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A Conceptual Framework for Assessment of Governance Performance of Lake Basins: *Towards Transformation to Adaptive and Integrative Governance*

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Abstract: Governance is essential to lake basin management, but it is the most challenged and needs increased attention. Lake Basin Governance performance assessment is designed to measure the progress and impacts of policies, institutions and the roles of various actors in ensuring sustainability. It measures the performance of technical/operational, social/networks, and institutional arrangement that make up the socio-ecological system. Governance performance assessment becomes very necessary with over-emphasis of institutions on resources utilization and exploitation. 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 performance assessment tool with an outcome to produce an adaptive and integrative system with equity, inclusiveness, transparency, accountability and flexibility to problem-solving and resilience. A case study on water governance performance assessment of the Songkhla Lake Basin (SLB) in Thailand is provided for illustration and application and indicated a poor performance rating on governance in the Basin, revealing gaps, defects, strengths and weaknesses in the current system, necessary to recommend future improvements.

Keywords: assessment; lake basin; diagnostic; prescriptive; governance; management; performance; conceptual framework

1. Introduction

Lake Basin Governance (LBG) is essential to the preservation of the resource-rich socio-ecological system, especially considering the unique and peculiar characteristics of lake basins. But, it is one key aspect in lake studies that has not received the attention it deserves and has fundamentally challenged the sustainability of the world's lakes, and sadly, often ignored in most management plans. Ballatore and Muhamdiki (2001) [1] 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 [2,3]. The Great Lakes of the USA/Canada have been richly studied and most of the scholars agree that governance is the most challenging aspect and needs increased attention [4–7]. Lake Basin management and governance should capture the

synergistic linkages and inter-connectivity as well as interactions between processes and actors to ensure sustainable governance. To achieve this requires a comprehensive and systematic association of all elements (policies, institutions, regulations, actors, resources, ecosystem characteristics and management system) in a consistent manner for decision making and planning.

Governance is the structure and process that society uses to make decisions and power sharing [8] especially in the interaction between the formal and informal institutions [9]. It essentially addresses the horizontal and vertical linkages as well as processes between and within organizations and social groups involved in making decisions, choices and trade-offs [10–13]. Moore (2010) [14] describes it as 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. It sets the rules under which management operates [15]. In other words, management is not merely a technical issue, but should respond to the provisions of governance, and include technical guidelines and standards, policies; institutions and regulatory issues, which if properly harnessed could provide better benefits to society [16]. The definition of water governance reflects these issues: " ... 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" [10]. Lake Basin Governance performance assessment is designed to measure the progress and impacts of policies, institutions and the roles of various actors in ensuring sustainability, measuring the performance of technical/operational, social/networks, and institutional arrangements that make up the socio-ecological system [17].

Specific methodologies for performance assessment of Lake Basin Governance (LBG) are very scanty and in most cases absent, where they exist, they focus on resource utilization, management and conflict resolution. For example, socio-ecological system (SES) frameworks were applied for the assessment of urban lake governance in Ahmedabad and Bangalore, India respectively [18,19], but the SES concept was not specifically designed for LBG assessment. Other examples include the use of the Integrated Lake Basin Management (ILBM) framework as a plan-do check for basin managers [20–25]. The point of note here is that none of these other frameworks assessed governance performance.

This study developed 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. The research questions addressed are: How can the assessment of lake basin water governance performance be improved and what are the essential components of a framework that different stakeholders could utilize for improving the collective governance performance? This article aims to contribute to the development of the body of knowledge on governance as well as to identify and present components of water governance performance assessment. This article is divided into six parts: introduction, conceptual foundation, framework components, assessment process, application as well as discussion and conclusion.

Lake Basin Governance

Lakes are traditionally under-valued, poorly managed and governed in most human society [26]. Managing lakes require taking cognizance of their drainage systems, catchment characteristics, precipitation, groundwater inflows, surrounding wetlands, floodplains and pollutant pathways [27]. Lake characteristics of long retention, complex response, dynamic and integrating nature have serious implications for the engagement of stakeholders in pollution management and their ability to accommodate many water users represent major potential source of conflict [20]. This paper defines Lake Basin Governance (LBG) 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 socio-ecological system in a transparent and accountable manner. This implies that governance instruments should account for all issues, hydrological characteristics and socio-economics to ensure sustenance, especially since the issues, that motivate stakeholders are in their essence not scientific, but political [3,28]. Resolving resource

use congestion, competition and conflicts are not simple because arriving at a generally agreeable compromise plan for all stakeholders can be phenomenally difficult and time consuming. LGB should be able to achieve a better compromise for overall well-being (Research Centre for Sustainability and Environment (RCSE) and International Lake Environment Committee [29].

In order to understand Lake Basin Governance and proffer specific and long standing solutions, it is essential that the governance performance be properly investigated to determine ecological, political, social and economic conditions. Governance performance assessments are important diagnostic and prescriptive tools guiding policy reforms, monitoring progress and ensuring that water resources are sustainably managed [30]. Performance assessments guide the designs of effective policy interventions by helping to identify where changes are needed and what actions can make them happen [31,32]. Governance performance assessments include but are 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 [33]. Performance assessments become very necessary with regard 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 [7,34]. Some of the key insights gained from the review of several studies are summarized thus:

I Governance is essential to lake basin management [35–37], but, not yet a strong component of development and management plans and where it is mentioned, mostly glossed over and rarely reflected in programmes of actions or areas of priority investments) [20–22,29,38].

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 [39–48].

III Institutional response to management of resources is grossly inadequate due to rigidity and inflexibility [49–52]; often based on the assumption that natural resources can be controlled and managed; and not integrative and adaptive [40,53,54].

IV Systems are highly fragmented with problematic overlapping laws and agencies as well as conflicting implementing mandates because different sets of institutions administer and regulate different sets of resources, users and actors [55–62].

V Governance is highly ridden with institutional gaps, mismatch and misfit across various scales, hardly accounting for all aspects of the socio-ecological systems [63–65].

VI Inadequate mechanisms for resolving disputes and conflicts over resources use, administration and jurisdictional issues occur among state and non-state actors [53,66–69].

VII 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 exist [50,70–76].

VIII Interagency and intergovernmental coordination and collaboration are very weak [20,27,39,40,77–81].

IX Legal and regulatory frameworks are obsolete resulting in lack of adequate compliance and enforcement for sustainable use of resources [67,82–84].

These factors affect lake basin governance and a performance assessment approach that particularly distills these issues will go a long way to determine their true situation, highlight problem areas and expose connected solutions. The purpose of the AILBM framework is to assist decision-makers to assess LBG performance in order to determine the impact level on the resource system, users and activities as well as make empirically based decisions towards resolving problems and future planning. It can also guide managers in the design of their management systems and assessments.

2. Conceptual Foundations

The conceptual foundation of the Adaptive Integrated Lake Basin Management (AILBM) framework was 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. These three frameworks formed the structural basis used in designing the AILBM. They provided different understanding of socio-ecological system management and governance that could be adapted for the effective governance performance assessment that can provide an in-depth understanding of management operations.

The Adaptive Management and Governance (AMG) concept aims to increase the resilience of socio-ecological systems in the face of future uncertainties [65,85]. Scholars have developed several approaches for the assessment of adaptive management and governance such as adaptive capacity and multi-level learning processes [13], the management and transition framework [86], the adaptive capacity wheel [87] and resilience based framework [88] among others. However, these frameworks were not specifically designed for the performance assessment 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 [75], and was designed to assess the level of integration in governance and management systems [89–93]. Hooper (2006) [94] developed indicators of best practice for the assessment of the IWRM performance at the river basin level. However, according to ILEC (2011) [22], 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 [22,29]. The Global Environment Facility (GEF) project of the Lake Basin Management Initiative (LBMI) led to the birth of the ILBM [20,22,27]. The ILBM assessment indicators took into consideration the concepts of basin approach, lake characteristics, ecosystem services and governance challenges [25]. This framework has six pillars (institutions, policies, participation, information, finance and technology) providing the essential components of governance. However, the pillar of "institutions" refers to organizations that pursue the collective aims of a group (government-sanctioned organizations and traditional or nongovernmental organizations) [27]. 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 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 steps towards transformational processes. This concept aims to measure the adequacy of current solutions and strategies designed to ameliorate these challenges and then develop and prescribe adequate futuristic solutions. For instance, while the ILBM is designed to ensure sustainable management and governance, the AILBM measures governance performance. One is how to and the other 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 frontiers toward providing a framework that measures the impact and performance of governance and management to determine a practical sustainable roadmap towards transformation.

3. The AILBM Framework

The Adaptive Integrated Lake Basin Management (AILBM) framework has two parts: diagnostic and prescriptive. The diagnostic process generates data that determines the current situation of management and governance, after which the prescriptive assessment uses the diagnostic results to determine the degree of the prescriptive elements embedded in the current governance situation and thereby come up with the performance level. The combinations of the results from both tiers of assessments give a comprehensive picture of the performance status of the governance system.

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. The diagnostics components are the socio-economic-ecological and biophysical aspects that could impact the lake basin positively or negatively depending on how the interactions are managed. These components were selected to cover the social, economic, political, physical and ecological elements, and reflect the major issues of concern in lakes and their basins. These components are the first tier assessment process to determine the status of the lake basin, *i.e.*, checking out what is the current situation in the lake basin: 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? The diagnostic elements analyze the complexities in the lake basin's socio-ecological systems to identify the challenges and problems peculiar to that ecosystem.

The prescriptive (adaptability, collaboration, resilience, decentralization, integration and participation) assessment anticipates what will happen and when it will happen, but also why it happened. Prescriptive measures the management and governance processes. This assessment suggests decisions and options on how to take advantage of future opportunities or mitigate future risks and shows the implication of each decisions options. This, the second-tier assessment, measures the capacity of the governance system to be adaptive and integrative as well as proffers empirically based solutions to challenges. In spite of the overwhelming challenge of developing a governance system that is wholly lake basin focused, if we put into consideration the peculiarity of lakes (lentic-lotic properties), then we can assume that lake basin governance should have certain and specific elements to achieve fit-for-purpose governance [95]. 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 the governance system.

Prescriptive analysis is can continually take in new data to re-assess and re-prescribe, thus automatically improving the empirically based solutions and also ingest hybrid or complex data from the diagnostic to accurately prescribe better solutions without compromising other priorities [96]. It also takes into account uncertainties and recommends ways to mitigate possible risks, while examining potential outcomes [97,98]. It is not necessarily ideal, but provides practical solutions to the current challenges, with extensive and expansive capacities to prepare for future changes [99]. Prescriptive analysis has often been described as being too narrow, dictatorial, and restrictive and overlooking the complex nature of governance. Contrary to this view, it is adaptive and does not only recognize the complex nature of governance systems, but also the fact that only a pragmatic approach that produces workable solutions for today and tomorrow will be effective (Table 1).

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 [98]. The AILBM framework is not a normative (or ideal) framework because it can be adaptable and operated in any context. The outcomes of these assessments will be dependent on individual contexts (*i.e.*, lake basins) and the prevailing governance challenges under consideration.

Table 1. Interpretation of the components of Adaptive Integrated Lake Basin Management (AILBM).

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 [100].
Stressors	Constitute major agents and sources of nuisance and impact negatively on the lake basins resources [100–104].
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 [84,105–109].
Resource systems	Ecosystems services and functions of the lake basin which includes the exploitation and utilization of the basin resources [20,27,29,110].
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 [20,27,29].
Institutions	Fundamental tools for resource management and reflect the way people interact with one another and the environment [37,78,111–117].
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 [87,118–126].
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 [38,81,127–137].
Resilience	Deals with the ability of the lake basin to absorb disturbance and still maintain the functioning of the ecosystem [40,138–145].
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 [70,73,74,146–149].
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 [13,74,150,151].
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 [152–156].

Figure 1 shows 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 center 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 governance system. 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 completed 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 1).

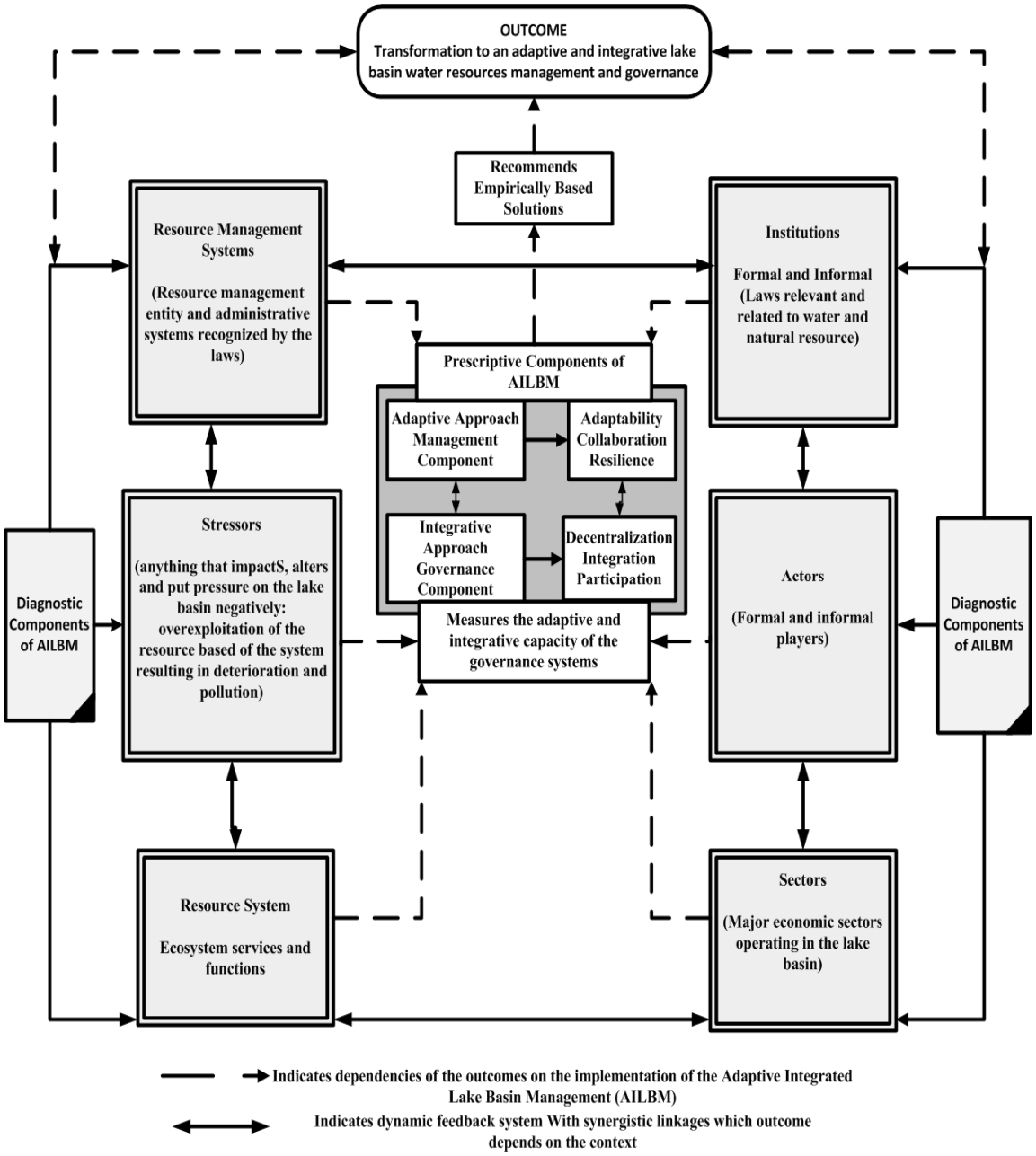

Figure 1. The flowchart of the conceptual framework of the Adaptive Integrated Lake Basin Management (AILBM) for assessment of governance performance of lake basins.

The significance of the AILBM framework is based on the need to concurrently strengthen the enabling environment, institutional roles and functions of various administrative levels, stakeholders, and management instruments, including effective regulation, monitoring and enforcement of laws. 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 governance discourse because it provides a possible assessment tool for governance performance. 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. Framework Assessment Process

In this section, the assessment process is described in more detail. The AILBM framework was applied in the Songkhla Lake Basin (SLB), Thailand to qualitatively and quantitatively assess the water governance performance. The steps in this process are: defining and analyzing the existing situation; stakeholders' selection; 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 as well as monitoring and evaluation. The assessment process takes seven steps based on the experience gained from the application of the framework in the SLB. In this section, these steps are elaborated and described (Figure 2).

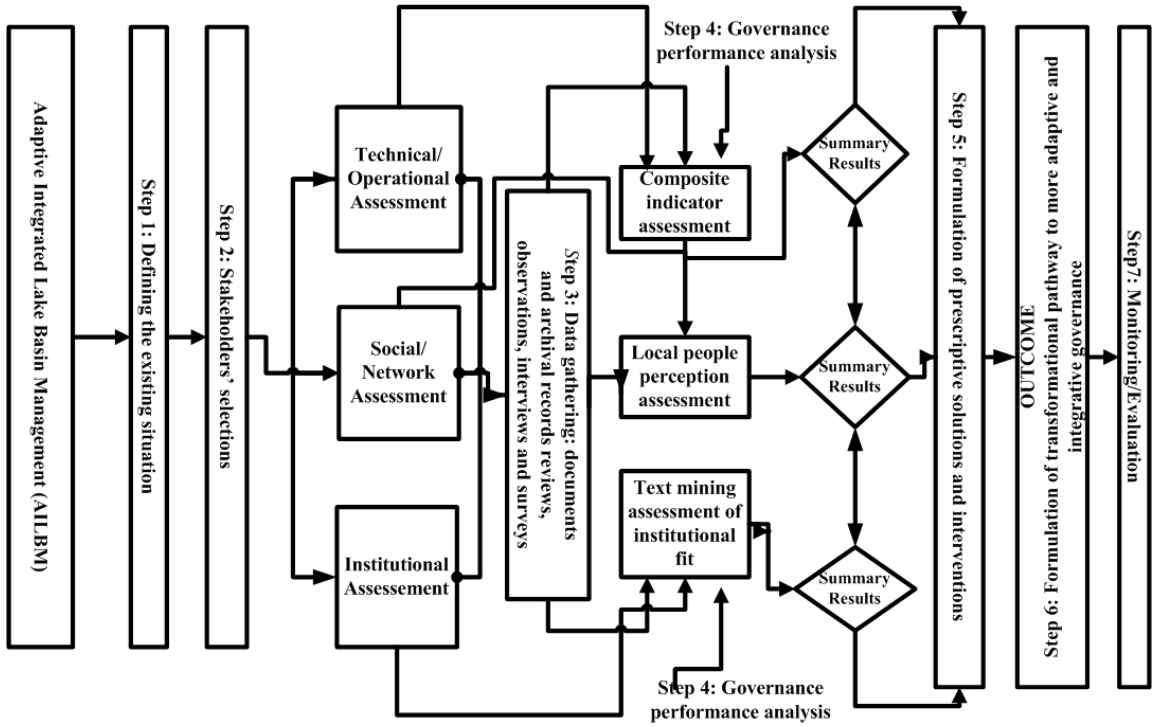

Figure 2. Multidimensional AILBM governance performance assessment process.

4.1. 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. It focuses on the need for proper understanding of the hydrological and socio-economic characteristic which is critical to performance assessment and analysis. This involves intensive reviews on the current management and governance system and challenges as well as inventories of stakeholders and other interest groups. 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. Operators of water services as well as relevant committees/agencies, academic institutions, NGOs/CBOs and private sector could also be inventorised. 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.

4.2. Step 2: Stakeholders' Selection

After the first inventory of stakeholders is made in step one, stakeholder groups should be approached for in-depth interviews, surveys and focus group discussions.

4.3. 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: experts/professionals interview surveys used for evaluation of overall water governance performance and local communities perceptions from the stakeholders assessment approaches. To assess the governance performance, experts/professionals are requested to complete questionnaires developed for this purpose; and to determine the local communities' perceptions on governance performance, interviews and surveys could be targeted at the participants drawn from members of households in the communities. Institutional assessments may also require quantitative analysis such as 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.

4.4. Step 4: Governance Performance Analysis

The analysis deploys qualitative and quantitative research tools in order to reveal and distill the main status of governance performance, to make recommendations and provide well thought-out pathways and strategies to direct transformation. A consistent and objective assessment begins at the conceptual dimension using the AILBM framework, 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 assessment of the relevant and related water and other natural resources institutions using a combination of text mining analysis and other content analysis approach [56,58,157,158]. Second level focuses on social/networks analysis involving the use of the mixed method approach to measure the local communities' governance performance perception [158–160]. Third level targets the technical/operational assessment using the quantitative approach of Lake Basin Water Governance Performance Composite Index (LBWGPCI) [158,161]. 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.

4.5. Step 5: Collation and Triangulation of Results to Determine Governance Performance Status

At this stage 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. It could also identify the actors, their roles and responsibilities and the degree of the impact of their activities as well as their level of contribution to the improvement of the adaptive and integrative capacity of the system. Further examination and inventorization of the resource system can be conducted here to determine how they are exploited, utilized and managed. These results can also show the degree to which the institutions support and enhance the operations of the resource management system, and have 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 resource governance system and further confirm earlier results obtained from the diagnostic components by revealing the degree of the adaptability, collaboration, integration and resilient capacity of the governance and management system. The level of stakeholders' connectedness and involvement

to mainstream resilience, the degree of their participation, their level of access to environmental knowledge and information and their level of willingness to support improvement can be determined.

4.6. Step 6: Formulation of Prescriptive Solutions and Interventions

This is the stage where solutions are prescribed for governance challenges towards more adaptive and integrative solutions. The recommended solutions are distilled from the 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 transformation pathway towards more adaptive and integrative governance.

4.7. Step 6.1: Formulation of Transformation Pathway Towards More Adaptive and Integrative Governance

The main outcome of the governance performance assessment is the determination of the systems' level in the Holling [162] 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 stakeholders around common vision, mobilizing social capital, redesigning flow of political authority and resources, challenging technical and legal frameworks and encouraging integration of local knowledge with experimentation and new scientific frameworks [163].

4.8. 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.

5. Application of the Framework

5.1. Songkhla Lake Basin Case Study

The Songkhla Lake Basin (SLB) was chosen because it is the largest lagoon system as well as the only lake basin in Thailand and is made up of 12 sub-basins covering three provinces in Southern Thailand: Phattalung, Songkhla and Nakhon Si Thammarat [164,165]. It supports the livelihood of more than 1.7 million members of the population [166], and the major economic activities in the Basin include, rubber plantations, paddy rice farms, fruit tree orchards, fishery, aquaculture, animal husbandries and a high attractive tourism [167]. The SLB is currently challenged with myriad of socio-ecological and institutional issues. The fundamental cause of these problems is the management approach, which regards water as an open access resource and the impact of indiscriminate discharge of wastewater [168]. This has resulted in significant challenges for the existing water management and governance despite several attempts by relevant stakeholders to rescue the SLB from imminent ecological disaster (Figure 3).

The diagnostic and prescriptive aspects of this study were based on the application of a mixed method or integrative research (qualitative and quantitative) [169,170] for investigations and data analysis. The qualitative case study approach explored and evaluated the diagnostic and prescriptive components to develop a rich and synthetic understanding of the governance structure and dynamics of decision-making [171]. The quantitative approaches used in the application of this framework include: local people perception analysis [158,159]; performance evaluation using composite index [158,161] and application of text mining equations and computation for institutional analysis [157,158]. Qualitative approaches of interviews, observations and content analysis were used to support the quantitative. It is expedient to point out that the purpose for highlighting the SLB example in this paper is not to present an in-depth analysis, but to demonstrate the potential of the application of this framework.

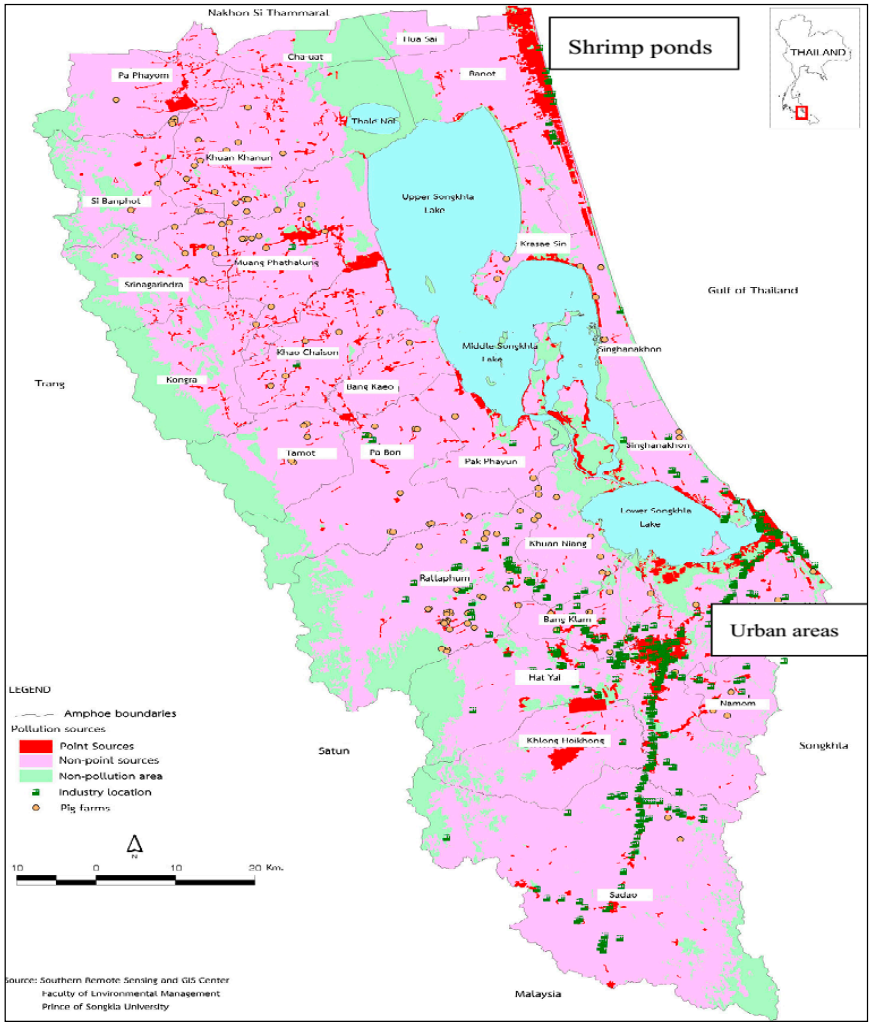

Figure 3. Map of Songkhla Lake Basin showing the lagoon system of the Songkhla Lake in Thailand, Source: [172].

5.2. Results of SLB's Diagnostic Assessment

5.2.1. Actors

A diagnostic assessment of the actors involved in the governance and management revealed that water management and governance are centrally coordinated from the national government's ministries, which supervise more than 30 departments (agencies) with various roles in water resources management. These departments, in the spirit of de-concentration, delegate responsibilities to their provincial/regional department offices under the direct supervision of the provincial governors who are career civil servants appointed by the Ministry of Interior (MOI) [173,174]. Provincial/regional offices of the central government ministries and deconcentrated departments (under the direct supervision of the provincial governors) are responsible for the direct management and governance. The two Basin committees with similar mandates established by the Ministry of Natural Resources and the Environment (MONRE) were the Songkhla Lake Basin Development Committee (SLBDC), established in 1993 and disbanded in 2015, and the Songkhla Lake Basin Committee (SLBC), established in 2007, by the Department of Water Resources (DWR) [166,174–176]. Also in existence are some active development-related civil society organizations in the Basin [165,166,177–179]. Other actors include the fishers, farmers, *etc.* The diagnostic assessment revealed the relationship and interactions between these actors as it relates to water governance.

5.2.2. Sectors

The diagnostic assessment revealed that some of the economic activities include agriculture, industrial/manufacturing, trade, services and tourism, and the agricultural sector is the major water user. The fisheries sub-sector account for a large part of the economic activities, *i.e.*, fishing and aquaculture; some businesses and profit related concerns as well as government offices [172]. All these sectors contribute negatively to the Basins' well-being leading to natural resources deterioration and also pose harm to humans and the ecosystem, as well as, positive impacts by providing livelihood support. Studies on other lakes also show the impact of sectors like agriculture on water quality and quantity on the ecosystems [105,148,180].

5.2.3. Stressors

Stressors investigations revealed that actors and sectors contribute to cause diverse effects 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 [172,181–183]. The sources of stressors are water pollution from households and industries, and deforestation of the catchment area. Industrial water pollution originates mainly from rubber and food industries, agricultural pollution from the shrimp farms, pig farms, crop farms and rubber plantations, tourism from the home-stays, restaurants and hotels, and the human communities around the Lake [104,168,181–191]. Of increasing concerns is the possibility of the negative effects of climate change on the SLB [172]. The assessment revealed the impact of stressors following other similar studies [6,106].

5.2.4. Institutions

The assessment discovered at least 28 water related laws administered by over 30 departments overseeing water issues in eight ministries [192,193]. The laws governing water and other natural resources were derived from related legal instruments regulating natural resources for the whole country. Noticeably, was the fact that the same law may regulate more than one single aspect of use, however, no umbrella legislation linking these laws and codes exists [194], and coordination and cooperation are very weak. In order to address these challenges, the government established the National Water Resources Committee (NWRC) in 1996, co-ordinated by the Department of Water Resources (DWR) [175,176]. The major deficiency is the lack of a specific law that makes reference to the SLB and no legally authorized agency/body responsible for its management [195–200]. The results indicated serious institutional fragmentations and gaps, conflict issues, obsolete and archaic laws and priority focus on resource utilization to the detriment of conservation and protection [157,158,176,192,193,195,201–204].

5.2.5. Resource Systems

The complex ecosystem is rich in biodiversity with multitude of flora and fauna species including endangered species as well as two national parks, two wildlife sanctuaries, two non-hunting areas and two forest parks. It is one of the two lakes in the world that is home to the Irrawady dolphins (Orcaella brevirostris) [104,181] and about 53 forest reserves [172]. An estimated 450 fish species and 30 shrimp species were found in Songkhla Lake in addition to serving as an important nursery ground for many economically important species of fish, crabs and shrimps [194,205–207]. The diagnosis further revealed that aquatic resources are the most exploited and are the most endangered [157,158].

5.2.6. Resource Management System

The water resources management system is the traditional top-down management approach with a strong national focus administered by over 30 departments in eight ministries [192,193].

Inadequate development of the local and Basin institutions, inhibits effective implementation of the decentralization policy of the government. It is mainly a command and control resource management system that situates all major decisions on water and other natural resources management at the central government level occasioned by weak coordination mechanisms [176,182,201,202,204]. The decentralization of responsibilities to the Local Administrative Organizations (LAOs) has not yielded successful results because central government agencies' officers in the provincial/regional offices under the direct supervision of the Provincial Governors are more accountable to their superiors at the center because of career progression and other related incentives. Thus, vertical accountability and interaction tend to take more priority than the horizontal communications [208–211]. Also, the SLB does not have specific government agencies responsible for its management [157,158].

5.3. 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. Collaboration and participation were also assessed, as well as, the resilient capacity of the institutions and degree of decentralization. Table 2 summarizes the results of the governance performance assessment and measured the diagnostic components against the prescriptive components to determine the overall performance status of the water governance.

Table 2. 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.

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 [161]. This assessment component is based on the concept that lake basins are complex ecosystems and should be managed with considerations 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. The results show that the level of integration is very low and often lead to constant conflict between multi-agencies with separate mandates [209]. The LBWGPCI for these groups of indicators recorded the lowest score in the ranking system, showing serious poor performance.

This study revealed that the elements of adaptability, collaboration, integration and resilience are currently lacking in the existing water governance instruments. Text mining analysis revealed that the conventional resource management representative terms highest score was 6 percent (very low) while, the representative terms for adaptive and integrative elements recorded zero percent [157].

The centralized characteristics of public administration challenged full implementation of the Thai constitutional provisions on decentralization, most likely because the system practices de-concentration. Effective decentralization requires that stronger efforts be put in place to ensure effective and efficient vertical and horizontal coordination, collaboration and interaction. Stakeholders observed that the direct supervision of the LAOs by the line officers of the central administration is an indirect way of achieving re-centralization rather than decentralization.

Participation and collaboration assessed the degree of involvement, engagement and partnerships of actors (stakeholders). The study revealed high level of stakeholders' disconnectedness resulting in low level of participation and involvement as well as in the level of collaboration and partnership with the private sectors. Lack of cooperation and stiff rivalries among the departments in the ministries and the deconcentrated departments' offices under the supervision of the provincial governors were big issues [208]. The Lake Basin Water Governance Performance Composite Index (LBWGPCI) showed poor performance capacity for coordination, decentralization and participation.

5.4. Specific SLB 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. Overcoming these challenges will require among others, a performance assessment framework that is diagnostic, prescriptive and iterative in approach and that encourages adequate built-in feedback mechanisms. 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. The recommended prescriptive action for improvement and transformation towards more adaptive and integrative system based on the AILBM includes:

I Create a coordinating and policy harmonization mechanism that will promote coherent actions among all the formal and informal actors involved in the governance using the Songkhla Lake Basin Committee (SLBC) to, possibly, form the nucleus of the proposed coordinating mechanism for the SLB;
II Enact the water draft law;
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 Give Local Administrative Organizations more powers to act on governance provisions and upgrade their human, political and financial capacities;
V Allow LAOs to budget for certain protective and regulatory measures in the SLB;
VI Involve Lake Basin communities and lower decision units in protecting and managing the Basin because they are willing to commit their time and resources;
VII Require regular engagement, deliberation and negotiations to improve the relationships between regulators, users and Basin communities in order to overcome the mistrust and lack of confidence which often lead to conflicts;

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 these areas as well and not just water governance as was done in this study.

SLB Transformation Pathway to More Adaptive and Integrative Governance

The AILBM supports prescriptive actions of transformational processes towards creating more adaptive and integrative sustainable governance systems for lake basins. Figure 4 shows the proposed transformation processes for Songkhla Lake Basin, which include three major prescriptive actions:

(i) The organization of two separate roundtables (technical and institutional reviews). Objectives of roundtables, organized under the supervision of the Ministry of Natural Resources and Environment (MONRE), were to develop strategies and guidelines for a transformation process and coordinate participation of all state and non-state

(ii) Formation of coalition of formal and informal actors (*i.e.*, all stakeholders), called the people transformation platform. Objectives of coalition were to produce Songkhla Lake Basin Development Roadmap (SLBDR). The Roadmap is based on roundtables' reports and as well as stakeholders buy-in and support. The Roadmap leads to the establishment of a formal management and policy harmonization organization with adequate legal mandates to implement the SLBDR.

(iii) International Partners Development Conference. The conference goal is to draw financial, technical and knowledge assistance for the re-development and reorganization of the SLB. The conference outcome will support and lead the execution of the transformative process of Songkhla Lake Basin.

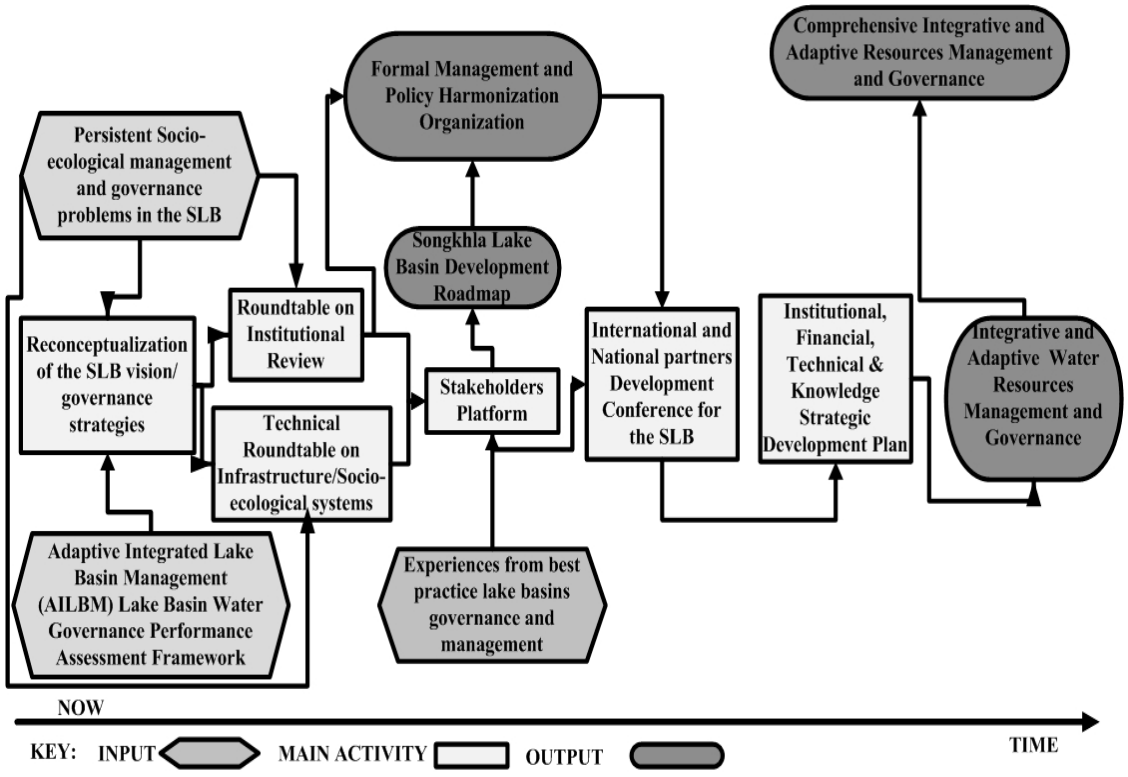

Figure 4. Possible transformation pathway towards adaptive and integrative Songkhla Lake Basin water resources management and governance.

6. Discussion and Conclusions

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. The framework recognizes that individual lakes have unique characteristics, differing communities and cultures, and are situated in countries with different governance systems as well as the exceptional dynamics and complexities of the ecosystem and the interactions and counteractions arising from the economic value of lake resources. The central role of actors in creating resilient institutions are prioritized 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 AILBM is designed to assist sustainable governance in resolving conflicts among multi-sectoral demands, actors and users of the 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 stays 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. 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 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's 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. This framework is contextual in nature, which makes it adaptable to different situations and locations. For instance, if the AILBM is applied to two different lake basins the results will be different and specific for each. Also, the components of the framework are generic to capture the essence of the complex, dynamic and peculiar nature of lake basins as well as provide 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 pathways toward more adaptability and integration. 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 relate with the uncertainties and complexities of climate change, biodiversity, human interactions and extreme hydrological events. 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 challenges 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, which makes information and data to be scattered in various related and unrelated sources. This framework, however 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.

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

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Abbreviations

The following abbreviations are used in this manuscript:

AILBM	Adaptive Integrated Lake Basin Management
AMG	Adaptive Management and Governance
DWR	Department of Water Resources
ILEC	International Lake Environment Committee
ILBM	Integrated Lake Basin Management
IWRM	Integrated Lake Basin Management
MONRE	Ministry of Natural Resources and the Environment
MOI	Ministry of Interior
MOAC	Ministry of Agriculture and Cooperatives
NWRC	National Water Resources Committee
LAOs	Local Administrative Organizations
LBG	Lake Basin Governance
LBMI	Lake Basin Management Initiative
RCSE	International Lake Environment Committee
SES	Socio-Ecological System
SLB	Songkhla Lake Basin
SLBC	Songkhla Lake Basin Committee

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