Discussion Paper on: "Conservation and Management of Freshwater Resources"

Discussant:
Macrina T. Zafaralla
Intitute of Biological Sciences
College of Arts and Sciences
University of the Philippines Los Baños
College, Laguna

First, I would like to thank the NAST for the opportunity given me today to discuss the paper entitled "Conservation and Management of Freshwater Resources" by Dr. Rafael Guerrero. I am extremely interested in this topic which I consider very relevant and timely. The exchange of ideas on it should help put into correct perspective the importance of inland water resources to the country's economic stability. I think it is of utmost importance that inland water resources be underscored among our development priorities because of the unjustifiable low priority these resources receive at present.

There are a number of reasons why management should take a second look at the state of freshwater resources of this country. The ones which I consider important reasons are:

1) these resources have not been performing to the level of our expectations,
2) our inland water resources today are highly threatened by misuse and abuse; and
3) there is much to be desired in terms of the equitability of the distribution of the benefits derivable from their use.

For us here gathered today, it is therefore relevant that we ask ourselves why these observations hold.

Dr. Guerrero has given us a good vista on the state of the most significant of our inland water resources, namely, lakes,

swamps, reservoirs, rivers, ponds and small impoundments. We submit that these resources are significant based on areal coverage alone. Alternately stated, area-wise they have a potentially high production. But let me focus your attention on the distinction between secondary (fish) production and secondary (fish) productivity and in the process put emphasis on which of the two tells us more about the ecological status of an aquatic resource.

Production or fish production to be specific, refers to the quantity of fish produced within an area or within a year. Table 1 shows the production of some well known lakes and reservoirs.

Productivity, on the other hand, refers to the rate of fish production per unit area or volume of water per unit time. (Note how this differs from primary productivity which refers to plants). The same table above shows the differences in the productivity of the same lakes.

As you can see from the table, productivity can change the whole picture of performance. Productivity gives us an idea of how each resource is performing in comparison to another. From the tables presented you can very well see that production values cannot be taken at their face value without first having an idea about productivity.

Productivity therefore is an expression of the performance of a resource. Because it reflects the rate of performance, it gives a better basis for the comparison of different lakes. Productivity depends on such natural factors as land use and water use. Fig. 1 shows how these two elements impinge upon productivity by way of their effects on light, temperature and nutrients. Fig. 2 shows the larger context in which Figure 1 would fall. Within both contextual frameworks one can readily understand that little disturbed watersheds lead to little disturbed lake ecosystems (as shown by the nutrient fluxes that take place there). In contrast, disturbed watersheds which result from various activities including the conversion of forests into agricultural lands, industrial estates and settlement areas can cause a disturbed lake. Disturbance can be seen in the highly variable nutrient levels, the excessive loosening of the soil which in turn results in higher erosion rates. The latter aggravate siltation problems in impounded waters.

Having presented the interrelationships of human activities with the changes taking place in an aquatic resource, I shall now dwell on my views on what should be the concerns of manage-

ment in three inland resources, namely, Laguna de Bay, Taal lake and Lake Buhi. In my short discussion I shall expound on the reasons why I believe that some of our inland aquatic resources must be managed using unique and appropriate management strategies.

With Laguna de Bay, I tend to think that the problem of declining fish yield is more complex than we care to imagine. At least three factors interplay in a yet not so well understood way and bring about the stunted fish growth. These factors are: (1) heavy siltation; (2) pollution; and (3) salinity. Dr. Andy Santiago and Dr. Nielsen correctly predicted in the early eighties that siltation will become the problem to contend with where primary production in Laguna de Bay is concerned. And yet today, even lake parts that are not heavily silted also experience fish growth stunting. This focuses our attention on another lake problem - that of pollution. But pollution itself has a hidden facet that is associated with salinity. Such an association is given importance by both fishermen and fishpen operators.

Relevant to the discussion of the problem of siltation is the issue on the Hydraulic Control Structure. The HCS is the monumental realization of the technocratic minds that foresaw the need to prepare the lake for: (1) tapping as a source of domestic water supply by the year 2000; (2) water quality improvement for the purpose of meeting the irrigation needs of agricultural areas surrounding the lake; and (3) controlling the infusion of pollutants collected and dumped into it by the inflowing Pasig River.

The changes in lake behaviour noted after the start of operation of the HCS are: (1) the lowering of the slinity level particularly in areas directly surrounding the mouth of th Pasig River; (2) the proliferation of water hyacinths in various lake areas; (3) the alteration of the priod of development of clear and turbid waters; and (4) the continue decline in fish production. Of these reported changes, that involving slinity decrease was most expected since the salinity of the Pasig River itself can go up to 20 ppt. Mixing with lake's own water, this saltwater intrusion can very well make the latter brackish. Water hyacinth proliferation following operation of the HCS may therefore have arisen from the altered osmotic conditions within the plant system as a result of the fall in lake salinity. Parenthetically, it must also be pointed out that the river aides who were in charge of the removal of this plant from the water stopped doing their job even before then president Ferdinand E. Marcos left the country.

The occurrence of lake clearing is a phenomenon that highly rests on the slinity of the water. Saline water intrusion from Manila Bay via the Pasig River is an important factor that causes the autoflocculation of suspended organics in Laguna de Bay. Clearing takes place from March to April of each year for the Pasig River generally bacflows prior to this when the lake loses depth in relation to the Manila Bay. Fishpen operators and fishermen of Laguna de Bay claim that saline water entry is vital to a good harvest. Thus, the opening of the HCS' gates in 1990 caused a tremendous boom in fishpen production, so the fishpen operators claim.

Given the above observation of people who have practically been living their lives out in the lake's waters, it is logical to consider the notion that saline water entry into the lake is not only physically rejuvinating to the lake but is also ameliorating. It could chemically bind the suspended and dissolved pollutants which in one way or antoher contribute to the fish's stunted growth. It could also remove the suspended materials that reduce light penetration and therefore lead to lower photosynthetic production in the plankton. Limited phytoplankton photosynthesis or production also reduces the amount of plant-derived nourishment for the fish. But allowing polluted Pasig River water to flow in is also a way of exposing peoples health and well being to risks and hazards of unknown nature and dimension. For Laguna de Bay, the complex problems that now beset it are primarily rooted in the lake's multiple uses coupled with the destruction of the watershed.

Taal Lake is another lake with its own set of management problems. Compared with Laguna de Bay, however, it can be considered as ecologically better situated. Free form the influences of industries, Taal Lake teems with tawilis (*Harengula tawilis*) whose population fluctuates with the alternating dry and wet seasons. The fish, whose biology needs further elucidation, seems to survive the growing pressure of catch fishing. The fishcage practice of raising tilapia does this fishery a lot of good by making the water more fertile. The lake, as you will know, is 198 meters deep and is oligotrophic.

With the sustained high demand for *tuyo* that the tawilis processed into, it beocmes readily appreciable why pressure on this fishery would continually rise. The impending threat of overfishing ha sjustified the establishment of a fish sanctuary in the lake extending from the municipalities of Agoncillo to Laurel. This takes up roughly one-third of the entire lake surface area.

Sanctuary area dedication, on one hand and gear regulation, on the other, are sound policies to apply to this lake which is also a tourist spot although it is considered a high-risk area. But similar to what obtains in other lakes, the fishery regulations of Taal lake are not being implemented to the fullest. Forbidden areas for fishing remain as the haven of "suro"-using catch fishermen, the "suro" being a banned type of fishing gear.

Local fishermen claim that extreme measures like those of sanctuary establishment and gear regulation need not be implemented in the lake since the tawilis has its own self- preserving mechanism. According to the local fishermen, the fish migrates to great depths when its population is thinned to a critical level. During such time, there is no type of gear that could possibly be used for the economic advantage of the *tawilis*. In contrast, the times of fish abundance are a time of economic well being for the Taal Lake fishermen. The prolific tawilis could even force fishermen to turn off some of their lanterns at night so as to attract less fish. Where the tawilis is concerned, the need for management is to know more about the biology of the fish so that reduction in size of the sanctuary can be considered if this is warranted.

Efficient management of Taal Lake also calls for a zoning plan for this lake. We have proposed four zones for the lake, namely, the tourist zone, the aquaculture zone, the open fishery zone and the fish cage zone. The zones are necessary in order to: (a) regulate the fish cage prolifereation; (b) ensure the most economic routes for catch fishermen; (c) ensure fishery rehabilitation for a sustained high yield; (d) safeguard the lives of pleasure seekers inthis tourist spot; and (3) maximize the redound of benefits from resource use upon the poor that have settled around the lake.

Lake Buhi is yet another lake with another set of problems. Unlike Taal Lake, Lake Buhi si relatively shallower, its littoral zone gently sloping. The littoral being of such topography, Lake Buhi favors the establishment of fishcages and fish pens. In 1983, the National Irrigation Administration (NIA) found the lake ideal as water source for a hydraulic control structure that would meet the irrigation needs of at least five adjoining towns. Prior to the operation of the structure, however, there was a teeming fishcage culture of tilapia which was boosted by the KKK program of then first lady Imelda Marcos. The initial activities to put the HCS in full operation caused the lake water to drop below the critial level of 0.8 meters. This exposed the fishcages and caused the operators not to honor their debts with KKK.

A second problem in Lake Buhi had to do with the determination of the area to be allocated for the sanctuary. As it turned

out, the sanctuary was decided to have a size of 86 hectares. This implied prohibition of the establishemnt of fish cages within the sanctuary limits. This prohibition, however, never materialized. As of 1987, something like 400 fish cages have been established inside the sanctuary.

A third management problem relates to biodiversity. As everyone knows, Lake Buhi is the home of the smallest commercial fish in the world, *Mistichthys luzonensis* or sinarapan. As early as 1983, sinarapan faced the threat of extinction by the predator tilapia which was released into the lake by the BFAR.

The points I have raised indicate that our lakes are beset with their own unique set of problems dictated by the particular set of environmental conditions surrounding them. Each lake must, therefore, be dealt with on an individual basis. Nevertheless, it is of primary importance that the government set up a unifying policy to safeguard biodiversity, productivity and sustainability in these bodies of water.

Table 1. Fish production (tons of fish) of some lakes and reservoirs for 1986

Reservoir	Area (has.)	Fish production (tons/yr)	Productivity (tons/ha/yr)
Magat	4,460	6,726	1.5
Angat (Norzagaray, Bulacan)	2,300	87	0.04
Pulangui IV (Maramag, Bukidnon)	1,100	2.4	0.002
L. Buhi (1985-86)	1,707	1,547	0.91
L. Taal (1989)	26,368	10,650	0.4
L. de Bay*	90,000		0.167

* - 1988 Data

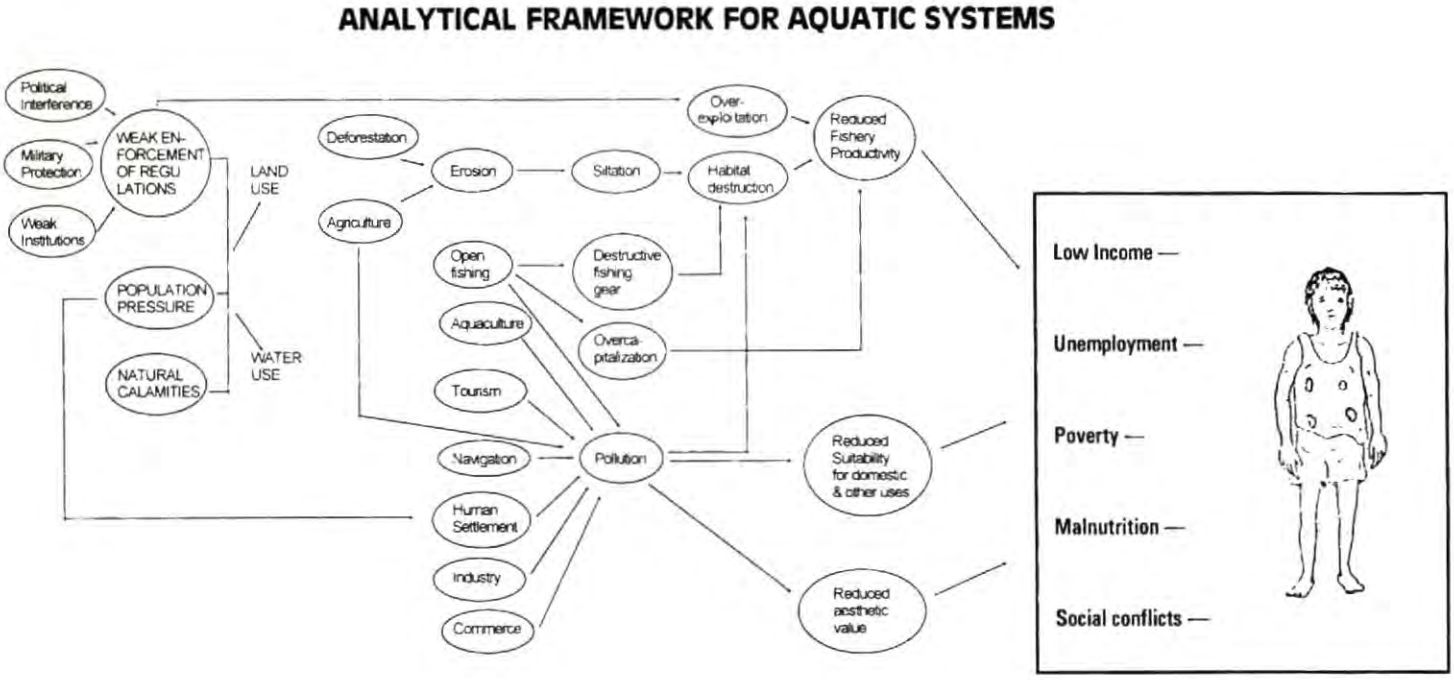

Figure 1. Analytical Framework for Aquatic Systems

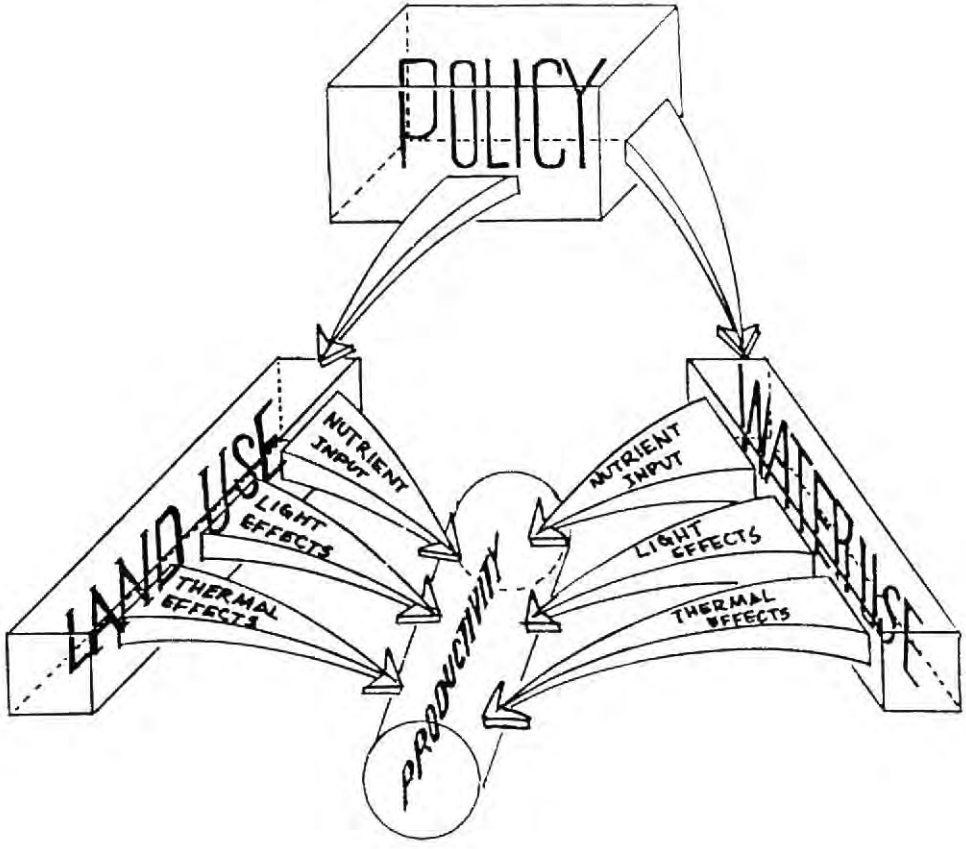

Figure 2. Context of the Analytical Framework for Aquatic Systems