Planning (ONEP) and the Songkhla Lake Basin Committee (SLBC) established by the Department of Water Resources (DWR) of the same Ministry is rather confusing, especially as those Committees have not being seen to be active in the affairs of the SLB. Kanjina (2008) noted that the Thai water sector has long been dominated by a myriad of largely uncoordinated state agencies acting independently, which is a serious challenge to coordination and collaboration among the actors in the Basin (Sukhsri 1999, Neef 2008).

The study also revealed that most of the SLB related and relevant water governance laws were obsolete and enacted between the period of 1913 and 1964, when resources were believed to be inexhaustible and these institutions had served their purpose then (Sirmon et al. 1993, Cortner and Moote 1994). Lazarus (2004) described the current environmental and natural resources laws as largely too inflexible to allow management for resilience because of slow response to new information due to organizational bureaucracy and conservative and resistant nature of institutional systems. For instance, the environment related laws were enacted in 1992, the decentralization laws were between the period of 1994 and 1999. Hence, it can be concluded that most water resources legal instruments and policies do not provide adequate protective measures to prevent adverse effects on the ecosystem because of their outmoded and obsolete nature (Wongbandit 1995).

3.4.2 Challenge of the decentralization policy

The centralized characteristics of public administration in the SLB challenge full implementation of the Thai constitutional provisions on decentralization. The strong centralization requires that stronger effort has to be put in place to ensure effective and efficient vertical and horizontal coordination, collaboration and interactions. The in-depth face-to-face interviews indicated that the implementation of the decentralization policy of the Thai government in the SLB was identified as one of the governance challenges in the Basin. For instance, the Decentralization Action Plan under the item of the natural resources and environmental protection as part of the issues to be transferred to lower level of government did not specifically mention water resources, but was clear on the issues of conservation of natural resources, development and protection of forests, management of the environment and pollution, management and protection of public places. The survey revealed that most LAOs focus more on issues of solid waste disposal and sewage evacuation services than water resource management related projects. Stakeholders observed that the direct supervision of the LAOs by the line officers of the central administration is an indirect way of re-centralization rather than decentralization because the dependence of the LAOs on the central ministries and the centralized-deconcentrated departments remain strong.

The Decentralization Act of 1999 also makes provisions for the remittance of 35 percent of the national governments annual budget to the LAOs. This funding was further reduced to 25 percent in 2007, thus limiting the resource capacity of the LAOs to embark and incorporate environmental and natural resources projects that are capital intensive, especially for low resource, less urbanized and low economic valued LAOs in the SLB. The Tambon Administrative Organization Act of 1994 placed a restriction on the officers of this level of government to 15 including both the permanent and temporary staff, thereby making it very difficult for this level of government to attract and retain high quality staff. One of the Mayors of a municipality in the SLB said that even though the LAOs may want to intervene in the improvement of the quality of the Songkhla Lake, they were often constrained by financial and human resources.

3.4.3 Challenge of coordination and service delivery

The strong influence of the centralized agencies reduces the institutional capacity and actual development of the local and Basin organization. This is because line ministries and their centralized-deconcentrated departments follow their own separate lines of authority, creating barriers to proper coordination, integration and collaboration. The centralized-style management with emphasis on individual ministries and departments makes it difficult to assign direct responsibility for SLB development to any particular agency of government. SLB problems identification are usually through the official mandates of centralized ministries and agencies, with little input from the Basin stakeholders. Even though by regulation and administrative directives, the central government agencies' officers in the provincial/regional offices are under the direct supervision of the Provincial Governors, they are, however, more accountable to their higher officers in the head offices because of the benefit of career progression and other related incentives, thus impacting negatively on coordination and integration.

Clearly, it is mainly social, institutional and administrative issues, and not engineering or technological issues that create problems. Loucks and Van Beek (2005) observed that effective management of water resources should involve influencing and improving the interaction of the three interdependent subsystem of physical, chemical and biological processes, socio-economic and governance, administration, legislation and regulations subsystems. They stressed the need to include the three of them in water resource management as inadequate attention to one can destroy the value of any work done to improve the performance of the others. It is very clear that the degradation and deterioration of the resource systems in the SLB is the neglect of the subsystems of governance and management. According to World Water Development Report 4 (WWDR4) (2012), management of water is not merely a technical issue, but requires a mix of measures including changes in policies, prices and other incentives, as well as infrastructure and physical installations.

There is also a challenge of coordination at the LAO levels. The study revealed limited coordination among LAOs on one hand, and LAOs and the centralized-deconcentrated departments of the line Ministries under the Provincial Governor, on the

other hand, this implies weak coordination between the LAOs and the provincial office (PAOs), and these seeming coordination are usually informal. From the field survey, we discovered that there were more than 200 Tambon Administrative Organizations (TAOs), in addition to the 3 Provincial Administrative Organizations (PAOs), more than 4 Municipality Administrative Organizations (MAOs) and various Sanitation Districts in the SLB with different jurisdictional mandates on natural resources management, water supply, wastewater and sanitation services, and this creates serious coordination challenges in the Basin. Although, all the representatives of LAOs have meetings with Provincial Governments, not much focus is given to water resources in terms of quality and quantity issues. The main purposes of the meetings are mostly on infrastructure and tourism development. During the field work, we noticed a lot of buck passing among the LAOs, especially in the area of intervention on sanitation and water related issues on the Lake.

For instance, the survey results pointed out that indiscriminate discharge of wastewater from industries, shrimp farms and sewage from households as well as pesticides, herbicides and fertilizers from non-point sources were the major water quality problems in the Songkhla Lake. We sought to find out from the LAOs with jurisdictional mandates on these issues what their various management strategies were; and discovered that none of the LAOs have any specific plans for the protection of the Songkhla Lake. The LAOs farther from the Lake referred us to the LAOs much closer to the Lake as the issues, they claimed, were not within their jurisdictional locations. The LAOs nearer to the Lake were of the opinion that the Provincial Governors who have higher mandates, capacity and bigger budgets were in a better position to address provincial-wide environmental challenges. These pose a huge barrier to service delivery because of the complexities of the governance structures and institutions as well as the presence of multiple actors in the SLB. Also, the issue of coordination is compounded by the fact that more than 17 deconcentrated departments in 6 different ministries are directly involved in some way or the other with control or management of water use in the Basin and therefore, no obvious host among the executing agencies handling the overall management functions (EMSONG 1999).

3.4.4 Stakeholders' disconnectedness and apathy

The study revealed the high level of stakeholders' disconnectedness and apathy on the issues of governance and management of the SLB. The stakeholders know almost nothing about the Basin's management and in most cases they were merely informed and not involved from the project conception. For instance, the SLBC was established by DWR to introduce a new mechanism for managing water resources in a river basin with an emphasis on participation of local communities. However, it was observed that the level of participation and involvement of the community members in the activities of the SLBC was very low. Some village leaders during the face-to-face oral interviews admitted that they only remember being invited for a meeting at the inception of the Committee. Also, the 34 members of the SLBC have only 7 members drawn from the communities and they must be experts, the rest are drawn from central government ministries and agencies. In the case of the SLBDC, with 28 members, only 6 are community representatives, the rest are drawn from the government establishments. This is capable of denying non-expert Basin community members with reasonable experience and traditional knowledge the opportunity to participate, which hinders community participation. It could also defeat the purpose of envisioning improved stakeholder participation.

The study showed that the number of the Basin community members' involved in community natural resource and environmental management as well as other non-governmental organizations' activities were low (figure 3.2). A majority of the respondents in all the three provinces of the SLB (90.17%; n = 1800) said that they were not involved in any natural resources and environmental development groups in the Basin, while others (9.81%; n = 196) were involved in such activities. However, the major community groups identified during the course of the study were mainly community cooperatives and thrift societies and few community environmental conservation groups in some communities.

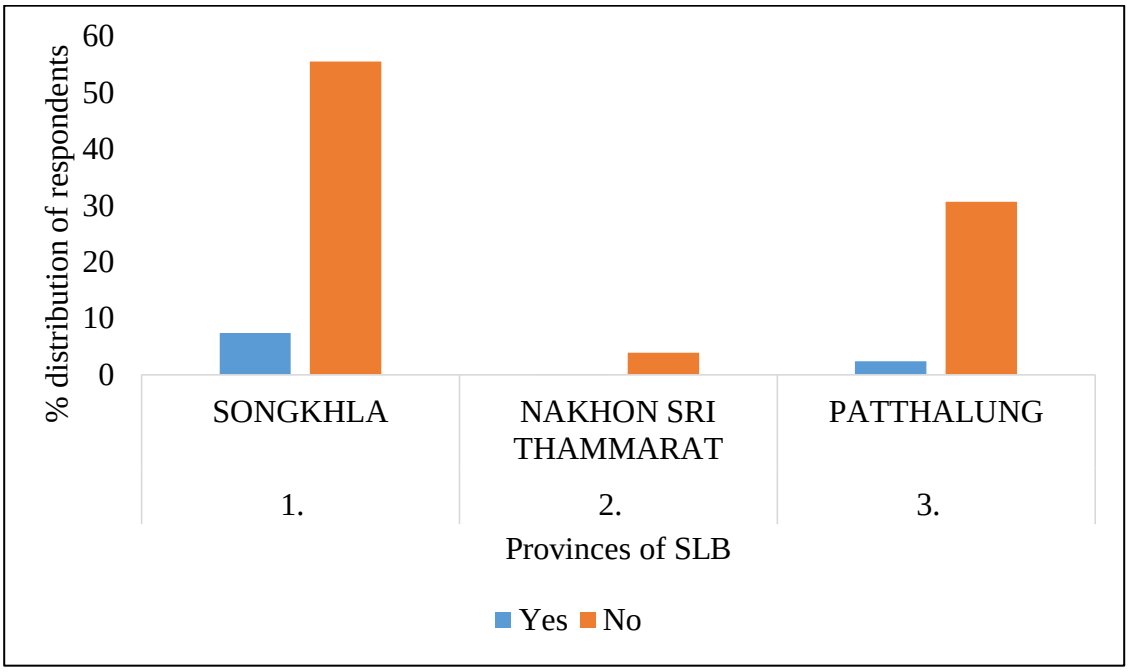

Figure 3.2: Involvement of respondents in community natural resources and environmental conservation groups calculated from survey data

It was also revealed that the level of awareness of relevant and related water and environmental policies and laws in the SLB was very low among the members of the communities under study (Figure 3.3). A majority of the respondents (56.86%; n = 1824) stated that they were not aware of any policies and laws for the protection of the SLB, while 4.89% (n = 121) said they were aware some relevant instruments for the SLB governance namely: (1) control and regulations on fishing, (2) environmental conservation and pollution control laws, (3) treatment and management of industrial and domestic wastewater, (4) promotion of public health and (5) marine protection and other aquatic resources. However, they still had very little knowledge about these policy instruments.

This is clear evidence of poor sensitization of the Basin communities as shown by the poor understanding of the existing legal and policy frameworks for the sustainability of the SLB. It was, therefore, not strange to see the level of disconnectedness of the Basin communities from the various natural resources and environmental conservation related activities initiated for the SLB. The low level of awareness on policies for the

governance and management of SLB is due to the fact that the policy process is top-down, which does not give the local communities the opportunity to participate from the inception of policy development and they are not also properly sensitized when the policies are been implemented.

The typical policy development approach follows the process of the centralized ministries and their deconcentrated departments, which is applied by the regional offices of these departments. These are then implemented down to the community levels with little or no modification and without taking cognizance of the peculiarities of the provinces; though there may be slight adjustments of the policies and frameworks at the provincial levels during implementation so as to accommodate province differences. However, this adjustment must remain within the defined policy framework.

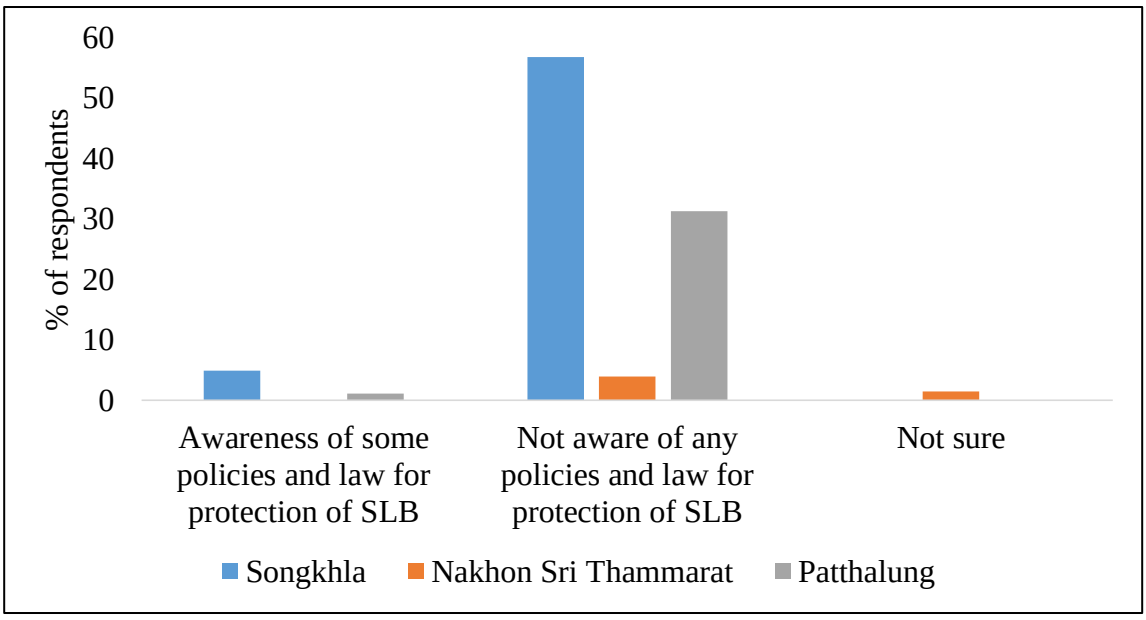

Figure 3.3: Respondents knowledge of legal framework governing SLB resources calculated from survey data

The better approach of resolving this challenge will be to intensify the local community's information, communication and education programmes on the policies implication and the impact of such policies on the livelihood of the Basin communities, while also giving them the opportunity to make inputs. Furthermore, the study measured

the respondents' level of awareness, sensitization and understanding of the various issues articulated in the reviewed SLB Development Master Plan 2011-2016. Overall, 86.55% of the respondents (n = 1731) were not aware of the SLBs' development plan and the various issues articulated within, while 13.45% respondents (n = 269) were aware of the development plan (figure 3.4). Then we took about 10 minutes to explain the objectives and critical development activities provided in the development plan to the respondents, as well as the fact that the plan was designed to ameliorate the various socio-ecological challenges facing the SLB. After the explanation, we then asked the respondents to prioritize the best activities that they think could help improve the environmental quality of the SLB.

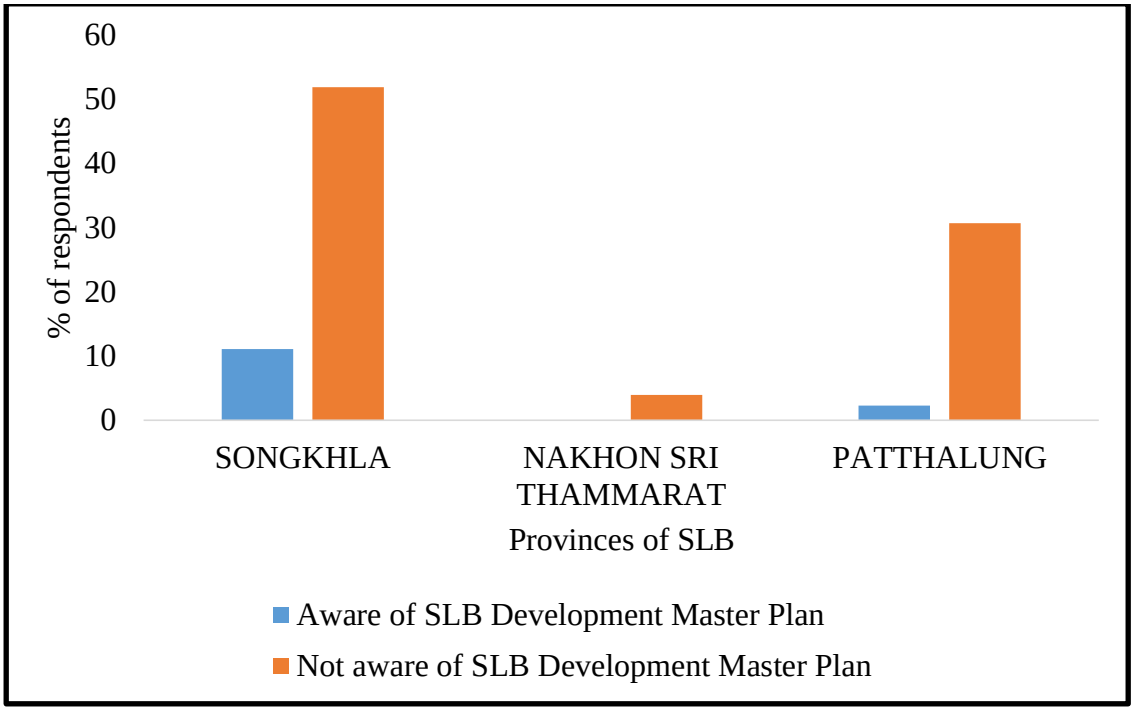

Figure 3.4: Awareness level of respondents and understanding of developmental issues articulated in the SLB Development Master Plan calculated from survey data

Stakeholders' choice for actions best suited to bring improvement to the Basin interestingly differed, to some degree, from the prioritization of the Master Plan. In all, 13.82% of the respondents (n = 492) chose improved management of municipal solid

waste and wastewater in the SLB as their number one top priority programme; this was followed by programs to improve water quality of Songkhla Lake to meet recommended standards (8.53%; n = 456); and third priority activity was reduce and prevent coastal erosion and flooding (2.97%; n = 293) (table 3.3). On the other hand, the order of prioritization of these activities in the SLB development plan was: improved terrestrial forest; improved peat forest; re-instatement of aquatic resources (fishery resources/rare species/biodiversity); etc. It could be observed that the priority activity of the stakeholders were activities targeted more directly to the improvement of water quality of the Songkhla Lake and its environment, while the SLB Development Master Plan priorities focused on resource utilization and exploitation. Stakeholders were also of the opinion that the implementation of the SLB Master Plan should be more of the responsibility of the LAOs, as they are the closest level of government to the communities.

Also, the stakeholders SLB Master Plan re-prioritization suggested improvement projects corresponded with the identification of the major problems affecting the SLB in the survey. According to them, the major socio-ecological challenge confronting the SLB were: emptying of all Basin communities untreated storm-water and wastewater into the Lake without at least some form of primary treatment (screening, grit removal, etc); indiscriminate disposal of solid waste; untreated industrial wastewater; water hyacinth and siltation; as well as densely populated standing fishing tools. Also, the water polluting activities of the home stay businesses, pig and shrimp farms as well as the mismanagement and indiscriminate disposal of industrial and agro-chemicals like pesticides, herbicides and fertilizer from agricultural activities were highlighted. Others include: deforestation of mangrove forest, the negative impact on the water quality of the barrier installed between the Gulf of Thailand and the Lake and the challenge posed by the lack of proper coordination amongst relevant government agencies and departments.

Table 3.3: Stakeholders' recommended priority activities for the improvement of SLB in the master plan 2011-2016 calculated from field survey data

Master plan recommended activity prioritization		SLB Provinces						Total	Stakeholders prioritization
		Songkhla		Nakhon Sri Thammarat		Patthalung			
		#	%	#	%	#	%	#	
1	Improved terrestrial forest	34	1.87	2	0.11	-	-	36	8th
2	Improved peat swamp forest	24	1.32	8	0.44	6	0.33	38	7th
3	Re-instatement of aquatic resources (fishery resources/rare species/biodiversity)	96	5.28	12	0.66	47	2.58	155	5th
4	Reduce and prevent sedimentation	76	4.18	3	0.16	36	1.98	115	6th
5	Reduce and prevent coastal erosion	221	12.17	18	0.99	54	2.97	293	3rd
6	Improve water quality to meet recommended standards	277	13.26	24	1.32	155	8.53	456	2nd
7	Improve management of municipal solid waste and wastewater	234	12.89	7	0.38	251	13.82	492	1st
8	Improved governance, coordination and cooperation amongst all stakeholders	156	8.59	6	0.33	68	3.74	230	4th
Total		1118	56.56	80	4.39	617	33.95	1815	

It was also noted that very limited number of NGOs/CBOs work on issues related to water resources in the SLB. In fact, there were more NGOs/CBOs working on issues of improvement of economic well-being of the community members (cooperative societies, especially on issues of loans and savings) than on environmental and water resources related issues. Even the few that deal with these issues make little impact according to the respondents. The study also observed very low levels of relationship between the communities based organizations with relevant government agencies/institutions responsible for the protection and conservation of Songkhla Lake. Stakeholders also deplored the fact that there is no particular government agency/committee saddled with the responsibility of the protection, management and governance of the SLB.

3.4.5 Challenge of weak enforcement mechanism

Overall, 63.85% of the respondents (n = 1276) reported that relevant and related water resources laws were not enforced in the Basin; 23.86% respondents (n = 477) thought they were moderately enforced, while 5.6% respondents (n = 112) confirmed that they were somewhat enforced and 6.65% respondents (n = 133) were neutral on the matter (figure 3.5). The respondents attributed the compliance and enforcement problems in the SLB to the following: (1) low level of awareness among the people on the various environmental and related policy (2) inadequacy of current relevant and related public policies and legislation, (3) lack of specific policy instruments developed for the sole purpose of protecting Songkhla Lake (4) the attitude of the regulating communities to the contraventions of the provision of these instruments making it very difficult to ensure compliance and enforcement and; (5) low level of involvement of stakeholders, community resource groups and other non-governmental organizations for supporting of law enforcement.

However, even when appropriate institutional instruments are seen to exist, weak law enforcement could probably be responsible for over-exploitation of the resource base of the SLB. The most abused laws in the SLB are the fisheries related legislation, which are more in breach than in compliance, evidenced by the destructive fishing methods practiced by fishermen without any sanctions. The regulation banning the use

of fishing equipment like small mesh size gillnets and trawl-like fishing gear, fyke nets as well as illegal fishing methods such as electric shocks are not enforced. Some studies have noted that there are no more space left for fishing traps because as at 2003, there were more than 29,604 standing traps in the SLB (Pornpinatepong 2010, Chufamanee and Lenholdt 200, GWP, 2012). Law enforcement is also seen to be lacking in the regulation of wastewater treatment and discharge into the SLB.

It is estimated that more than 100,000m^3 of untreated wastewater with BOD load of 17,000kg from domestic sources and 3,000kg BOD from industrial sources are discharged into the Lake daily. Also, wastewater from swine farms contributes BOD of 1,200kg and shrimp farms between 13,600 and 19,000kg BOD daily. The implication of this is nutrient enrichment in the Lake areas causing water quality degradation (Ratanachai and Sutiwipakorn, 2006, TSPR, 2010). DEQP (2008) declared Songkhla Lake is among the poor quality-highly polluted river systems in Thailand in 2003 (class 5 – very poor).

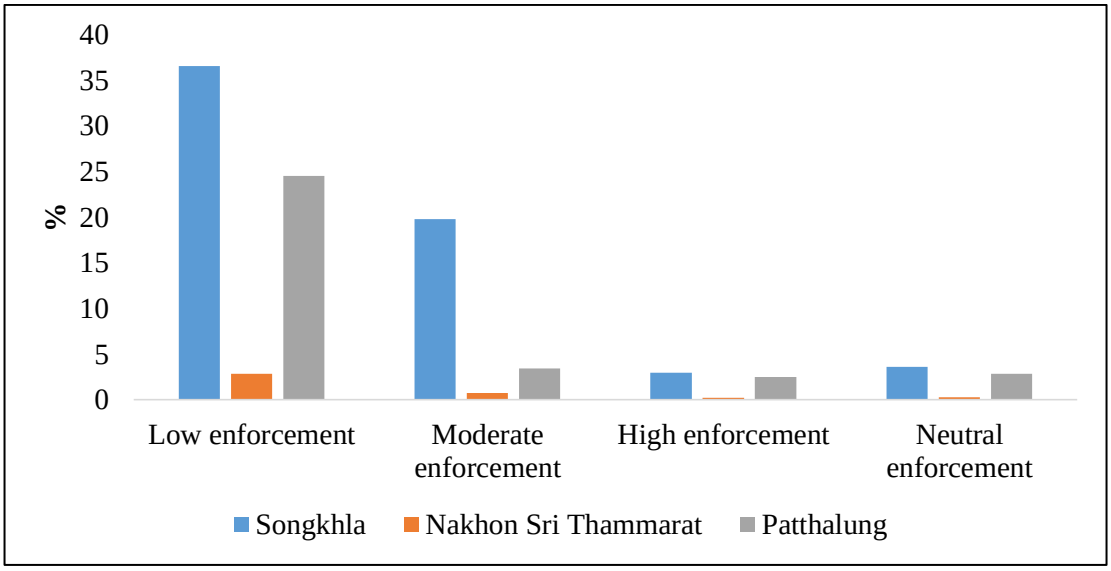

Figure 3.5: Rating of law enforcement level in SLB by the respondents calculated from field survey data

The challenge to law enforcement is the non-stringent penalties provided for in some of the legal instruments for defaulters, making the opportunity cost of compliance more expensive than non-compliance. This can be seen in the case of

industries who preferred to pay for the penalty of not having wastewater treatment plants than to install one for their operations. Legal provisions are obviously useless without the basic capacity of law enforcement and penalties (Flaherty et al. 1999, Christensen and Boon-Long 1994, Wongbandit 1995 and Kraisoraphong 1995).

3.4.6 Over-emphasis on resource utilization and exploitation

The existing SLB institutional priorities are more on resource utilization and exploitation than wise use. The results of this study showed that the overriding focus of the SLB laws were more on resource utilization and exploitation than in its sustainability. The analytical review showed that while the environmental laws recognized the presence of stressors in the SLB, they lacked adequate management measures to ensure resource sustainability (the ability for the Lake Basin to exist and continue to deliver). The study further revealed that the resource utilization priorities of the existing institutional frameworks in the SLB contributed a great deal to the degradation and deterioration of the environmental quality of the ecosystem. The institutional priorities of laws designed for the purpose of harnessing water and fisheries resources put less emphasis on wise use and conservation resources and paid little attention to the challenge of stressors in the SLB, with no recommended management strategies in place to improve the environmental and natural resources quality of the Basin.

The resource over-exploitation focus of these institutions often resulted in overall mismanagement of the Basin's resources and has led to loss of fisheries resources, biodiversity, and cultural identity of fishing communities (Chufamanee and Lenholdt 200, GWP, 2012). It is not wrong to harness the resource systems of the SLB to support the livelihoods of her teeming population, but there is an urgent need to also strengthen the resources management systems of the laws to prevent and reduce the level of degradation and deterioration of the ecosystem services and functions of the SLB. An example is the uncontrolled change of land from agriculture to shrimp farms and the destruction of wetlands and mangrove forests for the same purpose. Private economic interests seem to prevail in the development priorities (Chufamanee and Lenholdt 200, GWP, 2012). For instance, legal instruments like the Conservation of

Public Water Supply Canals and Eradication of Water Hyacinths Acts of 1913 were enacted for the promotion of agricultural activities. The Maintenance of Canals Act, 1904, the People's Irrigation Act, 1939, State Irrigation Act, 1942 and Fisheries Act, 1954 were also targeted at resource exploitation and not necessarily for water resources conservation and management.

Furthermore, the construction of the Pak Ra Wa canal water gate in 1956 by the RID was in order to preserve freshwater for paddy rice fields to avoid salt water intrusion. However, this closure hindered the exchange of water between the Lakes and the Gulf of Thailand, resulting in the lower salinity level and the hydrological change, especially in the Thale Noi, which has affected many natural resources (Iwasaki and Shaw 2010). The construction of the Ranod Irrigation Pumping station was for the purpose of pumping freshwater in Thale Sap Songkhla, exclusively for the expansion of agricultural activities. This resulted in the over-pumping of freshwater from the Lake on an average of 58,000,000m^3 per year for irrigation of the paddy rice farms, coupled with siltation, which has increased the shallowness of the Lake. Also, Groundwater extraction from Hat-Yai Basin alone is estimated at approximately 35,000,000m^3 per year or approximately 96,000m^3 per day, which experts believe may be depleting at a faster rate (Ratanachai and Sutiwipakorn, 2006). The introduction of extensive and semi-intensive shrimp aquaculture in the Basin in 1970 also affected many paddy rice fields on the fringes of the Lake as they were converted to shrimp farms (Ratanachai and Sutiwipakorn, 2005), causing severe damages to the lakes' ecosystem and deforestation and illegal logging from conversion of forest lands to rubber and oil palm plantations (Suviboon et al. 2007).

The accelerated growth of shrimp aquaculture and increase in the rubber plantations between the period of 1982-1996 was a result of promotion by the National Plan (NP4 to NP7) because the policy favoured the conversion of forests to rubber plantations and government offered certificates of ownership to rubber farmers (Tongrak, 2003). This resulted in an increase in the number of shrimp farms in the Basin from 3,491 ha in 1982 to 7,799 ha in 2000 (Tanavud et al., 2001) and 9,628 ha in 2011 (IRCNE, 2010), as well as the number of rubber plantations from 1982 - 1984. Therefore, it can rightly be assumed that the main objectives behind most of the

decisions of the actors where for the purpose of exploitation of resources and not for conservation and management; and this poses a huge challenge to the wellbeing of the SLB.

3.5 Discussion

The SLB obviously, needs a water governance system that is robust, flexible, adaptable and integrative at the same time with high levels of citizen involvement and participation. Its existence is endangered and much will be required to reactivate the ecosystem and ensure its sustainability. The vast exploitation of her resources for rubber, rice, aquaculture, fishing, water supply, etc., has taken its toll, add to it poor regulation and weak governance and what you get are 'troubled waters'. Let's not forget that this Basin serves a large population and contributes hugely to the national economy. In other words, the deterioration of this great resource can and will lead to negative impacts on the people's well-being as well as local and national economy. The implication, therefore, is that quick, workable and drastic measures are required to restore and sustain the SLB. However, the findings of this study have shown that the mother of all troubles for the SLB is the challenge of governance and management. The lack of a specific governance instrument at the central and local levels, and the absence of a coordinating body leave the SLB without an advocate, hanging like an over-ripe fruit.

Also, the problems of pollution through untreated wastewater and solid waste affect aquatic life habitat (Ratanachai and Sutiwipakorn 2006, TSPT 2010) as well as the challenges facing the mangroves and peat swamp forest and the lakes; all related to poor basin resource management and a clear indication of institutional and governance challenges. One issue of note is the fact that majority of the legal frameworks ascribed to water and natural resources management in Thailand are obsolete and outmoded, some enacted as far back as early 20^{th} century where resources were believed to be inexhaustible, and of course, they worked well at that time (Sirmon et al. 1993, Cortner and Moote 1994). Craig (2010) observed that most environmental laws of today were developed around the prevailing scientific understanding of the 60's and 70's that the natural world was predictable and balanced of nature, easy to manage and sustain.

However, global lakes current challenges have proved these assumptions wrong. It seems that Thai water governance instruments are not just based on archaic assumptions; they are also inflexible and rigid, which can result in slow response of management systems to the lake basin stressors. According to Lazarus (2004), inflexibility will not allow for resilience in management because of slow response to new information due to the organizational bureaucracy, conservative and resistant nature of institutions. It is obvious that the Thai water governance system needs an overhaul, i.e. adaptive and integrative reforms, in order to meet the challenges of today. These reforms should be able to proactively address potential harm before they occur instead of focusing on restoration and mitigation measures, and this will require a change from the values of the past that created the institutions of the present, while the changing social values will affect the institutions of the future (Cortner et al. 1998).

One thing the critical analysis of this study revealed is the lack of specific and regulatory instruments for the SLB at all levels of government. As a matter of fact, this was more clearly evidenced at the LAOs levels, in spite of the fact that several related and relevant natural water resources and regulation make provisions for the LAOs' byelaws to address domains not contained in the national framework. This, of course, is not surprising since the SLB has no national legislation or authority specifically mandated with its management. However, we are of the opinion that the LAOs should have used their mandates to enact bye-laws for the protection of the SLB.

But, then the challenge would be with the Decentralization Plan, which does not specifically indicate transfers of water resources mandate to the lower level of government, thereby informally restricting the LAOs. Philip, et al. (2008) observed that the national level of government sets an overall framework for wide ranging policies, water laws and the establishment of institutions for water resources management. In the case of the local government, the rules set at the national level are the most relevant; they form the national frameworks and shape the way in which local governments can engage in water resources management. Local Government, as the level of government most closely associated with local affairs, is in a unique position within the water governance system. Although, it has no direct mandate for water resources management, it does have numerous mandates that are directly and indirectly

linked to water resources. Local government can also use its ‘authority’ to broaden stakeholder involvement in local decision-making processes, thereby enabling a more participatory approach to water resources management at the local level (UNDP, 1997). The Thai water governance system is opposite to this, and since it is the same governance operating over the SLB, the SLB suffers as we have seen.

The hands of the LAOs are further tightened by the operations of the Thai decentralization policy. As revealed in the critical analysis of the findings of this study, decentralization in the SLB is more of de-concentration and the issues of institutional and agency overlaps and gaps create confusion in governance, which leads to weak enforcement and compliance. The implication is that people will break the laws, there will be no sanctions, there will be conflicts and livelihoods will be affected; the final victim is the SLB. It is no wonder, therefore, that the SLB is in the state that it is. In spite of numerous related and relevant water resources and ancillary legislation and institutional provisions, the desired ambitions and expectations for the SLB is still a long way off. This is also compounded by the fact that stakeholders’ participation, especially the Basin community, is not given priority, neither are the peculiar characteristics of Lake Basin considered in the governance system of the SLB.

Overcoming the institutional and governance challenges of Thailand’s SLB will require more than annual boosting of the population of aquatic resources by introducing fingerlings and engaging in other Hard Path Approaches, or infrastructure approach or hydraulic mission and Basin programmes not governance and management related. These challenges are as a result of not ‘fit-for-purpose governance instruments, making it difficult to translate what is on paper to the realities on ground. There is a huge gap in the current policies, institutions and legislations used for the management of this great resource, and everything else depends on the right governance mix. To resolve these challenges, we propose the following actions, which we believe are the most urgent actions needed to rescue the SLB:

I. Create a coordinating and policy harmonization committee that will promote coherent actions among all the formal and informal actors involved in the SLB governance and their role will be to coordinate and organize all the activities of the actors in the Basin for a more purposeful governance and management. Its

tasks would be to strengthened cooperation between cross-ministerial, de-concentrated departments and LAOs through greater communication and production of integrated strategies for the SLB. It is also recommended that Songkhla Lake Basin Committee (SLBC) and Songkhla Lake Basin Development Committee (SLBDC) be merged into one committee, which may form the nucleus of the proposed coordinating agency or committee for the SLB,

II. Review existing water resources and related governance instruments and make them appropriate, adequate and relevant to the SLB, as well as adaptive and integrative,

III. Local Administration Organizations (PAOs, MAOs, and TAOs) should be encouraged to enact bye-laws to address specific challenges not covered in national legal frameworks,

IV. Set up public and stakeholders participation activities to encourage broader participation of interested persons, community-based organizations and non-governmental organizations in the Basin. This would provide the forum for discussion and resolutions of various conflict issues over resource utilization in the Basin. This would also create a common ground for the fishers, rubber farmers, rice farmers, aquaculture, hospitality businesses, etc., to begin to discuss and interact to ensure their livelihood and ensure the SLB sustainability.

V. Encourage more researches on governance as studies on water governance in the SLB are very scarce. This will create the enabling environment for the much desired development. Further research on how to achieve effective coordination and collaboration among all actors is necessary. Also, building and developing institutional capacities of the public actors as well as on the principles of decentralization and de-concentration for implementation in the Thai context need to be further research to create a clear and balanced understanding.

CHAPTER FOUR

GOVERNANCE PERFORMANCE ASSESSMENT FRAMEWORK

This chapter is adapted from:

Cookey, P. E., Darnswadi, R. and Ratanachai, C. 2016. A Conceptual Framework for Assessment of Governance Performance of Lake Basins: *towards transformation to adaptive and integrative governance.* Manuscript submitted for publication: Hydrology. www.mdpi.com/journal/hydrology. ISSN: 2306-5338

Abstract

Governance is essential to lake basin management, but it is the most challenged aspect and needs increased attention. One way to ensure sustainable governance is through continuous performance assessment. The purpose of this paper is to present a governance performance assessment framework specifically for lake basins. The Adaptive Integrated Lake Basin Management (AILBM) framework is a diagnostic and prescriptive governance performance assessment tool for lake basin transformation to more adaptive and integrative governance. Incorporated in the concept is the submission that successful governance of lake basins depend on our ability to create adaptive and integrative governance systems with equity, inclusiveness, transparency, accountability, flexibility, to problem-solving and resilience. A case study on water governance performance assessment of the Songkhla Lake Basin (SLB) in Thailand is provided to illustrate the application of the proposed methodology.

4.1 Introduction

Lake Basin Governance (LBG) is one key aspect in lake studies that has not received the attention it deserves. It is a fundamental challenge for the achievement of

sustainability for the world's lakes and is often ignored in the management plans of most lake basins. Ballatore and Muhamdiki (2001) pointed out that in as much as scientific knowledge about lakes is widely available, management and governance is just trying to catch-up and policy makers have not fully considered the value of lakes (Bakker et al 2008, Ozawa 2008). The Great Lake of the USA/Canada has been much studied and most scholars agree that governance is the most challenged aspect and needs increased attention (Kakkainen 2006, Manno and Krantzberg 2014, John 2013, Jetoo et al 2014). Specific methodologies for assessment of Lake Basin governance (LBG) performance are very scanty and in most cases absent; where they exist, they are focused on resource utilization, management and conflict resolution, though The socio-ecological system frameworks were applied for assessment of urban lake governance in Ahmedabad and Bangalore India respectively (Bal et al. 2013, Nagendra and Ostrom 2014). However, the socio-ecological system concept was not specifically designed for lake basin governance. Others include the use of the Integrated Lake Basin Management (ILBM) framework as a plan-do-check for lake basin managers (ILEC 2005, 2007, 2011, Saunders et al 2014, Chidammodzi and Muhandiki 2015).

In order to understand lake management and proffer specific and long standing solutions, it is essential that the governance performance be properly investigated to determine the ecological, political, social and economic conditions of the lake basins. This will ensure that the required degree of adaptive and integrative capacities of lake basin governance systems are determined for the needed transformational process. The objective of this study was to develop a specific lake basin water governance performance assessment framework with an overall outcome to guide the transformation to more adaptive and integrative water governance for lake basins as well as provide empirically based solutions and interventions for improvement. RSCE and ILEC (2014) observed that the operationalization of the Integrated Water Resource Management (IWRM) principle in lake basins is a challenge because of the inability of lake basin stakeholders to play critical roles in influencing most IWRM integration needs. This necessitates the need for a lake basin governance performance assessment framework with an outcome that can guide lake basin transformation process to more adaptive and integrative systems. Therefore, the research questions this paper addresses

are: How can the assessment of lake basin water governance performance be improved and what would be the essential components of a governance framework that different stakeholders could utilize for improving the collective governance performance of lake basins? This article aims to contribute to the development of the body of knowledge on lake basin governance as well as to identify and present components of a lake basin water governance performance assessment framework. This article is divided into seven parts: introduction, conceptual foundation, framework components, methodology, assessment process, application as well as discussion and conclusion (Figure 4.1).

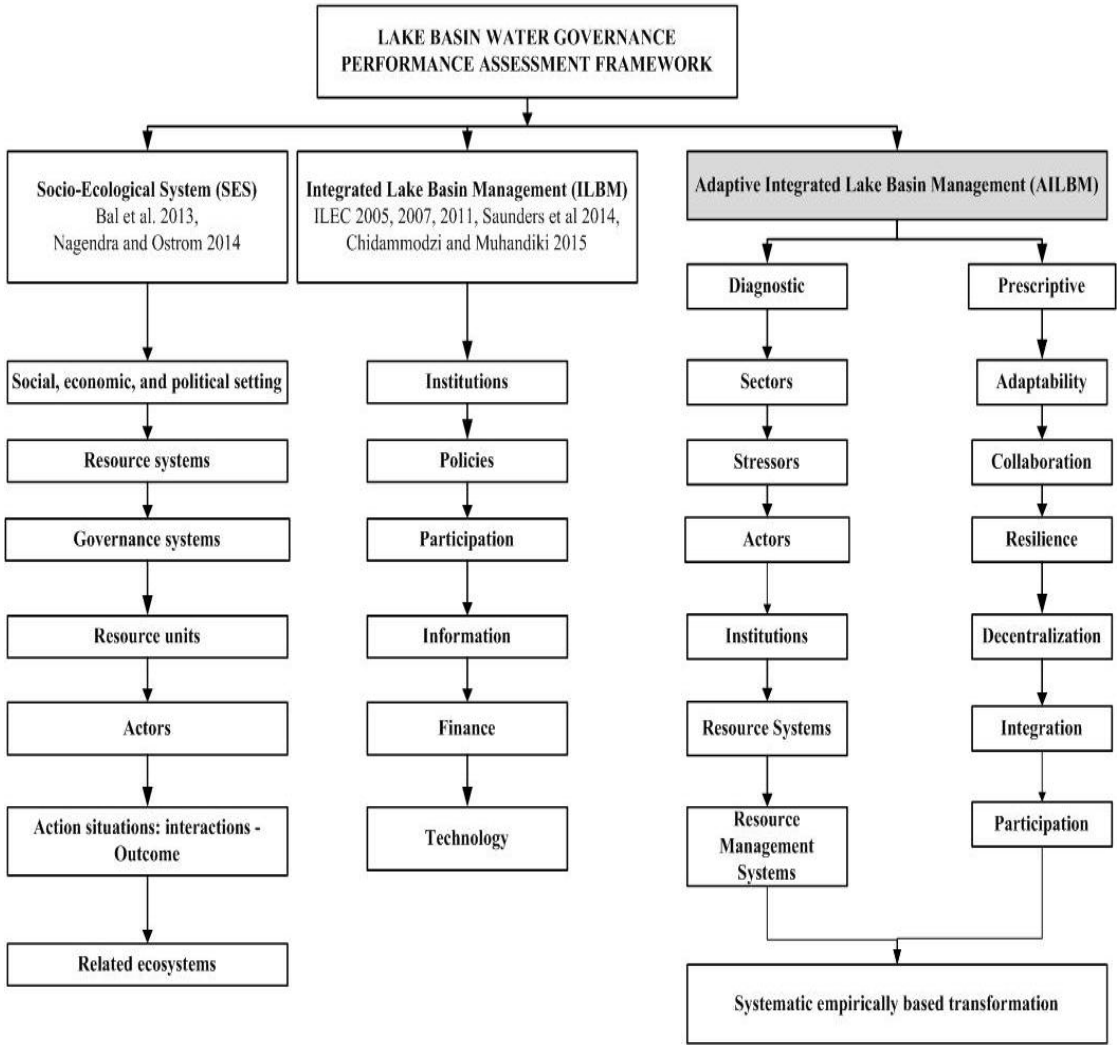

Figure 4.1: Literature mapping of lake basin governance assessment frameworks

4.2 Lake Basin Governance

Governance is essentially about addressing linkages and processes between and within organizations and social groups involved in decision-making, both horizontally and vertically (Rogers and Hall 2003), as well as such processes of making choices, decisions and trade-offs (Folke, et al 2005, Tropp, 2007, Pahl-Wostl, 2009). Moore (2010) argues that governance is the interaction of laws and other norms, institutions, and processes through which a society exercises powers and responsibilities to make and implement decisions and ensure accountability. This is reflected in the definition of water governance as: ' …the range of political, social, economic and administrative systems that are in place to develop and manage water resources, and the delivery of water services, at different levels of society' (Rogers and Hall, 2003).

Management of lakes is not merely a technical issue; but requires a mixture of measures like changes in policies, prices and other incentives, as well as infrastructure and physical installations. Lake basin management includes technical, policies, institutions and regulatory issues and if properly harnessed, provides better chances of generating benefits to society (WWDR4 2012). Resolving resource use congestion, competition and conflicts is not simple because arriving at a generally agreeable and compromise plan for all stakeholders can be phenomenally difficult and time consuming. It is within the framework of governance that a better compromise can be reached for the overall well-being of the lake basin (RCSE and ILEC, 2014). Also, the issues that motivate stakeholders are in their essence not scientific, but political (Ozawa 2005).

The proposed Adaptive Integrated Lake Basin Management (AILBM) framework for lake basin governance performance assessment is based on the understanding that lake basin governance should be gradual, continuous, holistic, systemic and integrative in nature, while also being capable of ensuring resilience, flexibility, adaptability, active participation of all stakeholders, and equipped with effective/efficient decentralized systems with adequate feedback mechanisms. Incorporated in this framework is the assumption that successful governance of lake basins depend on our ability to create adaptive and integrative institutions with equity in representation, inclusiveness in decision-making processes that encourage scientific

and public learning with response to problem-solving, transparency and accountability (Scholz and Stiftel 2005). Lake basin management and governance should capture the synergistic linkages and inter-connectivity as well as interactions between processes and actors in lake basins to ensure sustainable governance. This paper defines lake basin governance as a process of interaction and collaboration for the purpose of decision making among various actors in the basin aimed at proffering solutions to common problems for sustainable use of resources and preservation of the ecosystems of the lake basin in a transparent and accountable manner. This implies that governance instruments for lake basins should account for all issues, hydrological characteristics and socio-economics to ensure sustenance of the basin. Some of the key insights gained from the review of several studies are summarized thus:

I. Governance is essential to lake basin management (Nowlan and Bakker 2007, van Bueren and ten Heuvelhof 2005, Pahl-Wostl et al 2012, Saleth 2004), but it is not currently a strong component of lake basin development and management plans and where it is mentioned, it is mostly glossed over and rarely reflected in the programmes of actions or areas of priority investments (World Bank 1997, 2005, ILEC 2005, 2007, 2011, RCSE and ILEC, 2014).

II. Institutional priorities of governance instruments are tilted more to resource utilization with little or no regard for sustainable management and wise use of resources (Hooper 2003, Berkes and Folke 1998, Folke et al. 2007, Beverton 1998, Wilson 2006, Clarvis et al. 2014, Craig 2009, Garmestani and Benson, 2013, Hutching et al. 1997, Tafee 1997, Johnson 1999).

III. Institutional response to management of resource is grossly inadequate because they are rigid and not flexible (Benson and Garmestani 2011b, Garmestani et al 2009, Lazarus 2004, Liu et al. 2007); often based on the assumptions that natural resources can be controlled and managed; and they are not integrative and adaptive (Kalikoski et al 2002, Folke et al. 2007, Craig 2010).

IV. The governance systems are highly fragmented with problematic overlapping laws and agencies with conflicting implementing mandates because different sets of institutions administer and regulate different sets of resources, users and actors (Cumming et al. 2006, Ekstrom and Young 2009, Clark et al. 1991,

Ekstrom et al. 2009, Hill et al, 2008, Clarvis et al, 2014, Cook 2014, Jetoo et al. 2014).

V. Governance is highly ridden with institutional gaps, mismatch and misfit across various scales, hardly accounting for all aspects of the socio-ecological systems of lake basins (Daily et al. 1997, Levin 1999, Lee, 1993).

VI. There are inadequate in-built mechanisms for resolving disputes and conflicts over resource use, administration and jurisdictional issues among state and non-state actors (Hashimoto and Barrett 1991, Kalikoski, et al, 2002, Moss 2012, Jasper 2003).

VII. There are weak mechanisms for decentralization and inadequate financial support from the central/national government to the local level as well as inadequate community empowerment for effective participation (Manor 1999, Moss 2004, Lebel et al. 2005, Ribot 2004, Lebel et al. 2013, Blomquist et al. 2005, Cash and Moser 2000, Garmestani et al. 2009).

VIII. Interagency and intergovernmental coordination and collaboration are very weak (ILEC 2005, World Bank 2005, Moss 2012, Young and Underdal 1997, Folke et al. 1998, 2007, Geisler and Kittel 1994, Cumming et al. 2008).

IX. Legal and regulatory frameworks are obsolete resulting in lack of adequate compliance and enforcement for sustainable use of resources (Peczenik 1995, Kalikoski et al. 2002, Ostrom et al. 1999, Young 1999).

X. Governance is state-centred and users are not seen as part of the actors and neither are they represented nor their opinions considered in decision making (Luyet, et al. 2012, Rowe and Frewer 2000, Kira and Sazanami 1991, Krick, et al, 2005, ILEC 2005).

XI. Ultimately, institutions are mismatched to the nature and scale of the problems of lake basins and need to be realigned and where necessary, redesigned to better fit the scope and nature of the challenges (Young 2002, 2008, 2010, Ekstrom, 2008 and Ekstrom et al. 2009).

These factors affect lake basin governance and a performance assessment approach that particularly distill these issues will go a long way to determine the true

situation of governance, highlight problem areas and expose connected solutions. Therefore, the purpose of the AILBM framework is to assist lake basin managers to assess the governance/management performance on their lake basins in order to determine the impact level on the resource system, users and activities of the lake basin as well as make empirically based decisions towards resolving problems issues and future planning.

4.3 Conceptual Foundations

The conceptual foundations of the Adaptive Integrated Lake Basin Management (AILBM) framework were derived from the Integrated Water Resources Management (IWRM), Integrated Lake Basin Management (ILBM) and Adaptive Management and Governance (AMG) to develop an adaptive and integrative framework designed to assess governance performance of lake basins. These three frameworks formed a structural basis to determine pragmatic and sustainable lake basin governance and management systems. They provided different understanding of socio-ecological system governance that could be adapted for the effective governance of a lake basin, even when they are not specific to lake basins (AMG, IWRM) and where they are, they provided in-depth understanding of lake basin management and what to do.

The Adaptive Management and Governance (AMG) concept aims to increase the resilience of socio-ecological systems in the face of future uncertainties (Lee 1999). Scholars have developed several approaches for the assessment of adaptive management and governance. Some of these approaches are: adaptive capacity and multi-level learning processes (Pahl-Wostl (2009), the management and transition framework (Pahl-Wostl et al. 2010), the adaptive capacity wheel (Gupta et al. 2010), resilience based framework (Plummer and Armitage 2007) among others. However, these frameworks were not specifically designed for the assessment of the performance of lake basins governance.

The Integrated Water Resource Management (IWRM) concept strives to integrate water management across multiple scales while incorporating a multitude of stakeholder interests (Blomquist et al 2005). It is designed as a means of assessing the level of integration in governance and management systems (Jønch-Clausen and Fugl

2001, GWP 2004, Hooper 2003, Jonker 2002, Odendaal 2002). Hooper (2006) developed indicators of best practice for the assessment of the IWRM performance at the river basin level. However, according to ILEC (2011), the IWRM did not take into consideration the biophysical features, socio-economic and managerial requirements of the lake basin system, especially as it covers the lentic-lotic properties.

The Integrated Lake Basin Management (ILBM) is a conceptual governance framework for assisting lake basin managers and stakeholders to achieve sustainable management of lakes and their basins (ILEC 2011, RCSE and ILEC 2014). The Global Environment Facility (GEF) project of the Lake Basin Management Initiative (LBMI) led to the birth of the ILBM (World Bank 2005, ILEC 2005, ILEC 2011). The ILBM assessment indicators took into consideration the concepts of basin approach, lake characteristics, ecosystem services and governance challenges (Chidammodzi and Muhandiki 2015). The ILBM six pillars (institutions, policies, participation, information, finance and technology) provide the essential components of lake basin governance (LBG). However, the pillar of 'institution' is refer to as organizations which pursue the collective aims of a group (government-sanctioned organizations and traditional or non-governmental organizations) (World Bank 2005) in the ILBM, but, 'institutions' are the body of rules, regulations and processes that guide management actions and procedures (Ostrom 1990, Scott, 2001, North, 1990, Folke, et al. 2007, Pahl-Wostle, 2009) in the AILBM. They are much broader than organizations (Saleth and Dinar 2000). Also, the ILBM pillar of 'policy' covers laws and legislation while policy in the AILBM is only an aspect of 'institutions'. Lake basin actors were not explicitly captured in the ILBM concept, although it can be assumed that the actors can come under the pillar of 'participation'.

The AILBM framework, however, is a conceptual framework to assess governance performance of lake basins to critically diagnose problematic issues and areas as well as proffer empirically based solutions and determine best possible solutions and steps towards transformational processes. The AILBM concept aims to measure the adequacy of the current solutions and strategies designed to ameliorate these challenges and then develop and prescribe adequate futuristic solutions to them. It is different to the ILBM in that while the ILBM is designed to ensure sustainable

management and governance, the AILBM is designed to measure governance performance of lake basins. One is how to and the other one is measuring the impact of what has been done and what is being done. To this effect, the AILBM does not attempt to improve on the ILBM or act as an alternative, but to push the frontier forward by providing a framework that measures the impact and performance of governance and management to determine practical sustainable roadmaps toward transformation to more adaptive and integrative governance system peculiar to specific lake basins. Furthermore, the AILBM framework is strategically designed for the improvement of governance performance assessment in lake basins and to ensure that governance captures the synergistic-linkages of the major components of lake basin management and governance. This paper, therefore, presents the AILBM, a comprehensive framework for governance performance assessment of lake basins that can support the design and outcome of transformational processes toward more adaptive and integrative lake basin governance.

4.4 The AILBM Framework

The Adaptive Integrated Lake Basin Management (AILBM) framework has two parts: diagnostic and prescriptive. The diagnostic (sectors, stressors, resource systems, institutions, actors and resource management system) measures the how and why processes, which give more insight into the governance structure of the lake basin while the prescriptive measures the management and governance processes and recommends empirically based solutions. The prescriptive (adaptability, collaboration, resilience, decentralization, integration and participation) assessment anticipates what will happen and when it will happen, but also why it happened. Furthermore, the prescriptive assessment suggests decisions and options on how to take advantage of a future opportunity or mitigate a future risk and shows the implication of each decision option. Prescriptive analysis can continually take in new data to re-assess and re-prescribe, thus automatically improving the empirically based solutions. It can also ingest hybrid or complex data from the diagnostic and accurately prescribe better solutions without compromising other priorities (Riabacke et al. 2012). It also takes into account uncertainties and recommends ways to mitigate possible risks and has the

ability to not only examine potential outcomes, but also make empirically based recommendations that make governance decisions of lake basins sustainable (IBM 2013, Grant Thornton 2014) (Figure 4.2).

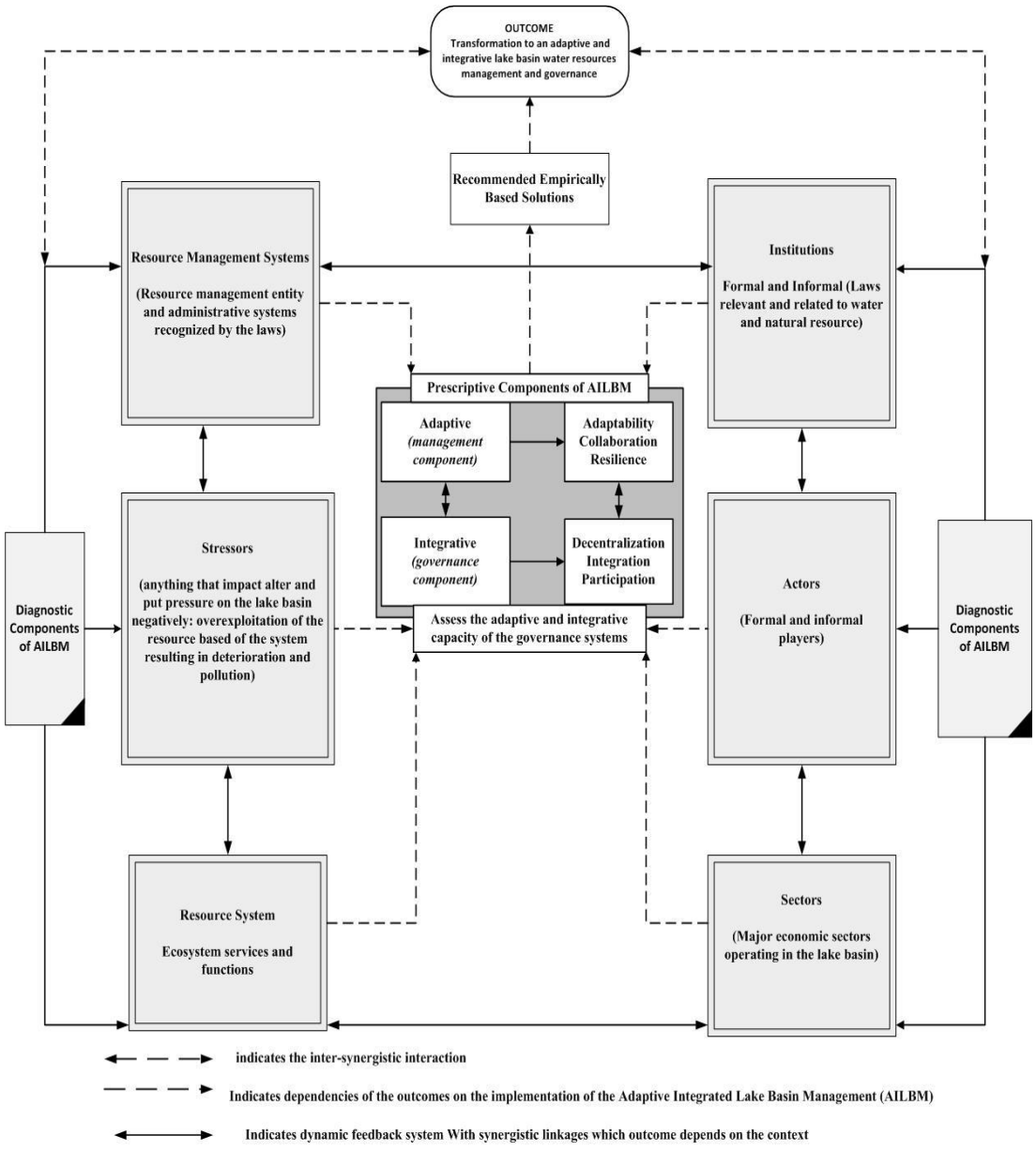

Figure 4.2: Diagnostic and Prescriptive components of the conceptual framework of the Adaptive Integrated Lake Basin Management (AILBM) for analytical assessment of governance performance of lake basins

Figure 4.1 is a depiction of the interaction between the diagnostic and prescriptive components of the AILBM framework. On the left and right are the diagnostic components. The double straight arrows indicate the inter-synergistic interactions in a systemic pattern. In the centre are the prescriptive components divided into two parts: adaptive (management) and integrative (governance) and the double straight arrows also indicate the inter-synergistic interactions. Connecting between the components, the single broken arrows indicate how the diagnostics feed into the prescriptive to assess the adaptive and integrative capacity of the lake basin governance. Consequently, the cumulative results of these assessments make possible the recommendations of empirically based solutions, which provide the transformation pathway towards the outcome of adaptive and integrative lake basin governance. After the transformational outcome has being implemented, another AILBM performance assessment will be carried out when due for continuous improvement of the governance system, thereby making the process an unending cycle. The double broken arrows indicate the iterative process of the AILBM framework (Figure 4.3 and Table 4.1).

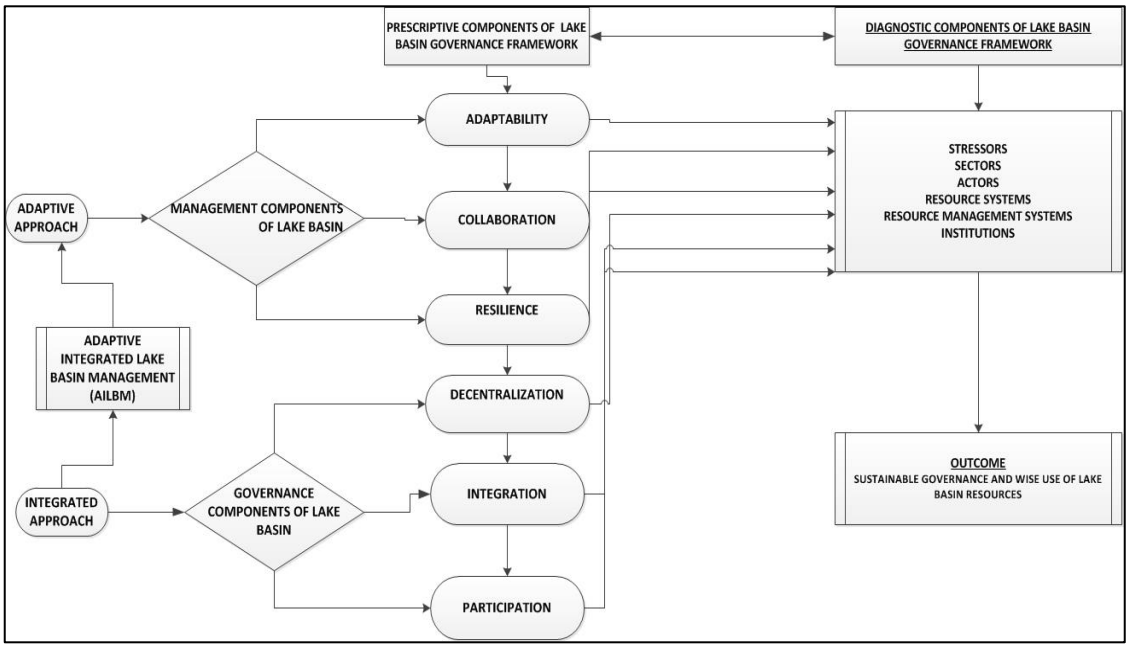

Figure 4.3: Adaptive and Integrative content of the Adaptive Integrated Lake Basin Management (AILBM) conceptual framework

Table 4.1: Diagnostic and Prescriptive components of Adaptive Integrated Lake Basin Management (AILBM) framework

Components	Interpretation
Diagnostics Components of AILBM	
Sector	Major social and economic activities in the lake basin, which may affect the quality and quantity of water and other natural resources in the basin (Jorgensen and Vollenweider, 1997).
Stressors	Constitute major agents and sources of nuisance and impact negatively on the lake basins resources (USEPA 2009, Jorgensen and Vollenweider, 1997, UNEP-DHI 2011, Johns 2013, Kira 1997, Iwasaki and Shaw 2010, Servos, et al., 2013, UNU-INWEH 2011).
Actors	Key players or stakeholders involved in the designing of the governance system as well as those involved in the usage. The actors create or exacerbate many of the current lake basin challenges (Young 1999, 2002, 2005, 2008).
Resource systems	Ecosystems services and functions of the lake basin which includes the exploitation and utilization of the basin resources (UN/ECE-WGMA 2003, ILEC 2005, World Bank 2005, RCSE and ILEC 2014).
Resource management systems	The core of the lake basin administration. It includes the entity of the resources management, administration and technology for pollution control and funding mechanisms for resource management in the basin (ILEC 2005, World Bank 2005, RCSE and ILEC 2014)
Institutions	Fundamental tools for resource management and reflect the way people interact with one another and the environment. (Saleth and Dinar 2000, Saleth 2004, Cosens, 2013, North 1990, Young 1999, Ostrom 1990, Scott 2001, Bandaragoda 2000, Young and Underdal 1997)
Prescriptive Components of AILBM	
Adaptability	Focus on the ability of human actors in the lake basin to mainstream resilience in the management of lake basins to achieve institutional fit (Walker et al. 2002, Chapin et al. 2009, Brown and Westaway 2011, Smit and Wandel's 2006, Gallopin 2006, Gunderson 2000, Folke et al. 2010, Walker et al. 2004, Grupta et al. 2010, Nelson et al. 2007).
Collaboration	Ability and measure of social actors in the lake basin to work together to enhance the capacity of the socio-ecological systems to cope with intermittent shocks (Berkes and Folke 1998, Blumenthal and Jannink 2000, Tompkins and Adger 2004, Newman and Dale 2005, Scholz and Stiftel 2005, Ostrom 1998, Cousins 2002, Gerlak and Heikkila 2007, Hall 1995, Kinnaman and Bleich 2004, Imperial 2005).
Resilience	Deals with the ability of the lake basin to absorb disturbance and still maintain the functioning of the ecosystem (Berkes et al. 2003, Holling 1973, Berkhout et al. 2006, Næss et al. 2005, Eriksen and Kelly 2007, Nelson et al. 2007, Ebbesson, 2010; Folke 2006, Folke et al. 2007, Folke et al. 2010).
Decentralization	Deals with the issue that the lake basin requires an organization, committees, agencies or authorities of some sort to manage them at the lowest level of government (Manor 1999, Ribot 2004, Lebel et al. 2013, Larson and Soto 2008).
Integration	Synergistic interaction among agencies involved in lake basin management and related policy fields and also the capacities of the actors to coordinate their activities between government agencies and with other stakeholders (Lebel et al. 2013, Paavola et al. 2009, Nielsen et al. 2013, Pahl-Wostl 2009, WETwin 2011).
Participation	The ability of stakeholders to influence and share control over the development initiatives and the decision and resource that affect them in the lake basin (Ramsar Convention 2004, EU Water Framework Directive 2000, 2003, Krick, et al, 2005 Luyet et al. 2012).

This is not a normative (or ideal) framework because it can be adaptable and operated in any context. The prescriptive is not necessarily ideal, but practical solutions to the current challenges, with extensive and expansive capacities to prepare for future changes (Walker 2012). Prescriptive analysis has often been described as being too narrow, dictatorial, and restrictive and overlooking the complex nature of governance. Contrary to this view, prescriptive analysis is adaptive because prescriptive analytical assessments do not only recognize the complex nature of governance systems of lake basins, but also the fact that only a pragmatic approach that produces workable solutions for today and tomorrow will be effective. On the other hand, the diagnostic elements of the framework balance the prescriptive by analyzing the complexities in the lake basin's socio-ecological systems to identify the challenges and problems peculiar to that ecosystem so as to prescribe workable solutions.

The prescriptive components are different from the diagnostics because these are components we believe should be a part of any lake basins governance systems. The prescriptive components were selected based on their ability to address the challenges thrown-up from the interactions of the diagnostic components. The diagnostics (sectors, stressors, resource systems, institutions, actors and resource management system) components are the socio-economic-ecological and biophysical aspects of lake basins that could impact the lake basin positively or negatively depending on how the interactions are managed while the prescriptive components are the management (adaptability, collaboration and resilience) and the governance (decentralization, integration and participation) elements that are essential for effective and efficient governance systems of lake basins. Therefore, the prescriptive analysis is built upon the diagnostic to determine the current governance performance level and the best course of action to reduce identified risks and optimize outcome as well as provide reliable pathway toward transformation based on empirically based recommendations (Grant Thornton 2014).

The diagnostic component reflects the major issues of concern in the lakes and their basins. The diagnostic components were selected to cover the social, economic, political, physical and ecological elements of a lake basin while the prescriptive components were selected based on the principles of adaptive and integrative

management and governance. The diagnostic components are the first tier assessments process to determine the status of the lake basin; that is checking out what is the current situation in the lake basin. Like, who is who? Who is doing what? What laws are operating? What businesses and commercial concerns are operating? What are the challenges of the lake basins? What are the resources? And what are the management systems of the Lake? The diagnostic process generates data which determines the current situation of management and governance. Now after this process, the prescriptive assessment uses the diagnostic results to determine the degree of the prescriptive elements embedded in the current lake basin governance situation and thereby come up with the performance level, as well as use these results to make empirically based prescriptive recommendations. The outcomes of these assessments will be dependent on individual contexts (i.e. lake basins) and the prevailing governance challenges in the lake basin under consideration.

The prescriptive components, on the other hand, are the second-tier assessments to measure the capacity of the governance system to be adaptive and integrative as well as to proffer empirically based solutions to the challenges arising from management and governance of the lake basin. The prescriptive are critical elements we recommended should be seen in every lake basin governance systems. These elements were carefully selected to target the governance systems based on the inherent challenges of lake basin management and governance globally. Besides, it can be quite a challenge to want to develop a governance system that is wholly lake basin focused, however, if we put into consideration the peculiarity of lakes (lentic-lotic properties) then we can assume that lake basin governance should have certain elements in order to be fit-for-purpose (Rijke et al. 2012). To this regard, we selected these components directed to the governance system and not the lake basins. Therefore, in order to be specific in the prescriptive recommendations, it is expedient to first determine the level of the prescriptive components in that specific lake basin governance system. This will enable empirically based recommendations specific to that particular lake basin. The combinations of the results from both tiers of assessments give a comprehensive picture of the performance status of the lake basins governance system.

The significance of the AILBM framework is based on the need to strengthen concurrently the enabling environment, institutional roles and functions of various administrative levels, stakeholders, and management instruments, including effective regulation, monitoring and enforcement of laws in the lake basin. The framework also aids decision making in identifying areas of required actions and remediation as well as identifying factors that can impact each other. It is significant to lake basin governance discourse because it provides a possible assessment tool for governance performance in lake basins. The comprehensive and analytical nature of the framework gives it a wide reach, and its open and generic nature means that it is not restrictive to any particular lake basin.

4. 5. Framework Assessment Method

The AILBM assessment methodology combines an analysis of the overall lake basin management and governance system. The diagnostic and prescriptive analysis of the components of the framework is based on the application of the mixed method approach. The framework combines qualitative and quantitative evaluation measures like performance indicators, quantitative institutional fit analysis as well as qualitative content analysis, stakeholders and expert interviews, focus group discussions, observations, document and archival records reviews, among others; and this ensures a comprehensive coverage of scientific, socio-economic, demographic, ecological and political aspects to produce lake basin governance performance status results (Table 4.2).

Table 4.2: AILBM lake basin governance performance assessment methodology

Components	**Data Requirements**	**Assessment Parameters**	**Methodology**
Actors	Human resource data, trade associations, population figures, gender statistics, socio-economic data, historical data, livelihood data, civil society organizations, community based organizations, Human Development Report, Gross Domestic Product, Local Governance Index, documents and archival records, conflict management information, etc.	Roles and responsibilities, sectors, stressors, legal mandates, formal and informal governance structure and organizations, local communities governance perceptions, management system, human resource capacity, conflict management assessment, historical survey, etc.	Stakeholder analysis, Participatory analysis, focus group discussions, stakeholder workshops, interviews, perception assessments, accountability and rights analysis, documents and archival record, reviews, conflict management analysis, etc.
Institutions	Constitutions, laws, policies, regulations, standards and guidelines, frameworks, court judgements, legal reviews, institutional reviews, etc.	Institutional involvement and recognition, overlaps and gaps, institutional priority, resource management, institutional response to resource management, adaptive and integrative capacity of institutions, actors, their roles and responsibilities, predominant sectors and their activities, performance assessments, conflict management assessment, etc.	Institutional analysis, experts reviews, documents and archival record reviews, qualitative and quantitative content analysis, accountability and rights analysis, perception assessments, performance indicators analysis, conflict management analysis, interviews, etc.
Resource management system	Constitutions, laws, policies, regulations, standards and guidelines, frameworks, compliance and enforcement mechanisms, monitoring and evaluation reports, finance mechanisms, organizational plans and structures, standard operational procedures, procurement procedures, management plans and procedures, technical and financial audit reports, experts reviews, impact assessment reports, development and master plans, quality assurance and control, conflict management information, socio-ecological system reports/data, transparency index, etc.	Management system, management response, coordination, collaboration, integration, adaptability, decentralization, participation, resilience, compliance and enforcement, monitoring and evaluation, sectors, infrastructure and interventions, financial analysis, demographics, performance assessment, conflict management assessment, etc.	Information and communication systems analysis, accountability and rights analysis, prioritization and ranking analysis, SWOT analysis, experts reviews, documents and archival record, reviews, qualitative and quantitative content analysis, problem tree analysis, participatory analysis, focus group discussions, stakeholder workshops, interviews, perceptions assessment, performance indicators analysis, static and dynamic modelling, conflict management analysis, etc.
Resource systems	Resources inventory and productivity data, specie population and history, water quality and quantity, ecosystem services and	Institutional priority, stressors, sectors, actors, ecosystem services and functions, ecological analysis, climatic analysis, socio-	Institutional analysis, participatory analysis, focus group discussions, stakeholder workshops, interviews,

	functions, relevant hydro-bio-geochemical data, socio-economic provision, biodiversity, impact assessment, water footprint, water sustainability indices, water governance indices, development and master plans, GLAAS Report (Global Analysis and Assessment of Sanitation and Drinking Water Report), JMP Report (WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation Report), conflict management information, socio-ecological system reports/data, country natural resource statistics, etc.	economics, livelihoods, biodiversity, Biophysical, microbiological and chemical characteristics, adaptability, resilience, performance assessment, conflict management assessment, natural and aesthetic resources, etc.	perceptions assessment, experts reviews, documents and archival reviews, qualitative and quantitative content analysis, static and dynamic modelling, conflict management analysis, ecosystem services and functions analysis, ecosystem valuation, etc.
Sectors	Sectoral water accounting, water footprint data, water quantity and quality data, wastewater discharges, economic analysis of water use, socio-economic surveys, industrial survey, historical survey, impact assessment reports, annual reports, Corporate Social Responsibility Reports, development and master plans, conflict management information, etc.	Industry and business analysis, Institutional involvement and recognition, actors, stressors, collaboration, partnerships, participation, socio-economics, livelihoods, infrastructures and interventions, performance assessment, conflict management assessment, etc.	Industry survey, document and archival records reviews, perception analysis, expert reviews, corporate social responsibility analysis, interviews, accountability and rights analysis, physical artefact reviews, conflict management analysis, etc.
Stressors	Biophysical, microbiological and chemical data, land use report, water quality and quantity, species diversity and population density reports, human health data, wastewater and solid waste data, sanitation and environmental quality status report, state of the environment reports, socio-economic data, epidemiological data, conflict management information, country public health statistics, etc.	Resource system, actors, sectors, institutional capacity, cause and effects, impacts, protection and prevention, pollution control, conflict management assessment, natural and aesthetic resources, etc.	Biophysical, microbiological and chemical analysis, land use analysis, water quality and quantity analysis, species diversity and population density analysis, human health statistics, wastewater and solid waste treatment and management analysis, environmental quality analysis, socio-economic survey, epidemiological survey, static and dynamic modelling, conflict management analysis, sanitation and drinking water analysis, etc.
Adaptability	Geographical information data, Biophysical,	Resource systems, resource management	Biophysical, microbiological and

	microbiological and chemical data, land use report, water quality and quantity, species diversity and population density reports, ecological data, impact assessment report, climatic report, state of the environment reports, socio-economic data, epidemiological data, etc.	systems, institutions, actors, sectors, adaptive and integrative capacity, resilience, performance, human capacity, natural and aesthetic resources, etc.	chemical analysis, land use analysis, water quality and quantity analysis, species diversity and population density analysis, climatic change analysis, socio-economic survey, epidemiological analysis, human capacity assessment, performance indicators analysis, etc.
Collaboration	Laws, policies, regulations, standards and guidelines, frameworks, finance mechanisms, organizational plans and structures, standard operational procedures, management plans and procedures, corporate social responsibility report, annual reports, development and master plans, documents and archival records, conflict management information, etc.	Actors, sectors, resource management systems, institutions, partnerships, participation, intervention programmes, information and communication, integration, performance, conflict management, etc.	Stakeholder analysis, participatory analysis, focus group discussions, stakeholder workshops, interviews, perception assessment, accountability and rights analysis, documents and archival record reviews, performance indicators analysis, conflict management analysis, etc.
Decentralization	Constitutions, laws, policies, regulations, standards and guidelines, governance systems, frameworks, financing, management, organizational plans and structures, compliance and enforcement mechanisms, development and master plans, documents and archival records, conflict management information, etc.	Actors, institutions, resource management systems, collaboration, integration, participation, governance structures, information and communication systems, de-concentration, performance, conflict management assessment, etc.	Institutional analysis, Stakeholder analysis, participatory analysis, focus group discussions, stakeholder workshops, interviews, perceptions assessment, accountability and rights analysis, documents and archival record reviews, performance indicators analysis, conflict management analysis, experts reviews, etc.
Integration	Laws, policies, regulations, standards and guidelines, frameworks, management, organizational plans and structures, development and master plans, documents and archival records, conflict management information, etc.	Actors, institutions, resource management systems, decentralization, collaboration, integration, participation, governance structures, information and communication systems, performance, conflict management, etc.	Institutional analysis, Stakeholder analysis, participatory analysis, focus group discussions, stakeholder workshops, interviews, perceptions assessment, accountability and rights analysis, documents and archival record reviews, performance indicators analysis, conflict management analysis, etc.
Resilience	Biophysical, microbiological and chemical data, land use report, water quality and	Resource systems, resource management systems, institutions, actors, sectors, adaptive	Biophysical, microbiological and chemical analysis, land use analysis,

	quantity, species diversity and population density reports, ecological data, impact assessment report, climatic report, state of the environment reports, socio-economic data, epidemiological data, historical survey, etc.	and integrative capacity, adaptability, performance, conflict management, etc.	water quality and quantity analysis, species diversity and population density analysis, climatic change analysis, socio-economic survey, epidemiological analysis, performance indicators analysis, conflict management analysis, experts analysis, etc.
Participation	Laws, policies, regulations, standards and guidelines, frameworks, finance mechanisms, organizational plans and structures, standard operational procedures, management plans and procedures, corporate social responsibility report, annual reports, development and master plans, documents and archival records, conflict management information, etc.	Actors, sectors, resource management systems, institutions, partnerships, participation, intervention programmes, information and communication, integration, performance, conflict management, etc.	Stakeholder analysis, participatory analysis, focus group discussions, stakeholder workshops, interviews, perceptions assessment, accountability and rights analysis, documents and archival record reviews, performance indicators analysis, conflict management analysis, etc.

4.6. Framework Assessment Process

In this section, the assessment process is described in more detail. The AILBM framework was applied in the SLB to qualitatively and quantitatively assess the water governance performance. The steps in this process are: defining and analyzing the existing situation; stakeholders' selections; data gathering (interviews and surveys); governance performance analysis; collation and triangulation of results to determine governance performance status; formulation of prescriptive solutions and interventions to arrive at desired situation and monitoring and evaluation. The assessment process takes 7 steps based on the experience gained from the application of the framework in Songkhla Lake Basin, Thailand. In this section, these steps are elaborated and tools used successfully in the case study area are described (Figure 1.1).

4.6.1 Step 1: Defining the existing situation

The present situation on water and other related natural resources management and governance in lake basins should be well defined and known before interventions and solutions can be made. This is aimed at evaluating and analyzing the diagnostic and prescriptive components of the AILBM to determine the current situation in the lake basin and helps to highlight the challenges and problematic issues requiring urgent attention. The diagnostic answers the how and why questions and what will happen, which provides trending information on past and current situation (IBM 2013). This gives more insights into the governance structure of the lake basins while the prescriptive answers the question 'what should be done to make lake basin governance and institutions better equipped to take advantage of the future as well as transform to a more adaptive and integrative system of governance? Proper understanding of the existing situation will depend on the adequate and painstaking application of Table 4.2.

4.6.2 Step 2: Stakeholders' selections

A first inventory of stakeholders will be made in step one. These stakeholders could be officers of the central, regional and local administrative government

ministries/departments that have one responsibility or the other related to water and other natural resources in the lake basins. It could also include operators of water services as well as relevant lake basins committees/agencies, academic institutions, NGOs/CBOs and private sectors. Other populations of interest are representatives of the water user groups, traditional authorities, farmer associations, fishermen and other community members with first-hand knowledge or traditional wisdom on water management. These stakeholder groups should be approached for in-depth interviews, surveys and focus group discussions.

4.6.3 Step 3: Data gathering: documents and archival records reviews, observations, interviews and surveys

For the purpose of this step, two major stakeholder interviews, surveys and focus group discussions can be carried out. These include: The experts/professionals interview surveys used for the evaluation of overall water governance performance in the Lake Basin and local lake basin communities perceptions on governance performance as well as any other stakeholders assessment approaches. To assess the governance performance, experts/professionals are requested to complete the questionnaires developed for this purpose. To determine the local communities' perceptions on governance performance, interview and surveys could be targeted at the participants drawn from members of households in the lake basin communities. Institutional assessment may also require quantitative analysis of text mining and other content analysis approaches in addition to qualitative reviews of regulatory and legal documents as well as archival records, reviews and observations.

4.6.4 Step 4: Governance performance analysis

The analysis deploys qualitative and quantitative research tools in order to reveal and distill the main status of lake basin governance performance and to make recommendations and provide well thought-out pathways and strategies to direct transformation to a more adaptive and integrative governance system. A consistent and

objective assessment begins at the conceptual dimension using the AILBM frameworks which targets more than one type and source of information data, and ensures adequate triangulation in a more rigorous way (Figure 2). The first level analysis targets institutional assessment using the qualitative and quantitative methodology for the assessment of the relevant and related water and other natural resources institutions in the lake basin using a combination of text mining analysis and other content analysis approach (Ekstrom and Young 2009, Ekstrom et al. 2009, Cookey et al. 2015a/b); second level focuses on the social/networks analysis involving the use of the mixed method approach to measure the local communities governance performance perception (Cookey et al. 2016a) and the third level targets the technical/operational assessment using the quantitative approach of Lake Basin Water Governance Performance Composite Index (LBWGPCI) (Cookey et al. 2016b); and the triangulation of these analyses provided a clearer picture of the SLB water governance performance status. Also, other types of analysis can be used to capture relevant data in the process (Table 4.2).

4.6.5 Step 5: Collation and triangulation of results to determine governance performance status

This is the stage where the results of the performance assessment are collated and triangulated to determine the lake basin's water governance performance status. Summary of the results of the governance performance assessment could measure the diagnostic components against the prescriptive components to determine the overall performance status. The results of the diagnostic may highlight the types of stressors and their magnitude as well as determine their impact on the lake basin. It could also identify the actors, their roles and responsibilities and the degree of the impact of their activities in the basin as well as their level of contribution to the improvement of the adaptive and integrative capacity of the system. It could examine and inventorize the resource system as well as determine how they are exploited, utilized and managed. It can also show the degree to which the institutions support and enhance the operations

of the resource management system. It has the capacity to measure the institutional priority as well as the adaptive and integrative capacity of the management system.

The prescriptive assessment could possibly show the level of integration and adaptation in the resource's governance systems. It could further confirm earlier results obtained from the diagnostic components by revealing the degree of the adaptability, collaboration, integration and resilience capacity of the lake basin governance and management system. It has the ability to show the level of stakeholders' connectedness and involvement to mainstream resilience as well as the degree of their participation in the activities that improve management and governance. It can also determine the level of access to environmental knowledge and information by the stakeholders and the level of willingness of the basin communities to support improvement.

4.6.6 Step 6: Formulation of prescriptive solutions and interventions

This is the stage were solutions are prescribed to identify governance challenges towards more adaptive and integrative solutions for the lake basin governance as well as solutions to address the identified problems under the governance and management. The recommended solutions are distilled from engagement of the stakeholders as well as the results of the various analyses. Some of the prescriptive solutions and interventions may include: institutional reviews, administrative and management system reviews, infrastructural improvements, increased local people participation in decision-making as well as recommendations for a transformational pathway towards more adaptive and integrative governance.

4.6.6 Step 6.1: Formulation of transformational pathway to more adaptive and integrative governance.

The main outcome of the governance performance assessment is the determination of the systems level in the Holling (1986) adaptive cycle. The identification of the adaptive cycle stage of the system enables for the development of a tailor-made, well-guided and coordinated transformation process. This process promotes the organization

of the lake basin stakeholders around common vision, mobilizing social capital, redesigning flow of political authority and resources, challenging technical and legal frameworks and by encouraging integration of local knowledge with experimentation and new scientific frameworks (Westley et al. 2013).

4.6.7 Step 7: Monitoring and Evaluation

A monitoring and evaluation procedure is developed to see whether the interventions and transformational processes are taking place as planned and whether the envisaged results are achieved.

4.7 Application of the Framework

4.7.1 Summary results of SLB's Diagnostic Assessment

The diagnostic and prescriptive aspects of this study were based on the application of a mixed method or integrative research (qualitative and quantitative) (Teddie and Tashakkori, 2009, Feldman and Sanger 2007, Berelson, 1952) for investigations and data analysis. The qualitative case study approach explored and evaluated the Basin diagnostic and the prescriptive components to develop a rich and synthetic understanding of the governance structure and dynamics of decision-making in the Basin (Yin, 2009). The quantitative approaches used in the application of this framework include: local people perception analysis (Cookey et al. 2016a); performance evaluation using composite index (Cookey et al. 2016b) and application of text mining equations and computation in institutional analysis (Cookey et al. 2015a/b).

A diagnostic assessment of the actors involved in the SLB governance and management revealed that water management and governance are centrally coordinated from the national government's ministries, which supervise more than thirty departments (agencies) with various roles in water resources management. The diagnostic assessment revealed that some of the economic sectors in the SLB are agriculture, industrial/manufacturing, trade, services and tourism, while the agricultural

sector is the major water user in the Basin. Stressors investigations reveal that actors and sectors contribute to cause diverse effects on the SLB through overexploitation of the rich natural resources and serious environmental pollution resulting from human and industrial activities such as depletion of biodiversity, devastation of life supporting systems, deterioration of water quality, depletion of fishery resource, flooding and landslides, plus social conflicts in resource uses (Ratanachai and Sutiwipakorn 2006, Pornpinatepong 2010, Chesoh and Lim, 2008, ONEP, 2013).

The assessment discovered at least 28 water related laws administered by over 30 departments overseeing water issues in eight ministries (Biltonen et al. 2001, Biltonen 2011). The laws governing water and other natural resources for the SLB were derived from related legal instruments regulating natural resources for the whole country. It was noticed that the same law may regulate more than one single aspect of use; there is, however, no umbrella legislation linking these laws and codes (UN-Water/WWAP, 2007), and coordination and cooperation are very weak. The water resources management system in the SLB is the traditional top-down management approach with a strong national focus administered by over 30 departments in eight ministries (Biltonen et al. 2001, Biltonen 2011). There is little effort on actual development of the local and Basin institutions, which inhibits effective implementation of the decentralization policy of the government.

4.7.2 Results of SLB's Prescriptive Assessment

The prescriptive assessment began by measuring the adaptive and integrative capacity of the institutions used for the water governance of the SLB. Collaboration and participation were also assessed as well as the resilient capacity of the institutions and degree of decentralization. Table 3 summarizes the results of the governance performance assessment of the SLB and measured the diagnostic components against the prescriptive components to determine the overall performance status of the water governance of the SLB.

Lake Basin Water Governance Performance Composite Index (LBWGPCI) developed from the AILBM was used to assess the prescriptive components of adaptability, collaboration, integration and resilience (Cookey et al. 2016b). This assessment component is based on the concept that lake basins are complex ecosystems and should be managed with consideration for sudden change, uncertainty and unexpected occurrence. It assessed the system's capacity to adapt to changing conditions as well as the reduction of vulnerability of the system to actual or expected future changes.

Table 4.3: Summary of Songkhla Lake Basin governance performance status

Diagnostic Components	Prescriptive Components					
	Adaptability	Collaboration	Resilience	Decentralization	Integration	Participation
Sectors	+	+	+	n/a	+	++
Stressors	n/a	+	n/a	n/a	+	+
Actors	+	+	+	++	+	++
Institutions	+	+	+	++	+	++
Resource systems	+	n/a	+	n/a	n/a	n/a
Resource management system	+	+	+	++	+	++

Note Legend: + poor performance ++ average performance +++ good performance ++++ excellent performance n/a not applicable

It was also observed that the level of integration in the water resources governance in the SLB is very low and this is created by constant conflict between the multi-agencies with separate mandates for quantity and quality. From this study, it was revealed that the elements of adaptability, collaboration, integration and resilience are currently lacking in the existing water governance instruments in the SLB. Participation and collaboration assessed the degree of involvement, engagement and partnerships of actors (stakeholders) in the governance of the SLB. The study revealed

high level of stakeholders' disconnectedness on the issues of governance of the SLB. It was also observed that the level of collaboration and partnership within the public sectors were very low.

4.7.3 Specific SLB's Prescriptive Recommendation

The SLB's existence is endangered and will require a re-alignment of the governance system with the socio-ecological system to ensure adequate sustainable governance and wise use of resources of the Basin. A sustainable governance system can cope adequately with environmental variations, demand and production can be balanced, and the system function effectively (Wolf and Allen 1995). Absence of this may cause the system to stop working, experience a disruption of function and increased inefficiency in the system (Daily et al 1997, Levin 1999). Overcoming these governance challenges will require among others, a governance performance assessment framework that is diagnostic, prescriptive and iterative in approach and encourages governance system that has adequate built-in feedback mechanisms, especially from the actors and allows for the evolution of legal instruments (Garmestani and Allen, 2014). This will improve the relationships between the biophysical and socio-economic system as well as recognize that the achievement of sound governance systems will depend on the adequate integration of social, political, economic, scientific and institutional issues in a more holistic way. We, therefore, recommend some prescriptive actions for the governance improvement as well as transformational pathway to more adaptive and integrative governance in the SLB:

I. Create a coordinating and policy harmonization mechanism that will promote coherent actions among all the formal and informal actors involved in the SLB governance using the Songkhla Lake Basin Committee (SLBC) to, possibly, form the nucleus of the proposed coordinating mechanism for the SLB. The management structure for this mechanism could be developed thus:

    1.1 The mechanism could be in a form of a committee with legal mandate and appropriate budget (based on the Thai governance system)

1.2 The committee should have its own administrative office

1.3 This committee can be designed to progress into an agency in due course

1.4 There should be a supervising ministry to oversee the activities of the committee and this supervising ministry should be the Ministry of Natural Resources and the Environment. Other members should include Ministry of Agriculture and Cooperatives, Ministry of Interior, Ministry of Industry, Ministry of Transportation, Ministry of Tourism and Sports, Ministry of Energy, Ministry of Commerce and Ministry of Justice.

1.5 The committee membership should be reduced to a manageable size in order to avoid ambiguity.

1.6 There should be single representation per ministry to avoid over representation.

1.7 Also, single representation from the three Provincial Administrative Organizations (Songkhla, Phatthalung and Nakhon Sri Thammarat) and one representative from the Local Administrative Organizations.

1.8 The academia and the civil society organizations should have single representations each and one representation for women and youth.

1.9 Trade/commercial major groups should have single representations (fishers, rice farmers, rubber farmers, aqua-culturist, community markets, etc)

1.10 Single representation from each industrial sector in the Basin (Tourism/hospitality, manufacturing, commercial transportation, shopping malls, etc).

II. The water draft law should be enacted

III. Establish specific institutions for the SLB's governance and management and ensure that these institutions are adaptive and integrative enough to incorporate the dynamic and complex nature of the SLB

IV. Local Administrative Organizations (PAOs, MAOs, and TAOs) should be given more powers to act on governance provisions and their capacities should

also be upgraded to meet the expectations as the many political constraints and weak human capital hinders their capacity

V. LAOs should be allowed to budget for certain protective and regulatory measures in the SLB as one of the challenges is insufficient budget allocation

VI. Lake Basin communities and lower decision units should be involved in protecting and managing the Basin because they are willing to commit their time and resources if given the opportunity

VII. Regular engagement, deliberation and negotiations are required to improve the relationships between regulators, users and Basin communities in order to overcome the mistrust and lack of confidence which often lead to conflict.

VIII. LAOs should be encouraged and supported to address the specific issues not contained in the national legal frameworks

IX. Co-operations, collaboration and partnerships among agencies, private sector, Basin communities and the academia should be improved to enhance information and knowledge-sharing, capacity support, adequate funding, awareness, interconnections and effective coordination

X. Encourage ecosystem based management where protecting ecological systems take priority over utilization without compromising the economic value of the SLB

We recognize that the AILBM framework can also be used to assess the governance performance of other areas of focus in the SLB, for instance, tourism and hospitality, agriculture, fishery, aquaculture, industry and business, local administration, etc. In order to get a total picture of the governance performance in the Lake Basin, we recommend that the AILBM be used to assess the governance performance in the areas as well and not just water governance as was done in this study.

4.7.4 SLB transformational pathway to more adaptive and integrative governance

The AILBM supports the design and implementation of transformational processes towards more adaptive and integrative sustainable governance systems for lake basins. For instance, in the Songkhla Lake Basin (SLB) Thailand water governance performance assessment, the proposed transformation process included three major prescriptive actions: (i) the organization of two separate roundtables (technical and institutional review) under the supervision of the Ministry of Natural Resources and Environment (MONRE) for participation of key ministries, centralized-deconcentrated departments as well as other non-state actors in the Basin. The roundtables aim to develop strategies and guidelines for a transformation process as well as coordinate all actors; (ii) formation of coalition of formal and informal actors (i.e. all stakeholders) called the people transformation platform, which aims to produce Songkhla Lake Basin Development Roadmap (SLBDR) from the reports of the roundtables as well as get stakeholders buy-in and support. This then, leads to the establishment of a formal management and policy harmonization organization with adequate legal mandates to implement the SLBDR and (iii) International Partners Development Conference. This conference will be designed with the aim to draw financial, technical and knowledge assistance for the re-development and reorganization of the SLB, which will then lead to the execution of the transformative process (Figure 4.4).

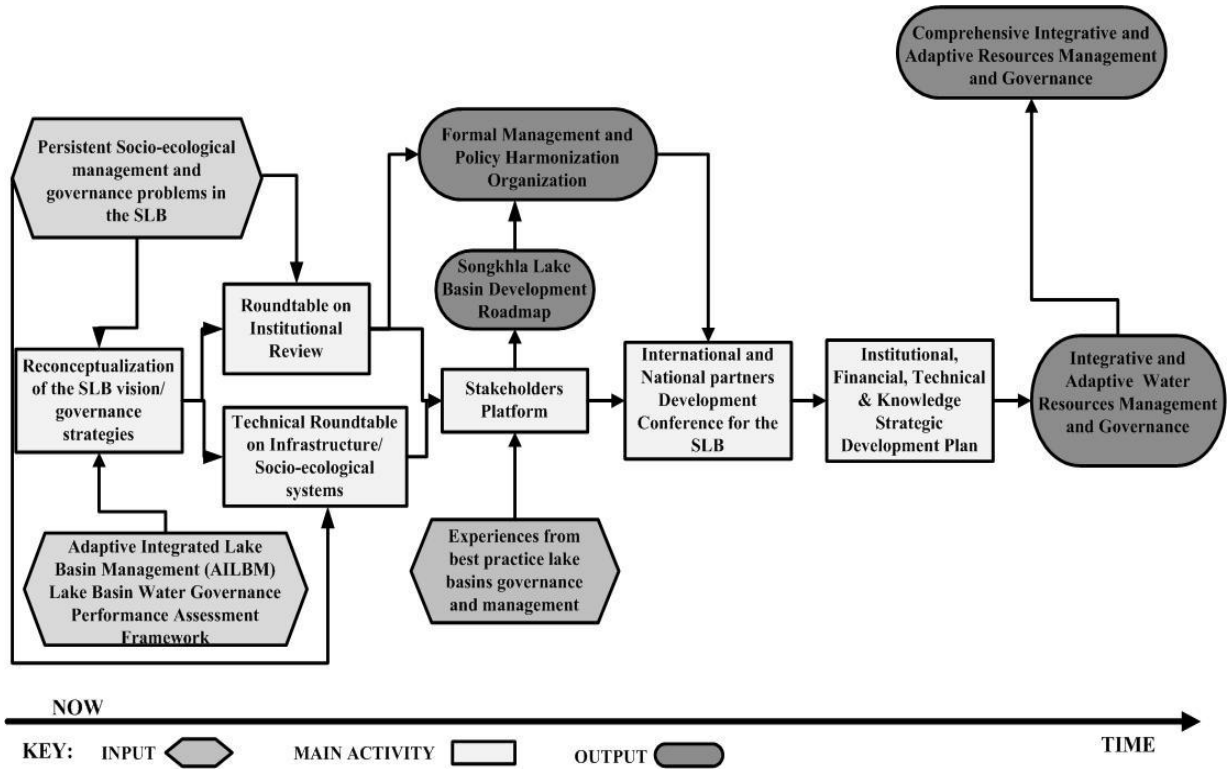

Figure 4.4 Transformation pathways towards adaptive and integrative management and governance

4.8 Discussion and Conclusion

The AILBM governance performance assessment framework proposed in this paper is not designed to be a blueprint with limits and barriers, but as a guide for effective governance performance assessment of lake basins. Its flexibility is guaranteed to enable its adoption in any context and with all lakes and their peculiarities. It recognizes that individual lakes have unique characteristics, differing communities and cultures, and are situated in countries with different governance systems. It also recognizes the dynamics and complexities of lake ecosystems and the interactions and counteractions arising from the economic value of lake resources. The framework also recognizes the central role of actors in creating resilient institutions, since they allocate resources, manage, create awareness and conducive environment for formal and informal learning, and ensure participation and collaboration, as well as embed decentralization, integration and adaptability into the entire system.

The framework is designed to assist sustainable governance in resolving conflicts among multi-sectoral demands, actors and users of the lake basin resources. It is not case specific, but is transferable and can be applicable to the assessment of governance performance of any lake basin. Some benefits of this framework include but are not limited to the determination of institutional priorities, institutional response to management of water and related natural resources, institutional fragmentation and gaps as well as the measurement of the integrative and adaptive capacity of lake basin management and governance, to mention but a few. Also, the framework works within the peculiar features of lake basins which include: integrating nature of lakes and their basins; the long retention time before problems are noticed and the complex response dynamics of quick, anticipatory and multifaceted response to issues (ILEC 2011). Recognizing all these, the AILBM seeks to introduce a balanced system, which allows the performance assessment of lake basins within the individual context of their countries' governance system and the peculiar features of particular lakes, but still with the same goal of contributing to sustainable governance and wise use of resources as well as continued existence of the lakes. In essence, the AILBM is a guide for assessing lake basin governance performance in a synergistic, collaborative, integrative and adaptive manner, which reflects the socio-ecological system they influence and the institutions that manage them.

The results of the AILBM diagnostic and prescriptive investigations are able to capture a comprehensive view of the current status of the lake basin's governance system within the context of the water governance structure of that country. It also ensures that performance assessment results are unique to that lake basin and does not in any way imply that the country's governance and management be aligned to any other country's system. The essence is to measure balance within the existing system through adaptability, resilience, integration, collaboration, participation and decentralization. The framework is contextual in nature, which makes it adaptable to different situations and locations. For instance, if this framework is applied to two different lake basins the result will be different and specific for each lake basin. Also, the components of the framework are generic to capture the essence of the complex,

dynamic and peculiar nature of the lake basin as well as providing common typology that can enable the comparison of governance performance across different lake basins globally.

The AILBM is not a governance design, analysis or how-to-do guide or management system approach for planning. It is an assessment tool designed to measure governance performance in order to determine current status, expose gaps and defects, strengths and weaknesses, and then make recommendations for the future. It does not show how to develop governance structures or systems, but assists in assessing the performance of already existing governance systems as well as provide transformational pathway towards more adaptive and integrative system. The design of the framework was geared towards seeking a balance between utilization and conservation in an adaptive and integrative manner to ensure resilience and flexibility so that governance can easily fall into step with the uncertainties and complexities of climate change, biodiversity, human interactions and extreme hydrological events. This is because we believe that a governance system that is open to continuous assessments and learning with regular input from all actors will be more anticipatory and quick to respond to unexpected changes, and the results and recommendations from the application of this framework can support the governance system design or reforms.

However, the major limitations and drawbacks in the application of this framework are the challenge of availability and accessibility of information and data, coupled with low response from actors and falsification of data and information, which may lead to erroneous conclusions. Also, acquiring huge reservoir of information and data for proper analysis is further heightened by poor document management systems and the ad hoc nature of lake basin management, which leads information and data to be scattered in various related and unrelated sources. Also, the framework presented here requires further investigation through application in other lake basins in order to assess its potential and limitations. We encourage readers to apply the framework in their own research, to test it, challenge it and/or enhance it. The application of this framework in other case studies could be a way forward for the achievement of institutional fit as well as an enhancement of lake basin governance performance.

We believe that this framework can be used by policy makers, researchers and lake basin managers for governance analysis, lake basin management and policy planning and development. Future research needs to study the AILBM further and how it can be used to improve lake basin governance performance as well as test it on other governance aspects of lake basins apart from water governance.

CHAPTER FIVE

INSTITUTIONAL FIT ANALYSIS

This chapter is adapted from:

Cookey, P. E., Darnswadi, R. and Ratanachai, C. Application of text mining in analysis of Institutional fit of water governance for Songkhla Lake Basin, Thailand. Manuscript submitted for publication: Lake & Reservoir: Research and Management.

Abstract

The purpose of this work was to quantitatively determine the institutional fit of the existing water governance instruments in the Songkhla Lake Basin (SLB) using text mining analysis. The study found out that the current governance system is not fit for the purpose of the sustainability of the SLB. Data derived from text mining were able to show the lapses in the institutional framework and the reasons for weak enforcement and compliance. Institutional priorities were identified and compared to management response to issues concerning SLB; this imbalance indicated another challenge to fit. The results of this study further buttressed the need for institutional reforms towards an Adaptive Integrated Lake Basin Management (AILBM). The general assessment of degree of recognition and involvement of institutions, overlaps, gaps, institutional priorities and response to resource management show a clear picture of misfit of the institutional instruments used to govern the SLB. To achieve institutional fit, future institutional reforms should be based on the principles of AILBM and the creation of a single harmonization committee.

5.1 Introduction

5.1.1 Making a case for institutional fit

Institutions are the core of Lake Basin management and they play a key role in maintaining and enhancing the sustainability and resilience of the systems as well as protecting it from externalities (ILEC, 2005); this critical role is supported by strong stakeholders participation in lake basin governance (Charles, 2004). Environmental Law Institute (2007) declares that if stakeholder participation is right apart from its legal obligations, it helps to provide meaningful input into the attainment of institutional fit. Garmestani and Benson (2013) proposed that an institution that reflects the wishes of the stakeholders – in the sense that the creation of rules (laws) incorporates not only a top-down imposition of rules by the sovereign but also a formalized feedback from the people to the sovereign, help to ensure fit (Dorf 2003). However, this is contrary to what is obtained in most institutional instruments for water governance in lake basins.

Globally, institutions for lake management are found in many bodies of legal references covering every aspect of the lake basin. This creates the problem of fragmentation of responsibilities, overlapping jurisdiction, different legislations covering the same area, inadequate facilities and funding for enforcement and agencies' capacities (FAO, 1995). Although, scientific knowledge about the cause and effects of stresses on lakes is available, the effective management policies and institutions have lagged behind; in most cases, the values of lakes have not been fully considered by policymakers (Ballatore and Muhamdiki 2001). Realizing the goal of coordinated systems for Lake Basin governance will require a comprehensive quantitative evaluation of the institutional fit of this ecosystem.

Even the operationalization of the Integrated Water Resources Management (IWRM) principles has been difficult; especially dealing with challenges of lakes because often than not, lake basin management stakeholders are not in the position to influence most IWRM integration (RCSE and ILEC, 2014). Moving forward in this

issue will require the need to critically examine and analyze existing institutional instruments governing lake basins globally to determine their degree of 'fit'.

The issues of institutional fit with ecosystems or the resource base has been the focus of many scholars (Ostrom, 1990; Scott, 2001; North, 1990; Young, 2002; Folke, et al. 2007; Pahl-Wostle, 2009). The problem of fit centres on the idea that governance systems need to reflect the structure, properties, and processes of the ecosystem within their scope (Ekstrom, 2008a/b and Ekstrom et al. 2009). Institutions mean the body of rules, regulations and processes that guide management actions and procedures (Ostrom, 1990; Scott, 2001, North, 1990, Folke, et al. 2007; Pahl-Wostle, 2009). Young (2002a, b) identified functional misfit as a substantial contributory factor to the deterioration of the ecosystem. The problems of resource over exploitation are the mismatch of scales between institutions and ecosystems (Lee, 1993) and common pool resources are challenges of fit and mismatch. Institutions will be more effective when they match the biophysical domain in which they operate (Kalikoski, et al. 2002, Ostrom, 2005, RCSE and ILEC, 2014). The crisis of world's lakes are the crisis of institutional gaps (misfit and mismatch), overlap (fragmentation) (World Bank 1997, 2005, Heol et al. 2005, ILEC 2005, 2007, Ekstrom 2008, 2009, Ekstrom et al. 2009, RCSE and ILEC 2014) and high institutional priorities to resource utilization as well as inadequate institutional response to resource management (Figure 5.1).

Therefore, developing institutions that are fit for lake basins and that will be able to enhance resource value, decongest resource use, resolve resource use conflict, reduce environmental stress, rehabilitate and restore riparian habitats, protect resource value damage from extreme events, take precautionary adaptation and mitigation measures and improve overall ecosystem health will require a proper and critical analysis of the existing institutional instruments to determine their degree of fit-for-purpose (Rijke et al. 2012, RCSE and ILEC 2014).

This study aims to quantitatively assess the fit status of lake basin institutions using the text mining tool based on the assumption that it can contribute useful and essential information towards determining institutional fit. Therefore, the purpose of this work is to quantitatively determine the degree of gaps, overlaps, institutional

priority, institutional involvement and recognition and response to resource management of the existing governance instruments in the Songkhla Lake Basin by using text mining analysis with the overall aim to determine institutional fit.

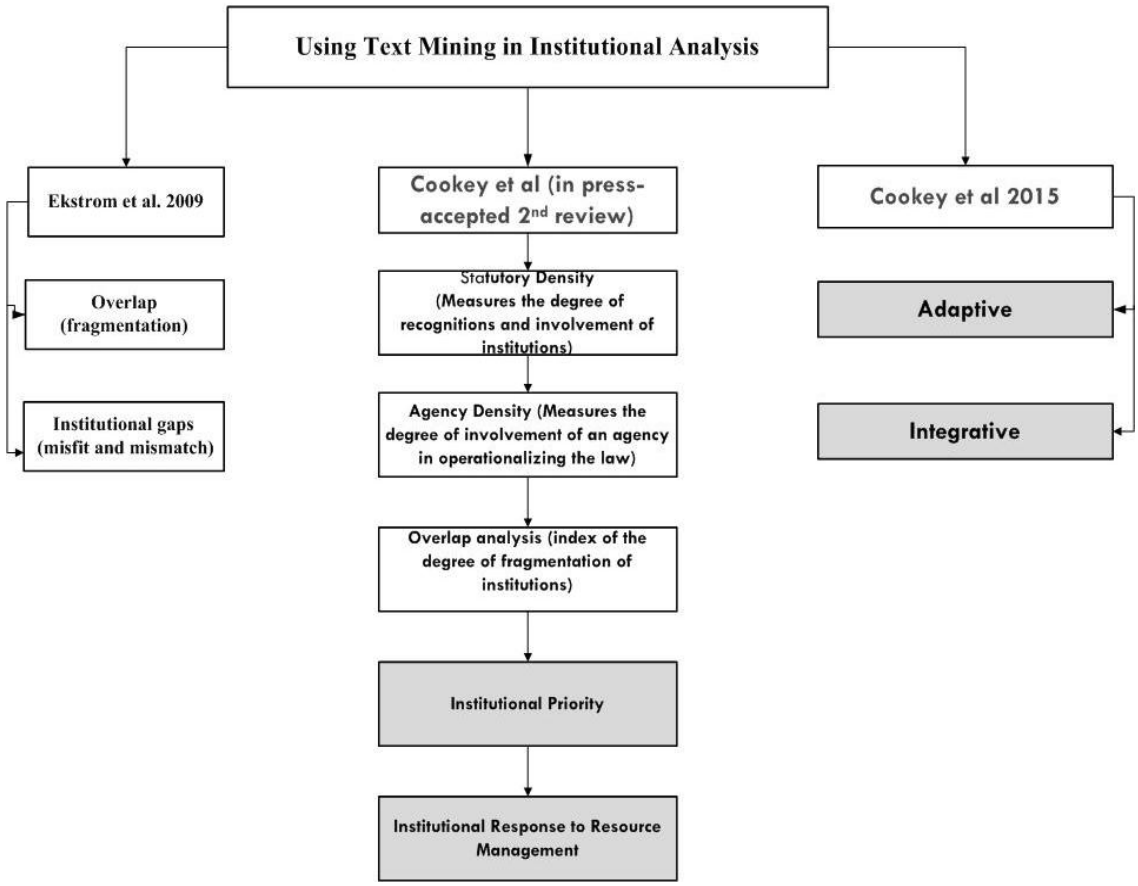

Figure 5.1: Literature mapping of text mining for institutional analysis

Therefore, the main research question that this work seeks to address is ‘can text mining be used to quantitatively determine institutional fit for lake basin governance?’ This will be the first time text mining analysis is used in the quantification of institutional fit for Lake Basin governance, although, Julia Ekstrom of the University of California, Santa Barbara had already used it to analyze overlaps and gaps in ocean laws across the geo-political jurisdictions of federal and three states of the United States of America (Estrom, 2008, 2009, Ekstrom et al., 2009, Ekstrom and Young

2009). This research goes beyond mining for ‘overlaps and gaps’, but also includes the determination of institutional priorities, institutional response to resource management in lake basins as well as their degree of involvement in lake basin governance. Therefore, the goals of this paper are to expand and test the use of text mining for institutional analysis and also evaluate the fit status of the SLB water governance systems, while verifying the results through literature review, stakeholders surveys and experts face-to-face interviews.

5.2 Methodology

The research applied text mining of content analysis as a quantitative approach (Feldman and Sanger 2007). Berelson (1952) suggests that content analysis is objective, systematic and quantitative, while Smith (1975) argues that content analysis blends both quantitative and qualitative (Tashakkori and Teddie, 2003, Teddie and Tashakkori, 2009, Tashakkori and Creswell, 2007). Abrahamson (1983) surmises that content analysis can be fruitfully employed to examine virtually any type of communication because it focuses on either quantitative or qualitative.

5.2.1 Conceptual Approach

The use of adequate and relevant conceptual framework for text mining for institutional analysis is an essential requirement because it helps to act as a guide and boundary in the preparation of the Term Document Matrix (TDM). The conceptual framework used for this work helps to identify the lake basin topics (sectors, stressors, actors, institutions, resource systems, and resource management systems), which served as a guide in the derivation of terms used in the text mining. It also enabled the consideration of lake-specific biophysical processes and social interactions as a component of the system or as a possible modifier of impacts as well as to show clearly the interconnected-synergistic linkages of the critical components of lake basin management and governance (Servos et al, 2013). The AILBM conceptual framework (used for this work) is a fusion of three concepts: Integrated Water Resources

Management (IWRM), Integrated Lake Basin Management (ILBM) and the Adaptive Governance Management (AGM) (see chapter 4). The process of text mining is presented in Figure 5.2.

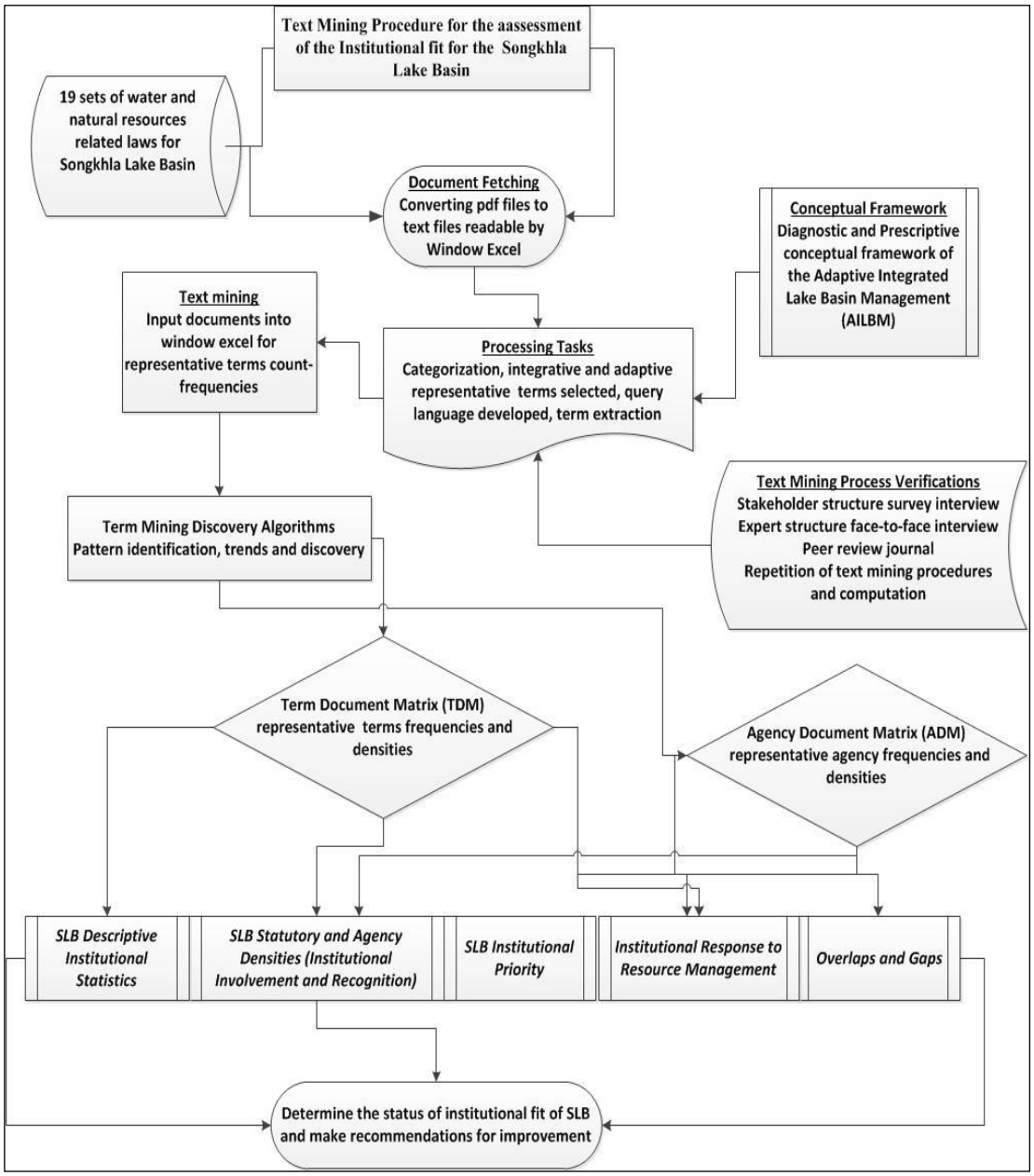

Figure 5.2: Study flow chart showing the process of text mining

The big question is, how can society create enabling institutions that would be able to link the socio-ecological systems in a synergistic manner to achieve a fit? Unfortunately, many of the laws in place were developed around the prevailing scientific understanding of the 1960s and 1970s that view the natural world as an envelope of predictability, assuming that there was a 'balance of nature' that could be managed and sustained (Craig 2010, Garmestani et al. 2013). Ebbesson (2010) noted that the new understanding of adverse environmental effects from human behaviour thoroughly challenges laws and legal thinking of the 21st century. The conclusion was that the legal regulations have failed to provide adequate protection for the environment and create settings that promote sustainable utilization of common-pool resource (Ostrom, 2005, Lazarus, 2004).

Several strategies have been proposed by authors on how institutions can be made to fit with the socio-ecological systems and some of these proponents propose that laws can be reformed to proactively address potential harms before they occur, rather than attempting to 'restore' ecosystem functions and services after they have been destroyed (Lazarus 2004). Garmestani and Benson (2013) as well as Cumming (2013) recognize that mismatch between scales of ecosystems and institutions can result in decreased resilience of a system. So, systems of governance should account for scale and have the necessary flexibility to account for resilience, while at the same time having the necessary accountability under the law.

In essence, what is needed is an iterative approach that has feedback built-in, especially from stakeholders, between the ecological and social system, which allows for policy to evolve in response to policy experiments, and laws to evolve in response to legal experiments, and not past assumptions about the system of interest (Garmestani and Allen, 2014). To evaluate water governance institutional fit in the SLB, the conceptual framework model of AILBM provided the frame for the quantitative evaluation of selected and relevant terms in the set of water governance institutions to determine their level of fit and to see if it collaborates with stakeholders' perception and similar studies on SLB natural resources governance).

5.2.2 Text Mining Approach

This is the application of computer science to discover patterns, trends and incremental knowledge between documents that would not be possible without the tools of computer programming language (Feldman and Sanger 2007). They can also be used to make inferences by systematically and objectively identifying special characteristics of the message (Holsti, 1968). Text mining was used to extract useful information from the selected legal instruments data sources through the identification and exploration of interesting patterns. The interesting patterns were found not among formalized database records, but in the unstructured textual data in the documents collections (Feldman and Sanger, 2007).

The research approach was adapted and modified from the works of Ekstrom (2008, 2009) and Ekstrom and Young (2009), who used text analysis method for laws in a manner different to legal analysis. This work employed the tool of Microsoft Excel Software for text mining for term-count-frequencies using Term-Document-Matrix (TDM) (as well as developing Agency Document Matrix (ADM)) in sets of institutions (laws) applicable to water governance in the SLB. Then, results of the text mining were subjected to computations of institutional variables, and data were visualized and presented in tables, line graphs and histograms using Microsoft Excel Software.

5.2.3 Data Set

Nineteen sets (out of the over 28 related water resources national laws) (Biltonen et al 2001) of translated Thailand water, environmental and other related laws were used in this work. The laws were identified and collected from an online source that is publicly accessible (www.thailawonilne.com). These laws were selected based on the recommendations of stakeholders and extensive literature review because of their direct bearing on the key economic and livelihood activities in the Basin as well as their direct linkages to water resources management and governance in the Basin (Figure 5.3). The laws were limited to Acts of Parliament and do not include ministerial or departmental regulations. A total of 38 (terms) representing various

issues relating to the SLB were used for the text mining, which were basically derived from the three SLB master plans (Emsong 1999, ONEP 2011 and ONEP, 2013), stakeholder survey and peer-reviewed articles. The 'Topics' represents the core elements of the diagnostic and prescriptive AILBM conceptual framework designed for the achievement of institutional fit in the management and governance of lake basins (stressors, actors, institutions, resource systems, and resource management systems). The 'Terms' are relevant words, concepts and issues extracted from the Topics. The 'Terms' are representative words used to mine for the 'Topics' because the 'Topics' were too broad and ambiguous.

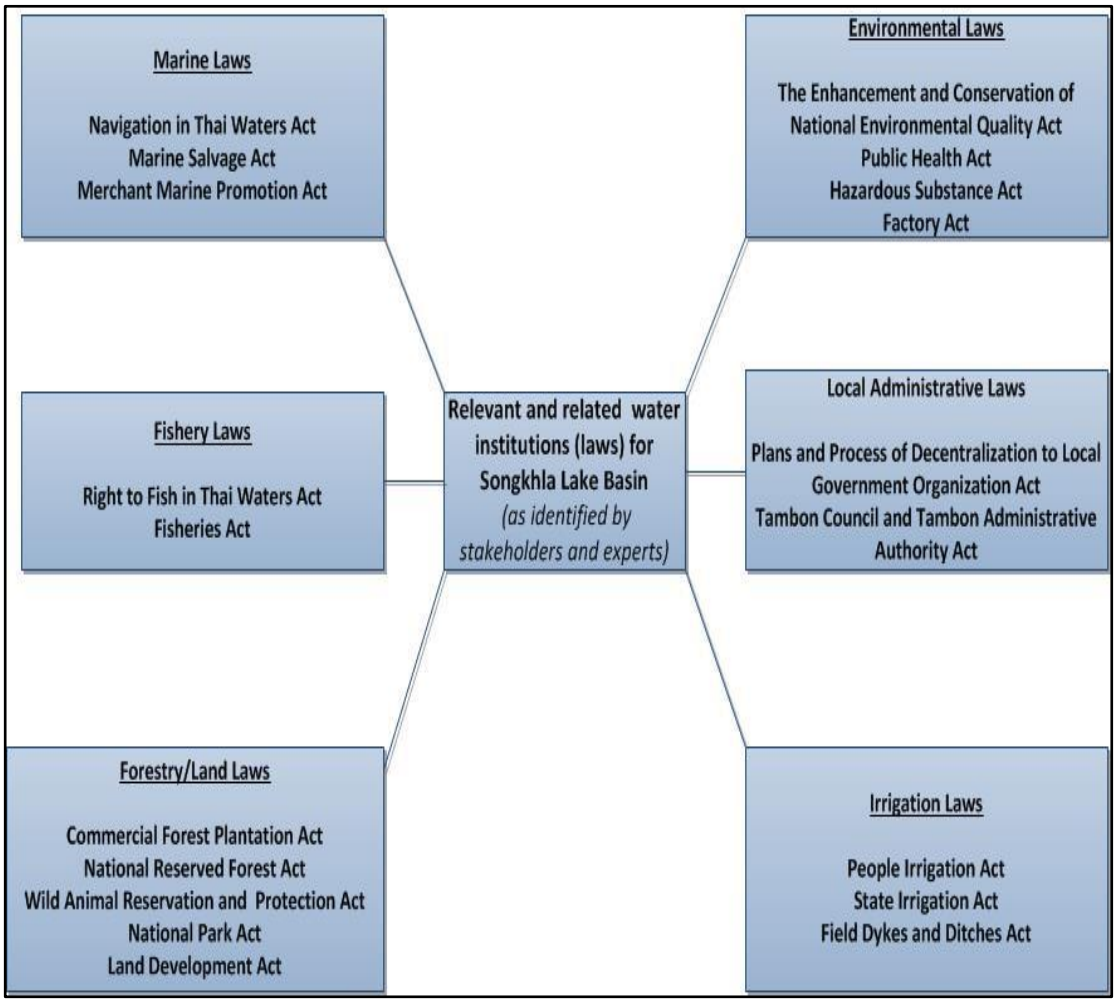

Figure 5.3: SLB relevant and related water institutions (laws) selected by stakeholders for text mining

5.2.4 Term Document Matrix (TDM)

TDM is commonly used to explore text mining techniques to organize terms in tables according to frequency of occurrence in each document analyzed (Feldman and Sanger 2007, Ekstrom and Young 2009). This process results in a smaller representation of lake basin governance, which is relatively a more semantically rich representation of the whole concepts (Feldman and Sanger 2007). The TDM model comprises of 6 topics, 38 terms, 19 sets of institutions grouped under 6 sub-divisions resulting in a total of 722 modeled matrix links (figure 5.4). The 6th Topic was 'institution', which was the Topic that was mined.

5.2.5 Agency Document Matrix (ADM)

Thai government ministries and departments responsible for the implementation of these sets of institutions (laws) were compiled by physically reading through each institution to identify government ministries and their agencies mentioned in the law as the responsible organizations for the implementation of the provisions of the laws. Also, other agencies were identified from peer-review-articles and official government documents. The result was used to produce the Agency Document Matrix (ADM). ADM was used in the determination of Agency Overlap (AO). Where a set of institutions identified an organization responsible for the implementation of the laws; one (1) point was awarded; where an organization was nominated into a committee under that law, an half point (0.5) was awarded and zero was awarded to none assignment of any responsibilities for the law under review (Ekstrom and Young 2009).

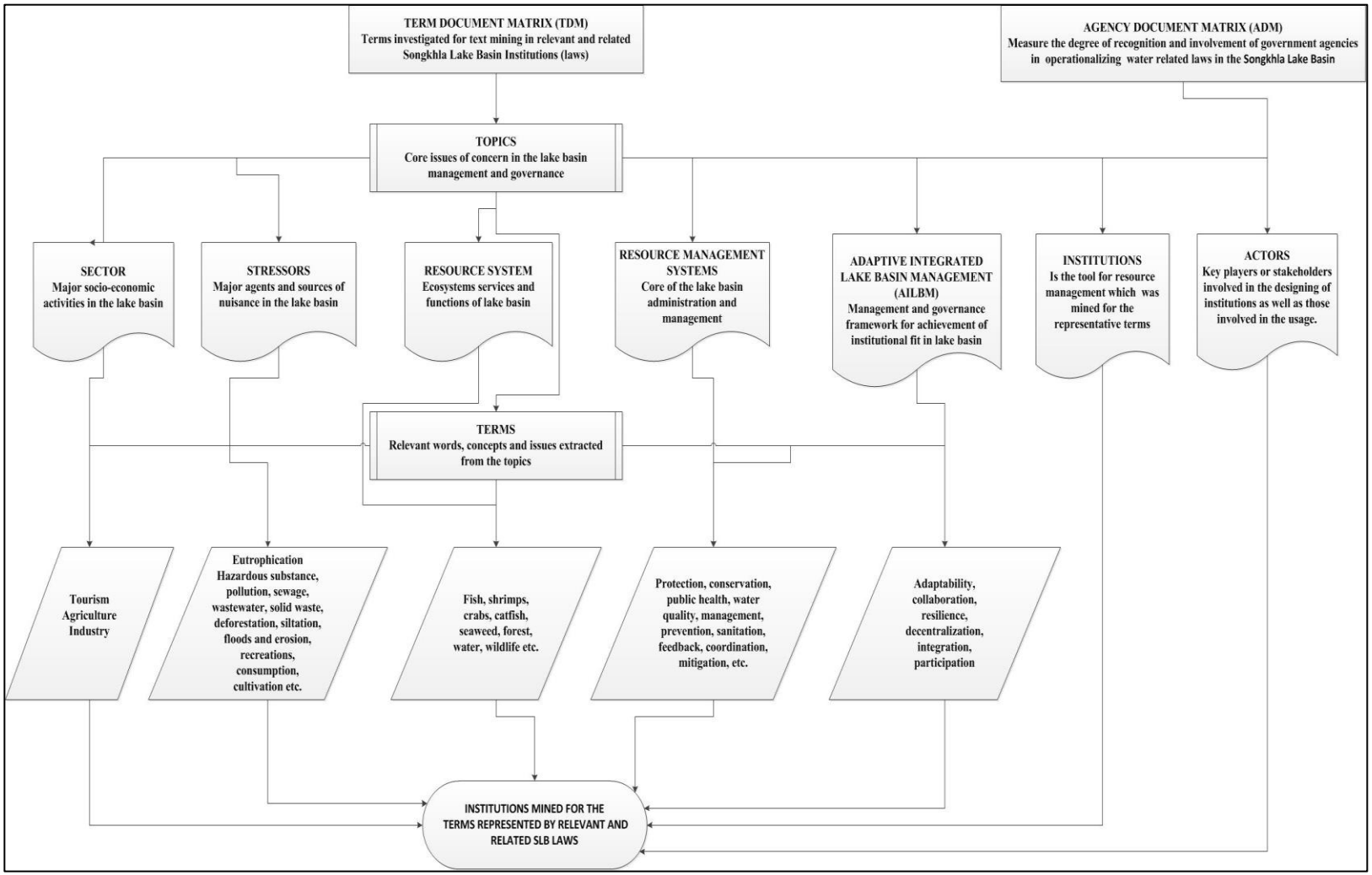

Figure 5.4: Key terms and topics investigated

5.3 Institutional Fit Analysis

5.3.1 Descriptive Statistics of Institutions

The basic statistics of the selected water institutions under review was determined using the descriptive statistics of the text mining analysis presented in the Term Document Matrix (TDM) and Agency Document Matrix (ADM). The timeline of the institutions were analyzed and plotted in a line graph. The hypothesis was tested using the P value statistical significance and was calculated from the Term Document Matrix (TDM) data generated from the text mining analysis. The main issue addressed by this work was the determination of the desirability of using text mining for the quantification of institutional fit of water governance in Songkhla Lake Basin, Thailand. Other statistical parameters determined include, but were not limited to mean, standard error, median, mode, standard deviation, etc.

5.3.2 Statutory Density (Measures the degree of recognitions and involvement of institutions)

The statutory density represents the degree to which laws are involved in the management of an issue related to the representative terms of the Topics. This parameter is designed to measure the degree of involvement and recognition of the representative terms in relevant institutions for lake basin. If mined terms density are low it means that the institutional involvement is poor and the implication is that such institutions cannot cater for the need of the resource system as well as enhance the performance of agencies set-up by such institutions. The statutory density is a measure of how much space the representative terms mined occupy in the laws or how much attention the sets of institutions under review give to these terms.

Statutory Density (SD) measured the magnitude of the number of time the term appears in the laws in the Term Document Matrix (TDM). It is a measure of the recognition of the representative terms in the law. It also graphically shows the degree of recognition of representative mined terms (words, concepts, and issues) in the laws, which is reflected in the most referenced terms in the sets of institutions. Since

institutions are the rule of the game (Ostrom, 1990; Scott, 2001; North, 1990; Young, 2002; Folke, et al. 2007) making them the players 'blueprint' of resource governance, it is then expected that the way they are crafted and the 'Terms' used to express these rules will have a great impact on their implementation. Therefore, it makes sense that analyzing institutions to measure their 'fit' status should assess the frequencies and densities of related and representative terms as they appear in relevant sets of institutions. In other words, fit institutions should contain appropriate 'Terms' that really capture the peculiarity of the ecosystems that they are designed to address. Statutory Density (SD) was determined by dividing the term frequency in water laws relevant to the SLB over the total number of term frequencies and multiplied by one hundred.

$$\mathrm{STD}\ (\mathrm{TF}, \mathrm{WLsSLB}) = \frac{\mathrm{TF\ \ WLs\ SLB}}{\sum(\mathrm{TF\ \ WLs\ SLB})}\ \mathbf{x}\ 100 \qquad \text{(I)}$$

Where: STD = Statute Term Density, Ls = Laws (Acts of Parliament), TF = Term Frequency, WLsSLB: Water Laws relevant to SLB, SLB: Songkhla Lake Basin.

5.3.3 Agency Density (Measures the degree of involvement of an agency in operationalizing the law)

Agency density measures the degree of involvement of the agency or organization in the management of the issue related to the representative terms mined. A high density shows that the institutions have taken cognizance of the need for the agency to address the issues of the representative terms. A low density implies that the agencies are not adequately equipped to manage and govern the resource systems. The interesting aspect of this parameter is that it is capable of showing agencies/organizations operating under an executive fiat, but without any legal mandates. Agency Density (AD) measured the number of times an agency is mentioned in the law as well as the number of times an agency appears in the Agency Document Matrix (ADM). It is also used to show the degree of involvement of an

agency in operationalizing the law. Agency Density (AD) was determined by dividing the agency frequency in water laws relevant to SLB over the total number of agency frequencies and multiplied by one hundred.

$$\mathrm{AD}\ (\mathrm{TF}, \mathrm{WLsSLB}) = \frac{\#\ \mathrm{A}\ \ \mathrm{WLs\ SLB}}{\sum(\mathrm{A}\ \ \mathrm{WLs\ SLB})}\ \mathbf{x}\ 100 \qquad \text{(II)}$$

Where: AD = Agency Density, Ls = Laws (Acts of Parliament), A = Agency that appear in WLsSLB, WLsSLB: Water Laws relevant to SLB, SLB: Songkhla Lake Basin.

5.3.4 Overlap analysis (index of the degree of fragmentation of institutions)

Overlap is one of the leading cause of institutional fragmentation and occurs when two or more agencies have the same jurisdiction or influence over the same area, activity, and/or resource (Ekstrom and Young 2009), and manifests as duplication or gaps in authority (Hill et al. 2008). The problems of uncoordinated overlapping laws and gaps have been highlighted by a lot of scholars (Ekstrom and Young, 2008, Ekstrom et al, 2009). Overlap measures the degree of fragmentation in water governance (Salaman and Bradlow, 2006), and fragmentation exists when responsibility is divided or allocated among multiple actors and/or agencies (Hill et al, 2008). This parameter measures the degree to which the representative terms overlap within the sets of institutions.

Also, overlapping terms can indirectly depict the institutional priority and a high degree of overlapping of representative terms can show the interests, aims and goals of the institutions. The tool can be used to produce an overlap index, which will show the true picture of the general overlap. For the purpose of this analysis, a fit institution of lake basin should not be overwhelmed with overlaps because the negative effects of overlaps will counteract the positive effects of gaps, while an overwhelming overlaps indicate potential problems arising from jurisdictional and interagency conflicts, the

challenge remains to determine what constitutes an acceptable overlaps and gaps as well as determine the balance between the two that will ensure institutional fit, which should be the subject of another research. The following parameters were determined under overlaps: statutory, agency and index.

(1) Statutory Overlap (SO), refers to the number of laws that contain a given term. The term with the highest number of laws ranked as having the highest overlap from this law variable (Ekstrom and Young 2009). Statutory Overlap (SO) was determined by dividing the number of laws containing the terms in the water laws relevant to the SLB over the total number of laws reviewed and multiplied by one hundred.

$$\mathrm{SO}\ (\mathrm{T}, \mathrm{WLsSLB}) = \frac{\mathrm{WLs}\ (\mathrm{T,WLSLB})}{\sum \mathrm{WLs\ SLB}} \mathbf{x}\ 100 \qquad \text{(III)}$$

Where: SO = Statutory Overlap, Ls = Laws (Acts of Parliament), T = Term, WLsSLB: Water Laws relevant to SLB, SLB: Songkhla Lake Basin.

(2) Agency Overlap (AO), refers to the agencies associated with the overlapping laws for a given term identified in the Agency Document Matrix (ADM). Agency overlap exists in water governance when responsibility is divided or allocated among multiple actors and/or agencies (Hill et al 2008), which manifests as fragmentation in authority. A term involving a high number of laws with high number of associated agencies would result in number closer to 100 percent (Ekstrom and Young 2009). Agency Overlap (AO) was determined by dividing the number of agencies associated with the water laws relevant to the SLB over the total number of agencies reviewed and multiple by one hundred.

$$\mathrm{AO}\ (\mathrm{T}, \mathrm{WLsSLB}) = \frac{\mathrm{A}\ (\mathrm{T,WLSLB})}{\mathrm{A(SLB)}} \mathbf{x}\ 100 \qquad \text{(IV)}$$

Where: AO = Agency Overlap, T = Term, WLsSLB: Water Laws relevant to SLB, A = Agencies, SLB: Songkhla Lake Basin.

(3) Overlap Index, was calculated using the two variables (SO+AO) over the six categories of water related laws relevant to the SLB (WLsSLB). The Overlap Index for any given term shows the institutions and agencies involved with its management. The results of the individual variables, however, stand-alone by showing individually the overlapping status of each term between institutions and agencies. The OI may show a high number based on the high result of one variable (SO or AO), and may miss the other concerns hidden in-between. For instance, OI may not show that although institutions overlap, agencies do not. Therefore, all variables and the OI provide detailed description of the overlapping status of a given topic. To compare the Statutory Overlap (SO) and Agency Overlap (AO) across the categories of the institutional framework for the study, we normalized the SO and AO by the total number of laws reviewed to get the OI (as seen above) (Ekstrom and Young 2009).

$$\mathrm{OI}\,(\mathrm{T}, \mathrm{WLsSLB}) = \frac{\mathrm{SO+AO}}{6}\mathbf{x}\ 100 \qquad \text{(V)}$$

Where: SO = Statutory Overlap, AO = Agency Overlap, 6 = subdivision of 19 sets of institutions under reviewed

5.3.5 Gaps analysis (index of the degree of misfit/mismatch of institutions)

Gaps measures the degree of mismatch, which often results in misfit of scales, spatial and temporal within institutions (Folke, et al, 2007), as well as quantifies agencies with overlapping responsibilities. Gaps occur when a critical linkage between two components of a term is not addressed in the institutions. These linkages are referring to the interactions between and across: sectors, stressors, actors, resource systems, resource management systems and the AILBM. Gap is a measure of institutional mismatch or misfit, in other words, a missing link of the terms in the body of the law. The modeled linkages that score zero in the Term Document Matrix (TDM) are a gap (Ekstrom and Young 2009). Also, fit institutions should not be overwhelmed

with gaps which are an indication of poor linkages between the core elements of the lake basin governance and management. There are two types of gaps determined in this work which are: Institutional Gaps (IG) and Overall Institutional Gaps (OIG).

(1)Institutional Gaps (IG), measure specific institutional mismatch or fit in each set of 19 institutions grouped under 6 sub-divisions (Fisheries, Irrigations, Marine, Environmental, Forestry/Land and Local Administrative) laws. It was calculated by dividing the number of the missing-links of a representative term in the law reviewed over the total of all the missing-linkages of a representative in the TDM multiplied by one hundred.

$$\mathrm{IG(WLsSLB)} = \frac{\#\ \text{gaps}}{\#\ \text{linkages}} \mathbf{x}\ 100 \qquad \text{(VI)}$$

Where: G = represents the proportion of the legal gaps to modeled links (gaps = number of modeled links absent from the law; linkages = number of total modeled links in the system); WLsSLB: Water Laws relevant to SLB

(2)Overall Institutional Gaps (OIG) gives an overall estimation of institutional gaps in the 19 sets of institutions reviewed. It was calculated by dividing the total number of the missing-links in the law reviewed over the sum total of all the missing-linkages in the TDM multiplied by one hundred.

$$\mathrm{OIG(WLsSLB)} = \frac{\sum\#\ \text{gaps}}{\sum\#\ \text{linkages}} \mathbf{x}\ 100 \qquad \text{(VII)}$$

Where: G = represents the proportion of the legal gaps to modeled links (gaps = number of modeled links absent from the law; linkages = number of total modeled links in the system); WLsSLB: Water Laws relevant to SLB; OIG = Overall Institutional Gaps; SLB: Songkhla Lake Basin.

5.3.6 Institutional Priority

Institutional priority is a measure of what is most important and takes precedence in institutions or sets of institutions for resource management and governance in lake basins. In other words, it is the evaluation of institutions based on their aims, objectives and goals. This is based on the assumption that acknowledges the capacity of actors in the lake basins to develop institutions or sets of institutions to address the environmental problems (Haller, et al, 2013). But, the challenge is in the fact that actors may have very specific desires that may lead to narrow management actions aiming at one objective (economic and biased interests) at the detriment of others (social and ecological) (Kalikoski, et al, 2002). This is because the goal actors want to achieve will eventually influence what is emphasized and are seen as challenges (Valn and Vedeld, 2012). Therefore, determining institutional fit should include identifying what aspects of the resource system the actors emphasize.

Also, most institutions were designed for strategic reasons and not because they were meant to solve socio-ecological challenges, thus achieving institutional fit becomes very difficult. Even when actors actually get their priorities right to address the need of the socio-ecological systems, in most cases they may be distracted in the process of negotiations. Therefore, this tool helps to keep the actors in line to develop the right priority that will match that of the resource system because well fit institutions will have incentives and priorities matching with that of the resource system (Wilson, 2006). Young (2002) noted that special interests of particular categories of human actors can lead to the creation of regimes that are poorly suited to the biophysical systems with which they interact. Therefore, this tool can be used to measure and quantify vested interests (priorities) and the magnitude of their influence on the institutions.

This parameter uses the text mining analysis to determine and measure the main aims and objectives as well as the purpose of the laws governing the lake basin. The quantitative measure of priorities of institutions will help illustrate if the laws under review encourage resource utilization over conservation and protection. For the purpose of this work a fit institution is that which ensures that there is a balance

between the resource systems and resource management systems; which does not focus all its attention on the resource system alone, but also covers the resource management system at a great length with particular attention to the peculiarities of the socio-ecological system. Therefore, the purpose of this aspect of the work was to use text analysis to determine the priorities of the sets of institutions reviewed and to see if it will agree with the conclusions of previous qualitative studies. This is a new perspective added to the use of text mining analysis to determine institutional fit for governance of resources. To determine the institutional priorities of the SLB water related laws, we divided the sum total of representative terms (T) under each topic (Tc) over the sum total of all the topics and multiplied by one hundred.

$$\text{IP (WLsSLB)} = \frac{(\sum \text{T WLsSLB} = \text{Tc})}{\sum (\text{WLsSLB Tc})} \mathbf{x}\ 100 \qquad \text{(VIII)}$$

Where: IP = Institutional Priority; T = Term; WLsSLB: Water Laws relevant to SLB; Tc = Topic; SLB: Songkhla Lake Basin.

5.3.7 Institutional Response to Resource Management

The institutional response to resource management presupposes that institutional fit can be determined if we can measure the degree of its response to resource management. For existing institutions, the aim is to determine the degree which the institutions have captured the current resource management and governance perspectives. It can also be very useful in testing management response for proposed new sets of institutions. The aim is to help the proponents and their stakeholders focus on developing sets of institutions that will be adequate to respond to management needs of the lake basin. The purpose of this indicator is to use text mining analysis to determine the institutional response to management of the resource base.

This indicator is capable of determining quantitatively the degree of institutional response to resource management in the area of property rights and ownership. The common literature has shown that variation in property rights can make a difference in

resource management outcomes (Sclagar and Ostrom 1992, Bromley 1991; 1992). Agrawal (2003) stated that markets or private property arrangement and public ownership or state management do not exhaust the range of plausible institutional mechanisms to govern natural resource use. This tool is capable of quantitatively measuring the degree of formal and informal property rights and ownership in sets of institutions, as well as determines their levels of impact on the governance of the lake basin. Thus, giving practical insights on how to achieve a balance for enhancement of institutional acceptance, which is a measure of public participation; a key factor in achieving institutional fit (Decaro and Stokes, 2013).

It can also be used to test for the adaptive capacity of existing institutions or sets of institutions that govern the lake basins, especially in this era of global climate change which demands that lake basin institutions to be able to rise to the challenge of developing resilient and robust governance systems that are more proactive and progressive in coping with the expected impact of environmental change (Gupta et al, 2010). The importance of this parameter cannot be over-emphasized, especially now that there is a possibility of climate change effect on the functions of lakes and their ecosystems (O'Reilly et al, 2003), which will not only affect processes within the lake, but also those in the watershed, potentially altering the availability and quality (e.g. nutrient and contaminant loads) of water entering the lake (Wrona et al., 2006). Therefore, the use of text mining for climate change and management representative terms in sets of institutions for lake basin can enable us to evaluate the integrative and adaptive elements of sets of institutions for lake basins governance and management. To strengthen the ability of this parameter to capture adaptive and integrative qualities of lake basin institutions, the AILBM conceptual framework of institutional fit of lake basin governance was introduced into the text mining analysis. This is based on the assumption that when the representative terms of AILBM are mined and analyzed, then a quantification of the institutional adaptive and integrative qualities of institutions of lake basin can be measured (see chapter 6).

To fully understand institutional fit of lake basin water governance instruments, we needed to determine and measure quantitatively the degree of response of the

existing institutions to the resource management for which it was designed. This is another new perspective added to the use of text mining analysis for the purpose of determining institutional fit for governance of resources. To determine the Institutional Response to Resource Management (IRRM) of the SLB water related laws, we divided the representative terms of Resource Management (RM) and the AILBM over the sum total of RM and AILBM and multiplied by one hundred.

$$\text{IRRM (WLsSLB)} = \frac{\text{(T,WLsSLB RM \& AILBM)}}{\sum \text{(T,WLsSLB RM \& AILBM)}} \mathbf{x}\ 100 \qquad \text{(IX)}$$

Where: IRRM = Institutional Response to Resource Management; T = Term; WLsSLB: Water Laws relevant to SLB; RM = Resource Management; AILBM = Adaptive Integrated Lake Basin Management; SLB: Songkhla Lake Basin.

5.4 Text Mining Process Verification

One process of verification was a stakeholder governance perception study of a 2000 sample population of the SLB carried out between the periods of April to July 2014 and 12 sub-basins communities' field survey carried out between November 2014 to May 2015. It was designed as part of the research supporting method for verification of the results of text analysis. We wanted to see if there would be convergent views from results of text mining analysis and stakeholder/sub-basin communities' surveys. The stakeholders also guided the process selection and the identification of relevant and related sets of institutions (laws) for water governance in the SLB. They also played a critical role in the identification of the SLB stressors and terms for text mining analysis (Term-Document-Matrix-TDM); although this was also supported by extensive review of literature. Other methods of verification include: terms components review and interview by experts, institutional fit equations and tools reviewed by experts, extensive relevant and related peer review journals, review of Thai government technical publications, review of SLB Master Plan Reports, ongoing

public, private and stakeholders water governance performance indicators survey and several repetitions of the text mining procedures and computations.

5.5 Results

This section presents results of the text mining analysis of institutional fit of water governance in the SLB.

5.5.1 Topic frequencies and density

5.5.1.1 Basic statistics of selected water institutions

Table 5.1: Descriptive statistics of text mining of terms from relevant and related water institutions in SLB

Parameters	Overlap in laws (links)	Absence of links (Gaps)	Terms in laws	Agencies in law
Mean	76.36842	15.57895	152.8947	3.421053
Standard Error	31.44829	0.630689	85.36457	0.568757
Median	13	17	56	3
Mode	0	18	16	3
Standard Deviation	193.8603	3.88783	372.0956	2.479153
Sample Variance	37581.81	15.11522	138455.1	6.146199
Kurtosis	24.20289	2.727448	17.60664	4.094696
Skewness	4.640229	-1.67326	4.137663	1.731188
Range	1125	16	1660	11
Minimum	0	3	5	0
Maximum	1125	19	1665	11
Sum	2902	592	2905	65
Count	38	38	19	19
Largest(1)	1125	19	1665	11
Smallest(1)	0	3	5	0
Confidence Level (95.0%)	63.72029	1.277898	179.3443	1.194913
P-Value		0.62		0.59

The 19 sets of institutions (laws) used in this study contained 1263 sections, 554,740 characters and 128,482 words. The detailed descriptive statistics of the text mining analysis is presented in table 5.1. The study also showed that the core water laws were enacted between the period of 1913 and 1964; the environment related laws were created in 1992, the decentralization laws were between the period of 1994 and 1999 (figure 5.5). The P-Value (0.62) indicates weak evidence against the assumption that text mining is a useful tool in the quantification of institutional fit for water governance of lake basins and the statistical significance showed that indeed, text mining can be useful in the assessment of institutional fit of water governance instruments for lake basins.

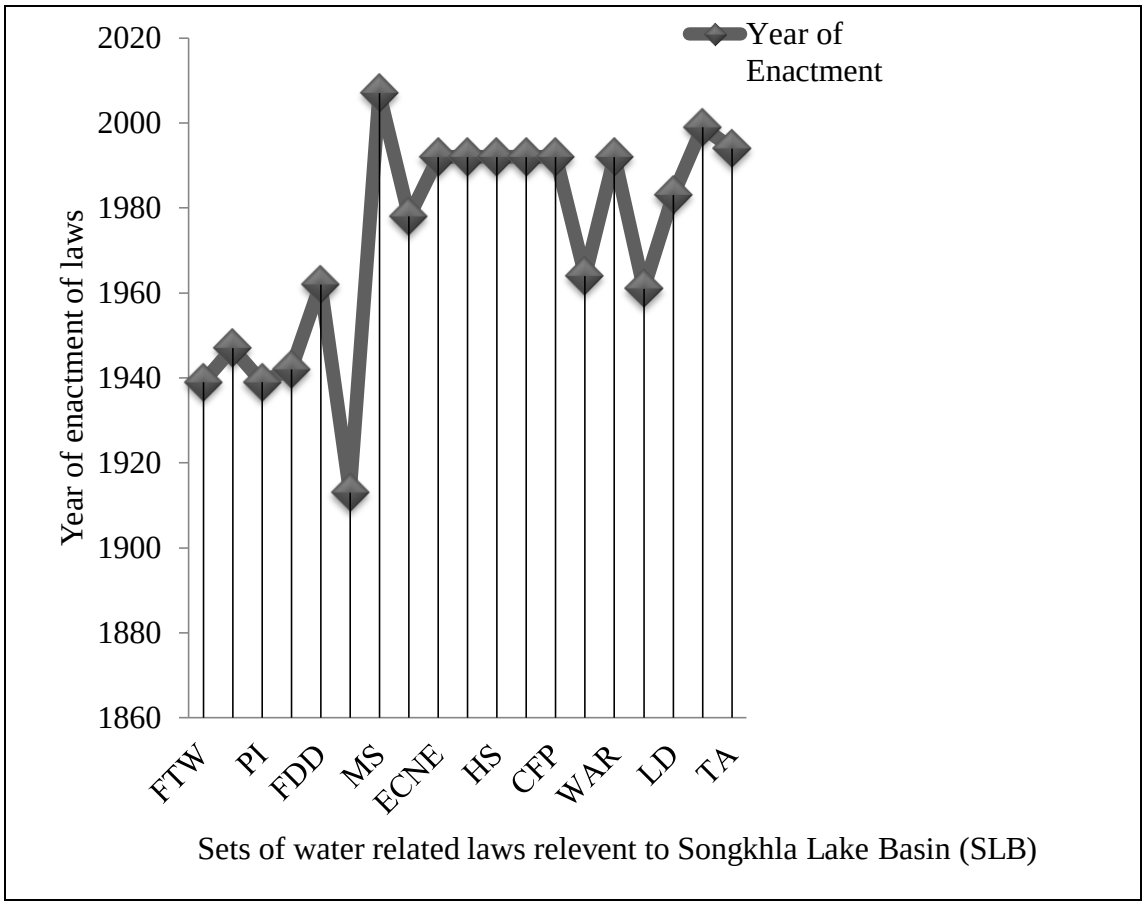

Figure 5.5: Years of Enactment of the SLB water related laws

(For interpretation see list of abbreviations and symbols page)

5.5.1.2 Statutory Density (measures the degree of recognition and involvement of institutions)

The most referenced terms were 'fish' (frequency = 1104, density = 62.66%) in Fisheries Laws, (frequency = 15, density = 5.51%) in Forestry/Land Laws, (frequency = 2, density = 0.90%) in Irrigation and Marine Laws etc. 'Water' (frequencies = 167, density = 74.89%) in the State Irrigation Act and in the in Fisheries Act (frequency = 106, density =6.02%) and 'agriculture' (frequency = 292, density = 16.37) in the Fisheries Act. Others 'forest' (frequency =188, density = 69.12%) in National Reserved Forest Act (frequency = 94) and Commercial Forest Plantation Act (frequency = 78) and 'hazardous substances' (frequency = 185, density = 33.94%) in Hazardous Substance Act (table 5.2 and figure 5.6). This shows that water and fishery resources are the most contested issues in the SLB. This result agrees with the stakeholders' survey findings because of the direct bearing of these issues to the livelihood support of the communities in and around the SLB.

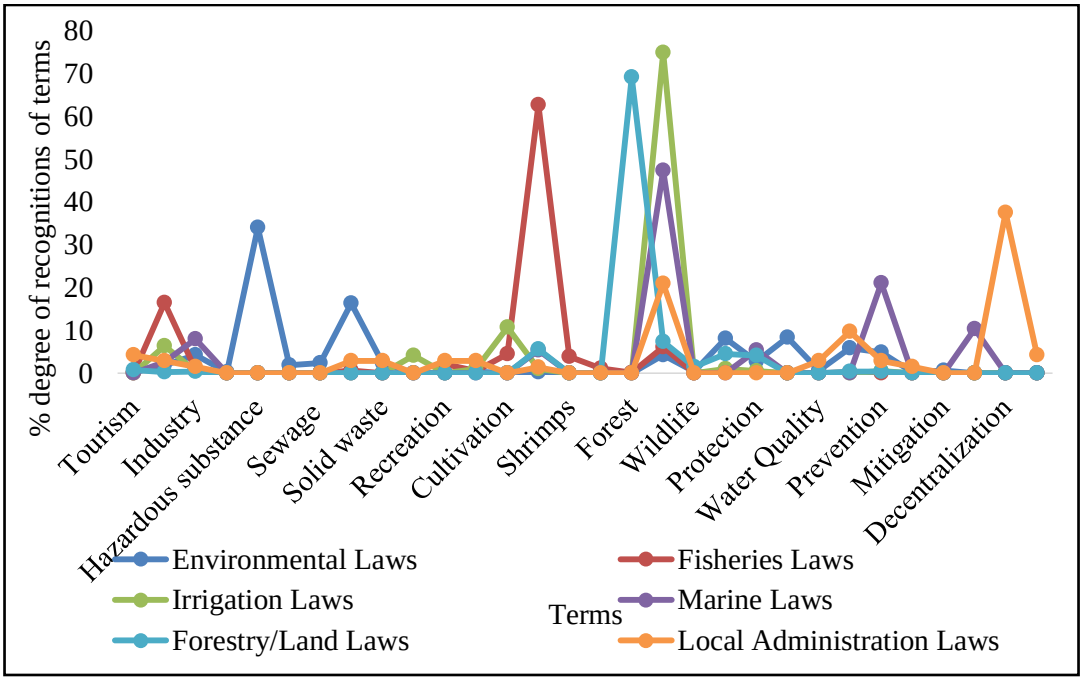

Figure 5.6: Statutory Density - measures the degree of recognition and involvement of nstitutions

Table 5.2: Term Document Matrix (TDM) modeled from text mining analysis use for institutional analysis in the SLB

Topics	**Terms**	**6 major sub-divisions of the 19 sets of institutions relevant and related to water governance in the SLB**						**Statutory Terms Frequency**	**Statutory Terms Density**	**Absence links (Gaps) Frequency**	**Total modeled links**
		Fisheries Laws	Irrigation Laws	Marine Laws	Environmental Laws	Forestry/Land Laws	Local Administration Laws				
Sector	Tourism	0	0	0	1	2	3	6	0.21	14	722
	Agriculture	292	14	1	10	17	2	336	11.57	5	
	Industry	14	1	3	23	1	1	43	1.47	10	
Stressors	Eutrophication	0	0	0	1	0	0	1	0.03	18	
	Hazardous substance	0	0	0	185	0	0	185	6.37	17	
	Pollution	0	0	0	10	0	0	10	0.34	18	
	Sewage	0	0	0	13	0	0	13	0.45	18	
	Wastewater	10	0	0	89	0	2	101	3.48	16	
	Solid waste	0	0	0	13	0	2	15	0.52	15	
	Deforestation	0	0	0	0	0	0	0	0	19	
	Siltation	0	0	0	0	0	0	0	0	19	
	Erosion and flood	0	9	0	0	0	0	9	0.31	17	
	Recreation	37	0	0	0	0	2	39	1.34	16	
	Consumption	9	2	0	2	0	2	15	0.52	15	
	Cultivation	78	24	0	0	0	0	102	3.51	15	
Resources systems	Fish	1104	2	2	1	15	1	1125	38.77	12	
	Shrimps	67	0	0	0	0	0	67	2.31	18	
	Crabs	19	0	0	0	0	0	19	0.65	18	
	Forest	1	0	0	0	188	0	189	6.51	13	
	Water	106	167	18	23	20	15	349	12.03	3	
	Wildlife	0	0	0	2	4	0	6	0.21	16	
Resource Management system	Conservation	10	2	0	44	12	0	68	2.34	13	
	Protection	4	1	2	15	11	0	33	1.14	10	
	Public Health	0	0	0	45	0	2	47	1.62	15	
	Water Quality	0	0	0	3	0	0	3	0.10	17	
	Management	4	0	0	32	1	7	44	1.52	14	

	Prevention	0	1	8	26	1	2	38	1.31	9	
	Sanitation	0	0	0	1	0	1	2	0.07	17	
	Mitigation	0	0	0	3	0	0	3	0.10	18	
	Coordination	0	0	4	0	0	0	4	0.14	18	
AILBM	Adaptability	0	0	0	0	0	0	0	0	19	
	Collaboration	0	0	0	0	0	0	0	0	19	
	Resilience	0	0	0	0	0	0	0	0	19	
	Decentralization	0	0	0	0	0	27	27	0.93	18	
	Integration	0	0	0	0	0	0	0	0	19	
	Participation	0	0	0	0	0	3	3	0.10	17	
	Total	**1762**	**223**	**38**	**545**	**272**	**72**	**2912**	**100**	**592**	**130**

Note: * AILBM – Adaptive Integrated Lake Basin Management; * Topics – are the core issues of concern in lake basin management and governance extracted from the AILBM

* Terms – are relevant words, concepts, and issues extracted from the 'Topics' because the 'Topics' were two broad and ambiguous; * Institution – is the 'Topic' that was mined for represented by relevant and related laws

5.5.1.3 Agency Density (Measure the degree of involvement of an agency in operationalizing the laws)

The most involved government agency in water resource management and governance in the SLB was the Ministry of Agriculture and Cooperatives (MOAC) (frequency = 4, density = 6.89%) in forestry/land laws, (frequency = 3, density = 5.17%) in irrigation laws, (frequency = 2, density = 3.44%) in fishery laws and in environmental laws (frequency = 1.5, density = 2.59%). The Ministry of Natural Resources and the Environment (MONRE), ranked fourth (frequency = 2, density = 3.44%) in forestry/land laws and (frequency = 2.5, density = 2.5%) in Enhancement and Conservation of National Environmental Quality Act (table 5.3 and figure 5.7). The most interesting aspect of the result is that no laws under review allocated responsibilities to the Department of Water Resources (DWR), which is the major implementing agency of government for water resources related concerns.

Table 5.3: Agency Document Matrix (ADM) use for analysis of agencies in the law

	Fishery Laws	Irrigation Laws	Marine Laws	Environment Laws	Forestry/Land Laws	Local Administrative Laws	Total
MONRE	0	0	0	2.5	2	0	4.5
MOAC	2	3	0	1.5	4	0	10.5
MOI	0	0	0	1	0	2	3
MI	0	0	0.5	3.5	1	0	5
MOT	0	0	2	1	o.5	0	3
MPH	0	0	0	2	0	0.5	2.5
DWR	0	0	0	0	0	0	0
DGW	0	0	0	1	0	0	1
PCD	0	0	0	1	0.5	0	1.5
ONEP	0	0	0	1	0	0	1
RFD	0	0	0	1	4	0	5
DNWP	0	0	0	1	1	0	2
DMCR	0	0	0	0	0	0	0
RID	0	3	0	0.5	0.5	0	4
DOF	2	0	0	0	0	0	0
DOPA	0	0	0	0.5	0	1	1.5
DLA	0	0	0.5	1	0	1	2.5
DDPM	0	0	0	0	0	0	0
LAO	2	3	0	2	2	2	11
Total	6	9	3	20.5	15	6.5	58

(For interpretation see list of abbreviations and symbols page)

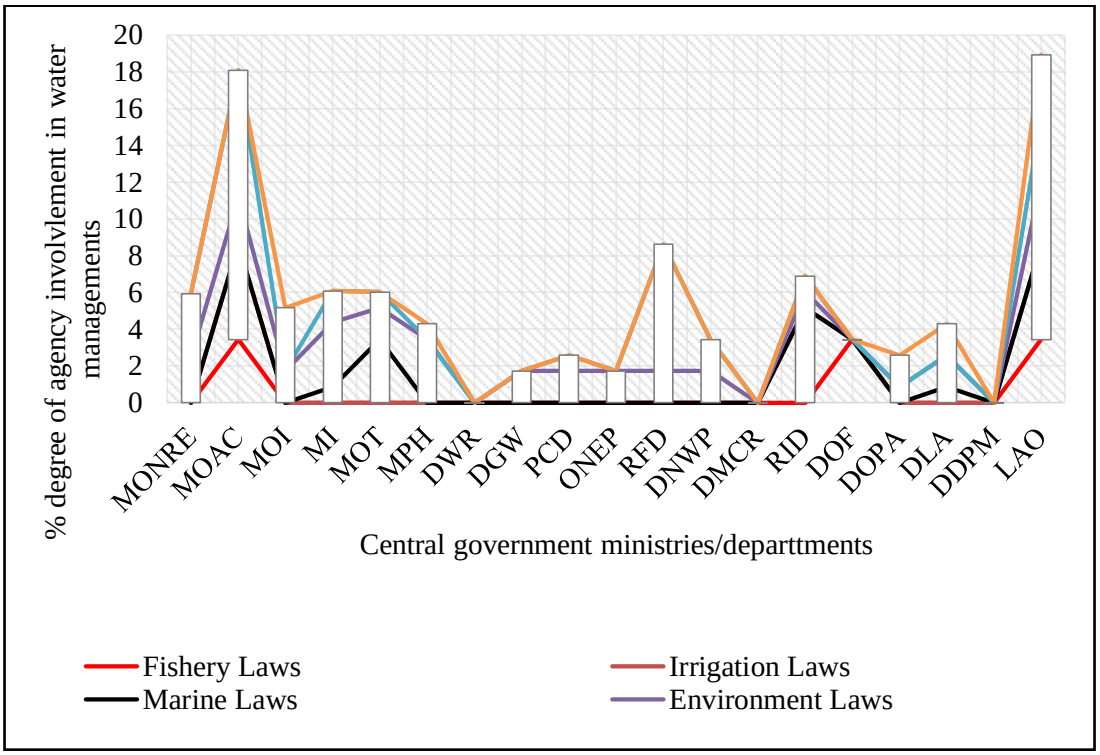

Figure 5.7: The degree of involvement of an agency in operationalizing the laws (For interpretation see list of abbreviations and symbols page)

5.5.2 Overlap Results

This section presents the overlap measurement results for terms, institutions and agencies. The term 'water' measured the highest overlap for the set of institutions under review (SO = 84.21%, AO = 84.21% and OI = 28.07); this was followed by 'agriculture' (SO = 73.68%, AO = 84.21 and OI = 26.31) and 'industry' (SO = 47%. AO = 78.95% and OI = 21.05). This showed that one of the Topics with the highest overlaps was Sectors. The lowest overlap results were with the terms: eutrophication, sewage, flood and erosion, shrimps, crabs, water quality, prevention, sanitation and decentralization. The results are summarized (figure 5.8). These results confirmed that water is the most fragmented issue in SLB covered by a large number of institutions (laws) and agencies handling it and no specific laws coordinating its management and governance (Christensen, and Boon-Long, 1994, Wongbandit 1995, Sukhsri 1999, Molle 2001, Neef 2008, Kanjina 2008).

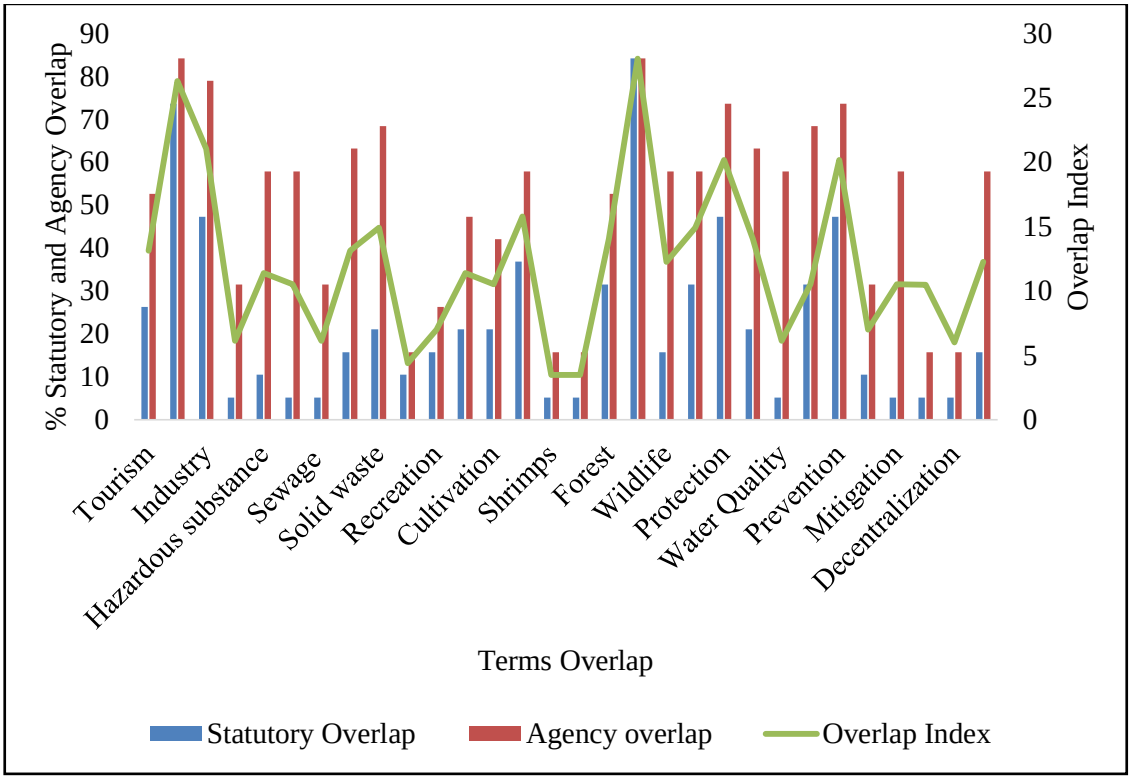

Figure 5.8: Institutional overlap in SLB

5.5.3 Gaps Results

There were high rates of institutional gaps recorded in the study (figure 5.9); a total of 592 gaps (absence links) and 130 links out of 722 modeled links in the sets of selected institutions (laws) respectively. This resulted in an overall 82.41% degree of mismatch/gaps in the sets of institutions under review. The terms with the highest number of gaps (absence links) with (19 absence links) were: deforestation, siltation; followed by (18 absence links), eutrophication, pollution, sewage, shrimps, and crabs. The absence links were experienced more in the term category related with stressors, resources systems and resource management systems. The term with the least gaps (absence of link) was water (3 gaps). These results indicate a misfit and mismatch in the institutional framework of the SLB because the resource system is composed of more than one core resource (water, fish, shrimps, land, wildlife, etc.) and in the case whereby one resource like 'water' has the least gaps (showing that there is a synergy

between components of the lake basin governance) and the other resources have high gaps, there is an imbalance. Furthermore, the high gaps of the stressors and resource management systems' representative terms, especially in the case where some of these terms were not mentioned at all in these laws, show a clear state of institutional misfit. In other words, there is more focus on water than all the other core and related issues, which implies that in implementation and management those issues could be overlooked.

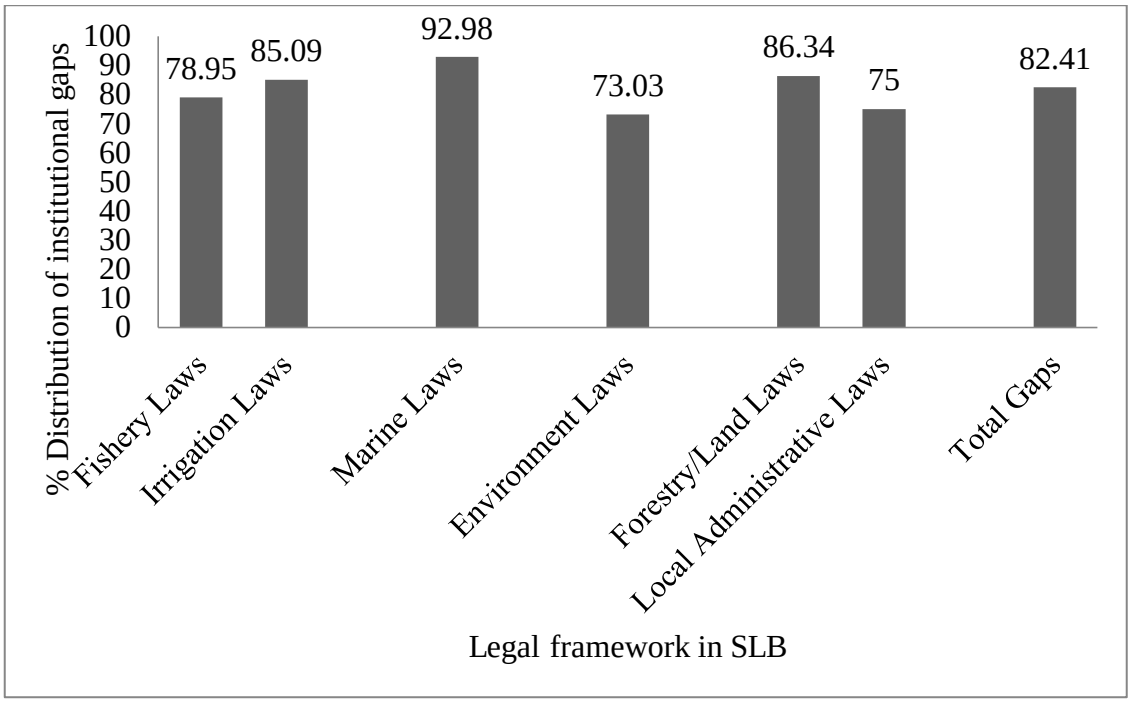

Figure 5.9: Institutional Gaps in SLB

5.5.4 Institutional Priority and Resource Management

Terms under the category 'resource management system' were designed to measure the response of the existing institutions to resource management and AILBM to see the level of the recognition given to these issues. The results brought out an interesting pattern, which showed that the overriding focus/priority of the sets of institutions (laws) under review were more on resource utilization than on its sustainability. This confirms the observations of several researchers on the SLB that

resource utilization far outweighs management and governance. While some terms like 'conservation' (frequency = 68, density = 2.34%), 'protection' (frequency = 33, density = 1.14%) and 'mitigation' (frequency = 3, density = 0.10%), showed that little attention is given to sustainability, terms related to the AILBM were hardly found in the sets of institutions reviewed (table 5.10).

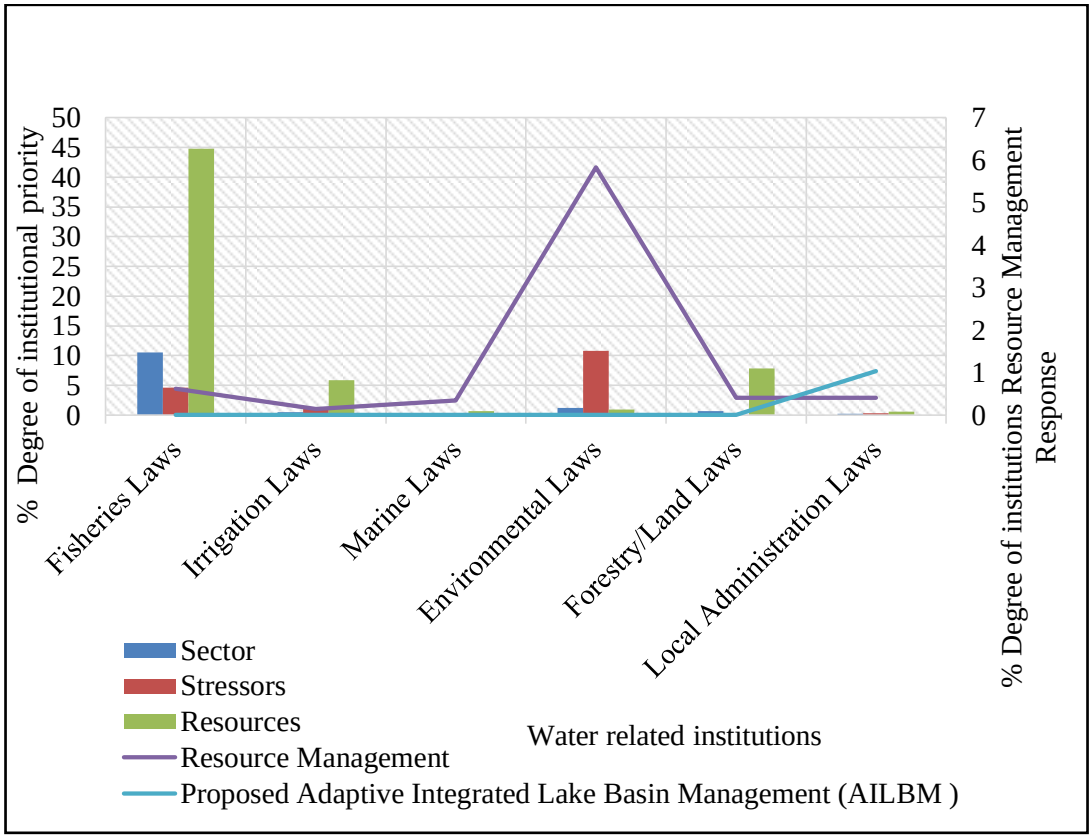

Figure 5.10: Institutional Priority and Resource Management Response

This confirms that the institutional instruments are very inadequate and not-fit for the governance of the SLB. A combination of institutional priorities and institutional response to resource management (figure 5.10) showed that while the resource category in the Fishery Acts were in the range of 44.76%, management was in the range of 5.83%, showing that there is not enough provision in the law to create a balance between resource utilization and sustainability. The results also showed that while the environmental laws recognized the presence of stressors in the environment

(10.80%), they lacked adequate management and mitigation measures to ensure resource sustainability (the ability for the lake basin to exist and continue to deliver).

5.6 Discussion - Interpretation of Results

5.6.1 Basic statistics of selected water institutions

The statistical significance (p-Value 0.62 for overlaps and gaps) shows the usefulness of text mining for the assessment of institutional fit of lake basin water governance instruments. This is in agreement with Ekstrom (2008 and 2009) and Ekstrom and Young (2009) results of analysis of overlaps and gaps in ocean laws across the geo-political jurisdictions of federal and three states of the United States of America. The results show that the laws regulating water in SLB are old and this agrees with Khambanonda (1972) who noted that Thailand's first forest protection law was promulgated in 1897 and can be considered as one of the oldest in the world. Although in recent years, other conservation and protection laws on forests and natural resources were enacted, revised, or improved, they are still inadequate to effectively and rationally conserve and protect these resources from encroachment and exploitation by the increasing population and modern technology. Also, Wongbandit (1995) described Thai water legal provisions as outmoded and obsolete and Biltonen (2001) concluded that the existing laws related to the management of water resources in Thailand are often old and based on conditions that no longer exist.

5.6.2 Water Resources

Water overlaps exist throughout the 19 laws reviewed and all the 19 agencies have mandates covering every aspect of water issues. This shows a high fragmentation of water issues in the laws and agencies, indicating duplication of responsibilities, which will inherently lead to conflicts and challenges in governance. On the other hand, the Department of Water Resources (DWR), which claims the major stake in water resource management, is not mentioned in any of the laws, in spite of 'water' been a high density term in all the laws. The Thai National Water law is still in draft

form, although the DWR has regulations with which they operate, however, regulations are supposed to be drawn from the Acts of the Parliament (i.e. institutions/laws), commonly issued by the Minister (Administrative Court of Thailand 2013).

This makes it difficult for the DWR to effectively manage water governance of the SLB. The Songkhla Lake Basin Committee (SLBC) (one of the 25 River Basin Committees established and supervised by DWR) obviously lacks an Act of Parliament for its operations. This may also affect the proper functioning of the National Water Resources Committee (NWRC) recently transferred from the Office of the Prime Minister to the DWR (UN-Water/WWAP 2007). Molle (2001) observed that the adoption of Water Basin Organizations (WBO) by Thailand would have helped solve the problem of governance conflicts in water resources management, but this has failed due to absence of strong political backing and legal empowerment as mere formation of the appropriate organization without appropriate legal mandates cannot result in integrated water resources management (Shal el al. 2000).

The obvious statutory and agency fragmentation shown by the sets of institutions overlap measurement indicates that Ministry of Agriculture and Cooperatives (MOAC) and her departments have the highest responsibility in water resources management and governance; the focus of MOAC is not water resource management, mainly utilization. DEQP (2008) noted that agriculture is by far the highest consumer of water with more than 57% of the 109.3 billion m^3 in 2006 and thus put enormous pressure on water resources. This implies that issues of water resources protection and conservation are not of high priority in the sets of institutions reviewed. Considering all these, it becomes clear that a holistic, integrative and adaptive water resources management institutional framework that is fit-for-purpose and covers all spectrum from utilization, protection, mitigation, etc., is urgently needed in the SLB. Furthermore, in spite of the overlapping nature of the term ‘water’ in the laws and agencies, the SLB is almost absent. Therefore, the quantitative text analysis confirmed previous qualitative studies on the fragmented nature of water institutions in the SLB, thus verifying the results of this study.

Stakeholders of the SLB identified industry as one of the biggest challenge of the SLB, pointing them out as major contributors of stressors like wastewater, hazardous substances, etc., which have adversely impacted the SLB to a high degree. Interestingly, the term 'industry' has a high statutory and agency density. In statutory, agency and index overlaps, 'industry' ranked the third. All the categories of laws recognized the activities of industry. How come then that these activities have caused so much negative impacts on the SLB, if they are so highly recognized in the laws? The answer is simple: the industry activities recognized in the laws are focused on resource utilization and exploitation and sparsely on protection, prevention and mitigation. This indicates an imbalance pointing to a mismatch in the laws, which has led to the deterioration of the SLB.

5.6.3 Aquatic Resources - Fish

Studies have shown that 'fish' is one of the most contested resource in the SLB and stakeholders corroborate these findings. This has put a lot of stress on the ecosystem of the SLB through overcrowding of fishing gear, illegal fishing among others. Other challenges are the issues of wastewater, solid waste and hazardous substances, which affect the ecosystem and the living organisms (mainly fish and other aquatic resources) of the SLB. Interestingly, the term 'fish' appears in all the 19 reviewed laws with the highest statutory term frequency and density, but this major resource is in a gross state of depletion so much so that there has to be an annual re-introduction of fish species into the Lakes. This also indicates that the focus of the laws is on utilization. Although, the terms 'conservation,' 'prevention' and 'protection' appear frequently in the 19 laws reviewed, ('conservation' however, strangely does not appear at all in Marine laws), and it can easily be assumed that they were not the focus of the laws. In as much as the term 'prevention' appears frequently (with a low density) in all the 19 reviewed laws, the institutional response to resource management indicates that the laws are not equipped to ensure prevention of the over-exploitation, degradation and deterioration of the resource base as well as disaster or emergency situations.

5.6.4 Institutional and Agency Overlaps

The overlap results clearly show the institutional and agencies overlapping per term. They also highlight those agencies that exist on the Agency Document Matrix (ADM), but which have no laws backing their authority (e.g. DWR); in the same vein, laws without implementing agencies were highlighted (Marine Salvage Act). This questions the status of 'fit' of a governance system with agencies having no statutory mandates and institutions (the rule) without implementing agencies (the players). Water with an overlap index of (28.07) is obviously the most fragmented issue, followed by agriculture (26.31) and industry (21.05). The least overlap index are shrimps and crabs (3.51), erosion and flood (4.39) and decentralization (6.0). This indicates that there are more governance functions concerned with water; agriculture and industry than there are for terms with low OI. The challenge to governance fit for the SLB is in the imbalance shown here by these overlapping functions. Most of the institutions and agencies working in the SLB are focused on resource utilization (water and agriculture) and exploitation (industry), while paying little attention to stressors like eutrophication (4.14), sewage (6.14), flood and erosion (4.39), issues that affect the sustainability of the SLB.

The Overlap Index revealed that the laws relevant to agriculture and fishing have the highest impact on water governance of the SLB and the associated agencies like the Ministry of Agriculture and Cooperatives, etc. This agrees with the findings of Khambanonda (1972) who noted that in addition to the inadequacies of the laws, there are also many loopholes in the existing laws and regulations. Biltonen (2001) also observed that the challenge of the DWR stems in part from the lack of a comprehensive water resources law at the national level, which also impact the actual development of local and basin organization for management of water resources. Also, the great diversity of managing agencies creates a wide dispersion of the information needed to effectively coordinate and manage water resources. Arbhabirama et al (1988) concluded that there is a serious challenge of fragmentation of responsibilities and roles regarding water resources among the different segments of Thai administration.

5.6.5 Institutional and Agency Gaps

The assessment of the 19 laws reviewed showed a high percentage rate of overall gaps at 82.41 percent. The following terms had the highest gaps: 'deforestation', 'siltation', 'ecosystems', 'resilience', 'flexibility', 'feedback' and 'adaptability', (frequency = 19). This was followed by terms with (frequency = 18): 'eutrophication', 'pollution', 'sewage', 'shrimps', 'crabs', 'mitigation', 'decentralization' and 'coordination'. Plus, 'hazardous substance', 'erosion and flood', 'water quality', 'sanitation' and 'participation' (frequency = 17). This sad indication goes to support the poor performance of the institutional management response, judging from the fact that issues like resilience, flexibility, feedback, adaptability, sustainability, mitigation, deforestation, participation and coordination are absent in these laws. AILBM cannot stand without these components.

Even going on the resource management priority of these laws, it is confusing to note that issues like water quality, mitigation, sanitation, have such high gaps; not to even mention the huge gaps identified with stressors and the resources. How can resources be adequately managed when their stressors are not given priority attention? Major stressors and their impacts on the SLB like sewage, eutrophication, hazardous substances and pollution have zero links in the institutions, implying that the resource is not protected from these stressors and their impacts. DEQP (2008) rated Songkhla Lake among the poor quality-highly polluted river systems in Thailand in 2003 (class 5 – very poor). Christenseen and Boon-Long (1994) declared that the root cause of the water quality problem can be resolved by institutional innovation and is caused by the failure of institutions and government to enforce compliance on the farmers (agriculture) and effluent control on businesses (industry). DEQP (2008) noted that water quality in Thailand has been under pressure over the years due to deterioration of watersheds, disappearance of wetlands and agriculture and industry.

Shrimps are major resources in the SLB, but this is not accounted for in the institutional framework under-review with a huge gap (frequency = 18). According to stakeholders of the SLB, shrimp-farming is a major source of pollution in the SLB, confirmed by several studies (Ratanachai and Sutiwipakorn, 2006, TSPR, 2010), and

the government supports shrimp farming by annual introduction of shrimps into the Lake. It is, therefore, contradictory to find such a huge gap in the institutions-showing no systematic follow-up in the management of shrimp farming in the SLB. In fact, there seems to be almost no recognition of this resource or its related activities as it is only mentioned in the fishery laws (frequency = 67), as a resource. The Code of Conduct (CoC) standards developed for marine shrimp's culture industry only covers shrimp production quality for harvest and transportation, without any reference to the impact on the environment and water resources. Even the National Fishery Development Policy's major aim for aquaculture was for a 5 percent annual increase in production (FAO 1988). This shows clear indication of misfit because where there is no balance for protection of the resource base, the resource will continue to be depleted no matter how many times shrimps are introduced into the Lake. Although, in 2010, the National Environmental Board agreed on solution guidelines for marine aquaculture in freshwater according to the proposal of MONRE (TSPR 2010), the situation has not changed. The indication of these results (gaps, overlaps, priorities, management response, and density) can explain the complaints of the stakeholders on poor enforcement and compliance of laws in the SLB. This assessment has also shown a confusing mix that will affect enforcement and compliance – who enforces what and how; and what are we complying to?

5.6.6 Institutional Response to Resource Management

The time relevance of institutions and its character of rigidity, which makes it not easily amenable to change, have been discovered as a major drawback of institutional response to change. This is further compounded by the fact that it is very difficult to achieve legal reforms under current conservative-bureaucratic paradigms (Lazarus 2004, Craig Ebbesson 2010). One major characteristic of the selected institutions for water governance in the SLB is that they are ancient (Wongbandit 1995). This makes the institutions inadequate to address the challenges and stressors of the SLB. The laws recognized resource utilization at the peak of about 45 percent, stressors were given a below 10 percent recognition in fishing laws and zero percent in irrigation laws,

marine, forestry/land and local administration laws, while environmental laws were at about 10 percent. In spite of the higher recognition of the stressors in the environmental laws (which is still low), the management response status of these laws were way too low (6%). It is expected that the environmental laws would focus more on addressing the stressors to ensure sustainability of the SLB, but the data disappointedly shows a different trend.

All the 19 laws reviewed showed a lack of preparedness for adaptive and integrative governance, that is the Adaptive Integrated Lake Basin Management (AILBM) (below 1%) indicating a gross misfit for the governance of the SLB. The low density terms like 'eutrophication' (frequency = 1), 'flood and erosion' (frequency = 9), 'wildlife' (frequency = 6), 'water quality' (frequency = 3), 'sanitation' (frequency = 2), 'mitigation' (frequency = 3), 'participation' (frequency = 3), 'coordination' (frequency = 4) and 'pollution' (frequency = 10) were obviously not considered priority issues in the laws reviewed. This is revelatory because these terms and concepts are vital to ensure a balance of utilization and protection, which leads to sustainability. The low appearances of these terms and concepts indicate a deficiency in the laws and this makes them inadequate for ensuring the sustainable existence of the SLB. This can be referred to what Christenseen and Boon-Long (1994) described as institutional stress, which occurs because the institutions for managing a resource are not adjusted properly enough to address the bottlenecks that arise as the supply of the resource declines.

Therefore, there is need to improve the institutional response to resource management. DEQP (2008) concluded that performance is affected in a number of ways by existing institutional and administrative structure because of unclear and ambiguous delineation of responsibilities and inefficient arrangement of horizontal and vertical communication among different agencies and between their stakeholders. Also, Biltonen et al (2001) observed that water resources management has been complicated by gaps and overlaps in management responsibilities because policy and planning lack coordinated policymaking by the agencies concerned, no single Act

directly relates to water resources management and information is not adequately organized in centralized manner because of too many implementing agencies.

5.7 Reflection and Conclusion

The essence of the study was to quantitatively assess institutions to determine their fit status, which required measuring several parameters that have to do with institutional fit. Also, we are assessing institutions of socio-ecological systems, i.e. the SLB; therefore, the fit status is focused on how the institutions reflect on the SLB using the representative terms. It is easy to make the mistake in assuming that the results of terms indicate a fit or misfit, but the vital point of note is that the fit of one term cannot assure the status of institutions that should cover all the terms required to manage a socio-ecological system. So, if water has low gaps and conservation has high gaps, it shows a low recognition of water conservation indicating that the institution is not fit.

The general assessment of frequencies and density of terms, overlaps, gaps, institutional priority and management response shows a clear picture of misfit of the institutional instruments used for water governance of the SLB which in turn affects the overall performance of the water governance system. This will indicate a low percentage of fit for the total governance system of the SLB. Furthermore, research is needed to clarify more on this technique, their usefulness and applicability. Additional analysis is needed to test all the relevant and related water laws and regulations, which can be extended to include bye-laws and related court judgments and pronouncements. This will give a full picture of the institutional fit of the water governance instruments in the country. The gaps and overlaps results revealed that where a term has low gaps, there will most likely be a high overlap results for those terms. More research is required to determine the acceptable range for overlaps and gaps, and the acceptable balance between the two to achieve institutional fit.

Pictures and figures derived from text mining were able to show the lapses in the institutional framework and the reasons for weak enforcement and compliance (research can also be done to understand the reasons for weak enforcement and

compliance). Institutional priority were identified and compared to management response to issues concerning SLB; this imbalance showed another challenge to fit and can be further researched. The results of this study further buttress the need for institutional reforms towards the AILBM conceptual framework (see chapter 3). To this effect, we make the following recommendations:

I. To further refine the text mining analysis technique and adopt it for the assessment of institutional fit of existing water and related governance instruments.

II. It can also be used in the development of new sets of institutions serving as a guide and roadmap that will help to reflect the intent and purpose of the resource management and also achieve institutional fit.

In summary, the current governance system is not fit for the purpose of the preservation and protection of the SLB. To correct this, it may be necessary to develop an institution that will create a singular coordinating and policy harmonization committee, which identifies roles and responsibilities, clearly delineates functions with appropriate management response and strong decentralization principles and also reviews the existing water governance instruments for the SLB and make them appropriate, adequate and relevant to the Basin. A successful example is the Clean Lakes Law of Japan, which designated ten lakes for water quality conservation works and policies as well as granting approval for the Prime Minister's Lake Management Plan (Ballatore and Muhamdiki 2001, www.worldlakes.org) and Lake Poyang of China, the largest freshwater lake in China. Poyang Lake Watershed programme was initiated in 1980, and resulted in the establishment of Mountain-River-Lake Development Commission (MRLDC) with the mandate to provide advice, formulate and modify plans, carry out research, coordinate necessary activities across relevant government and private institutions (Xingzhao 2007).

Also, the qualitative survey showed that the stakeholders, such as the basin community members, Local Administrative Organizations (LAOs) as well as the civil society organizations are willing to contribute positively to the management of the

SLB, therefore, collaboration and participation should be key components of the SLB institutions in order to tap into the potential benefits of those stakeholders. This will go a long way to redress the current speed of deterioration of the Basin and the apathy of the people as well as reduce the stressors that negatively impact the SLB. The tourism potential of the SLB is quite high, but is one economic resource that is not adequately captured in the institutions, and is grossly negatively impacted due to the pollution of the lakes, and due to weak wastewater management. This Sector can be used to improve the livelihood of the SLB's communities, as well as affect the national economy and image. The result of the text mining analysis shows that the tourism sector is poorly represented in the institution and should be given priority attention.

CHAPTER SEX

INTEGRATIVE AND ADAPTIVE CAPACITY OF INSTITUTIONS

This chapter is adapted from:

Cookey, P. E., Darnswadi, R. and Ratanachai, C., 2015 Using Text Mining to Evaluate the Integrative and Adaptive Elements of Water Resource Institutions for Songkhla Lake Basin, Thailand. This paper was presented at the 2015 International Conference on Water Resource and Environment (WRE2015), Beijing, China, 25-27 July 2015 and was also published in the Journal of Water Resource and Hydraulic Engineering, 4(4) 339-357

Abstract

The study was based on the use of text mining to evaluate the integrative and adaptive elements of water resources for related and relevant institutions in the Songkhla Lake Basin, Thailand. The results were able to show some very interesting patterns like being able to determine the basic statistics of the sets of institutions under review including the degree of fragmentation and gaps, institutional priorities and their capacity to support the element of integrative and adaptive resource management. The major outcome of this work is its ability to prove the quality of the legal operating documents for state natural resource governance, which can be quantitatively analyzed through using the text mining tool and the application of appropriate equations to determine the inherent policy weaknesses, degree of actors vested interests as well as the measures of their suitability for enhancement of resources governance.

6.1 Introduction

Almost all lake basin institutions are globally beset with inadequacies because most times they are not designed for the specific governance of lakes and their basins. These institutions often derive from countries' general water resources or even national resources institutions, which minimally address the complex combination of the lentic and lotic characters of lakes. Studies have been showing that the lentic characteristic of lakes, that is, their integrating nature, long retention time, and complex response dynamic is what sets them apart from other water sources (ILEC, 2011).

The biggest challenge is the inflexibility and rigidity of current institutional regimes for such complex and dynamic systems like the lake basins, which have resulted in slow management response to lake basin stressors, yet allowing the basin to be corrupted. According to Lazarus (2004), the inflexibility of current environmental and natural resources laws makes resilience management so difficult due to slow response to new information caused by organizational bureaucracy as well as the conservative and resistant nature of these institutions. This hinders the institutional capacity to capture and manage the synergistic linkages of the lake basin systems, thereby imposing constraints on sustainable governance (Garmestani et al. 2009). It is critical because environmental governance can only succeed on the condition that institutions evolve and fit with the ecosystems they are designed to govern (Dietz et al. 2003, Garmestani and Benson, 2013).

Institutions refer to the body of rules, decision making procedures and programmes that give rise to social practices, assign roles to the participants and guide interactions among occupants of the relevant roles (IDGEC 1999, Ostrom 1990). They can also be laws (Acts of Parliaments), regulations, standards, judiciary pronouncements, policies, directives, and management procedures and so on. They provide the stability and predictability required to maintain the collective existence of society (Scharpf 1997, Gupta, et al. 2010). However, there is the fact that these institutions are drafted, designed and implemented by actors (North 1990, Kalikoski et al. 2002) with vested interests and varied influences, which inhibits the capacity of institutions to be integrative and adaptive. Actors generally design institutions around

the resources exploited by them (North 1990, Kalikoski et al. 2002) to suit their vested interests, using ambiguities to cover up their real intentions without considering the complex and dynamic conditions of the ecosystem. This has often led to disastrous circumstances, which can explain the real phenomenon of most of the world's lakes.

Most of the current institutional regimes used to govern and manage lake basins are obsolete and outmoded, no longer fit for the governance of the natural resources they oversee. Hoffman and Zellmer (2013) note that resource management institutions in the United States and indeed all over the world have become 'prisoners of history' holding on to the past rather than the present, to say nothing of the future, knowledge and necessity (Dovers and Hezri 2010). These institutions were designed to manage water resources based on past conditions, which greatly differ from current conditions, and are therefore, ill-equipped to address today's challenges, especially with the challenges of global climate change (Hoffman and Zellmer 2013). Laws which seemed sensible at a time when resources were thought to be inexhaustible are now outmoded (Cortner and Moote 1994) because the institutions that served us well in the past have outlived their intended purpose; moreover, their usefulness (Wilkinson 1992); sometimes hindering their capacity to capture the current issues of resource governance and management. It could be worse for lake basins owing to the fact that none of these institutions ever captured the peculiar idiosyncrasies of lake basins, even in their outmoded state.

It, therefore, becomes expedient that lake basin institutions be designed to capture the complex and dynamic nature of lakes and essentially be adaptive and integrative in order to ensure flexibility and resilience as opposed to the current rigidity and inflexibility. Considering that these institutions have been identified as significant barriers to sustainable natural resource governance (Cortner et al. 1998), lake basin institutions must be designed and implemented to ensure sustainable governance. Lake basin institutions need to include both adaptive and integrative elements because they will ensure that institutions relate to the specific nature of the lakes as well as be flexible enough to assimilate future changes and deal with uncertainties, like unexpected challenges. The adaptive elements enhance the ability of resource

management systems to be robust and resilient as well as the capacity to handle all uncertainties arising from the lake basin system. The integrative element, on the other hand, strengthens and enables the governance systems to promote better coordination between all actors and organizations involved in the lake basin and its externalities (Rouillard, et al. 2013).

There already seems to be a shift from the traditional command and control, and top down institutional systems for water resources management to a more integrated and adaptive resource governance designed to meet challenges of institutions as well as enhance management decisions under uncertainties (Engle et al. 2011, Jønch-Clausen and Fugl 2001). Recognizing that we cannot reliably protect a natural resource legacy without a strong and substantive mandate (Flournoy and Driesen 2010), clarifies the United States National Research Councils (2001) declaration that 'the research agenda for the 21st century should give priority to developing new legal arrangements governing diversions and consumptive use that emphasize flexibility and facilitate the management of water scarcity' (US NRC 2001).

However, the inevitable and vital question becomes, 'how do we develop such institutional frameworks?' We argue that the first step is not to jump to conclusions and change the institutions, but rather to review the current institutions to measure the adaptive and integrative elements contained within. Traditionally, institutional analysis have been done qualitatively (Young, 2002), but Ekstrom and Young (2009) and Ekstrom et al (2009) have proved that institutional analysis can also be done quantitatively. We, therefore, believe that quantitative analysis of institutions can give much credence to the results of qualitative analysis. This is why we argue that a quantitative institutional analysis to assess adaptive and integrative readiness is of great essence in this context because it can show in numbers and graphical illustrations a guide picture of the current state of the institutional framework under review. To this effect, this work expands on the research of Ekstrom and Young (2009) and Ekstrom et al (2009) by using text mining to evaluate the integrative and adaptive elements of the related and relevant institutions for the Songkhla Lake Basin (SLB), Thailand.

6.2 Methodology

6.2.1 Conceptual Framework of Adaptive Integrated Lake Basin Management (AILBM)

The conceptual framework for this study is the Adaptive Integrated Lake Basin Management (AILBM) an analytical, diagnostic and prescriptive framework for the assessment of water governance performance of lake basins. AILBM is designed to be gradual, continuous, holistic, systemic and integrative in nature with the capability of ensuring resilience, flexibility, adaptability, active participation of all stakeholders, equipped with effective and efficient decentralized systems and adequate feedback mechanisms that address the resource management system as well as the water resources quality and quantity for the overall achievement of sustainable governance and wise use of basin resources (Cookey, et al. 2015a). In other words, the institutions that govern lake basins should capture the synergistic-linkages between the sector, actors, stressors and management to achieve an institutional fit for lake basins. The overriding aim of the AILBM is the achievement of institutional fit for lake basins (Garmestani and Allen, 2014) (see chapter 4).

6.2.2 Text Mining Procedure for Assessment of the Integrative and Adaptive Capacity of SLB Institutions

To quantitatively determine the degree of integrative and adaptive capacity of the institutions of governance of the SLB, a text mining tool was used to extract useful information from data sources through the identification and exploration of interesting patterns (Berelson, 1952). This approach focused on the collection of 19 sets of laws relevant and related to water and natural resources governance in the SLB (table 6.1).

The process involved the collection and conversion of the electronic copies of these laws into readable form by Windows Excel. Then, select representative terms with integrative and adaptive attributes were taken from the AILBM conceptual framework to develop a query language. The institutions were mined for these terms, and data visualized using the Windows Excel software statistical package. This

resulted in the development of a Term-Document-Matrix (TDM), which is a systematic table that organizes topics according to their frequency of occurrence in each of the documents analyzed (Feldman and Sanger 2007, Cookey, et al. 2015b) (Figure 6.1)

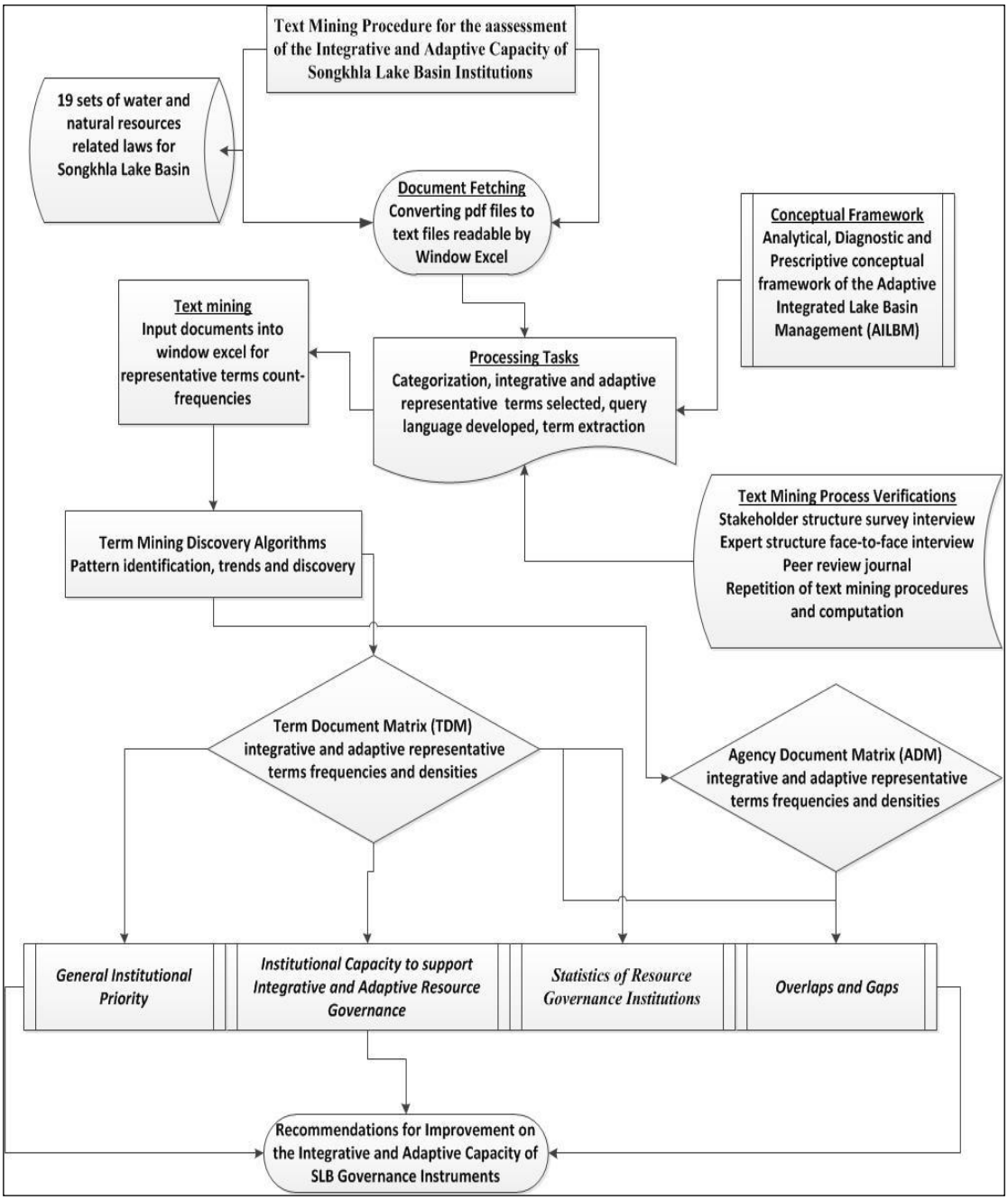

Figure 6.1: Simple concept flow chart representation of text mining for the assessment of the Integrative and Adaptive Capacity of Songkhla Lake Basin Institutions

Table 6.1: The 19 sets of laws in Thailand relevant and related to water resources in the SLB

Category	**Related water resources institutions in the SLB**
Fishery Laws	Right to Fish in Thai Fishery Waters Act (FTW)
	Fisheries Act (FA)
Irrigation Laws	People Irrigation Act (PI)
	State Irrigation Act (SI)
	Field Dykes and Ditches Act (FDD)
Marine Laws	Navigation in Thai Waters Act (NTW)
	Marine Salvage Act (MS)
	Merchant Marine Promotion Act (MMP)
Environment Laws	The Enhancement and Conservation of National Environmental Quality Act (ECNE)
	Public Health Act (PH)
	Hazardous Substance Act (HS)
	Factory Act (FAC)
Forestry/Land Laws	Commercial Forest Plantation Act (CFP)
	National Reserved Forest Act (NR)
	Wild Animal Reservation and Protection Act (WAR)
	National Park Act (NP)
	Land Development Act (NP)
Local Administrative Laws	Plans and Process of Decentralization to Local Government Organization Act (PPD)
	Tambon Council and Tambon Administrative Authority Act (TA)

Agency Document Matrix (ADM) was also developed by physically reading through the SLB relevant and related water laws to discover agencies with relevant statutory mandates. Where a set of institutions identified an organization responsible for the implementation of the laws (table 6.2); one (1) point was awarded; where an organization was nominated into a committee under that law, an half point (0.5) was awarded and zero was awarded to none assignment of any responsibilities for the law under review (Ekstrom and Young 2009, Cookey, et al. 2015b).

Verification of the text mining process was carried out using stakeholders structured livelihoods, perceptions and resources governance surveys, with simple

random sampling technique (Teddlie and Tashakkori, 2009), and semi-structured face-to-face in-depth interviews with key professional informants as well as reviews of relevant literature on governance of lake basins.

Table 6.2: Central government organizations responsible for the implementation of the water and natural resources related and relevant laws in the SLB

Centralized Ministries
Ministry of Natural Resources and the Environment (MONRE)
Ministry of Agriculture and Cooperatives (MOAC)
Ministry of Interior (MOI)
Ministry of Industry (MI)
Ministry of Transportation (MOT)
Centralized Deconcentrated Departments
Department of Water Resources (DWR)
Department of Groundwater Resources (DGW)
Pollution Control Department (PCD)
Office of Natural Resources and Environmental Policy and Planning (ONEP)
Royal Forest Department (RFD)
Department of National Park, Wildlife and Plant Conservation (DNWP)
Royal Irrigation Department (RID)
Department of Fisheries (DOF)
Department of Provincial Administration (DOPA)
Department of Local Administration (DLA)
Department of Disaster Prevention and Mitigation (DDPM)
Local Administrative Organization (LOA)

6.2.3 Overlap Analysis (index of the degree of fragmentation)

Overlap is one of the leading causes of fragmentation and occurs when two or more agencies have the same jurisdiction or influence on the same area, activity, and/or resource (Ekstrom and Young 2009) and manifest as duplication or gaps in authority (Hill et al. 2008). Overlap was determined by dividing the number of laws a particular agency appears in the Agency Document Matrix (ADM) over the total number of agencies in the laws reviewed and multiplied by one hundred. It can also be used to show the degree of involvement of central government ministries and their de-concentrated departments in resource governance of the SLB.

$$D\ (TF, WLsSLB) = \frac{\#\ A\ \ WLs\ SLB}{\sum(A\ \ WLs\ SLB)}\ \mathbf{x}\ 100 \qquad (I)$$

Where: AD = Agency Density, Ls = Laws (Acts of Parliament), A = Agencies that appear in WLsSLB, WLsSLB = Water Laws relevant to SLB, SLB = Songkhla Lake Basin.

6.2.4 Gaps Analysis (index of the degree of misfit/mismatch)

Gap is when a critical linkage between two components of a system (topic) is not addressed in the institutions (laws) (Ekstrom and Young 2009). The linkages refer to interactions across sectors, stressors, resource systems and resource management systems in the AILBM framework. The modelled linkage that score zero in each law matrix is a gap. Gaps measure of institutional mismatch or misfit. It was calculated by dividing the number of the missing-links of a representative term in the laws reviewed over the sum total of all the missing-links of the representative terms (TDM) multiplied by one hundred.

$$G(WLsSLB) = \frac{\#\ gaps}{\#\ linkages}\ \mathbf{x}\ 100 \qquad (II)$$

Where: G = represents the proportion of the legal gaps to modeled links (gaps = number of modeled links absent from the laws; linkages = number of total modeled links in the system); WLsSLB = Water Laws relevant to SLB; SLB = Songkhla Lake Basin.

6.2.5 General Institutional Priority

Several studies have submitted that the crisis of the SLB is the over-reliance on resource utilization of the laws negating wise use and conservation. To determine the institutional priorities of the SLB water related laws, we divided the representative

terms on topics (Tc) (sectors, stressors, resource system and resource management system) over the sum total of topics by issues category and multiplied by one hundred.

$$\text{IP (WLsSLB)} = \frac{\text{(T,WLsSLB Tc)}}{\sum \text{(T,WLsSLB Tc)}} \mathbf{x}\ 100 \qquad \text{(III)}$$

Where: IP = Institutional Priority; T = Term; WLsSLB = Water Laws relevant to SLB; Tc = Topic; SLB = Songkhla Lake Basin.

6.2.6 Institutional Capacity to Support Integrative and Adaptive Resource Management

To fully understand the capacity of existing institutions to support integrative and adaptive resource management, we attempted to determine and measure quantitatively the degree of response of the existing institutions to the conventional resource management and the AILBM conceptual representative terms from the Terms Document Matrix (TDM). The purpose of this indicator is to use text analysis to determine the institutional response to resource management in the SLB.

$$\text{IRRM (WLsLB)} = \frac{\text{(T,WLsLB RM \& AILBM)}}{\sum \text{(T,WLsLB RM \& AILBM)}} \mathbf{x}\ 100 \qquad \text{(IX)}$$

Where: IRRM = Institutional Response to Resource Management; T = Term; WLsLB: Water Laws relevant to LB; RM = Resource Management; AILBM = Adaptive Integrated Lake Basin Management; LB: Lake Basin.

6.3 Data analysis

Data analysis was triangulated by examining, categorizing, tabulating, testing and converging both the qualitative and quantitative evidence to critically analyze the integrative and adaptive capacity of governance instruments of the SLB. The text mining analysis employed the tool of Microsoft Excel Software for term-count-

frequencies using the Agency Document Matrix (ADM) (table 6.3) and the Term-Document-Matrix (TDM) (table 6.4). The results of the text mining were subjected to computations of institutional variables and data were visualized and presented in tables, line graphs and histograms.

6.4 Results and Discussion

6.4.1 Overlap - the degree of fragmentation

The results indicated that there were serious institutional fragmentation and gaps (mismatch) within the 6 main centralized ministries and the 13 deconcentrated departments involved in the governance of water resources of the SLB. , The results also revealed that water overlapped (fragmentation) throughout the 19 laws reviewed and all the 19 agencies have mandates covering some aspects of water issues and no laws addressing the issues of water resources comprehensively. This shows a high degree of fragmentation of water related issues in the relevant laws and agencies, indicating duplication of responsibilities, which may lead to conflicts in the Basin (figure 6.2).

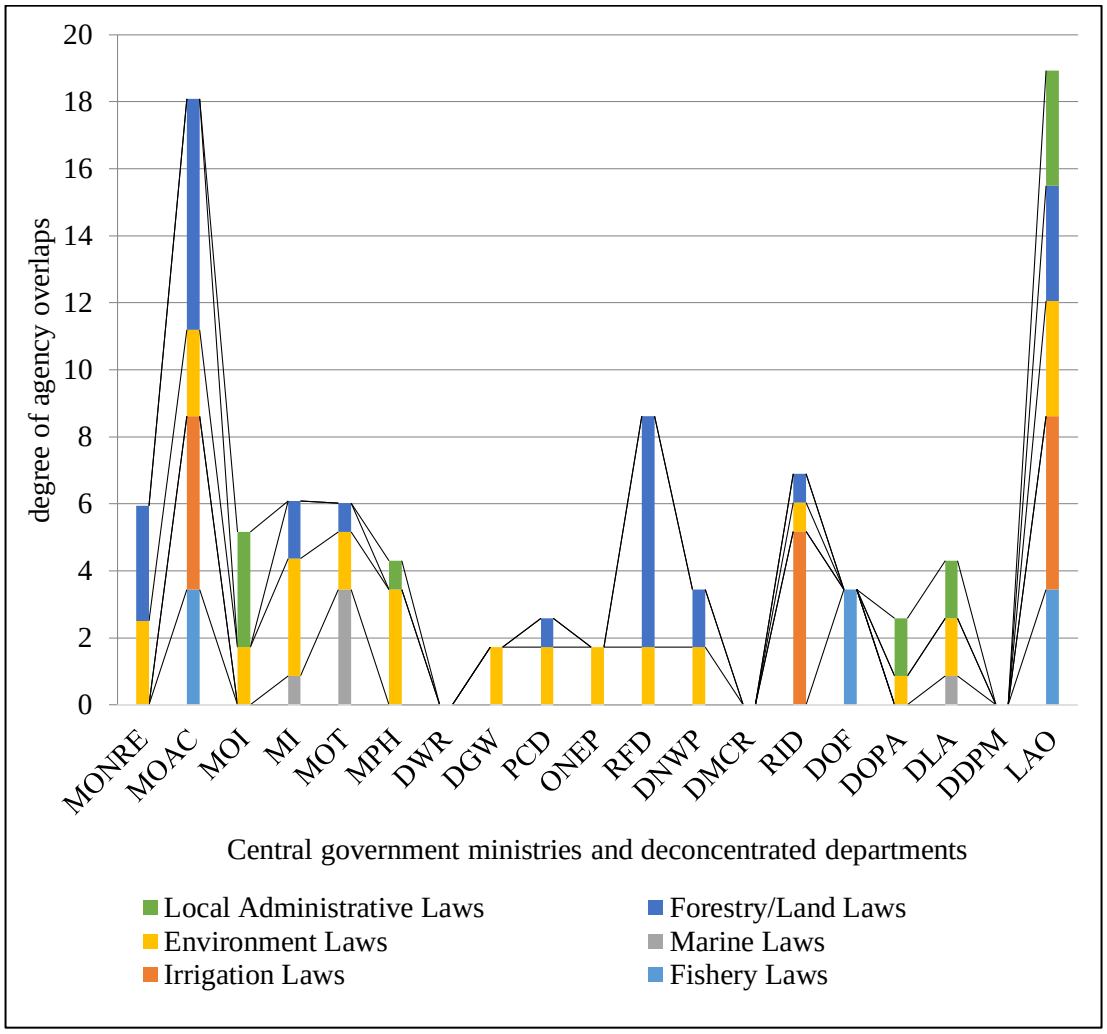

Figure 6.2: Central ministries and deconcentrated departments overlap (fragmentation) in the SLB computed from text mining analysis

(For interpretation see List of Abbreviations and Symbols page)

Table 6.3: Summary of Document Agency Matrix generated from text mining analysis used for the determination of institutional parameters in the SLB

Agencies	Fishery Laws	Irrigation Laws	Marine Laws	Environment Laws	Forestry/Land Laws	Local Administrative Laws	Total
MONRE	0	0	0	2.5	2	0	4.5
MOAC	2	3	0	1.5	4	0	10.5
MOI	0	0	0	1	0	2	3
MI	0	0	0.5	3.5	1	0	5
MOT	0	0	2	1	o.5	0	3
MPH	0	0	0	2	0	0.5	2.5
DWR	0	0	0	0	0	0	0
DGW	0	0	0	1	0	0	1
PCD	0	0	0	1	0.5	0	1.5
ONEP	0	0	0	1	0	0	1
RFD	0	0	0	1	4	0	5
DNWP	0	0	0	1	1	0	2
DMCR	0	0	0	0	0	0	0
RID	0	3	0	0.5	0.5	0	4
DOF	2	0	0	0	0	0	0
DOPA	0	0	0	0.5	0	1	1.5
DLA	0	0	0.5	1	0	1	2.5
DDPM	0	0	0	0	0	0	0
LAO	2	3	0	2	2	2	11
Total	6	9	3	20.5	15	6.5	58

* For interpretation of abbreviation see List of Abbreviations and Symbols

The ministries with the highest degree of overlaps are MOAC and MOI with their deconcentrated departments. In the 19 sets of laws under review, these ministries and their agencies have several related responsibilities. Institutional fragmentation challenge is manifested with duplication, overlap, or gaps in authority and of responsibilities among multiple actors and/or agencies jurisdictions and duplication between levels of government (Hill et al 2008). With more than 4 centralized ministries and 15 deconcentrated departments with fragmented responsibilities in the management of quantity and quality of ground and surface water resources in the SLB, the absence of integrated and adaptive management of the water resources in the Basin is quite evident and clear.

These findings are in agreement with Christensen and Boon-Long, (1994), Sukhsri (1999), Neef (2008), Kanjina (2008), who observed that the Thai water sector is heavily characterized by institutional and jurisdictional fragmentation with poor sectoral integration, and coordination and a strong adherence to command-and-control

approaches. The difficulty of moving toward a more integrative and adaptive water governance is perhaps best captured by Thomas and WAC (2005), when they observed that despite over thirty years of conscious efforts to adjust policies, organizational structures, regulations, programs and budgets to facilitate cross ministerial coordination, relatively little progress is apparent at the central government level. Indeed, even cross departmental coordination, within individual ministries, is a ridiculously haunting challenge.

Indeed, the challenge of integration in water resources management is fragmentation, described by Cook (2014) as ‘wicked problems’ and he argues that excessive fragmentation could be problematic with the potential to limit integrated planning and management in the Basin, even beyond individual departments’ boundaries (Ostrom 1990). Simachaya and Yolthantham (2006) also argue that in Thailand, there is no integrated water resources management approach because water management is separated between quantity and quality due to agency responsibilities and their respective regulations. However, Hoffman (2013) observed that the efforts of moving towards integrated management planning can strengthen accountability and enforceability in water resources.

Table 6. 4: Summary of Term-Document-Matrix (TDM) generated from text mining analysis use for the determination of institutional parameters in the SLB

Topics	Terms	6 major sub-divisions of the 19 sets of institutions relevant and related to water governance in the SLB						Terms Total Frequency	Terms Absence links (Gaps)
		Fisheries Laws	Irrigation Laws	Marine Laws	Environmental Laws	Forestry/Land Laws	Local Admin Laws		
Sectors	Tourism	0	0	0	1	2	3	6	14
	Agriculture	292	14	1	10	17	2	336	5
	Industry	14	1	3	23	1	1	43	10
Stressors	Eutrophication	0	0	0	1	0	0	1	18
	Hazardous substance	0	0	0	185	0	0	185	17
	Pollution	0	0	0	10	0	0	10	18
	Sewage	0	0	0	13	0	0	13	18
	Wastewater	10	0	0	89	0	2	101	16
	Solid waste	0	0	0	13	0	2	15	15
	Deforestation	0	0	0	0	0	0	0	19
	Siltation	0	0	0	0	0	0	0	19
	Erosion and flood	0	9	0	0	0	0	9	17
	Recreation	37	0	0	0	0	2	39	16
	Consumption	9	2	0	2	0	2	15	15
	Cultivation	78	24	0	0	0	0	102	15
Resource Systems	Fish	1104	2	2	1	15	1	1125	12
	Shrimps	67	0	0	0	0	0	67	18
	Crabs	19	0	0	0	0	0	19	18
	Forest	1	0	0	0	188	0	189	13
	Water	106	167	18	23	20	15	349	3
	Wildlife	0	0	0	2	4	0	6	16
Resource Management Systems	Conservation	10	2	0	44	12	0	68	13
	Protection	4	1	2	15	11	0	33	10
	Public Health	0	0	0	45	0	2	47	15
	Water Quality	0	0	0	3	0	0	3	17
	Management	4	0	0	32	1	7	44	14
	Prevention	0	1	8	26	1	2	38	9

	Sanitation	0	0	0	1	0	1	2	17
	Mitigation	0	0	0	3	0	0	3	18
	Coordination	0	0	4	0	0	0	4	18
AILBM	Adaptability	0	0	0	0	0	0	0	19
	Collaboration	0	0	0	0	0	0	0	19
	Resilience	0	0	0	0	0	0	0	19
	Decentralization	0	0	0	0	0	27	27	18
	Integration	0	0	0	2	0	0	2	18
	Participation	0	0	0	0	0	3	3	17
	Total	1762	223	38	547	272	72	2910	553

Note: * AILBM – Adaptive Integrated Lake Basin Management; * Topics – are the core issues of concern in lake basin management and governance extracted from the AILBM

* Terms – are relevant words, concepts, and issues extracted from the 'Topics' because the 'Topics' were two broad and ambiguous * Institution – is the 'Topic' that was mined for represented by relevant and related laws

6.4.3 Gaps - the degree of misfit/mismatch

There were high rates of institutional gaps recorded in the study (figure 6.3). There were a total of 592 gaps (absence links). The largest gaps was (n=19, 3.44%) and these terms were not found in all the 19 sets of laws that were text mined. These terms were 'adaptability', 'collaboration' and 'resilience'. These were closely followed by 'decentralization', 'integration', 'coordination' and 'mitigation' with (n=18, 3.26%) gaps and 'participation' recorded a total of (n=17, 3.08%) gaps. These were representative terms used for text mining for evaluation of the degree of the integrative and adaptive capacity of the institutions of water governance in the SLB. Even the text mining for the indicative terms for the conventional resource management system also recorded high number of gaps. The only indicative terms with low degree of gaps were 'water' and 'agriculture', and these were the most fragmented issues in the SLB. The implication of this result is that the challenge of weak integration and adaptation is beyond the reach of the SLB's institutions, thereby causing a misfit.

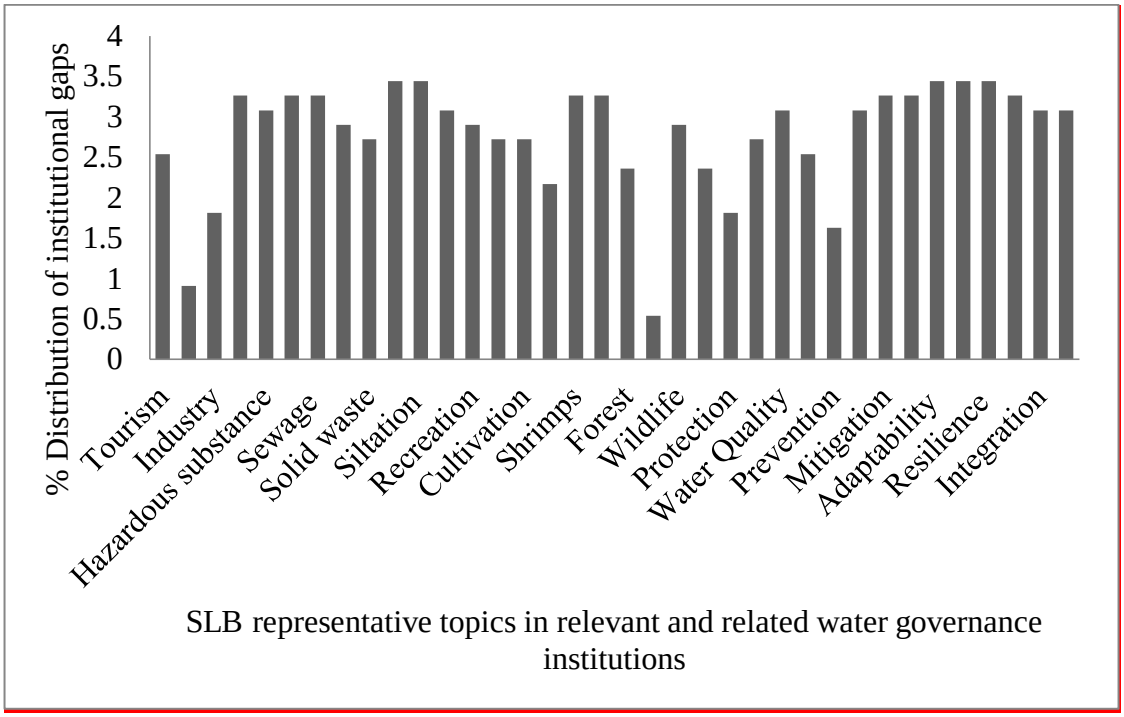

Figure 6.3: Gaps (mismatches) in the SLB relevant and related water governance Institutions computed from text mining analysis

One major revelation of the study is that there is no Act of Parliament that establishes the DWR (figure 6.3), but it operates by the 2002 Water Resources Regulations from the Office of the Minister (DWR 2006). This is unfortunate because regulations are supposed to be drawn from an Act of Parliament (i.e. laws), commonly issued by the Minister (Administrative Court of Thailand 2013), but the DWR has no such legal mandate. The question that begs for answer is how a DWR without an adequate legal mandate can influence top player members of the Committees (like Royal Irrigation Department (RID), Royal Forestry Department (RFD) and Department of Fisheries (DOF) etc.? Clearly, simply establishing and formalizing water basin organizations do not immediately translate to integrative and adaptive management of water resources (Shah et al. 2000).

It is then understandable to see why the Ministry of Agriculture and Cooperatives (MOAC) has greater influence and control on water resources management and governance than the Ministry of Natural Resources and Environment (MONRE), the 'supposed' regulator of the sector. MOAC and her departments are the highest users of water resources and consume more than 57% of the country's 109.3 billion m^3 water resources in 2006 (DEQP 2008). This makes them both user and regulator of the resources; however they are not legally mandated to inform other agencies of their activities (Christensen, and Boon-Long, 1994, Sukhsri 1999, Neef 2008, Kanjina 2008).

The high level of institutional gaps recorded in these studies, especially in the area of the representative terms for integrative and adaptive resource management systems means that the water resources related laws in the SLB are not adaptable to the needs of the ecosystems that will ensure a fair and consistent enforcement of the rules of the game (Kalikoski, et al 2002, Ostrom, et al, 1999, Young, 1999). The implication of this is a serious regulatory failure that can lead to inequalities and conflicts among resource users, widespread evasion, and deterioration of the resources (Hashimoto and Barrett, 1991). The findings of the stakeholder's survey indicated that the reason for weak enforcement of the rules was as a result of the unsuitability of the existing laws

because of absence of specific laws and provisions in them to address the numerous challenges in the Basin (Cookey, et al. 2014).

6.4.4 Institutional Priorities

The results revealed that the institutional priorities of the laws under review are more on resource utilization than on sustainable governance and wise use (figure 6.4). The resource systems representative terms in the Fisheries and Irrigation laws were reading more than 40 percent, the environmental management representative terms were at zero. When the stressors representative terms were about 10 percent in the Environmental laws, the resource management system representative terms were about 5 percent and the integrative and adaptive capacity (represented by AILBM) was zero.

This is probably the brain behind over-exploitation of the resource base of the SLB. An example is the uncontrolled change of land from agriculture to shrimp farms and the destruction of wetlands and mangrove forests for the same purpose. Private economic interests seem to prevail in the priorities for development of the SLB (Chufamanee and Lenholdt 2001, GWP, 2012), since the legal instruments and policies authorizing the exploitation of the SLB's resources do not provide for protective measures to prevent adverse effects on the ecosystem, making them unfit for the sustainability of the SLB. Talor et al. (1985) and Tanavud et al. (2001) along with Kriengkajon, (2006), IRCNE (2010) and Doungsuwan et al. (2013) all agree with the findings, pointing out that the National Development Plan influenced the expansion of shrimp farms and rubber plantations to the detriment of the SLB's sustainability.

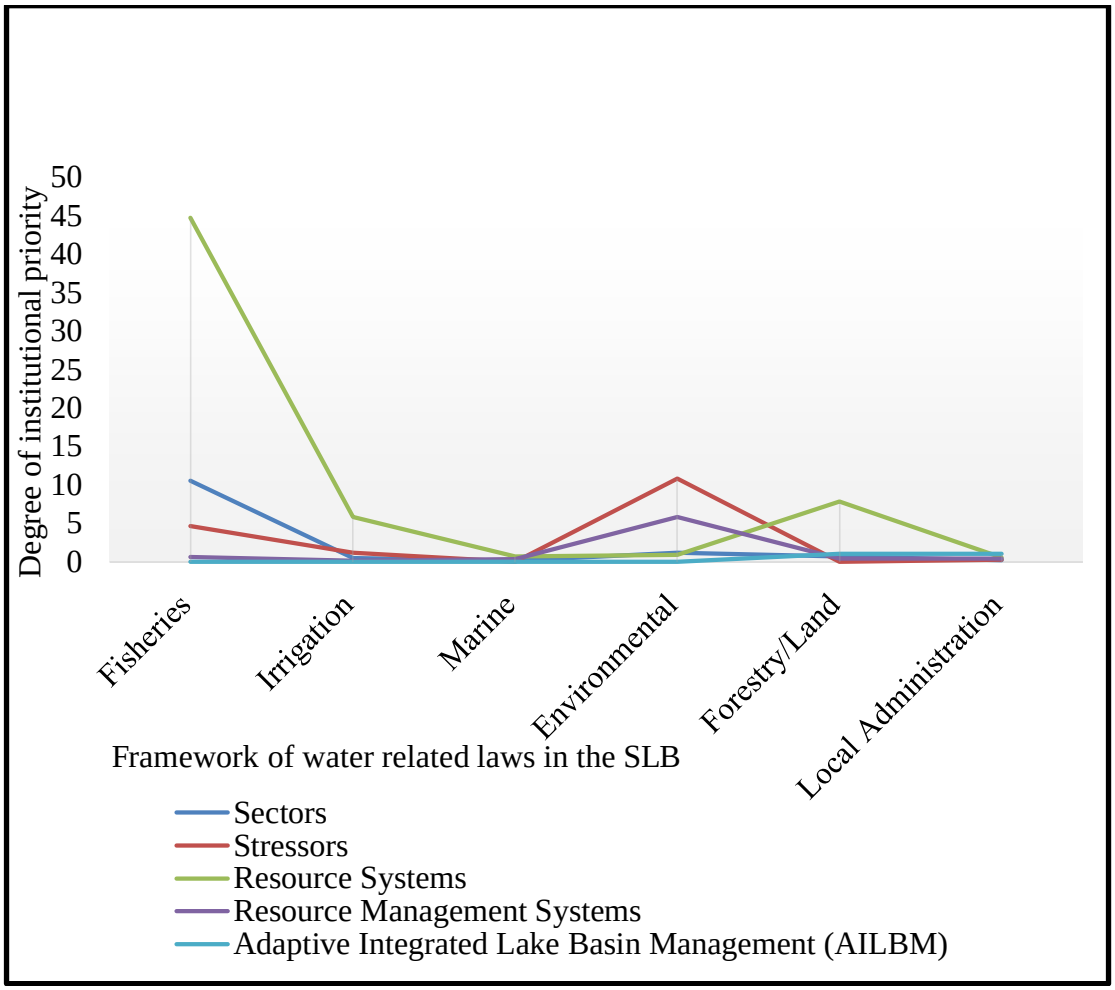

Figure 6.4: Framework of institutional priorities of related water governance laws in the SLB, computed from text mining analysis

6.4.5 Institutional Capacity to Support Integrative and Adaptive Resource Management

In order to determine the magnitude of the elements of the integrative and adaptive capacity of the current SLB institutions, the representative terms for conventional resources management systems were plotted against the representative terms of integrative and adaptive management and governance (AILBM) (figure 6.5). We found that the conventional resource management scored the highest point of about 6 percent (though very low) whereas the environmental legislations recorded zero percent in the same laws and in the forestry/land laws. The conventional resource

management systems were below one percent in fisheries, marine and local administrative laws. This showed that the laws lack all integrative and adaptive elements for effective governance of the SLB.

There is no way these kinds of institutions will be able to identify and pursue better and innovative opportunities for organizational learning with the core element of adaptive management and the capacity to improve resource management systems of the Basin as well as adjust and adapt to current realities. Folke et al. (2005) re-emphasized that institutions of resource management must be based on knowledge and learning generated by the ecosystems knowledge systems. This study has also clearly shown that most of the resource management institutions in the SLB are obsolete. Even though our studies revealed that most of these institutions have undergone some form of amendments, their original priorities and intentions as well as their vested interests on resource over-utilization have not really changed at all.

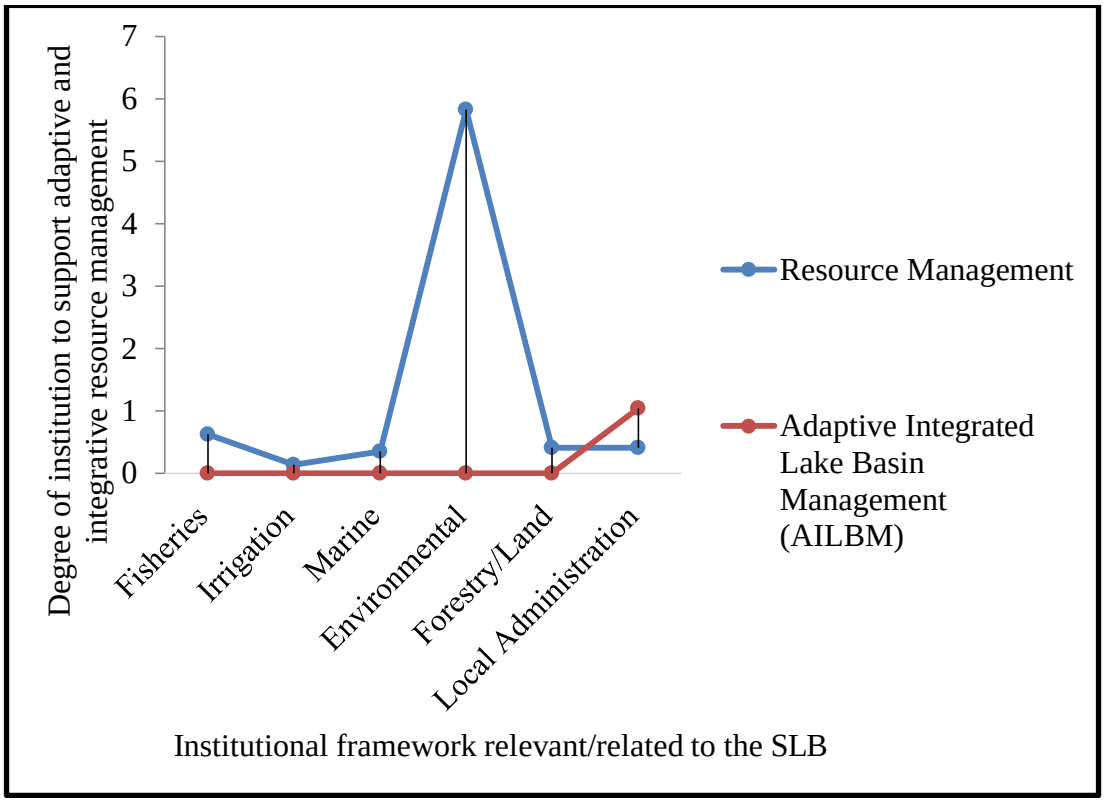

Figure 6.5: Capacity of institutions to support integrative and adaptive resource management

6.5 Conclusion

The purpose of this study was to test the use of a quantitative analysis tool like text mining for institutional analysis, and to use this tool to analyze relevant and related water/natural resources governance and management institutions for the SLB, and then measure their adaptive and integrative capacity. Hitherto, institutional analysis have been considered strictly a qualitative process, but this research aimed to prove that introducing quantitative analysis can strengthen the results of qualitative analysis and even go further to give expressive and irrefutable data. Agreeably, as many have argued, text mining is not adequate to give insight into the efficacy and efficiency of resources management and implementation because of the wide gap between theory and practice, however, this tool can be a strong complement to collaborate and strengthen other analytical approaches.

Since, institutions are the rules of the game, making them the players' blueprint of resource governance, it is then expected that the way they are crafted and the terms used to express those rules will have a great impact on their implementation. Therefore, it makes sense that analyzing institutions to measure their adaptive and integrative capacities should involve assessing the frequencies and densities of related representative terms as they appear in relevant sets of institutions. This research work has been able to show that the quality of legal operating documents for water/natural resources can be quantitatively analyzed using text mining tool, and it could also develop equations to determine inherent policy weaknesses, degree of actors vested interests as well as determine the measure of their suitability for the enhancement of resources governance and management.

The results of this research go a long way to prove the essential nature of the text mining tool in institutional analysis and policy research. Some interesting patterns were revealed by the text mining results; for example, the degree of fragmentation, overlaps and gaps, priorities of the institutions and their capacity to support adaptive and integrative elements of resource governance. The institutions that were analyzed in the case study were those directly related and relevant to the governance and management of the SLB. The text mining analysis was able to throw up the fact that the existing

institutions were not adaptive or integrative, which led to major recommendations for institutional reviews and reforms of related and core water/natural resources laws for the SLB in particular and Thailand in general.

Taking institutional analysis into consideration, we think that it is expedient to review how provisions of the laws can keenly and clearly capture adaptive and integrative elements like resilience, stakeholder participation, organizational and community collaboration, decentralization, integration, adaptability as well as conservation, prevention and conflict management. It will ensure to anticipate future challenges and assimilate future changes, especially in a complex and dynamic ecosystem like lake basins. Now, the question is how this can be achieved if the laws do not contain these elements and others in clear terms or at least closely related terms? How are the implementers (i.e. actors) supposed to understand and acknowledge the importance of such requirements in policy and legal documents if they are not clearly stated? Obviously, to avoid ambiguities, which can lead to bending of rules or just plain ignoring them, lake basin institutions need to contain clear and related adaptive and integrative terms to be considered fit; and text mining representative terms can guarantee this.

We are not arguing that text mining alone will be enough to do institutional and policy analysis, but the results of this research show that it can be a very important aspect of any such analysis. Although, some people could argue that well drafted institutions with all the best intentions may still not be properly implemented if at all. Perhaps, because actors choose to operate outside the ambit of the policy and legal provisions. This does not mean that pursuing for well drafted and fit-for-purpose institutions, especially for endangered resources like lake basins, should be pushed aside. The world's lakes are facing a huge crisis today and urgent measures should be taken to solve them. No quick fixes or ad hoc solutions will settle the dust. Hardware fixes alone will not even come close to stemming the deterioration lake basins like the SLB face, unless there is a fit governance system guiding the way for things to be done and for actors to interact. Researches have shown that the current institutional frameworks for lake basins in most countries, and Thailand's SLB in particular, are not

fit for the complex and dynamic nature of lake basins, and since they are more focused on exploitation and utilization than on conservation and protection, there, cannot guarantee sustainability. We consider this as a major challenge to the wellbeing of lakes today and that is why we recommend that lake basin institutions globally should be reviewed with a focus on the lake basins themselves, as well as on their peculiar nature and inherent characteristics.

It makes the text mining analysis tool so important because of its ability to be deployed as a complementary analytical tool at the initial stage of drafting and reviewing new or old policies and legal documents, as well as to determine the real priorities, resource management systems and response capacity of relevant institutions. It is also relevant for assessing management, standards and procedural documents for the implementation of relevant institutions. Further researches can extend to test the tool on other legal and management documents for lake basin governance. It can also be tested on other policy, legal and governance frameworks in other areas and for other focus apart from adaptability and integration. Even if it adds only credence to the results of qualitative analysis, this tool is still an essential keepsake.

CHAPTER SEVEN

LOCAL PEOPLE'S PERCEPTIONS OF GOVERNANCE PERFORMANCE

This chapter is adapted from:

Cookey, P. E., Darnswadi, R. and Ratanachai, C., 2016. Local People's Perceptions of Lake Basin Water Governance Performance in Thailand. Ocean & Coastal Management (120) 11- 28, DOI:10.1016/j.ocecoaman.2015.11.015

Abstract

Local people's perceptions on water governance performance were explored in the Songkhla Lake Basin, Thailand. The study was conducted through self-administered survey questionnaires, interviews, observations as well as review of relevant literature and archival records. The objective was to understand the perceptions of the local people regarding performance of the water governance of the Songkhla Lake Basin in order to support a wider research assessing the water governance performance of the Lake Basin. The local people perceived the governance performance as below average and highlighted some pertinent challenges such as institutional and agency fragmentation, weak coordination and integration as well as enforcement and compliance. They suggested that governance performance could be improved if these issues were resolved and if the local people were involved in the governance of the Lake Basin. The study concluded with recommendations to integrate local people's perceptions in governance and management decision-making as well as highlighting some issues that arose from the study like a single formal

management and policy harmonization organization for the Basin and livelihood support for the local people to reduce environmental degradation.

7.1 Introduction

7.1.1 The role of local people's perceptions in lake basin water governance

Assessment of local people's perceptions of lake basin water governance performance is a useful measurement barometer for citizen involvement and participation because across many developing countries, decision-making on day-to-day water use and management issues is in the responsibility of the local community (Trakolis, 2001, Debrot and Nagelkerken, 2000, Moench et al. 2003, UNDP 2013). They possess substantive knowledge about the resource system and areas where they live and their local knowledge is often holistic and spatially specific and could be critical in local governance performance assessment (Carr 2000). Local people are always the most important participants in participative water resource management because they offer key information related to local natural and socio-political systems (Weber et al 2003, Wondolleck et al. 2000, Sabatier et al. 2005, Jingling et al. 2010). However, their support is dependent on their perception of the effectiveness and quality of management and governance policies, institutions and processes (Pomeroy et al. 2004, Webb et al. 2004, Bennett and Dearden 2014). Therefore, assessment of local people's perceptions on governance performance within their communities can be a strong tool to determine the efficacy of natural resources governance systems (Western and Wright 1994, Sponsel et al. 1996, Trung Ho et al. 2012). However, water governance performance assessments that explore local people's perceptions are under documented and rarely get due attention.

There have been more studies on local people and community perceptions on marine protected areas (Debrot and Nagelkerken 2000, Peterlin et al 2005, Tokotch et al. 2012, Vodouche et al. 2010, Marin et al. 2009, Wallner et al. 2007,

Dimitrakopoulos et al. 2010, Green 2005, Tran 2006, Tran et al. 2002); forestry (Lund et al. 2010, Paré et al. 2010, Dhubháin et al. 2009, Roy et al. 2013, Jones et al. 2015); fishers (Kincaid et al. 2014, Dimech et al. 2009, Stewart et al. 2014); national parks (Nasution and Zahrah 2014, Trakolis 2001, Jones et al. 2012) and resource degradation (Tenge et al. 2015), which is one of the few studies on a lake environment (Figure 7.1). None of these studies focussed on the local people's perceptions on water governance performance. Therefore, this paper seeks to explore the local people's perceptions on the performance of the existing water governance systems of the Songkhla Lake Basin (SLB), Thailand. Local people in this paper refers to individuals who live and interact through various practices and in particular places, especially in small

spatial unit (communities), has homogenous social structure and shared norms within the jurisdictions of a lake basin (Agrawal and Gibson 1999, Broderick 2005), while lake means lentic water and the term lake basin is used here to mean 'lake river basins' or more broadly 'lentic-lotic basins' (ILEC 2005, World Bank 2005, RCSE and ILEC 2014). In other words, local people are those who live and work within the jurisdiction of the SLB and maintain close contact with the Basin, the Songkhla Lake and the other subsidiary lakes and more than 100 streams of all sizes that drain the Basin.

Perception refers to the personal understanding of the phenomena, causes and its effects, which influences necessary actions to be taken by the individual, group or community (Bagheri et al. 2008). Perception influences interactions with the resource systems, how they are managed and governed (Ormsby and Kaplin, 2005; Allendorf et al. 2006, Ramakrishnan, 2007; Vodouhe et al. 2010) as well as the people's attitude towards the use of the water resources in the lake basin (Rodriguez 1995, Tran et al. 2002, Dungumaro et al. 2003, White, 1966; Sewell, 1974; Trakolis, 2001). The local people's continued interactions with the resource system can be seen as some form of 'expertise' grounded in experiential knowledge (Davis and Wagner, 2003), which can be related to context or location (Eschuis and Stuiver, 2005).

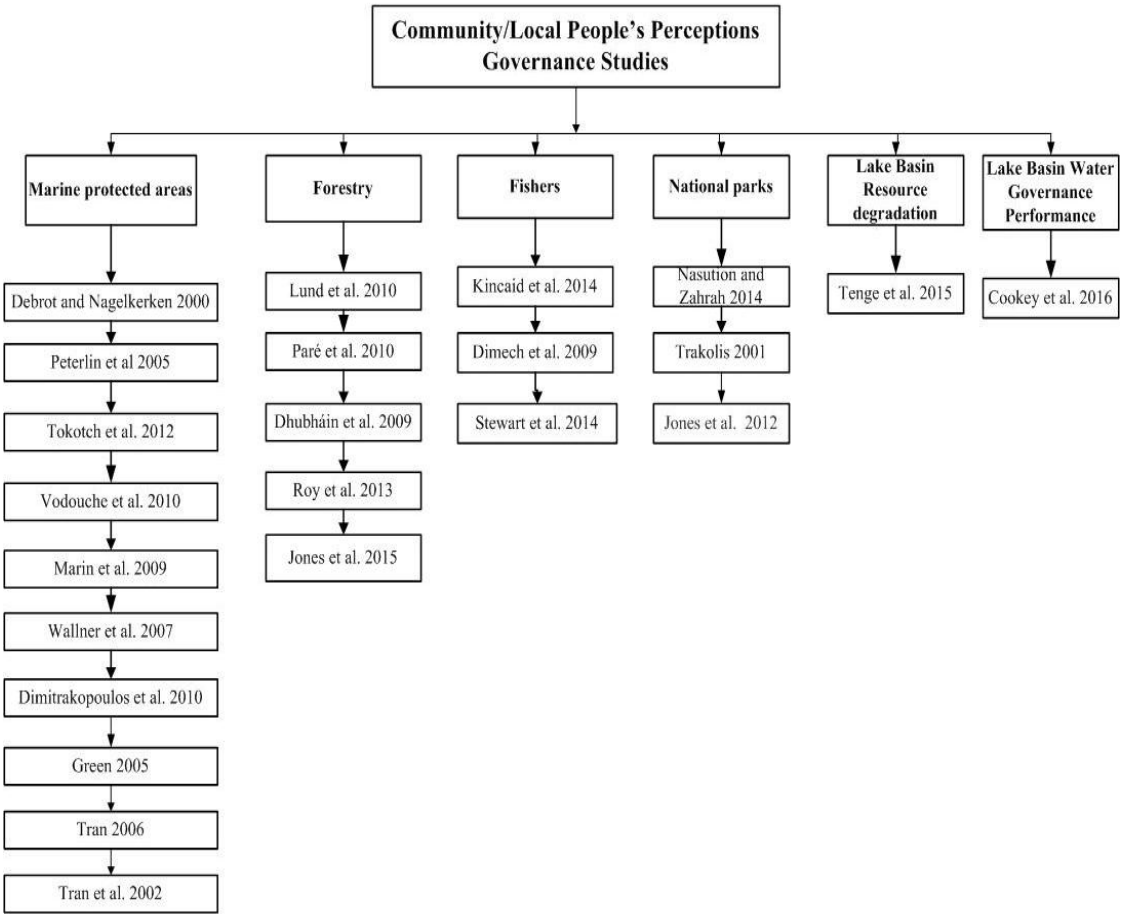

Figure 7.1: Literature mapping of local peoples' perception on governance studies

This type of knowledge and insight are strongly entwined with the day-to-day activities of the people (Edelenbos et al. 2011) and can complement scientists with skills, knowledge and information that may be lacking (McGall, 2003; Berks, 2000) while also providing important ecological data in areas where studies have not been conducted (Aswani and Hamilton, 2004; Doswald et al. 2007; Elbroch et al. 2011). Therefore, evaluating the local people's perspectives on water governance performance becomes important with regards to their needs, preferences or willingness to support government efforts. It also helps decision-makers and managers identify management and governance needs, choose between options, and pinpoint strategies for successful

resource management (Debrot and Nagelkerken, 2000; Gallego-Ayala and Juizo, 2012, Pimbert and Pretty, 1997; Wallner et al. 2007).

It is, therefore, expedient to explore the way the local people of the Songkhla Lake Basin (SLB) perceive the governance performance of the resource system, since they are the closest to the resource in proximity and constant use. This is because a good understanding of the local people's perception is vital to obtain effective public participation and support for sustainable lake basin governance and wise use of resources (Avramoski, 2004; Rodriguez, 1995; Tran et al. 2002). Therefore, this study attempts to provide meaningful feedback on water resources governance performance at the local Basin level and to explore the local people's views and experiences of the SLB governance. How satisfied are they with the governance performance? How do they perceive the SLB governance system? What do they think can be done to improve governance performance? This paper is divided into six major sections. The first section introduces the concept of local people's perceptions in Lake Basin water governance, followed by the case study area with extensive deliberations on issues of local governance in the SLB as well as the physical, socio-ecological impact of human pressure in the study area. The next section addresses the methodology of the study and this is followed by the presentation of the results of the study. The paper ends with discussion, conclusion and recommendations for the improvement of governance in the SLB.

7.1.2 Local governance in Songkhla Lake Basin

The Thai Constitution of 1997 strengthened the existing Tambon (Sub-District) Administrative Organizations (TAOs) established in 1994 by allowing local communities and authorities to participate in the management of natural resources. The villages (muban) were placed into an administrative hierarchy within sub-districts (tambon), districts (amphur) and provinces (Tan-Kim-Yong 2003). This gave increasing autonomy to local administrations in development planning as well as enhancing involvement with central governments' line ministries, departments and agencies in natural resources management and governance (Heyd and Neef, 2004;

Neef, 2008). These TAOs operate under the supervision of the Ministry of Interior (MOI) with the mandate to empower local communities in decision-making, policy formulation, as well as activities related to community development. The TAOs are the main planning mechanism at the local level and the main formal institution for local participation in planning processes (Kaosa-ard et al. 1998).

In addition, the laws governing water and other natural resources in Thailand are derived directly or indirectly from some basic legal texts, traditional and customary laws and or special laws regulating one or more uses of water. There are at least 28 to 48 water related legislations in Thailand (Sukhsri, 1999, Biltonen et al. 2001, Biltonen 2011), and more than 30 national departments in 9 ministries as well as 7 national committees (UN-Water/WWAP, 2007). A single law may regulate more than one aspect of use (Sukhsri, 1999, UN-Water/WWAP, 2007). The laws are generally fraught with fragmentation and overlapping responsibilities and are besetted with a lot of gaps (Cookey, et al. 2015a/b/c/d/f/e) (Figure 7.2).

Technically, the direct management and governance of water and other natural resources in the SLB are the responsibilities of the 6 most dominant ministries and their centralized deconcentrated departments (by the policy of deconcentration the ministries and the departments delegate their responsibilities to the provincial and district offices under the direct supervision of the provincial governors). These ministries include: Ministry of Agriculture and Cooperatives (MOAC), the Ministry of Natural Resources and Environment (MONRE), Ministry of Industry (MI), Ministry of Interior (MOI), Ministry of Transport (MOT) and Ministry of Public Health. In specific terms, water resources development, management, allocations and quality control activities are undertaken by the Department of Water Resources (DWR), Royal Irrigation Department (RID), Groundwater Resources Department (GRD) and Pollution Control Department (PDC) regional offices located in the SLB.

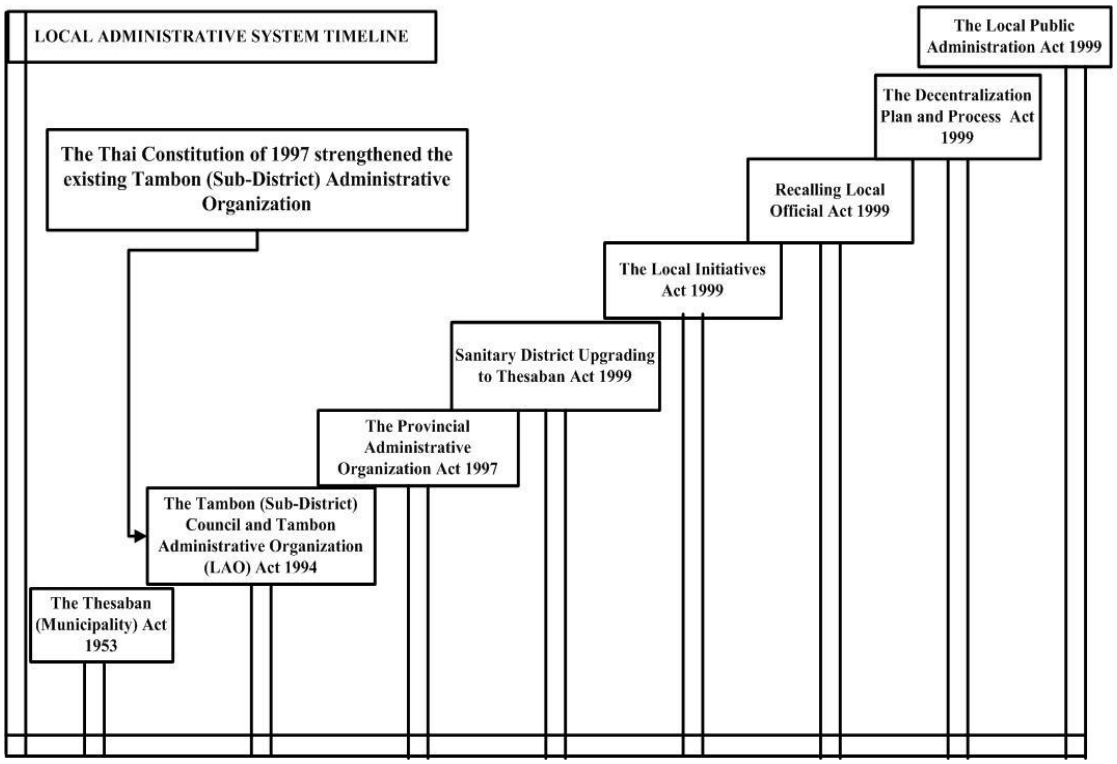

Figure 7.2: Local administrative system timeline in Thailand

The institutional framework for the implementation of the Integrated Water Resources Management (IWRM) can be found in the 2002 Water Resources Regulation, which makes provisions for water resources to be managed using the river basin as a territorial and administrative unit with a committee as a management organization. This resulted in the establishment of the Songkhla Lake Basin Committee (SLBC) as one of the 25 river basin committees (RBCs) by the Department of Water Resources (DWR) of the Ministry of Natural Resource and Environment (MONRE) (DWR 2005). Thus, Songkhla Lake Basin Committee (SLBC) is the formal government agency responsible for the implementation of the integrated water resources management in the SLB under the supervision of the DWR (DWR, 2006; Kanjina, 2008). However, the Songkhla Lake Basin Development Committee (SLBDC), an administrative committee established in 1993 with the mandate to formulate policies for conservation and restoration of natural resources by the Office of

Natural Resources and Environmental Policy and Planning (ONEP) (Uraiwong, 2013), coexists with the SLBC, howbeit, less visible.

One of the challenges that hinder full participation of the local communities in the governance of the SLB is the SLBC/SLBDC structures, which are dominated by the relevant/related central line government agencies and departments, accounting for more than two third of its total members with few slots allocated to the local people. The 34 members of the SLBC have only 7 members drawn from the communities and they must be experts (in most cases academia). The SLBDC is skewed with 28 members and only 6 community representatives, the rest are also drawn from the government establishments (Kongthong and Ratanachai, 2012). The implication is that local people are seldom involved in decision making, planning or implementation of policies because of the already misconstrued perception by the bureaucrats that local people have limited knowledge on resource governance and management (Rattanasuwongchai, 1998; Thammajinda, 2013).

On the other hand, local communities have strong informal structures for managing water and other natural resources. For instance, the informal governance and management of the Lakes' fishing have two types of rights: the area where semi-permanent fishing gear is applied, which are basically managed according to the rules of 'private property regime; and the areas where only mobile fishing gear can be used/allowed and where 'open access' is the rule, i.e. the harvesting is done on a 'first-come first-serve rule' (DANCED and MOSTE, 1999). But, most government representatives are sceptical about the value of local knowledge and do not believe in the capacity of communities to govern their own resources as well as the fear that established agencies and their staff would lose their influence in more inclusive decision-making processes (Neef, 2008). There are also doubts of the willingness of the local communities to engage in participatory natural resources governance. Consequently, this study shall also investigate the claim of the unwillingness of the local people to participate in the governance and management of the Lake Basin and if this is in any way related to their perception of the governance/management system (Figure 7.3).

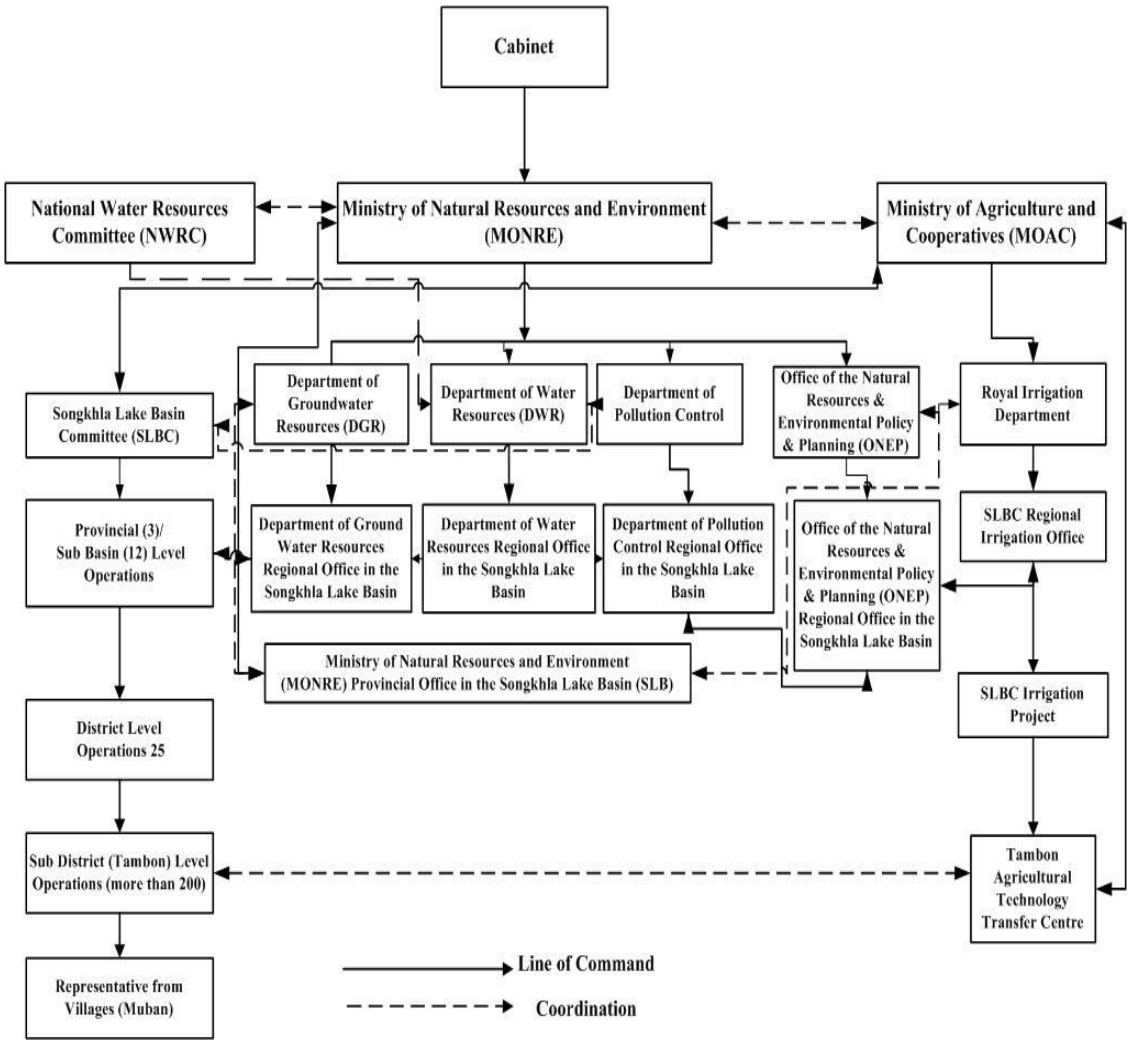

Figure 7.3: Water Resources Management organizations and agencies with water related missions as applicable in the Songkhla Lake Basin (SLB)

7.2 Methodology

7.2.1 Theoretical Framework

This study is based on the Adaptive Integrated Lake Basin Management (AILBM), a diagnostic and prescriptive conceptual framework designed to assess the performance of lake basin governance (Cookey et al. 2015a/b/c/d/e/f/g). The AILBM framework was derived from the Integrated Water Resource Management (IWRM) (Jønch-Clausen and Fugl 2001, GWP 2004, Hooper 2003, Jonker 2002, Odendaal

2002), Integrated Lake Basin Management (ILBM) (World Bank 2005, ILEC 2005, ILEC 2011) and Adaptive Management and Governance (AMG) (Holling 1978, Folke et al. 2005, Green and Garmestani. 2012, Clarvis et al. 2014) frameworks. It is built to critically diagnose the governance challenges of lake basins as well as measure the adequacy and capacity of the current solutions and strategies to develop and prescribe appropriate futuristic solutions (Cookey et al. 2015d). Incorporated in the framework is the assumption that successful governance of lake basins depend on our ability to create adaptive and integrative systems with equity in representation and inclusiveness in decision-making (Scholz and Stiftel 2005, Cookey et al. 2015e).

The AILBM framework is significant to lake basin governance discourse because it is designed to be gradual, continuous, holistic, systematic and integrative in nature with the capability of ensuring resilience, flexibility, adaptability, active participation of all stakeholders, effective and efficient decentralization systems and adequate feedback mechanisms that address the resource management system of the lake basin. The framework has two parts: diagnostic (i.e. sectors, actors, resource system, resource management systems, stressors and institutions) and prescriptive (i.e. adaptability, collaboration, resilience, decentralization, integration and participation). The diagnostic measures the how, what and why of the lake basin governance, which gives more insight into the governance structure of the lake basin (Young 2002, Cox 2011, Walker 2012), while the prescriptive measures and recommends solutions based on the outcome of the diagnosis (Hersen and Ammerman 1994, Bromley 2006, Rose Technologies 2013). The local people's perceptions of lake basin governance performance are hinged on three of the AILBM's diagnostic components (actors, resource management system and institutions) and four of the prescriptive components (collaboration, decentralization, integration and participation).

The AILBM recognizes the critical role of actors (players) who are capable of significantly affecting the outcome of governance processes positively or negatively. The institution (rule of the game) determines the interactions between the sectors, stressors, actors and the lake basins, and also lays the foundation for resource utilization and management and this is the core of the lake basin administrative and

organizational system (Young 1999, Avramoski 2004, ILEC 2005, World Bank 2005, Cookey et al. 2015d). The prescriptive aspect of the AILBM recognises the importance of effective collaboration (one of the core theme of this paper) to support the promotion of citizen participation in order to enable actors to influence each other's behaviour to advance common and individual interests (Berkes and Folke 1998, Blumenthal and Jannink 2000, Tompkins and Adger 2004, Newman and Dale 2005, Scholz and Stiftel 2005). For instance, the integration component looks at the capacity of the governance system to coordinate government agencies and other stakeholders in the lake basin and is designed to act as the connecting link between all the AILBM components (Lebel et al. 2013, Hooghe and Marks, 2003, Newig and Fritsch 2009). The role of decentralization is viewed from the governance principle that deals with devolution or transfer of power from the central or national government to the lowest level of government in political administrative and territorial hierarchy (Manor 1999, Ribot 2004). Participation, another core theme of this paper, is a complex and delicate process through which stakeholders influence and share control over development initiative, decision-making and the resources that affect them (World Bank 2000, Luyet et al 2012). Stakeholders in this case are all those actors involved directly or indirectly with the lake basin. The ALIBM recognizes the fact that the lake basin's local people and their communities can organize themselves for effective management and they are knowledgeable enough to understand the resource system and the regular interplays because of their accumulated experiences (Davis and Wagner 2003) and would surely have strong perceptions about the governance performance in the basin.

7.2.2 Sampling design

The data for this work were gathered from literature and official documents of relevant government and non-governmental organizations combined with structured field surveys, face-to-face interviews and observations. The perceptions of local people in the SLB were explored using two series of structured questionnaire field surveys for 200 Tambon Administrative Organizations (TAO), the sub-district local administrative structures and 12 sub-basins in the SLB with different populations. The 12 sub-basins

in the SLB include: Klong Pa Payom, Klong Thanae, Klong Nathom, Klong Tachiad, Klong Pa Bom, Klong Phru Poh, Klong Ratthaphum, Klong U-Tapao, East Coast Sub-Basin 1, 2, 3 and 4. Also, structured face-to-face interviews were conducted with some officers of the TAOs; the idea was to get more detailed perceptions of the local communities on the governance performance of the SLB. All research instruments were verified by a panel of three experts before they were administered.

7.2.3 Questionnaire surveys

Local people's perceptions of governance performance were measured through two series of field surveys. The first field survey was conducted between the periods of April - July 2014 and covered 200 Tambon Administrative Organizations (TAOs) and the sub-district local administrative structures of the three provinces of Phattalung, Songkhla and Nakhon Si Thammarat in the SLB. A standard questionnaire was developed to elicit information from 2000 households, which was based on the random sampling method and then 10 questionnaires were served in each sub-district to the heads of households of research interest. Data was collected via a household survey using a structured questionnaire, which consisted of 50 questions in four sections. The first section aimed at background and livelihoods of the respondents which addressed issues of land ownership, cost of living and access to common pool resources of the communities as well as the respondents' assessment of the degree of their livelihood support dependent on the natural resources of the Basin. This is based on the assumption that livelihood dependencies embedded within specific localities are assumed to result in very intimate relations among the people, the environment, and natural resources. The more they engage with the resource system (in work, in living, in leisure, for culture, etc.), the more dependent they are on the environment and natural resources and this creates a personal connection as well as particular and detailed knowledge of local environmental conditions and ecological relations (Davis and Wanger 2003).

The second sections involved the assessment of the perception of the respondents on the resource governance performance and were basically qualitative questions

because we wanted to understand their perceptions on the resource governance challenges confronting the SLB, law enforcement and compliance and how they are engaged and involved in the activities of community resource groups. The third section was a mix of qualitative and quantitative questions designed to get the respondents' perceptions and their level of understanding of the Songkhla Lake Basin development plan. Finally, the fourth section was designed to assess their degree of willingness to support and what will make them oppose development activities geared towards the improvement of the environmental quality of the case study area.

The second phase of the field survey was carried out from November 2014 - May 2015 and covered the 12 sub-basins of the SLB. The population of interest were households, but with particular attention to those respondents from water user groups like traditional authorities, farmer associations, fishermen, members of the NGOs and CBOs and other community members with first-hand knowledge or traditional wisdom on water management (Black, 1999; Kuzel, 1999). A standard questionnaire was developed to collect useful information from 120 households using a purposive sampling method based on the snowball technique. To ensure equal treatment 10 questionnaires were administered in each sub-basin for the population of interest as earlier stated. Data was collected via a household survey using a structured questionnaire, which consisted of 41 questions in five sections. The first section aimed at background and livelihood of the respondents and addressed issues of land ownership and access to common pool resources of the communities as well as to enable the respondents to assess the degree of their livelihoods support dependent on the natural resources of the Basin.

The second section involved the assessment of the respondents' perceptions on water resources related/relevant policies, legislations and regulations and their effectiveness and as well as how these have improved the environmental quality of the Basin. In the third section, several questions were asked about how they perceived the level of effectiveness of the natural resources management and administration as well as their preferred choice of management and administrative options for the SLB. In the fourth section, the respondents were asked how they perceived the level of stakeholder

participation and engagement as applied by the relevant/related government agencies. Issues on the involvement of the NGOs/CBOs were also considered. The fifth section was designed to assess the willingness of the respondents to support activities geared towards the improvement of the SLB. The entire questionnaire was then translated into the Thai language and verified by Thai-English specialists. The survey was conducted with a team of three trained Thai speaking field research assistants.

A total of 2120 questionnaire interview surveys were conducted, equating to an overall response rate of 100%. This was made possible because the respondents were not given the option of going home with the questionnaires, rather the field assistants asked the respondents the questions and the answers were completed by the field assistants on the spot. The questions regarding local peoples' profile and environment and water sections were multiple choices. The questions on the policies and laws implementation, management, coordination and governance activities of Songkhla Lake Basin Committee (SLBC) and Songkhla Lake Basin Development Committee (SLBDC), preferred choice for administration and management system, public participation, local communities' willingness to support development efforts and information and communication for development sections were a mixture of multiple choice with open-ended questions. This gave the people the opportunity to express their in-depth perceptions. A five-point Likert-scale (with anchor points ranging from 'good' to 'poor' and excellent' to 'poor' or three-point ('yes' to 'neutral') was also used depending on their appropriateness. Interview transcripts were entered into a Microsoft Excel database and used for analysis.

7.2.4 Structured face-to-face interviews/observations

Structured face-to-face interviews were conducted with 10 officers of the sub-district local administrative organizations and some community leaders. The idea was to dig deeper into their perceptions, especially from the communities's opinion leaders. The interviews were conducted in English language with the help of a Thai interpreter. The participants were asked questions on their perceived governance challenges, etc.

They were also asked to suggest what they considered the best decentralization structure for improved management, administration and governance of the SLB.

Fields visits to the case study area were also carried out, which created the opportunity for direct and indirect observations. These field visits were used to further interview some respondents like fishers and the homestay owners to capture their involuntary reactions with the SLB as well as other users of the Lake Basin. These observations provided another source of useful evidence concerning the depth of the local peoples' connection to the SLB (Yin, 2003, 2009, Gillham, 2000). It helped to yield important insights and to gauge their emotions and feel their pulse from their body language and unspoken but meaningful actions (Sithole 2011).

7.2.5 Data analysis

Survey responses were analysed using descriptive statistics with the help of Excel Statistical packages. Qualitative data generated were analysed using a thematic approach (Yin 2003, 2009, Creswell 2009). Basic statistics including mean, frequency and percentages were computed for the results. For ease of analysis, the two surveys were presented under the following thematic headings: local people profile, environment and water issues, policies and laws implementation, management, coordination and governance, public participation and access to information.

7.3 Results

7.3.1 Local people's profile

The majority of the respondents interviewed were female (63%) and male (35%). The result indicated that a relatively large proportion of the sampled population in the SLB were within the age group of 40 - 60 years (64%) while 37% were between 18 - 30 years and only 2% were below 18 years. This implies that the respondents had experience on various issues relating to water resources governance and management related to their communities. This is because traditional knowledge is often believed to reside with the older members of the communities who act as the custodians of the

local customs and norms of the local communities as well as the gain of long term interactions with the resource system. Education-wise, 37% were primary school graduates, 5% attended secondary school, and graduates from technical college and university were 27% and 13% respectively, while only 8% had non-formal education. Majority of the respondents had enough education to understand water resources management issues and challenges in the communities as it related to governance. The duration of stay (i.e. amount of time someone has lived in the SLB) of the respondents in the communities was as follows: 29% had stayed for 40 to 60 years, 55% stayed for 10 to 30 years and 15% stayed for 1 to 10 years. The longer the amount of time the respondents lived in the communities indicates better acquaintance with the SLB and its governance, which increased their understanding of local values and customs and also enhanced their access to local knowledge.

The study revealed that the local people of the SLB are homogenous ethnic groups consisting of: those living off the natural resources in the Thale Noi swamp resources, Pak Payun lake fishery, Ban Thung Yai-hill forests, and Ban Mai (Khao Daeng) estuarine fishery as well as communities based on lowland rice or mixed cropping, coastal fishing villages based on inshore fishery resources, combined agricultural and fishing villages, rubber estate villages and new peri-urban communities (Taylor and Sons 1985). Also, there were 8 major types of land holdings in the communities: residential lot 42%, aquaculture (fish or shrimp) ponds 1% swine farms, 1% vegetable gardens/cash crops/orchards, 34% paddy rice farms, 11% rubber plantations, 8% fishing lots in Songkhla Lake, 2% oil palm plantations.

Interviews with the local people revealed that the fishing lot acquisitions in the Lakes depend on the first person to stake a claim and then he/she can pass it on to their families or sell it to another person. Each family lives in simple dwellings well-built with wood, cement, fabricated materials and/or roofing materials made of galvanized zinc, asbestos roofing sheets and some with thatched roofs. Wood and cement are common materials used for the floors and walls. Cooking is done with wood, gas cookers and in some cases electricity. However, most of the households eat out often, buying food from the many restaurants and food vendors around them.

Also, from the surveys, observations and document reviews, we noted that the major means of livelihood and economic activities in the area are mainly agricultural and commercial activities with very few working in the public service. The common agricultural activities include: rice farming, animal husbandry, aquaculture and processing, fishing, latex collection from rubber plantations, among others. The distribution of respondents' livelihood activities were: business and commerce 38%, rubber planting 17%, rice farming 16%, fishing and aquaculture 19%, public services 8%. The communities were well sufficient because of high level of economic activities that generate income within the communities. All members of the family contribute to the labour pool in every household's economic activity.

Some major conclusions that can be drawn from the results of the interviews, surveys and observations is that majority of the communities' livelihood activities were connected to the natural resources of the SLB. The majority of the households also raised animals as alternative and complementary livelihood and the communities very close to the Songkhla Lake engaged in fishing activities. Also, from the interviews and surveys, we discovered some resource conflicts issues. The respondents highlighted the real and perceived conflict issues within the local communities (depending on how each of their livelihoods were impacted by others activities). For instance, the residents of Kho-yo are of the opinion that noise from home-stays is a major public health issue in the community. The fishing community of Khu Tao feels that home-stays at Kho-yo have more polluting effects than wastewater from the shrimp farms in Songkhla Lake, which in turn affects their livelihood negatively. They also perceived that it is difficult to regulate the home-stay activities because of their influence and status in the community. On the other hand, the home-stay businesses feel that the fishers impact negatively on the environment of the Lake because of the over-crowded nature of their permanent and semi-permanent fishing gears, which they feel encroaches on their space and affects their guests' water leisure activity. These issues and perceptions often result in serious conflicts among users. The study also revealed that the average monthly income per household in the study area ranges from: 30-150 USD (20%), 150-300 USD (29%), 300-500 USD (27%), 500-600 USD (13%) and >600 USD (115%)

(Table 7.1). Also, majority (52%) of the respondents felt that the cost of living was high in the study area, (6%) were of the opinion that it was low and (17%) were not sure.

The interviews and observations revealed how passionate the local people are about the Songkhla Lake and its subsidiaries. When asked about the challenges facing the SLB and the benefits they enjoy from it, they get excited and really emotional. One community leader, a local fisherwoman who doubles as a volunteer protector of the mangrove forests, insisted that the best place for the interview was on her canoe and in the middle of the Songkhla Lake. She talked about the Lake in personal terms and as a living being and her commitment to the mangrove was so strong, her anger could literally be felt when she talked about those destroying the mangrove forest. In other interviews, the fishers bemoaned the quality of the Lakes and how it affects their livelihood. But, more than that they were saddened by the fact that the poor environmental and water quality removed from the aesthetic beauty of the Lakes. They talked passionately and almost intimately about how important the Lake is to their community, and to show their appreciation they set up lamp-lights in the centre of the Lakes at night to add to the Lakes' allure and serenity. Listening to them talk about the Lake was like listening to someone talk about a beloved friend. Field visits to the fishing communities were quite interesting as the local people took pleasure in introducing us to the Lake and its features – taking us around on walks, in their canoes - and telling us stories.

7.3.2 Water Environment Issues

The majority of the people (55%) perceived that the benefits of Songkhla Lake were more on flood/drought control while 25% were for irrigation, 12% water (groundwater) supply, 3% water (surface) supply, 3% fisheries and marine resources, but only 1% gave tourism any consideration and swimming was not considered a benefit at all. This is interesting because the SLB is said to have a high tourism potential and it is expected that coastal communities will take pleasure in swimming in the waters available to them for free. But, interviews and observations revealed that the local people are not exactly keen on the tourism issue, especially

with the challenge of the Kho-yo home stay and they are not easily aware of the tourism potential. Also, water quality challenge caused by inadequate solid and industrial waste and wastewater management makes swimming an undesirable activity. Expectedly, majority (43%) of the respondents perceived that the main environmental challenge of the SLB is municipal solid waste and wastewater management, others considered issues like water quality and pollution (23%), problem of management, administration and governance (21%), fishery and aquatic resources depletion (12%), deforestation of mangrove and peat swamp forest (6%) as well as siltation and sedimentation (5%) (Figure 7.4).

Table 7.1: Respondent profiles

Characteristic	Description	Sub-district survey _2014		Sub-basins survey _2015		% Mean
		#	%	#	%	
Sex	Male	747	37	44	33	35
	Female	1253	63	76	63	63
Age (years)	< 18	30	3	2	2	2
	18-20	55	4	3	2	37
	20-30	320	16	11	9	
	30-40	350	18	29	24	
	40-50	409	21	25	21	64
	50-60	419	21	38	32	
	> 60	393	20	16	13	
Educational Status	Non Formal	140	7	-	-	7
	Primary	829	42	38	32	37
	Secondary	479	24	31	26	25
	Technical	479	13	38	32	27
	University	278	14	15	12	13
Duration of stay (years)	1-10	345	17	16	13	15
	10-20	243	12	18	15	55
	20-30	349	18	30	25	
	30-40	322	16	29	24	
	40-50.	239	12	11	9	29
	50-60.	227	12	8	7	
	>60	245	12	8	7	
Monthly Income (USD)	30-150	493	25	19	16	20
	150-300	581	29	35	29	29
	300-500	407	20	38	35	28
	500-600	224	11	19	16	14
	>600	291	15	9	8	11

Domestic water supply was sourced from municipal water facilities (50%), boreholes (groundwater) (29%), hand dug well (11%), rain water (5%) and others (packaged water) (4%); and sanitation (toilets) systems in use were pit latrines (85%), septic tank systems (13%) and pour flush (2%). During interviews, the respondents expressed their deep worries over the quality of the Lakes and how it affects their communities. They were equivocal in their willingness to support any move by government to improve the waste and wastewater management challenge in the SLB.

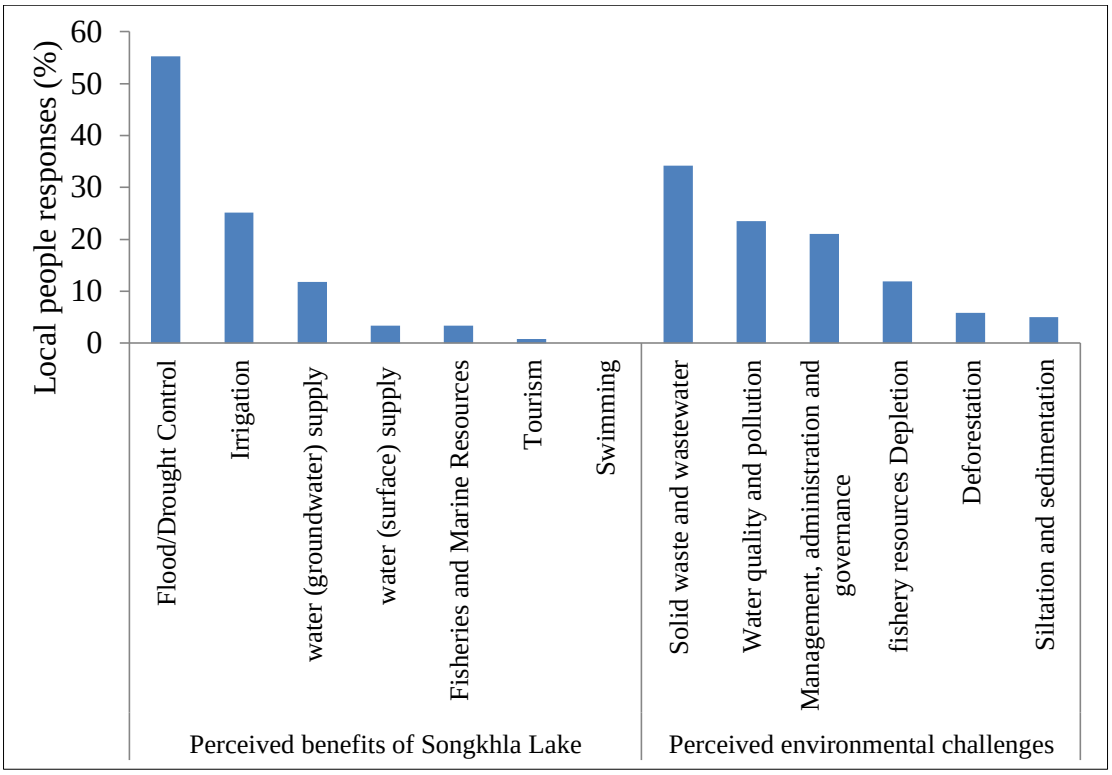

Figure 7.4: Local people's perceived benefits and environmental challenges of the Songkhla Lake

7.3.3 Implementation of policies and laws

The local people were of the opinion that the water policies and laws were not adequately implemented in the area. 54% accepted that the policies and laws were fairly implemented, while 35% said they were poorly implemented and 8% rated the implementation level as good. However, 52% considered effectiveness of

implementation to be fair, while 30% said effectiveness was poor and 13% perceived that the implementations were effective. When asked which particular legal instruments they thought should be given adequate consideration, especially for improving environmental quality, the following legal instruments were listed by the respondents: laws for the control and regulation of fishing, environmental conservation and pollution control laws, treatment and management of industrial and domestic wastewater laws, promotion of public health laws, marine protection and other aquatic resources related laws. The respondents' perceptions on the issue of enforcement and compliance in the SLB were: rated fairly by 47%, poorly by 36% and 16% perceived it to be good (figure 7.5). Interview revealed their dissatisfaction with enforcement of regulation and they complained of the fact that home-stay owners could get away with anything because they were influential implying a disparity in enforcement and compliance mechanisms.

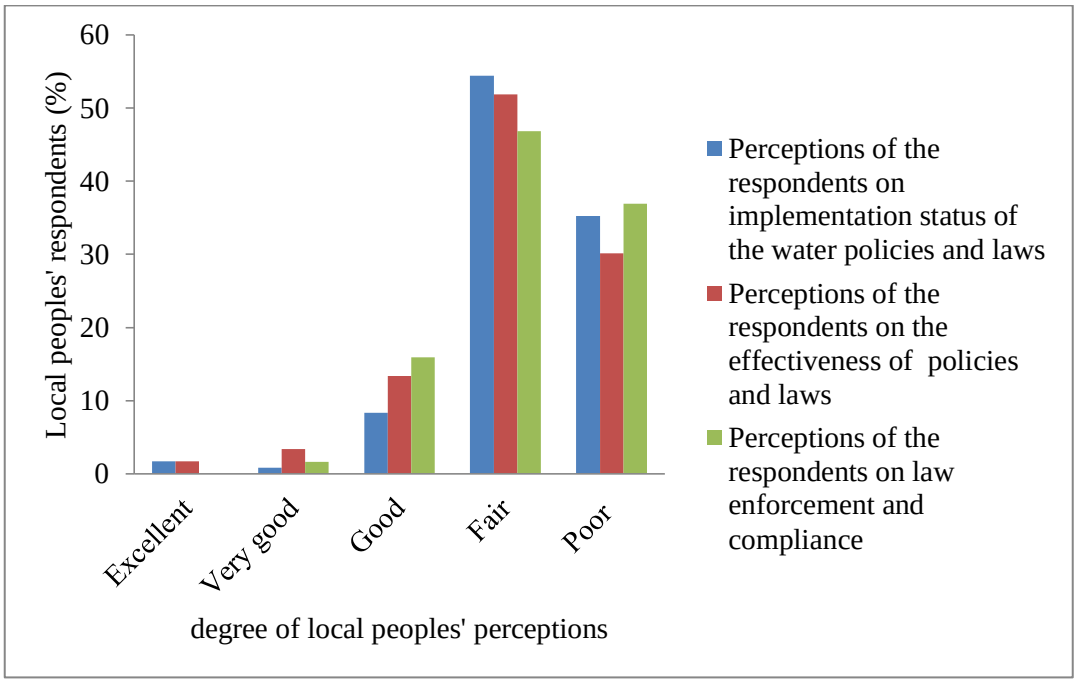

Figure 7.5: Local people's perceptions on implementation of water policies and laws

5.3.4 Management, coordination and integration

The majority of the respondents (54%) perceived that management and governance of water and related resources were unsatisfactory, while 20% perceived it to be satisfactory, 14% said that the management and governance systems were fair, 9% rated it as poor and only 1% said it was good. Also, 64% of the respondents viewed the coordination and integration among various levels of government (national, provincial and local) as well as with the agencies and departments as unsatisfactory, 15% believed it to be poor, 14% perceived it to be fair, 4% said it was satisfactory and 1% believed it was good. On their perception of the number of government ministries, departments and agencies involved in the governing of the SLB, 33% of the respondents perceived that the number of government actors were high, 31% perceived that the number of the formal actors were fair, 30% perceived the number of the actors to be low and 3% were of the opinion that the number of the government agencies in the Basin was satisfactory (figure 7.6).

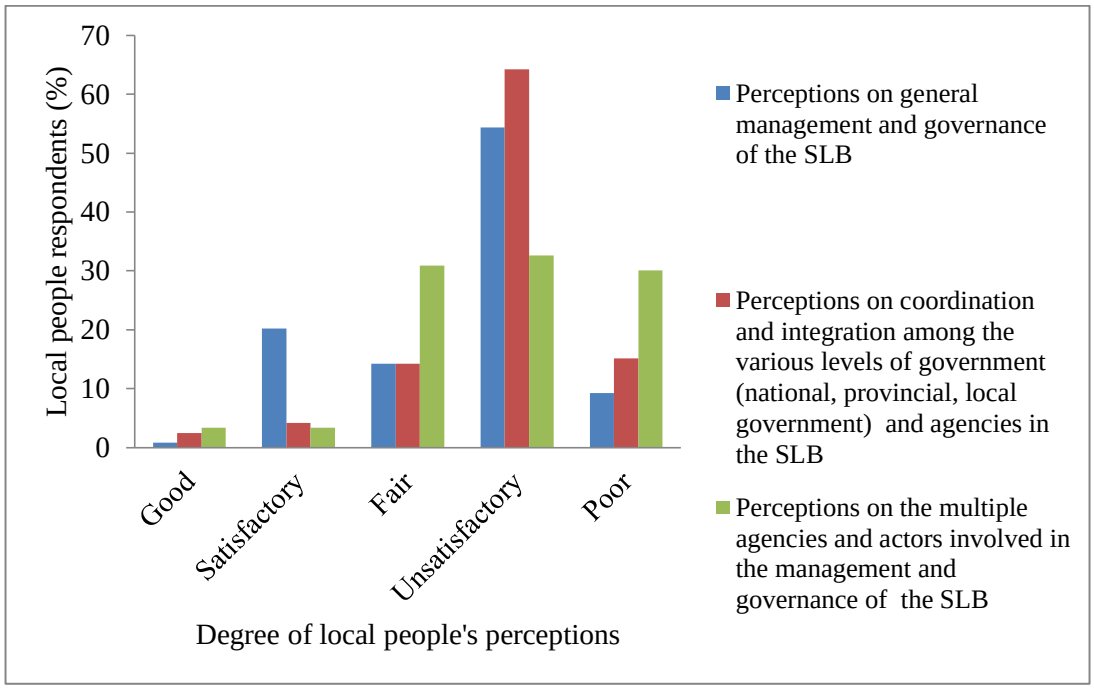

Figure 7.6: Local people's perceptions on management, coordination and integration

In all, 68% of the respondents were not satisfied with the idea of multiple agencies and actors involvement in the management and administration of the SLB; only 15% of the respondents preferred the existing system and 17% had no opinion on the matter. 45% of the respondents preferred a single formal management and policy harmonization organization for the coordination of the use and management of the diverse resources used in the Basin, 21%, however, were not in support of this proposition and 34% were neutral. Also, 58% of the respondents preferred that Local Administrative Organizations (LAOs) {Provincial Administrative Organizations (PAOs), Municipal Administrative Organizations (MAOs) and Tambon Administrative Organizations (TAOs)} be more involved in the management and administration of the SLB, while 17% were not in support and 25% were neutral (figure 7.7 and Table 7.2). However, during interviews the respondents complained about the confusion of having too many State actors regulating the same resource. For instance, they argued that the SLBC and the SLBDC seemed to have the same mandates and it's not quite clear how people are to differentiate them. They were also cynical about the activities of the Committees and other governance agencies, claiming that they were so much talk and too little action. Some suggested that the issue of too many different government bodies could be responsible for weak enforcement and compliance.

Table 7.2: Some highlights of the SLB water governance qualitative survey and face-to-face interviews

Interview Questions	**Findings**
What do you perceive as the main challenges confronting the SLB?	Disposal of untreated industrial, swine farms and domestic wastewater; indiscriminate disposal of solid waste; channelling of storm water without primary treatment (screening, grit removal) into the lake; densely populated, crowded and congested fishing gears and tools; sewage pollution from homestay businesses; deforestation of mangrove and destruction of peat swamp; rapid sedimentation and siltation of the lake resulting in shallowness; pesticides, herbicides and fertilizers contamination from agricultural activities; negative impact of erosion and flooding; depletion of fisheries resources; inadequate and weak enforcement of relevant policies and laws by responsible agencies of government; and weak coordination amongst relevant government agencies
What do you consider to be the challenge of enforcement of relevant and related water resources policies and laws?	Unsuitability of the relevant and related legal and policy instruments making enforcement difficult; low level of awareness among the people on relevant and related legal and policy instruments; legal instruments not specifically targeted at addressing the challenges of SLB; and low level of commitment by the regulatory and enforcement community
What in your opinion are the implementation challenges of the SLB's Development Plan 2011-2016?	Low level of awareness of the Plan by Basin local communities; priority actions for the plan for the SLB should be staggered a little bit in the following order: improved management of municipal solid waste and wastewater; improved water quality to meet recommended standards; reduce and prevent coastal erosion and flooding; improved governance; improved coordination and cooperation amongst all stakeholders; reduce and prevent sedimentation; and re-instatement of aquatic resources (fishery resources/rare species/biodiversity). Going forward will require a strong community education on the development plan.
What will be your recommendations for the improvement of the SLB?	Dredging for the removal of sediments from the Lake to improve its depth; lake shore protections with adequate system of drainages installed and installation of pre-treatment systems for storm-water before entering the Lake; dialogue with the fishing communities on how to improve fishing activities; carry-out special activities targeting the garbage bank operators and municipal cities solid waste collectors; empower the communities around the Lake for self-management and protection of the Lake; in the case of Kho-yo Home Stays, the issue of land ownership need to be properly addressed so that proper investments can be made to improve their infrastructures, which will also address the current sanitation challenges they face; development of improved and appropriate sanitation devises that will be suitable for the home stay businesses location; organizing joint regular meetings between the government, local people and policy makers; improvement in the law enforcement mechanisms; and enforcement of fishing legislation and other relevant legal instruments for the protection of the Lakes.
What is your opinion on the water policy and other related legal instruments?	Nothing is really wrong with the policies but ineffectiveness is due to the inability of the government to take decisive actions to stop the degradation of the environmental quality of the Basin, especially by stopping illegal activities like the use of unauthorised fishing gears/tools as well as absence of treatment of wastewater by industries in the Basin, inadequate sanitation systems, especially for households communities nearer to the Lake, etc.
Suggestions for improvement	More authority should be given to the provincial level of government and the local administrative level; balanced shared responsibility between the central and local administrative organizations and proper delineation of functions and responsibilities among agencies and departments involved in the management of the Basin

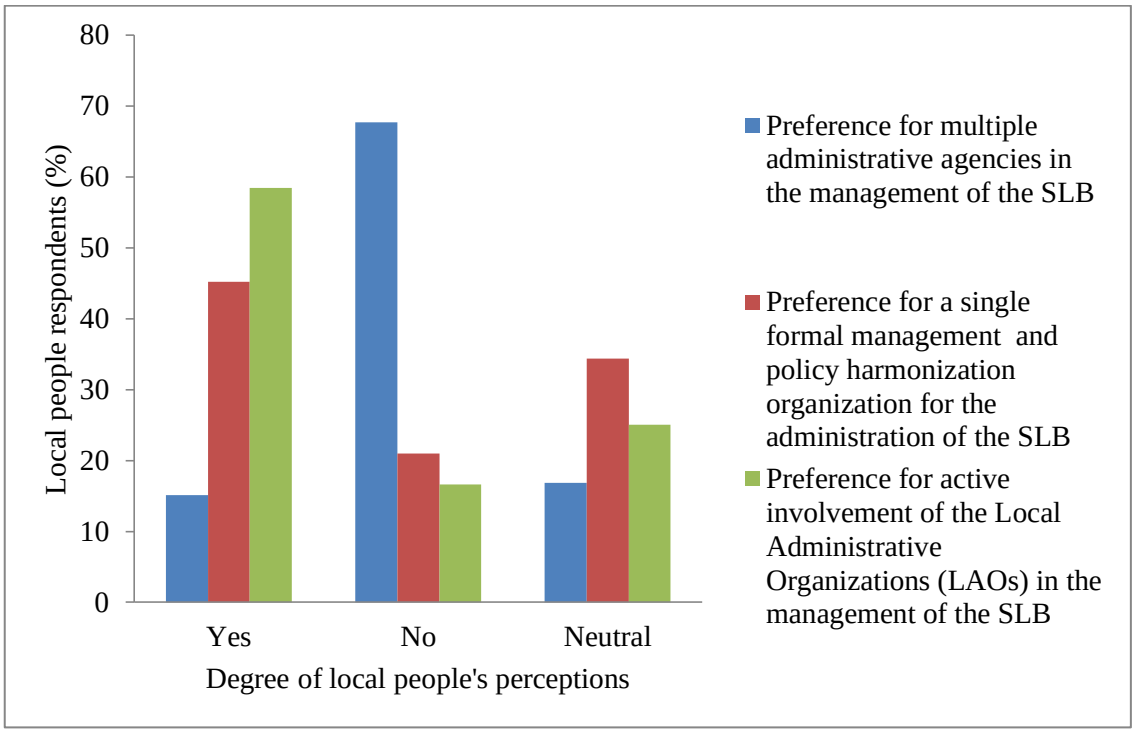

Figure 7.7: Preferred choice for administration and management system

7.3.5 Public participation

This study revealed that 35% of the respondents perceived that the participatory policies of the government agencies in the SLB were unsatisfactory, 28% perceived it to be poor, 17% said they were satisfactory and 15% rated it as good. However, 43% deemed participation and involvement of the NGOs/CBOs in the development activities with the relevant/related government agencies unsatisfactory, and 21% perceived it to be fair and satisfactory respectively, while 9% rated it as good. Also, on the involvement and participation of the local community members in the activities and programmes to improve the status of the SLB: 47% perceived it to be fair, 35% believed it to be unsatisfactory, 14% said it was satisfactory and 8% regarded it as poor (figure 7.8).

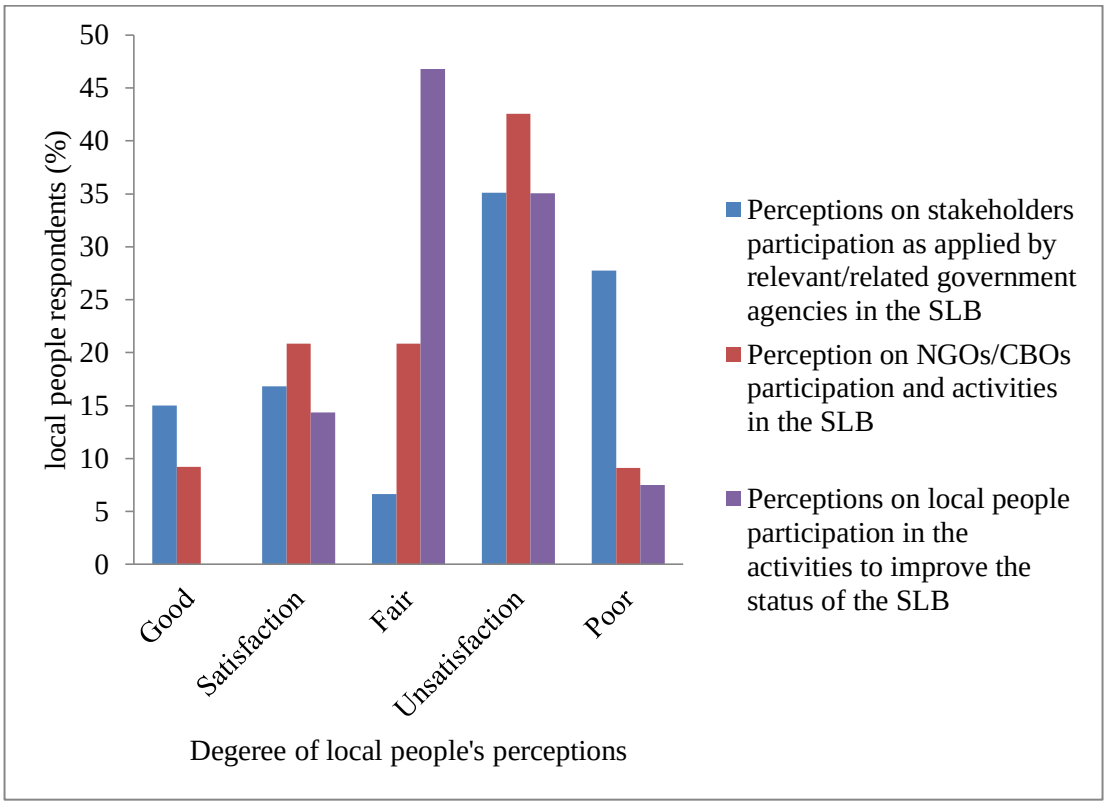

Figure 7.8: Local people's perceptions on public participation in the SLB

Overall, 42% of the respondents said that they were aware of the presence and activities of the Songkhla Lake Basin Committee (SLBC), 33% said they were not aware and 20% were neutral on this issue. Pushing further to determine the level of their participation and involvement in the activities of the SLBC: 33% said they have never participated in their activities, 29% said they had participated and 38% were neutral. However, 45% of the respondents were aware of the presence and activities of the Songkhla Lake Basin Development Committee (SLBDC), 34% were not aware and 21% were neutral, although only 29% participated in the activities and programmes of the SLBDC, while 32% had not participated and 39% were neutral (figure 7.9).

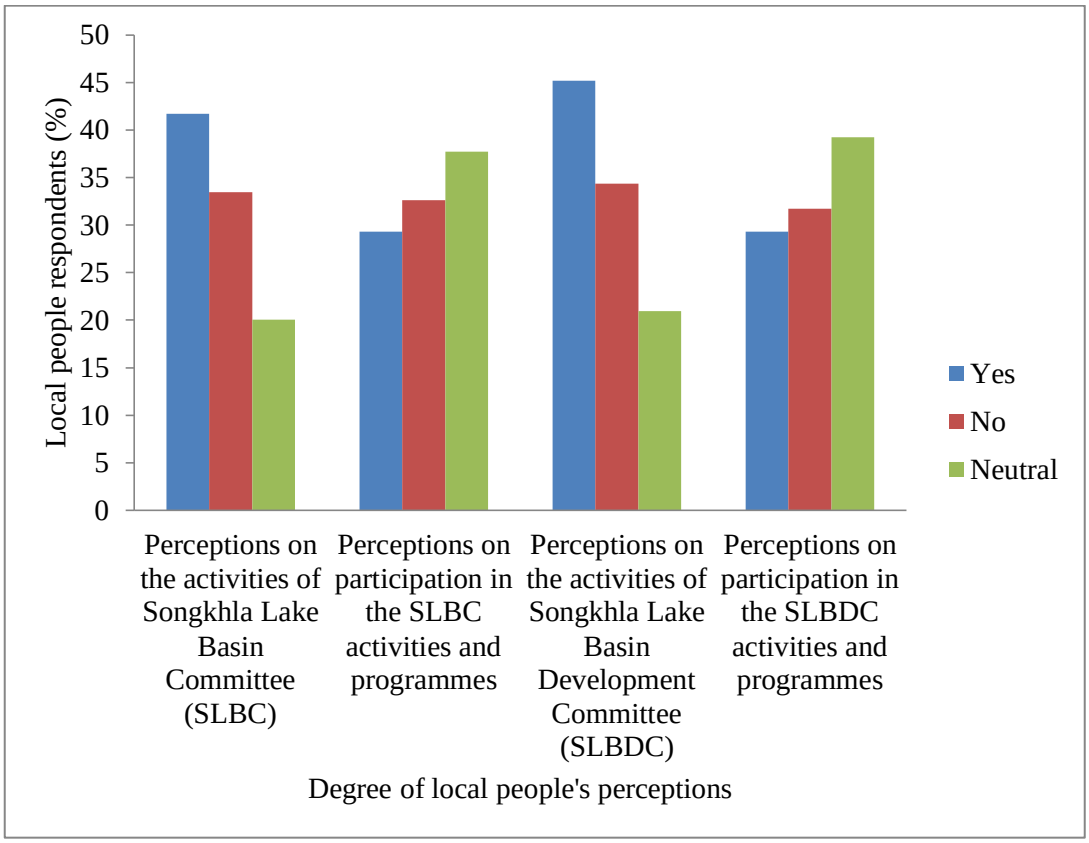

Figure 7.9: Local people's perceptions on participation in the activities of Songkhla Lake Basin Committee (SLBC) and Songkhla Lake Basin Development Committee (SLBDC)

The study revealed that most of the local people surveyed were more willing to support any government intervention for the improvement of the SLB: 68% were willing to support, 21% were not willing and 12% were neutral. On the willingness of local communities to contribute a token to show their level of support: 68% were willing to make such contributions, 16% were not willing and 18% were neutral. Also, on the willingness of the stakeholders to work together for the development of the SLB: 69% said they perceived that all the stakeholders would be willing to partner for the progress and improvement of the environmental quality of the SLB, 19% were negative, while 13% were neutral (figure 7.10). During interviews with respondents from the Kho-yo home stays, they revealed that one of their major challenges was that

they did not have ownership rights on the land on which their businesses are located and so could not go into proper development with environment-friendly sanitation and hygiene systems. They suggested that if the ownership structure of the land is regularised, then they could source for the required finance from the financial institutions. They bemoaned the current status of their facilities and regret the negative impact they have on the quality of the Songkhla Lake.

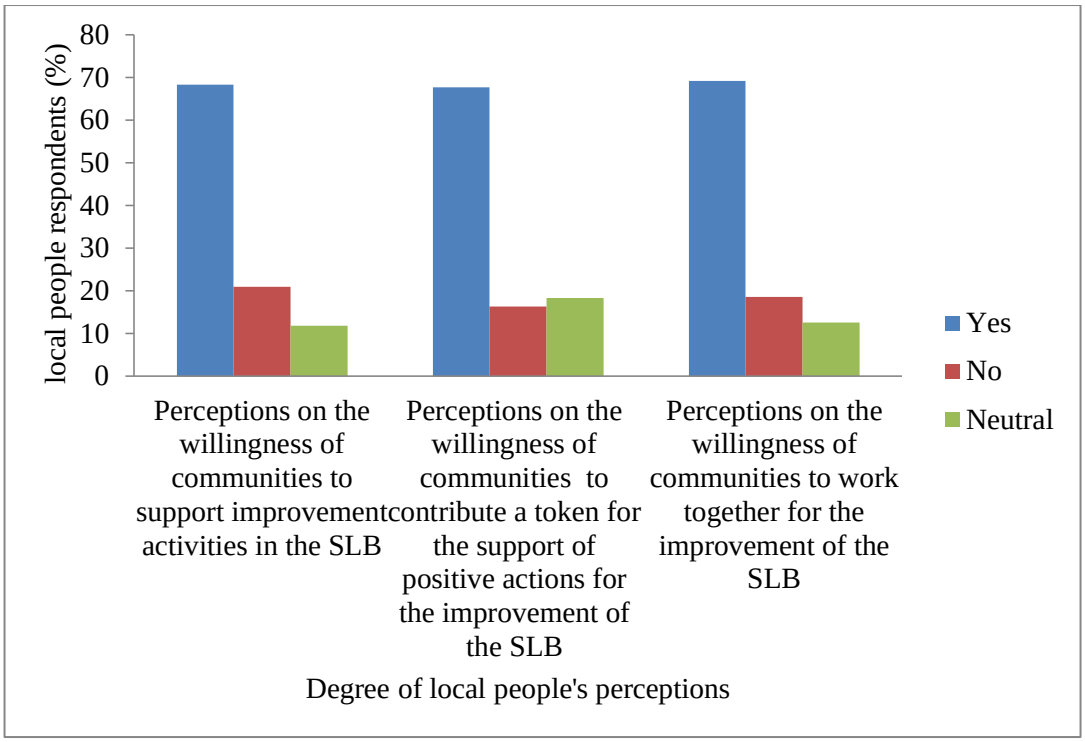

Figure 7.10: Perception on the willingness of local communities to support the improvement of the SLB

7.3.6 Access to information

The study revealed that the respondents had access to fairly good environmental knowledge and information from the government agencies, NGOs/CBOs and mass media. This could be based on the higher level of education of the respondents that helped them to access and understand environmental related information. This level of education needs to be considered in developing communication materials for

sustainable resources management (Tenge et al. 2015). Overall, 43% perceived that the quality of the environmental awareness campaign programmes organized by the government agencies in the SLB were fair, 24% perceived it to be unsatisfactory, 19% perceived it to be poor and 13% said it was satisfactory. On the quality of environmental awareness campaigns organized by the NGOs/CBOs, 38% of the respondents perceived it to be unsatisfactory, 30% said it was fair, (18%) were of the opinion that it was poor and 14% perceived it to be satisfactory. Also, 28% of the respondents perceived the quality of the environmental awareness programmes of the media on the SLB to be fair and unsatisfactory respectively, while 15% stated that it was poor and 15% noted that it was satisfactory (figure 7.11).

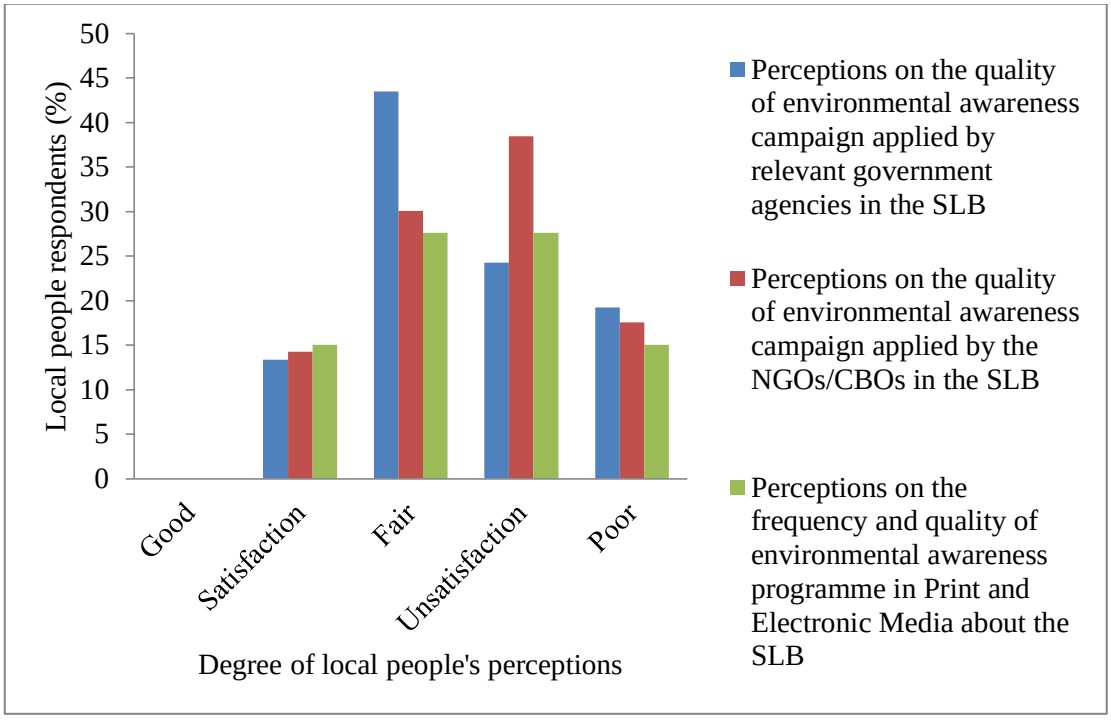

Figure 7.11: Access to information and communication for development

7.4 Discussion

Local people are part of the stakeholders (individuals and groups who are directly and indirectly connected to the Lake Basin and will be potentially affected by

its management) who usually do not receive due consideration in the decision-making of the governance process for the SLB, even though they are the ones with an intimate and long standing relationship with the resource system. It has been erroneously assumed that the local people do not have much to contribute to resource governance and management and so it is not required to seek their input. However, evidence shows that the local people, based on their long standing interactions and relationships with the resource system, possess substantive knowledge because the SLB provides direct and indirect benefits to them as well as meet their local needs (McNeely 1995). They have a personal relationship with the resource based on their connection to it, whether as a source of their livelihood or religious rites or relaxation or simply identity. The Lake Basin can be said to be like a beloved friend, something they have come to know and trust. It can, therefore, be rightly assumed that they would be protective and possessive about it. This will influence their response to the governance and management of the Lake Basin. If they perceived that the governance and management system is not good enough to protect the resource they have come to know and love, they will inadvertently resist or ignore the system. This can, to some extent, explain the failure of the system to protect the Lake Basin. Consequently, it becomes quite essential for decision-makers to know and understand the perception of the local people, so that there will be a buy-in and support for the formal management of the SLB in order to ensure success.

According to Gibson (1966 and 1987), perception is what guides actions towards the right or wrong direction; however, it is not passive; it is shaped and nurtured by learning, memory, expectation and attention that influences actions (Gregory, 1987 and Bernstein, 2011). This indicates that perception is built over time and it can be right or wrong, but strong enough to develop beliefs and influence actions. Therefore, development initiatives that ignore the perception of stakeholders (especially closely related stakeholders like the locales) will not be able to capture their wide range of need especially as it concerns livelihood risks and relationships with the resource systems (Cookey et.al. 2014). This can gravely affect participation, which is a key element of measuring modern day resource governance. It is, therefore, misguided to

assume that governance and management of natural resources like lake basins can succeed or be effective by downplaying or misrepresenting the perception of the local people.

The local people of the SLB, for instance, were quite dissatisfied with the management, coordination and governance of the SLB because they had over time arrived at their own conclusions. In their view, the implementation of solid waste and wastewater management strategies were inappropriate and inadequate, enforcement of standards for sanitation practices (especially for the coastal communities nearer to the Lake) was weak, and there were too many meetings with too little concrete actions that improved the environmental quality of the Basin. Interestingly, they believed that some of the governance instruments are fair enough, but implementation is weak. They seem to prefer the establishment of a single formal management and policy harmonization organization for coordination instead of multiple agencies and actors (as the case is currently) because this leads to confusion and administrative/jurisdictional conflicts. They also advocate for active participation of the local communities and more involvement of the Local Administrative Organizations (LAOs) in the management and administration of the SLB. Furthermore, to disprove the assumption that the local people are not adequately equipped to understand natural resources governance and management issues, they made specific recommendations such as: requiring more authority for the Provincial Administrative Organizations (PAOs) above the other lower LAOs in order to reduce the current bureaucratic hurdles; balanced and shared responsibility between the central government and LAOs; proper delineation and responsibilities among all actors; reduction in the number of government agencies and departments involved in the direct management of the Basin; and commensurate funding for the LAOs to enable them to discharge their duties creditably. These are core issues of governance that require deep and long term thoughts arrived at based on these local peoples' perceptions of what they viewed as the challenges of governance and management of 'their' SLB.

However, the local people of the SLB are equally guilty because of their own negative impacts on the SLB, through the direct discharge of sewage from home-stays

and households, indiscriminate fishing and illegal fishing gears by fishers, indiscriminate disposal of solid waste, deforestation of mangrove and peat swamp forests, disposal of wastewater from aquaculture ponds, poor agricultural practices that cause excessive discharge of nutrients and silts materials into the Lake, etc. It is interesting to note that these local people recognize the impact of their activities on the Basin and would like to know what to do to correct it. Most conflicts among users of the Lake Basin arise from these negative impacts on the livelihoods of others. There is the perception that some stakeholders are given priority over others because of their level of wealth and positions. For instance, the fishers perceived that the home-stays are more polluting than the other activities, but because they are richer and more influential, they hardly comply. This is a perception that often leads to conflict. On the other hand, the home-stay owners feel that the fishers' activities and the aqua-culturists contribute more to the deterioration of the Lake. Other local people, apart from the fishers, aqua-culturists and home-stay owners, complained about the negative impact of the noise pollution from the home-stay business, odour nuisance of wastewater from aquaculture ponds and swine farms, as well as the fact that the Lake has been turned into a sewer for storm-water and untreated wastewater from homes, rubber and food industries. These are all perceptions that lead to conflicts among the local people and they are desirous to reduce these conflicts as well as the negative impacts on the Lake Basin. Evidently, if the governance and management system had taken these perceptions into cognizance, probably things would have been done differently.

These perceptions are largely why the local people of the SLB considered the implementation of the governance instruments ineffective and inadequate, judging them highly unsuitable, making enforcement and compliance difficult. They also identified low level of awareness among the people on the relevant and related governance instruments and the fact that these instruments do not specifically target the SLB challenges as pointers to their failure. They went further to claim that there was low level of commitment by regulators. These perceptions can be related to the fact that the institutions for water resources governance in the SLB are actually outmoded and obsolete (Christenseen and Boon-Long, 1994; Wongbandit, 1995; 2005). So, the

perceptions of the local people are actually in agreement with the findings of the experts; and actually strengthen the need for institutional review.

There are informal tenures, rules, customs and traditions (or in summary local structures) that exist in the communities, which influence how water and other natural resources are managed. This informal management system was devised and is implemented by the community of resource users, and it co-exists with the formal government management system. In fact, the local people consider this informal structure to be more legitimate than the formal (TWRA and ONEP, 2006). This will influence their behaviour and may inform their hesitance to participate in the governance and management of the SLB, as it may seem to contradict with their accepted structure. For example, fishers have staked claims in most of the Lake surface water like fishing lots ownership. The local people said that over the years these fishing lots were acquired by *'first come–first serve'* basis, inheritance or outright sale. It is, in fact, a big offense to be caught fishing in another person's lot and no new entrant is allowed except by permission from the fishers who own the lots. This is a strongly held belief, in spite of the standing formal law (Civil and Commercial Code), which provides that a resource like the SLB is for the 'common benefit of all', and the Fisheries Act 1954, which also requires permits, licenses and concessions from the Department of Fisheries (DOF) (KOT, 1954) and also makes provisions for public fishing designated within each Province by the PAOs with approval from the Ministry of Agriculture and Cooperatives (MOAC). This informal structure is so strong that compliance to formal rules and regulations is limited where it overlooks the traditionally accepted norms. Like in the case of Thale Sap Songkhla (outer Lake) and Thale Sap (inner Lake) where there are more shrimp traps than are officially allowed, which indicates that the local people have little faith in the relevance, legitimacy or efficacy of these rules (DANCED and MOSTE, 1999). In the same vein, local communities have developed their own system of water management, which was later formalised by the People's Irrigation Act of 1939, where irrigation water is managed either on a group or individual basis, particularly to supply water to agriculture areas for growing rice (Kaosa-ard et al. 1998). A State Irrigation Act was enacted in 1942

under direct supervision of the Royal Irrigation Department (RID) with more diverse purposes differentiating it from the local people irrigation. It can be assumed that the efficient functioning of the People Irrigation System is as a result of the community members' participation, which in turn contributes to the maintenance of the systems (Kaosa-ard et al. 1998; Sukhsri, 1999). In as much as water and indeed other natural resources are 'common pool' (Ostrom, 1990; Ostrom el at. 1999; Kalikoskia 2002), they are without open access (Heyd and Neef, 2004). Therefore, the local people's perceptions, based on their local informal structure, can lead to conflicts with each other and formal regulatory authorities. It is interesting to note however, that conflicts among local users of the Lake Basin arising from informal rights and tenures are resolved traditionally and rarely go through the formal mediatory system (DANCED and MOSTE, 1999).

Patel and Stel (2004) argue that creating better governance at the local level cannot only occur through assigning greater roles to local communities, but rather through the local population being given roles within the wider 'decentralizing' process of the country. It is, therefore, understandable when the local people of the SLB perceive that their participation and involvement in natural resource governance is fairly-unsatisfactory. These perceptions cause them to distrust the system and can influence their responses and behaviours. Furthermore, the fact that the SLBC and SLBDC are dominated by members from the public sectors and almost no representative from the local people makes them to assume that they are unimportant in the scheme of things. In as much as they acknowledge the presence of these bodies and even participate in their activities occasionally, they believed that it is just much talk and very little action. They said they are willing to support and contribute for the improvement of the SLB because they really want to enjoy the benefits therein, but the decision-makers have not given them the opportunity to do so. These perceptions go a long way to interpret the assumptions that the bureaucrats have about the local people and the constant challenges of the governance and management system of the SLB.

7.5 Conclusion and Recommendations

The data collected in this study are the first of its kind in this area and can be of great help for local managers of the SLB in order to develop programmes that enhance the management and governance of the SLB that will address the local people's perception. Also, this study has demonstrated that proper understanding of the perception of the local people in lake basins is strategic to achieve better compliance to resource governance policies and legislation. Understanding perception makes governance and management easy because the people will not likely resist the formal institutions, but will be more inclined to obey the related laws and regulations. It will ensure the cooperation of the local communities with the agencies of government and less conflict between the people and the government, and among themselves. This will go a long way to strengthen participation because the local people will be more inclined to contribute for the progress and development of the lake basins.

The local people of the SLB were eager to talk about their perceptions on the governance performance of the natural resource that provides livelihood and shelter for their families and communities. They exhibited a high knowledge of the SLB and its governance based on their experiences, relationship, intellectual capacity and historical connections to the Lake Basin. They showed rich interest in the improvement of the quality of the Lake Basin, in spite of their misgivings concerning implementation and enforcement of laws and regulations. They were happy that they are finally being consulted and that their opinions matter, and indicated a strong support for government intervention in the SLB. To this regard the following recommendations could be drawn from the views of the SLB locales:

I. The respondents perceived that capacities to implement and enforce laws and regulation are weak, especially financial, technical and human as well as limited involvement of the local communities. Therefore, they would want these capacities strengthened with special emphasis on stakeholder/public engagement.

II. The local people prefer a single formal management and policy harmonization organization with an effective participation of the local communities for the management and administration of the SLB. They also prefer the involvement of the Local Administrative Organizations (LAOs) in the management and administration of the SLB because the local people can easily access them.

III. The issue of the removal of the various structures in the Songkhla Lake that constitute serious sources of degradation, deterioration and pollution will require very intense negotiations with the local communities. In some cases, alternative livelihood activities will have to be encouraged, especially for the fishers, while land has to be guaranteed for the home-stays to construct better structures with sound sewage treatment systems that will protect the Lake from direct discharge of sewage. The households may require some form of subsidy support that will enable them build better sanitation facilities that will not discharge its contents into the Lake. Furthermore, the wastewater and storm-water from adjoining urban centres need to be primarily treated before discharge into the Lakes.

IV. There has to be formal recognition given to the informal tenure, rules, customs and traditions or the local structure that exists in the communities, which influence how water and other natural resources are managed. This will encourage discussions around it and broker agreements on how to streamline such practices and make them to be part of the governance structure of the SLB.

V. Further research needs to be done to know how much the local people understand the requirements and expectations of the laws and regulations that govern the SLB and how that knowledge influences their perceptions, attitude and behaviours.

In conclusion, the local people's perceptions survey of water governance performance in the SLB highlighted key issues that affect the governance performance of the Basin, some of which are fragmented institutional issues, weak coordination,

unclear allocation of roles, responsibilities and weak capacities for enforcement and compliance, coupled with lack of adequate integration between the formal and informal institutions. The respondents opined that resolving these issues are key to effective and efficient governance and management of the Lake Basin. While these core issues are very essential, we should not also overlook the aspect that concerns the perceptions of the local communities. This study identified the competition between the formal and informal institutions in the SLB as very critical issues that need to be addressed because of the social conflicts in the area. Our experience in this study showed us that the local people have strong views about the governance and management of the SLB and so their opinions should be given due consideration and included in governance decision-making.

CHAPTER EIGHT

GOVERNANCE PERFORMANCE COMPOSITE INDEX

This chapter is adapted from:

Cookey, P. E., Darnswadi, R. and Ratanachai, C., 2016. Performance Evaluation of Lake Basin Water Governance Using Composite Index. Ecological Indicators (61) 466–482. 10.1016/j.ecolind.2015.09.048

Abstract

A Lake Basin Water Governance Performance Composite Index (LBWGPCI) framework was developed to test and evaluate the performance of water governance for lake basins using the Songkhla Lake Basin (SLB), Thailand as a case study. The (LBWGPCI) integrates a range of water resources and environmental related indicators together to provide a holistic profile of lake basin key water governance issues. The purpose of this work was to identify, examine, develop and analyze key lake basin water governance performance indicators, test them on the SLB, and make appropriate recommendations for improvement. In the light of the results obtained in this study, overall Composite Index of the (LBWGPCI) indicated poor performance, which required high priority, urgent and critical actions. We conclude that the water governance performance of the SLB is still evolving and has a lot of great potential to grow in the right direction if the current focus and commitment of government and stakeholders at all levels, are maintained and sustained.

8.1Introduction

Measuring governance performance is often complex because in most cases we do not know what and how to measure (Bohringer and Jochem 2007). This has made the development of water governance performance indicators difficult and extremely limited; and often, the existing indicators only measure governance outcomes and do not offer holistic views of governance practices (Dunn and Bakker 2009). On the flip side, if developing water governance performance indicators is such a challenge, imagine the even greater challenge of developing lake basin water governance indicators. Most researches that involve lake basins are usually focused on water management (quantity and quality) with little on governance; and where governance indicators are developed, they are majorly measuring outcomes only (Cosgrove and Rijsberman, 2000, Ballatore and Muhamdiki 2001, Dunn and Bakker 2009, RCSE and ILEC. 2014, Pahl-wostl et al. 2012, Nowlan and Bakker 2007). Stakhive et al. (2014) observed that one of the most difficult evaluations is the performance assessment of institutional change (laws, policies, regulations), which are considered key to effective water resources management. Research revealed that performance indicators for lake basin water governance have not been developed as a specific framework. To this effect, this paper attempts to develop a structured framework for lake basin water governance performance composite index and used it to evaluate the governance situation of the Songkhla Lake Basin (SLB), Thailand.

Performance measurements are best captured by the use of indicators to assess the working of a system; an indicator can help to determine what direction should be taken to address the problematic issues (Hiremath et al. 2013, Walmsley, et al. 2001, De Sherbinin 2003, Nardo et al., 2005, Lawrence et al. 2002, Mercer and Christensen 2011, Behn 2003, Guy and Kibert 1998). In general terms, it is a quantitative as well as a qualitative measure derived from a series of observed facts that can reveal relative positions in a given area and helpful in setting policy priorities and in benchmarking or monitoring performance (OEDC 2008, Brand et al 2007). On the other hand, a composite indicator is formed when individual indicators are compiled into a single index on the basis of an underlying model/framework. Composite indicators are

aggregate index of individual performance indicators (Jacob et al. 2004) and they reflect the relative values of what is being measured and it should ideally measure multidimensional concepts that cannot be captured by a single indicator. Composite governance indicators offer possible explanation behind the different levels of performance achieved through the intervention of various policies, programmes and regulations (Smith 2002, OEDC 2008, Fekete and Stakhiv 2014). Sandoval-Solis et al. (2011) noted that performance indicators can evaluate water management policies and enable the comparison of alternative choices as well as give insight into the performance of natural resources management systems (Hooper 2006) (Figure 8.1).

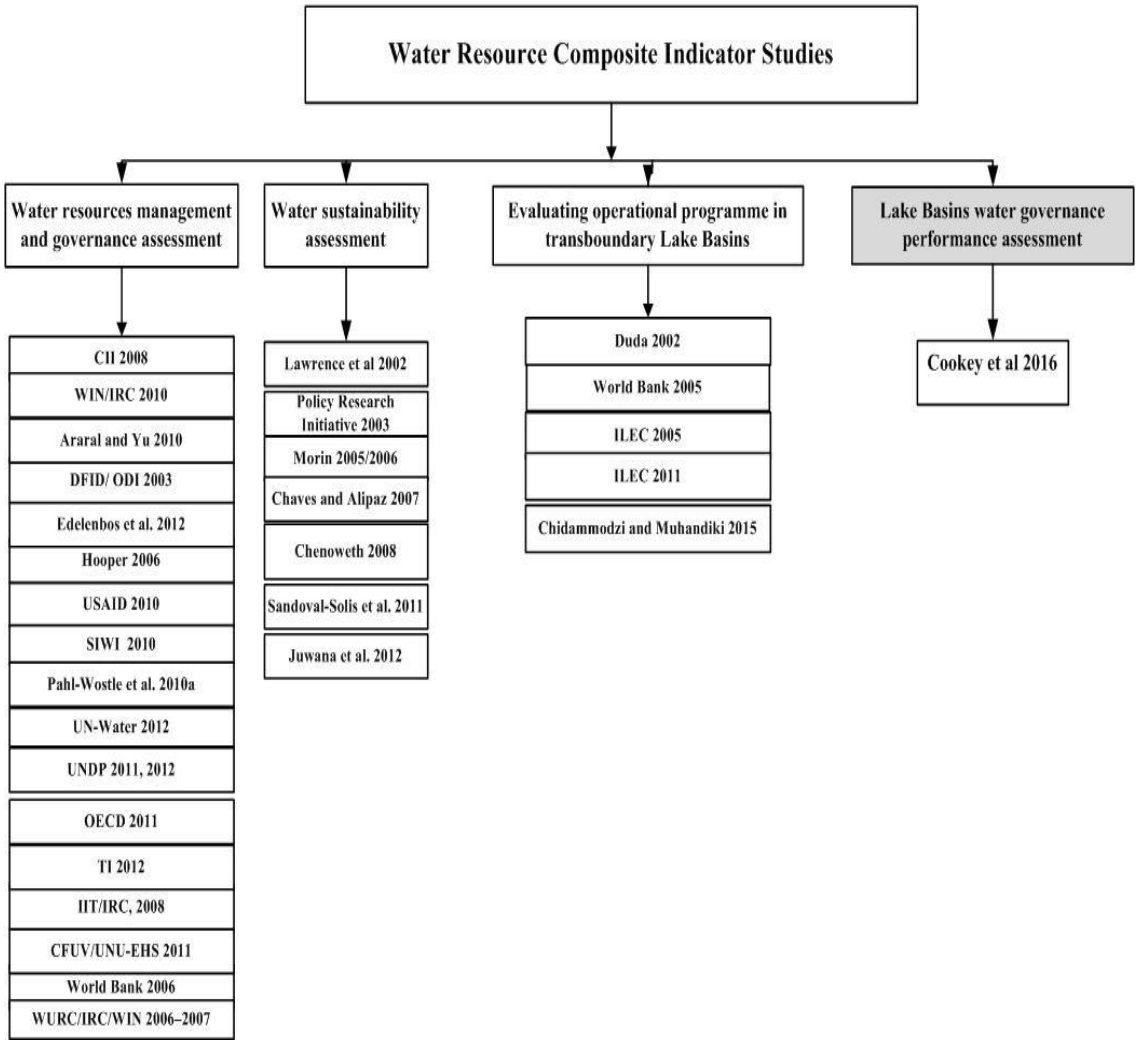

Figure 8.1: Literature mapping of water resource composite indicator studies

However, some performance indicators have been developed to track the relative effectiveness and efficiency of policies on water resources management and governance (CII 2008, WIN/IRC 2010, Araral and Yu 2010, DFID/ ODI 2003, Edelenbos et al. 2012, Hooper 2006, USAID 2010, SIWI 2010, Pahl-Wostle et al. 2010a, UN-Water 2012, UNDP 2012, OECD 2011, TI 2012, IIT/IRC, 2008, CFUV/UNU-EHS 2011, World Bank 2006, WURC/IRC/WIN 2006–2007, UNDP 2011) and water sustainability (Lawrence et al 2002, Policy Research Initiative 2003, Morin 2005/2006, Chaves and Alipaz 2007, Chenoweth 2008, Sandoval-Solis et al. 2011, Juwana et al. 2012). Research also revealed that water related sustainability indices tend to be more popular and widely used, while water governance related indicators seem to be more restricted to development and UN related organizations, and international development NGOs.

Few indicators for lake basins have been properly documented. Duda (2002) presented an indicator framework for evaluating operational programmes in transboundary lake basins. Also, the Global Environment Facility (GEF) project of the Lake Basin Management Initiative (LBMI) developed the Integrated Lake Basin Management (ILBM) governance indicators (World Bank 2005, ILEC 2005). The ILBM indicators took into consideration the concepts of basin approach, lake characteristics, ecosystem services and governance challenges (ILEC 2011). Chidammodzi and Muhandiki (2015) using the ILBM framework developed indicators for the assessments of Lake Malawi Basin even though it was not tested in the reported study. As much as they all successful experiences in the implementation of the existing indices, we still need more specific lake basin water governance performance indices tailored to address the complex socio-ecological challenges of governing lake basins. This index will be able to assess the status of management and governance processes of lake basins and to assist in the prioritization of water resources plans and programmes in the basin.

The main purpose of this work is to identify, develop, examine, analyze and test key water governance performance indicators for lake basins. Therefore, the work is of utmost significance because it presents a unique and innovative system for continuous

assessment of water governance performance in lake basins through a specific structured framework of composite indicators. The remainder of this paper is structured as follows: following this introductory section, we present the description of the case area - Songkhla Lake Basin (SLB), Thailand, and the next section presents detailed methodology used in this research; this is followed by the section presenting the summary of the most relevant results and finally discussion and conclusion.

8.2 Methodology

The Lake Basin Water Governance Performance Composite Index (LBWGPCI) used to assess the governance performance of the Songkhla Lake Basin was designed following the guidelines suggested by OECD-JRC (2008) and the modified procedures adopted by De Carvaiho et al. (2008), Callego-Ayala (2012), Juwana et al. 2012 and Callego-Ayala et al. (2014) in their various works. The specified methodological outline is presented in Figure 8.2.

8.2.1 Theoretical Framework of Governance Performance Composite Indicators

In this work, we introduce a composite index with the aim of measuring the water governance performance of lake basins, named as the Lake Basin Water Governance Performance Composite Index (LBWGPCI). The conceptual foundation for the LBWGPCI was derived from the diagnostic and prescriptive framework of the Adaptive Integrated Lake Basin Management (AILBM) for the assessment of governance performance of lake basins (Cookey et al, 2015a/b/c/e). The AILBM framework was derived from the Integrated Water Resource Management (IWRM) (Jønch-Clausen and Fugl 2001, GWP 2004, Hooper 2003, Jonker 2002, Odendaal 2002), Integrated Lake Basin Management (ILBM) (World Bank 2005, ILEC 2005, ILEC 2011) and Adaptive Management and Governance (AMG) (Holling 1978, Folke et al. 2005, Green and Garmestani. 2012, Clarvis et al. 2014) to develop an adaptive and integrative framework designed to assess governance performance of lake basins.

Incorporated in the framework is the assumption that successful governance of lake basins depends on our ability to create adaptive and integrative institutions with equity in representation, inclusiveness in decision-making processes that encourage scientific and public learning with response to problem-solving, transparency and accountability (Scholz and Stiftel 2005). This framework was designed based on the need to strengthen concurrently the enabling environment, institutional roles and functions of various administrative levels, stakeholders, and management instruments, including effective regulation, monitoring and enforcement.

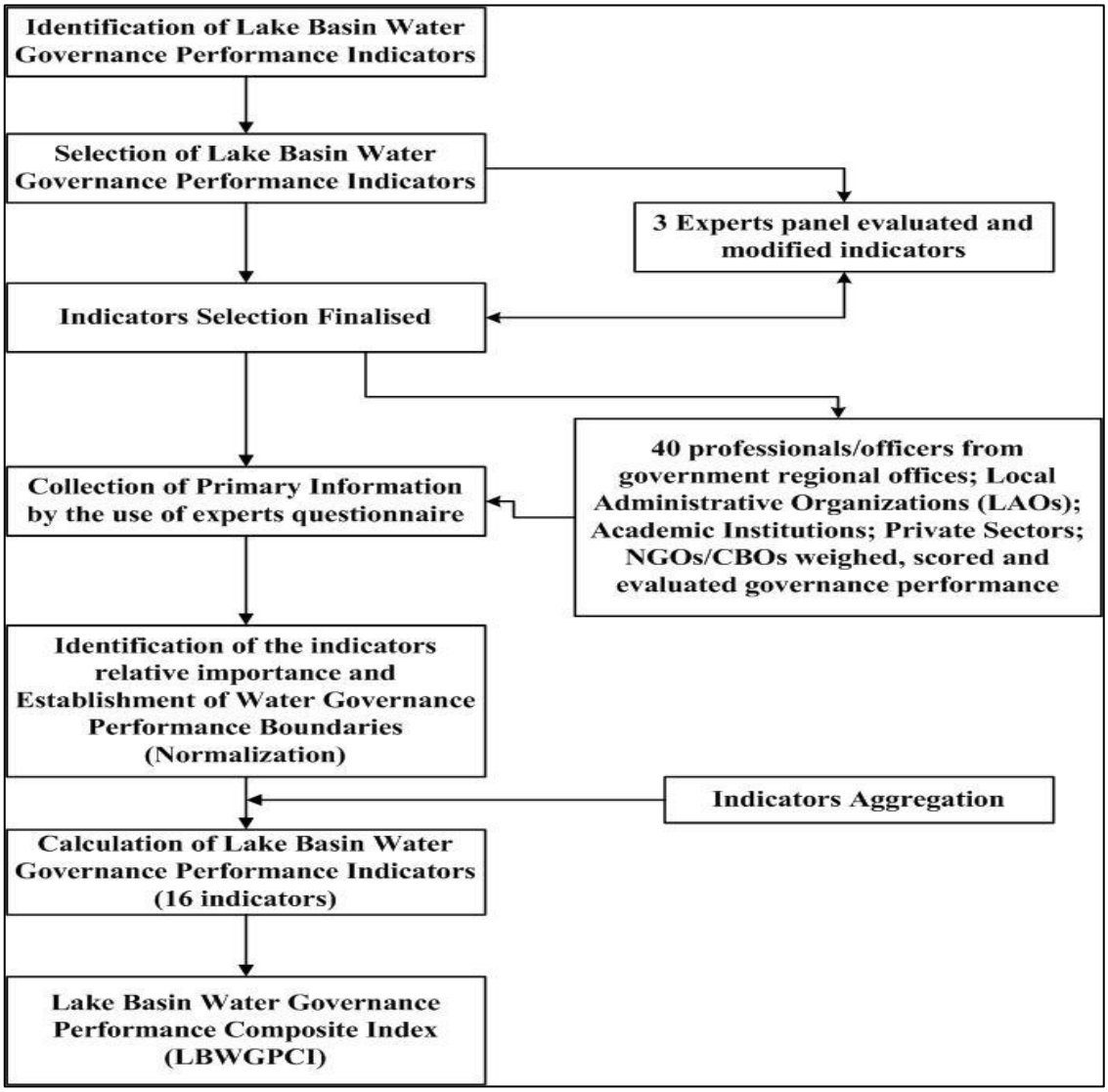

Figure 8.2: Methodological outline

The Adaptive Integrated Lake Basin Management (AILBM) framework is a governance performance assessment tool for lake basins. It is built to critically diagnose the governance challenges of lake basins as well as measure the adequacy of the current solutions and strategies designed to ameliorate these challenges and problems and then develop and prescribe adequate futuristic solutions to them (Cookey et al. 2015a/b/c/e). The framework has two parts: diagnostic and prescriptive. The diagnostic measures the how and why questions, which give more insight into the governance structure of the lake basin (Young 2002, Cox 2011, Walker 2012), while the prescriptive measures and recommends solutions empirically based on the outcome of the diagnosis (Hersen and Ammerman 1994, Bromley 2006, Rose Technologies 2013). This framework is significant to lake basin governance discourse because it provides a possible assessment guide for governance performance in lake basins. The comprehensive and analytical nature of the framework gives it a wide reach, and the open and generic nature means that it is not restrictive to any particular lake basin. The framework combines qualitative and quantitative evaluation measures like performance indicators and stakeholder expert analysis (Cookey et al. 2015e).

AILBM is an approach of lake basin governance designed to be gradual, continuous, holistic, systematic and integrative in nature with the capability of ensuring resilience, flexibility, adaptability, active participation of all stakeholders, effective and efficient decentralized systems and adequate feedback mechanisms that address the resource management system of lake basin. In other words, the institutions that govern lake basins should capture the synergistic-linkages between the sector, actors, stressors and management to achieve sustainable governance and wise use of basins' resources. The performance of the lake basins' governance system impacts the diagnostic components of the AILBM (sectors, actors, resource system, resource management systems, stressors and institutions) while the prescriptive components (adaptability, collaboration, resilience, decentralization, integration and participation) should impact the governance system to produce empirically based prescriptive recommendations. The implementation aspects are the resource management systems and the institutions

(Cookey et al, 2015a/b/c/e) and they impacted and are impacted by the governance system.

The Lake Basin Water Governance Performance Composite Indices (LBWGPCI) were drawn from the River Basin Organization indicators (Hooper 2006), Integrated Lake Basin Management (ILBM) indicators (RSCE and ILEC 2014, Chidammodzi and Muhandiki 2015), Governance Standard and Assessment Framework for the Australian Natural Resource Management (Lockwoord et al, 2008, Davidson et al, 2006) and the Integrated Coastal Management Performance Indicators (Ehler 2003). It is a composite index because it compiled into a single index from five components, 16 indicators and 137 variables that are specific to lake basins management and governance. This paper defines lake basin governance as a process of interaction and collaboration for the purpose of decision making among various actors in the basin aimed at proffering solutions to common problems for sustainable use of resources and preservation of the ecosystems of the lake basin in a transparent and accountable manner; in that case the LBWGPCI attempts to measure water governance performance of lake basins (Figure 8.3).

The Lake Basin Water Governance Performance Composite Index (LBWGPCI) is a composite index that evaluates the water governance performance of lake basins. It integrates a range of water resources and environmental related indicators together to provide a holistic profile of lake basins key water governance issues. The key water governance issues addressed by the indicators fall into the following broad policy categories: institutional, management, interactive, information and adaptive systems. The LBWGPCI results reflect the lake basins governance performance status. This is predicated on the premise that the higher the LBWGPCI's scores, the better positioned the basin is to enjoy and maintain the ecological, socio-economic and health benefits associated with its resources. The LBWGPCI can contribute to raising awareness of the state of water and related resources in the lake basins, focus attention on areas of governance that need improvement as well as identify areas of the lake basins governance that need serious attentions (CWSI 2007).

One innovative quality of the LBWGPCI is that it embeds finance and technology as part of the indicators under components of institutional and management systems instead of assessing them as individual components like in other lake basin assessment frameworks. This is premised on the view that issues of finance and technology are provided for based on institutional provisions and mandates and since institutional frameworks determine the level of funding and technology that can be provided for the lake basins, and are essentially key drivers of governance, it is expected that they initiate and determine the processes and the kind of funding and best appropriate and applicable technology uptakes. It seems out of order to measure or investigate the impact of finance and technology implications that are not provided for in the institutional framework.

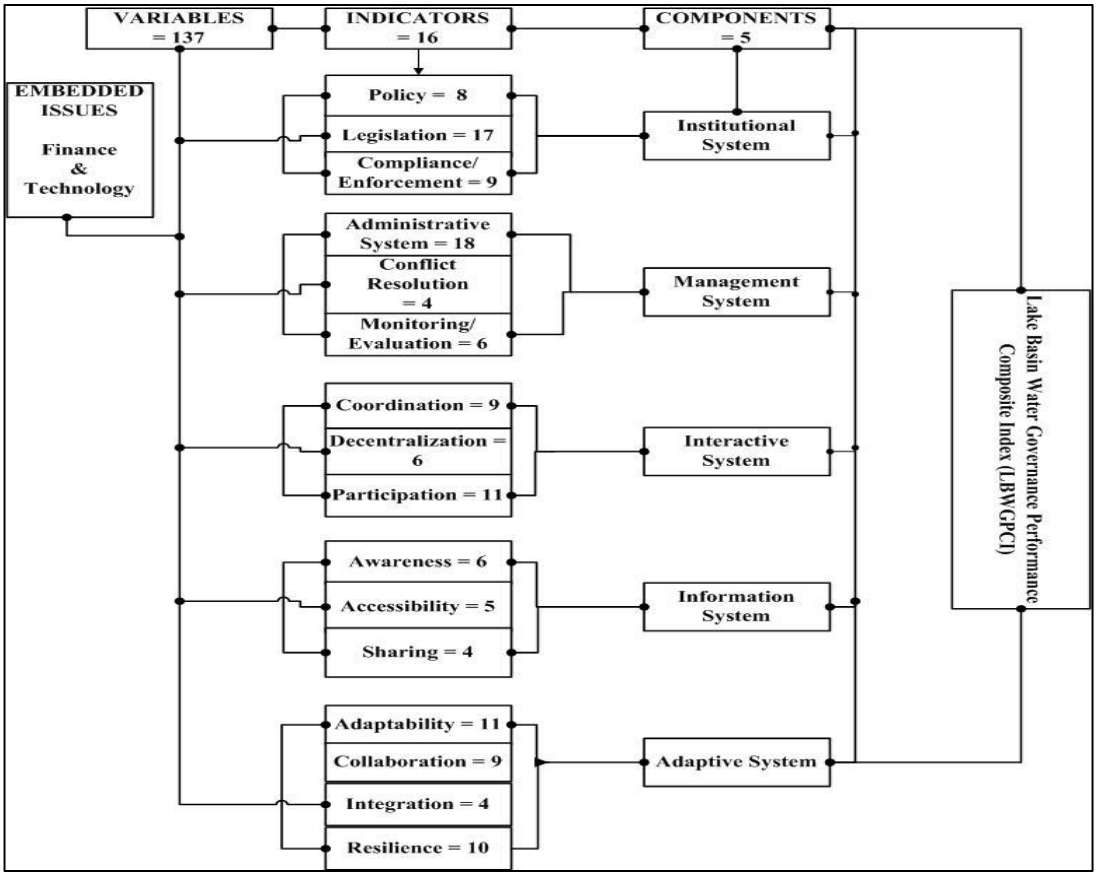

Figure 8.3: Hierarchical structure of the Lake Basin Water Governance Performance Composite Index (LBWGPCI)

Moreover, when the purpose is to measure a governance performance, because institutions, as the rule of the game, cannot support or protect what they don't cover; and this directly affects implementation as implementation does not take place outside institutional provisions. Also, performance indicators relating to non-financial aspects enhance more focus on result-oriented indicators that relate to the various aspects of the system, making it possible to formulate better commitments and track fulfilment.

Another innovative quality of this framework is that institutions are elevated to a core position in governance because most water crisis is mainly functions of institutional limitations (Saleth and Dinar 2004, Fekete and Stakhiv 2014). Corroboratively, implementation is the enforcement of the institutions, therefore, it is expected that finance and technology should be embedded in the institutions before they are considered in the governance. Furthermore, the ability of the LBWGPCI to measure governance performance in real time and highlight the connection between performance, implementation and sustainability gives it a unique quality. This quality enables it to clearly detect the problems and concerns so as to pinpoint direct trouble spots, which is vital for decision-makers, policy-makers and lake basin managers. This is because it provides them information and data on the real and current status of the lake basin governance performance so that they can make appropriate and adequate decisions, plans and programmes. Furthermore, the inherent adaptive and integrative nature of the LBWGPCI framework gives it a unique leverage because it is broad enough to measure the capacity of the governance system for resilience and flexibility in the face of unexpected changes and disturbances allowing decisions makers and managers to develop plans that are adaptable to change. The distinctive attribute of the LBWGPCI is not just the development of a comprehensively and standardized water governance performance indicators framework for lake basins, but also its ability to measure the actual governance accomplishments.

8.2.2 Indicators of Lake Basin Water Governance Performance Assessment

The primary purpose of this work is to identify, develop, examine and test the lake basin water governance performance index. The key highlight of this paper is the development of 16 sets of indicators that were used for evaluation of governance performance for lake basins. In developing these indicators, we drew on the rich background of academic literature on water resources governance, management, natural resource management, marine protected area management, adaptive management and governance, integrated water resource management, integrated lake basin management, etc. The 16 indicators were designed to promote effective legal structures and strategies for good management to enhance enforcement mechanisms, which in turn will reduce conflicts, enhance stakeholder participation and representation, increase awareness of rules and regulations among the basin communities for the achievement of sustainable governance and wise use of the resources of the basins. The ultimate goal is to strengthen decentralization and integration as well as enhance collaboration and participation with different sectors of the basin to ensure that the governance systems are, resilient, adaptive and flexible enough to catch-up with inherent changes in the socio-ecological systems.

The LBWGPCI institutional system indicators measure the availability and adequacy of lake basin policy, legal structures (legislations) as well as compliance and enforcement mechanisms of the existing rules and regulations. This is because specific policy and legislative frameworks for lake basins are rare; instead government directions are contained in sectoral policies for the use of the resources of the lake basins (World Bank 2005, ILEC 2005). This is designed to ensure that lake basin managers accomplish the goals and objectives they set out for themselves so as to ensure that formal legislation provided are sound, recognised, respected and enforced in the lake basins (Pomeroy et al. 2004). The indicators under the components of management system focus on the administrative systems, conflict resolution mechanisms and monitoring and evaluation. These indicate the measure of the capacity

of the management system to administer the lake basins, existence of a decision-making and management body, measure the effectiveness of the leadership structures and strategies for the lake basins as well as the existence and adoption of lake basin management plans (Pomeroy et al. 2004, Davidson et al. 2006). The use of these indicators also measures the level of resource conflicts associated with the lake basins and the characteristics of the conflict as well as the interventions put in place for conflict resolutions and management.

The LBWGPCI interactive system indicators measure the degree of coordination, decentralization and participation in the governance of lake basins. The indicator of coordination measures the degree of connection between and across different levels of governance as well as critically looks at the alignments of priorities, plans and activities across governing bodies (Davidson et al. 2006). The participation indicator measures the level of involvement of people in governance and management decisions and activities as well as the level of satisfaction of the stakeholders with participation. Table 8.1 summarises the core components of the LBWGPCI, while 8.2 shows a summary of the LBWGPCI indicators.

Table 8.1: Components of Lake Basin Water Governance Performance Composite Index (LBWGPCI)

Components	Variables	Indicator – broad objectives
Institutional System	34	This aspect addresses the broad topics of policy, legislation, compliance and enforcement. In general terms, it measures the effectiveness of the policy, legal and enforcement strategies for management of the resource system and in specific terms, measures the existence of laws and policies related and relevant to water and other natural resources management and their degree of implementation and enforcement in the Basin. It also looks at the established and accepted Basin rules or laws including legislation that clearly identifies functions, structure and financial and technological provisions, and measures their degree of implementation.
Management System	28	This indicator focuses broadly on the administrative system, conflict resolution mechanism over resources uses between formal and informal actors and monitoring and evaluation of implemented Basin programmes and plans. In a nutshell, it measures the effectiveness of the resource management structures and strategies. It looks especially at the existence of management systems that allow for organizational structures with cross-sectoral planning, responsive and coordinated decision-making in the Basin as well as existence of lake basin management plans and their degree of implementation. It also measures the economic issues of allocation and use including pricing, change, subsidies and penalties, as well as the effectiveness of the technical aspects of water resources management.
Interactive System	26	This indicator broadly addresses the degree of implementation of coordination, decentralization and participation in the Basin. It seeks to measure the effectiveness of public, local communities and stakeholders in Basin resources management, and directly measures the Basin community's level of awareness and participatory processes and involvement/engagement in resources governance and management.
Information System	15	This indicator covers the broad issues of awareness, accessibility and sharing of information. It measures the degree of implementation of the information system in the Basin, and assesses the quality, content, reliability, types and how the information is accessed and shared among the formal actors and between the formal and informal actors in the Basin. It also indirectly measures the issues of transparency and accountability in the Basin.
Adaptive System	34	This indicator includes: adaptability, collaboration, integration and resilience. This indicator is based on the concept that lake basin is a complex ecosystem and has to be managed with high degree of change, uncertainty and unexpected occurrence. The indicator measures the system's capacity to adapt to changing conditions as well as the reduction of vulnerability of the system to actual or expected future change, especially in the cases of climate change. The main objectives are to make governance instruments reduce adverse impacts of actual and expected events, and to the extent possible, meet the water requirements for human and environment.

It also assesses the existence of community organizations, their management and how they enhance participation (Pomeroy et al. 2004, Davidson et al. 2006). Decentralization indicator measures the degree of the devolution or transfer of powers from the central or national government to the lowest levels of government in political administrative systems of the basin. It seeks to determine the degree of interactions between the levels of government, lake basin managers and the communities. This indicator favours the performance of more strategic actions at the lowest possible decision making authority. This enhances flexibility and adaptability of the governance system to uncertainty and sudden changes (Manor 1999, Ribot 2004, Iza and Stein 2009).

The LBWGPCI information system indicators include awareness, accessibility and sharing of information. It is anchored on issues of transparency and accountability in the lake basins. It requires openness of institutions, free flow of information as well as transparent decision-making processes with relevant information, honesty in consultation, adequate input opportunities, explanations and reviews (Davidson et al. 2006, Lockwood et al. 2008). This indicator is based on the premise that reliable, widely understood, and accepted information is central to effective lake basin management and governance. Absence of information results in misdirected policies, inefficient institutions and ill-informed stakeholders (World Bank 2005, ILEC 2005). Therefore, these sets of indicators measures the degree of relevant information made available and their level of accessibility by the basin administrative systems using a variety of media, targeted to the needs of particular stakeholders as well as look at the way information is shared among the formal and informal actors in the basin (Lockwood et al. 2008). The indicator on awareness measures the people's knowledge and their level of understanding of the rules and regulations of the resources management systems and their ability to put such knowledge into practice; while the indicator on accessibility seeks to determine the degree of ease in getting this information and how they are disseminated. The indicator for information sharing measures the frequency and the degree of formal information sharing among

government agencies with jurisdictional responsibilities in the lake basin as well as sharing of monitoring and evaluation reports among all stakeholders.

The LBWGPCI adaptive system set of indicators measure for the degree of adaptability, collaboration, integration and resilience in the governance systems of the lake basins. The Adaptability indicator measures the collective capacity of human actors in lake basins to manage resilience (Walters 1986, Chapin et al. 2009). It measures the degree of openness to innovation and how it allows for changes in the light of new and better information in the context of environmental uncertainty (Malnchuk et al. 2012, Davidson et al. 2006, Lockwood et al. 2008). The indicator of collaboration measures the degree of connection, synergistic-linkages, partnerships as well as the collaborative capacity of the actors and sectors of the governance system in the lake basin to work towards the achievement of shared goals. This indicator encourages actors and sectors in the basin to work together to enhance the ability of the system to cope with intermittent shocks (Berkes and Folke 1998, Blumenthal and Jannink 2000, Scholz and Stiftel 2005) as well as partner together (public and private sectors and even among the public sectors who are the engine room of government activities in the lake basin). The indicator of integration measures the linkages between institutions, administrative systems, among all the actors as well as other sectors of the lake basin (Malnchuk et al. 2012). It also determines how decisions in the lake basin integrate economic, environmental and social elements as well as the socio-ecological economic information in decision-making processes (Davidson et al. 2006, Lockwood et al. 2008). On the other hand, the resilience indicator measured the degree to which the system is susceptible to change, while still retaining its structure and functions as well as the degree of flexibility and connectedness of all components of the lake basin governance and management systems (Berkhout et al. 2006, Næss et al. 2005, Eriksen and Kelly 2007, Nelson et al. 2007).

8.2.3 Selection of Performance Indicators

The selection of the components and the main indicators for lake basins were based on in-depth analysis of the institutional framework that guide the operations and

management of lake basins. Other considerations were based on their relevance to the lake basin's context, cost-effectiveness, ease of interpretation, reliability, robustness, replicability, timeliness and scientifically well-founded (Bell and Morse 2008, Gallego-Ayala and Juizo 2012, Gallego-Ayala et al. 2014). Thus, 5 components, 16 key indicators and 137 variables of governance performance indicators were selected after they were evaluated and modified by three panels of experts comprising of legal academia/practitioners with good knowledge of environmental and natural resources legal framework, academia/practitioner of environmental and water resources engineers well-grounded in water resources issues and practising water resources engineers with international water and sanitation organizations having sound knowledge of lake basins. In the computation, we followed the methodological guidelines suggested by the OECD-JRC (2008), De Carvaiho et al. (2008), Callego-Ayala (2012), Juwana et al. 2012 and Callego-Ayala et al. (2014). Each of the 137 variables that make up the 16 indicators of the LBWGPCI is assigned a score between 0 and 5. The higher the score, the closer the lake basin is to having the ideal performance conditions for that given indicator. The scores were based on standardized statistical evaluation procedures.

Table 8.2: Summary of Indicators for Lake Basin Water Governance Performance Composite Index (LBWGPCI)

Institutional System	Management System	Interactive System	Information System	Adaptive System
Policy	*Administrative System*	*Coordination*	*Awareness*	*Adaptability*
Constitutional provisions Water policy Policy funding mechanism Policy alignment with other key sectors Actors role clarification National development plans National water resource development plan	Clear delineation of responsibilities Overlaps of central government agencies Standards operational procedures Mandates of agencies clarity Lake Basin Committee/organization/agency Lake Basin Development Committee /organization/agency Political Administrative System s(Federal/Central/State/Province/Municipality/Local government/Districts) NGOs/CBOs in water management Formal and informal actors relationship Acceptability of administrative system Recognition and respect for local knowledge Water use and management Actors management capacity Technical and administrative skills Training courses Funding for management	Effective coordination Coordination within central government system Vertical coordination Horizontal coordination Interagency coordination Overlaps and gaps Local administrative organizations coordination (LAOs) NGOs/CBOs coordination	General environmental awareness NGOs/CBOs involvement in awareness campaign Environmental awareness in print and electronic media knowledge and awareness on climate change Environmental awareness in the communities Community awareness on water management system	Responsiveness of institutions to incidence of disaster Adaptive capacity of legislation/regulation Flexibility in decision making mechanism Continual improvement in resources management policies Management outcomes clearly identify Degree of institutional response to socio-ecological changes Institutions openness towards uncertainties Community-led natural resource management Experimental approach to decision-making Suitability of key government agency Provisions and powers during emergency
Legislation			*Accessibility*	
Basin development plan Water laws Laws compatible with informal arrangement Water quality standards and regulation Water allocation laws Property rights Water pollution control and prevention laws Fisheries laws Marines laws Forestry and conservation laws Agricultural laws Groundwater laws Irrigation laws Endangered species laws Solid waste management laws Public health and sanitation laws Wastewater laws Planning and zoning laws		*Decentralization* Decentralization policy Authority for decentralization Motivation for LAOs for water resources related initiatives LAOs capacity for decentralization Decision-making power of communities Effectiveness of decentralization programmes	Free-flow of information from governance agencies Mechanism for information dissemination Information accessibility by stakeholders Information management Adequate feedback mechanism	
			Sharing	*Collaboration*
		Participation Private sector involvement Stakeholders involvement Public and stakeholders	Information sharing among government agencies Information sharing between government and stakeholders Promotion of dialogue for decisions management Citizens/indigenous knowledge input into management	Organizational incentive to cooperate Institutional mandates encourages collaboration Collaboration among government agencies Collaboration between government and stakeholders Collaboration between government and private sector Collaboration between government and NGOs/CBOs

Environmental quality laws		participation Local communities involvement Community's membership of basin committees/organization NGOs/CBOs membership of basin committees/organization Users empowerment Local communities empowerment local stakeholders Influence and control Basin committees/organization gender status Support for institutions		Collaboration between NGOs/CBOs and the communities Collaboration in decision-making among all actors Room for encouragement of collaboration
	Conflict Resolution			*Integration*
	General conflict resolutions mechanism Interagency conflict resolution Resolution of conflicts among users Future uses and conflicts anticipated			Link between institutions and socio-ecological system Coordinated management of resource systems Policies integration and coordination Integration of climate change and adaptation into basin plans Risk acceptance and management in decision-making
	Monitoring and Evaluation			*Resilience*
Enforcement	Monitoring and evaluation Governance performance monitoring Resource use Surveillance and monitoring Users involved in monitoring Development plans evaluation Monitoring and evaluation capacity			Capacity of system to absorb disturbance and reorganize Degree of management for uncertainties The degree of institutional flexibility System feedback mechanism System interconnectedness System vulnerability to disturbance Local appropriate standards Use right at local administrative organizations level Institutional mandates for exchange of data
Authority to enforce relevant laws Ambient air quality standards enforcement Aquacultures regulations and standards enforcement Industrial effluent and wastewater standards enforcement Sewage management standards enforcement Planning and zoning regulation and standards enforcement Natural resources permit systems enforcement Polluters pays principles enforcement Water quality standards enforcement				

8.2.4 Collection of Primary Information

In order to feed numerical values into the calculation of lake basin water governance performance, indicators were assessed and scored through qualitative expert knowledge of 50 professionals/experts drawn from the regional offices of the central government ministries/departments that have one responsibility or the other related to water and natural resources, Provincial Administrative Organizations (PAOs), Municipality Administrative Organizations (MAOs) and Tambon Administrative Organizations (TAOs). Others include: relevant Basin committees (Songkhla Lake Basin Committee and Songkhla Lake Basin Development), academic institutions, NGOs/CBOs, private sectors and local development organizations within the Lake Basin. The reasons behind the selection of this technique is simply to select specific sample populations that are information rich in regards to the research questions as well as based on the expert judgment of the researchers and informants. The experts were selected using non-probability technique of a purposive sampling also commonly called a judgmental sample (Tashakkori and Teddlie, 2003). Table 8.3 gives information about the general characteristics of the questionnaire respondents.

The experts/professionals evaluated the overall water governance performance in the Lake Basin, which was derived from completion of questionnaires distributed and delivered to them in their respective offices by the field assistants. In some cases, we utilized the opportunity of public meetings as an avenue to meet the relevant government officers, especially in meetings organized by the Songkhla Lake Basin Research Centre (SLBRC), of the Faculty of Environmental Management, Prince of Songkla University, Thailand.To assess the governance performance, experts were requested to complete the questionnaires using a 5-value (poor, unsatisfactory, fair, satisfactory and good) Likert rating scale. Before the application of the questionnaire, it was translated into Thai language and verified by Thai-English expert speakers. It must be noted that efforts were made to ensure that only one questionnaire was assessed per expert from a particular organization. This was done to avoid over domineering response from a particular organization, which is capable of affecting the quality result of the index. A total of 50 questionnaires were handed out to the water

experts/professionals that were identified for the study and only 40 questionnaires were retrieved giving a 90 percent success rate (Table 8.3).

Table 8.3: General Characteristics of the questionnaire respondents

Characteristics	Number	Percentage of total sample (%)
Gender		
Female	21	52.5
Male	19	47.5
Total	40	100.00
Employer institutions		
Regional Office of Centralized-Deconcentrated Ministries/Departments	8	20
River Basin Committees (SLBC/SLBDC)	2	5
Provincial Administrative Organizations (PAO)	3	7.5
Municipal Administrative Organizations (MAO)	5	12.5
Tambon Administrative Organization (Sub-District) (TAO)	5	12.5
Public Utility (Water and Electricity Agencies)	4	10
Private Sector	5	12.5
Association/Networks/NGOs/CBOs	4	10
Academic Institutions and research Centres	4	10
Total	40	100

8.2.5 Weighting indicators

The normative approach, which uses participatory methods that integrate experts opinions to obtain the relative importance of the base indicator was used in this study (OECD – JRC 2008, Gallego-Ayala et al. 2014) because we wanted to contextualize the weighting system to reflect the opinions of the SLB experts and major stakeholders. Also, weighting in this context entails the aggregation of indicators and/or variables as were scored by the expert groups' assessment. For ease of calculation, an equal balanced weighting system was applied to all components, indicators and variables to establish an initial based situation (De Carvalho et al. 2008). The 5-value Likert rating scale was then normalised as presented in Table 8.4.

Table 8.4: Lake Basin Water Governance Performance Composite Index (LBWGPCI) Structure

Likert rating scale	Likert value	Aggregated index and sub-indices	Performance rating	Priority	Action
1	0.00	0	Non-Performance	High	Immediate and critical action needed
2	0.25	25	Poor Performance	High	Urgent and critical action needed
3	0.50	50	Average Performance	Medium	Urgent action
4	0.75	75	Good Performance	Least	Non-critical action
5	1.00	100	Excellent Performance	Least	Maintain action

8.2.6 Indicators Normalization

Indicator normalization is used to transform the sets of indicators expressed in different units of measurement into a homogeneous set of variables expressed in the same unit to allow for clear comparisms (OECD – JRC 2008, Gallego-Ayala et al. 2014, De Carvalho et al. 2008, Callego-Ayala (2012), Juwana et al. 2012). For ease of determination, we used the max-min technique as this is one of the commonest normalization procedures used for construction of composite indicators. According to Gallego-Ayala et al. (2014), the max-min technique uses the minimum and maximum values of a given sample (in our case, the selected base indicators for the lake basin water governance performance) to re-scale the base indicators; the base indicators are then measured on a scale from 0 (very poor possible performance) to 1 (the best possible performance). The mathematical formulation of the max-min technique is as follows:

$$LBWGPCI_i = \quad X_{max} \geq X_i \geq X_{min} \qquad (1)$$

$$LBWGPCI_i = \quad \left(\frac{Xi - Xmin}{Xmax - Xmin}\right) \quad \text{'more is better'} \qquad (2)$$

Where LBWGPCI $_i$ is the sub-index value for indicator Xi the actual value for indicator i and X_{min} and X_{max} are the threshold value of the indicator

8.2.7 Indicators Aggregation

After normalization, comes the aggregation of all the normalized indicators into a single indicator, which can also be referred to as the grouping of indicators according to the underlying conceptual frameworks (OECD – JRC 2008, Gallego-Ayala et al. 2014, De Carvalho et al. 2008, Callego-Ayala 2012 and Juwana et al. 2012). In this work, we adopted the additive aggregation method as was applied by De Carvalho et al. (2008). The Lake Basin Water Governance Performance Composite Index for Songkhla Lake Basin (SLB-LBWGPCI) is the sum of all the weighted components (Eq. 2). The standardized value for the variable, X_i, was multiplied by the attributed weight W_I , to give a value on a scale of 0 to 5. The score for each indicator was then determined from the sum of the variable value multiplied by their respective weighting, expressed as a percentage by multiplying by 100. The scores for the 5 components and LBWGPCI were determined in the same way (De Carvalho et al. 2008).

$$\text{LBWGPCI}_{\text{i}} = \frac{\sum_{i=1}^{N} W_I X_I}{\sum_{i=1}^{N} W_I} \; x\ 100 \qquad (3)$$

Where N is the number of the indicators W_I is the weight attached to indicator I and X_I the score of the indicator I.

$$\text{LBWGPCI}_{\text{Institutional System}} = \frac{\sum_{i=1}^{N} W_I X_I}{\sum_{i=1}^{N} W_I} \; x\ 100 \qquad (4)$$

$$\text{LBWGPCI}_{\text{Management System}} = \frac{\sum_{i=1}^{N} W_I X_I}{\sum_{i=1}^{N} W_I} \; x\ 100 \qquad (5)$$

$$\text{LBWGPCI}_{\text{Interactive System}} = \frac{\sum_{i=1}^{N} W_I X_I}{\sum_{i=1}^{N} W_I} \; x\ 100 \qquad (6)$$

$$\text{LBWGPCI}_{\text{Information System}} = \frac{\sum_{i=1}^{N} W_I X_I}{\sum_{i=1}^{N} W_I} \; x\ 100 \quad (7)$$

$$\text{LBWGPCI}_{\text{Adaptive System}} = \frac{\sum_{i=1}^{N} W_I X_I}{\sum_{i=1}^{N} W_I} \; x\ 100 \quad (8)$$

The second aggregation method is the use of multiplication aggregation function to combine the five components obtained in (Eq. 4 – 8) to obtain the single LBWGPCI through the following formula:

$$\text{LBWGPCI hybrid}_i = \prod_{C=1}^{C=5} LBWGPCI\ C_5 W_i\ x\ \frac{1}{100} \quad (9)$$

C refers to each of the components used to construct the LBWGPCI, W is the weight of the component i.

8.2.8 Sensitivity and Robustness Analysis

A sensitivity analysis was conducted to assess the robustness of the composite index with regard to the underlying assumptions made in the construction, as well as 'sensitivity'to change in such assumption by the estimation of standard error and confidence level in the descriptive statistics. Large standard error around the composite indicators would produce wide confidence intervals (Jacob et al. 2004). The standard error is an estimate of how far the sample mean is likely to be from the population mean. The large standard error as well as the confidence level (95%) of the descriptive statistics of this study clearly showed the robustiness and sensitivity of the LBWGPCI (Table 8.5).

8.2.9 Application

The application of the index provided an opportunity to make comparisms to other indices and where possible, verified and validate certain assumptions and choices made during index development. This study was validated in two ways: through expert

consultations (see 3.3 for more details) and concurrent validity by seeking for high correlation between the scores of two measures (Ruane 2005) of previously established methods of assessment on a particular indicator (other well-known indices) and concurrently assessing similar indicators by comparing the results with the LBWGPCI (new index).

This study by way of validation and application was compared with other well-known indices of water governance in the region (Asia and Thailand) respectively, because the method adopted in these researches were similar to what was applied in this work. This method of validation is similar to the method that was used by De Carvalho et al. (2008) to validate the Sustainability Index for Integrated Urban Water Management (SIUWM) in Mozambique. For this purpose, the SLB-LBWGPCI was compared with the Asia Water Governance Index for Thailand 2013 (Araral and Yu 2013) and the European Union Twin2Go project at Bang Pakong River Basin, Thailand (one of the River Basins Committee alongside Songkhla Lake Basin Committee). The aim of the European Union Twin2Go project at Bang Pakong River Basin was to assess water governance performance regimes focussing on adaptation to climate change in basins around the world (Pahl-Wostl et al. 2010). In the Twin2Go project, Thai water resources experts/professionals were engaged in a workshop in Chiang Mai, Thailand to complete water governance performance case study assessment questionnaires for the Bang Pakong River Basin.

For a close enough comparison, we decided to use select indices from both Asia Water Governance Index and the European Union Twin2Go project, Bang Pakong River Basin that are very close to the LBWGPCI. Of the 16 indicators that were selected from both indices, 7 were selected from the Asia Water Governance Index for Thailand 2013 and 9 from the Twin2Go governance performance assessment of Bang Pakong River Basin, Thailand (Pahl-Wostl et al. 2010, Araral and Yu 2013). These indicators were selected based on the fact that they both measure water governance performance in Thailand and also adopted the same rating scale (1-100 or 1-10) and the same normalization and aggregation methods adopted in this work.

8.2.10 Visualization

Visually appealing and user-friendly tools were developed in an effort to enhance visualization of the final product and to ensure that the index was well receieved by its target audience. Findings are presented in a simple and transparent manner, and interpretation of the results displayed to elicit the desired responses.

8.3 Results

8.3.1 Descriptive Statistics of LBWGPCI Components and Indicators of SLB

The summary of the descriptive statistics of the LBWGPCI components and indicators calculated for the SLB water governance performance is presented in Table 8.5. The highest mean value of the LBWGPCI indicators was recorded by the indicator measuring the administrative system (84.956) and the lowest mean value was the conflict resolution (15.336). In the LBWGPCI components, the highest mean value was the institutional system (415.05) and the lowest was the adaptive system (0.1414). The highest confidence level (95%) of the LBWGPCI indicators systems of the SLB was recorded by administrative system (173.497) and the lowest was integration (0.033577) and the highest confidence level of the statistics in the components category was institutional system (139.35991) and the lowest was adaptive system (0.03577). The reason for this result may be attributed to the fact that the administrative system (18) had the highest number of indicators while, conflict resolution, sharing and integration (4) indicators respectively had the lowest. In the category of components, institutional and adaptive systems (34) had the highest total number of indicators respectively and the lowest was information system (15).

Table 8.5: Descriptive Statistics Computation of LBWGPCI Components and Indicators

LBWGPCI Components	LBWGPCI Indicators	Means	Median	Standard Error	Standard Deviation	Variance	Kurtosis	Skewness	Range	Min	Max	95% Confidence Level
	Policy	31.672	8	22.95688	51.33314	2635.092	4.325563	2.065578	121.56	0.44	122	63.73851
	Legislation	61.644	17	44.3116	99.0839	9817.608	4.33005	2.06506	235.55	0.45	236	123.0288
	Enforcement	34.328	9	24.82405	55.50827	3081.168	4.32566	2.06505	131.58	0.42	132	68.92262
Institutional System		417.05	481	50.19365	112.2364	12597.01	1.358447	-1.443823	263	235	498	139.35991
	Administrative Systems	84.956	18	62.4889	139.7294	19524.32	4.30889	2.06314	330.32	0.43	330.75	173.497
	Conflict Resolution	15.336	4	11.02924	24.66213	608.2204	4.34167	2.06956	58.31	0.44	58.75	30.62207
	Monitoring/ Evaluation	23.75	6	17.21831	38.50131	1482.351	4.32603	2.06586	91.08	0.42	91.5	47.8057
Management System		83.43	96.2	10.03518	22.43935	503.5245	1.386452	-1.449252	52.6	47	99.6	417.15
	Coordination	31.364	6	22.6002	50.53559	2553.846	4.31205	2.06046	119.91	0.34	120.25	62.74823
	Decentralization	25.922	9	18.88995	42.2392	1784.15	4.32410	2.06639	99.78	0.47	100.25	52.4469
	Participation	41.864	6	30.2135	67.55945	4564.279	4.32905	2.06571	160.3	0.45	160.75	83.88613
Interactive System		11.868	13.12	1.447685	3.237123	10.47897	1.267215	-1.259013	8.21	6.7	14.91	4.01942
	Awareness	23.506	6	17.02597	38.07124	1449.419	4.32670	2.06590	90.08	0.42	90.5	47.27168
	Accessibility	20.562	11	14.91328	33.3471	1112.029	4.33013	2.06743	78.8	0.45	79.25	41.40589
	Sharing	17.142	6	12.47012	27.88404	777.5199	4.35765	2.07454	65.77	0.48	66.25	34.62261
Information System		1.352	1.31	0.051614	0.115412	0.01332	3.459101	1.8081797	0.29	1.26	1.55	0.1433033

	Adaptability	42.834	5	31.18558	69.73307	4862.701	4.31321	2.06230	165.12	0.38	165.5	86.58504
	Collaboration	34.994	9	25.42145	56.8441	3231.251	4.31828	2.06357	134.6	0.4	135	70.58127
	Integration	14.51	4	10.41476	23.28811	542.3363	4.33821	2.06793	55.11	0.39	55.5	28.91601
	Resilience	36.816	10	26.7437	59.80072	3576.126	4.31082	2.06102	141.62	0.38	142	74.2524
Adaptive System		0.414	0.42	0.012884	0.028809	0.00083	-1.80433	-0.037638	0.07	0.38	0.45	0.035772

8.3.2 LBWGPCI Components and Indicators of the SLB

The LBWGPCI components with the highest value indicating the best performance was information system (45%); closely followed by management system (43%) and interactive system (42%). In the same vein, the lowest value indicating poor performance was institutional system (38%) and adaptive system (39%). For the indicators, the highest value indicating the best performance was recorded by information sharing indicator (48%); closely followed by the indicator of decentralization (47%) and legislation (45%). The lowest value indicating poor performance was recorded by the indicator of coordination (34%), closely followed by adaptability and resilience (38%) respectively, and then integration (39%). On a general note, the LBWGPCI of the SLB indices (42%) is below the 50 percent mark, which is the class mark for an average performance rating and falls in the category of poor water governance performance; highlighting the need for urgent and critical priority actions to remedy the situation (Figure 8.4 and 8.5).

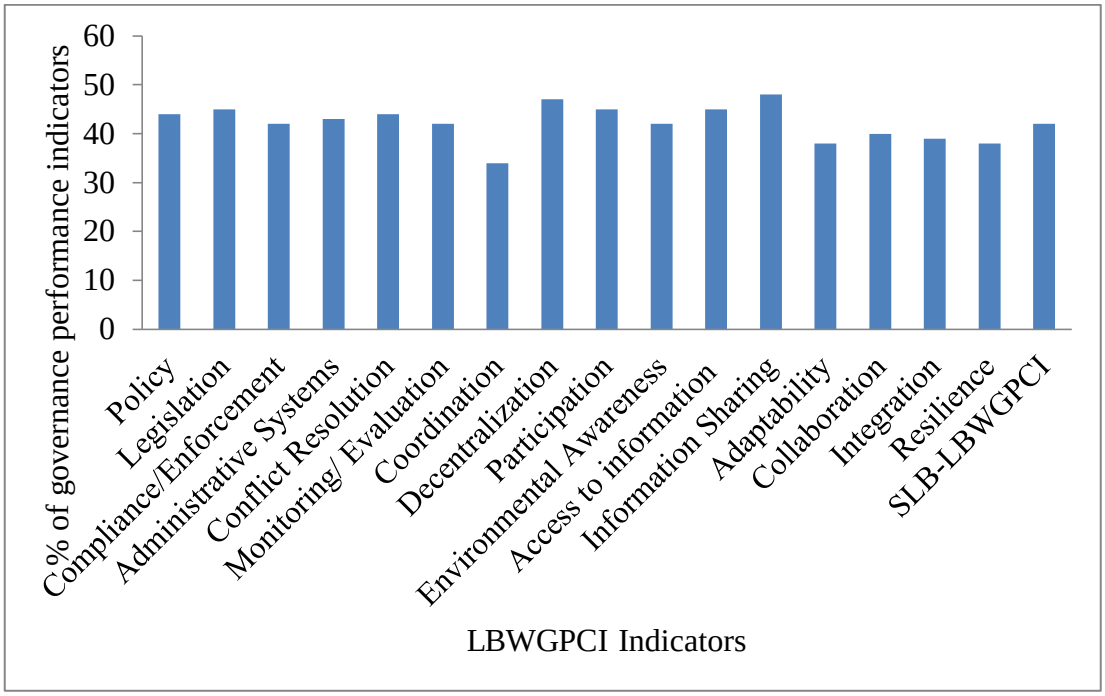

Figure 8.4: Lake Basin Water Governance Performance Composite Index (LBWGPCI) of Songkhla Lake Basin

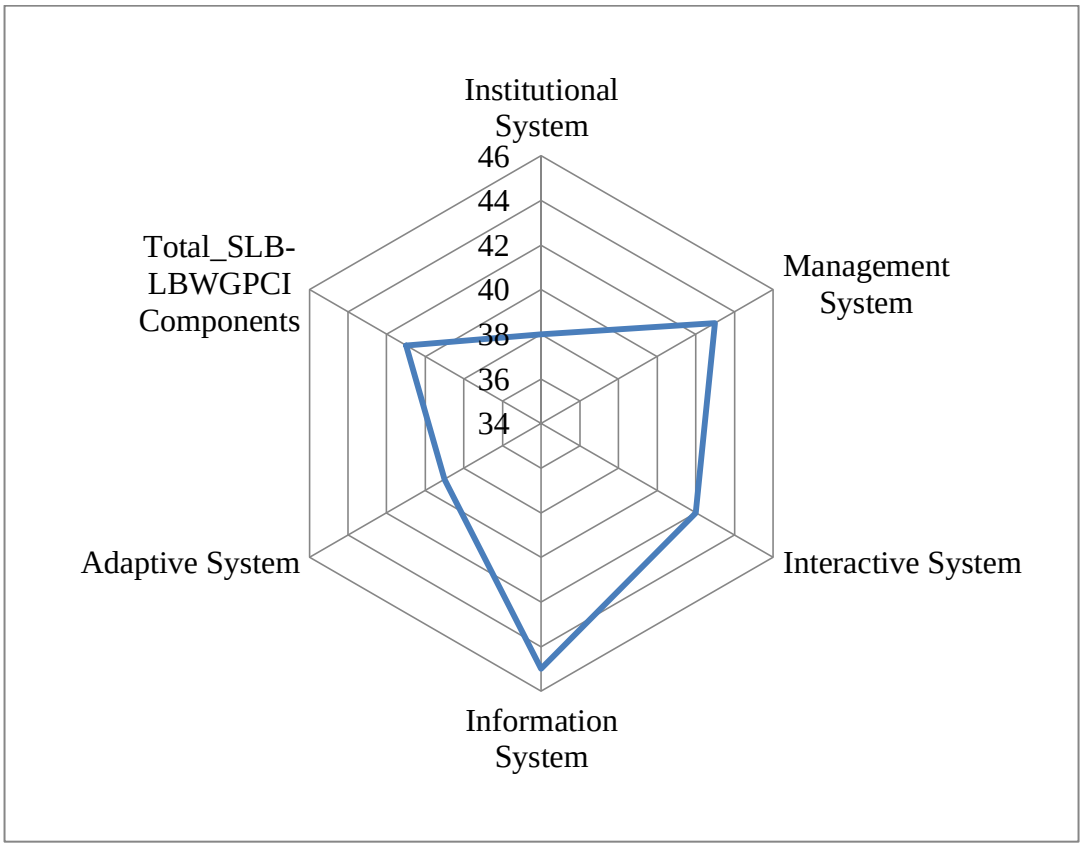

Figure 8.5: Summary of Components of Lake Basin Water Governance Performance Composite Index (LBWGPCI) of Songkhla Lake Basin

8.3.3 Comparison of LBWGPCI Index with Asia Water Governance/Bang Pakong River Basin Governance Performance Assessment

The results of the SLB- LBWGPCI were compared with two other like assessments (Table 8.6). There was a good correlation between the results obtained in the LBWGPCI of the SLB with that of Asia Water Governance and Bang Pakong River Basin governance performance assessments. The only significant differences were the results obtained from the enforcement indicators (42%) of the LBWGPCI and the accountability and regulatory mechanism (70%) indicators as well as for all the indicators under the management system component, which averaged of 60% for the other two assessments (Araral and Yu 2013, Pahl-Wostl et al. 2010), but 42% for SLB-

LBWGPCI. It is interesting to note that in the final analysis, there were no significant differences in these indices: SLB-LBWGPCI (42%) and AWG/Twin2Go (47%) respectively (Figure 8.6).

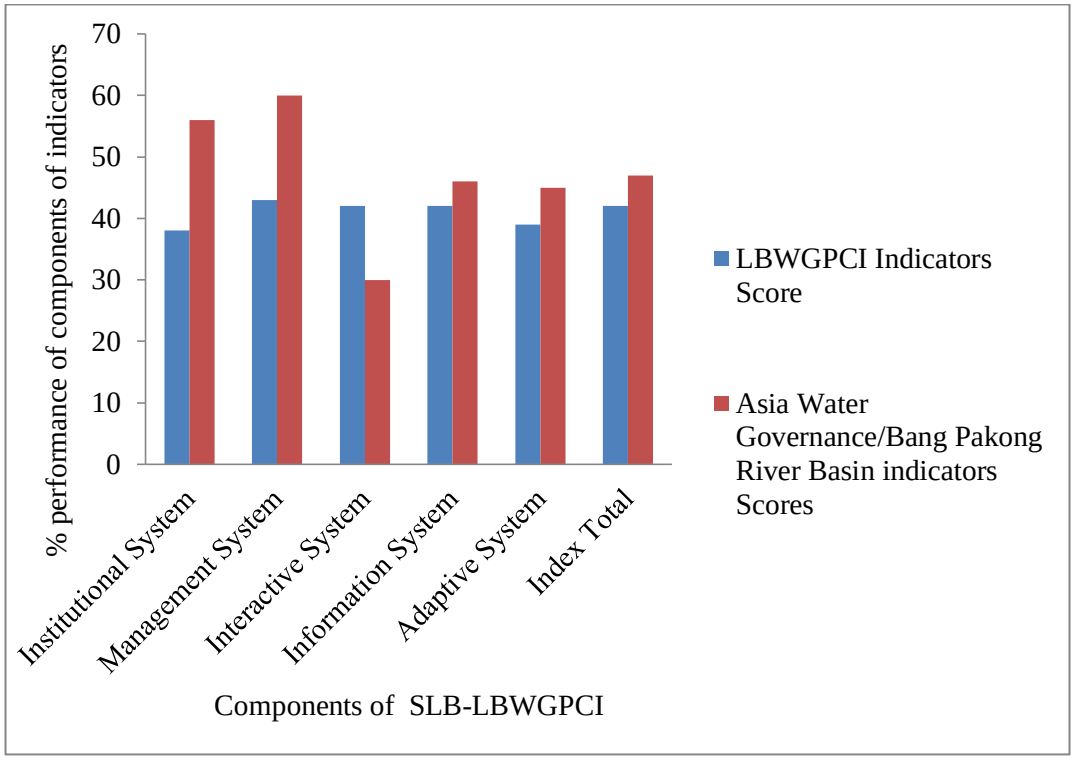

Figure 8.6: Comparison of SLB-LBWGPCI Components with Asia Water Governance Index for Thailand 2013 and Twin2Go 2010/Twin2Go 2010: Bang Pakong River Basin-Thailand

8.4 Discussion and Conclusion

8.4.1 Discussions

8.4.1.1 Institutional System

The results of the institutional system indicators require that immediate, urgent and critical actions be taken because the overall performance was the lowest, which is indicative of poor performance. This result was supported by related and relevant indices and studies as well as the stakeholders/experts survey conducted in the course of the study. The legal instruments designed to govern the exploitation and utilization

of the SLB's resources do not provide adequate protective measures against the effects of bad practices. They are often outmoded and obsolete (Wongbandit 1995), some even more than a hundred years old (example water and natural resources management laws). To make matters worse, enforcement of the existing and sometimes ancient laws, is very poor, especially the fisheries laws, which are often in breach than in compliance (GWP, 2013, Pornpinatepong 2000).

Table 8.6: LBWGPCI Components and Indicators/Asia Water Governance Index and Bang Pakong River Basin Governance Performance Assessment Indicators

Components	Indicators	# Variables	∑Scores	Ẋ Score	∑Scores Indicators	# LBWGPCI Indicators	% LBWGPCI Indicators	Asia Water Governance/ Bang Pakong River Basin indicators Scores
	Policy	8	122	24.4	3.52	0.44	44	60
	Legislation	17	236	47.2	7.57	0.45	45	40
	Enforcement	9	132	26.4	3.82	0.42	42	70
Institutional System		*34*	*490*	*98*	*14.91*	*0.38*	*38*	*56*
	Administrative Systems	18	330.75	66.15	9.45	0.43	43	60
	Conflict Resolution	4	58.75	11.75	1.74	0.44	44	60
	Monitoring/ Evaluation	6	91.5	18.3	2.53	0.42	42	60
Management System		*28*	*481*	*96.2*	*13.72*	*0.43*	*43*	*60*
	Coordination	9	120.25	24.15	3.08	0.34	34	50
	Decentralization	6	100.25	20.05	2.84	0.47	47	10
	Participation	11	160.75	32.15	4.97	0.45	45	30
Interactive System		*26*	*381.25*	*76.35*	*10.89*	*0.42*	*42*	*30*
	Awareness	6	90.5	18.1	2.51	0.42	42	20
	Accessibility	5	79.25	15.85	2.26	0.45	45	60
	Sharing	4	65.25	13.05	1.93	0.48	48	60

Information System		*15*	*235*	*47*	*6.7*	*0.45*	*45*	*46*
	Adaptability	11	165.5	33.1	4.19	0.38	38	40
	Collaboration	9	135	27	3.57	0.40	40	60
	Integration	4	55.5	11.1	1.56	0.39	39	20
	Resilience	10	142	28.4	3.80	0.38	38	60
Adaptive System		*34*	*498*	*99.6*	*13.12*	*0.39*	*39*	*45*
Total		136	2085.25		6.76	0.42	42	47

As a matter of urgency, the challenge of fragmentation should be tackled and by reviewing the policy instruments to clearly state expectations and responsibilities. There is urgent need for a policy change that will encourage resources management as against focus on projects. The bedrock of the change will be a full and comprehensive institutional review addressing gaps and unclear as well as conflicting mandates. One high priority action that is urgent and critical right now is to review and pass into law the National Water Resources draft legislation to address the current institutional challenges of the SLB. Presently, there are several Acts and regulations used to govern water resources, but there is no single one directly related to water resources management. In short the SLB requires an adaptive and integrative institutional framework that guarantees resilience and flexibility to handle the complex dynamics of this unique ecosystem.

8.4.1.2 Management System

Water management and administration connects with various resources and development activities, relating to plethora of sectors and political interests (Keskienen and Varis 2012). The quality of the institutional arrangements for water management and administration will determine the level of the efficiency and effectiveness of the management system. LBWGPCI management system components measured the administrative systems, conflict resolution and monitoring and evaluation and it scored below the average mark of 50%, which is indicative of poor performance requiring urgent and critical priority actions. This was expected because more than 6 central government ministries and 13 centralized-deconcentrated departments (agencies) are involved in some way or the other with the ‘control’ or management of water use in the SLB (Cookey et al. 2015b/c/d). The Local Administrative Organizations (LAOs) do have some responsibility over the management of natural resources within their jurisdictions, but their scope is limited and are constrained by the challenge of budget and lack of autonomy in decision-making (Heyd and Neef 2004). This study observed that although a river basin water resources development plan has been developed for

the SLB, there is more emphasis for resource development than management. Progressive change will require putting in place adequate management systems that will strengthen Basin-wide monitoring and evaluation mechanisms that support compliance and enforcement create conducive environment for sustainable resource management and ensure effective and efficient conflict resolutions mechanisms to address the challenges arising from resource management programmes and actions.

8.4.1.3 Interactive System

The interactive system components of the LBWGPCI indicators comprise of coordination, decentralization and participation. These are crucial indicators and play key functions of measuring the degree of involvement and engagement of the stakeholders, coordination of governance activities and their actors as well as determine the level of decentralization of power to the lowest level of the Basin and also indirectly measures public acceptance of the resource governance system. These indicators also performed below the average mark of 50%. This result is in agreement with Neef (2008), which noted that public participation in water management is still in its infancy, with legislative and executive responsibilities being divided between a variety of state agencies and local authorities. Kanjina (2008) also noted that Thai water sector has long been dominated by a myriad of largely uncoordinated state agencies acting independently. The challenges of coordination can be viewed from many angles: between the centralized-deconcentrated ministries and departments with relevant and related mandates on water resources governance and between the various Local Administrative Organizations (LAOs) in the SLB.

There is also the challenge of lack of cooperation and stiff rivalries among the departments in the ministries and from the deconcentrated departments' offices under the supervision of the provincial governors (Thomas and WAC 2005) and stronger vertical chain of command within individual departments than the horizontal interactions among field staff from the other departments, which impact negatively on coordination in the provinces and districts (Uraiwong 2013, Nagai, et al. 2008, Cookey et al. 2015e) and also complicate the relationships among the governance actors (Moss

2007, OCED 2011). This large number of agencies working independently in the management of water resources result in work duplication and lack of cooperation among actors. Also, lack of stakeholder participation in the governance of the SLB may be responsible for the poor support for several plans and programmes designed by the government to improve the SLB. Kanjina (2008) observed that the membership structure of the River Basin Committees (RBCs) in Thailand, by extension the SLBC are dominated by members from the public sector, accounting for more than two-thirds, leaving few seats for the real Basin local residents. As it stands, there is zero participation of the private sector and very low activity of NGOs/CBOs in the governance of the SLB. Moving forward will require very high priority actions by developing effective stakeholder engagement and involvement strategies that will encourage bottom-up initiatives capable of promoting effective cooperation among the formal and informal actors in the Basin as well as partnerships between actors and sectors.

8.4.1.4 Information System

Information system refers to the measurement of the level of environmental awareness among the Basin communities, ease of access and sharing of information concerning water and other natural resources management and governance. This indicator (48%) was the best performed even though it was still below the average mark of 50%. The importance of this indicator lies in the fact that the awareness of rules and regulations measures people's knowledge and level of understanding of the resources management systems. This is also in agreement with Biltonen et al (2001), which noted that too many implementing agencies results in poor management of information on water resources development and thus affects the smooth flow of information among the actors. Information is critical for developing awareness programmes and seeking stakeholder participation. If community members are not aware of the regulations and rules that exist, it will be difficult to engage them in resource governance and management. Monitoring community's awareness of rules and regulations is important for determining the impacts of attitude and perceptions of

the people. High priority actions are essential towards the creation and development of resource information management systems for the SLB, which are currently scattered in different agencies of formal and informal actors. It is recommended that sharing of information should be institutionalized, especially where actors are less willing to share data. This will support effective planning and implementation of relevant management and governance plans and programmes for the sustainability of the SLB.

8.4.1.5 Adaptive System

The biggest challenge affecting lake basin governance performance is the inflexibility and rigidity of current institutional regimes governing such complex and dynamic systems, which make resilience management difficult due to slow response to new information caused by organizational bureaucracy as well as the conservative and resistant nature of these institutions (Lazarus 2004). This hinders the institutional capacity to capture and manage the synergistic linkages of the lake basin systems, thereby putting constraints on sustainable governance (Garmestani et al. 2009, Dietz et al. 2003, Garmestani and Benson, 2013). This group of indicators recorded the lowest score in the ranking system. From this study, it was revealed that these elements are currently lacking in the existing water and other related natural resources governance instruments in the SLB. Also, vertical (hierarchical) and horizontal (sectoral) integration are considered to be essential characteristics of an adaptive and integrated governance system. Moving forward will require institutions and management systems that have four basic characteristics: adaptability, collaborative, integrative and resilience. Therefore, better hierarchical and sectoral integrations that anticipate emergent problems, resolve conflicts and coordinate policy implementations are urgently needed (Pahl-Wostl 2009, Pahl-Wostl et al. 2010, Huntjens et al, 2010, Knuppe and Pahl-Wostl. 2011).

8.5 Conclusion

This study presented and tested a framework to quantitatively evaluate the performance of water governance in Songkhla Lake Basin using a composite indicator approach. Within this context, the LBWGPCI allowed us to measure the performance of water governance in the SLB in a more integrated and comprehensive manner. The results obtained helped to show the potential benefits of these composite indices as tools for identifying areas in need of improvement in lake basin water governance. The computation of the LBWGPCI components and indicators for the SLB makes it possible to evaluate and identify weaknesses and strengths of the water governance system. This is important as it will enable the setting of the right priority actions to improve water and other related natural resources governance. It is expedient to point out here that the LBWGPCI is designed to adapt to the specific and particular context it is evaluating and results cannot be assumed or extrapolated from outside.

In the light of the results obtained, even with an overall Lake Basin Water Governance Performance Composite Index (LBWGPCI) of 42% in the SLB, which indicates poor performance requiring high priority urgent and critical actions, it still expressly correlates with the results of the Asia Water Governance Index for Thailand 2013 and Bang Pakong River Basin governance performance assessment, European Union Twin2Go project, 2010 (Araral and Yu 2013, Pahl-Wostl et al. 2010). Thus, we can conclude that the water governance performance of the SLB is still evolving with a lot of room for growth depending on if the momentum towards change and better governance and collaboration is maintained and sustained. This movement towards change can be seen, especially in the overwhelming support and willingness of all formal and informal stakeholders in the on-going project on the governance of natural resources and environmental management in Songkhla Lake Basin support by the National Research Council of Thailand (NRCT), which seeks to address the degradation of the biological resources, improve governance and enhance knowledge and information management system in the SLB.

However, the critical areas needing immediate and urgent actions are the institutional and adaptive systems, especially in the aspect of comprehensive reviews

of existing institutional frameworks and the enactment of a national water resources management legislation to incorporate best practices of resource management (with adequate fit-for-purpose institutional provisions). Law enforcement has to be strengthened and stakeholder participation improved. Also, we cannot downplay the need for an effective and efficient coordination and policy harmonization that will promote coherent actions among all the formal and informal actors involved in the SLB's governance.

Significantly, the introduction of the LBWGPCI complements other similar initiatives and strengthens the on-going efforts towards composite indicators standardization for the assessment of performance of lake basins water governance. This is the first time that an attempt was made to develop such a comprehensive and standardized composite indicators framework, specifically for measuring governance performance of lake basins. It is unique in its ability to measure actual governance performance and express the linkages between performance, implementation and sustainability. The strength of the LBWGPCI can be seen in its ability to detect symptoms of problematic concerns and pinpoint trouble spots to enable decision-makers, policy-makers and managers make quick, appropriate and accurate decisions and choices. It also provides relevant stakeholders with the knowledge required to determine management and development procedures as well as programmes and plans. The inherent adaptive and integrative nature of the LBWGPCI gives it a broad leverage as it can be used to measure the capacity of the governance system to be resilient and flexible in the face of unexpected changes and disturbances. This will enable decision-makers and managers to make sustainable plans that are adaptable to change. The framework is also relevant to researchers and scientific studies on lake basin management because it can serve as a 'rain gauge' of lake basin governance performance. The LBWGPCI will assist policy makers, decision-makers, administrators, academia as well as researchers who can use it to determine policies and management priority actions needed for the development of an adaptive and integrative as well as sustainable programmes and plans for lake basins.

When used with the AILBM framework (framework developed specifically for the assessment of governance performance of lake basins), it can be made more effective because of the multi-dimensional coverage of the AILBM, which qualitatively and quantitatively assesses governance performance in a comprehensive manner to cover all aspects of exploitation/utilization and conservation/management. Therefore, measuring governance performance draws from all the other resources gained from the AILBM's assessment, while the results of the governance performance composite index benefits the overall results of the AILBM. This will finally produce a clear-cut all-round picture of the governance performance situation in the lake basin. The fact that the LBWGPCI is built on a conceptual framework for lake basins governance performance assessment, that is not arbitrary, gives it an innovative quality because it is not drawn from general water resources governance assessment protocol.

Further research will be necessary to determine the capacity of this framework to exist as a standardized platform in the assessment of lake basin governance performance. Also, variations in the indicator selection/composition, weighting schemes and methods of aggregation can be used in the determination of the Lake Basin Water Governance Performance Composite Index (LBWGPCI) in other contexts. We encourage wide application and use of this tool as we believe it will go a long way to improve its efficacy.

CHAPTER NINE

SYNTHESIS

9.1 Conclusion, reflections and recommendations

9.1.1 Research question: How can the assessment of lake basin water governance performance be improved?

9.1.1.1 Conclusion

As highlighted in chapters (4, 5, 6, 7, and 8), the Adaptive Integrated Lake Basin Management (AILBM) framework proposes a diagnostic and prescriptive performance assessment for governance of lake basins to make empirically based prescriptive recommendations as well as measure the adequacy of the current solutions and strategies created to ameliorate these challenges and problems and then develop and prescribe adequate futuristic solutions to them. The framework was geared towards achieving a balance between utilization and conservation in an adaptive and integrative manner to ensure resilience and flexibility so that governance can easily fall into step with the uncertainty and complexities of climate change, biodiversity and extreme hydrological events. The objective is to develop a specific lake basin water governance performance assessment framework with an overall outcome to guide the transformation to more adaptive and integrative water governance for lake basins as well as provide empirically based solutions and interventions for improvement. Thus, this framework can be applied in the assessment of lake basin governance globally.

9.1.1.2 Reflections

The Adaptive Integrated Lake Basin Management (AILBM) framework was designed with a focus on the complex and dynamic nature of lakes and their basins and used components that particularly allow the peculiar and specific nature of lake basins to be captured without depending on general presumptions based on several water

resources management as well as giving room for particular contextual information to be gather instead of extrapolation from other socio-ecological systems outside the context being studied. Incorporated in the framework is the assumption that successful governance of lake basins depends on our ability to create adaptive and integrative institutions. In the early stage of this work the AILBM framework was used for the assessment of institutional-fit-analysis using the tool of text mining. This is because an adequate and relevant conceptual framework is an essential requirement for institutional analysis as it helps to act as a guide and boundary (Chapter 5 & 6). The AILBM framework help to identify the diagnostic which are the socio-economic-ecological and biophysical (sectors, stressors, actors, institutions, resource systems, and resource management systems), aspects of lake basins as well as tthe prescriptive which are the management (adaptability, collaboration and resilience) and the governance (decentralization, integration and participation) which served as a guide in the derivation of terms used in the text mining and aided the analysis of institutional fit parameters employed in chapters 5 & 6, (see also appendix 4).

In Chapter 7, the theroritical framework for the local people's perceptions of lake basin governance performance was hinged on the three of the AILBM's diagnostic components (actors, resource management system and institutions) and four of the prescriptive components (collaboration, decentralization, integration and participation). This was the first study of using local people's perceptions to assess lake basin water governance performance. Also, in Chapter 8, the conceptual foundation for the Lake Basin Water Governance Performance Composite Index (LBWGPCI) was derived from the AILBM framework, which was applied to test and evaluate the performance of water governance for lake basins using the SLB as a case study.

The introduction of the LBWGPCI compliments other similar initiatives and strengthens the on-going efforts towards composite indicators standardization for the assessment performance of lake basins water governance globally. In chapters Chapter 2, 7 & 8 the AILBM framework influenced the contents development of questionnaires and interview tools employed in this study and the boundary for literature reviews that aided the qualitative and quantitative analysis of the results of this work. These five

chapters of the thesis (4, 5, 6, 7, and 8) help to demonstrate the robustness of the AILBM as a credible framework for the measurement and assessment of governance performance of lake basins and in extension other related natural resources institutions and governance systems (appendix 2-4).

As described in chapter 4, the major limitations and drawbacks in the application of this framework is the challenge of availability and accessibility of information and data, coupled with low response from actors and falsification of data and information, which may lead to erroneous conclusions. Other constraints are the poor document management system and the ad hoc nature of lake basins management, which makes information and data to be scattered in various related and unrelated sources. Also, the application of this framework in all chapters of this work (4, 5, 6, 7, and 8) has shown that it is a time consuming process that requires the input of all key stakeholder groups to get a comprehensive assessment of the governance of lake basin resources.

9.1.1.3 Recommendations

The following recommendations for practice can be derived from the conclusions and reflections above:

I. The application of this framework for assessment of governance performance of other lake basins and related natural resources governance systems is recommended to improve governance performance.

II. The enhancement of the adaptive and integrative capacity of lake basin governance institutions is recommended for policy makers and managers of lake basin governance performance upgrade.

III. It is recommended that the application of this framework be conducted in a multi-stakeholder setting to capture all relevant perceptions of the challenges of governing lake basins for better solutions to be found.

IV. The AILBM framework helped develop three complimentary lake basin water governance performance assessments: institutional fit assessment based on text mining and the use of appropriate mathematical equations for analysis of institutional documents (policies, laws, regulations, standards and guidelines),

local people's perceptions of water governance performance of lake basin and Lake Basin Water Governance Performance Composite Index (LBWGPCI). This high level triangulation assessments approach and the adoption of multi-dimensional tools further confirmed that the AILBM is indeed a diagnostic and prescriptive framework for the assessment of the governance of the socio-ecological systems like lake basins.

V. We encourage readers to apply the framework in their own research, to test it and to enhance it. The application of this framework in other contexts will be a way forward for the improvement of governance performance assessment of socio-ecological systems.

9.1.2 Research question: Who (individuals, groups, formal and informal institutions) are the key actors in implementing water governance programmes in lake basins? What are their roles in the governance of the lake basins?

9.1.2.1 Conclusion

Based on the insight of chapters 2, 5, 6 & 7 (see also appendices 2, 3), it can be concluded that the key issues that affect the governance of the SLB is fragmented institutions, weak coordination, unclear allocation of roles, responsibilities and weak capacities for enforcement and compliance, coupled with lack of adequate integration between the formal and informal institutions as well as lack of a specific governance instrument at the central and local level, and the absence of a coordinating and harmonization body that leave the SLB without an advocate. Therefore, SLB obviously, needs a water governance system that is robust, flexible, adaptable and integrative at the same time with high levels of citizen involvement and participation. It was also assumed that these challenges could be global concerns for most lake basins.

9.1.2.2 Reflections

The study identified 19 sets of Thailand national laws that were relevant and related to water governance in the SLB. The laws are fraught with fragmented and overlapping responsibilities and filled with a lot of gaps. The 6 most dominant ministries and their departments in terms of water resources governance and management in the SLB were the Ministry of Agriculture and Cooperatives (MOAC) (Royal Irrigation Department (RID) and Department of Fisheries (DOF)), the Ministry of Natural Resources and Environment (MONRE) (National Water Resources Committee (NWRC), Department of Water Resources (DWR), Department of Groundwater Resources (DGW), Pollution Control Department (PCD), Office of Natural Resources and Environmental Policy and Planning (ONEP), Royal Forest Department (RFD), Department of Marine and Coastal Resources (DMCR) and Department of National Park, Wildlife and Plant Conservation (DNWP)), Ministry of Industry (MI), Ministry of Interior (MOI) (Department of Provincial Administration (DOPA), Department of Local Administration (DLA), Department of Disaster Prevention and Mitigation (DDPM) and Provincial Waterworks Authority (PWA)), Ministry of Transport (MOT) and Ministry of Public Health. The two SLB committees (Songkhla Lake Basin Development Committee and Songkhla Lake Basin Committee) had no legal mandates. At the local level, the Local Administrative Organizations (LAOs) under the authority of the Ministry of Interior's Department of Local Administration (DLA) plays an important role in local natural resources governance and management. Complementing the LAOs are active civil society organizations involved in development activities in the Basin.

We also observed that local people perception on governance performance of lake basins is a useful measurement barometer for citizen involvement and participation in governance and can help a great deal in helping decision-makers and managers identify management and governance needs, choose between options, and pinpoint strategies for successful resource management. Interestingly, although superficially, it may seem that the communities in the SLB do not care about the deplorable state of the lake and are not supportive of several efforts to put the lake back

on the part of sustainability, contrarily, field work revealed that the people are worried about the downward turn of this major source of their livelihood.

The erroneous assumption that the local people are not knowledgeable enough about the lakes was debunked through the field work results, as they expressed some in-depth and valuable insights that corroborated major literary findings. Understandably so, because these people are closely connected to the Lake Basin and spend a good portion of their lives on, in or around it. They have experienced and witnessed the Basin at its worst and at its best; suffered and benefitted from it. They know this natural resource intimately through personal contact and a long standing ancestral history passed down through generations. The stories of their own existence may not be complete without the SLB; as they depend on it to provide, feed, protect, connect and preserve them and their coming generations. The SLB is not merely a body of water flowing by or pride of rice fields, rubber plantation, palm oil etc, she is everything and the people will do almost anything to keep her around and well for a very long time. This means that the sustainability of the SLB cannot be achieved without putting the perceptions of the local people into deep consideration, as well as devising a way to formally include their thoughts, concepts and support into all governance and management plans and programmes. This will ensure effective and adequate stakeholder participations.

9.1.2.3 Recommendations

The following recommendations for practice can be derived from the conclusion and reflections above:

I. Review existing water resources related governance instruments and make them appropriate, adequate and relevant to the SLB and her peculiarities.

II. Improve the enforcement mechanisms of the existing laws for the protection of the SLB

III. Create a coordinating and policy harmonization committee that will promote coherent actions among all the formal and informal actors involved in the SLB governance; and their role will be to coordinate and organize all the activities of

the actors in the Basin for a more purposeful governance and management design towards the wise use and conservation of the SLB's resources. Its tasks would be to increase cross-ministerial, deconcentrated departments and LAOs cooperation strengthened through greater communication and production of integrated strategies for the SLB.

IV. It is also recommended that Songkhla Lake Basin Committee (SLBC) and Songkhla Lake Basin Development Committee (SLBDC) be merged into one committee, which may form the nucleus of the proposed coordinating agency or committee for the SLB, as well as enhance the involvement of the Local Administrative Organizations (LAOs) in the management and administration of the SLB.

V. The issue of the removal of the various structures in the Songkhla Lake that constitute serious sources of degradation, deterioration and pollution will require very intense negotiations with the local communities. They range from semi-permanent fishing equipment, home-stay pier structures as well as the direct channeling of septic tank contents into the lakes by households.

9.1.3 Research question: What are the existing legal and policies instruments governing water in Songkhla Lake Basin? How 'fit-for-purpose' are these instruments?

9.1.3.1 Conclusion

Based on the insights of chapters 3, 5 & 6 (see also appendix 4), it can be concluded that the current governance system is not fit for the purpose of the sustainability of the SLB. Data derived from text mining were able to show the lapses in the institutional framework (policy, legislation, regulations, guidelines and standards) and the reasons for weak enforcement and compliance. The results of this study further buttressed the need for institutional reforms towards an Adaptive Integrated Lake Basin Management (AILBM). The general assessment of degree of

recognition and involvement of institutions, overlaps, gaps, institutional priorities and response to resource management shows a clear picture of misfit of the institutional instruments used to govern the SLB.

The major outcome of this work is its ability to prove that the quality of the legal operating documents for natural resource governance can be quantitatively analyzed using the tool of text mining and the application of appropriate equations developed for the purpose of determining the inherent policy weaknesses, degree of actors vested interests as well as the measures of their suitability for enhancement of resources governance. Also, it is a useful tool for quantitative verification of a qualitative analysis of sets of institutions. Traditionally, institutional analysis was mainly qualitative; however, this tool can be used to verify the results of qualitative analysis.

9.1.3.2 Reflections

The essence of the study was to quantitatively assess institutions to determine their fit status, which required measuring several parameters that have to do with institutional fit of the institutions of socio-ecological systems, i.e. the SLB; therefore, the fit status is focused on how the institutions reflect on the SLB using the representative terms. It is easy to make the mistake of assuming that the results of terms indicate a fit or misfit, but the vital point of note is that the fit of one term cannot assure the status of institutions that should cover all the terms required to manage a socio-ecological system. So, if water has low gaps and conservation has high gaps, it shows a low recognition of water conservation indicating that the institution is not fit. The general assessment of frequencies and density of terms, overlaps, gaps, institutional priority and management response shows a clear picture of misfit of the institutional instruments used for water governance of the SLB. This will indicate a low percentage of fit for the total governance system of the SLB.

Taking institutional analysis into consideration, we think that it is expedient to review how provisions of the laws can keenly and clearly capture adaptive and integrative elements like resilience, stakeholder participation, organizational and community collaboration, decentralization, integration, adaptability as well as

conservation, prevention and conflict management. Institutions will be able to anticipate future challenges and adjust to future changes, especially considering the complex and dynamic characteristics of lake basins and the unpredictability of climatic conditions. It makes sense then to ensure that lake basins institutions are devoid of ambiguities, with clear and related adaptive and integrative terms. This can reduce rule-bending and feigning of ignorance among actors – whether regulators, users or communities. Only then can 'fit' institutions be guaranteed and text-mining for representative terms can help in this.

We are not arguing that text mining alone will be enough to do institutional and policy analysis, but the results of this research show that it can be a very important aspect of any such analysis. The text mining tool is a complementary measure that can contribute to governance analysis for improvement. The world's lakes are facing a huge crisis today and urgent measures should be taken to solve them by every means measure possible.

9.1.3.3 Recommendations

The following recommendations for practice can be derived from the conclusion and reflections above:

I. The results of this study further buttress the need for institutional reforms towards the AILBM conceptual framework.

II. There is the need to further refine the text mining analysis technique and adopt it for the assessment of institutional fit of existing water and related governance instruments.

III. It can also be used in the development of new sets of institutions serving as a guide and roadmap that will help to reflect the intent and purpose of the resource management and also achieve institutional fit.

9.1.4 Research question: What is the status of critical water governance performance indicators in the case study lake basin?

9.1.4.1 Conclusion

The SLB recorded an overall Lake Basin Water Governance Performance Composite Index (LBWGPCI) of 42%, which indicates poor performance requiring high priority urgent and critical actions. The critical areas needing immediate and urgent actions were the institutional and adaptive systems, especially in the aspect of reviews of existing institutional frameworks and the enactment of a national water resources management legislation to incorporate best practices of resource management (with institutional fit provisions).

9.1.4.2 Reflections

The Lake Basin Water Governance Performance Composite Index (LBWGPCI) allowed us to measure the performance of water governance in the SLB in a more integrated and comprehensive manner. The results obtained helped to show the potential benefits of these composite indices as tools for identifying areas in need of improvement in lake basin water governance. The computation of the LBWGPCI components and indicators for the SLB makes it possible to evaluate and identify weaknesses and strengths of the water governance system. This is important as it will enable the setting of the right priority actions for the improvement of water and other related natural resources governance. However, the LBWGPCI is not a generic framework, but it is designed to adapt to whatever specific and particular context it is evaluating.

The LBWGPCI is unique in its ability to measure actual governance performance and express the linkages between performance, implementation and sustainability. It clearly detects symptoms of problematic concerns and clearly indicate cracks to enable quick, appropriate and accurate planning and interventions. It also provides relevant stakeholders with the knowledge required to determine management and development

procedures, as well as programmes and plans. It can also measure the resilient and flexible capacity of governance systems in the face of unexpected changes and disturbances, and support sustainable plans that are adaptable to change. The framework is also relevant to researchers and scientific studies on lake basin management because it can serve as a 'rain gauge' of lake basin governance performance. The introduction of the LBWGPCI complements other similar initiatives and strengthens the on-going global efforts towards composite indicators standardization for the assessment of performance of lake basins water governance.

9.1.4.3 Recommendations

The following recommendations for practice can be derived from the conclusion and reflections above:

I. Application and testing of the Lake Basin Water Governance Performance Composite Index (LBWGPCI) is recommended to improve its value and use.
II. Law enforcement has to be strengthened and stakeholder participation improved.
III. Improve and enhance coordination and policy harmonization to promote coherent actions among all the formal and informal actors involved in the SLB's governance.
IV. Further research on other Basins and socio-ecological systems can be done using the LBWGPCI.
V. Also, the LBWGPCI can be extended to cover all governance areas of the SLB or any other context.
VI. The LBWGPCI can be assessed by experts to see how it can be adapted as a global standard for lake basins assessments of governance performance.

9.2 Closing comments

The main purpose of this work was to critically carry out an assessment of the performance of water governance systems in Songkhla Lake Basin with an initial

expected outcome to develop suitable governance performance assessment framework and Lake Basin Water Governance Performance Composite Index (LBWGPCI). But, by the end of this research, we had developed additional tools and parameters for testing institutional fit of lake basin water governance instruments (text mining tools and institutional fit analysis parameters: chapter 5 and 6), which can also be applicable to other similar resource systems.

We also assessed the basin communities' perception of water governance, and critically analyzed the natural resources governance environment of the SLB to unpack the governance challenges of the case study area, while providing recommendations for their improvement. Also, the original plan was to publish three peer-reviewed articles and one conference paper, but at the end we were able to produce 6 peer-reviewed articles and 4 oral presentations at conferences (one national and three international conferences) with articles published in the respective conference proceedings.

Three research questions were initially developed at the proposal stage of the research but at the end an additional one was developed on the AILBM conceptual framework, making it altogether four research questions. These four research questions were adequately well addressed and answered with specific recommendations provided for their practical implementations for improvement of lake basin governance.

This thesis contributes and makes an outstanding innovation in the discourse of lake basin management and governance: the AILBM framework for assessment of governance performance in lake basins; quantitative parameters for institutional analysis and the development of the Lake Basin Water Governance Performance Composite Index (LBWGPCI), which was all tested in the study area.

I, therefore, declare that this thesis contributes to the practices and science of governance and management of lake basins and other similar socio-ecological systems. This thesis contains information that enriches and fills the vacuum of what and how to measure and assess governance performance of lake basins as well as procedural steps and guides for reforms of these institutions for improved governance and management performance of our socio-ecological systems.

I want to close this thesis with a statement of a Darwinian approach to poverty, ‘if the misery of our poor is caused not by the laws of nature, but by our institutions, (then) great is our sin’.

I hope this piece of research work stirs up new investigations in governance and management of lake basins; and in the preservation of the Songkhla Lake Basin.

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APPENDIX 1

LAKE BASIN WATER GOVERNANCE PERFORMANCE COMPOSITE INDEX (LBWGPCI) ESTIMATION

Components = 5	Sub-Indicators = 13	Variables= 136	Poor	Unsatisfactory	Fair	Satisfactory	Good	∑	Ẋ	Sub-Index	Composite
			1	2	3	4	5				
			0.00	0.25	0.50	0.75	1.00				
Institutions											
	Policy = 8		0	2.5	5	6	2	15.5	3.1	0.52	
			0	2.25	7.5	3.75	1	14.5	2.9	0.39	
			0	3.75	5	2.25	2	13	2.6	0.52	
			0	2.25	10	3.75	1	17	3.4	0.34	
			0	1.5	8	6	1	16.5	3.3	0.38	
			0	2.5	5	6	2	15.5	3.1	0.52	
			0	1.25	9	7.5	2	19.75	3.95	0.44	
			0	3.75	5	1.5	0	10.25	2.05	0.41	
		Sub_Total_ Policy	**0**	**19.75**	**54.5**	**36.75**	**11**	**122**	**24.4**	**3.52**	**0.44**
	Legislation = 17		0	3	7.5	3.75	3	17.25	3.45	0.46	
			0	3.75	7.5	0	0	11.25	2.25	0.3	
			0	2.5	7	3.75	1	14.25	2.85	0.41	
			0	1.25	10	2.25	2	15.5	3.1	0.31	
			0	3.25	7.5	3.75	2	16.5	3.3	0.44	
			0	2.25	7.5	3.75	1	14.5	2.9	0.39	
			0	3.75	5	2.25	2	13	2.6	0.52	
			0	3.5	7.5	3.75	1	15.75	3.15	0.42	

			0		2.5	7.5	3.75	2	15.75	3.15	0.42	
			0		3.75	5	2.25	2	13	2.6	0.52	
			0		3.25	5	3.75	2	14	2.8	0.56	
			0		3.25	5	3.75	2	14	2.8	0.56	
			0		2.5	7.5	2.25	2	14.25	2.85	0.38	
			0		2.5	5	2.25	2	11.75	2.35	0.47	
			0		2.5	5	2.25	2	11.75	2.35	0.47	
			0		2.5	5	2.25	2	11.75	2.35	0.47	
			0		2.5	5	2.25	2	11.75	2.35	0.47	
		Sub_Total_ Legislation		**0**	**48.5**	**109.5**	**48**	**30**	**236**	**47.2**	**7.57**	**0.45**
	Compliance/ Enforcement = 9		0		2.5	10	2.25	2	16.75	3.35	0.34	
			0		3.25	7.5	3.75	2	16.5	3.3	0.44	
			0		2.25	7.5	3.75	1	14.5	2.9	0.39	
			0		2.25	7.5	3.75	1	14.5	2.9	0.39	
			0		3.75	5	2.25	2	13	2.6	0.52	
			0		3.25	7.5	3.75	2	16.5	3.3	0.44	
			0		1.25	10	2.25	2	15.5	3.1	0.31	
			0		2.5	5	2.25	2	11.75	2.35	0.47	
			0		3.75	5	2.25	2	13	2.6	0.52	
		Sub_Total_Enforcement/ Compliance		**0**	**24.75**	**65**	**26.25**	**16**	**132**	**26.4**	**3.82**	**0.42**
Organization/ Management												
	Administrative Systems = 22		0		2	7.5	3.75	5	18.25	3.65	0.49	

	0	2.5	6.5	5.25	0	14.25	2.85	0.44	
	0	2.5	7.5	2.25	2	14.25	2.85	0.38	
	0	2.5	7.5	2.25	2	14.25	2.85	0.38	
	0	1.75	10	2.25		14	2.8	0.28	
	0	1.25	10	5.25	2	18.5	3.7	0.37	
	0	3.75	7.5	3.75	0	15	3	0.40	
	0	2.5	7.5	2.25	2	14.25	2.85	0.38	
	0	2.5	7.5	1.5	3	14.5	2.9	0.39	
	0	1.25	7.5	3.75	5	17.5	3.5	0.47	
	0	3.75	7.5	3.75	0	15	3	0.40	
	0	2.5	7.5	2.25	2	14.25	2.85	0.38	
	0	2.5	7.5	2.25	2	14.25	2.85	0.38	
	0	3.25	7.5	3.75	2	16.5	3.3	0.44	
	0	2.5	3	3.75	3	12.25	2.45	0.65	
	0	3.25	7.5	3.75	2	16.5	3.3	0.44	
	0	2.5	5	6	2	15.5	3.1	0.52	
	0	3.75	5	2.25	2	13	2.6	0.52	
	0	3.75	5	2.25	2	13	2.6	0.52	
	0	3	7.5	2.25	0	12.75	2.55	0.34	
	0	3	7.5	3.75	3	17.25	3.45	0.46	
	0	3.5	7.5	3.75	1	15.75	3.15	0.42	
Sub_Total_ Administrative Structures	**0**	**59.75**	**157**	**72**	**42**	**330.75**	**66.15**	**9.45**	**0.43**

	Monitoring/ Evaluation = 6		0		2.5	7	3.75		1	14.25	2.85	0.41
			0		2.5	7.5	2.25	0		12.25	2.45	0.33
			0		2.5	7.5	2.25		2	14.25	2.85	0.38
			0		1.75	10	5.25		1	18	3.6	0.36
			0		1.25	9	7.5		2	19.75	3.95	0.53
			0		3.75	5	2.25		2	13	2.6	0.52
		Sub_Total_Monitoring/ Evaluation		**0**	**14.25**	**46**	**23.25**		**8**	**91.5**	**18.3**	**2.53**	**0.42**
Cooperation												
	Participations = 11		0		3.25	7.5	3.75		2	16.5	3.3	0.44
			0		2.5	6	3.75		3	15.25	3.05	0.51
			0		3	6.5	3.75		0	13.25	2.65	0.41
			0		3.75	4.5	3.75		1	13	2.6	0.58
			0		2.75	7.5	1.5		2	13.75	2.75	0.37
			0		2.5	7.5	2.25		2	14.25	2.85	0.38
			0		3.75	7.5	2.25		2	15.5	3.1	0.42
			0		2.5	7.5	2.25		2	14.25	2.85	0.38
			0		3.75	7.5	2.25		2	15.5	3.1	0.42
			0		2.25	8	3.75	0		14	2.8	0.75
			0		1.25	10	2.25		2	15.5	3.1	0.31
		Sub_Total_ Participations		**0**	**31.25**	**80**	**31.5**		**18**	**160.75**	**32.15**	**4.97**	**0.45**
	Collaboration = 9		0		2	7.5	5.25	0		14.75	2.95	0.39
			0		1.75	10	2.25			14	2.8	0.28
			0		2.5	6.5	5.25		0	14.25	2.85	0.44

			0		3.75	7.5	3.75	0		3	0.40	
			0		3.25	7.5	3.75		2	15 3.3	0.44	
			0		1.25	7.5	3.75		5	16.5 3.5	0.47	
			0		2.5	7.5	1.5		3	17.5 2.9	0.39	
			0		2.5	7.5	2.25		2	14.5 2.85	0.38	
			0		2.5	7.5	2.25		2	14.25 2.85	0.38	
		Sub_Total_ Collaboration		**0**	**22**	**69**	**30**		**14**	14.25 **135**	**27**	**3.57**	**0.40**
	Decentralization = 6		0		2	7.5	4.5		1	15 3	0.40	
			0		2.5	7.5	2.25		2	14.25 2.85	0.38	
			0		2.5	6.5	5.25		0	14.25 2.85	0.44	
			0		2	7.5	3.75		5	18.25 3.65	0.49	
			0		2.5	7.5	2.25		2	14.25 2.85	0.38	
			0		2.5	6.5	5.25		10	24.25 4.85	0.75	
		Sub_Total_ Decentralization		**0**	**14**	**43**	**23.25**		**20**	**100.25**	**20.05**	**2.84**	**0.47**
Information/ Communication													
	Awareness = 6		0		2.5	6.5	5.25		0	14.25 2.85	0.44	
			0		1.25	7.5	3.75		5	17.5 3.5	0.47	
			0		3.25	7.5	3.75		2	16.5 3.3	0.44	
			0		2.5	7.5	2.25		2	14.25 2.85	0.38	
			0		2.5	7	3.75		1	14.25 2.85	0.41	
			0		2.5	7.5	3.75	0		13.75 2.75	0.37	
		Sub_Total_ Awareness		**0**	**14.5**	**43.5**	**22.5**		**10**	**90.5**	**18.1**	**2.51**	**0.42**
	Accessibility/ Sharing = 9		0		3.5	5	3.75		1	13.25 2.65	0.71	

			0		3.75	6.5	0.75	1	12	2.4	0.37	
			0		1.25	7.5	3.75	1	13.5	2.7	0.36	
			0		2.5	7.5	3.75	10	23.75	4.75	0.48	
			0		2.5	10	2.25	2	16.75	3.35	0.34	
			0		3.75	7.5	3.75	5	20	4	0.53	
			0		2.25	7.5	3.75	1	14.5	2.9	0.39	
			0		3.25	7.5	3.75	2	16.5	3.3	0.44	
			0		3.75	5	4.5	1	14.25	2.85	0.57	
		Sub_Total_ Information Accessibility/Sharing		**0**	**26.5**	**64**	**30**	**24**	**144.5**	**28.9**	**4.19**	**0.47**
Flexibility/ Responsiveness	**Adaptability = 11**		0		2.5	7.5	2.25	2	14.25	2.85	0.38	
			0		2.5	7	3.75	1	14.25	2.85	0.41	
			0		1.25	10	2.25	2	15.5	3.1	0.31	
			0		3.25	7.5	3.75	2	16.5	3.3	0.44	
			0		2.5	10	2.25	2	16.75	3.35	0.34	
			0		2.25	7.5	3.75	1	14.5	2.9	0.39	
			0		2.5	7.5	2.25	2	14.25	2.85	0.38	
			0		2.5	5	2.25	2	11.75	2.35	0.47	
			0		1.25	10	2.25	2	15.5	3.1	0.31	
			0		3.75	7.5	2.25	2	15.5	3.1	0.42	
			0		2.5	10	2.25	2	16.75	3.35	0.34	
		Sub_Total_ Adaptability		**0**	**26.75**	**89.5**	**29.25**	**20**	**165.5**	**33.1**	**4.19**	**0.38**

Resilience = 10		0		2.25	7.5	3.75	1	14.5	2.9	0.39
		0		2.5	7	3.75	1	14.25	2.85	0.41
		0		3.75	6.5	0.75	1	12	2.4	0.37
		0		1.25	7.5	3.75	1	13.5	2.7	0.36
		0		2.5	7.5	2.25	2	14.25	2.85	0.38
		0		3.25	7.5	3.75	2	16.5	3.3	0.44
		0		2.5	10	2.25	2	16.75	3.35	0.34
		0		2.25	7.5	3.75	1	14.5	2.9	0.39
		0		1.25	10	2.25	2	15.5	3.1	0.31
		0		3.75	5	1.5	0	10.25	2.05	0.41
	Sub_Total_ Resilience		**0**	**25.25**	**76**	**27.75**	**13**	**142**	**28.4**	**3.80**
Integration /Coordination = 12		0		3.75	5	1.5	0	10.25	2.05	0.41
		0		1.5	8	6	1	16.5	3.3	0.38
		0		2.25	7.5	3.75	1	14.5	2.9	0.39
		0		2.5	7.5	2.25	2	14.25	2.85	0.38
		0		1.75	10	2.25		14	2.8	0.28
		0		2.5	6.5	3.75	2	14.75	2.95	0.45
		0		2.5	10	2.25	2	16.75	3.35	0.34
		0		2.5	6.5	3.75	2	14.75	2.95	0.45
		0		2.5	10	2.25	2	16.75	3.35	0.34
		0		2.5	6.5	3.75	2	14.75	2.95	0.45
		0		2.5	7.5	2.25	2	14.25	2.85	0.38

	0		2.5	7.5	2.25	2	14.25	2.95	0.39	
Sub_Total_ Integration/ Coordination		**0**	**29.25**	**92.5**	**36**	**18**	**175.75**	**35.25**	**4.64**	**0.39**
Total										**5.52**
										0.42

APPENDIX II

SUPPLEMENTARY PAPER 1

Understanding Stakeholders Perception for Effective Governance Of Songkhla Lake Basin: Case Study of Some Tambons in Songhkla Province, Thailand

This chapter is adapted from:

Paper Presented at the 2nd National Songkhla Lake Basin Annual Conference on the 14-15 August, 2014 at the Prince of Songkhla University International Conference Centre. Organized and hosted by the Faculty of Environmental Management, Prince of Songkhla University, Hat Yai, Campus, Songkhla, Thailand

Abstract

There have been many studies on stakeholder participation and engagement in natural resources management in Songkhla Lake Basin (SLB), but none has targeted to the assessment of stakeholder perception as a tool for improvement of public participation in governance of natural resources in SLB. It was based on this that we decided to assess stakeholder perception on critical sustainability issues in Songkhla Lake Basin. The study adopted stakeholder engagement and analysis survey. Other research techniques used in this study include, desk-top study and interview with key communities' leaders. Data were analyzed using Excel statistical package. The major findings of this study was that majority of the stakeholders were not aware of the SLB Development Master Plan and when asked to select the aspect of the Master Plan Project that they would support if given the opportunity based on their own priority for

the sustainability of the lake, they had glaringly different priorities from the order presented in the SLB development plan. Stakeholders did not really consider all the recommended actions as being essential for the sustainability of the lake. We conclude by stating that perception is fed and nurtured by proper education and information which will cause people to act in the proper manner required of them. To mold the right public perception for stakeholders in the SLB, we recommend the adoption of a new ladder of citizen participation with the purpose to provide a systematic approach to molding stakeholder perception based on the right knowledge achieve through a well thought-out public education and information programming. We believe that this is the right way to enhances the public perception that will ensure sustainable governance of natural resources in the Songkhla Lake Basin.

Keywords: perception, stakeholders, participation, governance, Songkhla Lake Basin

1.0 Background

Participation has become the main focus of attention for resource governance discourse and practice. Aggestam (2007), suggested that the solution for real-world problems requires the involvement of all stakeholders. ELI (2007), further stated that public participation is inextricably tied to the right to a healthy environment. Public participation had its earliest articulation in the human rights instruments of the mid-20th century. Ramsar Convention, (2004) recognized community involvement and participation in the management of natural resources as a condition for their sustainable use. It has also been pointed out that public participation and active stakeholder involvement is essential to managing lakes and their basins (ILECF, 2005); there is the need for greater integration between water users and others who impact on water availability (Moriarty, et al., 2007). Lakes can only be environmentally stable as long as its basins or catchment area maintain ecologically sound conditions (Kira and Sazanami, 1991), which can also be achieved by active participation of the people.

Effective stakeholder participation cannot be ensured without a clear understanding of the way the stakeholders view (i.e. their perception) the relevant and

salient issues connected to management actions. Perception is the organization, identification, and interpretation of sensory information in order to represent and understand the environment (Schacter, 2011). According to (Alan and Gary, 2011), there are three components to perception: *(1) the perceiver, the person who becomes aware about something and comes to a final understanding. The perceiver is influence by experience, motivational and emotional state, (2) the target, the person who is being perceived or judged needs additional interpretation and information to avoid ambiguity and (3) the Situation greatly influenced perceptions because different situations may call for additional information about the target*. According to Gibson, (1966 and 1987), without perception, action would be unguided, and without action, perception would serve no purpose. This implies that actions taken without cognizance of the perceptions of the relevant stakeholders' would produce no meaningful results. Therefore, actions and perceptions must go hand-in-hand.

The modern concept of governance is portrayed as essentially socio-political in nature, and consists of a series of co-arrangements between state and non-state actors more oriented towards collaborative approaches to problem solving (Kooiman, 1993). Contemporary environmental governance articulates this trend and is exemplified by the interactions that occur between various networks and multiple actors functioning at all levels (Haas 2002 and Maraseni and Cadman, 2013). This can only work with proper understanding of the perception of the relevant stakeholders.

Several efforts to rescue Songkhla Lake has failed to produce the desired result because many of such plans and programmes were done without connecting with the perceptions of the people; which resulted in little or no active participation, involvement and engagement of the people whose daily life revolve around this resource. For instance, the 1984 in-depth master plan was never implemented (Emsong, 1999), the Environmental Management Project for Songkhla Lake Basin (EmSong, 1999) was partially implemented (SLBDMP, 2011) and the reviewed and amended Development Master Plan (2011) of Songkhla Lake Basin (2013-2016), is almost running into a close but not much has being done. These development plans are multi-sectoral in nature and require the active partnership of the public sector

(government), private sector (businesses and companies) and the people for full implementation and actualization. As it stands now, there is zero participation of the private sector and very few communities' actions geared towards the sustainability of the Songkhla Lake. There is also very low activity of NGOs/CBOs in the Songkhla Lake Basin.

Stakeholder participation is a complex and delicate process. In most cases, what people call stakeholder participation and involvement is just a system of dishing out information to the people (Arnstein, 1969). Successful stakeholder engagement helps to secure the lake basins and bring about systemic change towards sustainability (Krick, et al, 2005). People will definitely support interventions that will improve their livelihood (WFD, 2000). People will not change their behaviour until they realize or experience the benefits that particular change will deliver to them (ILEC, 2005). This comes through better management of their perception. It has also being proven that stakeholders who are involved in decision-making show increased acceptance of rules, even when the rules do not favour their interest (Syme, et al, 1999). Several studies on stakeholders' participation and engagement in natural resources management in Songkhla Lake Basin (SLB) have been done but there is little or no study on the management of perception as a tool for improvement of stakeholders' participation in governance of natural resources in SLB. It was based on this that we decided to assess stakeholder perception on critical sustainability issues in Songkhla Lake Basin. This paper focuses its attention on analyzing stakeholder perception and how it can be used to influence positive and effective stakeholders' participation in the governance of the natural resources in SLB, assess stakeholders' perception on some issues in the SLB development master plan, prioritize the recommended development activities in the SLB master plan as well as identify development activities that they would support in the SLB development plans based on their perception. This paper highlight some results of the first part of the broad research theme of public participation in water governance in Songkhla Lake Basin.

2.0 Methodology

The mixed research method was adopted for this study (Teddie and Tashakkori, 2009; Tashakkori and Teddie, 2003; Tashakkori and Creswell, 2007 and Onwuegbuzie and Teddie, 2003). The integrative nature of mixed method was to ensure the in-depth understanding of the research focus. This research work adopted purposive sampling (Tashakkori and Teddlie, 2003) and simple random sampling (Teddlie and Tashakkori, 2009) methods. The overall study was in two parts: *(1) stakeholders engagement and analysis simple random sampling survey of 164 Tambons of Songkhla Lake Basin (survey completed and currently in data collation and analysis) (2) purposive sampling of about 50 key public, private institutional actors and expert groups survey (yet to be commenced).* Other research techniques used in this study include, desk-top study, field study and post-consultative stakeholders meeting (to be held at the end of the study).

About 1064 households were interviewed in the 164 Tambons of Songkhla Lake Basin distributed in the three provinces of Songkhla, Nakhon Si Thammarat and Phattalung between the periods of April to June 2014 by a team of six field research assistants. The study was designed to administer a minimum of 10 respondents in each Tambons that make up the Songkhla Lake Basin in the three provinces. The interview for each respondent lasted for a period of half to one hour. Generally, the participating individuals and families were very open to the research. Data were analyzed using Excel statistical package. In this paper, we present the result of 10 Tambons in Songkhla Province. These tambons include *Khu Tao, Nam Noy, Thung Khamun, Khon Rom Chang, Khong Rang, Banpru, Kho-yo, Boyang, Kho Teaw and Phatong.*

3.0 Results

For easy data analysis, the survey tools for stakeholders' engagement were grouped into the following: (1) basic stakeholders' characteristics, (2) stakeholders' resources (3) community resource governance and (4) stakeholder perception on SLB Development Plans.

3.1 Basic Stakeholder Characteristics

The study area selected was designed to focus more on the residential area of the communities. The study area is well developed, advanced and equipped with basic infrastructure of roads, electricity and water supply. The average age of the respondents were between 18 to 60 and above (figure 2), the ratio of male to female respondents were equal (figure 3), majority of the respondents were married (figure 4), each family had an average of 3 children (figure 4), the average household size was 6.2 (figure 5), majority of the respondents had formal education of one form or the other (figure 6) and all the respondents had been in these communities for a minimum period of 10 years (figure 7). This showed that the respondents were knowledgeable and experienced enough to address the core issues of this research. The major water supply and sanitation systems in the communities were also identified (figure 8 and 9).

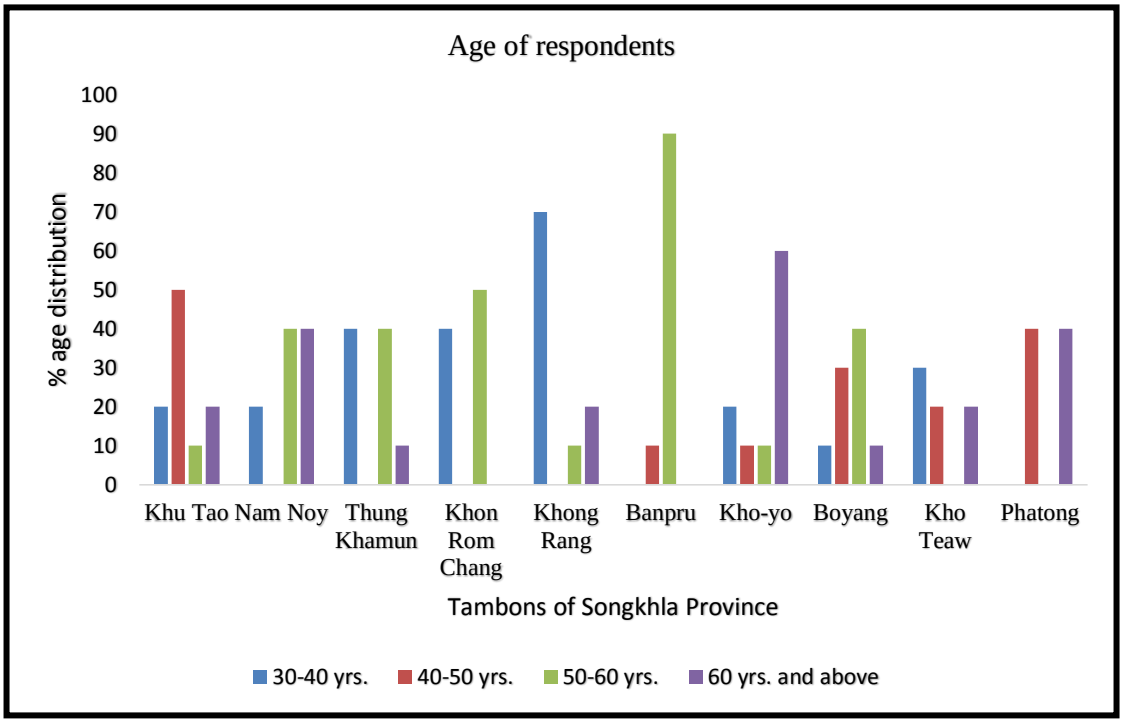

Figure 2: Age of respondents

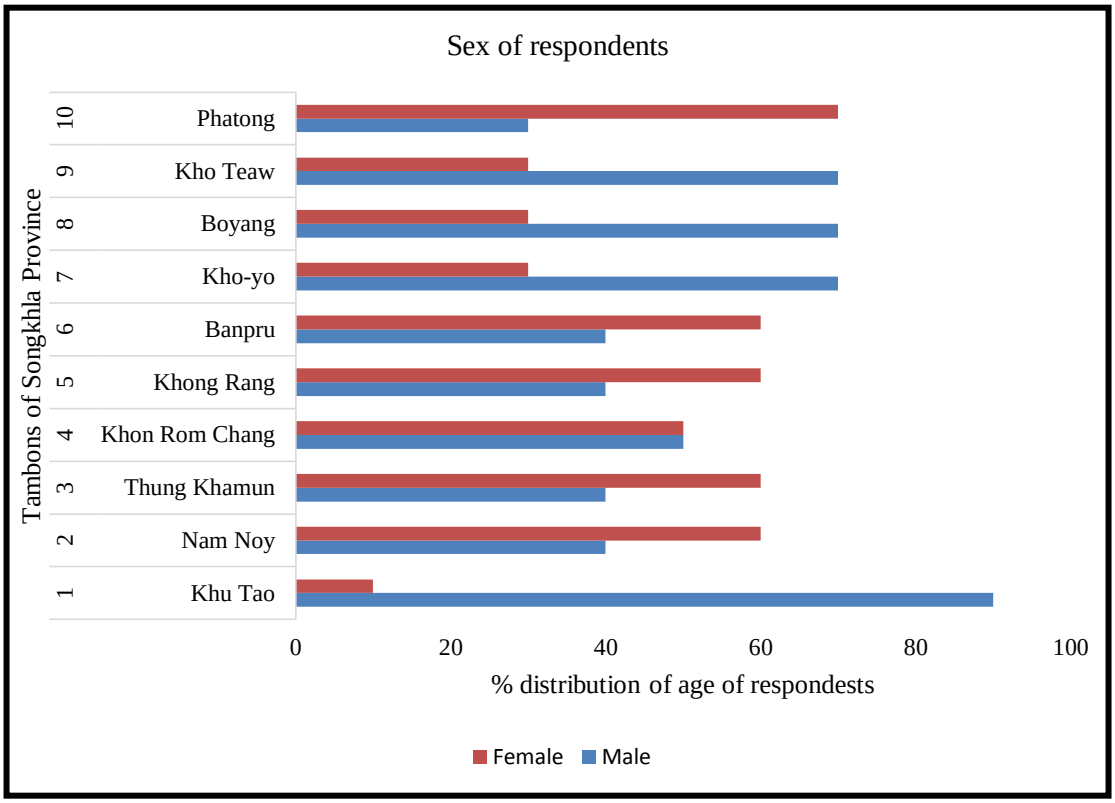

Figure 3: Sex of respondents

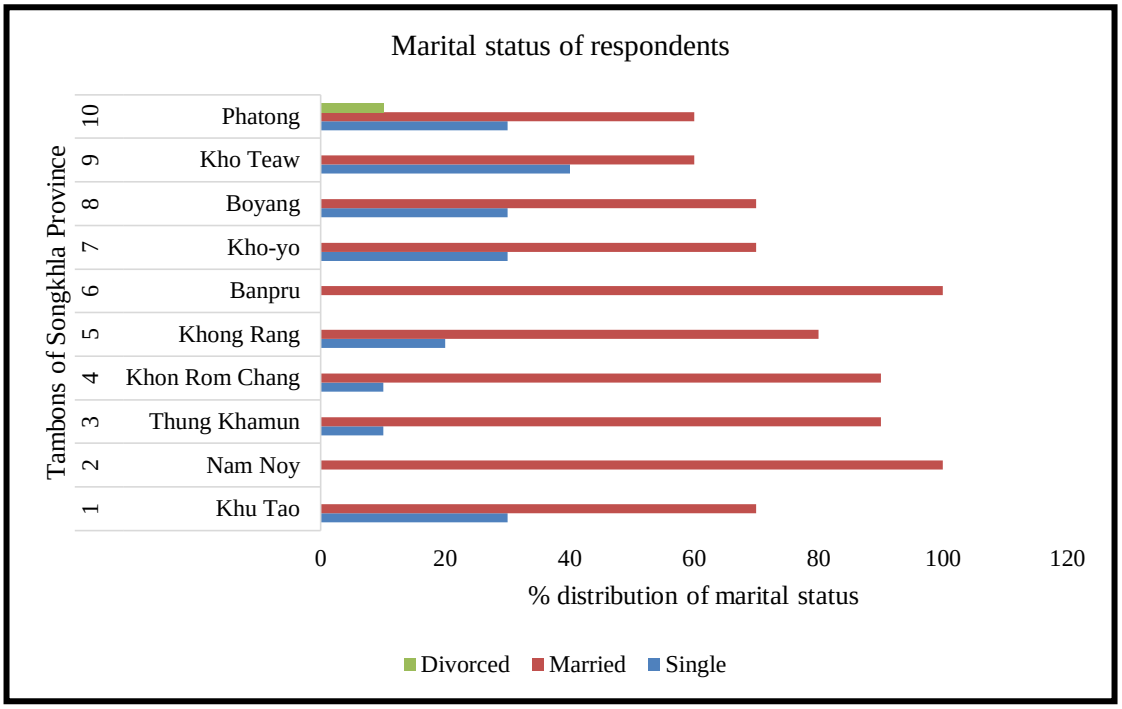

Figure 4: Marital status of respondents

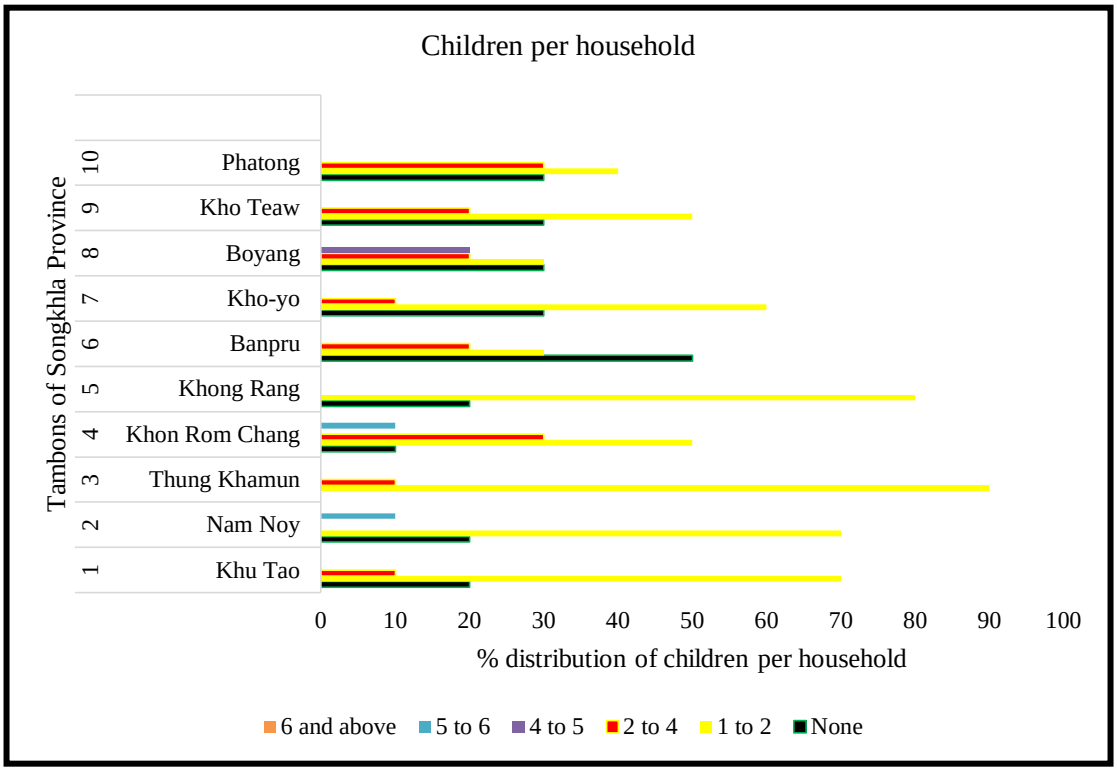

Figure 5: Number of children of respondents

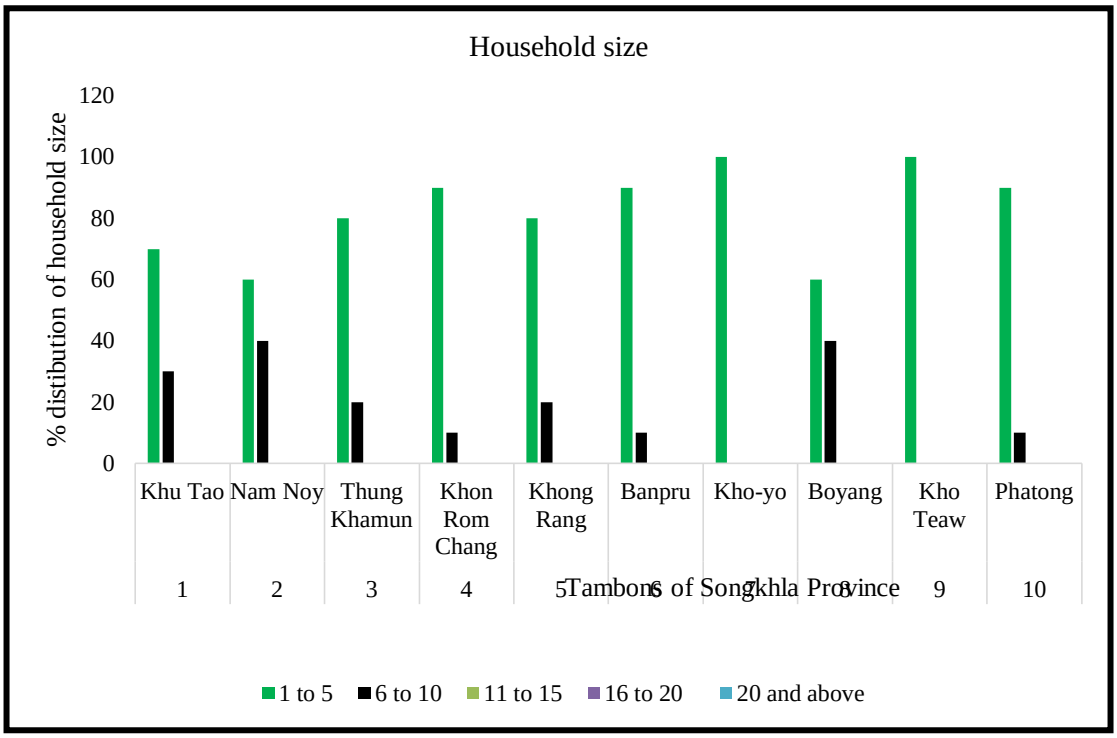

Figure 6: Household size of respondents

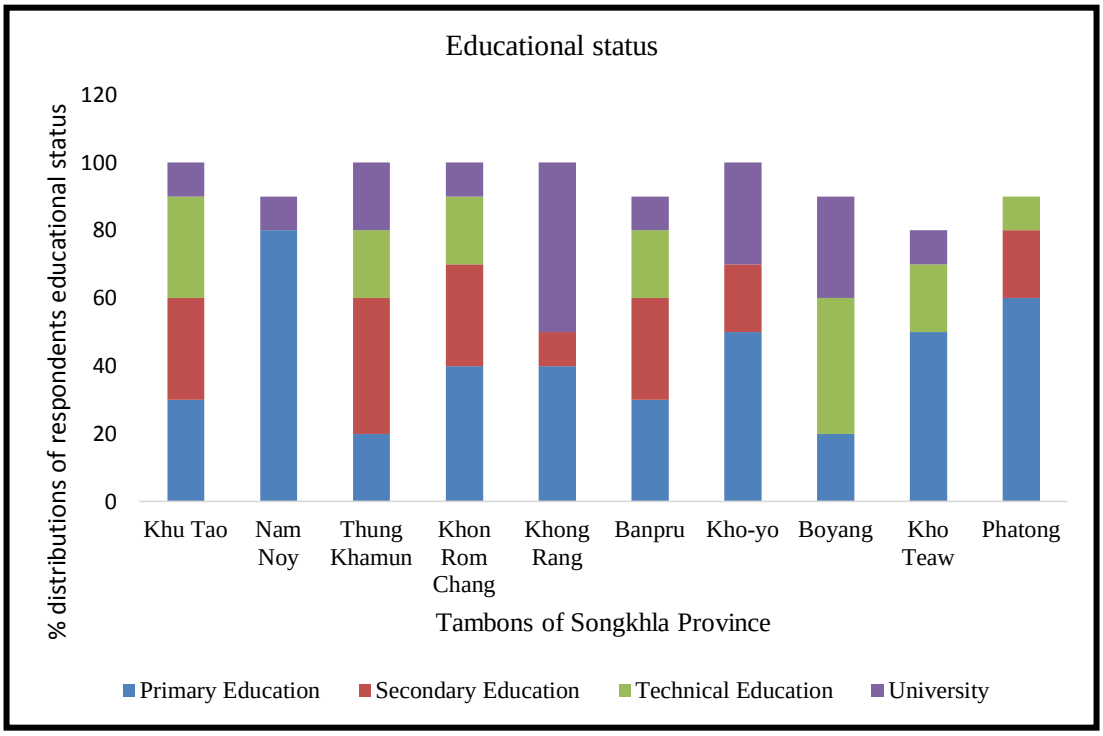

Figure 7: Educational status of respondents

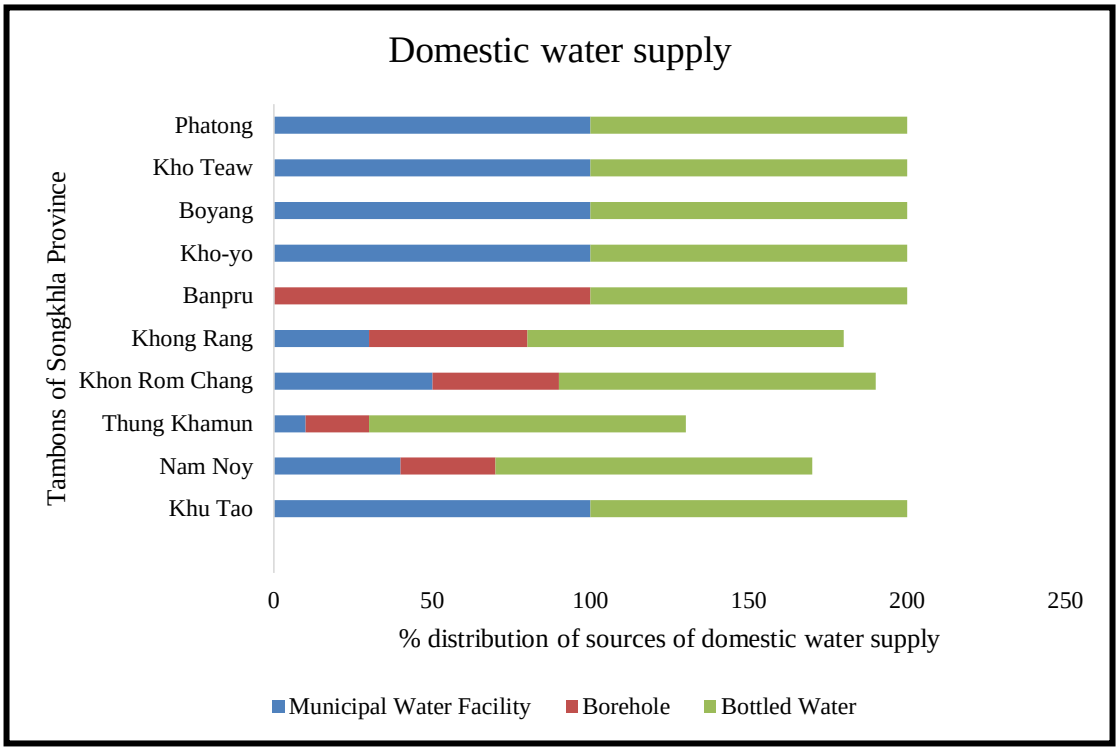

Figure 8: Domestic water supply

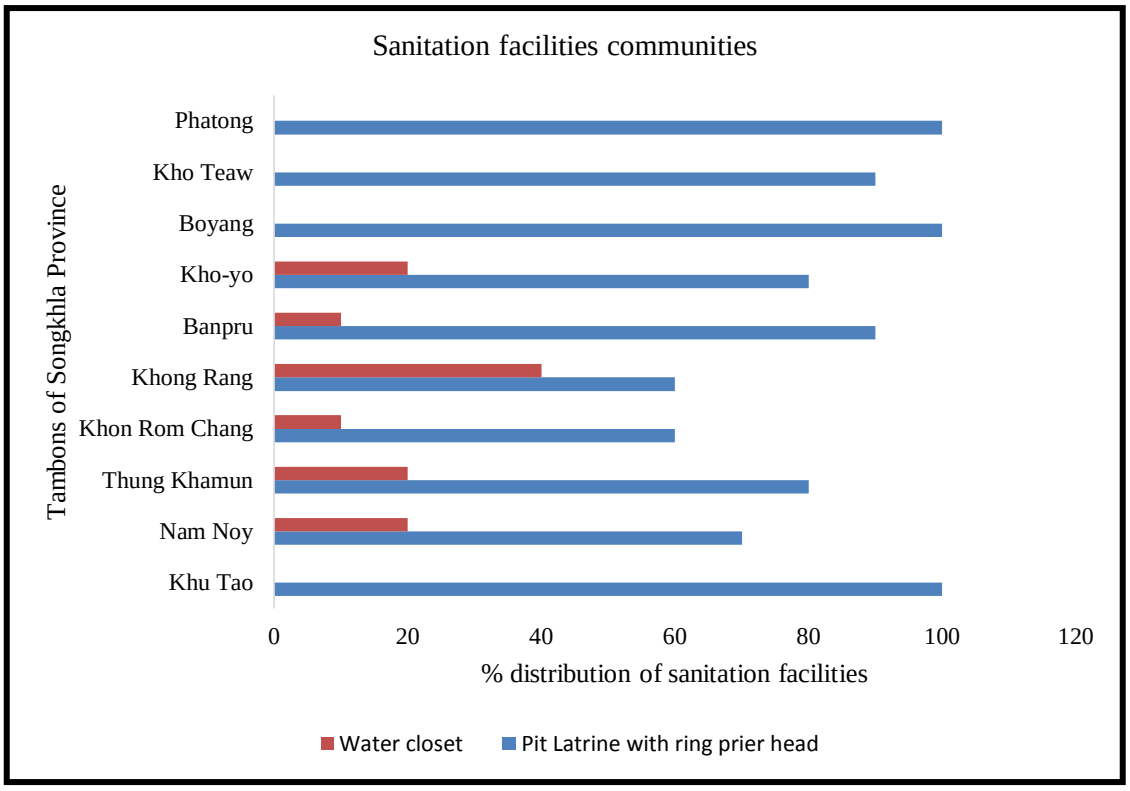

Figure 9: Domestic water supply

3.2 Stakeholders Resource Profile (Livelihood Issues)

3.2.1 Property and land ownership

There were 11 major types of land holdings in the communities of study: residential lot, aquaculture (fish or shrimps) ponds, cash crops other than rice, irrigated, rain fed and native rice, orchard, rubber plantation, fishing lots in Songkhla Lake, oil palm and vegetable garden. About 100 percent of the respondents claimed to have residential lots and none lived in rented apartments (figure 10). The fishing lot acquisition in the lake depends on the first person to stake a claim and he/she can pass it on to their families or sell it to another person. Each family lives in a simple dwelling well-built with wood, cement, fabricated materials and roofing materials made of galvanized zinc, asbestos roofing sheets and some with thatched roofs. Wood and

cements are common materials used for the floors and walls. Cooking is done with wood, gas cooker and in some cases electricity. However, most of the households eat out often by buying food from the many restaurants and food vendors scattered around.

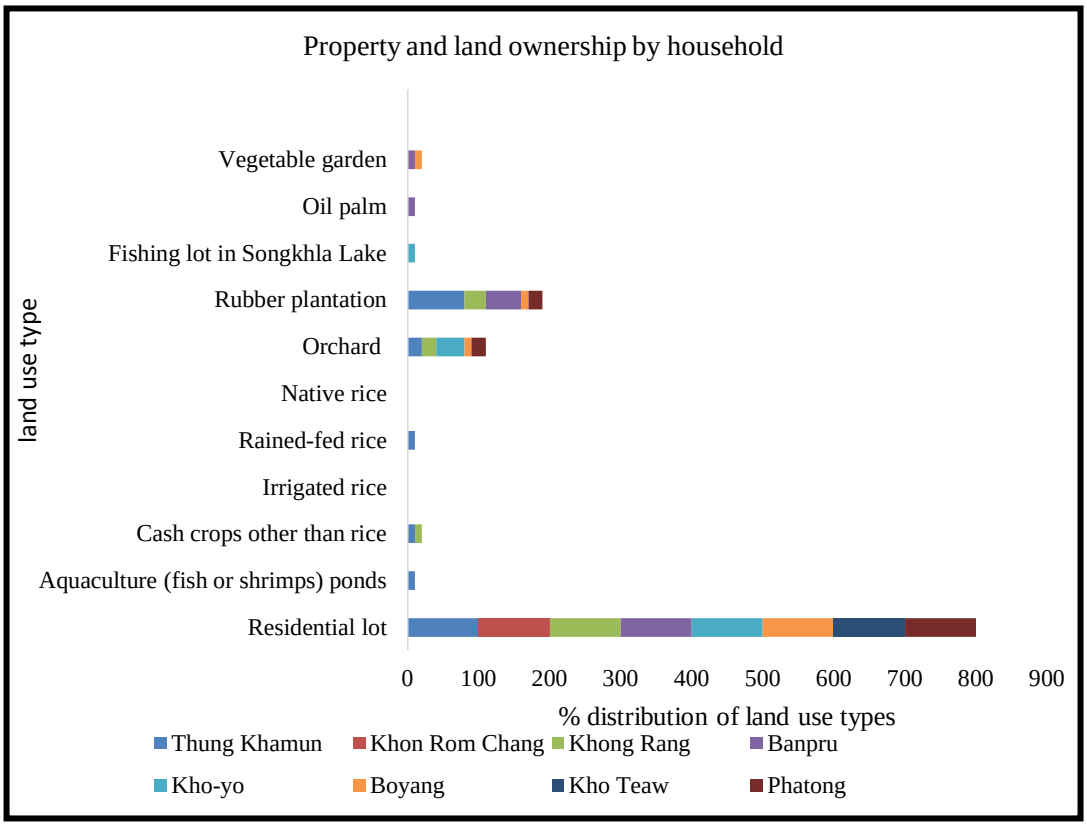

Figure 10: Property and land ownership

3.2.2 Livelihoods activities of the respondents

Agricultural activities which include rice farming, animal husbandry, aquaculture and processing, fishing, resin (latex) collection, etc, were considered the principal livelihood activities in the study area. There was also a high percentage of people who engaged in trading and in other commercial activities, very few were engaged in the public sector. The communities were well sufficient because of high level of economic activities that generate income within the communities. All members of the family contribute to the labour pool in every household's economic activities. The male and female played major role in fishing, hunting, resin collection and the hiring out of their labour services (figure 11). We observed that the rubber, palm oil tree and farming rice

communities were wealthier than the fishing communities. Farming were mostly non-mechanized and plows and harrow pulled by semi-automatic machines, land tractors, cows and water buffalo used in land preparation. The majority of the household also raised animals as alternative and complementary activity. Animals were used for home consumption or sold at the market to augment the family income. Fishing is the major contributor to the food security and nutritional requirements of the communities under study, especially those living near the lake. All the communities very close to the lake engage in one form of fishing or the other. The most commonly used fishing equipment include hook, line and grill net. There are also some reported cases of the use of destructive methods of fishing like electric fishing, etc. Resin collection from rubber plant is one of the most important economic activity in the study area. Rubber plantation is the dominant economic tree in the study area and stand as the major income generating activity. The average income per household in the study area ranges from minimum of 1000 to 5000 BTH (per month) and maximum of 20000 BTH (per month) (very few earned this amount) (figure 12). The study also highlights the major challenges affecting livelihood in each of the Tambons (Table 1) and majority of the respondents stated that there is high cost of living.

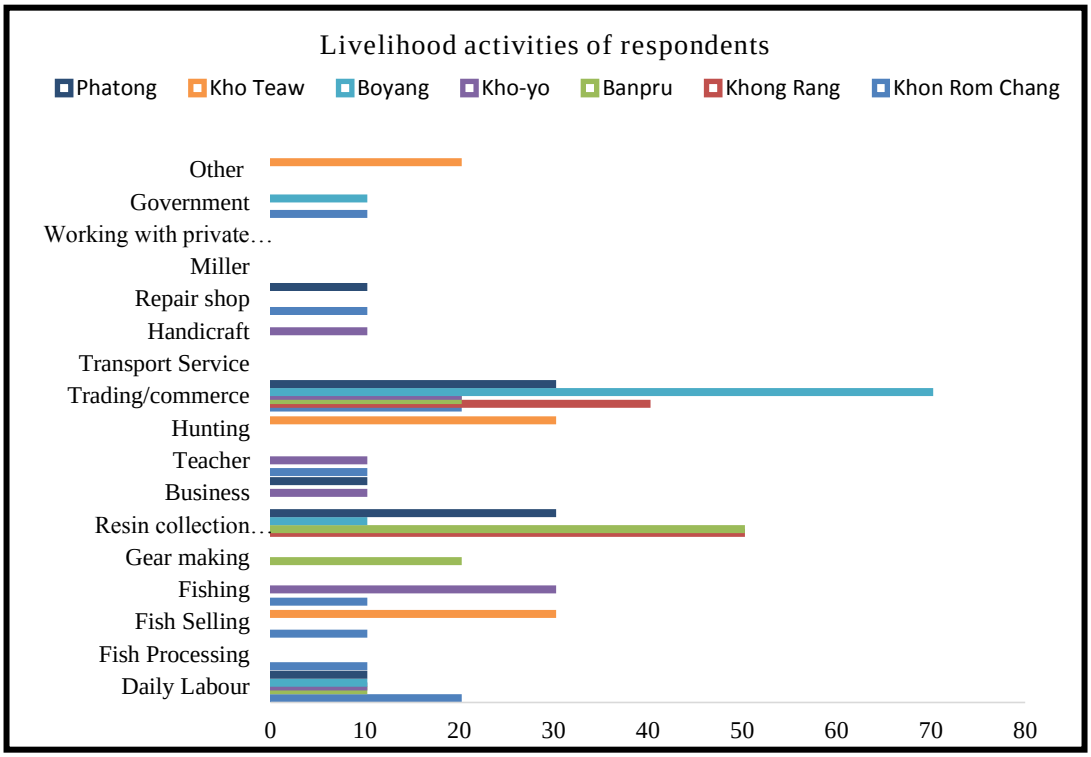

Figure 11: Livelihood activities of respondents

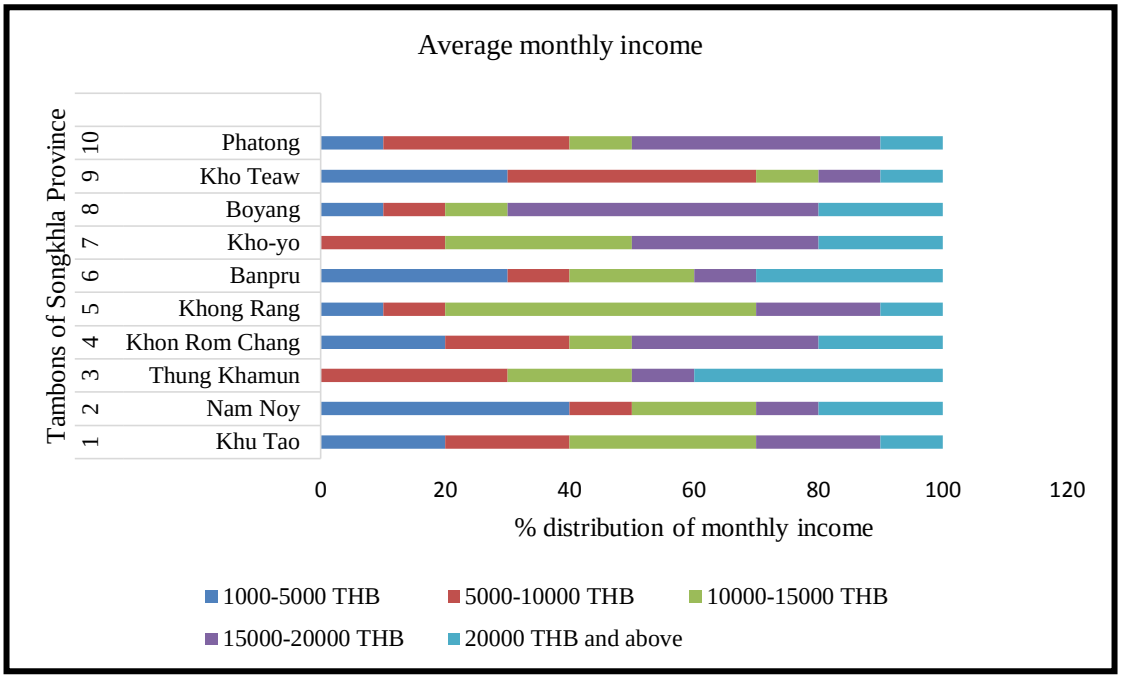

Figure 12: Average monthly income of respondents

Table 1: Major factors affecting livelihood in the Communities

Tambons	Major factors affecting livelihood in the Communities
Khu Tao	- High cost of living due to the present economic situation in the country; - Wastewater from shrimp farms, home-stay in Kho-yo and industries affect the water quality in the lake which in turn affect fish catch as well as high number of dead fishes often seen in the lake.
Nam Noy	- Economic and political situation in the country affect livelihood - Low fish catch from the lake - Unfavourable and unpredictable weather conditions - Untreated wastewater from all sources channeled into lake is responsible for low fish catch
Thung Khamun	- Low level of return on investment in agriculture - Improvement depend on government agricultural policies especially as it relates to rubber farmers - Economic situation due to fluctuations in the price of rubber in the world trading markets
Khon Rom Chang	- Lack of industry to process sea food affect livelihood of the fishing population - Low level of construction activities due to the present economic and political situations in the country
Khong Rang	- Low productivity of resin from rubber plant - Economic situation due to fluctuations in the price of rubber in the world trading markets - The challenge of subsistence agriculture
Banpru	- Lack of regular income for those in daily labour category - Issues with drug addictions, stealing and robbery - Uncertainty in the weather conditions affecting agriculture - Negative effect of current political and economic situation in the country
Kho-yo	- Current low economic activities in the country - Depletion of aquatic resources in the lake - Environmental conditions affecting coastal fishing - Regular interruption of water from municipalities water treatment plants - Insects and pest problem in the community
Boyang	- Economic situation due to fluctuations in the price of rubber in the world trading markets - Low business activities due to the present economic situations
Kho Teaw	- Issues related to weather conditions - Public health challenges in the community - Depletion of fisheries resources in the lake - Low fish catch
Phatong	- High level of unemployment - Economic down turn - Weather conditions not favourable to agriculture

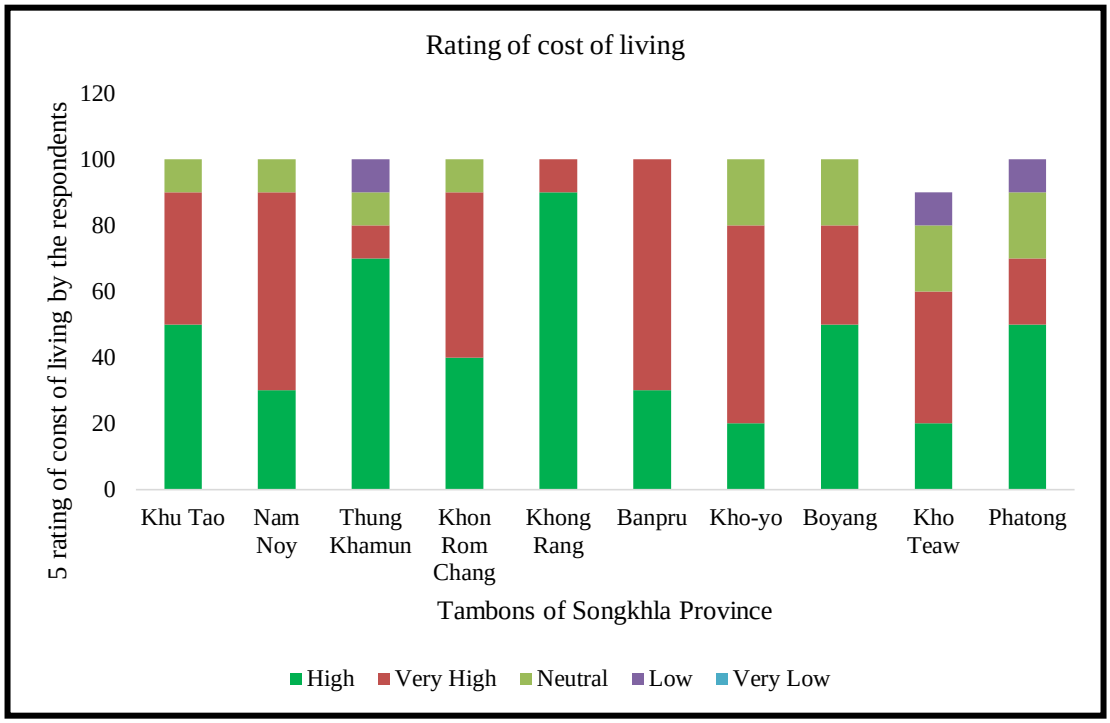

Figure 13: Cost of living in the community

3.3 Community Water Governance

3.3.1 Stakeholders' perception on SLB challenges

The respondents were asked to identify the major problems affecting Songkhla Lake based on their perceptions (Table 2) as they interact daily with in their environment. The major pressure on the lake as identified by the respondents, are issues of untreated wastewater and direct defecations into the lake, unregulated and crowded fishing lots, deforestation of mangrove forests, nutrient enrichment from agricultural (rice, rubber etc.) and aquaculture activities, etc. It was observed that the level of awareness of public policies for the protection of the SLB was very low in these communities (Figure 13). The few who were aware identified the following policy instruments that they perceived were relevant for the protection of SLB to includes *(1) control and regulations on fishing, (2) environmental conservation and pollution control laws, (3) treatment and management of industrial and domestic wastewater, (4) promotion of public health and (5) marine protection and other aquatic resources.* When asked to

comment on difficulty to achieve better compliance enforcement on relevant policies and legal instruments, they gave following reasons as being responsible *(1) low level of awareness among the people on the various environmental and related policies (2) inadequacy of current relevant and related public policies and legislation (3) lack of specific policy instruments developed for the sole purpose of protecting Songkhla Lake Basin (4) the attitude of the regulating communities to the contraventions of the provision of these instruments making it very difficult to ensure compliance and enforcement*. Involvement in community resource groups' management and other non-governmental organization activities in the communities for the purpose of protection of the SLB was found to be very low. The major community groups' activities identified during the course of the study was community cooperative societies, which has to do with saving and lending of money to their members (Table 3). There were, however, some community and environmental conservation groups in some of the communities, except in Nam Noy and Phatong where it was difficult to identify any community conservation or economic related groupings.

Table 2: The major problems affecting Songkhla Lake

Tambons	***Issues***
Khu Tao	- All the cities and communities around the lakes channeled untreated storm-water into the lake without primary treatment (screening, grit removal, etc.) - Disposal of solid waste (garbage) in the bank of the lake in almost all the communities surrounding the lake - Untreated industrial wastewater drained into the lake - Water hyacinth and siltation of the lake - Densely populated fishing tools in the lake - Fishing lots are not regulated by the relevant government agencies - The fishing communities' feel that the activities of the Kho-yo home stay are more polluting than the wastewater from the shrimp farms. - The home-stay in Kho-yo is partly responsible for the degradation of the water quality because of direct defecation and disposal of wastewater into the lakes. - They feel that it is very difficult for relevant agencies of government to regulate the activities of home-stay because according to them 'the home-stay businesses are very powerful'.
Nam Noy	- Deforestation of mangrove forest - Indiscriminate discharge of wastewater from shrimp farms - Direct discharge of untreated municipalities and cities storm-water and wastewater into the lake, especially during raining seasons - The water barrier installed between the Gulf of Thailand and the lake have also affected the water quality of the lake.

	-	Crowded fishing lots and tools
	-	Direct discharge of untreated industrial wastewater into the lake now responsible for the frequent sighting of dead fishes in the lakes.
Thung	-	Wastewater and garbage from the industries and communities
Khamun	-	Coastal erosion
	-	Deforestation
Khon	-	Wastewater from industry, home-stay and communities polluting the lake
Rom	-	Over-crowding of fishing tools in the lake
Chang	-	Coastal erosions and flooding
	-	Lack of effective solid waste management
Khong	-	Wastewater from the industry and communities
Rang	-	Solid waste from the communities
Banpru	-	Deforestation
	-	Sedimentation of the lake
	-	Too many fishing tools and overcrowded fishing lots
	-	Garbage, wastewater and industrial and agro-chemicals disposal into the lake
	-	Shallow depth of the lake due to high in-flow of siltation materials from surface run-off.
Kho-yo	-	Wastewater from the industries resulting in high number of dead fishes in the lake
	-	Wastewater from the cities and municipalities around the lake
	-	Poor solid waste management problems
	-	Wastewater from home-stay businesses and communities
	-	Direct defecation by home-stay businesses and communities into the lake.
		- The peculiar problem of Kho-yo is the issue of noise pollution from home-stay, which all the inhabitants complain about
		- Sewage pollution resulting from direct defecation by home-stay guests into the lake. These issues need to be addressed.
Boyang	-	High number of static fishing tools in the lake
	-	Obstruction of the drainage system of the lake by the erection of the barrier
	-	Presence of dead fish due to discharge of untreated wastewater from industries, municipalities and communities
	-	Surface run-off of agro-chemicals into the lake
Kho Teaw	-	Decline in resource base of the lake
	-	High density of fishing tools in the lake
	-	Wastewater discharges from industries and communities
Phatong	-	Wastewater from the industries and communities responsible for dead fishes in the lakes
	-	Lack of proper coordination amongst relevant government agencies and departments

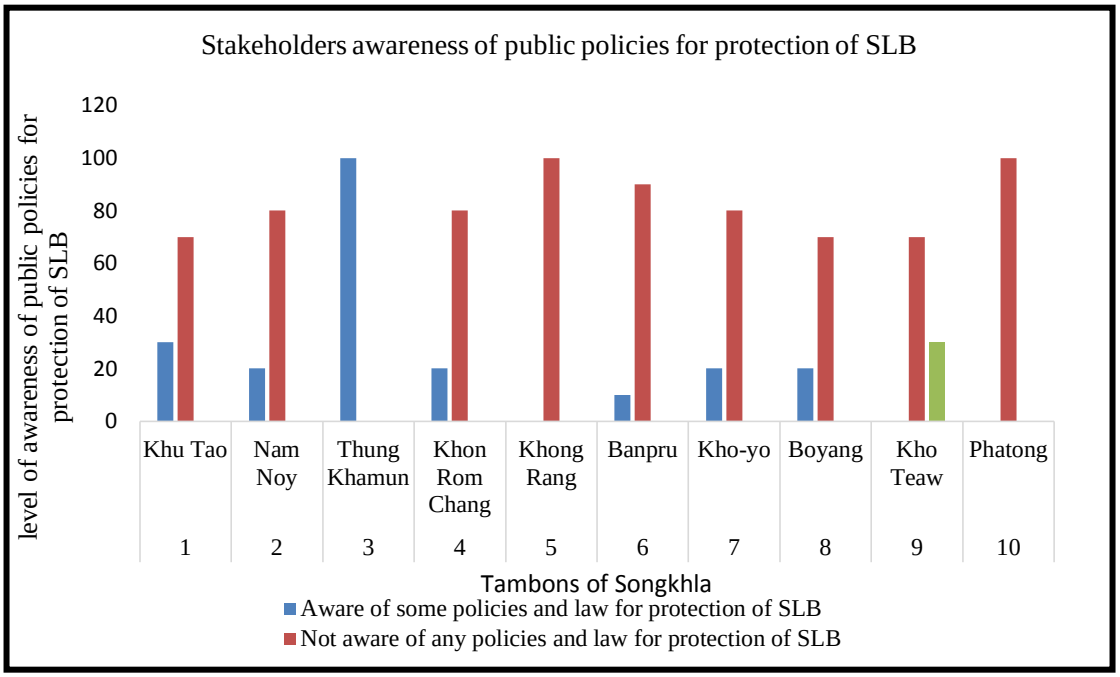

Figure 14: Stakeholders awareness of public policies for protection of SLB

Table 3: Activities of NGOs, CBOs, and community associations

Tambons	*Activities of NGOs, CBOs, community resource and cooperative associations*
Khu Tao	- Cooperative society for lending and borrowing money to support communities members - Mangrove Protection group support the conservation of mangrove forest and other aquatic resources in the lake as well as undertake environmental awareness campaigns in the communities.
Nam Noy	- None were identified
Thung Khamun	- Cooperative society for lending and borrowing money to support community members
Khon Rom Chang	- Protection and care for the elderly in the community - Environmental conservation and monitoring of water quality in the SUMRONG Canal.
Khong Rang	- Cooperative society for lending and borrowing money to support community members - Kornwit an NGO which main focus is on the campaign against indiscriminate discharge of sewage into water bodies and environmental protection.
Banpru	- Tree planting and reforestation programmes in the community
Kho-yo	- Weaving and handcraft development society which encourages weaving for making of local fabrics in the communities - Environmental protection and conservation group encourages conservation activities around the lake. They also organize seminars for the need to dredge the lake
Boyang	- Environmental protection and conservation of elephant group, their main activities is for the protection and conservation of elephant and also

		participate in environmental awareness creating in the community
Kho Teaw	-	Beach cleaning and artificial coral related activities
Phatong	-	None were identified

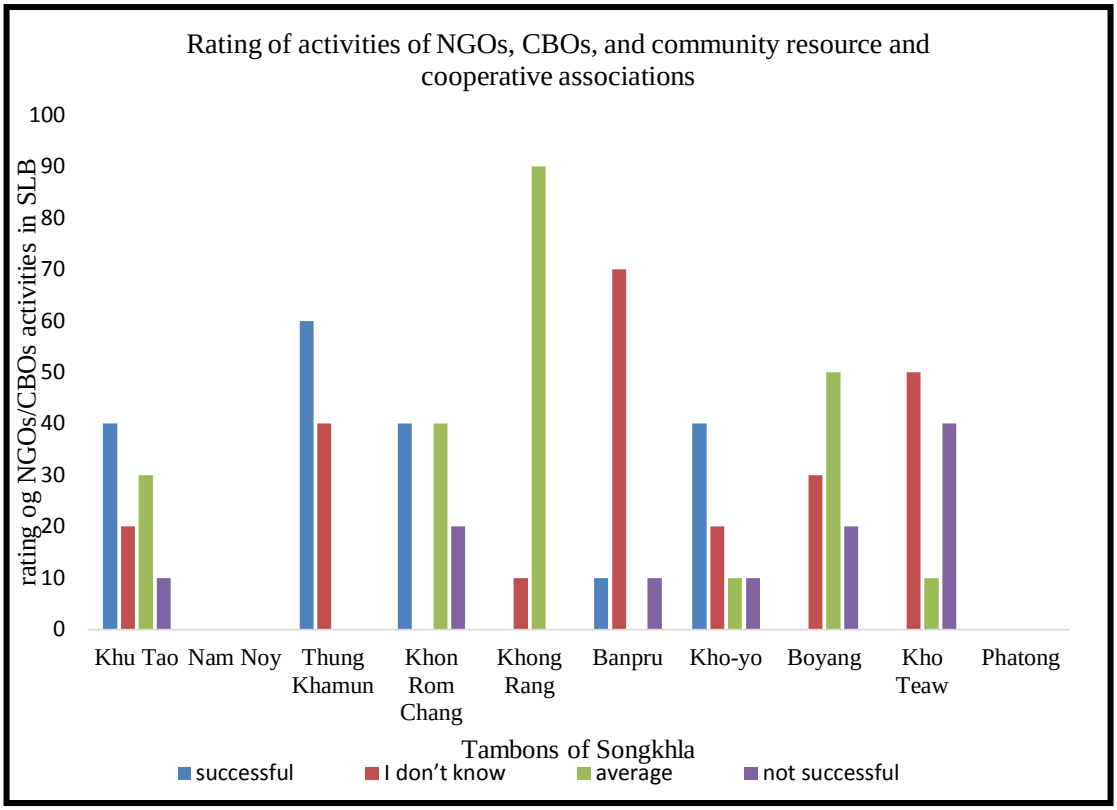

Figure 15: Rating of activities of NGOs, CBOs, and community associations

3.4 Stakeholder Perception on Songkhla Lake Basin Development Master Plan 2011-2016

The section tried to measure the level of awareness and to see if the respondents actually have a better understanding of the various issues in the SLB Development Master Plan and as well as to determine the level of support they would give for the actualization of this plan. The study reveals that the level of awareness of the SLB development master plan is very low among the members of the communities under study (Figure 16). On the issue of choosing the best actions that they think can actually

lead to improvement of the lake, the respondents made choices which are not actually in the same order as the prioritization in the SLB Reviewed Development Master Plan 2011-2016. It should also be noted that the choices of the respondents' development activities were actually based on how the needed improvement of Songkhla Lake will have a positive multiplier effect on their livelihood (Figure 17), and their willingness to support *their* priority actions was very high (Figure 18).

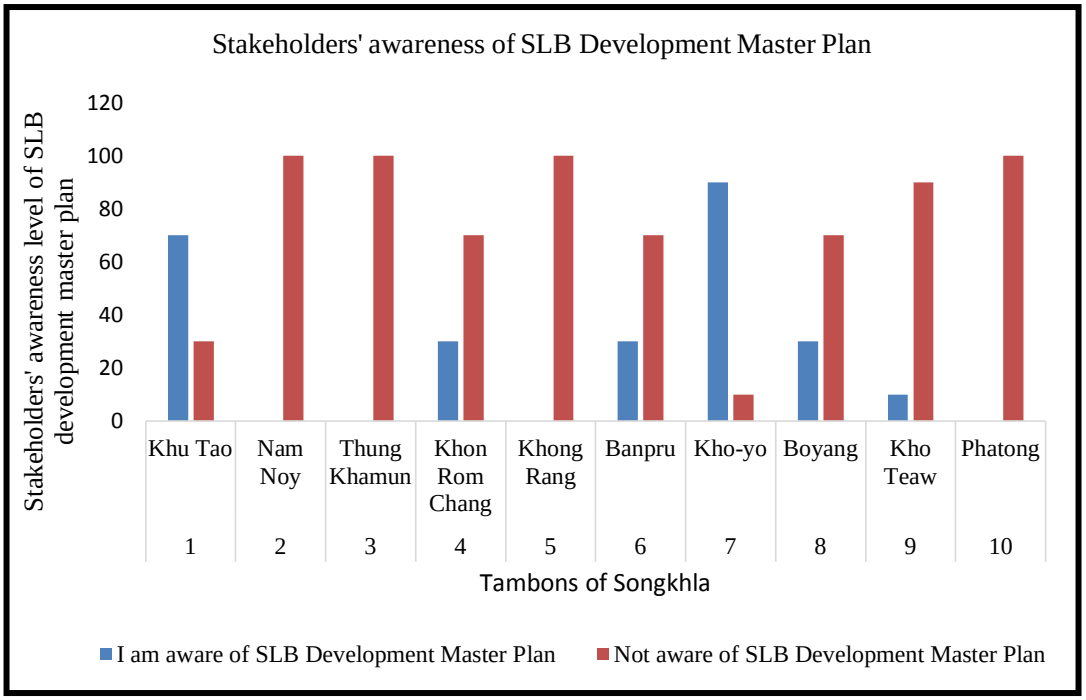

Figure 16: Stakeholders' awareness of SLB Development Master Plan

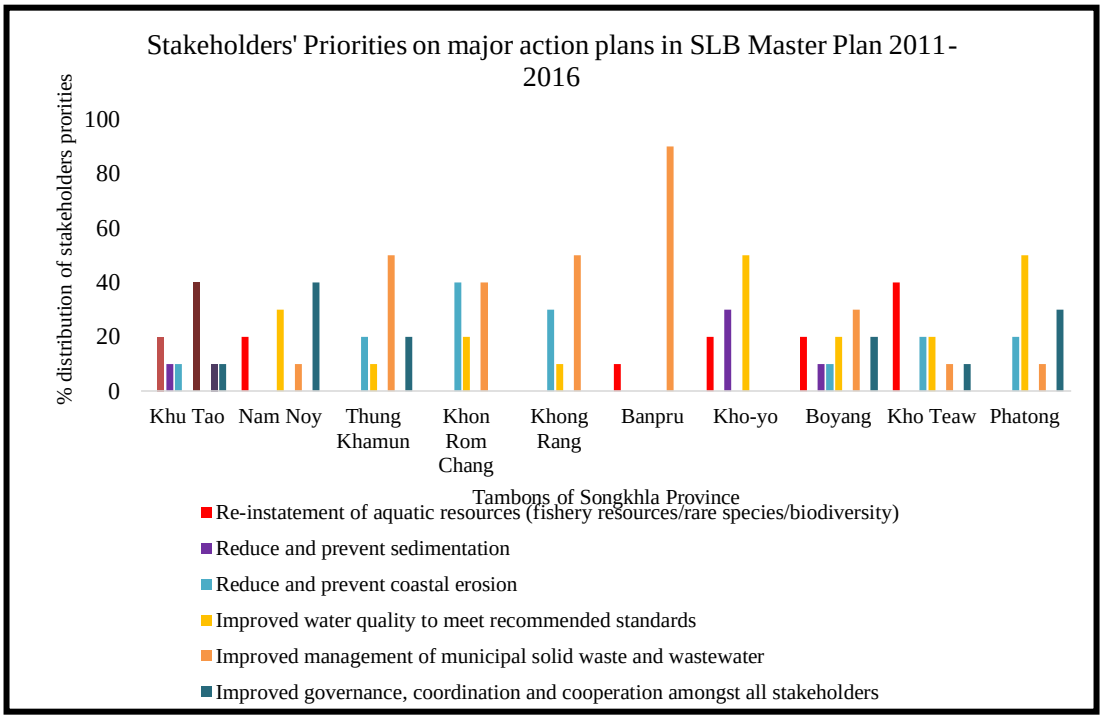

Figure 17: Stakeholders' Priorities on major action plans in SLB Master Plan 2011-2016

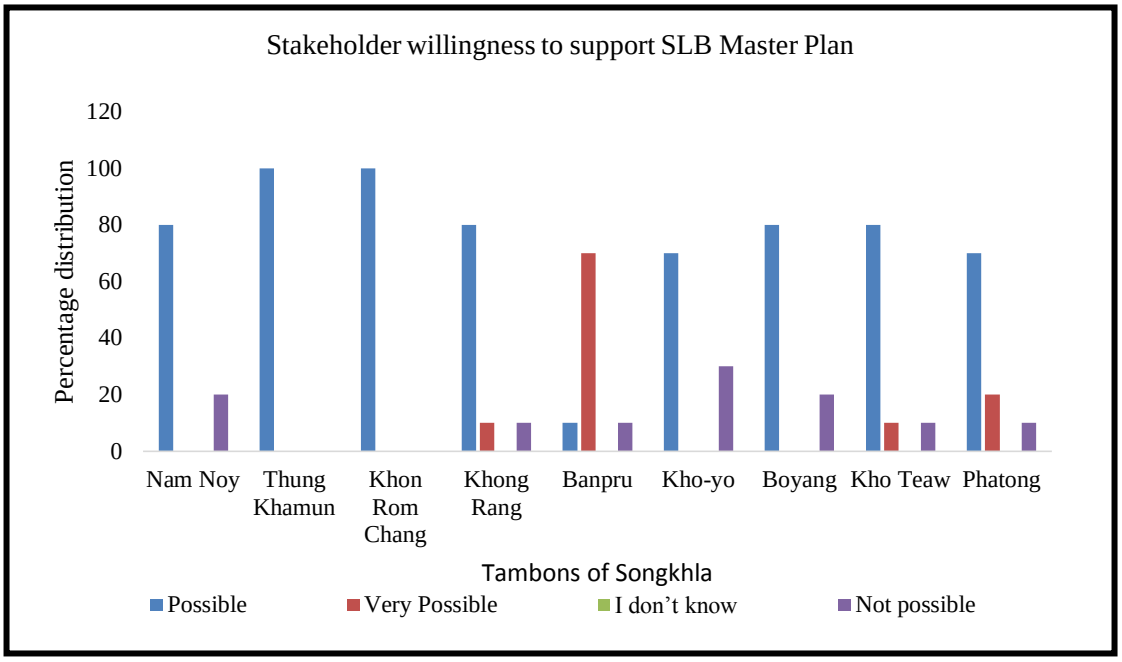

Figure 18: Stakeholder willingness to support SLB Master Plan

3.4.1 Stakeholders' willingness to support SLB Master Plan Development Activity

The respondents were asked to list some organizations that may be willing to support these actions plan and the following major actors identified were mentioned: village heads and their communities' members, relevant government agencies, Provincial Administrative Organizations (PAOs), Tambon Administrative Organizations (TAOs), Municipalities Administrative Organizations (MAOs), relevant Environment and Water Quality Regulatory agencies/department at National and Provincial level, manufacturing companies and industries operating in the SLB, Provincial Public Health office, Department of Fisheries, Ministry of Environment and Natural Resource, Garbage bank operators (solid waste recycling enterprises) in the SLB, Songkhla Port Authority of Thailand/Harbour Department, Construction industry and Fisheries groups in the communities. Though this list is inexhaustive, but it gives an idea of the level of knowledge of the respondents concerning the challenges facing the SLB and how the situation could be salvaged.

4.0 Discussion, Recommendations and Conclusion

This study has shown that the understanding of the perception of stakeholders is central to better participation and engagement. Perception is what guides actions toward the right or wrong direction (Gibson, 1966 and 1987). Perception is not a passive receipt of signal but is shaped by learning, memory, expectation and attention. It is nurtured by concept and expectations (knowledge) and selective mechanism (attention) that influences actions (Gregory, 1987 and Bernstein, 2011). When people's perception are properly understood and well-articulated into any development plan, responsibilities will be properly shared amongst the various actors, institutions and stakeholders. The key actors will seek for adequate buy-in from the people. This is what demonstrates the degree of transparency and inclusiveness of the decision-making

process. A development initiative that fails to address the issue of perceptions of their relevant stakeholders cannot cater for their wide range of needs, especially those at the risk of losing their livelihood because of the over exploitation and degradation of the resource seeking to be protected. Also, participation is a key element of measuring modern day resource governance, and since addressing the issues of perception is a major determinant of effective participation of stakeholders then we cannot continue to down-play it.

There is a paradigm shift from the stakeholders participation awareness of the 80s', the attentive era of the 90s', to the engagement era of the 21st century. But unfortunately, many experts in the field of development, especially in the government agencies, still practice awareness participation strategies. This is the greatest hindrance to up-take of solutions by the communities in natural resource governance (Krick, et al., 2005) and change of sustainability policy direction, especially those relating to the structure of the resource system and its interaction with broader society (Charles, 2004). This is because a sustainable natural resource governance system should be able to structure ways and means in which the divergent preferences of inter-dependent actors are translated into policy choices to allocate values, so that the plurality of interests is transformed into coordinated action and the compliance of actors is achieved (Eising and Kohler-Koch, (2000).

The high point of this study was the ability to gather information about the major challenges facing Songkhla Lake Basin in Songkhla province based on the perception of the stakeholders. It also brought-out the issues that are dear to the hearts of the stakeholders from the impact of the current state of the lake on their livelihoods. The study highlighted the real and perceived conflict issues within the stakeholders in each Tambon (depending on how each of their livelihood activities) in the lake basin were impacted by each other activities. It also brought out conflict issues between Tambons depending on the dominant livelihood activities in that Tambon. For instance, the residents of Kho-yo are of the opinion that the noise from the home-stay is a major public health issue in the community. The fishing community of Khu Tao feels that the home-stay at Kho-yo have more polluting effect than wastewater from the shrimp

farms in Songkhla Lake, which in turn affects their livelihood negatively. They also perceived that it is difficult to regulate the home-stay activities because of their influence and status in the community (Table 2).

The results also showed that majority of the stakeholders were not aware of the SLB Development Master Plan (Figure 16) and would support if given the opportunity (Table 4) their own priority actions for the Master Plan Project and their priority action for the sustainability of the lake was quite different from the order of prioritization in the development plan. Stakeholders did not really consider all the recommended actions as being essential for the sustainability of the lake, now their perception may not be right, but that is how they see it.

Table 4: Stakeholders' priority actions for the SLB Development Plan

SLB Development Plan Activity Prioritization	*Stakeholders Activity Perception Prioritization*
Improved terrestrial forest	Improved management of municipal solid waste and wastewater
Improved peat swamp forest	Improved water quality to meet recommended standards
Re-instatement of aquatic resources (fishery resources/rare species/biodiversity	Improved governance, coordination and cooperation amongst all stakeholders
Reduce and prevent sedimentation	Reduce and prevent coastal erosion
Reduce and prevent coastal erosion	Reduce and prevent sedimentation
Improved water quality to meet recommended standards	Re-instatement of aquatic resources (fishery resources/rare species/biodiversity)
Improved management of municipal solid waste and wastewater	
Improved governance, coordination and cooperation amongst all stakeholders	

In conclusion, the stakeholders suggested the following additional actions that should be taken to improve the sustainability of the Songkhla Lake Basin:

1. *Dredging for the removal of sediments from the lake to improve its depth*
2. *Dredging of the lake for improvement of transportation as a source of tourist attraction and income generation*
3. *Lake shore protection all around the lake communities with adequate system of drainages installed with primary wastewater separating system and grit removal before wastewater are drained to the lake*
4. *Installation of treatment systems for all storm-water entering the lake, especially the use of wetland wastewater treatment system*
5. *Dialogue with the fishing communities on how to improve fishing activities in the lake without damaging and destroying the aquatic resources and quality of the lake water*
6. *Carry-out special activities targeting the garbage bank operators and municipal cities' solid waste collectors for the purpose of achieving 80 percent solid waste collection rate in the SLB as against less than 30 percent collection rate in the whole of SLB*
7. *Using the communities' leaders to spread the message through their communities' monthly meeting and use of the community radio*
8. *Empowerment of the communities around the lake for self-management and protection of the lake*
9. *In the case of Kho-yo Home Stay, the respondents suggested that the issue of land ownership needs to be properly addressed so that proper investment can be made to improve the infrastructure of their business which will also address the current sanitation challenges they face.*
10. *There was also suggestion for development of improved and appropriate sanitation devises that will be suitable for the home stay business location; technology like sewage holding tanks and other technological option should be considered*

11. *One of the law enforcement officers interviewed stressed the fact that there is enough laws if properly enforced could improve the quality of the lake, but also called for better awareness creation among the people on the various relevant laws and policies for the protection of the lake*
12. *Enlisting the support of the community leaders in this area cannot be over-emphasized*

Since, developing the right perception is fed and nurtured by proper education and information, which will cause people to act in a proper manner required of them. We cannot act in the Arnstein (1969) *'tokenism'* and expect the people to develop the right perception that will produce the right resource governance actions. We should adopt Connor, (1988) '*a new ladder of citizen participation'* with the purpose to provide a systematic approach to molding stakeholder perception based on the right knowledge achieved through a well thought-out public education and information programming. This new ladder includes: (1) e*ducation, which is the foundation of any programme to prevent and resolve public controversy (2) information feedback (3) consultation (4) joint planning (5) mediation and in extreme cases (6) litigation and (7) resolution/prevention of conflict.* This is the right way to enhance the public perception that will ensure sustainable governance of natural resource of the Songkhla Lake Basin.

Superficially, it may seem that the communities in the SLB do not care about the deplorable state of the lake and are not supportive of several efforts to put the lake back on the part of sustainability. But, this is not true as the result of field work has shown that the people are worried about the gradual demise of their beloved SONGKHLA LAKE. If you think these people don't care about 'their lake' how then can you explain the light you see shinning every night in the middle of the lake? You may just conclude that the fishermen and women use the light for fishing but that is not the whole truth. They light the lamps for beautification of the lake in the night. The Home Stay businesses are very worried about how to solve the sanitation challenge their business

poses to the environment of the lake. Even if their ideas may lack any sound scientific reasoning, they are worried and looking for a way out of this sanitation challenge because their livelihood depends on the sustainability of the lake. Besides, it is wrong for anyone to assume to know more about the lake than those who live with it everyday, have witnessed and experienced its different moods and aura, hold treasures of the past 100 years of the lake passed down to them through ancestral lines, and know the deep secrets of the lake through a long-term relationship. To them, the SLB is a friend, a parent-a living support and pillar. Therefore, to understand and move SLB towards sustainability, will essentially require the insight of the perception of these gate keepers. Conclusively, we need to include the perception of the communities in SLB into the development plan for proper stakeholder participation.

See Reference

APPENDIX III

SUPPLEMENTARY PAPER II

Governing Songkhla Lake Basin, Thailand: the requirement for adaptive integrated lake basin management

This chapter is adapted from:

Paper Presented at the 1st National And 2nd International Conference on Ecotourism and Social Development for ASEAN Community, 22-23, January, 2015 at 100 Islands Resort and Spa (Roikoh Hotel) Muang District, Surathani Province, Thailand

Abstract

This paper examines the institutions of water resource management and governance of Songkhla Lake Basin (SLB) and the requirement for the implementation of the adaptive integrated lake basin management (AILBM) as solution to address the challenges of institutional fit in the Basin. A number of water resources management policies and legislation have been enacted in Thailand which cut across the administrative and hydrological boundaries giving rise to lots of institutional fit challenges in the Songkhla Lake Basin; thus, creating a multilevel, traditional top-down and *one-size-fit-all* institutional framework leading to mismatch of the management and governance instruments. We believe that to achieve 'fit', the Adaptive Integrated Lake Basin Management (AILBM) institutional diagnostic and analytical framework should be deployed to critically examine the existing relevant and related institutional framework of SLB to determine their 'fit' status. The result of this exercise will come out with the required adjustment needed for improvement of the existing institutional instruments and make them fit for the SLB.

Keywords

Lake Basin; governance; institution; legislation; enforcement; regulation

1. Introduction

The advocacy for a shift from the traditional command and control to integrative and adaptive forms of management is designed to reduce the unique problems of bureaucratic bottlenecks of hierarchical management institutions and enhance resources management decisions under uncertainty. In other words, a move towards an adaptive and integrated approach reflects the need for a better way to solve the overlapping and fragmented institutional problems of the water sector (Engle et al. 2011). The traditional governance approaches result in governing bodies representing conflicting interests with policy objectives that lack consideration of implications on water users and without consultation across sectoral and institutional boundaries (Jønch-Clausen and Fugl 2001).

The Adaptive Integrated Lake Basin Management (AILBM) is derived from three concepts: Integrated Water Resources Management (IWRM) developed from the first UNESCO International Conference on Water in 1977 (Medema et al. 2008), particularly concerned with the integrated and coordinated management of water and land to meet social and ecological needs and promoting economic development (odendaal 2002, Wallace et al. 2003, Jonker 2002); the Adaptive Management (AM) from the early work of Carl and Walters (Walters and Hiborn 1978), stems from the recognition that even though interactions between people and ecosystems are inherently unpredictable (Gundrson et al. 1995, Hebron 2003), there is the need to take management decisions and actions by learning (Shea et al. 1998, Johnson 1999); and the Integrated Lake Basin Management (ILBM) (ILEC 2007), which assist lake basin managers and stakeholders' to achieve sustainable management of lake basins by taking into account the biophysical features and managerial requirements of lake basin systems (ILEC 2005, 2011, RCSE and ILEC. 2014).

In this paper, we defined lake basin governance as a process of interaction and collaboration for the purpose of decision making among various actors in the basin

aimed at proffering sustainable solutions to common problems of resource use and preservation of the ecosystems of the lake basin. To achieve this objective requires that governance instruments of lake basins account for all issues, actors and hydrological characteristics (integrating nature, long retention time and complex response dynamics) of the system to ensure sustenance of the basin, and going forward will require the adoption of what we call the Adaptive Integrated Lake Basin Management (AILBM). The AILBM concept is based on a combination of organizational management (adaptive) and governance (integrated) system capable of critically diagnosing the institutional challenges of lake basins and also proffering of adequate solutions (Pahl-Wostl 2009, Pahl-Wostl et al. 2010, ILEC, 2005, RCSE and ILEC, 2014). Institution is used here to mean the body of rules, regulations and processes that guide management and are often behind the causes of environmental problems and hence, plays a very important role in solving them (Kalikoski, et al 2002, Young, 1999, 2002, Ostrom, 1990, 2010, North, 1990, Scott, 2001).

The challenges facing the sustainable management and governance of lake basins' resources are broad spectrum, complexly intertwined in nature, and quite encompassing. These crisis ranges from over-utilization, water quality deterioration, siltation, acidification, contamination, eutrophication, and the complete collapse of aquatic ecosystems in extreme cases (World Bank, 1997, 2005, ILEC, 2005, 2007, RCSE and ILEC. 2014, Jorgensen 1997). Resolving these challenges will require innovating approaches. Ballatore and Muhamdiki, (2001) noted that although scientific knowledge about the cause and effects of stressors on lakes are available, the effective management and governance policies and institutions have lagged behind and studies on water governance of lakes and their basins are very scanty and in most cases absent. Also, several studies revealed that lakes have not received sufficient attention in the global water policy and governance discourse (World Bank, 1997, 2005 and ILEC, 2005, Cosgrove and Rijsberman, 2000). Therefore, the objectives of this paper is to review the current institutional frameworks that govern and regulate water resources in SLB, assess their impact on the overall sustainability of the lake basin and recommend actions for their improvement.

2. Case study background

Situated in southern Thailand and spread across three provinces, including all 11 districts of Phattalung, 12 (of the 16) districts of Songkhla and 2 (of the 23) districts of Nakhon Si Thammarat and with more than 1.7 million population (NSO, 2012), the Songkhla Lake Basin (SLB) extends around 150 km from north to south and around 65 km from east to west. It covers approximately 8, 729 km^2, consisting of approximately 7,687 km^2 of land area and approximately 104 km^2 of the lake's area (Ratanachai and Sutiwipakorn 2005). This complex ecosystem is rich in biodiversity with multitude of flora and fauna species. The major economic activity in the Basin include; rubber plantations, paddy rice farms, fruit tree orchards, fishery, aquaculture husbandry and a high attractive tourism potential (Tanavud et al., 2000).

The major challenges of the SLB are issues of land degradation and water pollution caused by land use changes and shrimp farming expansion. There is also a broad range of water resources development and management problems combined with coastal zone management. Water shortage is a problem in the entire area, especially affecting water supply and the agricultural sector (GWP, 2012). Other stressors include overexploitation of the rich natural resources and serious environmental pollution resulting from human and industrial activities; depletion of biodiversity, devastation of life supporting systems, deterioration of water quality, depletion of fishery resource, shortage of fresh water in dry seasons, diminishing ground water supplies, inadequate village and urban water supplies, floods and erosion, plus social conflicts in water and other resource uses (Ratanachai and Sutiwipakorn 2006, Pornpinatepong 2010, Chesoh and Lim, 2008, ONEP, 2013).

3. Governance of Songkhla Lake Basin (SLB)

3.1 National Institutions and Organizations

Water management and governance in SLB are directly coordinated from the central government's ministries which supervises more than thirty national centralized-decentralized departments (agencies) with various roles in water resources

management. The centralized-decentralized departments through the policy of deconcentration delegate their responsibilities to the SLB provincial/regional decentralized department offices under the direct supervision of the provincial governors who is a career civil servant with the Ministry of Interior (MOI) (Nagai et al. 2008) (figure 2). The three most dominant ministries in terms of water management are the Ministry of Agriculture and Cooperatives (MOAC), the Ministry of Natural Resources and Environment (MONRE), Ministry of Industry (MOI) and Ministry of Interior (MI). Other ministries with tasks related to water resources in the Basin include Ministries of Energy, Public Health, Social Development and Human Securities and Tourism and Sports. Each of these ministries operate through their regional offices in the Basin. At the policy development and coordinating level, several committees play important roles relating to water resources management. These include the National Economic and Social Development Board (NESDB), Office of Natural Resources and Environmental Policy (ONEP) and National Environmental Board (NEB) (Biltonen et al. 2001, Biltonen 2011).

There are at least 28 water related laws administered by over 30 departments overseeing water issues in the eight ministries (Biltonen et al. 2001, Biltonen 2011). The laws governing water resources are directly or indirectly, derived from some basic legal texts, traditional and customary laws and/or from special laws regulating one or more uses of water. A single law may regulate more than one aspect of uses (Sukhsri, 1999, UN-Water/WWAP, 2007) (figure 3, table 1). Water resources management in the SLB is complicated by gaps and overlaps in management responsibilities because of many government agencies and private parties involved in the development and exploitation of the surface-water and ground water resources. The coordination and cooperation between the different parties are very weak. In order to address these challenges, the government established the National Water Resource Committee (NWRC) in 1996, co-ordinated by the Department of Water Resources (DWR), though formally under the Prime Minister Office (DWR, 2006, Kanjina, 2008).

The turning point in the management of natural resources in the country was the introduction of decentralization policy of natural resources management of 1997

Constitution (KOT, 1997) and the National Water Resources Management Policy was formulated in 2000 (Wongbandit 2005; Hirsch et al. 2005; WWAP, 2007; Sethaputra et al. 2001). Tan-Kim-Yong, et al (2003). The Thai 1997 Constitution makes provision for communities to be involved in managing natural resources. This was further re-echoed in the 2007 Thai Constitution with the provision that the public shall have the opportunity to participate in the development of policies and rules governing the use of natural resources. Another important policy instrument is the National Development Plans (NP) by NESDB, which set the direction for the development pattern of the country. The aim of the first development plan on water resources management was to respond to the demand for water in agricultural and other economic activities by emphasizing supply-side management (Sethaputra et al. 2001). Doungsuwan et al., (2013) noted that even though the direction of development has changed since National Development Plan eight (NP8), the development under these plans continue to negatively impact the SLB because much focus is on resource utilization.

3.2 Basin Central Government Ministries and Decentralized Departments

The direct management and governance of SLB are the responsibilities of provincial/regional offices of the central government ministries and decentralized departments under the direct supervision of the provincial governors. Water resources development, management, allocations and quality control activities are undertaken by the Department of Water Resources (DWR), Royal Irrigation Department (RID), Groundwater Resources Department (GRD) and Pollution Control Department (PDC) regional offices located in the SLB. The DWR is the main state agency responsible for coordinating surface water resources planning, development, conservation and protection in the SLB through their regional office. DWR directly supervises the operations of the Songkhla Lake Basin Committee (SLBC), for the implementation of the integrated water resources management programmes in the Basin. The RID is responsible for the allocation of water to farmers for agricultural purposes through

various irrigation schemes. Irrigation water is taken mostly from the diversion from the tributary streams and by pumping from the Lake at Ranot (Bamroongrugsa 1998, ONEP 1997, 2005, 2008, 2011). Small scale irrigation projects are constructed by RID and at completion projects are handed over to the Tambon Administrative Organizations (TAO), which makes decisions on operations and maintenance and regular visits and inspections are carried out by the Provincial Irrigation Office (PIO) for structurally and hydraulic failures.

The Department of Groundwater Resources (DGW) regional office in the Basin oversees the development and management of groundwater resources. The groundwater resources in the SLB are located in three major aquifers: shallow sand aquifers, deep gravel aquifers and the groundwater in rock contained in fractures or solution cavities (ONEP 2011). Groundwater resources in the Basin are accessed through shallow hand dug wells for rural water supply. Deep wells are mostly used by private, commercial and industrial plants in the basin. There are also private groundwater irrigation projects for some private farm holders use, especially by rubber, paddy rice and oil palm nurseries as well as for vegetable farms in the Basin. It is estimated that groundwater provides domestic water for an estimated 60 percent of the population in the SLB (Bamroongrugsa, 1998, Kongthong and Ratanachai, 2012).

Provincial Waterworks Authority (PWA) is responsible for the development and management of municipal urban water supply facilities located at Hat Yai, Songkhla, Phatthalung, Sadao, Patong, Plangla and Cha-uat. The PWA offices in the Basin report to the PWA in Bangkok and the revenue derived from water supply services are used for the operations and maintenance. Water supply schemes in smaller cities are operated, maintained and managed by the respective Municipality Administrative Organizations (tessaban), which report to the Provincial Governors. The village waterworks are managed by the Tambon Administrative Organizations (TAO); their budget derives from the local taxes and budget support from the central government. Wastewater and sanitation responsibilities is under the local government administrations (KOT, 1991, Nagari et al. 2008), which are subject to direct supervision by the relevant central government agencies regional offices in the Basin.

3.3 Basin Management Committees

The Songkhla Lake Basin Development Committee (SLBDC) was established in 1993 as an inter-agency coordinating body by the Office of Natural Resources and Environmental Policy and Planning (ONEP). The mandate of SLBDC is to formulate policies for conservation and restoration of natural resources and environment of the Basin. This Committee contributed immensely to the development of various master plans and other resource conservation projects and programmes in the Basin (ONEP 2011). Songkhla Lake Basin Committee (SLBC) was established in 2007, as a coordinating body for integrated water resources management in the Basin by the Department of Water Resources (DWR) (Uraiwong, 2013). They are charged with the responsibility to develop basin-specific programs in close consultation with stakeholders. SLBC has three working groups: integrated river basin planning, information and public relations; and participation (DWR, 2006). The working groups provide advice regarding water resource management, coordinate basin activities with other government agencies, determine the priority and allocation as well as monitoring and evaluation (DWR, 2006, Kanjina, 2008).

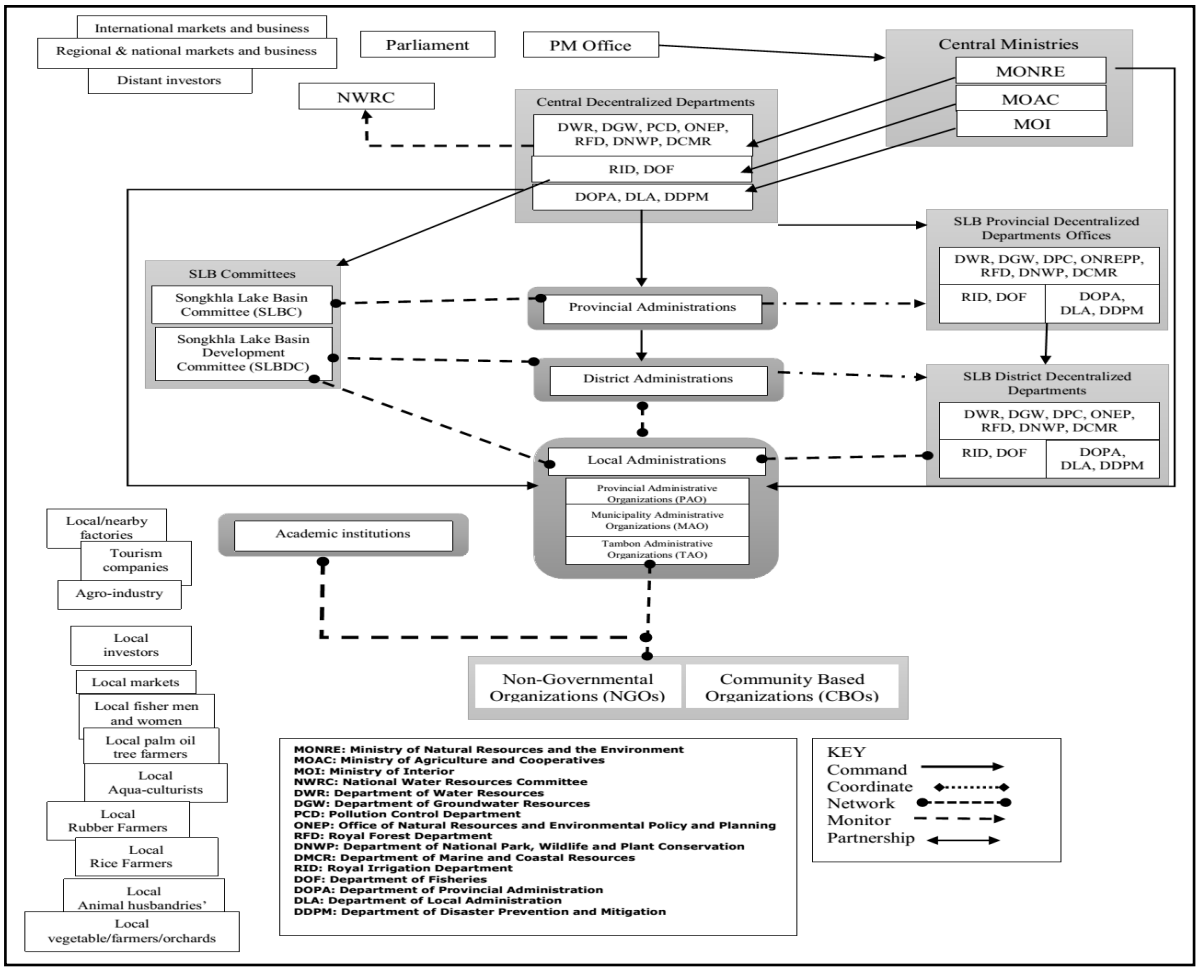

Figure 2: Institutional Actors in Songkhla Lake Basin

3.4 Basin civil society organizations

There are active civil society organizations involved in the development activities in the Basin. One of the major actors are the Water Users Association which partner with RID in the issues of irrigation. They play a key role in negotiating water allocation for its stakeholders according to farmers' planting schedules and help in settling water allocation disputes and irrigation canal maintenance and dredging (Kamnerdmanee, 2011, cited in Kumnerdpet, 2011 and Semmahasak, 2013). Others are the Songkhla Lake Basin Board (SLB Board), which is an active and entrepreneurial civil society organization (Kongthong and Ratanachai, 2012). The Tambon Ta-Hin Community Council with the main objective being to advocate against

illegal fisheries activities in the Lake. Others are the Ruk Thale Noi Fisherfolk Society responsible for stopping illegal fishing for natural restoration (Kongthong and Ratanachai, 2012). There are also numerous cooperatives and thrifts societies, mangrove protection groups, weaving and environmental protection and conservations of elephant groups actively involved in the conservation and protection activities of the SLB.

4. Challenges of Governance in Songkhla Lake Basin

4.1 Lack of support for growth of Basin Governance

The major challenge of water resources management and governance in the SLB is the strong national focus with little for on actual development of the local and Basin institutions. The line ministries and agencies follow their own separate lines of authority, creating barriers to proper integration resulting in problematic overlaps and fragmentations among the actors, which affects effective coordination and collaboration among the actors. The centralized-style management with emphasis on individual ministries and department missions makes it difficult to assign direct responsibility for SLB development to any particular agency of government (ONEP 2011). SLB problems identification are usually through the official mandates of centralized ministries and agencies, with little input from the Basin stakeholders. Even though by regulation and administrative directives, the central government agencies officers in the provincial/regional offices are under the direct supervision of the Provincial Governors, they are, however, more accountable to their higher officers in the main offices in Bangkok because of the benefit of career progression and other related incentives. Thus vertical accountability and interactions tend to take more priority than the horizontal communication and this hampers decentralization (Thomas and World Agroforestry 2005).

4.2 Emphasis on Resource Over-Utilization

The resource utilization priorities of the legal instruments in SLB contribute to the degradation and deterioration of the environmental quality of the ecosystem. One of the earliest legislation in Thailand applicable in the SLB was the Fishery legislation on the Water-Duty Act of 1862 designed for the purpose of harnessing fishery resources (Iwasaki and Shaw 2010). In 1913, the Conservation of Public Water Supply Canals and Eradication of Water Hyacinths Acts was enacted for the promotion of agricultural activities and this was closely followed by the Maintenance of Canals Act, 1904, People's Irrigation Act, 1939, State Irrigation Act, 1942 and Fisheries Act, 1954. The objects of these laws were targeted at resource exploitation but not necessarily for water resources conservation and management.

Also, the construction of the Pak Ra Wa canal water gate in 1956 by the RID was in order to preserve freshwater for paddy rice fields to avoid salt water intrusion. However, this closure hindered the exchange of water between the Lake, resulting in the lower salinity level and the hydrological change, especially in the Thale Noi, which affected many natural resources (Iwasaki and Shaw 2010). The construction of the Ranod Irrigation Pumping station was for the purpose of pumping freshwater in Thale Sap Songkhla exclusively for the expansion of agricultural activities. This resulted in the cases of over-pumping of freshwater from the Lake on an average of 58,000,000m^3 per year for irrigation of the paddy rice farms. Groundwater extraction from Hat-Yai Basin alone is estimated at approximately 35,000,000m^3 per year or approximately 96,000m^3 per day (Ratanachai and Sutiwipakorn, 2006).

The introduction of extensive and semi-intensive shrimp aquaculture in the Basin in 1970, also affected many paddy fields in the fringes of the Lake as there were converted to shrimp farms (Ratanachai and Sutiwipakorn, 2005), causing severe damages to the lake ecosystem. Deforestation and illegal logging set in by conversion of forest lands to rubber and oil palm plantations (Suviboon et al. 2007). The accelerated growth of shrimp aquaculture and increase in the rubber plantations between the period of 1982-1996 was a result of promotions by the National Plan (NP4 to NP7) because the policy favoured the conversion of forests to rubber plantations and

government offered certificates of ownership to rubber farmers (Tongrak, 2003). This resulted in an increase in the number of shrimp farms in the Basin from 3,491 ha in 1982 to 7,799 ha in 2000 (Tanavud et al., 2001) and 9,628 ha in 2011 (IRCNE, 2010). Also, from 1982 to 1984 the number of rubber plantations increased because of this policy. Therefore, it can rightly be assumed that the main objectives behind most of the decisions of the actors where for the purpose of exploitation of resources and not for conservation and management.

4.3 Local Administrative Organizations (LAOs) Budget and Skills Constraints

The constraints of budget challenges the ability of Local Administrative Organizations (LAOs) to incorporate more environmental and natural resources management issues into their annual plans, especially in low resources jurisdictions, coupled with pressures for infrastructural development from their constituents. The challenge of low capacities, lack of skills and relevant information of the LAOs tend to undermine water resources management in the Basin, despite the fact that mandates are in place for communities and LAOs to increase their role and participation in natural resources governance. There is also the problem of formulating meaningful natural resource and environmental management plans and how to create the needed awareness for the stakeholders to buy-in and make such plans top priorities at the Basin level. This study revealed that the current focuses of most LAOs in the area of environmental management are issues of garbage disposal and sewage evacuation services.

4.4 Uncertain Future of Basin Committees and Other Initiatives

The stakeholders are of the opinion that there is uncertainty for the future of the two basin management committees because both have conflicting mandates, similar roles, functions and status. They also complained that the presence of the Songkhla Lake Basin Development Committee (SLBDC) established by the Office of Natural

Resources and Environmental Policy and Planning (ONEP) and the Songkhla Lake Basin Committee (SLBC) established by the Department of Water Resources (DWR) of the same Ministry of Natural Resources and Environment (MONRE) creates lot of confusion and a sense of uncertainty among the stakeholders.

4.5 Challenge of Coordination of Local Administrative Organizations (LAOs)

The large number of Tambon Administrative Organizations (TAOs), approximately 200 of them in the SLB, in addition to the Provincial Administrative Organizations (PAOs) and Municipality Administrative Organizations (MAOs) spread through the three provinces (Phattalung, Songkhla and Nakhon Si Thammarat) with different jurisdictional mandates on natural resources management, water supply, wastewater and sanitation services create serious coordination challenges in the Basin. During the field work, we noticed a lot of buck passing among the LAOs, especially in the area of intervention on sanitation related issues on the Lake. For instance, a survey of 2000 households in the SLB conducted by us in first quarter of 2014 pointed out that indiscriminate discharge of wastewater from industries, shrimp farms and sewage from households as well as pesticides, herbicides and fertilizers from non-point sources were the major water quality problems in the Songkhla Lake.

We sought to find out from the LAOs with jurisdictional mandates on these issues what their various management strategies were. The LAOs farther from the Lake referred us to the LAOs much closer to the Lake as the issues were not within their jurisdictional locations. The LAOs nearer to the Lake were of the opinion that the Provincial Governors who have higher mandates and capacity to address provincial-wide environmental challenges and bigger budget were better to handle the issues. To address this issue will require the collaborative efforts of all actors from both the central government lines ministries and decentralized departments, provincial governors' offices and the LAOs (TAOs, PAOs, MAOs); meanwhile coordinating this multi-level actors is easier said than done.

4.6 No specific institutional framework for Songhkla Lake Basin

The existing laws related and relevant to water and other natural resources management and governance are very old and may be based on conditions that no longer exist (Biltonen et al. 2001, Biltonen 2011). For instance, there are no comprehensive water resources legislation, no specific laws with reference to Songkhla Lake with detailed provisions for its management and governance, and no legally authorized agency responsible for the SLB. The stakeholders' survey confirmed that the natural resources laws are not adequately tailored for the protection of the lake and that may the reasons law enforcement difficult to achieve.

4.7 Challenge of Stakeholders Participation in Basin Committees Activities

Stakeholders are very willing to support resource management and governance in the SLB as well as priority actions of the SLB master plans, but they are not given the opportunity to participate in such activities. For instance, the 34 members of SLBC have only 7 members drawn from the communities and they must be experts, the rest are drawn from central government ministries and agencies. In the case of SLBDC with 28 members, only 6 are community representatives, the rest are drawn from the government establishments. This is capable of denying non-expert Basin community members with reasonable experience and traditional knowledge the opportunity to participates, which makes community participation very challenging. It could also, defeats the purpose of envisioning improved stakeholder participation, which is the cardinal point of adaptive and integrated management approaches.

5. Implementing an Adaptive Integrated Lake Basin Management in Songkhla Lake Basin

The challenges of the SLB are so broad that it will required an innovative management approaches to regain the lost grounds that will reduce and prevent

resource-based conflicts and facilitate wise use of natural resources (Iwasaki and Shaw 2010). The adoption of the AILBM in the SLB will require the reforming of the existing institutional framework (Garmestani et al. 2013). AILBM is an approach of lake basin governance that is designed to be gradual, continuous, holistic, systemic and integrative in nature, and is capable of ensuring resilience, flexibility, adaptability, active participation of all stakeholders, also, equipped with effective and efficient decentralized systems with adequate feedback mechanisms, which is capable of accounting for the resource management systems designed to achieve institutional fit. In other words, the institutions that govern lake basins should capture the synergistic-linkages of the major components of the ecosystem (Walker et al. 2002) (See Chapter 3).

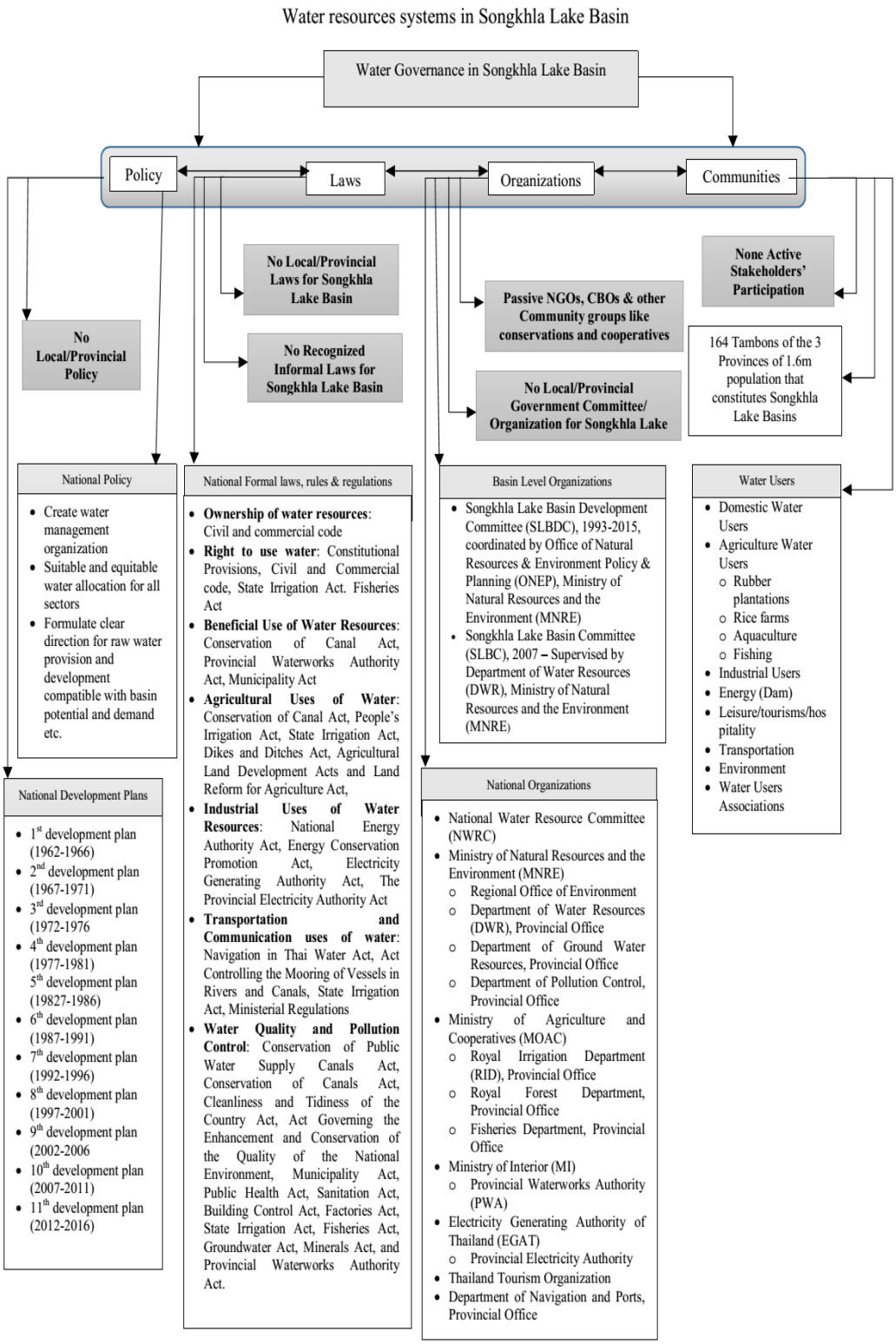

Figure 2: Components of water governance in Songkhla Lake Basin

The purpose is to support an institutional fit of lake basin governance that is capable to manage basin communities' activities in a manner that promotes better livelihoods without disrupting the social ecological systems and at the same time improves the design and implementation of management programmes that are resilient and adaptable (Holling, 1978, Walters, 1986, Lee, 1999, Wallace et al, 2003, Jonker 2002, Huntjens et al. 2010). In this paper, an institutional fit of lake basin governance is that which reflects a management and governance system that performs well over time and is robust in relation to external influence, shock and perturbation because of the synergistic linkages between the social and the ecological systems (Vatn and Vadeld 2012, Folke et al 207, Galaz et al. 2008, Ekstrom and Young 2009) (see Chapter 6 and 7).

The implementation of the AILBM in the SLB will require certain readjustments in the current governance system of the SLB. This is because many of the environmental and natural resources laws now in place were developed in the nineteen century with the assumption that the earth resources could easily be managed and sustained. Also, the rigid and inflexible character of legal frameworks run contrary to the principles of adaptive management and hence cannot properly account for the ecological systems they influence (Karkkainen 2006). This is further compounded by the current uncertainty in the global climate change and resource availability (Craig 2010, Garmestani and Benson 2013, Garmestani et al. 2013, Benson and Garmestani 2011, Lazarus 2004, Ebbeson 2010).

The process of implementation of AILBM in the SLB will require an extensive quantitative and qualitative analysis of the element of the AILBM framework (table 2) with the purpose of determining the level of water governance performance by measuring the five institutional fit parameters in the SLB. The expected results will be the determination of: institutional priority, institutional response to resource management systems, institutional involvement and recognition, institutional overlaps and gaps (the result of the analysis is the focus of another paper under consideration for publication) (table 3). The quantitative result of institutional fit will be used to support

the qualitative analysis, thus, giving a clearer picture of the status of institutional fit in the SLB.

6. Conclusion

The SLB's existence is endangered and will require drastic measures to improve the quality of the ecosystem and ensure its sustainability. Over the years her resources have been exploited for rice, rubber, oil palm, fishing, aquaculture, water supply among others, and mostly poorly regulated activities have led to the deterioration of the Basin. The Basin serves a large population and contributes hugely to the national economy. It is, therefore, expedient to pursue an adaptive and integrated lake basin management system for the betterment of the SLB. The SLB needs 'institutional fit' that would properly account for all the key elements of the SLB social-ecological systems. The absence of fit in the SLB is responsible for the current ecological challenges of the Basin. All these challenges can be addressed and corrected by the application of the AILBM governance structure designed to meet the needs of all the stakeholders. In this section, we list what we believe are the most urgent actions needed to rescue Songkhla Lake Basin:

5 Create a singular and specific agency or commission with a legal mandate to operate the management of the SLB by merging the Songkhla Lake Basin Committee (SLBC) and Songkhla Lake Basin Development Committee (SLBDC). This recommendation is in line with the Songkhla Lake Basin Development Project,

6 Review existing water resources and related governance instruments and make them appropriate, adequate and relevant to the SLB and her peculiarities,

7 Review resource utilization governance instruments related to the SLB to include mitigation and conservation measures for the protection of the resource of the Basin

8 Local Administration Organizations (PAOs, MAOs, and TAOs) should be encouraged to enact bye-laws to address specific challenges not covered in national legal frameworks,

9 Set up public and stakeholders participation activities to encourage broader participation of interested persons, community-based organizations and non-governmental organizations in the Basin. This would provide the forum for discussion and resolutions of various conflict issues over resource utilization in the Basin. This would also create a common ground for the fishers, rubber farmers, rice farmers, aquaculture, hospitality businesses, etc., to begin to discuss and interact to ensure their livelihood and ensure the SLB sustainability.

This study also revealed that studies on water governance in Songkhla Lake Basin are very scanty. It is essential that we encourage more researches on governance because that is what creates the enabling environment for the much desired development. Songkhla Lake Basin needs a water governance system that is robust, flexible, adaptable and integrative at the same time with high levels of citizen involvement and participation.

Reference (see reference section)

APPENDIX IV

SUPPLEMENTARY PAPER III

Text mining tool for institutional fit analysis for lake basin governance

This chapter is adapted from:

Paper Presented at the 2nd IWA Malaysia Young Water Professionals Conference 17 – 20 March_ Ref 1598. Organized by International Water Association (IWA), Malaysia Young Water Professionals and Universiti Technologie Malaysia.

Abstract

Water governance performance of lake basins requires a proper understanding of institutions that govern their multiple uses and the quantification of the degree of their institutional fit. Institutional fit, on the other hand, is very important for assessing the governance challenges of these resource systems. The objective of this paper is to present a step-by-step procedure of the text mining tool developed for testing and measuring quantitatively the institutional fit of lake basin water governance that support institutional analysis to easily capture the gaps and nuances of relevant institutional instruments. The application of this tool is based on the conceptual framework of institutional fit for governance of lake basins based on the principle of the Adaptive Integrated Lake Basin Management (AILBM), which we developed for the improvement of the institutional fit of lake basin. Also, the tool uses parameters of institutional priority, institutional response to resource management, institutional involvement and recognition, overlap and gaps for its quantitative measurement and testing. This quantitative approach generates quick and ease of information on the status of institutional fit for lake basins, which are valuable for improvement of

existing sets of institutions as well as a useful guide for new institutions in governance of lake basins.

Keywords
text mining, institutional priority, institutional response, institutional involvement and recognition, overlap and gaps, institutional fit, adaptive integrated lake basin management

1.0Introduction

It is no longer a contested fact that institutions should match the social ecological systems they were designed to protect (Young, et al. 1999). Considering that institutional effectiveness is, at least in part, a function of fit (Ebbin 2002, Young and Underdal 1997) as well as the ability to manage relevant impact to the resource base or to influence the activities of those regimes that can be controlled (Ebbin 2002). But, testing for institutional fit using a quantitative approach is not common among researchers and is even more uncommon in lake basin governance research. The quantitative approach generates a quick and easy access to baseline information about agencies, laws and regulations, and it helps to provide adequate and concise synthesis of institutional fragmentation and gaps (Ekstrom et al, 2009). This paper is designed to present a texting mining tool for analyzing institutional fit for lake basin water governance systems.

Institutions refer to laws, that is, sets of rights, rules and decisions making procedures which forms a fundamental part of environmental management systems (Young, 1999). They establish the rule by which decisions are made, bargains are struck, claims are granted legitimately and adjudicated, sanctions are applied, and resources are managed and distributed (Thromogton and Fisher, 1993). Laws, regulations, administrative rules and formal and informal guides to action and decision fall under this definition of institutions (Kallis and Coccossis, 2000). It must be noted that institutions are not equivalent to stakeholders; rather they regulate the activities of stakeholders, whilst simultaneously being created and enacted by stakeholders

(Bakker, 1999). Organizations are defined by institutions, and they are the norms and principles that define the organization and the organization itself operationalizes institutions (Bromley, 1982).

Researchers have advocated for changes in the institutional arrangements for the purpose of achievement of institutional fit that will ultimately improve water resources management and governance (Cook, 2014; Kidd and Shaw, 2007; Wallis and Ison, 2011), but often, many literature rarely provide details on how to quantitatively test for institutional fit. The International Waters Science Project Lakes Working Group reviewed 58 Global Environment Facility (GEF) projects that addressed serious environmental and human development issues in transboundary lakes and noted that 'implementation of change requires institutional fit which can be very difficult to achieve. Although institutional barriers can be subtle they can block even the most obvious and necessary actions' (Servos et al, 2013). Achieving institutional change requires the testing of existing institutions of Lake Basin management and governance to determine their level of fit. Servos et al, (2013) stated that institutional change or acceptance is a transitional process that requires appropriate legal frameworks, harmonization of policy at each level, implementation at the watershed scale and flexibility to enable adaptive management.

Traditionally, institutional fit analysis were often carried out qualitatively; which were time consuming because of large volumes and high numbers of legal documents (Young, 2002) and the first time institutional fit was evaluated functionally by quantitative determination of overlaps and gaps was done by Ekstrom and Young (2009) and Ekstrom et al (2009), using text mining analysis which systematically provided synthesis of overlaps and gaps in ocean laws across the geo-political jurisdictions of federal and three states of the United States of America. This work expands on this previous research by not only determining overlaps and gaps, but also determining statutory density, institutional priority and institutional response to resource management. The objective of this paper is to present a step-by-step procedure of the text mining tool developed for quantitative testing and measuring of institutional fit of lake basin water governance that support institutional analysis to

easily capture the gaps and nuances of relevant institutional instruments as well as show the various institutional fit parameters that were measured their application, significance, limitations and areas for future research.

1.2 The Challenge of Institutional Fit in Lake Basins

It is estimated that today more than 8 million lakes larger than 1 ha (Meyback, 1995), and more than 800, 000 smaller ones (McCully, 1996), and more than 10 million km^2 of wetlands (Finlayson and Davidson, 1999) exist worldwide. Due to their ability to retain, store, clean and evenly provide water, as well as their distinct characteristics as still-water bodies, lakes, reservoirs and wetlands constitute essential components of the hydrological and biogeochemical water cycles; they also influence many aspects of ecology, economy and human welfare. Globally lake basins' activities are impacted by multiple of institutional instruments and jurisdictions due to their multiple uses.

In most cases, they do not have any institutional framework specifically designed to address their peculiar nature and characteristics. This is further compounded by the fact that lake basins are hardly considered in most countries overall water resources management and governance (Ballatore and Muhamdiki 2001). Therefore, issues of institutional fit are very critical for the survival of the lake basins. It has been recognized that the challenge of institutional fit contributes majorly to the deteriorating health of the marine ecosystem (McLeod et al. 2005, Barnes and McFadden 2008), which is responsible for the many stressors impacting negatively on the resource base of lake basins globally.

Water resources in lakes and their basins are impacted by many activities both within (e.g. overfishing) and outside of the lake (e.g. changing land use) or its watershed (e.g., climate change) and thus affecting quantity and quality (World Water Assessment Programme 2012). Classical cases of this impact can be seen in the Aral Sea and Lake Chad drying up due to excessive water extraction and diversions for irrigation (Micklin and Aladin, 2008; Ceo and Foley, 2001); eutrophication challenges in Danube River resulting in nutrient overload in the Black Sea from poor agricultural

practices (Borysova et al, 2005) and sediment overload in Lake Tanganyike (Donohue, et al, 2003). The World Water Assessment Programme (2012); report noted that serious issues have arisen in lakes that cross political boundaries, especially in the developing countries where governance structures, scientific capacity and integrated approaches to water management have been weak or lacking. And, even when actors recognize and agree on its water issues, reaching agreement on a coordinated approach toward resolution often proves challenging (Jench-Clausen and Fugi, 2001).

Although, scientific knowledge about the cause and effects of stresses on lakes is available, the effective management policies and institutions have lagged behind; in most cases, the values of lakes have not been fully considered by policymakers (Ballatore and Muhamdiki 2001). In practice, water governance tends to be characterized by some degree of fragmentation, which could benefit from increased institutional integration but excessive fragmentation can be problematic (Bakker and Cook, 2011, Cook, 2014); these are the cases in most lake basins globally because of multiple uses of lake basins resource where utilization is the focus of institutions rather than conservation; as is the cases of Songkhla Lake Basin (Ratanachai and Sutiwipakorn, 2006), Tonle Sap (Varis et al, 2006), Lake Tanganyika (Cook, 2014), Lake Victoria (Odada et al, 2006) etc.

Therefore, developing a tool for institutional fit for lake basins would enhance resource value, decongest resource use, resolve resource use conflict, reduce environmental stress, rehabilitate and restore riparian habitats, protect resource value damage from extreme events, take precautionary adaptation and mitigation measures and improve overall ecosystem health; now this would require a quantitative approach like text mining to complement qualitative institutional fit analysis by quantitatively testing for institutional fit of water governance of lake basins.

2.0 Application Approaches

2.1 Conceptual framework of lake basin governance

The development of adequate and relevant conceptual frameworks before the application of this tools is a mandatory requirement, on the alternative users could adopt the conceptual framework proposed in this paper (see chapter 3) (Hedrick et al., 1993, Neuman, 2000, Miles and Huberman, 1994). Servos et al, (2013) noted that the absence of solid conceptual frameworks was one of the major challenges that affected the deliverables of the 58 transboundary lake basin projects funded by the Global Environment Facility (GEF). The conceptual framework helps to identify the lake basin stressors, actors, institutions, current resource and management response systems. It also enables the consideration of lake-specific biophysical processes and social interactions as a component of the system or as a possible modifier of impacts (Servos et al, 2013). Lakes and their basins are usually influenced by many stressors (Heugens et al, 2001), which must be accounted for in the testing of institutional fit. Lake Victoria has been impacted by intensive fishing, species introductions, species loss, eutrophication, water level changes and climate change variation (Hecky et al, 2010).

Adaptive Integrated Lake Basin Management (AILBM) was introduced into the conceptual framework as a corrective management and governance system capable of enhancing the achievement of institutional fit or comprehensive fit (Decaro and Stokes, 2013) as the case may be in the lake basins. AILBM was designed to act as a link between the concepts of Integrated Water Resources Management (IWRM) (ICWE, 1992, World Bank, 1993, Mody, 2004), Adaptive Water Management and Governance (AWMG)), (Van der Keur, et al., 2010, Pahl-Wostl, 2009) and Integrated Lake Basin Management (ILBM) (RCSE and ILEC, (2014), based on the assumption that the current water governance institutions (laws) for lake basins have not properly articulated the issue of adaptive governance, especially with the current adverse effect of the global climate change and also the fact that IWRM does not adequately cater for the need of lake basins (Servos et al, 2013).

AILBM is an approach of lake basin governance that is designed to be gradual, continuous, holistic, systemic and integrative in nature and capable of ensuring resilience, flexibility, adaptability, active participation of all stakeholders, equipped with effective and efficient decentralization systems and adequate feedback mechanisms that addresses the resource management system as well as the water resources quality and quantity issues for the achievement of overall comprehensive fit for the lake basin. In other words, the institutions that govern lake basins should capture the synergistic-linkages between the sector, actors, stressors and management to achieve an institutional fit for lake basins. Decara and Strokes (2013) content that a comprehensive fit is the ultimate goal of sustainable resource systems. In other word, the overriding aim of AILBM is the achievement of a good social, economic, environmental and institutional fit (Ekstrom and Young 2009, Co Cox 2012, Decara and Strokes 2013). In essence, what is needed is an iterative approach that has feedback built-in, especially from stakeholders, between the ecological and social system, which allows for policy to evolve in response to policy experiments, and laws to evolve in response to legal experiments, and not past assumptions about the system of interest (Garmestani and Allen, 2014).

2.2 Text mining procedure applied to institutional fit analysis

To quantitatively analyze institutional fit for lake basin governance, the text mining tool is extremely adapt in capturing hitherto hidden data. Text mining can be broadly defined as a knowledge-intensive process in which a user interacts with a document collection by a suit of analysis tools (Feldman and Sanger 2007). Text mining seeks to extract useful information from data sources through the identification and exploration of interesting patterns. Text mining also focuses on collections, in this case, collection of legal documents related to water resources management and governance in lake basins for a systematic and quantitative analysis (Berelson, 1952).

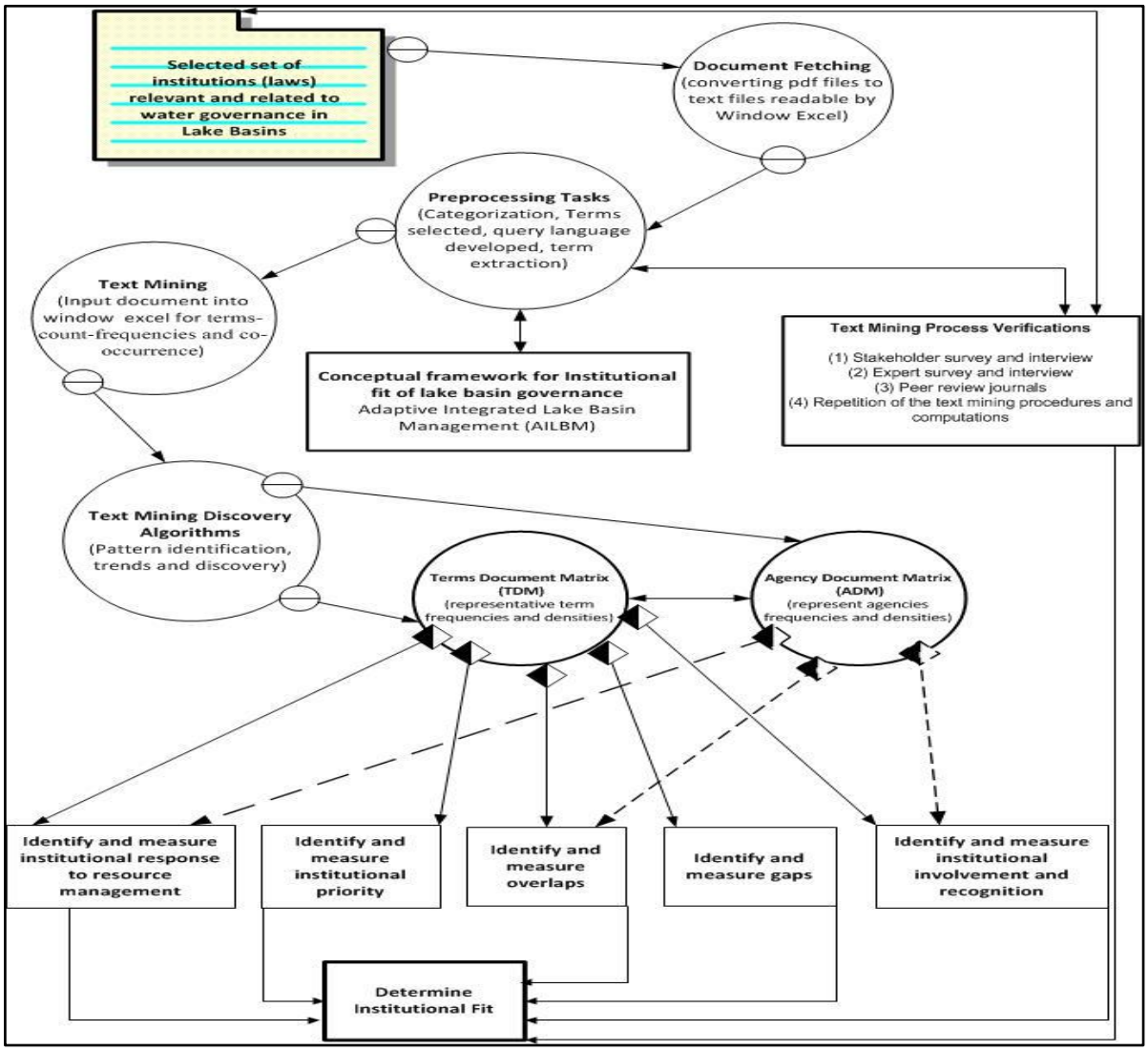

Figure 2: Simple concept flow chart representation of text mining for institutional fit in Lake Basins

This process involved the collection of relevant and related institutions (laws) of water management and governance of lake basins of interest electronically and convert files to readable form by Window Excel (figure 2). Then, selected representative terms that best represent the various aspects of resource management and governance are developed into a query language that is mined, and data visualized using the Window Excel software package for terms count-frequencies and densities. This will result in the development of Term-Document-Matrix (TDM) from sets of institutions (laws) applicable to governance of lake basins. The Document Agency Matrix (DAM) is also

developed by physically reading through these sets of institutions to discover agencies with relevant statutory mandates and other relevant information that will aid in the quantitative analysis of these sets of institutions (Ekstrom and Young 2009).

3.0 Analysing Institutional Fit Parameters

3.1 Terms Frequencies and Densities

Statutory Term Density (STD) measured the magnitude of the number of times the term appears in the laws and this is used to develop the Term Document Matrix (TDM). It is a measure of the recognition of the issues related to the representative terms in the laws. It also graphically shows the degree of recognition of representative mined terms in the laws, and the most referenced terms in the sets of institutions. Agency Density (AD) is the number of times an agency appears in the laws (Agency Document Matrix). It shows the agency's degree of involvement in resource management and governance in the lake basin.

3.1.1 Statutory Term Density (STD) equation

$$\mathrm{STD}\ (\mathrm{TF}, \mathrm{WLsLB}) = \frac{\mathrm{TF\ \ WLs\ LB}}{\sum(\mathrm{TF\ \ WLs\ LB})}\ \mathbf{x}\ 100 \qquad \text{(I)}$$

Where: STD = Statute Topic Density, Ls = Laws, TF = Topic/Term Frequency, WLsLB: Water Laws relevant to LB, LB: Lake Basin.

3.1.2 Agency Density (AD) equation

$$\mathrm{AD}\ (\mathrm{TF}, \mathrm{WLsLB}) = \frac{\#\ \mathrm{A\ \ WLs\ LB}}{\sum(\mathrm{A\ \ WLs\ LB})}\ \mathbf{x}\ 100 \qquad \text{(II)}$$

Where: AD = Agency Density, Ls = Laws, A = Agency that appear in WLsLB, WLsLB: Water Laws relevant to LB, LB: Lake Basin.

3.2 Overlap Analysis (index of the degree of fragmentation of institutions)

Overlap is one of the leading causes of institutional fragmentation and occurs when two or more agencies have the same jurisdictions or influence over the same area, activity, and/or resource (Ekstrom and Young 2009). There are two types of overlap: (1) Statutory Overlap (SO), refers to the number of laws that contain a given term. The term with the highest number of laws ranked as having the highest overlap from the law variable; and (2) Agency Overlap (AO), which is the agencies associated with the overlapping laws for a given term.

3.2.1 Statutory overlap equation

$$\mathrm{SO}\ (\mathrm{T}, \mathrm{WLsLB}) = \frac{\mathrm{WLs\ (T,WLLB)}}{\sum \mathrm{WLsLB}} \mathbf{x}\ 100 \qquad \text{(III)}$$

Where: SO = Statute Overlap, Ls = Laws, T = Term, WLsLB: Water Laws relevant to LB, LB: Lake Basin.

3.2.2 Agency overlap equation

$$\mathrm{AO}\ (\mathrm{T}, \mathrm{WLsLB}) = \frac{\mathrm{A\ (T,WLLB)}}{\mathrm{A(LB)}} \mathbf{x}\ 100 \qquad \text{(IV)}$$

Where: AO = Agency Overlap, T = Term, WLsLB: Water Laws relevant to LB, A = Agencies, LB: Lake Basin.

3.2.3 Overlap index equation

$$\mathrm{OI}\ (\mathrm{T}, \mathrm{WLsLB}) = \frac{\mathrm{SO+AO}}{6} \mathbf{x}\ 100 \qquad \text{(V)}$$

Where: SO = Statutory Overlap, AO: Agency Overlap, LB: Lake Basin, WLsLB: Water Laws relevant to LB.

3.3 Gaps Analysis (index of the degree of misfit/mismatch of institutions)

Gaps occur when a critical linkage between two components of a term is not addressed in the institutions. The linkages refer to interactions across sectors, stressors and management systems. The modeled linkages that score zero in each law matrix is a gap. Gaps is a measure of institutional mismatch or misfit. In other words, a missing link of the terms in the body of the law (Ekstrom and Young 2009).

3.3.1 Gaps analysis equation

$$\mathrm{G(WLsLB)} = \frac{\#\ \text{gaps}}{\#\ \text{linkages}} \mathbf{x}\ 100 \qquad \text{(VI)}$$

3.3.2 Overall Institutional Gaps equation

$$\mathrm{OIG(WLsLB)} = \frac{\sum \#\ \text{gaps}}{\sum \#\ \text{linkages}} \mathbf{x}\ 100 \qquad \text{(VII)}$$

Where: G = represents the proportion of the legal gaps to modeled links (gaps = number of modeled links absent from the law; linkages = number of total modeled links in the system); WLsLB: Water Laws relevant to LB; OIG = Overall Institutional Gaps; LB: Lake Basin.

3.4 Institutional Priority

This parameter seeks to use the text mining analysis to determine and measure the main aim and objectives as well as the purpose of the laws governing the lake

basin. The quantitative measure of priority of institutions will help illustrate if the laws under review encourages resource utilization over conservation and protection.

$$\text{IP (WLsLB)} = \frac{\text{(T,WLsLB iC)}}{\sum \text{(T,WLsLB iC)}} \mathbf{x}\ 100 \qquad \text{(VIII)}$$

Where: IP = Institutional Priority; T = Term; WLsLB: Water Laws relevant to LB; iC = Issue by Category; LB: Lake Basin.

3.5 Institutional Response to Resource Management

To fully understand institutional fit of lake basins' water governance instruments, we need to determine and measure quantitatively the degree of response of the existing institutions to the resource management for which it was designed. The purpose of this indicator is to use text analysis to determine the institutional response to management of the resource base.

$$\text{IRRM (WLsLB)} = \frac{\text{(T,WLsLB RM \& AILBM)}}{\sum \text{(T,WLsLB RM \& AILBM)}} \mathbf{x}\ 100 \qquad \text{(IX)}$$

Where: IRRM = Institutional Response to Resource Management; T = Term; WLsLB: Water Laws relevant to LB; RM = Resource Management; AILBM = Adaptive Integrated Lake Basin Management; LB: Lake Basin.

5.0 Discussion and Conclusion

5.1 Discussion: Interpretation of Institutional Fit Parameters

5.1.1 Institutional priority

Institutional priority is a measure of what is most important and take precedence in institutions or sets of institutions for resource management and governance in lake basins. In other word, it is the evaluation of institutions based on their aims, objectives and goals. This is based on the assumptions that acknowledges the capacity of actors in

the lake basins to develop institutions or sets of institutions to address the environmental problems (Haller, et al, 2013). But, the challenge is in the fact that actors may have very specific desires that may lead to narrow management actions aiming at one objective (economic and biased interests) in detriment to others (social and ecological) (Kalikoski, et al, 2002). This is because the goal actors want to achieve will eventually influence what is emphasized and are seen as challenges (Valn and Vedeld, 2012). Therefore, determining institutional fit should include identifying what aspects of the resource system the actors emphasize.

Also, most institutions were designed for strategic reasons and not because they were meant to solve social ecological system challenges, thus achieving institutional fit becomes very difficult. Even when actors actually get their priority right to address the need of the resource system, in most cases they may be distracted in the process of negotiations. Therefore, this tool helps to keep the actors in line to develop the right priority that will match that of the resource system because well fit institutions will have incentives and priorities matching with that of the resource system (Wilson, 2006). Kalikoski, et al, (2002) observed that institutional priorities of ocean and marine resources are more on resource exploitation which have resulted in overall mismanagement of coastal resources and over-exploitation of many fisheries resources, loss of biodiversity, poverty and loss of cultural identity of fisheries communities. Young (2002) noted that special interests of particular categories of human actors can lead to the creation of regimes that are poorly suited to the biophysical systems with which they interact. Therefore, this tool can be used to measure and quantify what is the interest (priority) and the magnitude of that interest.

5.1.2 The institutional response to resource management

The institutional response to resource management presupposes that institutional fit can be determined if we can measure the degree of its response to resource management. For existing institutions, the aim is to determine the degree which the institutions have captured the current resource management and governance perspectives. It can also be very useful tool testing management response for proposed

new sets of institutions. The aim is to help the proponents and their stakeholders focus on developing sets of institutions that would be adequate to response to management needs of the lake basin.

This indicator is capable of determining quantitatively the degree of institutional response to resource management in the area of property rights and ownership. The common literature has shown that variation in property rights can make a difference in resource management outcomes (Sclagar and Ostrom 1992, Bromley 1991; 1992). Agrawal (2003) stated that markets or private property arrangement and public ownership or state management do not exhaust the range of plausible institutional mechanisms to govern natural resource use. This tool is capable of quantitatively measure the degree of formal and informal property rights and ownership in sets of institutions, and as well as determine their level of impact in the governance of the lake basin. Thus, giving practical insight on how to achieve a balance for enhancement of institutional acceptance, which is a measure of public participation; a key factor in achieving institutional fit (Decaro and Stokes, 2013).

It can also be used to test for the adaptive capacity of existing institutions or sets of institutions that govern the lake basins, especially in this era of global climate change. In the case of climate change, lake basin institutions need to be able to rise to the challenge of developing resilient and robust governance systems that are more proactive and progressive in coping with the expected impact of environmental change (Gupta et al, 2010). The importance of this parameter cannot be over emphasized, especially now that there is a possibility of climate change effect on the functions of lakes and their ecosystems (O'Reilly et al, 2003), which will not only affect processes within the lake, but also those in the watershed, potentially altering the availability and quality (e.g. nutrient and contaminant loads) of water entering the lake (Wrona et al., 2006). Therefore, text mining for climate change and management representative terms in sets of institutions for lake basins can give a measure of the adaptive capacity of sets of institutions for lake basins. To strengthen the ability of this parameter to capture adaptive capacity qualities of lake basin institutions, the AILBM conceptual framework of institutional fit of lake basin governance was introduced into the text

mining tool. This is based on the assumption that when the representative terms of AILBM are mined and analyzed using these parameters then a quantification of the institutional adaptive capacity can be measured.

5.1.3 Institutional involvement and recognition

The statutory frequencies represent the degree to which laws are involved in the management of an issue related to the representative terms. This parameter is used to measure the degree of involvement and recognition of the representative terms in relevant institutions for lake basin. This will show the magnitude of involvement of the institutions as regards the representative terms being mined. The representative terms are derived from components of the conceptual framework (stressors-sectors-actors-management and governance systems). If mined terms frequencies are low it means that the institutional involvement is poor and the implication is that such institutions cannot cater for the need of the resource system as well as enhance the performance of agencies set-up by such institutions. The statutory density is a measure of how much space the representative terms mined occupy in the laws or how much attention the sets of institutions under review give to these terms.

In other words, what is the level or degree of recognition of the issues represented by those terms. A low density value gives an indication of poor and weak institutional recognition of the issues the terms represent. On the other hand, agency density measures the degree of involvement of the agency or organization in the management of the issue related to the representative terms mined. A high density shows that the institutions have taken cognizance of the need for the agency to address the issues of the representative terms. A low density implies that the agency are not adequately equipped to manage and govern the resource systems. The interesting aspect of this parameter is that it is capable of showing agencies/organizations operating under an executive fiat, but without any legal mandates, meaning that institutional siting and biophysical systems were not properly reflected in the governance structure (Vatn and Vedeld, 2012).

5.1.4 Institutional overlaps and gaps

The problems of uncoordinated overlapping laws and gaps have been highlighted by a lot of scholars (Ekstrom and Young, 2008, Ekstrom et al, 2009). Overlap measures the degree of fragmentation in water governance (Salaman and Bradlow, 2006), and fragmentation exists when responsibility is divided or allocated among multiple actors and/or agencies (Hill et al, 2008). It is often manifested as duplications of responsibilities. A gap, on the other hand, measures the degree of mismatch which often results in misfit of scales, spatial and temporal within institutions (Folke, et al, 2007). This parameter measures the degree with which the representative terms overlaps within the sets of institutions as well as quantifies agencies with overlapping responsibilities. Also, overlapping terms can indirectly depict the institutional priority because the tendency for their high degree of overlapping of representative terms shows the interests, aims and goals of the institutions. The tool can be used to measure an overlap index which will show the true picture of the general overlap (statutory and agency overlaps) situation.

5.2 Conclusion

The following is the application significance of the tool:

I. Quantitative verification for a qualitative analysis of sets of institutions. Traditionally institutional analyses were mainly descriptive with limited quantitative analysis. However, this tool can be used to verify the results of qualitative analysis through physical counting of representative terms to produce quantitative data visualized graphically.

II. Since it is term-specific it makes it easier to test sets of institutions based on specific parameters thereby reducing the ambiguity and over generalization.

III. This tool goes beyond overlaps and gaps, which is the traditionally the focus of institutional analysis, to test for institutional priority, management response, degree of involvement and recognition of terms and agencies. In other words,

this tool can help to identify the institutional priorities of sets of institutions and their abilities to responsed to resource management in lake basins.

IV. The tool is valuable for testing existing institutions or sets of institutions capacity to deal with current challenges and conditions, and also identify areas needing attention; at the same time, it is extremely valuable to assess new institutions or sets of institutions designed for resource management to ensure that they are fit and do not repeat the mistakes of previous institutions.

V. The component of Term Document Matrix (TDM) can be used to develop performance indicators for resource management and identify representative terms and their relevance to resource management for effective monitoring and evaluation in the lake basin.

VI. The Adaptive Integrated Lake Basin Management (AILBM) is relevant in that it can be used to ensure a comprehensive fit of institutions of governance for lake basins.

The limitation of the texting mining tool is that it is restricted to formal institutions and written documentations, besides, it does not replace the qualitative assessment and legal expertise requires for institutional analysis. It is a complementary tool. Further research will be required in the area of testing specifically for institutional priorities and management response of lake basin governance. The new area of research should also cover lake basin management system documents, master plans and all other relevant documents like regulations, guidelines, standards and reports on lake basin governance. This will show trends and patterns in the management and governance of lake basins for the purpose of clarification of institutional, management and governance issues in the lake basins.

In conclusion, the overall advantage of this text mining tool for institutional analysis of governance instruments of lake basin is in its simplicity and inexpensive nature, especially for developing countries researchers to apply as often as requires. All that is needed is the basic computer skills and competency with Microsoft Word and

Excel software packages. Of course, other sophisticated software's do exist for text mining analysis.

REFERENCE (See main reference section)

APPENDIX V

VITAE

Name Mr. Peter Emmanuel Cookey

Student ID 5610930028

Educational Attainment

Degree	Name of Institution	Year of Graduation
Master of Science in Environmental Science: Specialization in Environmental Technology for Sustainable Development	UNESCO-IHE, Delft, Netherlands	2013
Master of Science Degree in Environmental Engineering Management	Asian Institute of Technology (AIT) Thailand	2013
Master of Science Degree in Environmental Management	Imo State University, Owerri, Nigeria	2004
Post Graduate Diploma in Environmental Microbiology	University of Port Harcourt, Choba, Nigeria	1996
Final Diploma of Nigerian Institute of Science Laboratory Technology in Physiology/Pharmacology	University of Port Harcourt, Choba, Nigeria	1998
West African Health Examination Board Diploma in Public/Environmental Health	Rivers State School of Health Technology, Port Harcourt, Nigeria	1992

Scholarship Awards during Enrolment

Research support by the Faculty of Environmental Management Research, Prince of Songkhla University: 2015

Work – Position and Address (If Possible)

Chief Lecturer: School of Environmental Health, Rivers State College of Health Science & Technology, Port Harcourt, Nigeria.

List of Publication and Proceeding (If Possible)

(a) PhD Conference Proceedings Publications

1. Cookey, P. E., Darnswadi, R. and Ratanachai, C., 2014. Understanding Stakeholders Perception for Effective Governance of Songkhla Lake Basin: Case Study of some Tambons (sub-districts) in Songkhla Province, Thailand. Conference Proceedings of the 2nd National Songkhla Lake Basin Annual Conference, 14-15 August, 2014. Organized and hosted by the Faculty of Environmental Management, Prince of Songhkla University, Hat Yai, Songkhla, Thailand.
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6. Cookey, P. E., Darnswadi, R. and Ratanachai, C., (submitted). Critical Analysis of Water Governance Challenges in Songkhla Lake Basin, Thailand. Manuscript submitted for publication: Lake & Reserv.: Res. and Manag.

(c) Others Peer Review Articles/Conference Publications

1. Cookey, P. E., Koottatep, T., van der Steen, P. and Lens, P. N. L., (2nd review process**)**. Public Health Risk Assessment Tool: Strategy to Improve Public Policy Framework for Onsite Wastewater Treatment Systems (OWTS).

Manuscript submitted for publication: Journal of Water, Sanitation and Hygiene for Development.

2. Cookey, P. E., Koottatep, T., van der Steen, P. and Lens, P. N. L., (2nd review process**)**. Public health risks assessment of groundwater contamination from onsite wastewater treatment systems. Groundwater for Sustainable Development. Manuscript submitted for publication:
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