Guidelines: Ecosystem Service Shared Value Assessment (ESSVA)

for Integrated Lake Basin Management (ILBM)

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-Toward Participatory Assessment of the Perceptional Profiles of Ecosystem Service for Lake-River-Coastal Basin Management-

1. Introduction

Planning and managing a basin system of lakes, rivers, and coastal marine environments for sustainable use of their land and water resources requires holistically addressing various socio-economic, political, and environmental issues. Though unintended, the decisions to fulfill the stakeholder needs within and outside the basin also alter the basin ecosystems and their service profiles. The basin stakeholders today consider the long-term sustainability of the basin Ecosystem Service (ES) rather than the resource values in the narrow sense of the word. However, integrating the ES implications into planning and managing a basin system takes much work. There are two kinds of challenges, both of which pertain to conceptual and methodological issues. The first (1) relates to the very concept of ES, which consists of four subcategories of services, i.e., Provisioning (PS), Regulating (RS), Cultural (CS), and Supporting Services (SS), each requiring specific assessment and valuation approaches. The second (2) relates to integrating the ES assessment results into the planning and management process.

In addressing (1), this guideline presents the concept of Ecosystem Shared Value Assessment (ESSVA), which involves the identification of the Ecosystem Service Perceptional Profile (ESPP), a questionnaire survey approach complemented with the factual data which forms the basis for determining the Ecosystem Service Factual Profile (ESFP). In addressing (2), this guideline discusses the usefulness of the Integrated Lake Basin Management (ILBM) approach. The author will summarize some literature on integrating ES considerations into the basin planning process in Section 2. Precisely how the ES considerations, as represented by ESSVA, may be embedded into the Integrated Lake Basin Management (ILBM) and the Integrated Lentic Lotic Basin Management (ILLBM) frameworks will be elaborated in Sections 1 through 4. The document also refers to the applied study examples in Sections 5 through 7.

2. Ecosystem Service Framework (ESF)

2-1. The Ecosystem Service Concept, An Overview

According to the definition of the Millennium Ecosystem Assessment (MEA) framework[i], ES consists of subcategories of Provisioning Service (PS: food and fiber, fuelwood, genetic resources, bio-chemicals, natural medicines, and pharmaceuticals, ornamental resources, animal products, freshwater, Regulating Service (RS: air quality maintenance, climate regulation, water regulation, erosion control, water purification, and waste treatment, regulation of human diseases, biological control, pollination, storm protection), Cultural Service (CS: cultural diversity, spiritual and religious values, knowledge systems (traditional and formal), educational values, inspiration, aesthetic values, social relations, sense of place, cultural heritage values, recreation, and ecotourism), and Suppo1ting Service (SS: suppo1ting services are those that are necessaiy to produce all other ecosystem services such as primaiy production, production of atmospheric oxygen, soil formation and retention, nutrient cycling, water cycling, and habitat formation).

In the development and implementation of a basin management plan, the questions that typically arise on its ES framework may include;

a) What is the current understanding of the basin stakeholders about the basin ES?
b) What policy interventions should be introduced to enhance the sustainable use of the basin ES?
c) What lessons have been learned to pass on to future generations concerning the basin ES?
d) What is the status of ES regarding its four component services, and how well are PS and RS balanced today?
e) What is the prospect of achieving the desired balance between PS and RS?

Answering these critical questions is quite challenging. For example, Scott et al. (2014) consider that, although the Ecosystem Approach (i.e., the ES concept) provides a valuable framework for managing ecosystems, the concept needs to evolve further adequately inform decision-making on ecosystem management. The generic barriers to using the Ecosystems Approach in the policy and decision-making process are listed in Box 1 below.

Box 1. Generic Barriers to Using the Ecosystem Approach in Policy and Decision-Making Processes (source: Scot et al., 2014)

- Inconsistent approaches to ecosystem service modeling, assessment, and valuation.
- Lack of knowledge and appreciation of the Ecosystem Approach and the Ecosystem Services Framework and terminology amongst the built environment and business professions.
- Highly academic vocabulary and rhetoric that is not easily understood or implemented in practice by people at the grassroots level.
- Prevalence of complex ecosystem tools and ecosystem service models inaccessible to people on the ground.
- Cherry-picking of selected ecosystem services leads to non-systemic application and perceived deficits in understanding ecosystem services that are difficult to assess (e.g., cultural services).
- Economic valuation of nature is controversial and fails to capture the intrinsic (non-use) value.
- Ecosystem services are data-heavy and resource-intensive, which leads to the use of other techniques.
- Institutional inertia is prevalent amongst decision-makers and consultants who are reluctant to adapt working practices to encompass new and time-consuming approaches.
- Resource limitations make new work practices challenging to employ.
- No system exists that can be used reliably to test cumulatively and comparatively the different streams and trade-offs within different Ecosystem Services. For example, testing cultural heritage against water quality and the effect of one on the other.
- Mistrust or misunderstanding of ecosystem science.

Costanza et al. (2017) state, based on the literature review published over two decades since its inception in 2005, “The interaction between built, social, human, and natural capital affects human well-being. Built capital and human capital (the economy) are embedded in society. Ecosystem services are the relative contribution of natural capital to human well-being; they do not flow directly. Therefore, it is essential to adopt a broad, transdisciplinaiy perspective to address ecosystem services.”

2-2. Assessment and Valuation of Ecosystem Services

According to Berghöfer et al. (2015), “There is a considerable diversity of methods suitable for examining ecosystem services. Different methods generate different results because they represent different perspectives or choose different foci. Not all methods are suited to examine all ecosystem services, and not all are suitable for every assessment purpose. As a crude characterization, however, we can say that:

- **bio-physical methods** focus on ecological, hydrological, and atmospheric processes, among others;
- **economic methods** consider aspects of scarcity and efficiency, and many are used to calculate economic benefits, mainly in monetary terms;
- **social valuation and anthropological methods** examine stakeholder perspectives, particularly concerning the social and cultural meaning
- **integrated methods** seek to combine supply and demand data (e.g., using modeling)
- **(other) decision support instruments** process diverse data into scores, ratios, or qualitative conclusions (e.g., Cost-Benefit Analysis, Multi-Criteria Analysis).”

In a similar vein, Ervin et al. (2014) provide the following valuation spectrum in their article, “Principles to Guide Assessments of Ecosystem Service Values:

1) Quantification

Biodiversity and ecological integrity are highly challenging to quantify, and though there are various proposed approaches, there is much room for improvement. Also, many costs and benefits can be quantified, as exemplified by the number of lives saved through disaster planning and recovery. However, putting dollar values on human life or nature in certain situations may be inappropriate.

2) Monetization

We can monetize some benefits, typically because they are sold and bought in the market with observable prices, such as food, timber, and energy. Other services, such as flood mitigation or the social cost of greenhouse gas emissions, may not be traded, but we can estimate their monetaiy values.

3) Qualitative analysis

Other ecosystems’ benefits, especially cultural ones, may hold significant value. However, these values are not readily quantifiable and may be more appropriately analyzed qualitatively with interview and survey data.

In a different vein, ES mapping has been greatly emphasized in the last decade.[ii]

2-3. Applied ES Assessment Methods to Planning and Management

There are great many applied ES assessment methods reported in recent literature. For example, Harrison et al. (2017) undertook a rsearch "to develop a set of decision trees to structure and guide the process of selecting biophysical, socio-cultural and monetary methods for ecosystem service assessment. The trees are based on an assessment of reasons given for method selection in 27 case studies which could be broadly categorised into stakeholder-oriented, decision-oriented, research-oriented and method-oriented considerations." In the meantime, Costanza et al.(2017) state, "New formal valuation approaches acknowledge the variety of individual and group dimensions on the valuator side and incorporate the dynamics of natmal capital and ecosystem services at multiple geographical and temporal scales. This type of policy or project assessment generally includes identifying and mapping, modeling the properties and values of landscapes and ecosystems, eliciting social preferences, deliberative processes, ranking, and quantifying the potential benefits of the proposed policy. This so-called total system approach implies estimating the value of systems and their services, including the causal mechanisms in service-producing ecological systems and the contributions by human action to make possible services actual and on the appropriate spatial and temporal scales." He also states, '"Ecosystem services' (ES) are the ecological characteristics, functions, or processes that directly or indirectly contribute to human well-being: that is, the benefits that people derive from functioning ecosystems." He then goes on to state, "it is important to distinguish between ecosystem processes and functions, on the one hand, and ecosystem services on the other." and provides 17 such examples."

In the meantime, for the puspose of this article, introduced below are two rather popular but versatile approaches to applied ES assessment methods, i.e., 1) the Inventory Method and 2) the Mapping Method.

1) Inventory Method

According to Orenstein et al.(2012), the Inventory Method is a method aimed at inventorying a broad range of services and assessing spatial variation in the presence and amount of services across large scales along ecological gradients (e.g., country or continental). This approach allows characterizing ecosystems, not by using classical habitat classification approaches but by examining similarities between ecosystems in what they provide to people an assessment system of data sets and models to help users understand the provision of specific ecosystem services and the distribution of these services geographically across the province. Results are provided in a report or viewed in an online mapping application. Ecosystem Service Assessment (2022) introduced their system called "Ecosystem Services Inventory (ESI)" and presented it as "a credible, science-based estimation of the supply of ecosystem services in Alberta." It is based on an assessment system of data sets and models to help users understand the provision of specific ecosystem services and their distribution geographically across the province.

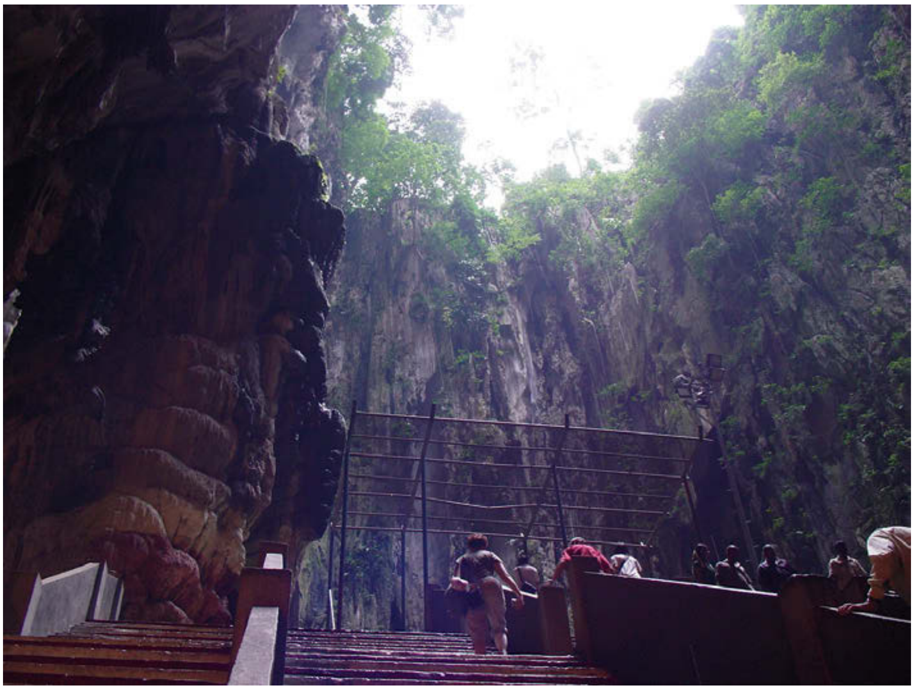
2) Mapping Method

Mapping has been extensively promoted in the EU Biodiversity Strategy for 2020 (European Union, 2022), called Mapping and Assessment of Ecosystems and their Services - MAES. It contributed to the subglobal assessments of ecosystems and ecosystem services under the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES). The fourth technical report (European Union, 2016) maps and assesses the urban ecosystems and their services. The fifth technical report (European Union, 2018) provides an integrated analytical framework and set of indicators for mapping and assessing the condition of ecosystems in the EU. Brouwer et al.(2013) state, "Most provisioning services are, or will be, valued using market prices, and most regulating services are valued using methodologies based on (substitution) costs, where possible; however, the monetary valuation of cultural ecosystem services, mainly using stated preference methods, is much more complicated. It is due to methodological challenges, lack of data, lack of resources to conduct valuation studies, and criticism of using monetaiy non-market valuation in some countries."

2-4. Assessment and Valuation of River Basin Ecosystem Services

Over the past decades, the literature on applying the ES concept to river basin management has significantly increased. For example, Brauman et al. (2014) present a review of ES application in the EU region in their paper entitled "Ecosystem Services and River Basin Management." They state, "This framework is inherently anthropocentric, organizing ecological processes by their effects on human beneficiaries and explicitly connecting ecosystem processes to human welfare." It also says, "The ecosystem services approach facilitates management of a complex system by incorporating important aspects of risk-informed management." Then it concludes that "ecosystem services are a useful tool for river basin managers because they provide a coherent context to incorporate stakeholders and complex biophysical processes into a consistent, learning-based management scheme."

On the other hand, McInnes and Everard (2017) developed a method called the Rapid Assessment of Wetland Ecosystem Services (RAWES). The approach is based on the trained local assessors using a variety of field indicators to assess the positive or negative contribution of over 30 wetland ecosystem services provided at local, regional, or global scales. The outputs are simplified, signaling decision-makers the diversity of interlinked ecosystem service outcomes consequent from management policies and actions. They illustrated through its practical application in over 60 wetland sites supporting the development of a Wetland Strategy for the Metro Colombo Region, Sri Lanka. With the above in the background, introduced in the following section is the Ecosystem Service Shared Value Assessment (ESSVA).



3. What is ESSVA?

3-1. Sharing of ES Values Across the Lake-River-Coastal Basin Systems

Successful management of lake basins requires a shared vision and understanding of the issues and challenges. It also requires the basin stakeholders to overcome differences by identifying and filling the perception gaps between different stakeholders and for the government to listen to the voices of the basin community. Such actions may lead to developing policies and programs that can be widely supported and easily implemented. Further, the basin stakeholders must mutually collaborate within the basins to address their commonly shared problems. The concept of ES would be beneficial for the above process.

On the above premise, we can make two important observations.

First, the lake-river-coastal basin systems form a lentic-lotic water complex compared to the lakes singly existing as lentic water systems. Second, people living in different locations of a basin system invariably possess different ES perceptions.

3-2. Configurational Features of Typical Basin Systems and Sharing of the ES Values

Figure 1 shows the case of a basin consisting of lentic-lotic-lentic-lotic linkages where the interactions of respective stakeholder communities may be complexly intertwined. The inflowing river, lake, and outflowing river form a subbasin uniquely endowed with PS, RS, CS, and SS. During PS pursuits, e.g., lake water withdrawal, the component RS values, such as biodiversity, healthy food chain, and self-purification capacity, might get damaged (see also Nakamura and Rast, ppl3-14 for visual illustrations.)

The overall Ecosystem Service (ES) associated with a river-lake-marine coastal complex provides values (benefits) to be shared by the basin communities. Still, its value would diminish if not adequately managed, and as a consequence, the ecosystem risk would increase. It may be possible to identify and assess future risks and their values using appropriate data and information if they are available. However, even with such data and information, sharing the values and risks across the entire basin would be difficult, not only because the predicted values and risks are often beyond the comprehension of the affected population but also because there are perceptional gaps among different groups of the population belonging to, for example, different sectors, or residing at different basin locations. Further, different perceptional profiles for the same physical existence of a basin complex might prevent equitably sharing the values and risks inherently associated with that basin.

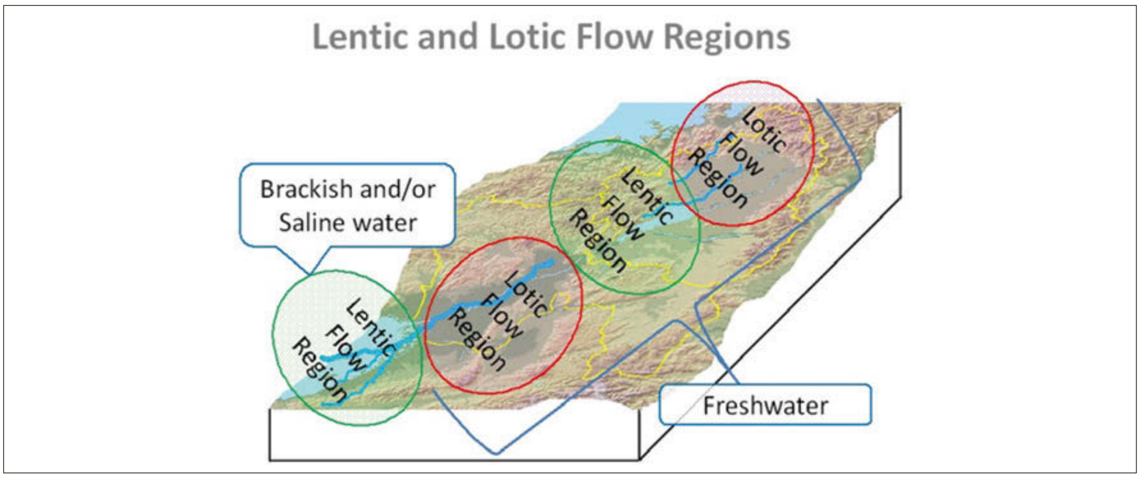


Figure l. A River-Lake-Coastal Basin System with Lentic-Lotic Flow Regions

3-3. ESSVA: A Method for Assessing the Sharing of Ecosystem Service Values

The term ESSVA stands for “Ecosystem Service Shared Value Assessment.” It is a method for assessing the state of the ES shared by the basin stakeholders, with the following aim in mind.

(a) To provide an opportunity for the basin population to undertake a comprehensive assessment of their lake basin ecosystem and ES by helping them to shape a shared vision and common understanding of the issues and challenges facing the lake basin;

(b) To support the participatory basin management process by allowing the stakeholders to recognize and overcome their perceptional gaps.

(c) To guide the government to listen to the community’s voice and allow the government policies and programs to be widely supported and easily implemented;

(d) To form a basis for mutual collaboration within a basin and across basins by enabling stakeholders to discuss their problems based on the same general ES framework;

Conceptually, one can perform ESSVA by assessing the factual profile or the perceptional profile, or both. In other words, ESSVA translates either the “Ecosystem Service Factual Profile (ESFP)” or the “Ecosystem Service Perceptional Profile (ESPP)” or both.

3-4. Factual Profile (ESFP) and Perceptional Profile (ESPP)

The ESFP assessment involves transforming “hard” factual data such as land and water uses, crop types, population distribution, and physical, biological, and chemical assessment through monitoring into ecological service values through 1) Quantification and 2) Monetization, and the results displayed typically using the inventory and mapping methods. In other words, if the factual data of ES are available, one can pursue the ESSVA process by resorting to ESFP. On the other hand, even if the factual data are unavailable, the ESSVA assessment can be performed by resorting to ESPP.

The ESPP assessment requires a questionnaire survey on the perceived magnitude of ES components, for example, on a discrete scoring scale between 1 and 5. While undertaking ESPP assessments can be demanding because of the time and human resources requirements, the whole process of survey design, spreadsheet computation, statistical analysis, and the display of compiled results make ESPP quite helpful both for the survey implementers and the survey participants. In particular, the surveyor and the surveyed communities can flexibly design and implement ESPP to allow maximum interactions between the basin community stakeholders and the authorities responsible for management. For example, they can discuss and determine if the assessment results truly reflect the reality faced by the basin community. Further, the ESPP assessment provides an excellent opportunity to prepare for the future ESFP assessment, i.e., initially, to compile and compare only a subset of the available factual data collected for other purposes, preparing for a more comprehensive ESFP in the future.

4. ESSVA for Participatory River-Lake-Coastal Basin Management

4-1. A Framework of the ESSVA Process for ILBM and ILLBM

Successful lake basin management entails stakeholders engaging in sustainable resource development, use, and conservation, with strong, long-term political commitment. For the above purpose, the stakeholders should be guided to work together to fill the gaps between what they have achieved and need to achieve in continuing governance improvement cycles. The same applies to the cases of managing river-lake-coastal basins. Integrating the ES considerations obtained through the ESSVA process is adaptable to ILBM and ILLBM. ILBM takes into account the biophysical features of as well as managerial requirements for lake basin systems that are associated with the lentic (standing or static) water properties of lakes as well as the inherent dynamics between humans and nature in the process of development, use, and conservation of lake and basin resources. ILLBM also considers the features and requirements for the basin systems interlinking inflowing and outflowing rivers in and out of a lake, the lake itself, and the coastal basin extension of the upstream lake-river complex. As with ILBM, ILLBM also features the gradual, incremental, and long-term process of basin governance improvement.

In the meantime, as discussed in Section 3.3, conceptually, one can perform ESSVA by assessing the factual profile ESFP, the perceptional profile ESPP, or both. Also, as discussed in Section 3.4, in cases when the factual data are unavailable, ESSVA can be performed by resorting to ESPP, which generally involves a questionnaire survey using a scoring scale. In the subsequent sections, the ESSVA discussion will focus only on ESPP, not ESFP. Before describing the details of the ESSVA, however, we need to understand two critical notions about ES; (1) the relationship between the basin configuration and the ES components and (2) the balancing of PS and RS.

4-2. The Relationship between the Basin Configuration and the ES Profiles

Figure 2 is a schematic representation of an example river-lake-coastal basin system where the magnitudes of various ES components, i.e., PS, RS, CS, and SS, characterize the ES profile of this basin. Typically, the subregional ES profiles pertain to the lake's upstream subregion, the lake's immediate shoreline surroundings, the lake itself, the downstream subregion, and possibly the coastal subregion immediately adjacent to the downstream subregion. Tue magnitudes of PS, RS, and CS can differ significantly from one location to another depending on the population distribution, industrial activities, etc., and different categories of land use and conservation. The perceived magnitude of SS is likely to remain constant because the spatial and temporal scales of variations are much greater than the scales of most basin systems.

Referring to **Figure 2**, lakes and their inflowing and outflowing rivers generally provide water for domestic, industrial, and agricultural uses as PS. At the same time, their lakeshores and the riparian buffer zones of rivers serve as habitats for fish and other fauna and flora, providing the RS value. Associated with them also are scenic beauty, environmental amenities, and educational values collectively serving as CCs. The inherently endowed PS values diminish as the population and industrial activities increase around the lake and downstream along the outflowing rivers. As a result, the wastewater discharges and the land use changes can significantly reduce the RS and CC values. In other words, the perceived magnitudes of the subregional PS, RS, and CS in the river-lake-coastal basin systems can vary significantly by location. Unless explicitly shown, it would not be easy to jointly address the need to improve the overall basin governance for sustainable resource use and conservation.

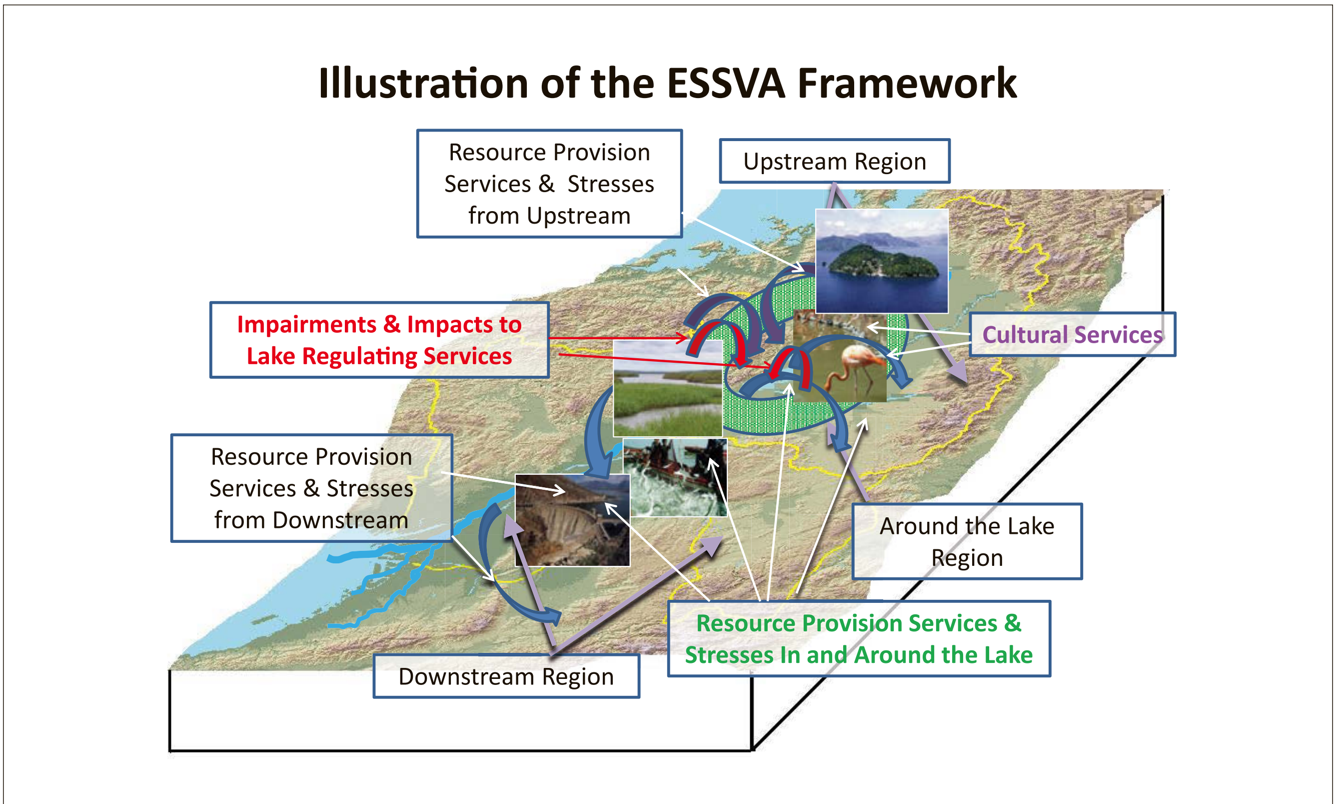


Figure 2. The ES Framework for a Lake-River Coastal Basin System

4-3. Outline of the ESSVA Applied Study Framework

The proposed methodology for undertaking ILBM-ESSVA applied Studies for ESSP is illustrated below (**Figure 3**) and described in the succeeding sections. In essence, the study procedure consists of the following steps:

1) Survey Design and Development of the Questionnaire (basin site identification, relative basin community locations, ecosystem features of the entire basin and the constituent community sub-basins, socio-economic and demographic information of the community and the basin, relationships among communities regarding the distribution of ES values and their usage, development of a Survey Questionnaire with provisions for score-rating of the scale for preference magnitudes, e.g., from one [1] to five [5], etc.)
2) Implementation of the Survey (forming of the survey teams, review, discussion, and confirmation of the Questionnaire and its usefulness for participatory basin management involving various stakeholders from the basin communities, collection and compilation of the Questionnaire survey results from the survey teams, etc.)
3) Data Assemblage and Summarization, together with the implementation of Basic Statistical Analysis (assemblage and summarization of the survey result into a spread-sheet software system, analysis of the obtained data for communication, and development of actionable insights with data visualization in the form of graphs, tables, and charts, etc.)
4) Assess the similarities and differences in ESPP magnitudes among the basin communities, stakeholder groups, and other attributes of the respondents, i.e., age, gender, occupations, years of residence, etc. Collectively, the interpretation of ESPP outputs and joint effort to interpret them would help address the complicated management challenges, including resolving conflicting interests, leading them to jointly pursue sustainable management of the basin ES values.
5) Continue looking for ESFP data to clarify the gap and/or justify the ESPP findings.
6) Feedback to Management Plan (Periodic pursuits of the ESSVA exercises will help strengthen the ILBM Platform Process.)

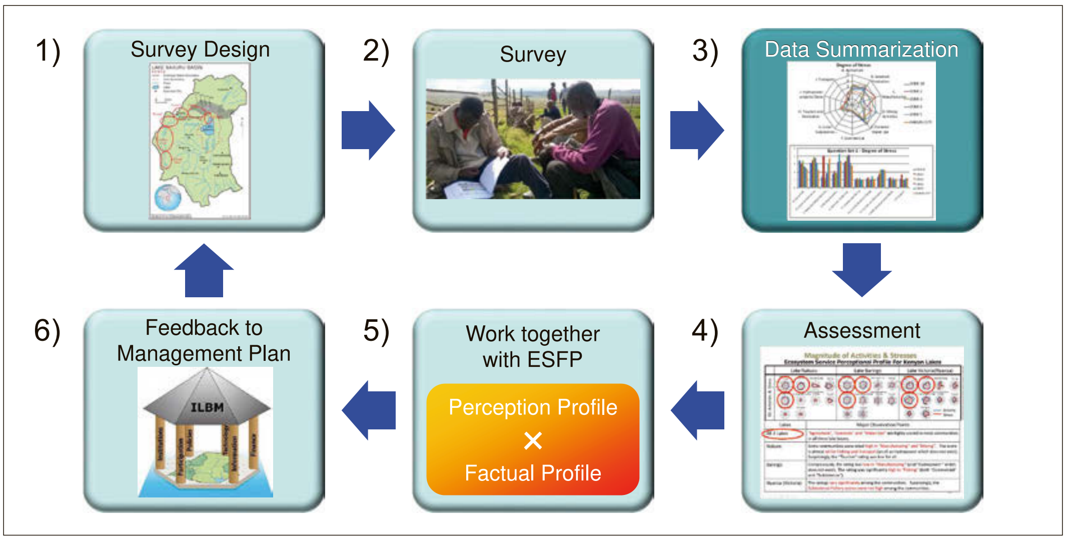


Figure 3. An ESSVA Applied Study Procedure

4-4. The Questionnaire Form

The questionnaire (see **Figure 4**) contains a series of questions regarding the kind of resource values (PS) provided in the drainage basin and the stresses, impairments, and impacts of these values. The respondents are asked to assign an ordinal ranking score between 1 and 5 by referring to illustrative images (photos) of the perceived prevailing conditions. It should be designed to suit local situations.

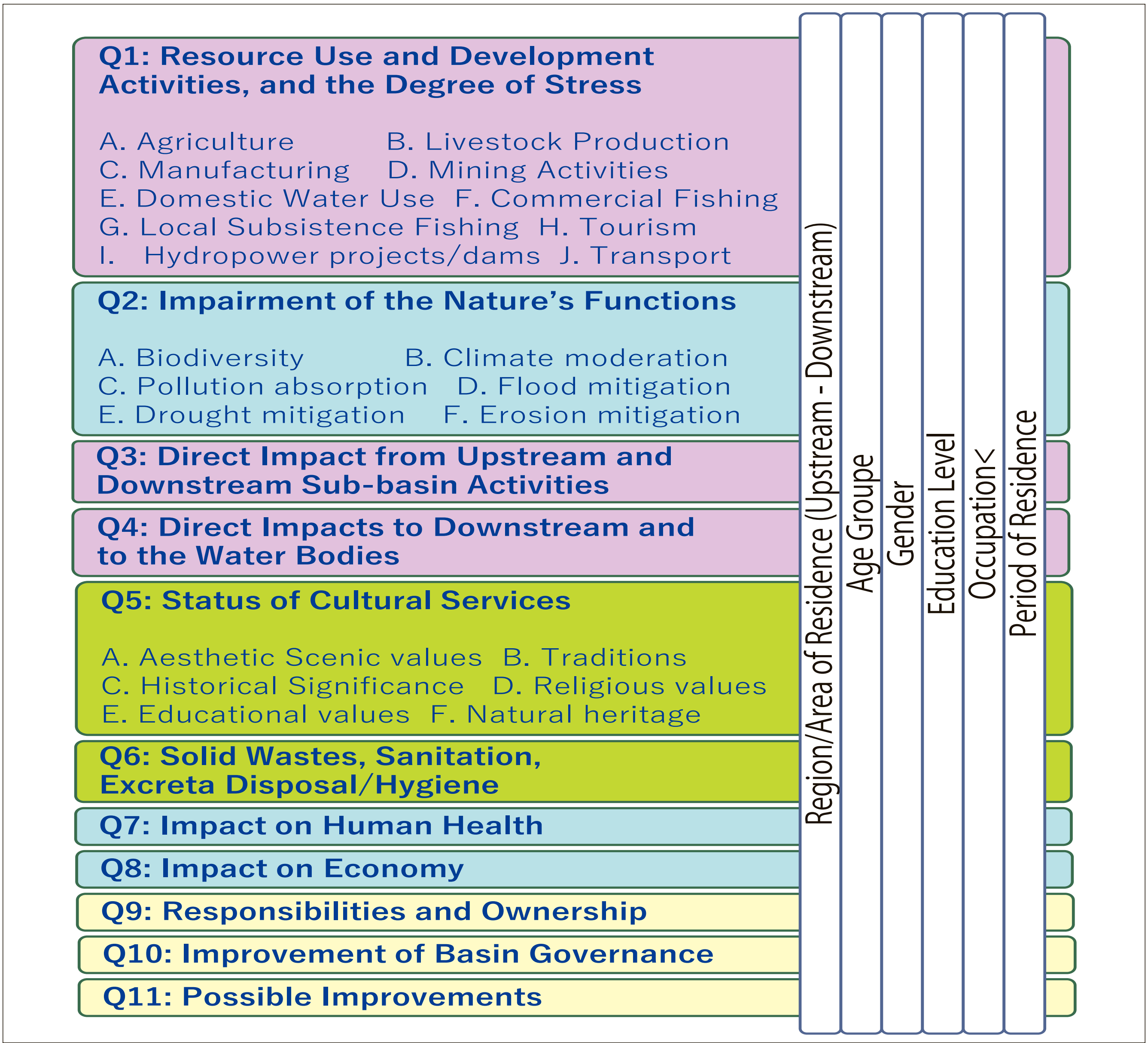


Figure 4. Structure and Contents of the ESSVA (ESPP) Questionnaire

images (photos) of the perceived prevailing conditions. It should be designed to suit local situations.

4-5. Participatory Approach

4-5.1 Participatory Development of an ESSVA Questionnaire

As noted above, in most lake basins, it is generally difficult to obtain data and information on ESFPs. Therefore, in most cases, the initial focus of ESSVA, after a preliminary consultative process involving hearing and interactive discussion on the occasion of community gathering **(Figure 5)**, will be on collecting data and information for ESPPs, later on incorporating ESFPs as data and information become available. This section describes the structure and content of questionnaires used to develop ESPPs.

Figure 5. Participatory Engagement of the ESSVA Respondents
(From the field survey scenes of the Kenyan and Malaysian ESSVA teams)

4-5.2 ESSVA Subjectivity Mediated by the Cyclic Process of ILBM

While the ESSVA methodology has been regarded as a valuable tool for enhancing stakeholder participation in ILBM, some concern has arisen about the inherent subjectivity in the magnitude of ESPP values and their statistical confidence levels. However, in applying to the ILBM process, the pilot project implementation teams have agreed that the above methodological shortcomings will not seriously hinder the adoption of ESSVA in the ILBM Platform Process

because of its cyclic nature. The Platform Process features gradual, incremental, and long-term improvement in cycles of the Six Pillars of Governance, i.e., (1) Institutions to manage the lake and its basin for the benefit of all lake basin resource users; (2) Policies to govern people's use of lake resources, and their impacts on lakes; (3) Involvement of People to facilitate all aspects of lake basin management; (4) Technological Possibilities and Limitations that are often quite dictating regarding long-term decisions; (5) Knowledge and Information of traditional, as well as modern scientific nature, forming the basis for informed decisions; and (6) Sustainable Finance to support the implementation of all of the above activities. Thus, the subjectivity of ESPP with ambiguity in the assessment results will generally be compensated for by the ILBM Platform Process.

5. ESSVA Survey and Analysis of Outputs

5-1 The Survey Implementation

The survey is implemented by administering the questionnaire to the target stakeholders in an interview or meeting setting (focus group discussion). Depending on the objectives, scope, and availability of resources and for ease and convenience to the prospective respondents, the questionnaire may be appropriately amended. An example of the ESPP score rating is shown in **Table 1**.

Table 1. Meaning and Interpretation of the ESPP Survey Scores

Score	Meaning	Interpretation of the ESPP Status
1	None	Problem-free situation
2	A little	The situation is indicative of problems requiring a minor level of remedial measures.
3	Moderate	The situation is indicative of problems requiring a moderate level of remedial measures.
4	Much	The situation is indicative of problems requiring a significant level of remedial measures.
5	Very much	The situation is indicative of problems requiring an intensive level of remedial measures.

5-2 Survey Data Compilation

The questionnaire survey generates data compiled in a spreadsheet to facilitate easy data handling. A spreadsheet template may be customized to suit specific local needs. A schematic image of the data system is shown in **Figure 6**.

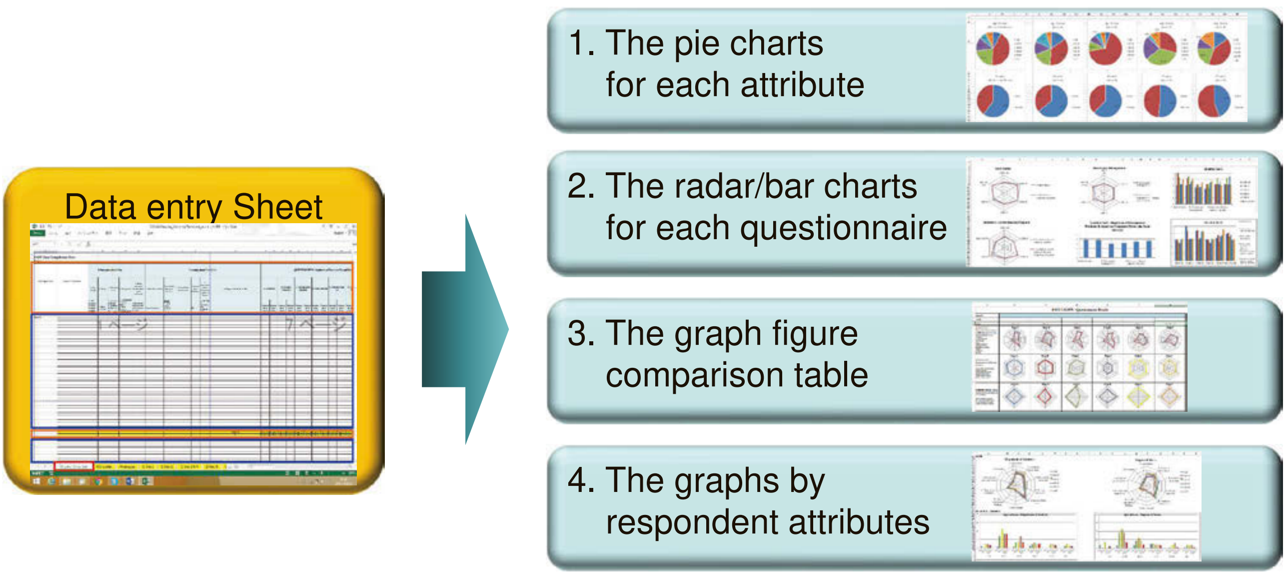


Figure 6. A Conceptual Image of the ESSVA spreadsheet Data Transformed into Output Displays

5-3. Data Analysis and Assessment

The questionnaire survey results should be analyzed to determine the differences in perception and possible reasons. For example, differences in perception may exist depending on the relative locations of the respondents in the basin (such as upstream or downstream, and rural or urban) or the socio-economic status of the respondents (such as age, gender, education level, occupation, and residency period in the basin). The average score of a specific item should be used to evaluate the status and interpreted as shown in **Table 1**.

5-4. Display of ESPP Outputs

5-4.1 Graphical Displays

The ESPP assessment of a particular basin is carried out using a questionnaire survey form. The form features the visual images of ES components associated with the basin. The basin stakeholder groups respond by assigning scores to the individual images according to their perceived magnitude of importance resulting in the outputs in the form of radar charts, the details of which will be discussed in Section 6.

5-4.2 Statistical Analysis

Because the ESPP approach in the ESSVA involves questionnaire surveys of stakeholder groups involving multiple factors (e.g., multiple numbers of ES components, multiple numbers of stakeholder groups, multiple numbers of attributes associated with different stakeholder groups, etc.,) the statistical analysis to be employed has to be related to "hypothesis testing of means that tests whether or not the means of different samples or subgroups of the same population are equivalent." The most widely used method is ANOVA[iii], or the "Analysis of Variance" technique, which tests the difference between two or more means and generalizes the t-test beyond two means.

6. ESSVA Application for Some Kenyan Lake Basins

6-1. ESSVA (ESPP) Survey Map

Figures 7-a, **7-b**, and **7-c** show the ESSVA (ESPP) survey maps, each for Lake Baringo, Lake Nakuru, and Lake Victoria (Nyanza Bay), for which the ESSVA pilot project was undertaken from 2015 through 2019. Lake Baringo is a freshwater lake located in the northern part of the Kenyan Rift Valley lake system, at about 1,000 masl (meters above sea level), some 220 km from Nairobi. It has a surface area of 130 km2, with a mean depth of some 5m. It serves water for humans and livestock and supports local fisheries and minor tourism featuring rich biodiversity and ethnic and cultural heritage. Lake Nakuru is a saline lake and part of the Kenyan Rift Valley lake system, some 160 km northwest of Nairobi, at an altitude of 1,759 masl. The lake has a surface area of 40–60 km2 and an average depth of 1 m. The lake and its surrounding shoreland constitute the Nakuru National Park, famous for the flamingo migrations, but it immediately borders Nakuru City with a population of 0.6 million. The Nyanza Bay (Gulf) is situated on the northeastern corner of Lake Victoria. It has a surface area of 1,400 km2, a mean depth of 7 m, and a maximum depth of 30 m. Its basin encompasses several municipalities, including Kisumu City, the capital of this region of Kenya, harboring a population of some 0.6 million. Many artisanal fishing communities and fish landing sites for pelagic fishery fleets along the lake shore exist.

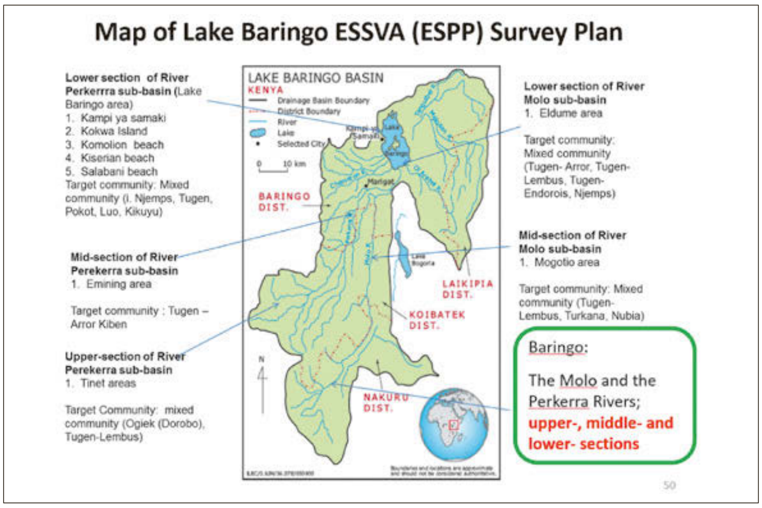


Figure 7-a. ESSVA (ESPP) Survey Map and the Basin Community Scenes of Lake Baringo

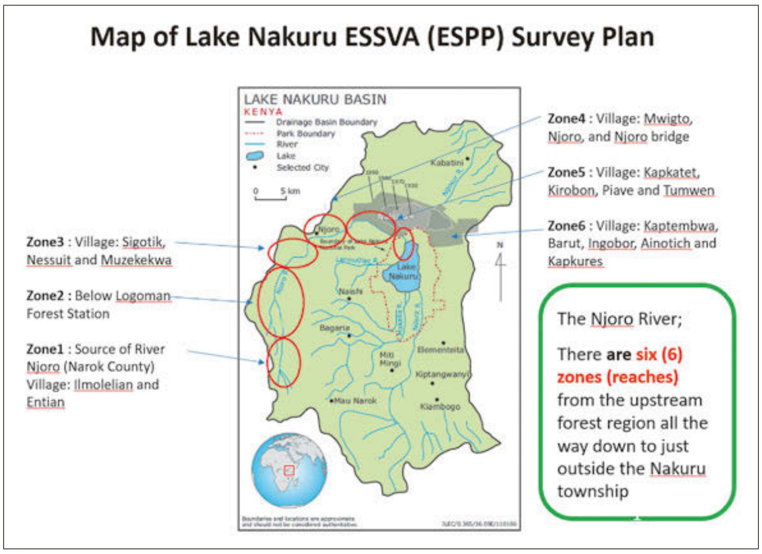


Figure 7-b. ESSVA (ESPP) Survey Map and the Basin Community Scenes of Lake Nakuru

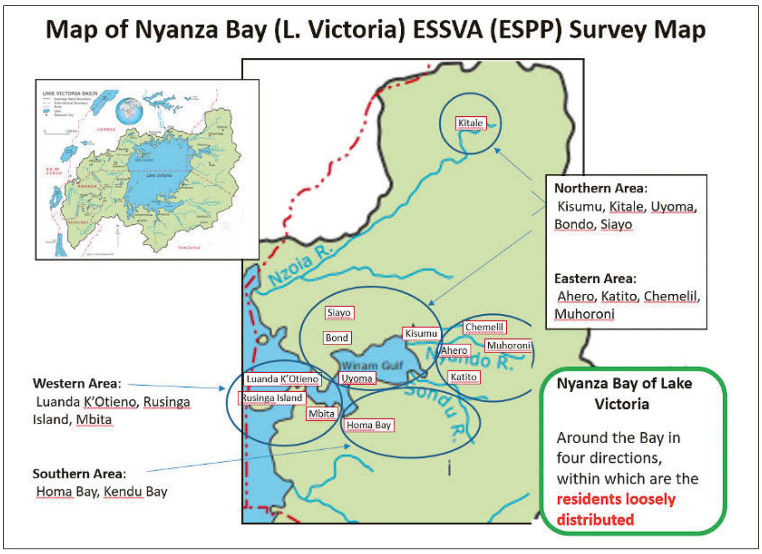


Figure 7-c. ESSVA (ESPP) Survey Map and the Basin Community Scenes of Lake Victoria [Nyanza Bay]

6-2. The Survey Form Structure

6-2.1 Typical Survey Form

Shown in **Figure 8** is an outline of the structural design of the ESPP survey form corresponding to the schematic image shown in **Figure 4**. Please note that the survey facilitators and the community members provided the photo images in the form. Underneath the photo images are the score-rating boxes indicating the magnitude of importance the respondents perceive.

Figure 8. Structural Design of the Survey Form

6-2.2 The Overall Survey Output for the Three Kenyan Lake Basins

Figure 9 summarizes the radar-chart ESSVA survey outputs on Questions 1 through 10 for the three Kenyan lakes. The axes of the charts represent the communities in each of the three lake basins, i.e., seven community zones (1A, 1B, 2, 3, 4, 5, Nakuru Municipality, and the Nakuru National Park) in the case of Lake Nakuru, six communities (upstream and downstream communities in each of the three major river basins) in the case of Lake Baringo, and fourteen townships in the Nyanza Bay basin of Lake Victoria. Please note that the rating-score scale is associated with each diagram axes for the respective survey questions. The radar diagram shapes and sizes appear indistinguishably similar in some cases while vividly different in others. It is essential to have interactive discussions among the participating stakeholder groups by referring to the factual profiles (ESFPs), if available.

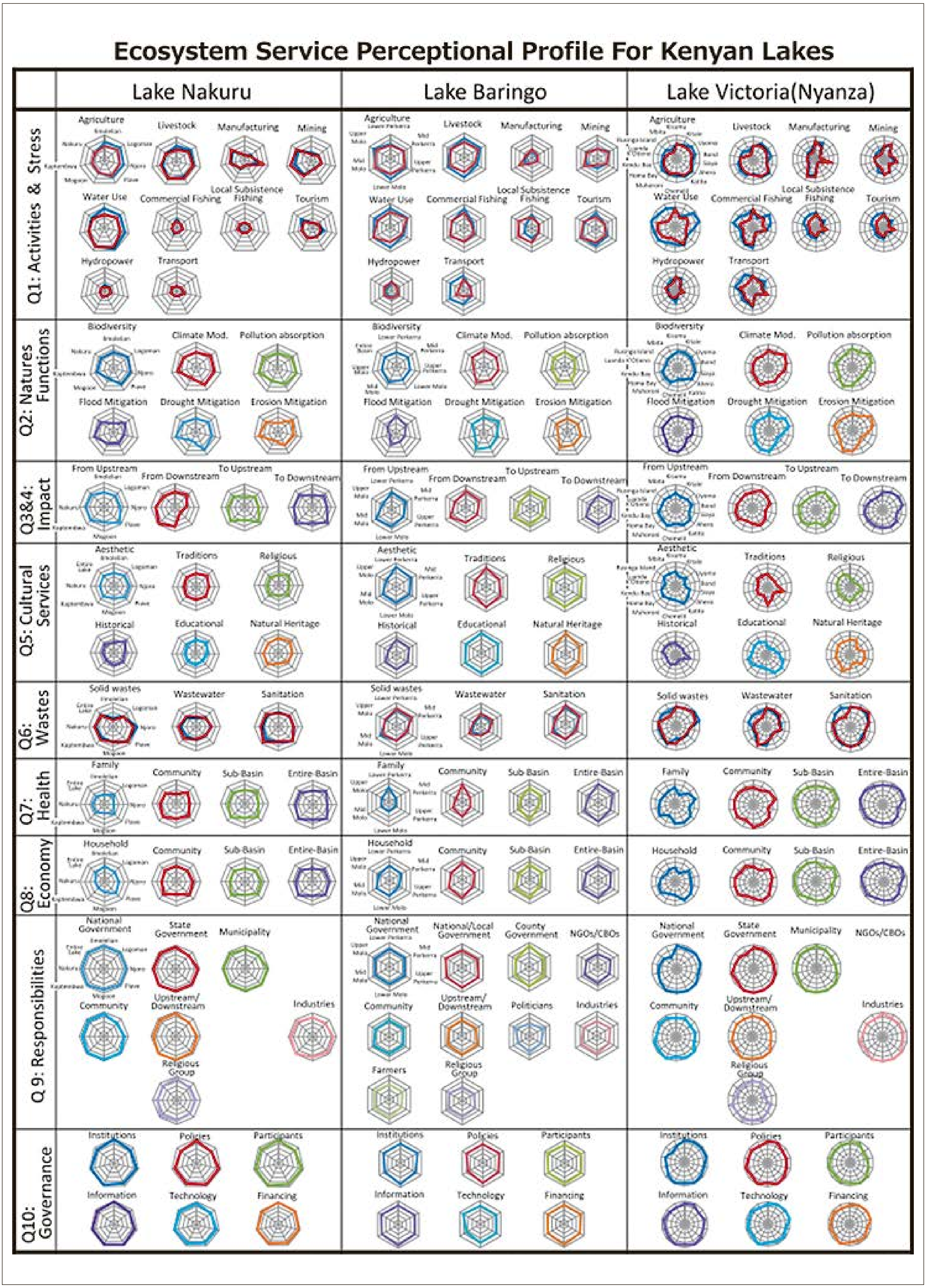


Figure 9. Comparison of the Survey Outputs of Question Sets 1-10 for All Three Lake Basins

6-2.3 The PS, RS, and CS Profiles

The balance between the kind and amount of activity pursuing PS and the type and the effort level to conserve RS, resulting from the ESPP assessment results, provides essential clues on whether or not the lake basin resource utilization is sustainable. The sustenance of the CS level depends significantly on the attained balance level of PS and RS. The ESPP and ESFP would facilitate the purposeful implementation of the ILBM Platform Process.

In the case of Lake Nakuru, both RS and CS are rated as moderately degraded, indicating that there are problems and, therefore, remedial measures are required. The collective knowledge of the basin communities was shared through the discussion sessions, often referring to the available ESFP data. **Figure 10** compares the Lake Nakuru PS, RS, and CS profiles for all-zone means, and **Figure 11** compares the Means of PS Component Services by Zones.

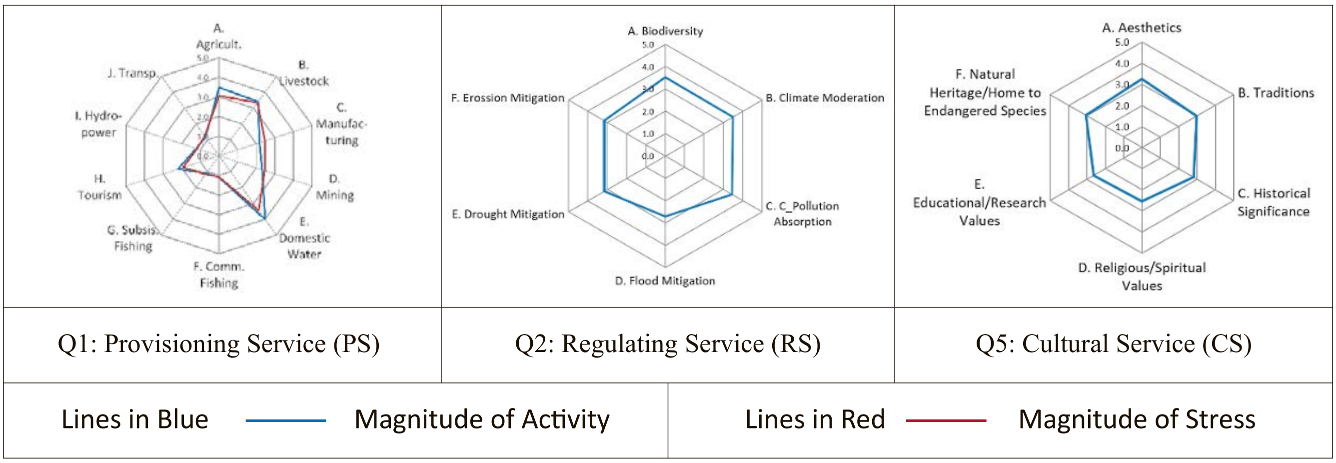


Figure 10. Comparison among the PS, RS, and CS Profiles for All-Zone Means

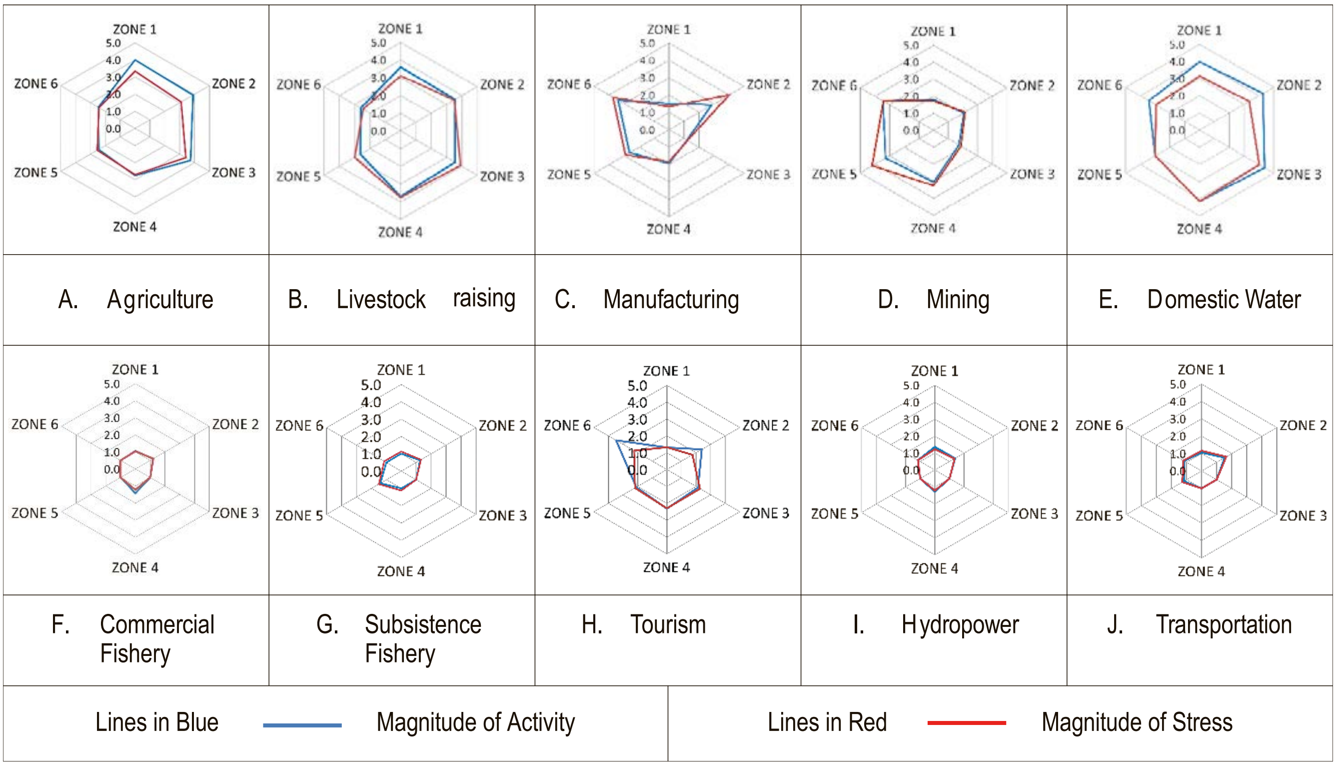


Figure 11. Comparison among the Means of PS Component Services by Zones

6-2.4 The Upstream-Downstream Relationships and their Interpretation

Questions **Q3** and **Q4** relate to the upstream-downstream relationships that can become complicated and often contentious because of resource-use competition and the transcending stresses from either side to the other.

Q 3: Direct impacts and stresses from upstream and downstream sub-basin activities

a) How much stress and impact do you think your sub-basin waters have been receiving from the activities of your immediate upstream communities?

b) How much stress and impact do you think your sub-basin waters have been receiving from the activities of your immediate downstream communities?

Q 4: Impacts and stresses to the immediate downstream and the most downstream water bodies

a) How much stress and impact do you think your sub-basin activities affect your immediate downstream communities?

b) How much stress and impact do you think your sub-basin activities affect the most downstream water bodies, such as lakes (in case the river water discharges into the terminal lakes) and the coastal estuaries (in case the river water discharges into the marine coastal environments)?

These questions are intended to clarify whether there is a discrepancy in recognition between adjacent upstream and downstream areas. It is also necessary to check the installation status of facilities (factories, waste disposal sites, dams, etc.) with ESFP. If there is a discrepancy in recognition, it may indicate that information sharing is insufficient, affecting efforts for improvement.

Tables 2 and **Figure 12** show that the upstream and downstream impacts are consistently recognized as a big problem. The recognition that the impacts from downstream are rather significant could be considered affected by the location of facilities such as a dam or a dumping site, as confirmed through ESFP data. If there is a discrepancy in recognition, it may indicate that information sharing is insufficient, affecting efforts for improvement.

Table 2. Q3 & 4: The Mean Scores of the Upstream-Downstream Impacts from the Q3-Q4 Responses

	(A) Direct Impact **from** Upstream and Downstream		(B) Direct Impacts **on** Downstream	
	(A-1) From Your Immediate Upstream	(A-2) From Your Immediate Downstream	(B-1) To Your Immediate Downstream	(B-2) To Most Downstream Water Bodies
Entire Lake Basin	3.62	3.04	3.36	3.65



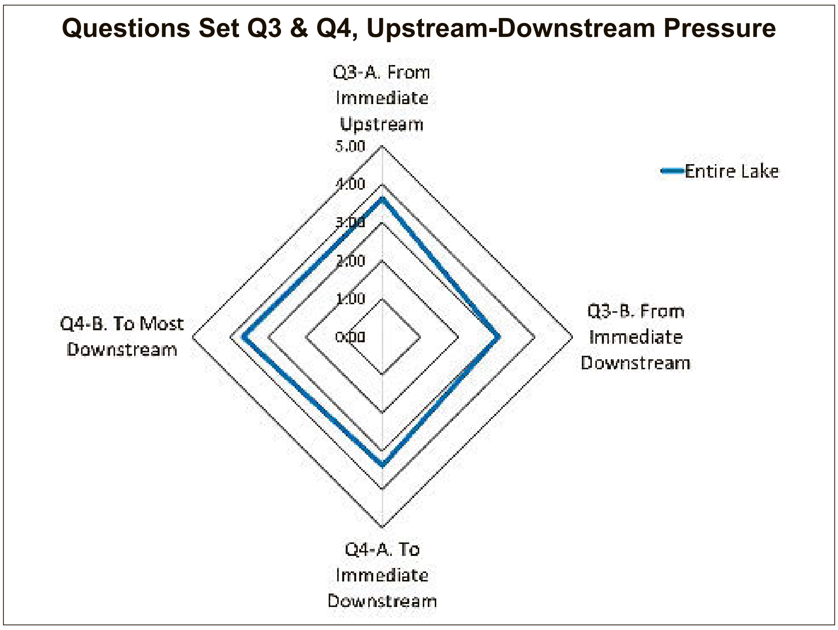



Figure 12.
The Mean Score Spider Graph of the Upstream-Downstream Impacts based on the Q3-Q4 Responses

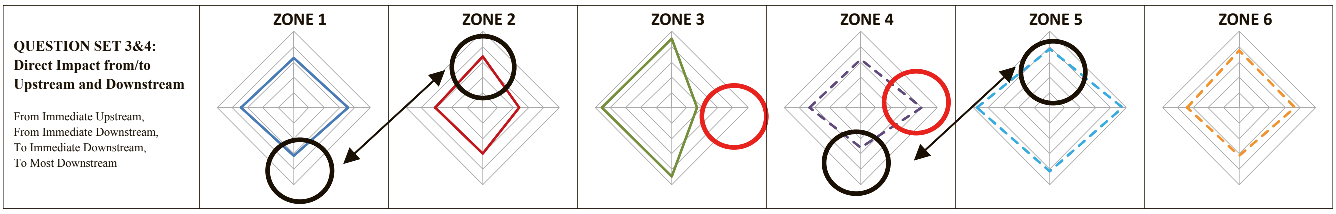


Figure 13. The Upstream-Downstream Impact Scores and their Neighbor-Zone Relationships

Further, as shown in **Table 3**, all regions except Zone 5 feel their sub-basins receive more pressure from their immediate upstream than they send to their immediate downstream. Zone 5, the exceptional area, thinks that its sub-basin receives less stress from immediate upstream (M=3.83). At the same time, it sends more pressure immediately downstream (M=4.17) and even more pressure to most downstream water bodies (M=4.75), which is the highest any region has acknowledged.

Table 3. The Upstream-Downstream Impact Scores for All Zones

	Direct Impact from Upstream and Downstream		Direct Impacts on Downstream	
	From Your Immediate Upstream	From Your Immediate Downstream	To Your Immediate Downstream	To Most Downstream Water Bodies
ZONE 1	3.29	3.54	3.12	3.41
ZONE 2	3.35	2.38	3.00	3.11
ZONE 3	4.55	1.65	4.48	4.55
ZONE 4	3.15	4.00	2.60	3.35
ZONE 5	3.83	4.75	4.17	4.75
ZONE 6	3.76	3.65	3.15	3.40

When the perception of the pressure is sent to the immediate downstream compared to the perception of the downstream community regarding pressure they receive from upstream (shown by arrows in column graph in **Figure 13**), the general trend is that upstream sub-basins feel they send less stress than how the downstream sub-basin communities feel. In contrast, the downstream communities feel more pressure from upstream than how the upstream communities feel. The exceptions are Zone 3 and Zone 5, which feel they send more force downstream than is owned by Zone 4 and Zone 6, respectively.

Regarding pressure to most downstream water bodies, two regions (Zone 2 and Zone 6) think they send less stress to most downstream water bodies than they receive from their immediate upstream. Zone 3 thinks there is a balance. The remaining three regions (Zones 1, 4, and 5) think they send more pressure to the downstream than they receive from their immediate upstream. However, the upstream-downstream differences were not significantly different at p=0.05.

Regarding pressure from immediate downstream, three regions (Zones 1, 4, and 5) feel they receive more pressure from downstream than from upstream. On the other hand, Zones 2 and 6 think they receive less stress from the immediate downstream than the pressure from the upstream. The upstream-downstream differences were significant in Zone 2, Zone 3, and Zone 4 (p=0.05). It is essential to confirm the situation of installation of facilities (such as dump sites) in the areas as possible reasons for the observed differences.

6-3. The Three Lake Basin Comparisons

Figure 14 shows the degradation of ecosystem functions causing a reduction in ecosystem service values that result in the "Impact on Human Health" at the levels of family, community, sub-basin, and entire basin of each of the three Kenyan lakes. The respondents rated "Family" highest in all three lake basins, then successively toward "Entire Basin." It is unclear if they consider that "Family" is relatively less vulnerable than "Entire Basin" because they can care for the family better than the entire basin.

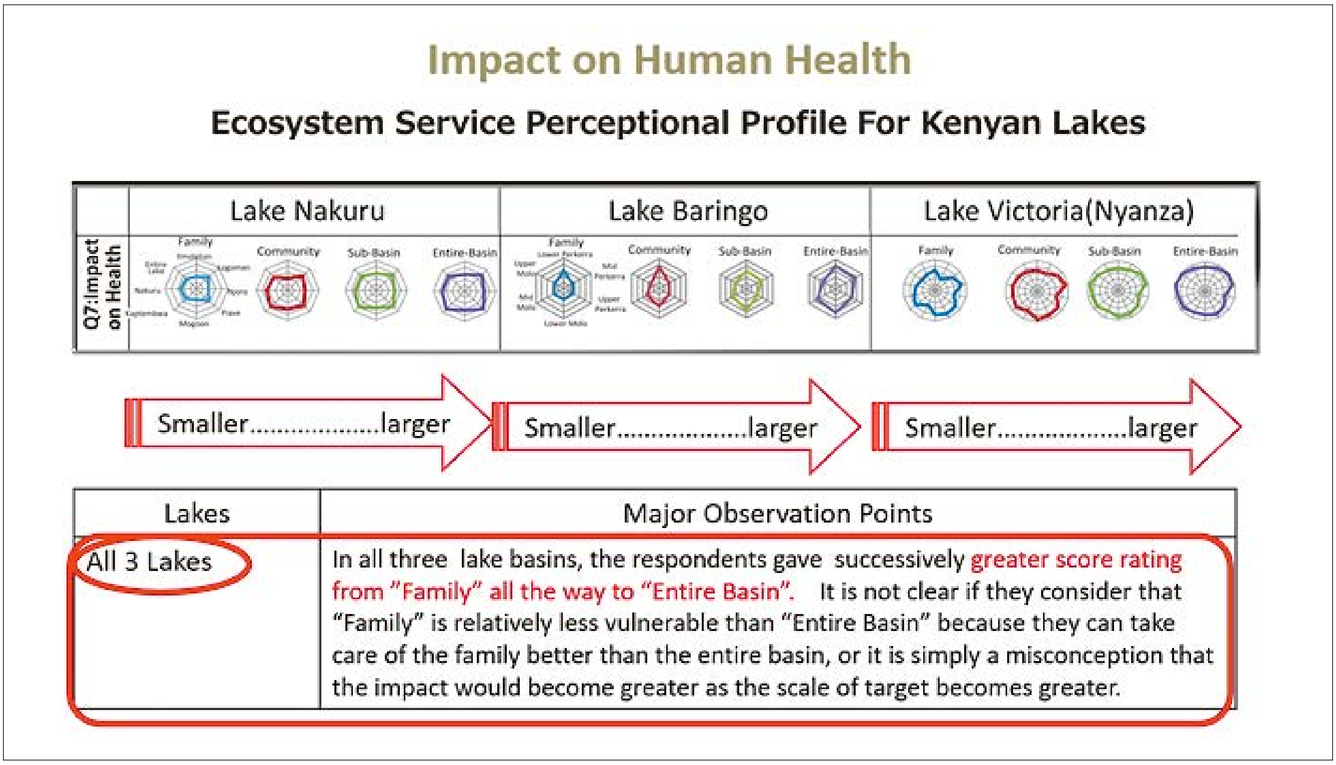


Figure 14. The Similarly Increasing Trends of Q8 "Impact on Human Health" from "Family" to "Entire Basin" for All 3 Lakes

Figure 15 shows an overall comparison of the ESPP scores. The figure gives the following rather striking observations about the three lakes. The Lake Baringo respondents seem less threatened about the states of the state stem Services than Nakuru and Nyanza respondents. The Lake Baringo respondents seem more concerned about the degradation of their Cultural Service aspects than the Nakuru or the Nyanza respondents. Moreover, the Lake Nyanza and Nakuru respondents seem to be more frustrated about the status of their Health, Economy, Responsibility-sharing, and Governance Failures.

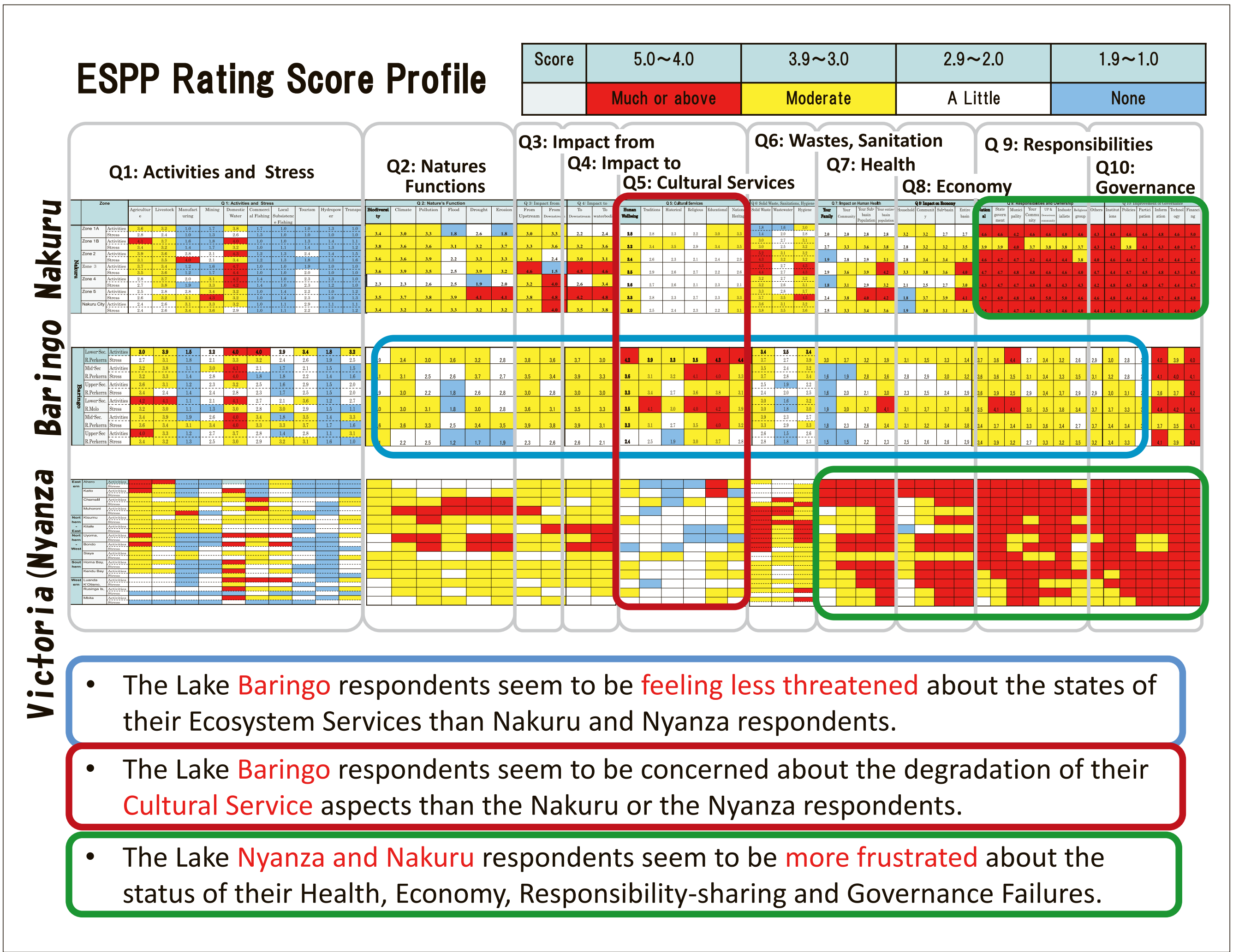


Figure 15. ESSVA (ESPP) Survey Output for All Question Items for All Three Lakes

7. Conclusion

The purpose of this document was to outline a method called ESSVA that integrates the assessed Ecosystem Service values into planning and management of the river-lake-coastal basin systems through the Integrated Lake Basin Management (ILBM) process. The document outlined the conceptual framework, methodological features, and implementation protocol. Specifically, the article discussed the development and use of the ESSVA concept for ILBM, illustrated a general framework for ESSVA applied studies, and presented a case application of the methodology to three Kenyan lakes, Kenya, with their survey questionnaires and implementation output summaries. There could be several ways to guide the planning and management processes to balance PS and ES of the overall basin Ecosystem Service to be accepted by the basin stakeholders. Since such balancing can be realized only through gradual, incremental, and long-term pursuit for participatory improvement of basin governance, the methodology illustrated in this document of combining ESSVA and ILBM seems quite promising if further refined through a broader range of application studies.

The general observations on the ESSVA (ESPP) study on three Kenyan lakes includes the following points.

1) The ecosystem service perception profiles of three lakes are unique.
2) The individuals and group entities can share the similarities and differences of ESPP.
3) The similarities would possibly lead to the development of the efficient implementation of plans and programs for pursuits toward sustainable ESs.
4) The differences among entities within a given lake basin would inspire those responsible for implementing the basin governance improvement process to be able to focus their attention on the issues and the reasons that lead to such differences.
5) In the long run, ESPP may be complemented with ESFP as much as possible, but ESPP without ESFP serves its purpose very well in many basin management cases.

The overall benefits of ILBM-ESSVA include the following points.

a) It allows the basin population to evaluate their lake basin on current and future status and values, helping them shape a shared vision and common understanding of the lake basin's issues and challenges.
b) It provides a way to fill the perceptional gaps between stakeholders with different views and interests and the gaps between people living in various locations in the basin (Upstream, Downstream of the lake, and around the lake).
c) It provides a methodology for the government to listen to the community's voice, enabling them to develop policies and programs to be widely supported and easily implemented.
d) It helps develop a sense of "ownership" in the basin population, facilitating community participation in the lake basin management process.
e) It enables different basins to discuss their problems based on the same general framework that would help enhance the opportunity for mutual collaboration

References

- Berghöfer, A. A.Wittich, H. Wittmer, J. Rode, L. Emerton, M. Kosmus, and H. van Zyl. 2015. Analysis of 19 Ecosystem Service Assessments for Different Purposes - Insights from Practical Experience. ValuES Project Report. Helmholtz Zentrum für Umweltforschung (UFZ) GmbH, Leipzig, and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Eschborn. Germany. 27pp. Accessed at: http://aboutvalues.net/case_studies/
- Berbe´s-Bla´zquez, M. 2012. A Participatory Assessment of Ecosystem Services and Human Wellbeing in Rural Costa Rica Using Photo-Voice. Environmental Management. 2012. 49:862–875, DOI 10.1007/s00267-012-9822-9. Accessed at: at: https://www.researchgate.net/publication/221688863
- Brauman, K. A. S. van der Meulen, and J. B. Brauman. 2014. Ecosystem Services and River Basin. Risk-Informed Management of European River Basins, the Handbook of Environmental Chemistry 29, DOI 10.1007/978-3-642, Springer-Verlag Berlin Heidelberg.
  Accessed at: file:///C:/Users/ILEC/Downloads/Brauman_ESRiverBasin_Riskbase2014.pdf
- Brouwer R, Brander L, Kuik O, Papyrakis E, Bateman I, 2013. A synthesis of approaches to assess and value ecosystem services in the EU in the context of TEEB. Final Report. 15 May 2013. VU University Amsterdam, Institute for Environmental Studies. Accessed at:
  at: http: //ec.europa.eu/environment/nature/biodiversity/economics/pdf/ EU%20Valuation.pdf
- Convention on Biological Diversity. 2020. Statement by Elizabeth Maruma Mrema, Executive Secretary of the CBD, at the opening of the Virtual Expert Forum on SEEA Experimental Ecosystem Accounting 2020, 24-25 August 2020.
  Accessed at: https://www.cbd.int/doc/speech/2020/sp-2020-08-24-ecosystem-en.pdf
- Costanza, R., de Groot, R., Braat, L., Kubiszewski, I., Fioramonti, L., Sutton, P., Farber, S., and Grasso, M. 2017. Twenty Years of Ecosystem Services: How Far Have We Come and How Far Do We Still Need to Go? Ecosystem Services, 28, 1-16. Accessed at:
  https://www.sciencedirect.com/science/article/abs/pii/S2212041617304060
- Duraiappah, A. K.; K. Nakamura; K. Takeuchi. 2012. Satoyama--satoumi Ecosystems and Human Well-being: Socio-ecological Production Landscapes of Japan, United Nations University Press.
- Ecosystem Service Assessment. 2022. Ecosystem Services Inventory. The Alberta Biodiversity Monitoring Institute, Accessed at: https://ecosystemservices.abmi.ca/ecosystem-services-inventory/
- Ervin, D., S. Vickerman, S. Ngawhika, F. Beaudoin, S. Hamlin, E. Dietrich, P. Manson, and J. Schoenen. Vickerman, E. D., S. S. Ngawhika, F. Beaudoin, S. Hamlin, E. Dietrich, P. Manson, and J. Schoenen. 2014. Principles to Guide Assessments of Ecosystem Service Values, first revised edition. Portland, Oregon: Cascadia Ecosystem Services Partnership, Institute for Sustainable Solutions, Portland State University.
- European Union. 2016. Mapping and Assessment of Ecosystems and their Services. Urban ecosystems. 4th Report Technical Report.
  Accessed at: https://ec.europa.eu/environment/nature/knowledge/ecosystem_assessment/pdf/102.pdf
- European Union. 2018. Mapping and Assessment of Ecosystems and their Services: An EU Ecosystem Assessment. An analytical Framework for Mapping and Assessment of Ecosystem Condition in EU Discussion paper – Final January 2018. Accessed at: https://ec.europa.eu/environment/nature/knowledge/ecosystem_assessment/pdf/5th%20MAES%20report.pdf
- European Union. 2022. Mapping and Assessment of Ecosystems and their Services – MAES.

Accessed at: https://ec.europa.eu/environment/nature/knowledge/ecosystem_assessment/index_en.htm

- Harrison, P.; Dunford, R.; Barton, D.N.; Kelemen, E.; Martín-López, B.; Norton, L.; Termansen, M.; Saarikoski, H.; Hendriks, K.; Gómez-Baggethun, E.; Czúcz, B.; García-Llorente, M.; Howard, D.; Jacobs, S.; Karlsen, M.; Kopperoinen, L.; Madsen, A.; Rusch, G.; van Eupen, M.; Verweij, P.; Smith, R.; Tuomasjukka, D.; Zulian, G. 2018. Selecting methods for ecosystem service assessment: a decision tree approach. NERC Open Research Archive, Center for Ecology and Hydrology. UK. Accessed at: https://nora.nerc.ac.uk/id/eprint/518213/1/N518213PP.pdf
- ILEC and UNEP. 2016. Transboundary Lakes and Reservoirs: Status and Trends. United Nations Environment Programme (UNEP), Nairobi.
  Accessed at: http://geftwap.org/publications/TWAPVOLUME2TRANSBOUNDARYLAKESANDRESERVOIRS.pdf
- Kumar, R., D. Mohil, A. Pattnaik, and Sikka, R. Perceptions, Attitudes and Preferences for Wetland Ecosystem Services: a Case Study of Tampara, OdishaRitesh. Wetlands International South Asia, New Delhi. Proceedings of the 17th World Lake Conference, Ibaraki, Japan. Pages 847-849.
  Accessed at https://www.pref.ibaraki.jp/seikatsukankyo/kantai/kosyou/documents/wlc17procidings-13.pdf
- Maes J., C. Liquete, A. Teller, M. Erhard, M. L. Paracchini, J. I. Barredo, B. Grizzetti, A Cardoso, F. Somma, J., E. Petersen, A. Meiner, E. R. Gelabert, N. Zal, P. Kristensenc, A. Bastrup-Birk, K. Biala, C. Piroddi, B. Egoha C. Lavalle, B. Egoh, P. Degeorges, C. Fiorina, F. Santos-Martíne, V. Naruševičius, J. VerbovengHenrique, M. Pereira, J. Bengtsson, K. Gocheva, C. Marta-Pedroso, T. Snäll, C. Estregui, J. San-Miguel-Ayanz, M. Pérez-Soba, A. Grêt-Regamey, A. I. Lillebøo, D. Abdul, M. Sophie, C. J. Moen, B. Czúcz, E. G. Drakou, G. Zulian, C. Lavalle. 2020. An indicator framework for assessing ecosystem services in support of the EU Biodiversity Strategy to 2020. Ecosystem Services, 17, February 2016, Pages 14-23.
  Accessed at: https://www.sciencedirect.com/science/article/pii/S2212041615300504
- Maes, J., Teller, A., Erhard, M., Condé, S., Vallecillo, S., Barredo, J.I., Paracchini, M.L., Abdul Malak, D., Trombetti, M., Vigiak, O., Zulian, G., Addamo, A.M., Grizzetti, B., Somma, F., Hagyo, A., Vogt, P., Polce, C., Jones, A., Marin, A.I., Ivits, E., Mauri, A., Rega, C., Czúcz, B., Ceccherini, G., Pisoni, E., Ceglar, A., De Palma, P., Cerrani, I., Meroni, M., Caudullo, G., Lugato, E., Vogt, J.V., Spinoni, J., Cammalleri, C., Bastrup-Birk, A., San Miguel, J., San Román, S., Kristensen, P., Christiansen, T., Zal, N., de Roo, A., Cardoso, A.C., Pistocchi, A., Del Barrio Alvarellos, I., Tsiamis, K., Gervasini, E., Deriu, I., La Notte, A., Abad Viñas, R., Vizzarri, M., Camia, A., Robert, N., Kakoulaki, G., Garcia Bendito, E., Panagos, P., Ballabio, C., Scarpa, S., Montanarella, L., Orgiazzi, A., Fernandez Ugalde, O., Santos-Martín, F. 2020. Mapping and Assessment of Ecosystems and their Services: An EU ecosystem assessment, EUR 30161 EN, Publications Office of the European Union, Ispra, 2020, ISBN 978-92-76-17833- 0, doi:10.2760/757183, JRC120383. Accessed at: file:///C:/Users/ILEC/Desktop/eu_ecosystem_assessement_final.pdf
- Malinga, R., L. J. Gordon, R. Lindborg, and G. Jewitt. 2013. Using Participatory Scenario Planning to Identify Ecosystem Services in Changing Landscapes. Ecology and Society 18(4): 10.
  http://dx.doi.org/10.5751/ES-05494-180410
- McInnes, R.J., M. Everard. 2017. Rapid Assessment of Wetland Ecosystem Services (RAWES): An example from Colombo, Sri Lanka. Ecosystem Services. Ecosystem Services 25 (2017), 89–105.
  https://www.sciencedirect.com/science/article/abs/pii/S221204161630417X?via%3Dihub

- Nakamura, M. 2011. Outline of the Lake Basin Governance Research Promotion Activities. Science for Environment and Sustainable Society. Vo. 8, No.1. Research Center for Sustainability and Environment, Shiga University, Otsu, Japan.
- Nakamura, M. D. Olago, W. Rast, V. S. Muhandiki, J. Raini, C. L. Chidammodzi, S. Matsumoto, H. Waki. 2022. Ecosystem Service Shared Value Assessment (ESSVA) for Integrated Lake Basin Management (ILBM). Science for Environment and Sustainable Society. Vo. 19, No.1. Research Center for Sustainability and Environment, Shiga University, Otsu, Japan.
- Nakamura, M. and S. Pokharel. 2011. Integrated Lake Basin Management (ILBM) for the Sustainable Conservation of Himalayan Lakes of Nepal. Science for Environment and Sustainable Society. Vo. 8, No.1, Research Center for Sustainability and Environment, Shiga University, Otsu, Japan.
- Nakamura, M., and W. Rast. 2014. Development of ILBM Platform Process: Evolving Guidelines Through Participatory Improvement, 2nd edition. Shiga University Center for Sustainability and Environment (RCSE-SU) and International Lake Environment Committee (ILEC). Accessed at: https://www.ilec.or.jp/wp-content/uploads/pub/DevOfILBMPP_en_2nd.pdf.
- Orenstein, D.E.; E. Groner, D.; E. Argaman, B. Boeken, Y. Preisler, M. Shachak, E. D. Ungar, and E. Zaady. 2012. An Ecosystem Services Inventory: Lessons from the Northern Negev Long-Term Social Ecological Research (LTSER) Platform. Geography Research Forum 32:96-118. Accessed at: https://www.researchgate.net/publication/235718872_An_Ecosystem_Services_Inventory_Lessons_from_the_Northern_Negev_Long-Term_Social_Ecological_Research_LTSER_Platform
- Prip, C. 2018. The Convention on Biological Diversity as A Legal Framework for Safeguarding Ecosystem Services. Ecosystem Services 29: 199-204. Accessed at https://nbsapforum.net/sites/default/files/cp%20Cbd%20ecosystem%20service.pdf
- Saito, O., C. Kamiyama, and S. Hashimoto. 2018. Non-Market Food Provision and Sharing in Japan's Socio-Ecological Production Landscapes. Sustainability 10, 213
- Scott, A., Carter, C., Hölzinger, O., Everard, M., Rafaelli, D., Hardman, M., Baker, J., Glass, J., Leach, K., Wakeford, R., Reed, M., Grace, M., Sunderland, T., Waters, R., Corstanje, R., Glass, R., Grayson, N., Harris, J., and Taft, A. 2014. UK National Ecosystem Assessment Follow-on. Work Package Report 10: Tools – Applications, Benefits, and Linkages for Ecosystem Science (TABLES). UNEP-WCMC, LWEC, UK. Accessed at: http://uknea.unep-wcmc.org/LinkClick.aspx?fileticket=DYBPt9wHeYA%3D&tabid=82
- van der Meulen, S. and J. Brils. 2013. Participatory ecosystem services assessment; lessons learned with special focus on scale issues. Deltares. Accessed at: https://www.deltares.nl/app/uploads/2014/12/Participatory-ecosystem-services-assessment-lessons-learned-with-special-focus-on-scale-issues.pdf

i The MEA concept has been brought into widespread use since its inauguration in 2005 by the United Nations initiative. Among other things, the UN Convention on Biological Diversity (CBD) in 2010 adopted the following Vision for its Strategic Plan: 'By 2050, biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people'; and the following Mission: 'to take effective and urgent action to halt the loss of biodiversity in order to ensure that by 2020 ecosystems are resilient and continue to provide essential services, thereby securing the planet's variety of life, and contributing to human well-being, and poverty eradication,' This makes the CBD a global framework for national-level action to protect not only biodiversity per se but also Ecosystem Service. (Prip, 2018).

In addition, a recent report by the CBD Executive Secretary (Convention on Biological Diversity. 2020) states, "As we are now five years into the Sustainable Development Goals, there is growing recognition that we cannot separate economic development, social development and the environment into siloed dimensions of development, but that protecting biodiversity and sustainably using natural resources is at the heart of achieving the Sustainable Development Goals." and then states, "There is also a growing recognition among leaders that the Sustainable Development Goals will fail without 'Urgent Action on Biodiversity for Sustainable Development'…". It also states, "Currently, Parties to the Convention, in collaboration with stakeholders, have embarked on developing a robust and ambitious post-2020 global biodiversity framework to build a resilient and sustainable future for all people. The global biodiversity framework will set a path to achieve an ambitious 2050 Vision for living in harmony with nature and will include a series of aspirational goals related to: (a) Improving the connectivity and integrity of natural ecosystems supporting healthy and resilient populations of all species while reducing the number of species that are threatened and maintaining genetic diversity; (b) Valuing, maintaining and enhancing nature's contributions to people through conservation and sustainable use, supporting the global development agenda for the benefit of all people; (c) Ensuring that the benefits, from the utilization of genetic resources are shared fairly and equitably; (d) Promoting means of implementation for achieving the global biodiversity framework. The post-2020 global biodiversity framework will also establish action-oriented targets which aim to provide a transformational pathway for realizing these goals, as well as means of implementation.

ii Typical "Qualitative Analysis" cases are discussed, for example, Berbe´s-Bla´zquez (2012). The key points of her view are as follows.

- Much of the work on ecosystem services to date has focused on the assessment and classification of environmental functions. The need for the inclusion of community perspectives in ecosystem assessments has been widely recognized in order to better understand the distribution of impacts and benefits resulting from natural resource use.
- Communities can offer a direct route to understanding the complex relationships between ecosystems and human well-being and how environmental management affects their livelihoods.
- Photovoice has been made popular as a tool for participatory needs assessment but it has had limited use in ecosystem assessments to date. The purpose of this document is twofold: (1) to present the results of a community-level assessment of environmental services in a watershed-dominated pineapple monoculture in Costa Rica; and (2) to evaluate the strengths and the limitations of photovoice as a tool for mapping the relationship between ecosystems and people.

Malinga et al. (2013) on the other hand propose the use of scenario development, a tool for dealing with uncertainties and complexities of the future gives important insights into the selection of ecosystem services in changing landscapes. Using an agricultural landscape in South Africa they compared different sets of services selected for an assessment by four different groups: stakeholders making the scenarios, experts who have read the scenarios, experts who had not read the scenarios, and services derived from literature. They found significant differences among the services selected by different groups, especially between the literature services and the other groups. Cultural services were least common in literature and that list was also most dissimilar in terms of identity, ranking, and numbers of services compared to the other three groups.

iii Analysis of variance (ANOVA)

ANOVA is a collection of statistical models and their associated estimation procedures (such as the "variation" among and between groups) used to analyze the differences among means. ANOVA was developed by the statistician Ronald Fisher. ANOVA is based on the law of total variance, where the observed variance in a particular variable is partitioned into components attributable to different sources of variation. In its simplest form, ANOVA provides a statistical test of whether two or more population means are equal, and therefore generalizes the t-test beyond two means. In other words, the ANOVA is used to test the difference between two or more means. (Ref. Analysis of variance, from Wikipedia, https://en.wikipedia.org/wiki/Analysis_of_variance)

Appendix 1

ESSVA Survey Form Template

<Introductory Remarks>

This assessment is prepared to learn from you the challenges in achieving sustainable use of resource values to obtain from the ecosystem (nature's benefits), i.e., for fulfilling our basic human needs. To do that, we need to develop a gradual, incremental, and long-term process of change in our thinking toward a more "ecosystem-based" way of life, i.e., the societal process. Noting that we benefit from the surrounding natural ecosystem, water, fish, forest products, etc., we also recognize that the development and use of such resources would not be sustainable unless carefully controlled. Too much use would lead to unsustainability in the available resource amount and long-term stresses and impacts on water, land, and ecosystem, such as depletion of groundwater, erosion of soils, damage to animal and plant habitats, etc. On the other hand, we have historically evolved our societal rules, cultures, behavioral norms, policies, programs, etc., to reduce such stresses, such as rules and regulations to control too much extraction of water, fish, forest products, etc. Many countermeasures are needed to reduce environmental pollution concerning solid and liquid wastes, which could be quite costly.

Nonetheless, those policies, programs, and countermeasures must be implemented best, with all community members, including citizens, industries, government agencies, young and old, upstream and downstream, etc., working together to make incremental improvements. Everyone must be aware of what to do, to what extent, by when, and how. It takes gradual, incremental, and long-term effort to achieve sustainability in the quality and quantity of resource values from the natural ecosystem. For us to find the best way toward that direction, we would like you to provide your view on the above issue and aspects in the form of rating scores from 1 to 5. The assessment outputs will contribute to successful long-term planning and implementation of the management plan.

1/11

INFORMATION ABOUT YOU

1. What is your age group?

< 20 ○ 20 – 29 ○ 30 -39 ○ 40 – 49 ○ 50 – 59 ○ > 59 ○

2. What is your gender?

Male ○ Female ○

3. What is your education level?

Primary school ○ Secondary school ○ Certificate ○ Diploma/Degree ○ Master/PhD ○ Others:

4. What is your occupation?

Government servant ○ Private sector personnel ○ Own business ○ Fisherman/farmer ○ Unemployed ○ Others:

5. What are the major sources of livelihood in your community?

Government servant ○ Private sector personnel ○ Own business ○ Fisherman/farmer ○ Unemployed ○ Others:

2/11

((Map of the Lake-River-Coastal Basin Under Study)

3/11

LEARNING ABOUT YOUR LAKE

1. Where do you live?

   ____

2. How long have you lived in this Nakuru Town?

   < 5 years ○ 5 – 14 years ○ 15 – 24 years ○ > 24 years ○

3. What is the name of the Lake closest to you?

   ____

4. How close do you live to Lake Nakuru (in km)?

   ____

5. How well do you know the community, flora, and fauna near your Lake?

   Very well ○ Reasonably well ○ Not very well ○ I don't know ○

6. What do you normally use the Lake for?

   ____

4/11

QUESTION SET 1: Magnitude of Resource Use and Development Activities (extent of activities) in Your River / Lake Subregion and their Stress (e.g., over-extraction of water, overfishing, erosion of land, etc.) on Your Immediate Surrounding

Please indicate **which one** of the ratings best reflects your opinion.

1: Not at all	2: A little	3: Moderate	4: Much	5: Very much	6: I don't know

		Magnitude of Activity						Degree of Stress on River / Lake					
A	Agriculture	1	2	3	4	5	6	1	2	3	4	5	6
		Magnitude of Activity						Degree of Stress on River / Lake					
B	Livestock Production	1	2	3	4	5	6	1	2	3	4	5	6
		Magnitude of Activity						Degree of Stress on River / Lake					
C	Manufacturing Industries	1	2	3	4	5	6	1	2	3	4	5	6
		Magnitude of Activity						Degree of Stress on River / Lake					
D	Mining Activities (Sand, Minerals)	1	2	3	4	5	6	1	2	3	4	5	6
		Magnitude of Activity						Degree of Stress on River / Lake					
E	Domestic Water Use (Drinking, Cooking, Laundry)	1	2	3	4	5	6	1	2	3	4	5	6
		Magnitude of Activity						Degree of Stress on River / Lake					
F	Commercial Fishing	1	2	3	4	5	6	1	2	3	4	5	6
		Magnitude of Activity						Degree of Stress on River / Lake					
G	Local Subsistence Fishing	1	2	3	4	5	6	1	2	3	4	5	6
		Magnitude of Activity						Degree of Stress on River / Lake					
H	Tourism and Recreation	1	2	3	4	5	6	1	2	3	4	5	6
		Magnitude of Activity						Degree of Stress on River / Lake					
I	Others	1	2	3	4	5	6	1	2	3	4	5	6

QUESTION SET 2: Solid Wastes, Wastewaters, and Sanitation, Excreta Disposal / Hygiene

Please indicate **which one** of these categories best reflects your opinion of the situation.

1: None	2: Little	3: Some	4:Serious	5: Very Serious	6: I don't know

		The Extent of Management Problems						The Magnitude of Impact on the Ecosystem					
A	**State of Solid Waste Management**	1	2	3	4	5	6	1	2	3	4	5	6
	(If helpful for the respondents, provide some visual images (photos, drawings) applicable to your situations.)												
		The Magnitude of Management Problems						The Magnitude of Impact on the Ecosystem					
B	**State of Wastewater Management**	1	2	3	4	5	6	1	2	3	4	5	6
	(Images)												
		The Magnitude of Management Problems						The Magnitude of Impact on the Ecosystem					
C	**State of Sanitation, Excreta Disposal / Hygiene**	1	2	3	4	5	6	1	2	3	4	5	6
	(Images)												

QUESTION SET 3: Stress put on the Regulating Service of Your Subregion

- The excessive degrees of pursuing Resource Provision Services, identified in the separately conducted ESPF Survey, can lead to the degradation of Regulating Services nature's ecosystem integrity) such as those listed in A through F. Please rate the degree of degradation in the past decades.

1: Not degraded (even improvements)	2	3: Degraded	4	5: Seriously degraded	6. I do not know

A	Biodiversity, food chain as well as animal and plant habitats	1	2	3	4	5
	(If helpful for the respondents, provide some visual images (photos, drawings) applicable to your situations.)					
B	Climate moderation	1	2	3	4	5
	(Images)					
C	Pollution absorption by wetlands and other natural environments	1	2	3	4	5
	(Images)					
D	Flood protection	1	2	3	4	5
	(Images)					
E	Drought mitigation	1	2	3	4	5
	(Images)					
F	Others if any	1	2	3	4	5
	(Images)					

QUESTION SET 4: Direct Impacts from Upstream and Downstream

QUESTION SET 4-1: Upstream and Downstream Stresses Impacting the Regulating Service of Your Subregion

How much stress do you think your sub-basin has been receiving from the communities located immediately upstream of yours (A)? How much from those located immediately downstream of yours (B)?

1: Little	2	3: Some	4	5: Much

A	From your **immediate upstream** sub-basin activities?	1	2	3	4	5
	(If helpful for the respondents, provide some visual images (photos, drawings) applicable to your situations.)					
B	From your **immediate upstream** sub-basin activities?	1	2	3	4	5
	(Images)					

QUESTION SET 4-2: Stress put on the "Regulating Service" in Downstream Subregions

- How much, do you think, has the Development/Use of water and land resources together (Q1-1 and Q1-2 together) been inflicting "**stress**" on **your immediate downstream sub-basin (A), and the most downstream water bodies such as lakes and estuaries (B)**?

1: Little	2	3: Some	4	5: Much

A	To your immediate downstream sub-basin?	1	2	3	4	5
	(If helpful for the respondents, provide some visual images (photos, drawings) applicable to your situations.)					
B	To the **most downstream water bodies such as lakes and estuaries**? (Images: lake and estuary environments, etc.)	1	2	3	4	5
	(Images)					

QUESTION SET 5: Cultural Service

- How do you rate the following **cultural service (intangible) values** in terms of importance as well as the degree of degradation through Q1-Q3 activities?

1: Little	2	3: Some	4	5: Much

A	Aesthetic, human well-being, and scenic values	1	2	3	4	5
	(If helpful for the respondents, provide some visual images (photos, drawings) applicable to your situations.)					
B	Traditions and traditional practices	1	2	3	4	5
	(Images)					
C	Religious and spiritual values	1	2	3	4	5
	(Images)					
D	Historical significance	1	2	3	4	5
	(Images)					
E	Educational values	1	2	3	4	5
	(Images)					
F	Natural heritage and/or home to endangered species	1	2	3	4	5
	(Images)					
G	Others	1	2	3	4	5
	(Images)					

QUESTION SET 6-1 Impact on Human Health [show "health impact scene" images]

- Human health is generally supported by ecosystem products and services (such as availability of fresh water, food, and fuel sources) which are requisite for good human health. Over the past decade, how much do you think ecosystem service degradation affected each of the following groups of people in your basin? …

1: Not much	2	3: So-so	4	5: Very much

	Group of people					
A	Your family	1	2	3	4	5
B	Your Community	1	2	3	4	5
C	Your sub-basin population	1	2	3	4	5
D	Your entire basin population	1	2	3	4	5

QUESTION SET 6-2: Impact on Economy: [show "economic impact scene " images]

- Economic activities in the river-lake basin use ecosystem products and services (such as freshwater, natural products, and fuels). Over the past decade, how much do you think ecosystem service degradation affected each of the following groups of economic activities in your river-lake basin?

1: Not much affected	2	3: So-so	4	5: Very much affected

	The Domain of Economic Activities					
A	Your household economic activities	1	2	3	4	5
B	Your community's economic activities	1	2	3	4	5
C	Your sub-basin economic activities?	1	2	3	4	5
D	Your entire basin's economic activities	1	2	3	4	5

QUESTION SET 7-1: Response Measures and Ownership

- The restoration and improvement of river-lake-coastal basin ecosystem integrity are a long-term, gradual, and incremental process, requiring every stakeholder group to take a responsible and proactive role. **How much more** do you think each of the following stakeholder groups should take a responsible and proactive role?

1: Not so much	2	3: Some	4	5: Very Much

	Stakeholder Groups					
A	National and local governments	1	2	3	4	5
B	You, your family, and your community	1	2	3	4	5
C	Your upstream and downstream communities	1	2	3	4	5
D	Politicians	1	2	3	4	5
E	Industrialists, business and commercial operators, plantation owners, and the like	1	2	3	4	5
F	Farmers, Pastoralists, fishermen, and the like	1	2	3	4	5
G	Others (who)	1	2	3	4	5

QUESTION SET 7-2: How to Improve Basin Governance (ILLBM Six Pillars of Governance)

- The long-term, gradual, and incremental process of improvement has to be applied to the Six Pillars of Governance. In the next decade or so, how much do you think **each of the Six Pillars of Governance needs to be improved** for making significant restoration and improvement of river-lake-coastal basin ecosystem integrity?

1: Not so much	2	3: Some	4	5: Very Much

	Six Pillars of Governance					
A	**Institutions** – for making organizations and programs more effective for action	1	2	3	4	5
B	**Policies and Programs** – for identifying policies and actions that may be most needed and most effective	1	2	3	4	5
C	**Participation** – for developing mechanisms and for obtaining public opinion and input	1	2	3	4	5
D	**Knowledge and Information** – for filling the knowledge gap for more informed decision-making in collaboration	1	2	3	4	5
E	**Technology –** for identifying and applying an appropriate mix of technological options	1	2	3	4	5
F	**Funding and Financing** – for exploring different funding sources and financial mechanisms	1	2	3	4	5

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