The Social Carrying Capacity of Lake Lanao

Keywords: social carrying capacity, social services availability, fish reduction, and peace/order condition

Abstract:

Social carrying capacity in this study is based on the social services and facilities available in the area and how this matches the economic needs and peace and order condition of the locality. As an economic resource, the social carrying capacity of Lanao Lake is greatly diminished. The Meranaws have moved on to other sources of income outside of that provided by the lake. Although there are existing social services for health, protection, and education, these are still insufficient to respond to the needs of the Meranaw constituents. The gap between the desired or standard condition and existing number of facilities for health, protection and education is apparently an issue of good governance. There is also a prevailing culture of distrust between Meranaws and perceived outsiders who use the lake as an economic resource.

INTRODUCTION

As global climate change haunts the world today, there is now a growing awareness to integrate ecological objectives with economic opportunity and social equity. Survival of the Meranaw as people of the lake is anchored on Lake Lanao, one of the ancient 17 lakes in the world and the largest freshwater lake in the Philippines. Despite the existence of various legislations such as Proclamation No. 871, dated Feb. 26, 1992 declaring Lake Lanao Watershed Reservation as a protected area; and Memorandum Order No. 421 dated March 25, 1992, as amended by Memorandum Order No. 242 on March 6, 2007 creating the Lake Lanao Watershed Protection and Development Council protecting Lake Lanao, unsustainable resource use practices and illegal exploitation of watershed resources apparently prevail. As the primary source of the hydroelectric power in the southern part of the Philippines, the culture and livelihoods of the Meranaws are seriously affected.

Lake Lanao's water flows down to Northern Mindanao through Agus River that host six cascading hydroelectric plants with rated capacity of roughly 700 megawatts showing its industrial usage. In the words of one local leader: "The deterioration of Lake Lanao has a catastrophic effect on the socioeconomic condition of the people of Mindanao, being the source of water that drives the turbines of Agus hydroelectric power plants that could supply over 50% of Mindanao's electricity needs." This poses an ecological nightmare to the stakeholders.

People are integral elements of the ecosystem. Sustainability of the country's environmental resources necessitates a comprehensive understanding of the interrelationship between the biophysical and anthropogenic activities. A balanced development requires a healthy and harmonious interplay between the natural and human resources involving ecology, economy, and social desirability. Carrying capacity as a concept is embedded in this framework. Balancing populations are said to be closely related to this concept where the area's resources can support the long term without significantly depleting or degrading those resources in the physical, cultural and social environments. Social carrying capacity in this study will be based on the provision of social services and facilities and theeconomic dimension focused on fish resource availability for food and livelihood and political dimension particularly the peace/order condition in one riverine and four lanao lake communities.

Significance and Limitation of the Study

The findings of this study could provide empirical inputs in understanding the social carrying capacity of the lake and its absorptive capacity. It also hopes to contribute to advocacy, research and development efforts, as well as policy formulation and meaningful implementation of environmental management projects. In terms of methodology, it aims to conduct a baseline study and identify appropriate development interventions.

The impact of this study to science, users, and the country lies in its potentials to reinforce existing theories or perspectives of sustainable development focused on carrying capacity. It likewise enriches the national scientific capital particularly on absorptive capacity.

MSU System as an academic institution with capacity for integrated and science-based planning must produce comprehensive knowledge on how to sustain development of Lake Lanao for food security, environmental health, and industrial sustainability of Mindanao.

The study is useful to the provincial government of Lanao del Sur as input to their development planning. Appropriate interventions either in programs/projects or policy building should not over utilize the Lake Lanao's resources, but should utilize the natural resources within their carrying capacity. This is dependent on the practices of people in the upland, lowland and lakeshore ecosystem and communities of Lake Lanao

To policy makers, both national and local, for the formulation or reformulation of existing policies based on the output of this research.

To government agencies/entities to have a feedback on delivered social services and to identify ways to improve service delivery so as to have alternative income source apart from utilizing the lake's resources.

To Mindanao residents in general to realize the value of Lanao Lake in the provision of the hydropower energy source to enjoy modern life. Thus, the need to help conserve its watershed for a balanced ecosystem for sustained development

Beneficiaries could include local government officials, policy-makers, line agencies, researchers, development practitioners, and the lakeshore communities.

It is noteworthy that the analysis of the study is limited to the outputs generated from the Meranaw survey respondents of the sample research loci and key informants and focus group discussion participants from 2015-2017. It does not cover the current situation and events of the May to October 2017 Marawi siege between the extremist groups and government forces.

Objectives

In general, the study deals with the social carrying capacity of Lake Lanao. Specifically, the study seeks to answer the following:

1. To describe the sociodemographic and economic characteristics of
    - four lakeshore communities (one city and three municipalities) ;
    - one riverine community;
2. To identify development interventions in these areas and absorptive capacity of the communities;
    - analyze the social carrying capacity;

- population growth trends;
- provision of social services and facilities;
- economic dimension: fish resource availability for food and livelihood; ○ political dimension: peace and order condition in lanao lake communities;

3. To come up with appropriate policies and strategies towards Lanao Lake conservation and management.

Conceptual/Theoretical Framework of the Study

Carrying capacity is a term usually associated with measurement. Generally, it refers to how many people the environment can support. It is simply defined as the maximum number of species that can be supported indefinitely by a certain area. Balancing populations are said to be closely related to this concept where the area's resources can support the long term without significantly depleting or degrading those resources in the physical, cultural and social environments.

There are various models for carrying capacity showing the possible relationship between population growth or resource exploitation and carrying capacity as forwarded by Nagle G and K., Spencer. 1997 and cited by Guzman and Guzman (2000:59-60): "Continuous growth may occur if there are huge resources or growing resources; Signoid (S-shaped) growth occurs when societies react before a crisis occurs or a resource is exhausted; Overexploitation and readjustment occur when societies react after a disaster and the environment is given time to recover. Resource exploitation becomes progressively fine tuned with resource availability and sustainability. Overexploitation and collapse occur if the resource cannot be replaced (finite resources) and society does not take any sustainable precautions." The last is catastrophic.

In this study, carrying capacity as a concept pays more particular attention not with the quantitative issue of "how many is too many" (not the number but the behavior of people), but with "what resource and social conditions are appropriate/acceptable, and how do we attain these conditions?" (Ibid, p. 2). In the words of Cole and Stankey (undated), the framework is embedded within the larger comprehensive planning process that can be useful for dealing with problems such as carrying capacity that are characterized by conflict and the need for compromise. This is significant to effectively deal with social and biophysical impacts.

According to Dally and Ehrlich (1992:16-17, 20), the social dimensions of carrying capacity in some ways seem to be more important than biophysical resources. The social elements may include patterns of socially controlled resource distribution, lifestyle aspirations, and various other aspects of sociopolitical and economic organization. It has been underscored that the more important aspect may be a political factor in establishing the institutional foundations for desirable changes, instead of the quantitative dimension of how many people the environment can support. To aptly quote the latter, the four major components comprise of the following:

1) the specification of acceptable and achievable resource and social conditions, defined by a series of measurable parameters;

2) an analysis of the relationship between existing conditions and those judged acceptable;

3) identification of management actions necessary to achieve these conditions; and

4) a program of monitoring and evaluation of management effectiveness (as cited by McCool (1996:7).

The term ‘social carrying capacity’ is hardly firmer defined as applied and utilized in science. In general, this is analysed regarding a certain spatial range. This can be in the one extreme the global range as well as the in the other e.g. a single small spatial unit as the individual’s carrying capacity (Mauerhofer, 2010). In this context, the social carrying capacity can be defined as:

'the limit of growth or development of each and all hierarchical levels of human or social integration within a certain spatial range, shaped by unilateral, multilateral and/or interdependent processes within an individual and between individuals or groups of individuals' (Mauerhofer, 2010: 14)

Social carrying capacity may also refer to “the carrying capacity on regional public good resources, such as the public service capacity and other conditions, to existing population growth and economic development” (Zhao, Liu & Gong, 2015: 161-162). This indicates the importance of social services and facilities to the human constituents. Focusing on socioeconomic and political dimensions, this concept or principle requires strengthening the competence of governments to provide public services and products to improve the living quality of the community or region within its capacity to bear or adapt to the adverse impacts that realities and challenges might bring. It may be viewed as a component of an integrated carrying capacity of developing or urbanizing communities (Zhao, Liu & Hong, 2015:162). Inability to manage well the population growth and the corresponding demand for social public services may worsen internal divisiveness and lead to a host of social, economic, and environmental problems.

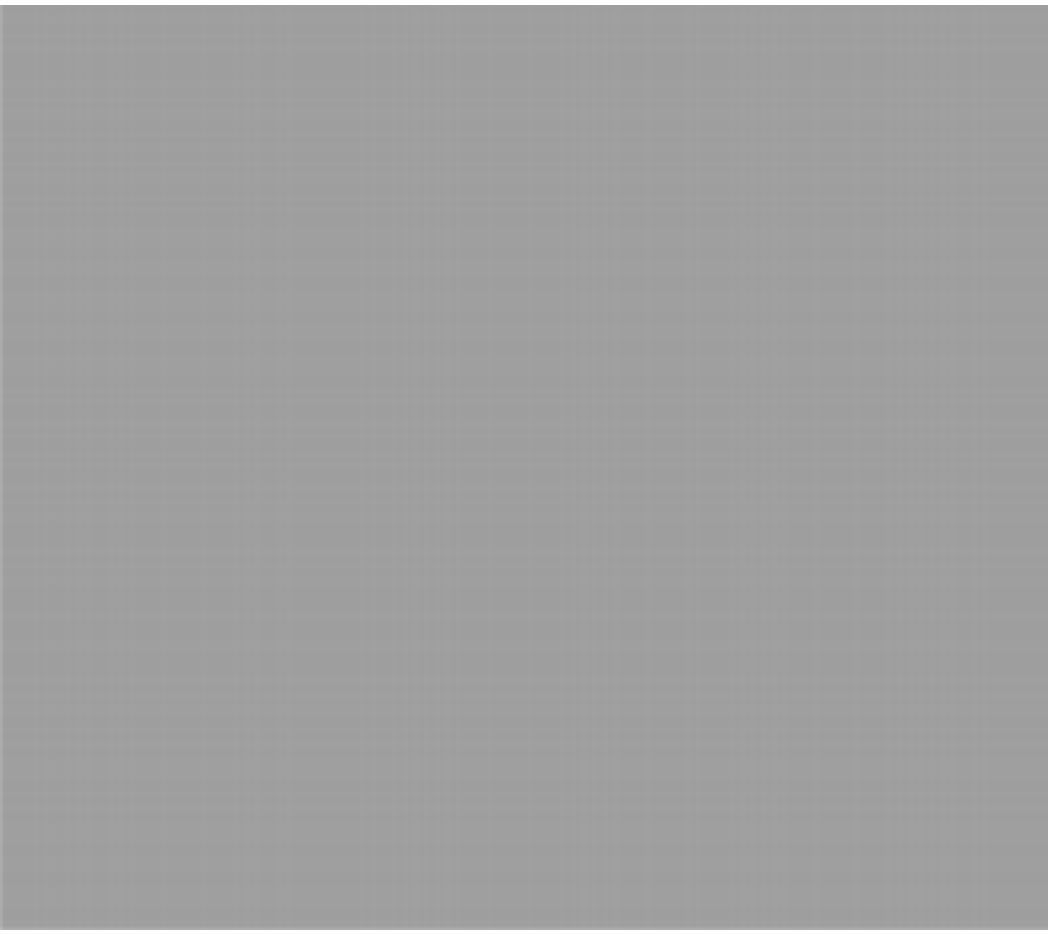
Carrying capacity is usually difficult to estimate. For human beings, the matter is complicated by two factors: substantial individual differences in types and quantities of resources consumed and rapid cultural (including technological) evaluation of the types and quantities of resources supplying each unit of consumption. Hence, carrying capacity varies markedly with culture and level of economic development. Biophysical carrying capacity refers to the maximal population size that could be sustained biophysically under given technological capabilities, while social carrying capacities, the maximum that could be sustained under various social systems such as the associated patterns of resource consumption. At any level of technological development, social carrying capacities are necessarily less than biophysical carrying capacity, because the latter implies human factory-farm lifestyle that would be not only universally undesirable but also unattainable because of inefficiencies inherent in social resource distribution systems (Hardin 1986).

In terms of operationalizing the patterns of socially controlled resource distribution, the concept of absorptive capacity may be of relevance. Absorptive capacity, as an accompanying concept refers to the capacity of group to reap project benefits and/or adapt to adverse impacts associated with development projects. It also describes the behavioral changes which may be required for communities to use and sustain the benefits which may be provided through any development project; and assesses their ability and willingness to make these changes in terms of their motivation for change, including aspirations, level of knowledge, skills and experience, social cohesion of the groups, and constraints. This is akin to the concept of adaptive capacity characterized by the existence of power structures that are responsive and consider the needs of stakeholders. In this context, social analysis may examine the variations in existing knowledge, attitudes, and practice which may influence the extent and manner in which development projects may be used.

Applying the socioeconomic and political dimensions of the carrying capacity based on the above literatures and study objectives, this study focuses on the social carrying capacity of the riverine or hydro host plant and lakeshore communities in terms of the absorptive capacity, desired social services and facilities that can be provided to the increasing population, and desired economic and political condition that bear on Lanao Lake. These are crucial in formulating appropriate development projects/programs and policies towards Lanao Lake conservation and management.

Figure 1-1 shows the variables in the study and the interconnections between them (please see diagram below)

Figure 1 – 1. The Social Carrying Capacity of riverine and lakeshore communities and other variables in the study

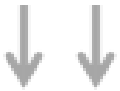


- 4 Lakeshore Communities
- 1 Riverine Community

Trends
-- Provision of Social Services and Facilities
- Economic Dimension: Fish Resource Availability for Food and Livelihood -
Political Dimension: Peace/Order Condition in Lanao Lake communities

- Development Project/ Program Interventions
- Community Benefits from Utilization of Lanao Lake
- Participation of the Community in Lanao Lake Activities
- Barriers/Obstacles to Lanao Lake Development

-Population Growth



Appropriate Development Projects/Programs and Policies towards Lanao Lake Conservation and Management

LITERATURE REVIEW

Lakes are defined as inland bodies of water with distinct basins or depressions that are formed by the natural sinking and rising of land (Guerrero, 2001). Guerrero reports that there are a total of 72 lakes in the country. Lakes have various uses and benefits to the communities. Aside from fisheries, lakes serve as transport routes, sources of irrigation supply, hydropower and cooling waters for industries and domestic water supply.

The intimate relationship between the Meranaw and Lake Lanao can be best captured by Lindy Washburn, an American writer (Lindy Washburn "Our Lake for Others? The Meranaw and the Agus River Hydroelectric Project," as cited by Naga, Research Bulletin, Vol.III, Nos.3 & 4 (November-December 1977):

> *… to the lake they have bound their identity: in their own eyes and in the eyes of the outsiders they are Meranaws, the People of the Lake. On its shores they established their villages and towns and built their mosques, with its water they purify themselves for prayer, in its wetlands they cultivate their rice, from its depths they gather fish,across its spans they transport goods and people, from it they take water for drinking and cleaning. Each boulder and island in the lake, each hill and valley in the land surrounding it, it is woven into the legends and epics of the people. And each Meranaw can willingly trace his ancestry to the original pat-a-pangampong- four encampments on the lake, and their mythical founders. Thus it is with some justification and no little pride that the Meranaws consider the Lake Lanao "our Lake."*

The scientific community has recognized the watershed and extensive land use and farming in the surrounding lakeshore communities along with the hydrological alterations, diminishing waterflow and pollution. A study conducted by Rosagaron (2001) on Lake Lanao revealed the dwindling fisheries resources, extinction of some endemic cyprinids, and the current interventions for fish production and conservation. The study also presented the various interventions from different local and foreign agencies such as PCAMRD-DOST, MSU-College of Fisheries, Southern Philippines Development Authority, Office of the Governor of the Province of Lanao del Sur. Most of the interventions focused on lake conservation, aquaculture projects, and creation of Lake Lanao Watershed Protection and Development Council.

Another interesting study undertaken by Rascal, *et al.* entitled *"Practices, Awareness and Attitudes of Meranaw Farmers in Three Watershed Barangays in Masiu, Lanao del Sur, Philippines towards the protection and conservation of the Lake Lanao Watershed"* in 2002 citing Saplaco (1998) and Sosmena (1991) reveals the cause of watershed degradation is a combination of ignorance and economic backwardness of people, outdated social system, overpopulation and overgrazing. These have implications to the social carrying capacity. The study implications highlighted that the Meranaw farmers of Lake Lanao watershed whose life depends on the natural resources of the area should be considered partners in

program development. Their participation is vital in program planning, development and implementation

In the 2011 masteral thesis of Gladys Ismail submitted to Oregon State University entitled "The Status, Life History Traits of Endemic, Native and Introduced Species in Lake Lanao, Philippines," the steady decline of endemic species was reported. From 18 identified endemic species in 1963, meaning they are native to the Lake, only two species were caught in a survey in 2008 comprising an insignificant portion of the total weight catch (0.01% and 0.04% catch respectively). An introduced species have taken over the lake as indicated by the 66.6% total weight catch. (Ismael 2011: 15) The introduction of this invasive species can be attributed to the varied uses of the lake to the detriment of the varied and vibrant fish ecosystem of before.

Carrying Capacity

Generally, carrying capacity refers to how many people the environment can support. It is simply defined as the maximum number of species that can be supported indefinitely by a certain area. Balancing populations are said to be closely related to this concept where the area's resources can support the long term without significantly depleting or degrading those resources in the physical, cultural and social environments.

There are various models for carrying capacity showing the possible relationship between population growth or resource exploitation and carrying capacity as forwarded by Nagle G and K., Spencer. 1997 and cited by Guzman and Guzman (2000:59-60): "Continuous growth may occur if there are huge resources or growing resources; Signoid (S-shaped) growth occurs when societies react before a crisis occurs or a resource is exhausted; Overexploitation and readjustment occur when societies react after a disaster and the environment is given time to recover. Resource exploitation becomes progressively fine tuned with resource availability and sustainability. Overexploitation and collapse occur if the resource cannot be replaced (finite resources) and society does not take any sustainable precautions." The last is catastrophic.

Carrying capacity is a term of measurement. It measures both living organisms and non living objects, and relates to the maximum amount of an organism or object that can be supported by a given amount of space. This limit depends on a large number of variable environmental factors. Carrying capacity can be concerned with population growth of humans and other species of living organisms (Paehlke, 1995). When a species grows rapidly over the carrying capacity of its environment (i.e. overpopulation) it results in problems (Dashefsky 1993). When the species crowds its environment (i.e. ecosystem, habitat, etc.) resulting in diminished resources, its "growth will decline". When this occurs the population of the species will "level off and eventually cease to grow or even suffer from a severe decline" (Paehlke, 1995).

In *Carrying Capacity*, Viau (1999) provides information regarding the carrying capacity of environments for both humans and animals. Territory plays a key role in animal existence

and that of animal hierarchies. Mongillo and Zierdt-Warshaw (2000) support this rule of nature when they mention the existence of competition among species and individuals for the “availability of resources in an environment”. Even though humans may not have to kill in order to survive, but they do have to maintain jobs to increase their income, which provides them with the basic necessities: food, clothing, water and shelter.

The concept of human carrying capacity has become a major issue and concern for resource managers. Finding a balance between human being and nature is becoming more and more of a challenge, with humans being the dominant force. In today’s society, with increase modes of transportation, mobility has been a major contributing factor in influencing the tourism industry. People are seeking new opportunities to travel and explore, but the conflict arises between at what cost should the environment have to suffer? Tourism is not all necessarily bad, as long it can be properly managed. Without such management, it “can be and engine of destruction rather than a force of human development,” (Eberlee, 1998). Tourism managers constantly ask the question of, how many is too many? An expert on international tourism sustainability states “it is only through government control, management of the industry, and self-policing that you can begin to counter that [downward spiral]" (Eberlee, 1998). This refers to the degradation that can occur to an area without proper management.

Defining human carrying capacity can take many directions, however when it comes to defining ecological carrying capacity, researchers have a better grasp on, as far as figures and predictions. People use K as a means of managing herds, to enhance productivity and ultimately income. For example cattle ranchers and fish farmers use carrying capacity estimates to maximize their return by understanding food resources, area, and animal requirements. Every manager will use carrying capacity estimates slightly differently to gain similar results. “As long as the appropriate limiting factors are monitored, the choice of method for estimating carrying capacity is a matter of operator preference” (Hinshaw 2000).

Social Carrying Capacity

This entails a framework and corresponding appropriate strategies. In this context, the concept of the Limits to Acceptable Change (LAC) to borrow the term employed by McCool (1996) is a system for management of tourism development. LAC planning system was developed over a period of years in the early 1980s to address the problems of managing recreational use in national protected areas and as originally articulated by Stankey and others in 1985. To aptly quote the latter, the four major components comprise:

The specification of acceptable and achievable resource and social conditions, defined by a series of measurable parameters; an analysis of the relationship between existing conditions and those judged acceptable; identification of management actions necessary to achieve these conditions; and a program of monitoring and evaluation of management effectiveness (McCool, 1996:7).

As articulated, LAC is based on the recognition that specific objectives are needed to identify what management wants to protect; change is always present in nature-dominated systems; any recreational use leads to some change; management is confronted with the issue of how much change is acceptable; and monitoring of the outcomes of management to determine if actions are effective. More importantly, LAC should deal not with the quantitative issue of "how many is too many" (not the number but the behavior of people), but with "what resource and social conditions are appropriate/acceptable, and how do we attain these conditions?" (*Ibid*, p. 2). In the words of Cole and Stankey (undated): LAC as a framework is embedded within the larger comprehensive planning process that can be useful for dealing with problems such as carrying capacity that are characterized by conflict and the need for compromise. This is significant to effectively deal with social and biophysical impacts.

According to Dally and Ehrlich (1992:16-17, 20), the social dimensions of carrying capacity in some ways seem to be more important than biophysical resources. The social elements may include patterns of socially controlled resource distribution, lifestyle aspirations, and various other aspects of sociopolitical and economic organization. It has been underscored that the more important aspect may be a political factor in establishing the institutional foundations for desirable changes are emphasized, instead of the quantitative dimension of how many people the environment can support.

The term 'social carrying capacity' is hardly firmer defined as applied and utilized in science. In general, this is analysed regarding a certain spatial range. This can be in the one extreme the global range as well as the in the other e.g. a single small spatial unit as the individual's carrying capacity (Mauerhofer, 2010). In this context, the social carrying capacity can be defined as: 'the limit of growth or development of each and all hierarchical levels of human or social integration within a certain spatial range, shaped by unilateral, multilateral and/or interdependent processes within an individual and between individuals or groups of individuals' (Mauerhofer, 2010: 14).

The same source forwards that the correct identification of this spatial level is a precondition for the identification of the correct measures not exceeding the carrying capacity. This applies as well to the social as well as to the environmental carrying capacity. Mauerhofer (2010) citing Del Monte-Luna et al. (2004) defines ecological carrying capacity as 'the limit of growth or development of each and all hierarchical levels of biological integration, beginning with the population, and shaped by processes and interdependent relationships between finite resources and the consumers of those resources'. With respect to the spatial range of an individual protected area the concept of carrying capacity is always articulated, either with regard to environmental issues such as effects on species and social issues like tourist satisfaction respectively alone or together (Mauerhofer citing Prato, 2001; Navarrete et al., 2004).

In addition, social carrying capacity may also refer to "the carrying capacity on regional public good resources, such as the public service capacity and other conditions, to existing

population growth and economic development" (Zhao, Liu & Gong, 2015: 161-162). This indicates the importance of social services and facilities to the human constituents. Focusing on socioeconomic and political dimensions, this concept or principle requires strengthening the competence of governments to provide public services and products to improve the living quality of the community or region within its capacity to bear or adapt to the adverse impacts that realities and challenges might bring. It may be viewed as a component of an integrated carrying capacity of developing or urbanizing communities (Zhao, Liu & Hong, 2015:162). Inability to manage well the population growth and the corresponding demand for social public services may worsen internal divisiveness and lead to a host of social, economic, and environmental problems.

Issues of Human Development and Carrying Capacity around Lakes

In a rapid assessment of Lake Mainit in Agusan del Norte conducted by De Guzman, *et al*. of MSU-Naawan in 2008 it was disclosed "the residents of lakeshore communities around Lake Mainit identified several issues and concerns in connection with fisheries-based livelihood, living condition, and sociopolitical situation and the Lake. The most common concerns include defining fish catch and poor income, resource use conflicts, degrading quality of lake water, and poor or ineffective management or governance.

In another setting abroad, French and Gilmour write about a non-profit organization in Ontario Canada which is geared towards education with specific goals of protecting and preserving lakes. This organization emphasizes Lake Plans and official Plans. The definition of a Lake Plan is a plan that evolves "a Comprehensive lake-wide approach to ensure development fits the context of a lake environment"(French and Gilmour, 2004). The specific criteria for a Lake Plan includes the following:

• "Identifies the special character of the Lake"
• "Consolidates information about past and current state of the lake"
• "Produces future direction concerning lake development"
• "Educates lake community members."
"Produces policy that may be used in a municipal level official plan" (French and Gilmour, 2004)

The organization not only views lake plans as the only way to protect lakes but also offers another plan which acts as a contract for residents and land owners around the lake. This official plan is a contract that residents and landowners make with municipal counsels and developers to decide where and how development will be structured around the lake. This proactive approach of involving residential and commercial stakeholders may increase the communication between the stakeholders and may lead to projects which benefit the community as well as the developers.

Another demand that humans put on the earth is the amount of trash that is produced around the globe. Products are constantly being designed for easy one time use and disposal.

Instead of trying to reduce the amount of waste per person we are increasing it. So as population levels grow, an increase of waste is being confined to smaller and smaller areas.

Carrying capacity is the “maximum number of species that can be supported indefinitely by a particular habitat, allowing for seasonal and random changes, without degradation to the environment and without diminishing carrying capacity in the future,” (Hardin, 1977). Possible outcomes of an exceed in carrying capacity include the exhaustion of non renewable resources (natural gas, oil, coal, etc.), desertification, overgrazing, degradation of the land, world-wide famine and water shortages, poverty, and the rapid decline in the quality of earth.

METHODOLOGY

This study employs triangulation method, a combination of quantitative and qualitative research design. Triangulation has been defined as the use of multiple observers, interpretive points of views, and levels of forms of empirical materials in the construction of interpretation (Denzin, 1989:270). This involves using multiple data sources in research to enhance data and deep understanding of patterns generated by the study. Employing qualitative and quantitative data complement aspects of the same phenomenon and provide more insights.

The triangulation of quantitative and qualitative tools employed primary and secondary data as follows:

Baseline Survey using Standardized Interview Schedule
(Quantitative) Key Informants (KIs) (Qualitative)
Focus Group Discussion (FGD)
Secondary Data (Qualitative and Quantitative) (e.g., CBMS, Ecoprofile, CLUP, NSO/Census Data, DENR & NPC data, Various Studies)

Quota sampling of 100 per municipality/city is employed where there is multisectoral representation. This includes the youth, elderly, women and men, local government officials/employees, businesspersons, farmers/fisherfolks, and professional, religious and educational sectors. Four or five purok are sampled per research area as identified by the local contact persons. To enhance the data, key informant interviews and focus group discussion (FGD) were conducted.

In all the 3 FGDs conducted, multisectoral representation was adopted in inviting the participants. However, in the actual activity, some of the participants failed to come, despite follow-up calls. A summary table of research tools and the corresponding number of participants is provided below.

Summary table of research tools used and number of Respondents/Participants

Research Tool	Number
Survey in 5 research areas/1 city and 4 municipalities (5 communities x 100)	500
Key Informant Interviews (multisectoral)	11
Focus Group Discussion July 19/16 = 14 August 31/16= 22 Sept 13/16 =17	53
Community/Stakeholders' Validation	35
Total	599

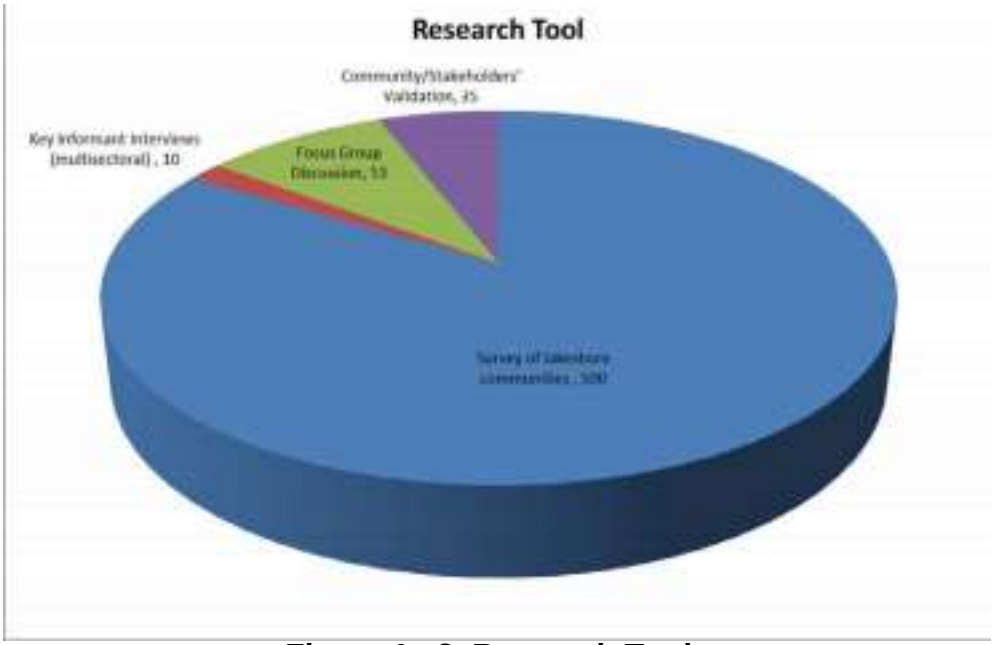


Figure 1 –2. Research Tools

Ground truthing and pre-testing of the survey instrument were done. Ethical standards were observed ensuring compliance with the following ethical requirements, among others: secure free prior and informed consent prior to its conduct, maintain confidentiality and anonymity, and give back to the community results of the study.

In regard to compliance with ethical research, the study undertook the entry protocol through a visit of the lakeshore communities to consult the local government officials and clarify the nature and purpose of the research. A letter explaining the research was sent to the various government units, and barangay/purok officials. Free prior and informed consent was also done with the Meranaw men and women respondents informing them about the nature of the research and was asked if they were willing to participate in the research process. Confidentiality and anonymity were observed where the respondents' identities were given code names. To veer away from being an extractive-oriented research, the study researchers conducted community/stakeholders' data validation and solicited appropriate culture and gender-sensitive development interventions.

For the entry protocols, formal letters were sent to the local governments to include the province of Lanao del Sur, city of Marawi, and municipalities of Balindong, Ganassi, Saguiaran and Tamparan. In each of these areas, the research team presented the purposes of the study and methodology, as well as answered their inquiries. The municipal development office facilitated which specific barangay/purok will be included and assigned a staff to guide the field enumerators.

In the actual conduct of the study, informed consent was solicited from the respondent. In

all cases, the Meranaws were willing respondents. To ensure efficient relay of the questions, almost all of the interviewers were Meranaw themselves. Except for a few olderly, the Meranaw respondents are fluent in Tagalog.

In this context, the operational parameters of the social carrying capacity employ the following:

Population growth and density: Trends and insights
Absorptive Capacity: Community participation in lake development
interventions Social services (medical/health, police/firemen force, education)
Economic dimension: fish resource availability for food and livelihood
Political dimension: peace and order condition in Lanao lake communities

For variables that cannot be quantified, opinions of the stakeholders in regard to development impact can be solicited to establish the limits (Subic Bay Freeport Zone Comprehensive Master Planning Project, March 2012:9).

Source: Google Maps

Figure 1 –3.Map of Research Areas

HIGHLIGHTS OF FINDINGS

Sociodemographic and Economic Profile

Of the 500 sample Muslim Meranaw respondents from the four lakeshore and one riverine communities, their ages range from less than 20 years to more than 70 years old, more women than men, mostly married having 4-6 household members. About 45.5% having income between Php5,000 to Php10,999 and 41.7% with 1-3 durable goods, engaged in housekeeping, business or trade, fisherfolks and farmers, almost half obtaining potable water from the spring, lake or river, and 8.3% not having toilet speak of the economic condition of the Lanao Lake respondents.

Various uses of the lake include domestic, economic, religious and transportation purposes. The most serious problems currently affecting Meranaw are varied with environmental, socioeconomic, and political implications. Foremost, is the environmental concern about the garbage polluting the lake (57.2%) with high responses emanating from Marawi City (56.1%), and Saguiaran (72.2%). These are repeated in Balindong (54.1%), Ganassi (56.7%), and Tamparan (43.7%). Use of dynamite and other illegal methods, as well as catching small fishes top in Tamparan and less catch of fish is uppermost in Balindong both linking to fish supply and recognizing the lake as an important source of food and protein. Overpopulation is highlighted in Saguiaran which is a hydro host plant. Logging and lack of concern/ awareness about policies on Lake Lanao development are specified as obstacle to development carry implications to policy implementation.

The industrial use of the lake appears to be an issue in lake utilization with such responses as widening of Agus/NPC and PESCO and unpredicted rise of water level. Other issues revolve around corruption, no power, no pier, lack of drainage, presence of settlers near the lake, water lily in the lake, and conflict/*rido* (this refers to an unsettled family/clan conflict), and others. Harmonized with the responses above as most serious problems, the following are repeated as barriers/obstacles to Lake Lanao development, namely: corruption in project implementation/weak governance (20.7%), throwing of garbage along the lake/improper waste disposal (19.7%), lack of discipline or community cooperation (11.9%), lack of concern from government (9.7%), and hydro power generation/ NPC/ Agus (6.5%). Moreover, increasing population, absence of public toilet, use of dynamite fishing and other illegal methods, lack of budget, fish reduction /dependence on lake for livelihood, settlers along the lake rido, settlers near the lake of interest/lack of unity, crisis, education, and high electric/current bills are also enumerated.

There are apparently social problems such as overpopulation, less catch of fish, and presence of conflict that bear implications to the absorptive capacity at the individual/household and government/structural levels.

Absorptive Capacity. Based on the survey data, there are varied development interventions implemented in the four lakeshore communities and one riverine community. These involve infrastructures involving the roads, ports and bridges (27.3%), health and sanitation (18.3%),

sports and recreation (16.6%), buildings (9%), water utilities (8.6%). The rest are religious/cultural livelihood/economic,, education, power in nature. Projects have been implemented since the 1990s, but a greater number have been undertaken in 2013 to 2015.

Implementing the projects are the local government units and national government agencies/institutions such as DPWH, TESDA, DSWD, DILG and National Power Corporation, as well as other organizations such as USAID and Save Lake Lanao Movement.

Of the five research areas, it appears that Balindong has few activities related to Lanao Lake. Of the 40 survey respondents, a greater number mention clean up drive followed by fish pond/ port and solid waste disposal program showing concern for the lake as a resource.

In regard to participation in community activities pertaining to Meranaw development, a great majority of 91% responded negatively as against 9% registering active participation. The diminishing economic viability of the lake may have also reduced its importance to the lives of the common Meranaw who are now into business and trading as compared to being farming and fishing a generation ago.

To describe further community involvement by socioeconomic status, a cross-tabulation of participation in activities pertaining to Lanao Lake by monthly income and area shows that most likely those who participate in the activities come from the income bracket of P5.000 to P10.999.00 and followed by those earning a monthly of P4,999.00 & below. These must be the ordinary folks who have the time and are enticed to engage in community activities. In addition, a cross-tabulation of participation in activities pertaining to Lanao Lake by education and area displays that a greater number of those who participate possess a college or high school level of education.

When asked if they favor the utilization of the lake for the power needs of Mindanao, 70.6% are generally amenable. A close look at the data shows a great majority (88.2%) from Tamparan register positively followed by 70.8% from Marawi, 68.4% from Saguiaran, and 68% from Ganassi. Moreover, a little over half (55%) from Balindong say “Yes.” More negative and uncertain responses emanate from the latter. About 20% from Meranaw respondents from Saguiran also register uncertain position.

The absorptive capacity is manifested with the common Meranaw who are now into business and trading as compared to being farming and fishing a generation ago. It is remarkable that ecological balance and economic sustainability surface as significant. This is displayed in the responses to the desired condition Meranaw respondents consider as most important to happen in Lake Lanao. Maintaining cleanliness emerges topmost as the most important thing to happen in Lanao Lake. This is followed by closely interrelated items such as preserve/ develop the lake and stop logging, bring back abundant fish, sound utilization of water, and restore the lake’s beauty. Others declare peace and development and economic related responses like improve agriculture, establishment of a fish port and fishpond and good electric generation and free electricity.

Social Carrying Capacity. On the whole, from the years 1960 to 2015, there is an increasing trend in the population with Marawi City leading with 3.7% growth rate and with almost the same pattern with 1.1%, 1.2 %, 1.1% and 1.1% for Saguiran, Balindong, Tamparan, and Ganassi, respectively. Note that Marawi, the capital city of Lanao del Sur where government

line agencies and business establishments are situated, displays a relatively higher average population growth rate for more than 50 years as against the other four areas. The growing population signifies the need to provide the basic social services and facilities, food security for the human constituents in terms of fish supply and stable fishing as livelihood source, and peaceful community.

Table 1. Social Carrying Capacity: Services and Facilities

Location	Services/Facilities	Standard Ratio	Existing Condition Services/Facilities	Desired Condition Services/Facilities
Marawi City	Population		201,785 (2015) Annual Growth – 2.96% Household Population - 174,253	
	Population Density		2,300/km^2 (6,000/sq mi)	
	Water Supply		Water District	
	Power Supply		LASURECO NPC Effectively Covered – 90 Barangays Individual Households Connection (Registered) - 12,879 Residential – 91.2% Commercial – 6.4% Public Building – 0.88%	
	Health Resources	Doctor Population 1:20,000 Nurse-Population 1:15,000 Dentist Population 1:20,000 Midwife Population1:5,00 0	Public Hospital – 1 Private Hospital – 10 RHU – 1 BHS – 10 Nutrition Posts – 2 BnB – 2 Microscopy Center - 1	No data on no of medical doctors dentists,midw ives, and nurses

	Protection	Police-Population 1:1,000	Police Force - 72 (2010) Police Vehicles - 3 Traffic Officers and Traffic Aiders – 24	Lacks 129 policemen
	Fire Protection	Firemen Population 1:2,000	Fire Stations – 2 Firemen and Staff - 21 (2010) Fire Trucks – 5 (city proper and at MSU)	Lacks 80 firemen
	Education Facilities	Classroom Student 1:50 Teacher-Student Public (Primary) 1:50 Private (Primary) 1:52 Private (Secondary) 1:50 Private (Tertiary) 1:50	Public School Teachers (2006-2007): Elementary - 1,125 Secondary - 286 Pupil Ratio (2006-2007): Elementary - 1:67 – 1:75 Secondary – 1:57 – 1:60	Deficient no of teachers
Municipality of Saguiaran	Population		24,619 (2015)	
	Population Density		480/km^2 (1,200/sq mi) (2015)	
	Water Supply		Have access to safe water – 1,821 Have no access to potable water – 1,211	
	Power Supply		LASURECO	
	Health Resources	Doctor Population 1:20,000 Nurse-Population 1:15,000 Dentist Population 1:20,000 Midwife Population1:5,000	Doctor - 1 Nurse - 7 Dentist - none Midwife - 7	No dentist Lacks 1 medical doctor Sufficient nurses and midwives

	Protection	Police-Population 1:1,000	Police Force - 23	Sufficient police
	Fire Protection	Firemen Population 1:2,000	Firemen and Staff - 14 Fire Trucks - 1	Sufficient firemen

	Education Facilities	Classroom Student 1:50 Teacher-Student Public (Primary) 1:50 Private (Primary) 1:52 Private (Secondary) 1:50 Private (Tertiary) 1:50	No. of Students (2008): Elementary – 1,021 Secondary – 4,267	No data on no. of teachers
Municipality of Ganassi	Population		23,016 (2015)	
	Population Density		90/km^2 (230/sq mi) (2015)	
	Water Supply		Level 1 and 2 water systems	
	Power Supply		LASURECO	
	Health Resources	Doctor Population 1:20,000 Nurse-Population 1:15,000 Dentist Population 1:20,000 Midwife Population1:5,00 0	No data available	
	Protection	Police-Population 1:1,000	No data available	

	Fire Protection	Firemen Population 1:2,000	No data available	
	Education Facilities	Classroom Student 1:50 Teacher-Student Public (Primary) 1:50 Private (Primary) 1:52 Private (Secondary) 1:50	No data available	

		Private (Tertiary) 1:50		
Municipality of Balinding	Population		29,180 (2015)	
	Population Density		64/km^2 (170/sq mi) (2015)	
	Water Supply		Level 1 and 2 water systems	
	Power Supply		LASURECO	
	Health Resources	Doctor Population 1:20,000 Nurse-Population 1:15,000 Dentist Population 1:20,000 Midwife Population1:5,000	Physician - 1 Public Health Nurse – 1 Midwives – 3 Brgy. Health Workers - 12	Lacks 1 medical doctor, 1 nurse, 3 midwives No dentist
	Protection	Police-Population 1:1,000	Police Force - 19	Lacks 11 policemen

	Fire Protection	Firemen Population 1:2,000	Lack of fire trucks Lack of firefighting materials/facilities Lack of standby water supply	No data on no of firemen
	Education Facilities	Classroom Student 1:50 Teacher-Student Public (Primary) 1:50 Private (Primary) 1:52 Private (Secondary) 1:50 Private (Tertiary) 1:50	No. of Teachers and Staff: Primary and Elementary - 276 Secondary – 51 No. of Schools: Elementary – 7 High School - 2	No data on no. of pupils/student s
Municipa lity of Tampara n	Population		25,874 (2015)	
	Population Density		150/km^2 (390/sq mi) (2015)	
	Water Supply		Brgy. Poblacion – Lvl II and III	

			Far-flung barangay residents – wells,spring, surface water	
	Power Supply		LASURECO	
	Health Resources	Doctor Population 1:20,000 Nurse-Population 1:15,000 Dentist Population 1:20,000 Midwife Population1:5,00 0	Hospital Worker: Doctor - 1 Nurse - 5 Dentist - none Midwife – 7 Medtech- 1 6 Health Centers: Midwives – 3 Dentist – 1 Sanitary Inspector – 1	Lacks 1 medical doctor Needs at least 1 dentist Sufficient midwives and nurses

	Protection	Police-Population 1:1,000	Police Force 25	Lacks 3 policemen
	Fire Protection	Firemen Population 1:2,000	No data available	
	Education Facilities	Classroom Student 1:50 Teacher-Student Public (Primary) 1:50 Private (Primary) 1:52 Private (Secondary) 1:50 Private (Tertiary) 1:50	No. of Students: No Grade – 2,241 Preschool – 929 Elementary – 5,362 High School – 3,744 Post-Secondary – 480 College Undergrad – 2,614	No data on no of teachers

Sources of Data: Wikipedia, NSO and City, Municipalities and Provincial Planning Office Basic Services Standards References: National Framework for Physical Planning, NEDA NLUC, 2002; Guide to Population and Development Planning, NEDA, 2004; Philippine Health Statistics; Revised Organizational Structure and Staffing Standards for Government Hospitals, Department of Health, 2013; Republic Act 7880 An Act Providing for the Fair and Equitable Allocation of the Department of Education, Culture and Sports' Budget for Capital Outlay; Philippine Standard Classifications of Education (PSCED), Department of Education, Philippine Statistics Authority; Philippine National Police; Presidential Decree No. 1184. Integrated National Police Personnel Professionalization Law of 1977

Based on the existing data, it is lamentable that the facilities in the sampled research areas do not match the desired or standard condition for health, protection, and education. The gap between the desired or standard condition and existing number of facilities for health,

protection and education is apparently an issue of good governance. Key informant work indicates that the historical distrust between the Meranaws and government agencies such as NPC/MINGEN are products of the same decades of government neglect that remains in many Meranaw perception.

Economic Dimension: Fish Resource Availability for Food and Livelihood

From the ongoing study of Nacua, S., R. Gimena, and N. Eza entitled *"Fisheries of Lake Lanao: Reproductive Characteristics and Abundance,* " an NRCP funded project(2017), the reduction of fish species is scientifically captured where the monthly relative abundance of

fishes caught from the four sampling stations (Marantao, Ramain, Taraka, Ganasi) shows that throughout the sampling months, “it is dominated by introduced fish *Hypseleotris agilis* (= *Giuris margaritacea*),locally known as “katulong”, and the fries of Hypseleotris agilis, locally known as “Kuyabog”… . the catch for “Katulong” increases monthly showing a peak sometime during the colder months (October, November and December. The graph also shows that the native species “Arowan” (*Channa striata*) and “Katipa” (*Clarias* spp.) has a very low relative abundance while, another introduced fish “Tilapia” (*Oreochromis* spp.), whose fingerlings are seeded into Lake Lanao regularly the College of Fisheries of MSU Marawi, has a moderately high abundance. Only one endemic species “Tumba” (*Barbodes tumba*) was recorded sometime in December 2017.” Raw data from the survey report that many of the respondents (139) observe that there has been a dwindling catch of fish from the lake.

As relayed in previous sections, the perceived reduction in fish catch particularly the old endemic species is also present in key informant data gathered. The interviews reveal the similar observation that fish that can provide meals for the households in communities surrounding the lake used to be plentiful but as a source of economic sustenance, has since declined. People use to not buy fish from the lowlands and instead relied on the bountiful catch from the lake by fishermen.[1] But gradually, over the decades, the people noted that new species of fish were introduced during the Marcos Martial Law period that soon took over the lake, replacing the endemic fish that they preferred. [2] The narrative of the American scientist who supposedly “poisoned” the lake or the operations of the NPC/MINGEN both belie the distrust towards the motives and activities of perceived outsiders that continue to color their perspectives on the current contemporary uses of the lake.

Table 1 – 24. Number of Fishing Boats per Municipality (as basis for estimating the number of fishermen)

MUNICIPALITY	REGISTERED BOATS (Boat-R)
Balindong	166
Ganassi	47
Marawi	152
Tamparan	185

[1]NRCP -Lake Lanao Sessions-160719_001– 08/00/2016
[2] Interview with a Tabligh, August 18, 2017.

Data Source: BFAR Boat-R, 2016 thru BFAR Provincial Fishery Office- Lanao del Sur

Despite the reduced productivity of fish produced by the lake, many meranaws still use fishing boats for fishing to augment perhaps their other sources of income. Note that many of the respondents in the survey report small business as their source of income. It is possible that these registered fishing boats also serve as transportation for the retail of goods to and from Marawi and the lake-side municipalities.

Political Dimension: Peace and Order Condition in Lanao Lake Communities

Lanao is also known as the hot-bed of violent clan wars that decimate whole families in violent assasinations and clashes known as rido. However, a key informant traces the rise of these destructive clashes from the breakdown of traditional leadership when local government units were given autonomy and finances.[3] The source argues that clan wars are the consequence of families battling it out for the internal revenue allotment that each municipality is granted. Election, therefore, become the flashpoint for these war over government funds and spill over even after the voting period in a never-ending cycle of violence that pit political families against each other. These warring political families who also fight over land are considered sources of conflict by the key informants more than the Moro rebel groups also present within their communities according to a key informant.[4] The MILF are actually more peaceful in their ways as compared to their families engaged in rido.

However, it is not just rido that is the source of conflict in their communities, an informant discloses. The presence of drug peddling and use, particularly shabu, was also reported by a number of key informants.[5]

The perceived reduction in fish catch particularly the old endemic species is reflected in key informant interviews revealing similar observation that fish that can provide meals for the households in communities surrounding the lake used to be plentiful but as a source of economic sustenance, has since declined. Despite the reduced productivity of fish produced by the lake, many Meranaws still use fishing boats for fishing to augment perhaps their other sources of income.

[3] Interview with Alikman, August 18, 2017.
[4]NRCP -Lake Lanao Sessions-Imam - 160110_002– 08/00/2016

[5]NRCP -Lake Lanao Sessions-Imam - 160110_002– 08/00/2016

Lanao is also known as the hot-bed of violent clan wars that decimate whole families in violent assasinations and clashes known as rido. However, a key informant traces the rise of these destructive clashes from the breakdown of traditional leadership when local

government units were given autonomy and finances. The source argues that clan wars are the consequence of families battling it out for the internal revenue allotment that each municipality is granted. These warring political families who also fight over land are considered sources of conflict by the key informants more than the Moro rebel groups also present within their communities according to a key informant. However, it is not just rido that is the source of conflict in their communities. The presence of drug peddling and use, particularly shabu, was also reported by a number of key informants.

The above-mentioned issues may adversely affect the social carrying capacity of the lake and provide important information in coming up with strategic solutions to address them.

CONCLUSION

As articulated by Dally and Ehrlich (1992:16-17, 20), the social dimensions of carrying capacity in some ways seem to be more important than biophysical resources. The social elements may include patterns of socially controlled resource distribution and various other aspects of sociopolitical and economic organization. It has been underscored that the more important aspect may be a political factor in laying the institutional foundations for desirable changes

To reiterate, the absorptive capacity is manifested with the common Meranaw who are now into business and trading as compared to being farming and fishing a generation ago. It is remarkable that ecological balance and economic sustainability surface as significant. This can also be gleaned in the responses to the desired condition Meranaw respondents consider as most important to happen in Lake Lanao. Maintaining cleanliness emerges topmost as the most important thing to happen in Lanao Lake. This is followed by closely interrelated items such as preserve/ develop the lake and stop logging, bring back abundant fish, sound utilization of water, and restore the lake's beauty. Others declare peace and development and economic related responses like improve agriculture, establishment of a fish port and fishpond and good electric generation and free electricity.

As an economic resource, the social carrying capacity of Lanao Lake is diminished. The Meranaws have moved on to other sources of income outside of that provided by the lake. Although there are existing social services for health, protection, and education, these are still insufficient to respond to the needs of the Meranaw constituents. The gap between the desired or standard condition and existing number of facilities for health, protection and education is apparently an issue of good governance. There is also a prevailing culture of distrust between Meranaws and perceived outsiders who use the lake as an economic resource.

Recommendations of the Study. To ensure conservation, management and meaningful development of this important water body resource, among others recommendations of the

study include policy formulation/implementation in establishing a functional Lanao Lake Development Authority to oversee the overall management and supervision of the lake for conservation and development; research and training of collaborative and multidisciplinal research undertakings and comprehensive information, education and communication (iec)

program to entice the stakeholders to be more involved in community activities attuned to lanao lake conservation and management; infrastructure and others ensuring equitable access to basic social services in health, education and protection by providing the corresponding infrastructure in these areas and monitoring and evaluating the performance of these services regularly; and peace and order mechanisms engaging all sectors/stakeholders in the formulation of the rehabilitation of Marawi and lakeshore communities with the involvement of the traditional leaders and restoration of local autonomy with budgetary support.

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