Proceedings of the Workshop/Discussions on

INTEGRATED MANILA BAY/LAGUNA LAKE SYSTEM AND SURROUNDING WATERSHEDS

Sponsored by the

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Tokyo Institute of Technology
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De La Salle University

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CONFERENCE/DISCUSSIONS ON MANILA BAY/LAGUNA LAKE

Foreword

This conference was sponsored by Water and Environmental Group of the Core University Program (1999-2009) of the Japan Society for the Promotion of Science (JSPS) in coordination with the Department of Science and Technology (DOST). The Core University Program provides technical and cultural exchange between science and engineering faculty of the Philippines and Japan. The lead universities in this Program are Tokyo Institute of Technology and the University of the Philippines.

Early in this program, the Water and Environmental Group has agreed that a promising collaborative research effort that is comprehensive, integrative and multi-disciplinary in nature would be to study Manila Bay and Laguna Lake including its tributary rivers. The Manila Bay/Laguna Lake system is important since it is in the vicinity of Metro Manila, which is the most economically, politically and demographically active area in the Philippines. For a complex and multipurpose water resource system such as the Manila Bay/Laguna Lake system, the concern of the Group is mainly on the investigation of various technical and environmental issues and concerns of the system although it is recognized that there are important economic and political dimensions that need to be considered.

As a first step towards this goal, the Water and Environmental Group decided that a conference/discussions of the state of Manila Bay/Laguna Lake system would be a first, logical activity to gather people of various expertise, experience, stakes and interests in this system. Thus, the major objective of this conference was for the participants to learn, to become aware, to share, to update themselves and to be able to assess or reassess the various issues, problems, knowledge, studies, and ongoing programs of the state of the bay/lake system. To put structure in the discussions, various key persons were invited to discuss the different topics as follows:

- Physical Environments
- Biological Environments
- Pollution, Sedimentation and Water Quality
- Socio-Economic Developments and Infrastructure
- Governance and Institutions
- Data Monitoring and Needs
- Modeling and Research Needs

This was a two-day conference and the format was that the morning were presentations by the various speakers for each given topic and then the afternoons were devoted to discussion or open forum according to topics.

In this conference, we are again reminded that it is always important to have a continuous dialogue among the academics, government personnel, practitioners and

consultants. We have realized that there are indeed several and parallel efforts of water and environmental related works in the Manila Bay/Laguna Lake system that offer possibilities of collaboration and sharing of information, ideas and knowledge without starting from scratch. Problems in data monitoring and information dissemination was also widely discussed. The lack of data collection is primarily due to lack of and/or low priority in funding. However, lack or delay in information dissemination is perhaps due to lack of networking among ourselves. Casual phone calls or formal conferences like this should be a continuous process so we can communicate freely with each other.

Guillermo Q. Tabios III
Kazuo Nadaoka
March 2001

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Contents

	FOREWORD	Ii
	ACKNOWLEDGEMENTS	iii
	CONTENTS	iv
I.	OVERVIEW AND OBJECTIVES……	1
II.	PHYSICAL ENVIRONMENTS……..	5
III.	BIOLOGICAL ENVIRONMENTS……..	15
IV.	POLLUTION, SEDIMENTATION AND WATER QUALITY……..	26
V.	OPEN FORUM ON PHYSICAL ENVIRONMENTS, BIOLOGICAL ENVIRONMENTS AND POLLUTION, SEDIMENTATION AND WATER QUALITY……..	34
VI.	SOCIO-ECONOMIC DEVELOPMENTS AND INFRASTRUCSTURE……...	59
VII.	GOVERNANCE AND INSTITUTIONS…….	69
VIII.	DATA MONITORING AND NEEDS…….	72
IX.	MODELING AND RESEARCH NEEDS……..	77
X.	OPEN FORUM ON SOCIO-ECONOMIC DEVELOPMENTS AND INFRASTRUCTURE, GOVERNANCE AND INSTITUTIONS, DATA MONITORING AND NEEDS, AND MODELING AND RESEARCH NEEDS…….	85
A.	LIST OF PARTICIPANTS……..	109
B.	CONFERENCE/DISCUSSION PROGRAM…….	110
C.	LIST OF ACRONYMS USED IN THIS TEXT……..	115

I. OVERVIEW AND OBJECTIVES

Speakers:

Guillermo Q. Tabios III, University of the Philippines, Diliman
Kazuo Nadaoka, Tokyo Institute of Technology

Topics Discussed:

Goals, expectations, format and schedule of conference/discussions
Involvement of Japanese professors

I. OVERVIEW AND OBJECTIVES

Dr. Guillermo Q. Tabios III
Department of Civil Engineering
University of the Philippines
Diliman, Quezon City

Good morning, ladies and gentlemen. Welcome to this conference. We hope to have a good time in the next two days. This conference is made possible by the Japan Society for the Promotion of Science in cooperation with the Department of Science and Technology under the Core University Program. This is a 10-year program that started in 1998 and it provides technical and cultural exchange between scientists, engineers and professors of the University of the Philippines, De La Salle University and various other universities in the country. There are four areas of studies or groups in this program: geotechnical engineering; structural and construction, transportation; and, our group, the environmental and water/coastal/marine resources group.

This specific project on integrated Manila Bay/Laguna Lake study is going to run for four or five years and our main objective is to investigate technical and environmental issues and concerns of this system. We have three major plans and activities for this project, and this conference on Manila Bay-Laguna Lake System is one of them. We want to gather people of different interests in this conference, the stakeholders in the Bay-Lake systems, government agencies, NGOs, and other organizations; to learn from each other, to share ideas, to become aware and updated on the various problems, knowledge, studies, programs related to the topic, the Bay-Lake system.

Our second plan or activity is writing a resource book on the status of the Bay Lake system. This is a two to three years project and we welcome anyone who wishes to get involve in the book writing. The topics of the resource book basically will be the same as the coverage of this conference.

The third major activity is to develop a comprehensive hydraulic/hydrodynamic model of Manila Bay and Laguna Lake including the hydrology of surrounding watersheds. This model will be a water quantity and quality model of the bay/lake system. It is essentially a linked model of Manila Bay and Laguna Lake, linked through Pasig River. While I was in Japan from July to September this year, we have started a very preliminary version of a linked hydraulic/hydrodynamic model of this bay/lake system. It still lacks the water quality model and especially model calibration.

The fourth and another big project is data monitoring project of Manila Bay and Laguna Lake. Using modern devices and computer data acquisition techniques, this project is to monitor water data, two-dimensional velocities, turbidities, especially at short time intervals.

In the beginning, we thought that in order to make a concrete framework to aid in solving problems in the Manila Bay/Laguna Lake system, we need to create a large-scale model of the Bay-Lake system. But then, even if we have the model, it would not be useful if we are not able to calibrate it. Moreover, if we just develop the model based on our background, interests or

biases, it might not be useful to the real world. So we decided to hold this conference to bring in people and raise significant and substantial issues, concerns and problems and incorporate these ideas, experiences and results in the model.

The Bay/Lake system itself is very dynamic and for that matter, even the way we view things, concerns, issues, problems will always be dynamic, so we hope that this activity will be a continuing effort for all of us.

The resource book is of course another good vehicle for sharing information. Among other things, it will contain output from the modeling effort, the data collection activity and the outcome of this 2-day conference.

I hope you all got copies of the program and the details of our activities for today and tomorrow. Just to give you a quick rundown; today we will look at the physical and biological environments, we will delve into pollution and sedimentation of the Bake-Lake system; tomorrow, we will look at other aspects of the Bay-Lake system, such as socio-economic developments, infrastructure, governance and institutions. Then, finally, we will discuss the topics on data monitoring and modeling needs as we progress into the conference. I am sure there are many efforts in data monitoring and modeling of the Bay-Lake system so I hope we can exchange ideas in these efforts.

Thank you very much. Professor Nadaoka, my co-organizer will give his thoughts about this conference and especially the role of Japanese side.

Dr. Kazuo Nadaoka
Department of Mechanical Engineering and Informatics
Tokyo Institute of Technology
Tokyo, Japan

Good morning. My name is Nadaoka from Tokyo Institute of Technology. As Dr. Tabios already mentioned, we have a ten-year core university exchange program sponsored by the JSPS and DOST, the counterpart organization in the Philippines.

The Program will foster the mutual exchange of persons from the Philippines to Japan and vice versa. However, in order to conduct special studies like the IMSWES that stands for Integrated Manila Bay-Laguna Lake and the Surrounding Watersheds Environment Study, we had to get extra research fund.

Group I of this project will be headed by Dr. Glen Tabios on the Philippine side and myself on the Japanese side. We will be looking at atmospheric circulation of water and air and environmental problems.

I want to emphasize here again the importance of the integrated approach because generally speaking, the environmental system can be regarded as an open and comprehensive system.

This is an illustration (*overhead slide shown*) to show the general situation of the coastal aquatic environment. To properly understand and analyze such a coastal water system, we have to look at the four boundary processes because environmental areas, like Tokyo Bay and Manila Bay, are surrounded by a lot of boundaries; the boundary between oceans, boundary between atmospheres, the sea-bottom and land. It is in this sense that we say the environmental system is not closed but should be regarded as an open system

Knowing this aspect of the environmental system, we need to properly introduce the integrated approach. We have to integrate target areas, like the bay areas and the surrounding watersheds and the link between bay and ocean and others. We also have to introduce the integration of various methodologies as well as different specialties.

One of the more important things to do is to look at the needs of integration of environmental data itself. And may be as one of the final output of this project, we could identify what kind of data needed and ways to integrate them.

Anyhow, I want to emphasize here the importance of the key words *integration of various aspects.* That is the reason we named our project Integrated Manila Bay-Laguna Lake and Surrounding Watersheds Environmental Study. I hope that in this 2-day workshop, we can find the importance of the various integrated approaches. I really hope that this workshop will be a good starting point to boost such integrated collaborative study. Thank you.

II. PHYSICAL ENVIRONMENTS

Speakers:

Cesar Villanoy, University of the Philippines, Diliman
Eric Cruz University of the Philippines, Diliman
Leonardo Q. Liongson, University of the Philippines, Diliman

Topics Discussed:

Physical layout of Manila Bay-Pasig River-Laguna Lake and surrounding watersheds
Geography, geology, climate, hydrology, hydraulic characteristics of physical system
Issues, concerns and problems of physical system

II. PHYSICAL ENVIRONMENTS

Dr. Guillermo Q. Tabios III
Department of Civil Engineering
University of the Philippines
Diliman, Quezon City

I hope that you already got your copy of the program. Before we begin the session, let me explain briefly how we will conduct this conference.

We have allocated the mornings to lectures and talk, and the afternoons to discussions of the topics presented in the mornings. We will do this rather informally. The topics presented may overlap in some aspects and to some extent we expect that a wide variety of the issues, problems and concerns will surface during the presentation. Nevertheless, we will structure the different topics when we discuss in the afternoon based on what is the *state of the art* in the Bay-Lake area.

Hopefully, with some of the lectures in the morning, we will be able to cover various issues, problems and concerns, and in the afternoon, the further discussions on these issues and concerns will be taken up. Of course, if you have something to say right away, you are free to bring it up anytime.

At the end of this conference or in the process of this conference, we hope to answer various questions and also, to be able to advance some agenda in assessing the present status of the environmental and technical issues of the Bay-Lake system taking into consideration, economic, political and social dimensions.

Prof. Nadaoka emphasized the need to identify possible integrated approaches to analyze and address the various environmental and technical issues of this system. And even if we already have some concrete plans and activities, we still want to see if we could further identify or prioritize possible research agenda and methodologies for our group.

Again, while this study of the Bay-Lake system will be for a period of four to five years, the exchange program is a 10-year program, and within the 10-year period we could probably establish other research collaborations between the Philippines and Japan.

Dr. Cesar Villanoy
Marine Science Institute
University of the Philippines
Diliman, Quezon City

Good morning everybody. I will share with you some of the information we have on Manila Bay from a DOST-PCMARD sponsored project we conducted.

The Manila Bay is a very interesting area because compared to other bays in the Philippines, it has a very narrow mouth so residence time of the water inside the Bay is relatively longer. It also

has a lot of rivers emptying into it so that over a year it exhibits large variations in temperature and salinity characteristics.

It is essentially influenced by the monsoon seasons. The southwest monsoon is characterized by large precipitation rates while the northeast monsoon is characterized by lesser precipitation and colder temperature.

This is a temperature-salinity diagram (*overhead slide shown*). It gives us an idea of the stratification of the water column. This point represents measurements of temperature-salinity made in Manila Bay over those periods. This is the temperature and salinity axis. X represents salinity and Y represents temperature. The lines here represent densities. Here the density of seawater is controlled by temperature-salinity so there is low density here, high density here.

This set of points for the month of June varies over a very wide range of densities; and this variation in density is due to freshwater discharge. We have a large variation along X thus very large salinity variations. We get the strongest stratification of the water column in Manila Bay during the rainy season because that is when we have the highest temperatures. During the rainy season, we have higher temperatures and the lowest salinity that result in a very strong layering. We can see that at the top of the graph

In contrast, we get relatively uniform water columns throughout the year during the northeast monsoon as shown by the blue (star) points. During this season, we experience a weaker influence of freshwater from the rivers and the colder temperature coming from the northeast results in the mixing of the water columns by convection. This is from surface to bottom, so they combine here.

This is near the shore of Bataan. They get even lower temperatures because there are a lot more rivers along the Bataan side, the discharge from the rivers flow along the coast towards the mouth as it moves to Manila Bay.

We get inversion of the temperature during high rainfall periods. The temperature at the surface is colder while that at the bottom is warmer. But the water temperature profile is still stable because of the very low salinity.

What was just shown was how the temperature-salinity varies throughout the year. Here is an example of how it varies over a period of a day (*overhead slide shown*).

Here some significant variations can be seen, this is during March and we get a very strong two-layer system, temperature and the dissolved oxygen distribution are essentially controlled by the stratification of temperature.

This is of South Harbor (*overhead slide shown*). This is time and this is depth. This gives us the temperature distribution at different depths over a period of a day.

We get similar features of Bataan taken three months later, but there is still the layering, mainly driven by freshwater coming out from the rivers. We have a thinner top layer, and again the oxygen follows the same trend.

During that time when we took these measurements, we also took phytoplankton, chlorophyll and transmissivity data and we can see the suspended matters in the water are essentially divided into two layers. This is transmissivity, the large value indicates that we have a lot of suspended matters in the water column. It can be seen at the top layer, the chlorophyll distribution is somewhat similar to the transmissivity distribution so that most of the suspended matter at the top layer is due to plankton. But this trend disappears when we look at the lower layer. Chlorophyll does not seem to be correlated with transmissivity so that most of the particles in the lower layer, we believe, are made up essentially of suspended sediments. So we have transmissivity of the water controlled by planktons in the upper layer, and controlled by sediments in the lower layer.

Surprising also was that chlorophyll distribution showed a very strong relationship with dynoflagellates. Dynoflagellate is a species of noctilucca. Where we have a lot of noctilucca we have low chlorophyll. Based on literature, there is an inverse relationship between chlorophyll and noctilucca and this is believed to be due to the fact that noctilucca grazes on phytoplanktons.

Again, this is taken over a period of 24 hours, it shows that there is a significant amount of variation over a period of a day. Our problem with special data is essentially that they become more difficult to interpret when we there are large variation in the data.

We have made some tide models of Manila Bay. This represents the fourth tidal component of four major tidal components, the O1, K1 and S2. These are the diurnal components and semi-diurnal components. The tides in Manila Bay are essentially controlled by variation of sea levels at the mouth. It is such a small area that tidal potential is negligible. But there is some increase in amplitude as one moves towards the head of the Bay and this is probably due to the fact that the depth of Manila Bay at this area becomes gentle and shallow.

These are the cophase lines which show that the tides come in through the southern part of Corregidor and propagate towards Pampanga River.

We made two days worth of ADCP data and measurements and compared these with some of the models we've developed and we found a good agreement between them. Significant feature is this. It appears to be a twin (gyre?) system. We have some sort of recirculating cells that split the Manila Bay into two regions. If we look at the satellite image, we can see Pasig River's discharge and the very turbid water. And looking at this is Spot Image. We can see the plumes spreading this way, but there is a very distinct almost linear boundary along this side; very clear on one side, very turbid on the other side. We don't know what this means but it might be related to the separation of circulation into two cells.

We've also made some measurements at Limay but we had some problems with the current meter, some period it was working, some period it was not. But off Bataan side, it was mainly north south flow.

We are currently looking at how circulation, nutrients and chemical characteristics influence occurrence of red tide in Manila. In the 90s, there used to be a regular occurrence of the bloom during the southwest monsoon.

We have tried to relate the structure of water columns with the occurrence of red tide and to do that we made some one-dimensional models applying different conditions of temperature-salinity at the surface and wind magnitudes. We also looked at how the different distributions of temperature-salinity would look like. This is a distribution of pyrodinium at different depths and at different months. We can see that the cell counts peak during the months of June and July. This is the period when we get the strongest stratification. Looking at the vertical processes is only one aspect.

If we look at the distribution of cysts at different months, we can see that different areas of the Bay have different concentration of cysts. But the phase of their occurrence is very similar. They peak during the southwest monsoon and dip during the northeast monsoon. There are some similarities but the amplitude or magnitude of their concentration varies according to the prevailing season.

If we look at the Bay as if it were divided into cells and relate it to the occurrence of red tide, we might see that the behavior of the blooms in the Bataan and Cavite varies. Here we can see that the bloom in Cavite is made up of two modes. It starts early in June and persist until August. In Cavite, red tide starts early and lasts longer. On the other hand, the bloom in Bataan starts later than that in Cavite, it peaks only once around the month August but the concentration is much higher. The differences in the occurrence of red tide may be due to differences in the physical, geological or chemical environments of the two provinces.

It may occur to you that we have not had any bloom for the past few years, and we are looking into its causes. We studied the nutrient concentration-the ratio of nitrogen and phosphorus-in Manila Bay and we found out that the nitrogen phosphorus ratios increased from 1995 to 1998**.** The result probably means that nutrient is increasing or the phosphorus is decreasing. We have not yet established the real cause, but we got the same results in 1999. Looking at measurements taken over a 24-hour period, we found a consistent increase from 95 to 98.

What I presented is the information we have so far. We need long-term measurements taken at appropriate time scales in order to resolve these variations. If the project pushes through then it will really be a big help. Thank you.

Dr. Eric Cruz
Department of Civil Engineering
University of the Philippines
Diliman, Quezon City

Good morning. As Dr. Tabios already said, I am supposed to talk about the physical layout of Manila Bay.

Manila Bay is situated on the western cost of Luzon as you can see in the transparency. The boundaries on the south are Cavite, Metro Manila and Rizal on the east, Bulacan and Pampanga on the north, and Bataan on the west and northwest. The Bay has an area of approximately 1,700 square kilometers. Its length along this curve is about 60 kilometers, and a width that varies from about 50 kilometers at the mouth and about 60 kilometers along the direction of the Pasig River. The average depth of Manila Bay is about 17 meters; multiplying the average area at still water level by the average depth, the possible storage capacity of the Bay is 30×10^9 cubic meters.

Manila Bay receives drainage from nearly 72,000 square kilometers of watershed area composed of 26 catchment basins. The Pasig River Basin includes Marikina River Basin and the Laguna Lake watersheds. This basin has a total catchment area of about 3,900 square kilometers.

The other big basin, which is actually the biggest, is the Pampanga River Basin. It has a catchment area including the tributaries of about 9,000 square kilometers. Adding the catchment area of Pasig River Basin and Pampanga River Basin, we will get a total of 12,900 square kilometers. That is more than 75% of the total watershed that is draining into Manila Bay. The Pampanga River contributes approximately 49% of the net fresh water influx into the Bay, while the Pasig River contributes about 21%.

The other river systems make up 26% of the fresh water source and the remaining 4% come from precipitation into the Bay.

This is a satellite image that was downloaded from the website of IMSWES *(overhead slide shown)*. Manila Bay is variably used as marine fishing grounds and for aquaculture and fishponds; it is also the habitat of diverse natural aquatic life. It serves as a basin for ports and navigational waterways of Manila and the surrounding areas. This satellite image taken in late 1999 indicates the extent to which the various tributary watersheds have affected the conditions of the Bay.

The southern part of the Bay opens to the South China Sea while its northern end receives lahar sediments and freshwater discharges from Pasac Delta. This flow discharges from the Pampanga River basin. The western coasts receive discharges from the watersheds of Bataan while the eastern side receives a combination of rural and urban river flows from the coastal towns of Cavite and Bulacan. Also, the eastern coasts receive the more polluted run-off from Metro Manila rivers including the Pasig River which is the outlet of Laguna Lake.

The circulation or the natural movement of water within the Bay is an important process that needs to be studied. Some of us have already started that study and this is one result from the simulation computer modeling executed by Dr. Tabios in conjunction with the model of Professor Nadaoka.

Since Manila Bay is connected to the South China Sea, there is a natural exchange of water through the mouth. The atmosphere over the Bay exerts shear stresses on the water surface and that also affects the movement of water. Lastly, we have influxes from tributary watersheds, and these influxes exert various pressures or forces on the Bay water.

The three major factors that affect the circulation of Manila Bay are: 1) discharge from the surrounding watersheds; 2) effect of tides along the coasts which is interfaced with South China Sea; and , 3) wind stress.

Other factors include the dynamic balance of salinity, presence of hydraulic structures in both Manila Bay and Laguna Lake.

This is just to give you an idea of the interaction between Manila Bay and Laguna Lake.

Thank you.

Dr. Leonardo Q. Liongson
Department of Civil Engineering
University of the Philippines
Diliman, Quezon City

Good morning and welcome. I will present mainly geographic information, and I'll talk about modeling of the Laguna Lake tomorrow. These data were generated in the course of a research project we did with Laguna Lake Development Authority (LLDA) with funding from the Philippine Council for Marine and Aquatic Resources Development (PCMARD).

The basin of the Laguna de Bay is a huge one. It encompasses, Metro Manila, Rizal, Cavite, Batangas and Quezon Provinces. The total area of the land is about 2,865 square kilometers. The Lake area including the area of Talim is about 900 square kilometers. Talim is a knife-shaped island of about 30 square kilometers. We have a linear scale of 20 kilometers from here to there so around entire lake takes about a day to travel.

There are 22 sub-basins under the jurisdiction of the Laguna Lake Development Authority. The biggest one is Marikina in the north and the second biggest is Pagsanjan in the southeast. There are a few small ones, like San Juan, a foot watershed in the province of Batangas.

We excluded San Juan River Basin and the northern and southern Pasig River Basin in our study because they are not under the jurisdiction of LLDA, however we included them in the coupled modeling.

Some of the basins are agglomeration or groupings of much smaller coastal or lake coastal linearly shaped basins. If we subdivide them, we will see 668 small polygons. These 668 polygons are sub-sub-basins. We have developed the GIS (Geographic Information System) for these using all available maps with scales of 10,000 and 50,000.

Of special note here is the Taguig flood plain and this vacant area here represents the artificially controlled Caliraya reservoir.

The GIS we developed covers 322 creeks and rivers, five of which are in Talim Island. We have quite a deep network in the Pagsanjan River Basin. The famous Pagsanjan is actually a short arm

of the river basin, there is a longer branch which goes up to Mt. Banahaw area and passes through Lucban, Quezon.

This will show the extent of the water management issues in the lap of LLDA. The box diagram shows the various activities conducted in the Bay area; of these, public works like diking and dredging, navigation and fisheries are supervised by LLDA, cooling water by NAPOCOR, tourism by several government agencies. There is also withdrawal pump-storage system of Carliraya Reservoir and Kalayaan hydroelectric plant.

There are 21 sub-basins directly draining into the Lake and NIA is diverting water through a few of its communal and small irrigation systems.

As I mentioned previously, the Marikina River Basin is the biggest. During floods, the Rosario weir, a gated structure diverts flood through the Mangahan floodway toward the Lake. Farther down Marikina River is Pasig River, where another junction, the Napindan hydraulic structure controls (HCS) the flow between the Lake and Pasig River. The Napindan HCS has also other purposes; water quality control and to a certain extent flood control.

Of current interest is how much lake diversion should be allowed given all the inflows and losses, e.g., evaporation and seepage. This gives a bird's eye view of the water management issues among other things. The available data we obtained include topographic maps from NAMRIA, land use cover and soil GIS developed by the task force on water resources-DENR. Most of the land use cover and soil data used to develop the GIS were taken from the Bureau of Soils and Water Management-DA. We can get data on rainfall, evaporation, wind speed and direction from PAGASA. Recently, LLDA installed five more continuous recorders of rainfall. Data gaps from PAGASA may be filled in with information coming from these recorders. The Laguna Lake Development Authority and the Hydraulics Center conducted field survey and verification to ascertain cross section and network data.

The National Irrigation Authority has the layout and the diversion capacities of the irrigation systems; small communal types and the big national irrigation systems. The Department of Public Works and the Bureau of Research and Standards maintain stream flow measurements in five gauging stations.

The Public Works is busy with a lot of activities and they can discuss these lengthily today or tomorrow.

Here is a schematic diagram of the lake water management system. These polygons in particular represent the modeled hydraulic system. We won't look at the entire picture yet, we will initially examine the first layer of the aquifer that is in contact with the stream, rainfall, evapo-transpiration, evaporation, over land flow, root zone and unsaturated zone-both the root zone and the inter-flow zone. Interflow is flow above the saturated layer brought about by local saturation. My report will not cover deep aquifers and we won't model ground water yet.

There are three organizations doing water quality modeling on Laguna de Bay. One is the Delft Institute group in LLDA, the Manila Water Services Inc. and our group. What we have so far is the hydraulic model.

This is called the finite difference model. It is older than the finite volume model created by Dr. Tabios. I am using this for geographical information. The light areas in the diagram represent, in digitized form, the areas allocated for fish cages for year1997. These indicate fish pens, and some fish cages around Talim Island. Not all of the allocated areas are occupied.

Here is the floodplain of Taguig, between 12.5 meter water station, I think 10.5. The flood plain will soon be inside the West Mangahan diking system that will be built by Public Works. There will be a diking system from here to the side of the Mangahan flood way. LLDA's jurisdiction will still be up to that portion. The path starts at Mangahan floodway, goes to Napindan, Marikina River, Pasig River up to Pandacan.

This picture is taken from the penstock of the Caliraya reservoir. Down there is the Kalayaan pump storage hydroelectric plant.

This is the navigation canal of the Napindan Hydraulic control structures. They are usually kept opened to allow the barges to pass through. There are also gauges built parallel to the control structures.

This is also Napindan, visible from the C5 highway, going to Makati.

This is a picture taken in April 1998, of the Rosario weir of Mangahan floodway that diverts Marikina flow towards Laguna de Bay.

These show the changes in Marikina River brought about by changes in the season. Comparing the collected flow in the overflow bridge crossing culvert in April 1998-dry season and October 1998-wet season, we can see that there is an observable difference.

This is a view of eastern Laguna. The area is characterized by a different climate type; no defined dry season with an almost continuous rainfall throughout the year. This picture was taken in summer, it depicts a small swamp some trees and an old fence, the next photo shows the same place after a typhoon, the swamp had become bigger and the trees and old fence were gone, perhaps flushed away by the torrent.

This in another view of the Lake, there is a difference of two meters in water surface elevation at Pakil.

This is a close up view of Senator Maceda's rehabilitation of a creek called the Longos River in Barrio Kalayaan, Laguna. The sides maintain a natural stone formation and there is some amount of natural flow coming from the eastern side of the region.

This is Botokan River in Lucban, Quezon. The place is also characterized by type IV climate - no distinct dry season, wet through out the year. This is in stark contrast to a place that has Type

I climate – distinct dry and wet seasons, e.g., Marikina River. We can see that the Laguna Lake system is defined by type I and type IV climate zones.

This is Matang Tubig Spring in Canlubang, at the back of the Canlubang Country Club. Most of the flow is diverted to supply water to Cabuyao. So you don't really see the natural flow.

Measurements were taken in May and October 1998 and showed a two-meter difference in the water surface elevation of Taguig River. That was my last slide.

Thank you.

III. BIOLOGICAL ENVIRONMENTS

Speakers:

Fernando Siringan, University of the Philippines, Diliman
Zenaida Catalan, University of the Philippines, Los Banos

Topics Discussed:

Inventory of natural and aquatic resources
Inventory of native, exotic and endangered species,
Food web and resources; benthic communities
Problems, issues and concerns

III. BIOLOGICAL ENVIRONMENTS

Dr. Fernando Siringan
National Institute of Geological Science
University of the Philippines
Diliman, Quezon City

Magandang umaga. I will present the results of an on-going work I am doing. However, I will also discuss part of the results of a project I did with LLDA. Towards the end, I will go through the results of a thesis being conducted by one of my students.

This is Laguna de Bay based on the bathymetric surveys we conducted during the years 1997 and 1998. It showed that the Lake's average water depth is now at two meters. Previously it was set at 2.8 meters, the present lake surface area is 949 square kilometers and the total lake volume is 189,000 cubic meters.

In the project we did with LLDA, we looked at changes in the water depths spatially; we also tried to estimate sedimentation rates. To do this, we examined overlays of old maps.

This is the change in water depths in the Lake from 1939 to 1968. The green regions are areas that experienced shoaling. In contrast, the regions in blue are areas that underwent deepening. The question that can be asked is did deposition take place in the regions where shoaling occurred and did erosion took place in the regions where deepening occurred? What we did was to look at the grain size data and surface sediments and correlate these with the bathymetric changes.

We also looked at the distribution of clay in the Lake. We acquired more than 100 surface sediment samples and made grain size analyses. Results showed that the west bay has the highest concentrations of clay while the east bay has the lowest concentrations of clay.

Silt seems to be the more abundant sediment particles. And it is most abundant both in the central bay and in east bay. Sediments here are mostly silt which go up to as much as 80% of the surface sediments. The same is true for this portion right here. In contrast, we got lower values for this part right here. And we think that the reason for this is the slope of the rivers entering Laguna de Bay. Rivers entering this part of the Lake and also here have steep slopes, they are efficient in delivering their sediment loads into Laguna de Bay. In contrast, the major contributor of sediment in this part is Pasig River that passes through a relatively flat area so most of the coarse grain materials that flow through it are trapped in the flood plains.

Correlating the grain size distribution with the bathymetric changes for the most recent period from 1968 to 1997, we can see some correlation. Where there is an abundance of clay, there is also shoaling.

Based on such correlation we concluded that the bathymetric changes do represent deposition in green areas and possible erosion in the blue regions. We say possible erosion because we think that subsidence due to compaction is a major factor in the Lake as well.

Looking at the differences in the trends of changes in bathymetry between the periods 39-68 and 1968 to 1997, we can see differences in the extent of shoaling and also regions where we see shoaling. For 1939 to 68, there was not much shoaling in the west bay, but for the period 68-97, we can see a great amount of shoaling. We think that this shift is due to the opening of the Mangahan floodway. By opening the Mangahan floodway during floods, sediment-laden waters from Marikina River enter Laguna de Bay and thus bring in more sediment.

The net sedimentation rate into the lake is within the order of 1 to 1.7 centimeters per year. But we know based on lead 210 profiles from sediments taken in the Lake. Sedimentation rates can be twice or even three times higher than these values.

What we did was to select sites for coring based on maps like this. We selected sites that might have experienced continuous sedimentation. And the cores that we acquired were submitted to an agency that did lead 210 and cesium 137 profiling for us.

This is a sample profile and base on the lead 210 profiles and cesium 137 profiles we were able to estimate sedimentation rates for the specific sites where the cores were taken. We compared the sedimentation rates derived from these cores with the sedimentation rates that can be calculated based on the bathymetric change.

In some of the core sites where there was a sedimentation rate of around one centimeter per year based on the bathymetric change, the lead 210 profiles indicate sedimentation rates of about four centimeters per year. This was repeated in all of the core sites. The sedimentation rates based on lead 210 are always higher than sedimentation rates derived from bathymetric change. That tells us changes in bathymetry don't reflect the actual input of sediment and that led us to infer that subsidence is occurring in the entire Laguna de Bay. And the rate of subsidence is anywhere from about one centimeter to three centimeters per year. Because of subsidence, the length of the life span of the entire Laguna de Bay is being extended. If there is no subsidence, then probably Laguna de Bay would not be existing today.

Part of the work we did for LLDA was to look at the distribution and concentrations of metals in the Laguna. One of my colleagues, Prof. Joselito Duyanen, looked at the clay fraction and did an AAS analysis and this is a sample output from that work. This is for lead, the regions with the highest concentrations of lead in milligrams per kilogram. The concentrations are fairly low relative to shale. Laguna de Bay for lead is not polluted.

This is for copper, very high values are found in areas where Mangahan floodway, Sta. Cruz River and San Cristobal River discharge their flows. The distribution of concentrations differs a little bit form the previous diagram. The actual source of pollutant can be pinpointed in that where there is a source right in front of it there is also high concentration. In contrast to the diagram on lead previously shown, there is no concentration of lead in right in front of river mouths and this might be due either to 1) the chemical behavior of lead, or 2) there are sources within the Lake itself. The area is volcanic and there could be volcanic emanations. In fact there are reports that sediments are very warm in some parts of the Lake. We suspect that volcanism is

contributing to the natural elevation of some of the metals in Laguna de Bay. And it may be worthwhile to pursue that.

This is the distribution of mercury. Like copper, it is also correlated with out-fall coming from the Pasig River. Nowhere else in the Lake is there such high concentrations of mercury except in the area where Pasig River discharges its flow.

We were not able to analyze other samples after the project ran out of funds.
Subsequently, one student picked up from where the project with LLDA left off. She looked at the sedimentation history of Laguna de Bay I the past 100 years. Cores were taken from several sites in Laguna de Bay and were subjected to lead 210 for age control. Grain size analysis using a laser particle analyzer and bulk sediment XRF analysis were also done to examine the changes in the physical and chemical conditions of the Lake through time. To determine the biological component of the Lake changes in the gastropods and pelecypods were likewise studied.

In a core measuring almost 11 meters taken from one site, there were some drastic changes in the concentrations of metals as well as changes in the types of organisms living in the Lake. One such drastic change can be found at a sub-depth of around 560 to 600 centimeters. And based on the biological component and geo-chemical signature from radio carbon analysis, it could be deduced that the change was brought about by the shift from brackish water into that of freshwater which happened roughly about 4,000 years old. Geologically speaking, this event occurred fairly recently.

Looking at sea level changes in the Philippines, that was the time when sea level dropped down from an elevation that was slightly higher – about 1 to 1.5meters - than the present elevation. It is possible that the shift from brackish water to fresh water was driven by the change in sea level position, or it could also have been brought about through changes in elevation of the strip of land separating Laguna de Bay from Manila Bay due to tectonics. There is an active fault called the west Marikina Valley fault system that cuts across the eastern side of that strip of land. There were movements recorded during the Holocene Epoch or during the past 10,000 years.

The activity of Taal could also caused the shift from brackish water to freshwater. There is a volcano just to the south of this region and we know that in about 6,000 or 4,000 years ago, Tall Volcano had explosive eruptions.

Based on Lead 210 analysis, there were changes in the concentration of silica oxide, TOC and silica aluminum ratio starting at sub-depth of about 280 centimeters that occurred 100 years ago. There was a fairly constant concentration of silica from three sites and then a shift to a lower amount at a depth corresponding to about the 1960s. Concentration of TOC was fairly constant exhibiting only slight change. It decreased at about the same time that $Si0_2$ decreased. Based on a study conducted by Reyes, the construction of fish pens and the introduction of aqua-culture in Laguna de Bay in the 60s led to the lowering of primary production in the Lake. And that the decrease in TOC could have bee brought about by the lowering of primary production. One of the major components involved in primary production is the diatom. Diatoms take silica from the water and they are incorporated in the sediment column when they settle at the lake bottom. When production is low, the amount of silica in the sediment also decreases.

Just to make sure that the decrease in silica is not due to the change in the amount of sediment supply derived from rocks, silica was normalized with aluminum, a substance that is more refractory. The results showed the same decrease indicating that the change was not due to change in the type or amount of materials being derived from the watersheds but is mainly due to the change in the concentration of silica in the Lake by biological processes.

From 1962 to the present, there was a general increase in the concentration of copper, lead and zinc specially zinc.

Joselito Duyanen who looked at this profile attempted to relate the changes in the zinc and copper to the changing economy of the Philippines, specifically activities in Metro Manila. He noted that there was a decrease in lead in 1972 when Martial Law was declared and a corresponding increase when industries were later re-activated.

What I have just related showed the long-term and short-term history, different persons at the Institute are addressing these aspects right now.

I did not see anyone showing this diagram or any similar diagram so I thought that it would be good, being a geologist, to draw out the geology of Manila Bay and Laguna de Bay. I mentioned earlier that this side of Laguna de Bay is cut by a fault which can be traced all the way up to the north and can be linked to the Marikina Valley fault system. This portion right here is believed to be the latest caldera that was formed in Laguna de Bay. Some people are proposing that all of these lobes are in fact calderas. And one can see that the north of the Bay is intersected by other structures. This is synthetic aperture radar image. It defined the extent of the latest caldera, this is the bigger caldera and within that is a smaller caldera. The caldera may possibly extend up to the Alligator Lake in the south.

How do we connect Manila Bay with Laguna de Bay? Tidal gauge records of the mean se level through time taken in the South Harbor show that at about 1963, there was an abrupt, drastic increase in the rate of sea level rise. And the estimates of the rates of rise are in the order of two to three centimeters per year. That order of magnitude is higher than the global rates of sea level rise because the global (eostatic?) rates of rise estimates that the highest is about two millimeters per year. Prior to 1963, there was a very low, very small rate of increase. It is theorized that the increase in the rate of rise is due to ground water extraction.

The upper diagram shows the changes in the Lake water elevation through time. The lower part shows the trend for the low lake level, the middle for the mean lake level, and the upper part for the high lake level.

It is expected that through time, the capacity of the Lake will decrease due to sedimentation. Thus it is also expected that the water in the Lake would go up during the rainy season because the dimension of the reservoir has been reduced. This explains the recorded change; a high of 12.1 centimeters per year.

The mean lake level shows a lower rate of about 6.4 centimeters per year. The low side with a negative trend might be due to some changes in the precipitation trends. Based on the long term record of El Niño – La Niña cycles, we shifted from a La Niña dominated period to an El Niño dominated period starting in 1976. Thus, it could be theorized that the negative trend was caused by this shift in the cycle.

The interesting part of this information is mean lake level. In some ways, it will balance the changes in precipitation and changes in the size of the reservoir. The water of Laguna Lake shows a relative increase in elevation at a rate of 6.4 centimeters per year. These measurements were taken from the Napindan area.

Napindan is somewhere over in this area right here. The tidal gauge is right here and based on the tidal gauge record we can see that this area is going down. These data could indicate that it is not only this portion that is going down but this whole strip of land is in fact going down. Another student doing her thesis work in this region was able to document that. There are re-activation of old faults but they might not be due to tectonic forces rather, they could be caused by ground water withdrawal. There is actually an over-all lowering of land level across this area right here.

I will stop at this point.

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Good morning. So far the presentations have been very interesting. I learned new things about Laguna de Bay. For my part, I would like to give a brief presentation of the knowledge we have accumulated about the lake biota in the past decades. I have not done a complete review of literature, although I have gone through most of the literatures that are available about Laguna de Bay. Also, I am going to present the research gaps that I think are important in the management of the Lake.

I have also prepared a list of references, if you are interested, you can get a copy from me.

I am sure that during my presentation you will hear ideas you have heard before because this process we are going through now has been the topic of past conferences.

For the purpose of assessing the present knowledge on the system's component and identifying research priorities we used some principles of systems analysis and the concept of ecosystem health. System means the Manila Bay-Pasig River-Laguna de Bay and its surrounding watersheds.

Two principles were considered in the analysis of data as it is not necessary to know everything about the system to be able to understand or predict its behavior. To understand the properties

and behavior of systems knowledge of changes in only a few of key management decisions is important.

I will forego with the description of the Laguna Lake because it has been given earlier.

The concept of ecosystem health has emerged with the realization that man's activities are affecting his own well being. This is not a new concept but is similar to old concepts with a difference, and the difference is in the focus on the effects of environmental changes on human health. Relating environmental health to human health is ideally suited to foster communications between scientists and other sectors such as, politicians, community residents and administrators. We believe that policy makers would be easier to convince if they are able to see the direct effect of environmental health on their children and family rather than explaining it through socio-economic concepts.

With the concept of ecosystem health comes the idea of services being provided by the system to humans. The term ecosystem services is the preferred term. The ecosystem provides two kinds of services, those that have monetary value such as when the lake water is used for drinking, irrigation, and fisheries; and, 2) those that have no monetary value but are critical to humans and to the maintenance of the system itself, such as cycling of materials. Another service that ecosystems provides is assimilation of pollutants.

Most of the major species of organisms found in the Lake have already been identified and the biology of the most important species has been studied. So there seems to be no need of inventory of fauna and flora in Laguna de Bay.

Vallejo in 1986 reported that there are 25 fish species in the Lake. One of these is the land-locked kanduli which has three species. Kanduli (D. arius?) is a marine species that thrived in Manila Bay. It would migrate to the Lake during the time that Pasig River was still clean. It was able to establish itself in the system and has become land-locked.

There are seven species introduced in the Lake, among them the tilapia. There are two species of tilapia, the aureus and niloticus. We have also introduced the Thai catfish (D. batracus?), the African catfish and two species of carp one of which is the big head carp.

There are reports that only a few species of fish are remaining in the Lake, though this still needs scientific verification. There might not be sightings of most if not all of the species because the peak of abundance varies from species to species. So there might not be enough fish caught during seasons when the population is low.

It has also been reported that some species of fish have disappeared and that there areas in the Bay where the submerged aquatic microphytes have also disappeared. Again, these will also require scientific verification.

The food web was constructed by Rabanal and Delmendo in the early 60s by analyzing the gut of different major species. In 1995, a visit by Dr. Milagros Simmons, a faculty of the University of

Michigan, in the Philippines prompted a study of the contamination of the food web. She was invited to talk on the effects of certain chemicals called endocrine disrupting chemicals. At that time heavy metals were considered endocrine disrupters. Analyses of contamination were done based on the reports of academic and research institutions on the presence of chemicals in fishes and invertebrates.

There are organisms that are capable of accumulating in their bodies minute traces of natural and man-made substances in concentrations above the levels at which they are present in the ambient environment, soil, water or atmosphere. One example is the American oyster (R. virginia) was found to accumulate DDT in their tissues at a concentration level 70,000 times more than that in the seawater in which they are cultivated. The number, 70,000 times is the bio-accumulation factor or BAF. The BAF was computed as a means to determine if there is bio magnification of chemicals in organisms.

The study concluded that different species showed different levels of accumulation. The capacity of organisms to accumulate chemicals in their bodies is species specific. For instance, perch or ayungin, milkfish and tilapia can accumulate higher lead levels than carnivores and this could be related to the trophic level. It is expected that lower trophic levels have lower levels of contamination. The study had many limitations though, one is, it did not consider the age of the fish used in the analysis. The other is differences in methodologies. There are a lot of variations in comparing values.

In addition to the evidence based on BAF, reports from fishermen and specimens collected from the Lake showed the presence of fish with crooked spine, without tails, blind or with skin ulcers. The skin ulcers may indicate immuno-suppression of the system that lowers the organism's resistance to bacteria due to the effects of chemicals. These observations were also noted in other polluted lakes like the Great Lakes in the United States.

In US, Canada and Europe, deformities in human reproduction and development were correlated with the presence of these chemicals. For instance, scientists from these countries have associated cryto-orchidism (non-descent of testicles), immune deficiency, sperm deformities and low IQ with these chemicals. Based on these findings I conducted a brief study to identify by association deformities in children with the presence of these chemicals.

In this six-month study, individuals volunteered to give sperm for examination. Some of the specimens showed deformities like sperm cells with two heads, or two tails, there were also cells with very big heads or small heads. There were also children who had reproductive deformities. Investigating the history of all the cases, I found out that the mothers of these children spent part of their lives living along the shores of the Bay exposed to contaminated fish and agricultural chemicals.

This study indicates that the effects associated with these chemicals have been observed in some Filipinos. These results further encouraged me to focus my attention on the presence of chemicals in our environment.

Regarding the lake's primary production. In general, there are two factors that control primary production and these are nutrients and light. In the case of Laguna de Bay, it is mainly controlled by turbidity because the system contains very high levels of nutrients already.

Based on studies, the Lake undergoes an annual turbid-clear water cycle. The turbid period starts at the last quarter of the year and extends till the first quarter of the new year. At this time, the primary production is low, less than one gram carbon per square meter per day due to light limitation which allows the build-up of nitrogen and phosphorus.

When the Lake level falls to the mean sea level of Manila Bay, seawater intrusion occurs initiating an early clearing of the turbidity. A slight energy becomes available to the phytoplanktons and the stirring of the bottom due to strong wind stimulates production to a higher level and that ranges from 3 to 8 gram carbon per square meter per day.

Based on studies conducted in the 1930s and continued up to the present, high algal production is followed by increase in fish and snail population.

But if seawater intrusion does not happen, lake clearing won't occur. Thus, phytoplankton production will be low resulting in low fish growth. This is a problem in the aqua-culture industry.

The problem is that seawater coming from Manila Bay needed to clear up the turbidity in the Lake is very polluted.

In one of my early papers, I said that the pollution of Laguna de Bay seems to start from Manila Bay because before industrial development along the west bay occurred, the areas around Manila Bay……(end of tape)

…..effect of management because this is related to the food and livelihood of the fisher folks.

Two sets of data were compared to see the changes in two decades. The 1998 study was conducted with funding coming from the European Union and the 1978 study was conducted by (Mercene?) The same fishing villages in Laguna and Rizal were considered in both studies but the manner that of collecting the data was different.

Comparing these two studies in terms of the number of fishers, there was a 46% increase in the number of fishers in 1998 particularly, the full time and part time fishers in Rizal. There was no significant change in the number of fishers in Laguna. Results showed that the most numerous fishing gears that were used in 1998 were gill nets and fish corrals, the rest of the fishing gears decreased in number significantly in both provinces. The gill nets appeared to be the cheapest fishing gear while fish corrals were more durable and practical to use

Although the 1998 estimates of total fin fish catch appeared to be not significantly different from 1978 estimates, a decline in catch seemed to have occurred considering that there were more fishers in 1998. A decrease in trend is also apparent in the amount of shrimps gathered from the lake. The snails collected in 1998 were greater than that in 1978. This could be considered as an evidence of the influence of organic matter on the production of the Lake. Organic matters from the watersheds are accumulated in the Lake and are processed by benthic organisms.

Based on our study, the amount of snails gathered from the Lake depends on the market made up largely of duck raisers and fishpond operators.

Benthos production has been greater than fin fish catch as shown in all the studies. There is also a significant decrease in the catch per unit of effort with both gill net and motorized push net. These two fishing gears were considered in the study because there were available data on these two fishing gears.

The catch data also provided evidence of displacement of local species. Perch and tilapia are both plankton feeders but exhibit a difference in the preference of plankton. 1978 data compared the catch of perch, 21,831 metric tons with that of tilapia, 508 metric tons.

Another study conducted by Nacino et al in 1995 reported an equivalent amount, or almost a similar amount of perch and tilapia catch. But looking at 1998 catch estimates, we can see a big decrease in perch catch, and a significant increase in the volume of tilapia caught in the Lake.

Big head carp has been in the system for sometime. Many aqua-culturists are now raising big head carps in fish pens, which could be the reason for the tremendous increase of big head carp caught in 1998.

When one studies the displace of aquatic species like fish, it is quite difficult to separate the effect of the introduction of an exotic species from the effects of pollution or of over fishing. We believe that these factors influenced the catch we noted for 1998.

Lastly, I have identified research gaps that I think are still lacking in the study of the Lake. I feel that there is a need for our government to encourage the development of culture technology for some of our major endemic species. This is just to ensure that endemic species would survive despite the introduction of exotic species. A case in point is that of the local hito (C. macrocephalus). It disappeared in the 1970s ten years after the Thai hito was introduced in the Lake. It is important to consider developing technology so that endemic species could be perpetuated in hatcheries.

As previously noted, there are factors that affect fish catch and they have to be studied to determine their individual and combined effects. Toxicity should also be examined using local species. The Water quality standards we are currently using have been borrowed from the US and there has never been any validation of the standards in relation to the local species.

I have also presented results of studies that showed contamination of the fisheries resources. These studies, however, will have to be examined further to determine where the organisms get the pollutants

The assessment of the exposure of male fish individuals to endocrine disrupters is also important. There is a group of chemicals known to affect the vertebrates. Let us take this knowledge to be able to determine whether these are truly present in the environment and are affecting the different species of fish.

The telogenin is a protein that is produced by male individuals provided they are exposed to estrogen-like chemicals. And scientists have used telogenin as a bio-marker.

A 30 year study conducted in Michigan showed the effects of contaminated fish and mollusks on human health. The study consisted of monitoring mothers who regularly consume fish caught from the Great Lakes, and one of the significant result was a correlation between consumption of fish contaminated with PCBs, PBBs and other heavy metals and children with cryto-orchidism. On the other hand, a study of the effects of contaminated mollusks on ducks should that ducks became more active and their eggs were easily broken.

As previously mentioned, snails are fed to shrimps and fish grown in fishponds in Pangasinan which could mean that we are transporting chemical pollution to another place. And we are doing the same thing in the east bay, where polluted water is brought up to the Caliraya Lake where people fish. It would also be interesting to see the dynamics of the transport of the chemicals.

These are just some of my ideas and I know that the list is far from complete but that is all that I want to share with you. Thank you.

IV. POLLUTION, SEDIMENTATION AND WATER QUALITY

Speakers:

Fernando Siringan, University of the Philippines, Diliman
Zenaida Catalan, University of the Philippines, Los Banos
Laura David, University of the Philippines, Diliman

Topics Discussed:

Nature and behaviour of pollutant loads and transport
Human activities and man-made waste loads and pollution,
Industrial waste and pollution
Agricultural waste, soil erosion and sedimentation from surrounding watersheds
Lahars from Mt Pinatubo
Laguna Lake salinity and lake eutrophication
Problems, issues and concerns

IV. POLLUTION, SEDIMENTATION AND WATER QUALITY

Dr. Fernando Siringan
National Institute of Geological Sciences
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Earlier I showed a diagram that depicts the change in the mean sea level through time based on the tidal gauge record in South Harbor and I said that the increase in the rate of relative sea level rise is due to ground water extraction. In this diagram, we have superimposed the rate of ground water extraction with the trend of sea level rise through time and one can see an excellent correlation.

One of the things that we are doing together with Dr. Kelvin Rodolfo, is to look at changes in the region north of Manila Bay with specific interest in the impact of ground subsidence. The main source of the information I will present today is anecdotal accounts of long time residents in these regions. Incidentally, we used feet instead of meters because most folks in these areas are able to measure things in feet instead of the metric system.

This is (feet?) of enhanced flooding between the 1980s and 1990s. There were Increases in the order of about 1, 2 as much as 4 feet in the period between 1980s and 1990s that was made worse by the eruption of Mt. Pinatubo. There are regions previously not being flooded, but are now being inundated. Regions that used to dry up quickly after the rains are now experiencing flooding that persist for several days. The reason is the clogging of the river systems downstream of the network of rivers that cut across the coastal plain.

This information right here shows an enhancement of flooding prior to the eruption of Mt. Pinatubo. It means that this flood had nothing to do at all with the eruption of Mt. Pinatubo. This is1960s to 1980s, the values were a lot less. Earlier, we can see a lot of threes and fours now we see less of that; we see more of ones and twos. It correlates very well with the ground subsidence data gathered from the emergence of wells.

We've looked at wells in the area. And the wells are either going up from the ground or that the ground is going down relative to the well. In any case, we interpret the emergence of the wells as being indicative of subsidence and we are associating subsidence with ground water withdrawal although we do know that there are other factors involved. We are about to defend a proposal tomorrow asking for money from a government agency so that we can continue this type of work.

But, the values here are now in centimeters per year. We can see some clusters here within the order of magnitude similar to the rates shown to you earlier based on the tidal gauge record. In the tidal gauge record, we get rates of two to three centimeters per year. We get similar values here 1.9, even four centimeters per year. There is an outlier here of about 11 centimeters per year. We don't know whether we should believe that or not, but based on well emergence, that is what we get, 11 centimeters per year. And we think that the subsidence of this whole area is although slow, in the long term, is the major cause of increased flooding in these parts of Pampanga.

One consequence of ground subsidence is the need to regularly maintain the roads. Roads have to be raised. One anecdote we heard, which probably is not correct, this road was raised six feet in 1978. And as far as the residents could recall, the road has to be raised every year. But this only points to the necessity of maintaining the road systems. And we see that everywhere, Colgante, Caduang Tete, highway raised four feet in 72. There is also an interesting fish landing facility right here. When it was constructed in 1990, it was still abobe the high tide level. Now, during high tide even with no rains, it is flooded by about 30 centimeters of salt water. That area is sinking it is going down.

This shows the well information. The whole of the northern part of Manila Bay is underlain with thick piles of mainly mud. Mud can be easily compacted specially when water from aquifers sandwiched between mud layers is extracted. This way (pore?) pressure is lost. We think that salt intrusion in the wells might actually be due to the release of (pore?) waters in the clays eventually contaminating the ground water

Subsidence is not only occurring on the onshore regions, we think that it is also occurring in the offshore regions.

This is 1961 to 1985 bathymetric change. This part of Manila Bay is very shallow and from a previous satellite image….. (blank).

There are a lot of materials coming out of the rivers along this portion of Manila Bay. With the voluminous amounts of sediments coming out of those river systems, one would expect that from 1961 to 1985, drastic shoaling would occur along this portion. But shoaling is limited along a sub-tidal channel which is this part right here. Based on core data, we know that accumulation is taking place. So if accumulation is taking place, yet there is no shoaling, that would be an indication that subsidence is occurring.

One of the other things that we are doing in Manila Bay is to look at the impact of the 1991 Mt. Pinatubo eruption. To look at changes in sedimentation rates, changes in sediment quality. And then in some ways, we can get some sort of an idea (blank)… impact of Mt. Pinatubo eruption by looking at….(blank)

This is 1961 to 1985, this portion right here, we see a change in water depth. We should keep in mind that subsidence is occurring in this region but perhaps with varying rates along the different parts.

Looking at 1985 to1998 data, we see a big difference between this figure and the previous figure in that now we see shoaling of as much as three meters in a region that did not show much of a change for the period 1961 to 1985. We think that this is due to the influx of material from Pinatubo and we have cores that can show that …. (blank) .

The upper diagram shows the grain size distribution of the surface sediments before the eruption of Mt. Pinatubo. Most of the substrate covering this portion of Manila Bay consists of clay silt. This portion right here is clay silt. In the lower diagram, this is the sediment distribution after the eruption of Mt. Pinatubo. The samples were acquired in 1997.

What we expected was a change from clay silt to more of clayey silt. Mt. Pinatubo material being sandy. But we don't see that, instead of an increase in the silt and sand component, we see an increase in the clay component. It is a problem for us, but we think that the reason for this is the decrease in the efficiency of the river systems in flushing out materials due to choking of the rivers in this portion, thus delivery of sediments upstream going down towards downstream decreased in its efficiency. We are working on that idea and we would appreciate some help if you have any ideas then you are welcome to give us some leads that we can follow.

Two things that I would like to show in this diagram. One is the long term change in the shoreline position based on a 1902 map and a 1985 map. This is the 1902 shoreline position and this is the 1985 shoreline position there is a net progradation. But we know based on the previous diagram shown to you that in between we can refine the resolution of this record. Shown also in this diagram is the net change in bathymetry from 1902 to 1985. This color indicates shoaling as you move towards this direction, that is the deepening part. There are some portions that underwent deepening and perhaps the reason for the deepening in this portion is due to extraction of sand for the reclamation projects along this portion. Shoaling is found mainly here as expected and also here because of the input coming from Pasig River.

The work that we are doing now funded by DOST-PCMARD we can, in the next few months, put some positions here together with estimates of sedimentation rates based on lead 210 profiles.

We are also looking at sediment transport. These are different satellite images courtesy of the Mines and Geosciences Bureau. We are looking at the transport of suspended sediments as they emerge from rivers and once they get deposited. So the aspect of transport from the river mouths are taken care of by the satellite images. But to look at the transport or their re-working after deposition we use the granulometry of the surface sediments and based on the granulometry we then come up with estimates of the net transport directions of the sediment.

That is summarized in this diagram right here. We see influx or movement of sediment from this shallow portions moving towards the deeper part. But here in the deeper parts, we see a net onshore movement which is characteristic of estuarine systems. This type of work was also applied along the coast of Cavite, along this portion right here, but I don't have any figure with me to show you the results.

Thank you.

Dr. Zenaida Catalan
School of Environmental Science and Management
University of the Philippines
Los Banos, Philippines

For this presentation I will focus on the pollution in the system. The studies conducted on water pollution of Laguna de Bay has been limited. The studies that I used in the analysis of bio-magnification of heavy metals are I think the most important once. And there are listings of

chemicals that are purportedly present in the Lake. In terms of turbidity based on studies conducted by Dr. (Baril?) he has concluded that the Lake is becoming more turbid.

In a few minutes I'll be talking about issues and concerns. But at this point I would like to say that in the past decade and up to the present, LLDA has been active in preventing the continued degradation of the Lake in terms of pollution. For instance, they have instituted the polluters pay principle, they are now undertaking the rehabilitation of major rivers in the Lake and also they are monitoring quarterly the presence of heavy metals in fishes.

Going to the issues of concerns. The first one is developing a mechanism, at this time we are all convinced that Manila Bay and the Laguna de Bay are inter-dependent. They should be considered as one system so from this point of view, I am recommending the study on what mechanism is most applicable to our culture. Either there is a stronger coordination between Manila Bay Commission, LLDA, maybe placing the whole system under one committee or commission but there is that need structurally, so that the efforts will be concerted for the rehabilitation of the system. I attended a conference in the last two days, and they are going to work on the rehabilitation of Manila Bay. I think that if you just concentrate on the rehabilitation of one system and not a concerted effort to rehabilitate both simultaneously. Assuming that we have clean one system, how long will it remain to be clean. So there has to be a structure to be developed for that.

I welcome the new project that will be implemented through the JS core system of the JSPS and because there is really a need to study the dynamics of water in the system and a model is needed to be able to say.. One advantage that I see is with the use of the model, we can help the lakeshore communities, by informing them that at this time of the year, given this precipitation maybe you have to get out of your house. Because right now, the lakeshore areas are flooded and it would take until December or January for the water to level off.

of the pollutants coming from different sources we know that the tributaries of Laguna de Bay, Marikina River and Pasig River and Manila Bay are all polluted. We have to study the chemicals that are coming from one part of the system to the other.

Of course, part of the study would be on the fate and transport chemicals within the system. The determination of quality of underground water sources has been included because of a study conducted in 1995 wherein wells in Laguna, wells that are located at 25 or shallower contained very high levels of persistent chemicals. And these are the depths of wells, these are the types of wells that are used by farmers, so there is a greater risk of exposure to the farmers having contaminated underground water sources.

The use of Laguna de Bay as source of drinking water is I am really worried about this, although I talked to one of the past GM, why did you permit Ayala Alabang to extract water, he said that it is their responsibility, it is no longer the responsibility of LLDA. That is the point of view of the past administration. What I am worried about is that we have a certain group of chemicals that are capable of influencing human reproduction at very low levels. We are not talking of toxic materials that you have to accumulate through the years to have effects on us. It is not only the mother that is at risk but all the children that she will have in the future. Of course the human

health effects of pollutants. I think that it is high time that we also focus some of our efforts from the ecosystem, you know for a long period of time we have been focusing on Laguna de Bay and its watersheds and no correlation with human health at all.

Thank you.

Dr. Laura David
Marine Sciences Institute
University of the Philippines
Diliman, Quezon City

I would like to present my own studies as well as projects by other people in the Marine Science Institute specifically Dr. Jacinto San Diego, Miss Velasquez and Dr. Smith on the nitrogen and phosphate budget in Manila Bay.

We basically employed the same technique that LOICZ (Land-Ocean Interaction in the Coastal Zone) has been employing around the world. It's a project that specifically wants to compare different sites around the world with respect to biogeochemical fluxes. It is a simple model, it is based mainly on (steady state?) and it assumes that any flux of nitrogen and phosphate is either (effective?) or a mixing.

You've seen pictures of Manila Bay, I just want to specify that the area that we decided to deal with is 1,700 kilometers squared with a watershed area of 17,000 kilometer squared, so basically more or less 10 times more than the Bay. So that is what we are talking about in this project.

You see that there are many rivers that drain into it the biggest two are Pasig and Pampanga Rivers. Each draining around 75% of all the freshwater into the Bay.

What we want to emphasize in this project is that the population around Manila Bay including not just Manila itself but the watershed is 17,000 kilometer squared, it is approximately 16 to 18 million people at the moment.

They had given out handouts this morning and when I calculated that that came around to 18 million.

So the way LOICZ) made its simple budget is that it just takes in all the input and then all the output into the system and between that and the measurements inside the Bay and outside in the ocean, you manage to come up with the budget. Unfortunately in a lot of areas, specifically in developing countries, there are not many direct measurements specially of sewage and other industrial wastes.

So what we came up with, especially with Dr. McGlone and Dr. Jacinto was to estimate nutrient loading based on population alone. So out of the 16 million, we approximated that 25% of these people directly discharge into the system. And then using a direct approximation from BOD which is actually this, it is a published paper of relating your population and the approximate BOD demand of that, which is 20 kilogram per person per year and with the BOD COD ratio,

that approximates to 1,800 moles carbon per person per year. And taking the CNP ratio of organic matter to be a 190 x 15 x 1 of carbon, nitrogen and phosphate, we come up with more or less 9.5 moles phosphate per person per year and 140 moles nitrogen per person per year.

Using that and multiplying it with what we said was a population directly discharging into Manila Bay which is 4 million, we then get a 40 x 10^6 mole per year contribution of DIP into the system and a 600 x 10^6 mole per year of DIN.

Taking all that, we then make a simple model of just salt and water budget and basically we put in precipitation, evaporation, river, any ground water if you have any measurement thereof, and then you have the salinity of your ocean and the salinity of your system. Based on that you should have, if you add all these, a residual flux of –25 x 10^8 cubic meters per year in order to balance out the system.

Based on the salt budget of between 34.4 outside and 31.8 outside there should be an incoming water inside in order to balance out the salt, otherwise, the system will either become too salty or it will become fresh. That would come out to 308 x 10^8 cubic meters per year of mixing inside.

Basically you look at this two numbers and right now there is no approximate for sewage. We approximated it calculating backwards later on and the contribution of water with respect to sewage is negligible. For the water and salt budget, it does not come into consideration. However, once you start calculating the DIN and DIP, it becomes significant. For example, if we just multiply the VR that we calculated and your calculated (DINR?) which is the average between the outside and the inside of the system, you come up with –60 x 10^6 moles per year. Similarly with VX times the difference between the two, which would facilitate the mixing, you come up with 1,140 x 10^6 moles per year.

If you never consider input from sewage, this will not be here and you will come up with a much higher, right now your delta DIN is +400, so if you never considered this, your delta DIN would be +1,000. So it is a significant source with respect to nutrients.

Similarly, for DIP, going through the same calculation, we have a significant source of from sewage of 40 x 10^6 moles per year. Again that contributes, not as much as DIN, quite a lot to the delta DIP. Notice however that in both of the nutrient calculations, we assumed that DIP atmospheric and DIN atmospheric are negligible. And I believe that there will be a presentation tomorrow that will prove that this is wrong assumption. But since we have no measurement before, we had to assume this. But again, this is probably going to be significant but may be less so than actually the direct sewage.

Just for my own curiosity, looking at what they gave out this morning, I came up with an approximate of what this means when it comes to development or looking back to what Manila Bay was.

If you look at the hand out, they have a 1903, 1950 and 1990 population and if you add those all up from NCR down, you'll get a .6, 3 and 18 million people around the watersheds of Manila Bay. So approximately every 50 years your population is times 5 or multiplies by 5. So If I

project that times 5, 18 times 5 is approximately 100 million people around the watershed of Manila Bay. This may be an over-estimate. But just for the sake of argument, even if we keep at the estimate of only 25% of this actually discharging into the system, you have an approximate of .1, 1, 4 and about 16 million people discharging directly into the Manila Bay.

If you go through the calculations, your contribution of DIN with respect to sewage is such that it was 15, 100 years ago, it is 600 right now and it will be 2,400 by year 2040. Similarly for DIP, it was 1 before, it is 40 now, and it will be 160 50 years from now.

If you just use that to get an approximate of production minus respiration, by just multiplying the CNP ratio of (106, 16 and 1?) for a marine red field ratio, you will see that the production minus respiration has changed not much from a hundred years ago, from –12 to –15, but 50 years from now, that –15 will be –22.

Now, what does that mean in layman's terms. In layman's terms, it means you will double your production minus respiration by 50% in 50 years. That roughly translates to 50% doubling of your BOD to an already almost eutrophic system.

V. OPEN FORUM ON PHYSICAL ENVIRONMENTS; BIOLOGICAL ENVIRONMENTS; AND, POLLUTION, SEDIMENTATION AND WATER QUALITY

Dr. Eric Cruz (moderator). Good afternoon. According to the schedule we are supposed to have a discussion on physical environments. Dr. Tabios did not tell me what particular rules or guidelines to conduct this discussion so I suppose we can start by letting anyone ask questions on the topics presented this morning. You can also raise questions regarding issues and concerns as far as physical environment on Manila Bay and Laguna Lake is concerned.

Dr. Ricarte Javelosa (DENR). I am very much interested in the presentation of Dr. Siringan and I am happy that this kind of presentation was brought up in this kind of forum. My first question is, how valid are the information put in place by that projection (on the ground water subsidence?) is it a reality now? We want to recognize that kind of problem is really existing. I was quite surprised that the Potatan issue was not included. The one in Muntinlupa. This is one of our big problems. There are two different ideas being worked out by two different groups, but both of them are geologists. One side says that it is tectonics and the other side says that it is ground water. I am very much interested in the ground water issue. The problem there is too sensational, but then if these issues are brought up in a proper documentation, I will be very happy to support that. because now the task force is now heading towards declaring a moratorium on ground water use. As of today we have a deficit of 20 billion cubic meter per year and we cannot allow that kind of scenario to happen in the year 2015 that we will be having a deficit of 20 billion cubic meter per year. At the rate the ground water resources is being abused by the water users. *Kung napapansin ninyo, lahat tayo siguro ay may deep well na walang lisensiya* (If you will notice, maybe all of us have deep wells without license). We don't want that scenario to continue for how long. WE want to regulate the ground water use. By next year, water will become an economic good. Everybody has to pay for it. Otherwise, you will have to contend with bottled water. You don't want to have that kind of situation for how long. Now if there is this kind of scenario, because I know for a fact that there is this subsidence within the Makati district at the rate of 1 centimeter per year due to ground water pumping. But then mind you, Makati is a business area, and we don't want scientific findings to be used as a tool to discourage investors. But then, *ang* the question is if there is truth to that kind of information, we want that information to come out. Year 1992, when the MGB came out with that concern, when one of our guys did a master's study on ground water use against engineering and we found out that there is that kind of issue; subsidence due to groundwater pumping. Recently, the one in Alabang, the Potatan wherein we have the Ayala, Alabang center put up these industrial wells then followed subsidence issue in Potatan. What I want from the UP-NIGS is that you establish really the issue, is it tectonics or ground water? Because I think, one guy from PHIVOLCS, Dr. Ramos came out with that very good historical study and if that study could be properly validated by UP-NIGS, then maybe we can really talk on that on how to finance it because that would be a very good pilot issue to be used as a tool to convince the public that ground water use at the rate that we don't want it is really an issue. *Kasi mahirap mag-declare ng moratorium*

kung wala tayong scientific findings (Its difficult to declare a moratorium if we have no scientific findings) and may be it becomes a test case for us to use it. *Maganda yung findings ni Dr. Siringan sa groundwater* (*The findings of Dr. Siringan are good*). This is I think is really true.

Moderator. I think Dr. Siringan has a comment.

Dr. Fernando Siringan (NIGS). *Sige Ric bigyan ninyo kami ng pera* well do it (Ric, give us the money and we'll do it). When can we have it. Actually I have a student addressing that problem in the Sucat area looking at ground water usage and examining some of the changes in the centers of flooding, getting estimates of ground water extraction.

The question of is it purely tectonic or is it purely due to ground water withdrawal is a difficult issue. It needs, from my perspective, work in a larger area to show whether there is recent movement along the west Marikina Valley fault. But please, do you need a proposal? I can give it to you.

Going to the point that you were raising early on. How valid or how true are values we are getting in the Pampanga, is it just in the Pampanga area or in the South Harbor as well?

There are several indicators being used in our study and they are independent of each other. One is the emergence of well pipes, the other is flooding during high tide without any rainfall. And the third one is flooding in the upstream regions and we can see that all of these are, although they are tied together, the way we look at them is that they are separate, different indicators of ground subsidence.

We are confident in the trends that we are getting but we cannot pin down the actual rates and that is why we've proposed this study to the Bureau of Agricultural Research. What we want to accomplish is to map out the varying rates of subsidence all over the coastal plains of Pampanga and Bulacan and to do that we are proposing to look at difference indicators of subsidence. And it would be good if you could give some sort of financial aid.

I think all over the Philippines, the problem of relative sea level change is a serious problem not just in the Manila Bay area. If you have been aware of (Lanuz?) in the Lingayen Gulf area. People are complaining about floods, and if you are to look at the trends in the wetlands in these regions, the wetlands are increasing rather than decreasing. The demand for land by man, is to move to convert wetlands into dry lands so that they can build houses. But instead of seeing that we see a reverse trend. We see more wet lands in the form of fish ponds and we think that the reason for this is because they are forced to convert their lands which used to be agricultural into fishponds because that is the only way that they can earn money because now they cannot plant rice.

But as a caveat, there are some places in the Philippines where instead of the land going down, the land is going up and this is due to the tectonically active nature of the Philippines.

Dr. Ric Javelosa. I found out in the presentation that it is more focused on the geosciences, now if you do survey from the North Harbor down to Pasay City there are a lot of subsidence and the recent findings of the MGB is that it is due to reclamation. (differential?) settlement like for instance the Film Center. The other side of the problem is more on the engineering. The next group again conducted a study, they linked it to ground water pumping so there is that confusion. So what I need now is to link… saan ba? We have to link the engineering urbanization aspects, the ground water use which is more of water utilization and the third, geology which is more of a science. Because the fourth aspect is the salt water intrusion. We have to zoom into the area where we have the three interrelations activated not in the way that we want it. Pag-nagexceed yung isa doon, the two components also follow. So the fourth is the worst scenario, the salt water intrusion, which we are trying to address in the Paranaque side because of the ground water pumping.

Moderator. Yes, Prof. Lopez

Prof. Epifanio D. Lopez (Department of Geodetic Engineering – UPD) May I also make an observation on those and Dr. Javelosa's comment. One method of determining subsidence is through geodetic leveling and in the past 30 years I have been involved in geodetic leveling in Manila. I myself have established these controls from Quezon City all the way to Roxas Boulevard, Cavite and Pampanga. And the benchmarks that we recovered lately were recovered to the first order leveling established by the Coast and Geodetic Survey. First order means four millimeter square root of kilometer and the we have not recorded any significant deviation from the elevation established 30 years ago. As far as we know.

We are undertaking geodetic leveling along Roxas Boulevard all the way from Norzagaray to Pier 13 to Malabon, KAMANAVA (Caloocan, Malabon, Navotas, Valenzuela) area, so far we have not discovered any significant deviation from the first order accuracy standards of the Coast and Geodetic Survey. So one possibility is that possibly the whole mass is going down or the sea level is rising as Professor Siringan has theorized. That could be one possibility because we have records, we have data on first order geodetic leveling and we have not discovered any significant deviation.

Dr. Siringan. That is a good point which brings us to the point where it is important to do a regional study instead of a local study. There is a possibility that you have a large scale subsidence instead of local. We think that there are local subsidence. One independent method that can be made and in fact this has been attempted is to do remote sensing work through interpherometry. And the work done by Manoling Ramos of PHIVOLCS. He was able to define changes in the elevation of the ground along the strip of land separating Laguna de Bay and Manila Bay. It is not a small area but a huge area covering all the way from Sta. Rosa going all the way across a large to portion of Bulacan. It is difficult to think that no subsidence is occurring when you vast tracts of land previously not inundated by tides are now inundated by tides even in the absence of rains. The tidal range in Manila Bay based on the oceanographers did not change that much. The tidal range has remained fairly constant throughout the historical period.

I forgot to mention that perhaps another technology that can be used is GPS. With the removal of the degraded signal by the US military perhaps the resolution, not just for the horizontal but also for the vertical might have increased. And if the rates of subsidence are to be within centimeters per year. If the monitoring is done within the time frame of this JSPS project of five to 10 years then surely one will be able to detect that magnitude of vertical change. So there are different methods of looking at this problem and I think this is a good venue for us to look into these different possibilities.

Dr. Rosa Perez (PAGASA). I am from the Natural Disaster Reduction Branch of PAGASA. My field of interest is a little bit different from the rest because I am concerned with the long term effect of climate change. But the effect is on sea level rise, the impacts on the coastal ecosystem. I find that the works of Dr. Siringan is a very valuable input to our study on vulnerability and adaptation to sea level rise in particular, but to the impacts of climate change in general. Previously I always say that there is something more than the global warming which causes the sea level rise in Manila Bay. So it was quite a black box for me, but it is becoming gray and thanks to the group of Dr. Siringan for this invaluable inputs.

So whatever the cause, it could be ground subsidence or drawing out of water or tectonics, the effects would be the same. I am more interested in the resulting flooding and eventually in the long term it could be complete inundation or submergence of these low lying areas particularly in Manila Bay area. Also I find that there is a wealth of information in the geodetic survey that can be used as input for further study on the vulnerability. And this information can be used in our subsequent national communication to the United Nations Framework for Climate Convention.

Moderator. That is a good viewpoint. If any one has a question on other topics…

Jane Atienza (DPWH - Bureau of Design). This is a suggestion to Dr. Siringan. This morning on your presentation regarding sedimentation, the characteristics of the sediments that you are getting after Mt. Pinatubo is mostly fine grain sediments. And of course you are wondering why it should be more of sand from lahar. May be you should also consider the structural measures being undertaken by the Department along the rivers in these areas. I was discussing this with Mrs. Santiago, the head of the Hydraulics Division of the Bureau of Design and I was telling her that maybe if she knows where we can get data regarding the different projects that have been undertaken through the years since Mt. Pinatubo erupted, including the discharges, the dredging works, the dikes that had been constructed. And for the information of the group, there are plans to raise the dikes, I think along Pasig-Potrero and Sacobia and also building of a new bridge along Sto. Tomas. There are proposals for that.

I was telling our consultants why don't you recommend also for the continuous dredging of our river systems instead of raising the dikes and they were telling me that the rate of sedimentation is very fast compared to the budget that is coming for dredging works. They said that if we compute for the maintenance of the river system *vis-à-vis* the construction of a new bridge, it will be economical in the long run.

Mrs. Santiago told me that maybe the data from the Mt. Pinatubo emergency office could help UP NIGS regarding your studies. Because engineering intervention could also be one of the factors because the conveyance of sediments towards Manila Bay has been affected by these structures.

Don't worry, the administration of MPE nowadays is more accommodating rather than the past administration. Maybe you can talk to Dr. Ramirez. I will try to give you the data and the persons you should contact.

Moderator. We'd like to request you to identify yourself because the proceedings are being recorded by the sound systems.

Dr. Enrique Pacardo (School of Environmental Science and Management – UPLB). On our way here this morning with Dr. Catalan I jokingly asked her will there be something new that will be presented in this seminar. It might just be again a rehash of existing old data that are always being recycled every time there is a symposium. Indeed, there is something new in this presentation as I heard Dr. Siringan who presented a very interesting phenomenon of the shoreline moving inward. I am not sure to what extent is that; how many kilometers inwards. But the interpretation of this phenomenon if it is at all a phenomenon is as we have heard, not well established. It could be the warming of the water due to global warming and so it will expand it could be another round of glaciation, it could be subsidence due to water extraction. But this possibility might be a little bit far fetched may be because if it is near the shoreline there is also salt water intrusion and it will just balance extraction and replenishment. And there is another possibility that it could be a tectonic activity. What these all mean is that you will have more work to do, Dr. Siringan and your team. We really have to establish the cause or causes of this phenomenon because the policy statement that could be formulated will depend on what is the cause of this phenomenon. If it is man made then it could be remedied but if it is a natural phenomenon, *wala na tayong talagang magagawa doon (there is really nothing we can do about it anymore)*.

That is one point, another is the rate by which you mentioned the sedimentation in Laguna Lake about 1 to 4 centimeters per year, which means that in 100 years you will have 1 meter and that might even accelerate with increasing population and more activities in the watershed. The moment that there is no sign that this will be reduced just so much sediments are going into the Lake from the cultivated areas and from other earth moving activities in the upland. And this is to me very serious threat to the ecosystem and so I think this seminar is enlightening to us in the area of environment. This is I think an opportunity that we can raise the issues with the objective to accelerate more our scientific basis of our conclusions and findings.
Thank you

Dr. Kelvin Rodolfo (NIGS – UPD). My name is Kelvin Rodolfo, I am a visiting professor at the UP NIGS and I work under the leadership of Dr.Siringan. there's one point that needs to be stressed, exceedingly important, tayong mga pinoy ay very trendy and global warming has become a very popular topic. The point that we need to emphasize is the fact that sea level rise due to global warming is two millimeters a year. The kind of subsidence we are talking about is an order of magnitude greater than that so as inhabitants around Manila Bay we have to be really

more concerned, apart from climate change and global warming, with the local subsidence because it far outweighs sea level rise from global warming. Another point, I think, we need to make is that just a friendly piece of advice for Dr. Javelosa I do not believe that simply declaring a moratorium on ground water withdrawal is going to stop the problem because we Filipinos love to take baths, we're very hygienic people, we are also one of the notable example of population explosion, which simply means that there is more need for water. The reason why ground water pumping began very seriously in the early 60s in the Metropolitan Manila area was simply because there was not enough surface water and we have to have water to drink and to bathe and wash our clothes. It is a mistake sometimes for government to make a proclamation if it cannot follow through or the people cannot follow it because that merely reduces the authority of the government. I noticed that during the Pinatubo crisis when declarations were made that towns were supposed to be evacuated and the people simply did not listen. The net result of that is that the government is weakened so it is not enough to say that you cannot withdraw ground water, you have to offer water from somewhere else. And until they get that water they are going to continue pulling water our of the ground. *Hindi maiiwasan iyan* (That cannot be avoided).

Moderator. We will move on to the next topic, the biological environment. But we might as well mix the physical environments and biological environments, so if you want to ask questions, or make comments or give us your point of view on any of the topics, please feel free to do so.

Prof. Lopez. May I make some observations on our friend from UPLB on his comments about the map change of shoreline from 1902 to 1985 prepared by Ando's group. First observation is the shoreline was apparently compared between the 1902 map, 1985 map and aerial photographs. I wonder if the time of photography was considered in delineating the shorelines based on aerial photography. I wonder if the map used for 1902 was a topographic map or a nautical chart. The difference between the mean sea level and the mean low low water is about .4 meter. And the area in Pampanga, in Tubo-tubo area, that is a very flat area, a .4 meter difference can result in several hundred meter change in the shoreline. But I think the critical part here is the time of photography because if the photography was taken at low tide or high tide, that makes a lot of difference.

Dr. Siringan. For the figure that shows 1902 and 1985 both were maps. Both are nautical maps and both are referenced to mean low low water. So that takes care of your problem with the possibility that one might have been referred to mean sea level the other to mean low low water. I was trying to prevent myself from saying more to allow other people to speak but we've done work in several places in the Philippines looking at different time scales from long term to short term changes in the shoreline positions. The general trend that we are seeing is that from the early 1700s until the 1900s the predominant shoreline movement is progradation. From the mid 1950s to the present several shorelines exhibited, either the progradation stopped or the shoreline retreated. So not only in Manila Bay but in several places, in fact, this is true also for Laguna de Bay. The work that we've done for LLDA, we worked very careful in noting the references used in the construction of the maps. And we were very careful whenever we use or combine aerial photographs with maps because we do know that it is critical to know when the actual photographs were taken. The trend is there, the trend is that, previously we have a rapid movement of land towards the sea thus we gained land. And it is good business for the real estate people. But in the more recent times, the more predominant change is that of shoreline erosion.

Even in places where we expect to see shoreline progradation, in places we expect voluminous amounts of sediment coming count, we don't see that at all.

Dr. Perez. This is to put Dr. Rodolfo at ease. In our study of climate change due to global warming, our vulnerability and adaptation assessment due to sea level rise it also considers relative sea level rise. But the next one I would like to Dr. Catalan. In our study, we also consider other impacts of sea level rise includes salt water intrusion, and most of the time, the impacts are negative. Earlier this morning, I heard that in Laguna Lake salt water intrusion actually lessens the turbidity of the water and contributes to increase in primary production, so for the first time, I heard a positive impact of salt water intrusion specially to the lake. My question is, is this salt water intrusion that you are referring to is within the range of flow, because if it due to climate change, salt water intrusion will be more

Dr. Zenaida Catalan (School of Environmental Science and Management, UP Los Baños) It is a regular occurrence. I think it used to be a regular occurrence, except during times when the lake level needs to go down at a certain level, 10.5. When there is a simultaneous rise due to high tide in Manila Bay, water enters the Lake. To maintain the life of the Lake salt water intrusion is definitely required from Manila Bay. But as I have said, water coming from Manila Bay is not plain salt water, it is polluted and that is a problem.

Dr. Pacardo. May I add to that. I have read a study by SOGREAH done in 1974. He said that the behavior of Laguna Lake in relation to the bay is such that towards the end of the dry season the water in the Lake becomes a little bit lower than that of Manila Bay during high tide. The back flow of salt water from the Bay is a natural process that helps in flushing out sediments and could also be beneficial to some migratory fish. With the present conditions of Napindan and Pasig Rivers however, it would be a wonder if any living organism could survive the swim from one system to the other.

The government put up the Mangahan flood way control is to stop this back flow of salt water because of a plan to tap water from the Lake for Metro Manila's domestic use. They have already starting building the infrastructure when they learned that it would cost more to clean the water of its heavy metals than to look for water elsewhere. The government later abandoned its plan.

Dr. Leonardo Q. Liongson (NHRC – UPD). I would like to add another dimension to what has been said about salinity. Salinity is a surrogate variable for the pollution coming from the rivers to Laguna de Bay. If salinity is driven by the tides and seasonally varied by changes in the mean level of the Lake relative to Manila Bay, then the same forcing mechanism is responsible for the influx of pollution from both Pasig and Marikina rivers to the east bay of the Lake. And to visually verify this, one should only take an open boat ride on the Napindan Channel, pollution of all sorts can be seen with the naked eye, plus or minus zero error of measurement. And this will give us some thoughts that there are rehabilitation efforts to clean Pasig River, but nothing is being done for Napindan. There is a tidal loop of garbage in that area especially during the dry season.

As I said, salt water is a surrogate variable for pollutants thus we could measure chloride, BOD, COD, chemicals coming from factories along Marikina River, sewage outfall of people living along and other point sources.

Dr. Guillermo Q. Tabios III (NHRC – UPD). I want to add that the Lake is a multi-purpose system and management issues are also important to examine. Among other things, the Lake is used for fisheries and as a source of water. From the point of view of fisheries, salt water intrusion is good for the industry. And we saw this in the report presented by Dr. Catalan, that tilapia production increased because of salt water intrusion.

Although the Napindan hydraulic control structure was built to repel salt water from entering the Lake, in the past 10-15 years since it was built, it has never been closed for that purpose. Rather it has been left open to allow salt water to get into the Lake. Here we see a change in management objectives of the Lake as a multi-purpose system.

That is one angle. The other aspect is also the natural process of salt-water intrusion. How significant is the effect of fresh water inflow into the Lake compared to 20 or 30 years ago. Now, water in the Lake is diverted upstream in the surrounding watersheds so apparently less fresh water inflow would increase salt-water intrusion. The point is should we now look at a compromise between water supply extraction against fisheries? The fisheries sector would expectedly argue for salt-water to come in. On the other hand MWSS would opt to halt salt-water intrusion. Unless we decide to bring in other indicators, I think that by just looking at the natural systems and considering the various issues and concerns we could already determine appropriate the options to manage the Lake

Dr. Catalan. Salt water intrusion kills water hyacinths, this is good in a way because the decaying plants settle at the bottom of the Lake allowing nutrients to generate and return to the water column.

The Napindan hydraulic control structure was built to prevent salt-water intrusion and this provoked the fisher folks to rebel. Through mass actions, the fisher folks were able to persuade the government to keep the structure open throughout the summer time. LLDA saw that it was useless to regulate the in-flow.

I think that the idea of privatizing the use will be a useful input to the project. Since this is a policy matter, it would be good to air this out in a multi-sectoral consultation wherein the fisher folks should have a representation. This group must be consulted on the priority uses of the Lake because there are three million of them depending on the fishery resources

Dr. Liongson. Again, I think the problem is not so much of salinity but the pollution associated with it. Other than local pollution coming from Muntinlupa and the west bay, the Pasig River brings in pollution from the other two rivers and pours it into the Lake. This condition of the Lake is giving ideas to some people in MWSS to extract water either from the east bay or from the central bay. There is in fact one group who recently made a feasibility level design to extract water from east of the Talim Island. Using the salinity contour map, they decided that central bay,

right off east of Talim Island, could be a source of water. The idea is to keep west bay saline, and to extract water from the east bay.

Government has not bought the idea yet. And in LLDA's priorities, Laguna Lake is last in the list after the trans-basin schemes of Umiray, Laiban, Kaliwa and Kanan Rivers. These are other river basins lying in the Sierra Madre Mountains east of the Angat reservoir that could be tapped for water.

Dr. Catalan. I want to propose a compromise. Based on a study conducted by SEAFDEC, it takes about one and a half months for salt water to reach the east bay and results also showed that the primary production in that Lake is low. Maybe we could look at the possibility of closing the gates when salt water has moved to the central bay and midway through the south bay to prevent it from flowing to the east bay. This is just an idea I am thinking aloud here.

Dr. Tabios. I want to follow up on that. We have done some modeling in Laguna Lake and I think it is important to emphasize that the Lake is quite dynamic and with the fresh water inflow, different seasons of the year, we can have different regimes. And then the Lake is dynamically circulating, we can have varying concentration of saline or pollutants all over the Bay at different times of the year.

The Lake has three lobes, the processes in the west bay could be so much different in the central bay and in the east bay. The timing as well as the spatial distribution of pollutants, sediments, turbidity, will come into the picture when we make an ecological model of the Lake.

And I think in developing policies for the Lake, we must really look at it from a dynamic point of view. As you have mentioned, perhaps we could broker a compromise between the water supply people and the fisheries sector by opening and closing the gate at certain periods. During the wet season when there is a lot of fresh water inflow, there might be no reason to worry about salt-water intrusion. And there may be portions of the Lake where one could safely extract water with the least treatment to remove chloride. This way both sides are satisfied.

Dr. Pacardo. I think the concern for fishery has been overtaken by environmental problems. Because residents of Los Banos, Bay, and Calamba, for example refuse to buy fish coming from Laguna Lake. They prefer those that were caught from Taal Lake in Batangas. Meantime, the fisher folks are forced to sell their produce in Manila. I think that the pollution problem should be incorporated in the model. In addition, it will be worthwhile to look at the contribution of agriculture to the pollution problem in Laguna Lake.

Dr. Catalan. May I just add another information, from what I noted in the interpretation of results, salt water takes a long time to reach east bay due probably to the strong current produced by the inflow from Sta. Cruz and Pagsanjan Rivers. The two rivers, in effect, are counteracting the inward flow of salt-water.

Dr. Liongson. I've heard similar comments from some people in LLDA. The eastern basins of Pagsanjan, Sta. Cruz and Pakil belong to the type 4 climate. Although we have not determined the parameters of this factor it is a conjecture worth looking at in a modeling context. Whether or

not fresh water discharge from areas with type 4 climate is responsible for arresting the advance of salt water plume to the central bay should be investigated through modeling and field surveys.

Dr. Pacardo. There might be a gradient of salt from Napindan, and its concentration becomes lower as the flow moves to the east. Diffusion is slow and takes about one and half months.

Dr. Liongson. The contour plot developed by MSI for MWSS showed something like 250 milligrams per liter at the tip of Talim Island.

Dr. Tabios. I would like to emphasize the importance of the dynamics of the process. Going back 20 years ago, we might have experienced several El Niño events. And it is during this event when water supply is low that the problem on salt-water intrusion becomes very critical especially in places with Type 1 climate, like Metro Manila. Though I understand that 2 parts per thousand or about 250 milligrams per liter chloride is good for benthic communities. Perhaps during a normal year, salt water could be allowed to advance all the way to Talim until the end of summer when fresh water from Pagsanjan and San Cristobal watersheds dilutes the salt and lowers salinity concentration.

So we have to include the dynamics of the different climate types as well as the effects of El Niño and extreme weather conditions like storm in planning and modeling to develop policies. And I do not know how important a storm is in terms of its effects on the positions of salinity fronts.

Dr. Pacardo. Salinity is, I think a complicated matter. The fact that salinity concentration becomes high during the end of the dry season particularly during an El Niño could be the result of evaporation. However, nobody has yet computed the amount lost through evaporation.

Dr. Liongson. We have done some preliminary over-all water balance. May be this is an opportunity to discuss the results.

If we talk of direct evaporation and direct rainfall excluding the river inflow during the first four months of the year, there is more evaporation than rainfall. Throughout the year there is at least 100 cubic meters per second base flow representing the total of all river inflow. If we subtract the flow from Marikina River, which is 40, there remains 60 mean base flow. It means that there is always a net inflow into the Lake and therefor a net outflow to Manila Bay. From this we could see that evaporation is not a major component in the water balance. It is only significant in comparison to direct rainfall on the Lake during the dry season when even river inflow from the eastside where there is type 4 climate is minimal.

So we can see that evaporation is significant during the first four months of the years. But essentially, there is a net out flow from the system going to the sea.

Mr. Ed Norton (Consultant, LLDA). I am Ed Norton, I am working for the Dutch government supporting LLDA in setting up the decision support system for the Lake. At the moment we are in the stage of setting up models and I would love to show you something, but I think it is more appropriate to do it tomorrow.

Salinity intrusion in the Lake increases flocculation; it makes the water column clearer thus enhancing the primary production. Salinity levels up to 4 PPT will do that, anything higher will have no use anymore.

At the moment, Ayala is getting limited water out of the Lake and they have to dilute it with ground water for I think 2/3, 60%, 70% to reduce the salinity levels. Drinking water usually stands up to 500 milligrams chloride per liter, and the Lake's water can sometimes be up to 1500 to 2000 milligrams per liter at the end of the dry season.

The flow of salt water from west bay to east bay is indeed slow. I found that out from a historical analysis of data from LLDA. It takes at least one and ½ months and it is largely due to the very low effective velocity. Velocities in the Lake are in the order of centimeters per second, and that is slow. We are in a stage of calibrating the salinity intrusion further into the Lake and we are experiencing difficulty in reproducing the most eastern part because it takes a long time for salt water to move to the east and we only have two months.

Dr. Flaviana Hilario (Flood Forecasting Center, PAGASA). I would like to comment on the various points that had been raised here. But first let me say that the Flood Forecasting Division of PAGASA can use the data just presented. Rather than do a similar research, this conference gave us a good opportunity to see the results of these kinds of studies.

On salinity, there are many factors affecting salinity such as evaporation, rainfall, and inflow from watersheds. Dr. Liongson has already said that direct rainfall and inflow from the river systems comprise a big portion of water input into the Lake.

As of now, we do not have any rainfall station near the Laguna Lake.

Dr. Liongson. Right now we have a project with LLDA and we are keeping the rainfall records of the new stations. The most centrally located station is at Jalajala point. There are also stations located in Matang Tubig, Canlubang, Caliraya and Liliw.

Dr. Hilario. Do you get your data in real time?

Dr. Liongson. Yes. We have continuous recorders, we have the strip charts as well as the daily totals available. They are at NHRC at UP.

Dr. Hilario. Is it possible for government agencies like PAGASA, to get some of these data?

Dr. Liongson. Officially, LLDA should give the permission. But informally, you can go to the office and get copies.

Dr. Hilario. PAGASA has a flood monitoring project with DPWH funded by JICA to set up telemetering stations for rainfall in Metro Manila.

Dr. Liongson. The five new stations were set up to get better data on the water balance of the Lake. With PAGASA's stations in the watersheds and the new stations, we should get better estimates of direct rainfall on the Lake.

Dr. Hilario. As I was saying, it seems that we have already identified the factors needed for modeling. Although we might not have all the data, we could nevertheless discuss the data gaps and propose the ways to collect them.

The last point that I want to say is that we have discussed the existing conditions of the Lake like salinity, pollution and concentration of heavy metals in the Lake. But we have not touched on the sources of pollution. I think that it is important to know the sources so that we can propose solution to the problem.

Dr. Siringan. There are several people addressing the problem of sources. They were not presented today because there is no time to present. The report given to LLDA a year ago contains not just the distribution of the concentrations of the different metals there are also inferences on the possible sources. You can perhaps go to LLDA and request a copy. We cannot release a copy from our end because it is a project done for LLDA.

Joselito Duyanen did his dissertation in 1995 on Manila Bay. It addressed the distribution and sources of metals for the entire Manila Bay. We would gladly provide with copies of the published works by different people including myself.

However, some of the reports presented here are still in abstract form. The data needed for publication are not yet complete, but if you want them in abstract form we can give it you.

Mr. Albert Nauta (LLDA, Delft Hydraulics. One comment on the mix data set on metals. Be careful in just saying that we can link it to pollution sources. Because the ones that were shown this morning such as copper and lead are binded in a completely different way to the absorbents. Copper is mostly complex and organic metal while lead sticks to the clay particles. The fractions therefore should be dealt with very carefully. We've seen that concentration of copper increases near the outflow of the Pasig, which is quite understandable because most of the organic materials come from there. We should consider in the total combination all of these fractions and not only the clay fractions. While clay has the highest absorbent capacity, it might be diluted by the silt fraction if the silt is dominant in that specific place. So instead of merely comparing it to standards, we should consider more (factisence?) not so easily linked to pollution sources in the near area.

Dr. Siringan. A follow up study by a graduate student from the Environmental Science Program of the College of Science addresses the issue of the bio-availability and the partitioning of the different metals presented this morning. So that partly addresses your concern. If you are interested in looking at this, you may get in touch with her adviser, Joselito Duyanen, she's doing the work for the entire Laguna de Bay area.

The reason why we chose to limit out work with the clay size fractions fraction is so we can have a uniform criteria for determining which sites are polluted and which are not. The role played by

size of the particle is a major controlling factor and it would be more difficult to compare the sites if we used different grain sizes.

Moderator. We will continue our discussions after the break.

Dr. Tabios. If you don't mind, they are going to serve the snacks and we can perhaps continue the discussions. I'd like to announce that we will have cocktails after 5:00 p.m.

Dr. Hilario. Earlier this morning, I think it is Dr. Siringan, I forgot to tell about the so-called dominated El Nino years or La Nina period, what is the basis for saying this. Because from the meteorology point of view, we use the ENSO index on the intensity….

Dr. Rodolfo. The University of Colorado has what they call a multi-variant ENSO (El Niño Southern Oscillation) index. They use six parameters. I can probably send you a copy of what they have. The very striking thing really is that at about 1976 the climate just changed very dramatically from being La Nina dominated to El Nino dominated. And I've been looking for someone to address why this is so, just look at the plot of this index and it is there, it is very clear. I don't know what the reason is, I have no idea. Intuitively, one might think it is probably connected with global warming in some way but I don't know.

Mr. Ed Manalili (PCAMRD - DOST). I am Ed Manalili, from the Philippine Council for Aquatic and Marine Research and Development under the Department of Science and Technology. I speak for DOST as a funding agency. Since 1995, the Department of Science and Technology has provided over P37 million for the environmentally friendly management of Laguna de Bay. The Program has evolved into the Integrated Action Program for the Rehabilitation of Laguna de Bay. The DOST is now the repository of over 20 projects and results can be obtained from our Agency.

We have in fact provided LLDA data gathered by several researchers of the Lake Environment Information Systems. The group has gathered studies conducted since 1907, it has also established a mini museum at the BFAR-DA where specimens of different fish both extant and extinct are displayed in jars.

The program is four-pronged. It includes the Lake Environment Information System, the Lake Environment Monitoring System, the Lake Environment and Policy System and one other component.

Dr. Javelosa. ……That was conceptualized in year 1994 when I was in Delft then I (discuss it?) with the TNO and the Rex Water Ministry. We came up with this Laguna Lake issue. But it was tackled before on four grounds. First, the Lake is a potential alternative source of fresh water for industrial users. The structure for this scheme will be built in tandem with wastewater treatment facilities. Second, we have to find some solutions to the pollution and flooding problems and one option is to dredge. Third, we have to improve fish stocks in the Lake and to do we plan to link Manila Bay and the Lake by building a (deltaic?) similar to those found in Holland. The plan is

to control salinity input by erecting floodgates, which could be opened and closed depending on the level of the tides.

There were some problems that came out about dredging. We don't exactly know the sub-strata component of the pollution. So that we do not know up to what level or up to what depth are we supposed to dredge without disturbing the pollutants that have already settled at the bottom of the Lake. We fear that dredging might dislodge the sediments and cause more pollution. We certainly cannot afford to cause a fish kill in the Lake and I won't be amenable to dredging unless the environmental issues are addressed. Mr. (Reindam?) is now doing a profile of the entire lake to find out where and up to what level to dredge.

I think that salinity is a real problem in the light of Dr. (Harman's?) report that the Lake is a major source for ground water replenishment. The problem becomes direr when we consider that the Lake has been identified as a source of water for industrial use. Thus we have to get information like at what depth and how much should we allow industry to extract from the Lake without disturbing the balance for fish to thrive. I don't know if this is part of the study of NHRC.

There is also the issue raised against allowing Ayala, Alabang to get part of their water supply from the Lake. This might set a precedent for people to clamor for the same privilege. We should determine the economic value of these resources and make the user pay the price.

Mr. Nauta. …..I noticed that our discussion has moved gradually from scientific issues to management concerns. Indeed, salinity and specially the (recharge?) are very important with respect to the future of the Lake because of the plans to extracts a lot of water for drinking. It is hardly felt, but there is almost no water out of the Lake pumped to the Ayala station.

Our project will look into all sorts of plans that are laid out for the Lake. One is the plan to dam the Lake to prevent polluted water from mixing with clean water. We will also look into the issues on dredging: Why would we dredge? Where would we dredge? But more important, how should we dispose of the pollutants and where will be dump the dredged materials. Sometimes it is better to leave it in place and just remove it for reasons already mentioned.

At the moment we are looking at the pollution aspect. And from a pollution point of view, the questions we often ask ourselves are; Should we dredge? Or can we still leave it in place? If we dredge, how do we deal with nutrient recharge and internal loading into the lake, heavy metals and organic micro-pollutants, etc.? Where should we dredge to improve certain conditions? We are still in the stage of building decision support systems covering all these aspects to better study them. But ultimately, it will be, probably somewhere after March next year, we will deal with these sorts of items.

Moderator. Prof. Catalan?

Dr. Catalan. I know that dredging is a complicated matter. But we have to look at it in relation to controlling pollution from its source. We may do all the necessary steps to ensure that the ill effects of dredging will not aggravate the present condition of the Lake, but if we don't stop the pollution at its source then I think that it will just be another expensive project. From the

management point of view, it will be good if we control the discharge of pollution before we start any dredging.

Mr. Nauta. But we can use the dredging for the benefit of other uses and functions, like for instance, creating extra shoreline areas or do land reclamation for certain areas in the Lake.

Dr. Catalan. Each one of us has a point of view to be considered, and I think that we should consult the people who will be most affected and they are the fisher folks. We expect that pollutants will be released into the lake and will cause more contamination of the biota. I am not against dredging, but we have to study this option to make sure that it is not going to make the conditions more difficult for the fisher folks.

Dr. Pacardo. On the case of dredging, I think this really fits well into the integrated approach. I can suggest the lahar covered area in Pampanga as a suitable dumping site for the dredged material, since it is made up mostly of clay it could be mixed with the lahar to create a kind of soil for crop production. We should not even worry about the heavy metals because it could be diluted. We can connect a pipe from the Lake up to Pampanga and the dredged material, being liquid in nature can be moved by pressure. This is one solution, but it is going to be very expensive.

Dr. Liongson. I want to know if there is anybody here from Public Works. Dir. Fano will present his paper on the West Mangahan Diking System tomorrow, would anybody know if will also discuss dredging plans of Public Works?

Miss Atienza. Previous to Mr. Fano's current position as project director of flood control, he was with the Flood Control Division of the National Capital Region and continues to be in close contact with people involved in dredging. You can ask him about this activity tomorrow.

Dr. Liongson. I would like to add something to the pollution of the west bay. No body in this forum has raised the old idea of building a waste interceptor system along the coastline of Laguna de Bay. I heard that land prices in the areas where the interceptor is proposed to be established have gone up tremendously and it would now cost a lot more compared to the estimates made in the mid seventies. Nevertheless, would any body know if the government would still pursue this idea?

Miss Atienza. This is the first time that I have heard about that.

Dr. Liongson. It is an old idea drawn up in the seventies.

Miss Atienza. We all know that many of the areas in and near Pasig are flooded right now. And I was told that it would take about two and ½ months for the floodwater to subside. I was also told of a proposal that would remedy this situation, but that it is going to be very expensive because it would pass through EDSA.

Dr. Liongson. The project is the proposed Parañaque spillway. The proposal is as old as Napindan, in fact Napindan, Mangahan and the Parañaque spillway were components of an

integrated system conceived in the early 702. The first two components have already been built, but the third remains unimplemented because land values in Parañaque have gone up and it would be very costly to build it now. Other than the cost, the fisheries sector also opposed the proposal because of perceived of its impact on fisheries.

Again, we can ask the Public Works if it is still seriously considering the Parañaque spill way. I think it is necessary to rapidly drain Laguna de Bay once the rains are over.

Miss Atienza. I think we should address this question to Public Works-NCR. They have a big flood control project funded by JICA.

Dr. Liongson. You mentioned JICA and that reminds of one other alternative that might have originated in JICA. They are proposing a ring dike system instead of the Parañaque spill way.

Do we have representatives from JICA here who can talk about the flood control plans that are being advised to Public Works.

Mr. Taizo Yamada (JICA Expert). My name is Taizo Yamada. I am a JICA expert for Environmental Management Bureau. I am not informed of that specific activity of the JICA but I can give you some piece of information. As far as I know, JICA is assisting DPWH and may be also MMDA to study the existing condition of (?) drainage system and create some kind of data-base. It is a small technical assistance compared to the flood control project around the Navotas area being financed by the Japan Bank of International Corporation. The project is also looking at the flooding conditions in the area and will include the building of dikes or gates as well as relocation of people. As far as I know, those two projects are the relevant activities at this moment.

Dr. Liongson. Our expert from JICA mentioned the CAMANAVA area which I gathered has priority over Taguig, Pasig and Marikina.

Miss Atienza. This is a comment. I noticed that it is difficult to access data gathered by government agencies. And as a way to remedy this problem, the National Committee on Geological Sciences to which I belong is planning to make a list of data generated through the years by the different government agencies. It would be a good idea too if each agency could provide data in the list through the internet. I think that publishing researches in the net would facilitate comparison of works among agencies; that is one way to avoid duplication.

Working through the net would foster easier exchange of communications even among employees in the same agency

Dr. Liongson. In response to that, I want to mention the data base project for the Laguna de Bay basin funded by PCMARD or DOST and headed by NAMRIA.

Mr. Manalili. NAMRIA has already bought the computers and equipment and they are going-on during this last quarter of the year. The project is called the Laguna de Bay Management Information System.

Dr. Liongson. Somebody here is suggesting that you invite people to the project launching so that they will learn more about the system.

Mr. Manalili. Yes. It is unfortunate that we have not had a good networking system for all government agencies. Case in point is the task force on water management based in DENR. Its members are the different departments of government, it has met several times but we have yet see an improvement in its network.

Dr. Liongson. Personally, I think that networking should start at the personal level. We learned from experience that starting to network at the official level right away is not feasible. It is necessary to start professional links at the personal level and once this is established official networking follows.

I would like to recognize our representative from DENR. Please introduce yourself.

Mr. Bert Nasayao. I am Bert Nasayao of the Manila Bay Environmental Project, DENR. Much of our discussion has been focused on Laguna Lake maybe we could already discuss about Manila Bay. Our project has barely started. About three months ago, we conducted training on risk assessment and management of Manila Bay and we learned that we didn't have enough data particularly on the biological resources and pollution of the Bay. We looked at those from MSI unfortunately they are not on a bay-wide scale. Many of the other information are just on isolated portions of the Bay

Our project needs these data and we cannot generate them because we are not into actual research or rehabilitation and development. Our project is substantially concerned with action planning and building partnership with other government agencies and stakeholders. At the moment, we are in the process of developing plans together with the stakeholders and in order to make a credible plan we need sufficient information with scientific bases.

We don't think that we have to do the research work ourselves because we know that the academe and other government agencies are already doing the studies. Besides, our funds are intended only for consultations and establishing networks.

Dr. Liongson. I would like to respond to that. Agencies who lack money and staff to do research can link up with research centers or the academe and jointly propose studies that could be funded by DOST. This is the experience of LLDA, NIGS and our Center. The PCMARD identified the beneficiary which is LLDA and LLDA commissioned two academic centers of UP like NIGS and NHRC to do geological and hydraulic studies.

Another agency that benefited from this set is NAMRIA. It identified the data base projects for LLDA. So we have a tripartite case. The first component of the triangle is the funding agency, such as the DOST or other government agencies or even the private sector. The second component is the agency-beneficiary, a developmental agency that wants to avail of the services of a research center and funds from DOST, and the third component is the research center, which could either be a government agency or the academe.

I don't know if this has been duplicated in other councils but PCIERD is pushing for this kind of tripartite partnership. Instead of researchers doing projects for DOST in isolation from potential beneficiaries, It would be good if we could set up the partnership right away. DOST gave the funds to LLDA and LLDA farmed it out to different government agencies and research institutes such as the NAMRIA, NHRC and NIGS in UP.

Mr. Manalili. There are several planning councils in DOST: the Philippine Council for Agriculture and Resources Research, The Philippine Council for Industry and Energy Research and Development, the Philippine Council for Health and Research and Development. There is also the Research and Development Institute, and the Industrial technology Development Institute that does research and development and monitors the pollution levels in Laguna de Bay and Manila Bay, respectively.

Miss Preciosa Samonte (PCMARD). In addition to what Ed Manalili has said, The DOST is not only entering into partnership to fund projects but it is also into project implementation. The agency believes in working with a group to harness the expertise of the various institutions. For instance, the Red Tide watch in Manila Bay is conducted with NIGS; while the various researches are tide up with the Marine Science Institute. PCMARD-DOST and the International Atomic Energy provides the funds

Dr. Javelosa. I would like to add my comment on networking. World Bank gave money to the water sector to set up an information network called the National Water Information Network or NWIN. The technical working group has nine members, five of which are line agencies. Despite that, we did not know which of the nine agencies should lead. Since the project requires knowledge in information technology, we decided to ask DOST to set up the system. The money was given to DOST and we entered into a memorandum of agreement wherein the Department agreed to serve the needs of the members. The project has already started and I think it is going well. It has helped a lot and without it we won't get the information we need. Everybody knows that it is difficult to get information unless one is willing to pay. We did just that, we paid the information we got from PAGASA. That is also the reason for the NWIN project. Since DOST has already the network in place all we did was to transfer some of the funds to it so we can use its system to access the information we need

Dr. Liongson. Is any council at DOST handling that? One thing about the water sector is that its concern is lodged in different agencies or councils. Agriculture is handled by PCCARD, pollution and fisheries by PCMARD and construction by PCIERD (industrial application).

But I think we should take advantage of the fact that there are several councils that can simultaneously fund studies

Dr. Javelosa. We hope that the DOST will share the results of research projects it has funded. Because often than not research groups would expect you to supply the information they need but would refuse to share the results.

Dr. Liongson. There are many ways of getting the data. One way is to invite them to a conference. We have had several conferences on sectors other than water. It would be a good idea to invite DA, DENR, Public Works and other agencies to a conference. DOST, PCMARD or PCCARD could sponsor an annual gathering on water

In other words, researching for information would become easier if one establishes the professional relationship with fellow workers in the same field then hold conferences or seminars to get people to share the information they got. Of course it's easier to get data if one is willing to pay. Perhaps we could include the estimated budget for data acquisition in the study proposals we are going to submit to DOST for funding. We should not think that government data are always free, because government also spends on paper and diskettes in preparing the data.

Mr. Nasayao. I want to share my experience regarding data sharing. The task force bought 37 thematic information for P7 million. One year has passed and nobody has used the information because no one knows how to access it. It later became obsolete. When we took over, we made it known that we are willing to share the information free of charge to anybody interested on condition that it will not be plagiarized. I specifically prohibit the use of information for consulting services, because I came across an EIS prepared by a consultant who copied the information verbatim and passed it off as his work

Dr. Liongson. We have to distinguish between researches that are public documents and can be accessed by any body and reports that are imbued with confidentiality. Our focus should be on studies that should be made available for public consumption but are not due to some reasons, this I think is the communication gap that we have to address.

Dr. Hilario. Just a point of clarification about what Dr. Javelosa just said about paying P7 million for some information, I am sure the PAGASA did not charge that much. It is true that PAGASA is charging for its data but only for a minimum amount. It is actually a little more than P40 per page. We have plans of increasing our rates by 20% but these will have to pass through DBM for approval. I agree that data should be freely given to those who need them, but as Professor Liongson said it is only fair to consider the administrative cost of producing these data.

Dr. Hilario. Anybody can copy the data from the original free of charge, but asking for digital data is another thing.

Mr. Nauta. But that is actually the problem. Data should already be in digital form and the agency can still charge for administrative costs which is done world wide. I am from a research institution but I act as a consultant so I need a lot of data. And the problem we have over here is that we go to all sorts of institutions that give us piles of hard copies. We usually end up encoding the data ourselves. I think this is one area that you should work on.

Dr. Hilario. We are already digitizing our data, but we cannot do the same with data that are recorded hourly because of the volume.

Mr. Nauta. Yes that is true. But my remark is more in general. It does not concern only PAGASA, but actually all institutions. Even in LLDA, we had to do a lot of encoding in our project.

Dr. Liongson. Anyway, I think one of the long-term objectives of this program is to come up with a resource book. We really hope that the participants will contribute their report to this endeavor.

Mr. Manalili. We at PCMARD and DOST are also planning to publish a resource book, similar to those in-flight magazines. It will show the physio-chemocal characteristics of Laguna de Bay.

Dr. Liongson. That would be a good handbook for policy makers and maybe for promoting tourism. I recognize our JICA expert.

Mr. Yamada. From the viewpoint of international donors such as the JICA may be we can help to alleviate this frustration with acquiring digitized data. There have been a lot of studies and research activities done by Philippine Government sponsored by international donors. But these are kept in different repositories so that we have to create our own database ourselves. This I think is not productive. In this context, I would like to suggest that the Philippines create a sort of database to help donor countries like us to be more effective and productive. I am thinking of an inventory study which shows who knows what and what kind of activities have been done. Even if the inventory does not disclose the data, it would already be a big help to researchers.

Dr. Liongson. Hopefully the project of NAMRIA sponsored by PCAMARD will address this dilemma.

Mr. Manalili. LLDA is currently coordinating with NIGS, NHRC and PCMARD to draw up a proposal on Laguna de Bay for World Bank funding, but the Bank wants an action plan instead of only environmental policies. It also has a different set of criteria that propose to disallow use of the fishery resources.

Dr. Liongson. That is true. Even without the intervention of international donors like World bank, each agency should try to work out his problem (of acquiring). We can start by filing hard copies following bibliographic standards, or we can digitize data if equipment like computers and CD writers are available

PAGASA is one of the first agencies to computerize their data and has kept their prices reasonably low. But I think other agencies are still lagging behind. We don't mind so much going through hard copies if they are organized, besides it would be easier to transform data to digital form and downloaded into websites if they are already filed according to standards.

Moderator. The DENR Representative.

Mr. Nasayao. I think an agency or institution should take the initiative to lead this activity. I am saying this because it will take a lot of hard work to compile all the studies conducted on Manila Bay alone. The records show that there are at least 100 researches conducted on the Bay at a cost of P3 billion not to mention the $22 million allotted to conduct more studies. Tremendous

amount of money was spent yet we do not see the data collected in one repository. We might not only have wasted money but valuable information that could help us plan for the area

I want to repeat that there should be one institution or organization that should take the initiative. I don't know if UP could do it.

Dr. Liongson. We believe otherwise. We think that it is everybody's concern to generate, maintain and share data. What is more important is the networking and adherence to minimum standards of data formats.

Let every centers of expertise develop its own database. It is more important to create data pointers rather than a database of data themselves. Maybe NAMRIA or DOST could maintain a sort of super data set which would point to where the other data are. Because each specialized center will be best equipped to develop and maintain and disseminate their own data through a network.

Preciosa Samonte. I am Precious Samonte. Actually PCAMARD has started this data banking. For instance, we have already created a data bank on corral reefs and this is linked to other networks like those of MSI and Siliman University. We are able to exchange data through this network.

Mr. Brilliantes (NAMRIA). We have a technical working group for geographical information system that is standardizing the geographical information data and setting the standards for agencies mandated to generate the data. There must be a standard format for data coming from other agencies or research institutions, for instance, geographical information and maps from NIGS and geological data from the mines bureau must be done according to a uniform standard.

The technical group is also drafting an executive order for the distribution of these information. The implementing rules and regulations for this draft executive order will provide the ethics in distribution and pricing of data

Dr. Liongson. I understand that ethics is an important issue in the sharing of geological data. Because there is some treasures hidden sometimes in geological data.

Mr. Brilliantes. Ethics and intellectual property rights.

Dr. Liongson. Not so much in water and rainfall. Is there ethics involved in rainfall data?

Dr. Hilario. I think the EO will establish the guidelines in coordination among agencies and standardizing data. It will create a policy and planning council. But there is nothing in the draft Order that will require agencies to submit their data to one institution.

Mr. Manalili. The EO will create a sort of a national geographic information council that will take charge of all geographic information necessary for planning.

Dr. Liongson. Anyway that set up will provide the geographic and geologic data of researchers. Data on flooding will be provided by PAGASA through its website following an agreement reached by PAGASA, Public Works and LLDA in a conference held two months ago.

Dr. Hilario. Whatever data we have on flooding is already available on the website.

Dr. Liongson. I have tried the website and you can get a few rain and hydro-meteorological data.

We should welcome more websites. The important thing is that we have those links and connect them together.

Actually, we have already overshot the targets we have for the first day. The topic on data needs is scheduled to be discussed tomorrow. We have exhausted the topics specially the aspects of biological environment, physical environment and pollution. Dr. Rodolfo's report on the mean sea level rise was very interesting and was in fact the subject of several fora sponsored by the academe.

Mr. Manalili. Based on Prof. Lopez' comments, there does not seem to be any subsidence.

Dr. Liongson. As a matter of fact, JICA also did not find any appreciable change when it conducted a geological survey for MWSS 10 years ago.

Mr. Manalili. So are you saying that it contradicts Dr. Siringan's findings?

Dr. Liongson. Professor Lopez gave a caveat, he said that, may be the whole system is going down, even the benchmarks in Norzagaray, Bulacan and other places. What is lacking is a good explanation for all these.

We will still meet tomorrow and I hope that it is going to be an exciting day because Public Works will present their plans and it should be interesting to hear from them.

We will tackle four topics tomorrow. We'll talk about the socio-economic development and structure in the first half of the morning. Our presenters will be Professor Tanhueco of de la Salle University, Professor Cruz of NHRC and Professor Doi of Tokyo Institute of Technology. After that, we'll have Prof. Castro and Dr. Catalan again and a representative from Public Works to talk about governance and institutions.

After the coffee break in the morning, we will have another session on data monitoring and needs. We will hear from our key speakers, Prof. Nadaoka and Doi and Dr. Tabios. They will present the data monitoring and needs from the point of view of research people. Finally, the organizers of this forum will present modeling and research needs then in the afternoon, we will have an open forum on the topics presented in the morning.

Any last few words.

Mr. Nasayao. This is just a request. Can we have copies of papers presented today?

Dr. Liongson. We plan to transcribe and publish the proceeding for distribution in January. In fact we decided not to require handouts during the presentations to encourage more speakers.

Dr. Tabios. Yes we are planning to write the proceedings of this conference in a more structured and coherent form. We hope to finish it by January.

Dr. Liongson. I think many of the participants are interested in the reports of NIGS and MSI. You could ask for reprints without waiting for our output.

I think the report of Dr. Siringan is available. Anybody who wants a copy can write to Atty. Mendoza of LLDA.

Prof. Nadaoka. ……(?)deal with a lot of data sources and many papers. I can agree 100% with the opinion of Mr. Yamada, JICA expert. The result of our project should be a strategic one. We will publish the resource book with the list of references of previously written papers, including data sources, etc. It will also include an inventory showing who is doing what. This resource book, we hope, will become a helpful tool for researchers and we hope that more of these kinds of integrated data set will be produced.

May be as a preliminary version we should finish that kind of thing in one year or so. What do you think about this?

Dr. Tabios. We were thinking that the resource book is a two to three year project, three years will be the longest. We have at least 15 pages already written but the discussion in this conference would definitely help us identify the people who might be interested in this project. We need to put in a lot of work to come up with a comprehensive document. But we plan to have a draft by February to show around and get people interested in participating in writing the resource book. We think that a draft, even a sketchy one would entice more people to contribute their work.

Relative to Mr. Yamada's comment, we have definitely got some ideas, like an inventory of available data and their sources. That I think will be a good section to include in the resource book

Dr. Liongson. We will print the resource book and the electronic form will be available in the website

We are also going to reprint articles previously published if permitted by the authors.

Dr. Tabios. I think that this is a good idea because how to share information is an issue raised in this forum. We have a web page maintained by Professor Nadaoka in his laboratory in Tokyo. The web site is a facility to develop a repository of information and models perhaps we can expand the group of users as well as the web page. But I don't know if we can readily download information through the internet without violating any property rights.

Restrictions notwithstanding, we definitely want to give away the model that we are developing. We can also have the reports scanned and put in the (acrobat PBF?) form.

I was just thinking that perhaps the web page can also be a repository of information and models.

Mr. Manalili. I want to add that PCMARD will also publish abstracts of different researches including the addresses of the authors. It will be in CDSIS.

Dr. Liongson. Will the reports from NIGS, Phivolcs or MGB be in separate chapters? In which case, each author will have to write his own references.

Dr. Tabios. We already have the detailed outline of the resource book. And as I have said, we've written a few pages. The books will contain chapters on physical environments, biological environment, pollution and so on, but we won't attribute chapters by names of authors. Instead we will acknowledge their contributions in the beginning of the book and we might refer to them as a committee. I have seen similar resource books published in the US wherein the authors named are various committees and all persons who have contributed their worked are just alphabetically listed. We want to put out a book without so much emphasis on giving credits.

Dr. Javelosa. My friend is asking for a copy of the proceedings and the directory of data providers, if it is available right now. We can call up the authors or visit their website.

Dr. Liongson. The resource book is not just a directory, it is a resource book of data.

Mr. Javelosa. My friend is not referring to the resource book, anyway I think that it could not be finished even by February. All he wants is a copy of the workshop proceedings and January is a long time to wait

Dr. Liongson. The proceedings will have to be transcribed and will take about two months.

Dr. Nadaoka. I think the proceedings and the resource book should be published in two months. We can produce a preliminary, quick version of the resource book.

Dr. Liongson. We should at least come up with a better outline. We could perhaps expand it to include what we learned today and what we will learn tomorrow.

Mr. Nauta. Actually I want to ask you something on your modeling ideas, because you said something like you will give away for free the modeling tool which you will produce within this ten year project. I don't if you are allowed to do so? I don't know if its all your own software, but suppose you are allowed to do so will you give support or assistance to everybody who will operate it? Will you feel responsible for results produced with the modeling framework by whomever? These are all practical questions you have to address before you just give it away.

Dr. Liongson. Those points are well taken and we will look into it.

Contrary to some early expectations, I think that there are a few new things that we are able to hear today. This is the first time that I heard a geologist from the Public Works raising the geology banner. Because for so long Public Works has been represented by civil engineers. We appreciate the strong presence of PAGASA and DENR. Bureau of Soils and Water Management was invited. This is the end of the session thank you.

VI. SOCIO-ECONOMIC DEVELOPMENTS AND INFRASTRUCSTURE

Speakers:

Renan Tanhueco, De la Salle University, Manila
Kenji Doi,Tokyo Institute of Technology, Tokyo
Peter P.M. Castro, University of the Philippines, Diliman

Topics Discussed:

History and chronology of significant socio-economic developments
Demographics, population dynamics, migration patterns
Implications of urbanization, overpopulation and resource scarcity to health, livelihood, traffic and pollution.
Infrastructure for flood and river control, hydropower and fisheries facilities
Problems, issues and concerns

VI. SOCIO-ECONOMIC DEVELOPMENTS AND INFRASTRUCTURE

Prof. Renan Tanhueco
Department of Civil Engineering
De La Salle University
Manila

Of concern is the socio-economic conditions and locational decisions and their effects on Manila Bay and Laguna Lake Systems. In short, what I am going to present are the problems that arose as a result of the activities and the land use decisions on the Metro Manila area. This is not a very comprehensive report and I will just give some insights of the situation.

Who are the players? Who are the people involved in the spatial structure of Metro Manila?

This case presents the environmental problems that beset Manila Bay resulting from the socio-economic policies and conditions as well as the locational decisions. Locational decisions refer to decisions on the manner of establishing industries, commercial and residential areas around Metro Manila

I am going to present statistics that were culled from the National Statistics Office, Metro Manila Development Authority, Laguna Lake Development Authority and Environment Management Bureau.

Data taken in 1995 showed that Metro Manila was already a mega city with a population of 10 million. The average density was 14,864.8 persons per square kilometer compared to the national average of 228,7 persons per square kilometer. Based on these figures, it is projected that the population of Metro Manila will double in 20 years- about 20 million people. The population data is presented in Table 1.

The projected increase in population is seen to be due to the City's strategic location and the availability of facilities needed for business. Other business districts include Metro Cebu and Metro Davao, but none compares to Metro Manila.

The population growth may be seen in this diagram or figure.

This is a 1996 data from MMDA showing the population growth from 1980 to 1995. The yellow color indicates a negative increase, which could mean that there was either a saturation of the population or there was an outward migration. The green color indicates a population growth of 2.5% per year. This trend may be attributed to the fact that commercial/industrial areas are located mostly in the core of the City, while the residential areas are built outside the core.

As I have already said, people and business are attracted to Metro Manila basically because better work conditions are available as well as facilities such as water, power and telecommunications needed to conduct business with ease. Metro Manila is also the center of education as most of the big universities and colleges are located in the area.

Metro Manila accounts for about 30.3% of the total domestic output of the country. And based on the 95-96 figures, its growth rate was 6.9%. More families were earning more than P100,000 in 1994 compared to the number in the previous year. Prior to 94, the per capita income was less than P100,000.

The service sectors in the area are distinguished into primary, secondary and tertiary. The primary sector involves agriculture or any work or labor done on land. Secondary sector comprises manufacturing, while the tertiary sector includes banks and commercial establishments.

A big part of the population is employed in the secondary and tertiary sectors. The numbers in the diagram merely indicate the locations such as 1 for Manila and 5 for Quezon City.

The net density or the people per hectare employed are mostly found in Manila where the people per hectare employment are over 200. The people per hectare employed in Manila are between 100 and 200. And as we get out of the core the number decreases.

Migration creates problems like slums. Based on a 1992 estimates of the Population Commission on Urban Poor and quoted in the 1996 EMB report, the city with the largest population of urban poor was Quezon City, followed by Manila, Davao City was fourth, Kalookan City was fifth, followed by Cagayan de Oro City, Makati, Pasig, Pasay and the rest of Metro Manila.

People flock to Metro Manila to seek better opportunities. This creates tremendous demand for housing. Those who can not afford to pay for a house or apartment settle in slums along riverbanks and idle lands.

A survey conducted in 1992 and reported by MMDA in 1996 showed that 65% of Metro Manila was residential. 5% industrial, 3% commercial, and14% agricultural.

The patterns of industry location may be divided into two or three stages. Right after World War II, most of the industries located themselves near the mouth of the Pasig River. These industries were made up mostly of importers of raw materials, equipment and machinery who transported their stock to the North or South Harbor through the Pasig River. At that time, it was a locational advantage to set up business along Pasig.

Business owners also started setting up along major thoroughfares or roads that were strategically connected. There were two types of locational directions, one is radial from the port and the other is circumferential.

The manufacturing industry was starting to grow too. Cloths, leather goods and food were being manufactured. The commercial district started in the Quiapo-Binondo area after the war.
As the industries along Pasig River grew, pollution in the River also became worse. People occupying the area used the River as a dumping ground for their waste. Perhaps repelled by the stench, many businessmen started locating their establishments in the periphery. The move was also partly motivated by the growing costs of land and rent and business taxes in the area and partly by a directive in 1973 banning the establishment of industries within a 50 kilometer radius

from the Manila City Hall. After the 70s industries along the Pasig showed very little growth. And we know that industrial estates now are mostly located in the CALABARZON (Cavite, Laguna, Batangas, Rizal) and MARILAQUE (Marikina, Laguna, Qezon) corridor.

As industries move out of Pasig, the River became a less important mean of transport.

So the patterns of concentration of industrial/commercial establishments in Metro Manila is linear and nodal; centrally located in Manila and outward towards the periphery.

This is the urban structure of Metro Manila based on a 1996 MMDA report. I have not computed the size of these circles but they indicate a bigger urban structure. This is the main, near the Manila area, this is Makati and this Ortigas. It would appear that there are several small urban structures supporting the main organ structure.

Serote reported in 1993 that there are two types of investors. The large industrialists-the key figures in locating industries, who tend to build their establishments near ports. And the urban middle class comprising the small scale businessmen who usually use their residence as their place of business.

There were no studies made to determine the effects of environment of the 1973 directive banning industries within a 50 kilometer radius from the Manila City Hall. However, this order somehow led to irrational land use. For instance, it is common to see restaurants beside a funeral parlor or a church. We can see that spaces were occupied, but the uses were not properly classified.

We noted the overloading of facilities and the degradation of watersheds and estuaries. Table 4 of the handout shows the Manila Bay Region, which includes the Laguna Lake Basin. Table 5, on the other hand shows the environmental problems caused by these activities in the Laguna Lake region. I would like to correct one item in Table 4, I erroneously referred to THW as Toxic and hazardous substance when it should have been Toxic and Hazardous Waste.

We note the spatial environmental effects of the locational decisions, social, economic conditions, policies in the areas. So I suppose we need to look at policy directions that should be taken in order to bring about social and economic gains, without ignoring environmental considerations.

We have to assess the effects on the environment of change in land uses over the years. For instance, the effects of pollution on fisheries.

We also need to look into the prioritization of urban renewal plans; programs and projects that will shape directions, the intensity of development as well as the improvement of the lake/bay area

I'd like to show you some drawings of the land uses.

This is the 1996, I took this from MMDA. The black color represents the seas and water courses, the airport runways. The blue shows the Laguna de Bay areas and the built-up areas. The white

represents the industrial areas, areas under construction and the crop fields. The dark red represents the woods and natural areas and the bright red (these areas) represents the golf courses, parks and the aquatic vegetation.

This is the zoning map of Metro Manila in 1981. The yellow ones show the residential areas. The red ones are the commercial areas; they intended this to be basically commercial area, near the port. The orange ones indicate the institutions, the light blue, are the locations for light industrial. And the dark colors, are the intended locations for medium industries. Finally, the black ones, are PDAs, planned for development areas.

In 1996, the MMDA came out with a proposed land use. Again, the yellow ones are the residential areas. The red ones are the commercial areas, and the blue colors represent the industrial areas. I suppose the orange ones are the military areas. These two maps show the changing patterns of land uses in the region.

That ends the report.

Dr. Kenji Doi
Tokyo Institute of Technology
Tokyo, Japan

Good Morning, my name is Kenji Doi. I am an associate professor of Tokyo Institute of Technology. In 1998 I was invited as visiting professor in UP Diliman. I was assigned to the National Center for Transportation Research. My topic today is "Socio-Economic Development, Infrastructure and Atmospheric Environment in Metro Manila".

I would like to introduce an ongoing project aimed at developing an integrated simulation system of urban activities and its impact on environment. We are also aiming at scientific and objective formulations.

This shows some kind of a research framework of ongoing our project. We have two JSP projects. And my topic today is related to preceding our project which covers all of these. My special concern is modeling of urban activities and land use impact.

As you can see, most of our research projects are limited to inland issues. I hope this 10- year project will expand our viewpoint.

This shows my major concerns: how to predict the population, location, land use and land cover and also to develop interface for the environmental evaluation in respective aspect, i.e., energy, water environment, transport environment and sometimes natural disaster, environment and also atmospheric environment.

So far we have developed some kind of a database and quantified the linkage between urban activities, land use, transportation and environment. We are now in the stage of integrating the policy simulation systems which includes very analytical paths and also descriptive paths.

Next year, we must examine the applicability of the system for policy simulation.

This figure shows some kind of an integrated framework for the simulation of environmental improvement policies.

This box shows the model for urban activities and the light box shows the path of microscopic simulation of traffic environment and the red box shows the regional atmospheric simulation. Mostly, I am in charge in the center box and this is the project headed by Dr. Yai of TIT. The left path is headed by Dr. Kanda also of TIT.

Here, we predict the location of activities, as shown on the (upper) layer. The lower layer shows the predicted traffic demand.

Under the transportation sector, the traffic load and also emission of pollutants are predicted. In the medium atmospheric simulation based on the ? system some kind of simulation will be conducted based on the land use condition, heat condition and others.

Later, I will show some output of simulation based on this integrated framework.

This shows the special growth of Metro Manila. The thick blue color shows the urbanized area before 1948, may be before the era of Ayala development. As can be seen, the urbanized area grew very rapidly in the last 20 years. It is represented by the yellow color.

My question is, How is the carrying capacity of Metro Manila? Can NCR region accommodate the increasing population or not? We must predict the human activities and its location, as well as land use. Therefore, some kind of modeling the location of urban activities is necessary.

This shows the income distribution based on family income and expenditure survey. This part shows the factors affecting (?) locations, (drawback?) accessibility, family and community network and the water environment to some environments are included, but still on-going.

May be the (upper works ?) is very essential for lower income people. And according to inquiries of income level, (?) people demand higher level of (?) environment. But still now on-going. We are now integrating the very fundamental factors.

Based on such kind of behavior modeling, we have developed these kinds of simulation systems. The yellow color shows the economic activities and land use based on the market mechanism. The blue color shows the model for transportation to predict specially car ownership and car utilization, or automobile dependence. The green color shows the evaluation criteria for (policy?) evaluation.

Here, the environmental cost and its impact on social welfare have been included.
This shows a very (large?) sketch of the players and the kind of market included in the simulation systems. For example, (chapter?) market, good market and labor market, very key markets and has (?), farms and governments are included as players. We integrate the behavior

of each actor, and the locations of other activities are predicted. Job location and residential location and the commuting trips and (visiting?) trips were also predicted here.

Again, this shows the pattern of expansion of (virtual?) area in Metro Manila. It is on the left side map. The center map shows the progress of sprawl development. Sprawl means the disordered mixture of natural land use and urbanized land use. As you can see, especially in the south suburban areas, there is the big sprawl expanding rapidly. The light figure shows the share of middle-income people. Urbanization has been accelerated due to the expansion of middle-income people. Twenty years ago the share of middle-income people was very small, but recently, it has triggered an urban expansion.

As Dr. (?) pointed out, in these twenty years the population doubled. And you can understand the very dense development even in the suburban areas, especially in the south suburban area.

To understand and to model the synergetic effect of economic growths and spatial growth, we developed this kind of (?) models. It includes the expansion of middle-income people, the mechanism of sprawl and the impact of increase of car ownership and automobile dependence. These are the key factors for understanding the mechanism of urban growth.

This shows the land use and the road network. As understood, road provision is sometimes a very essential factor for urban growth. The light small box shows the land use pattern around here. If we predict the impact of road provision, for example, Diliman to (Dinukuskut?), what is the impact of the provision of this road? Maybe, the very (?) out land use, they are the big sprawl even in the north area around here. And also it will increase car dependence in this area. For example, in our prediction, the car ownership is predicted to increase by more than 10% because of the land use development and road provision.

Our director showed the projection of land use. This shows the present situation of land use. Red color shows the commercial area, yellow color shows the housing area, and this may be a little difficult to understand, the last is the green space. This is the prediction in 2010. There is an assumption behind these predictions. May be the behavior of urban activities, I mean the criteria of behavior will not change here. Their lifestyle, work style, such kinds of parameters are fixed for this prediction. But anyway, we would like to include such kinds of key parameters.

This shows again our simulation framework. Left (?) shows the policy input. This shows the impact of MRT, urban layout. The left figure shows the change of job location. The blue color shows decrease of population and red color shows the increase. In terms of job location, MRT might distant ride job location. But as you can see, in terms of residential location it may attract more people around the MRT and decentralize the population of the central area. As you can see the decrease of people in the suburban area will be predicted. I mean the MRT is a transport infrastructure but it will have a big influence on urban structure. Road sometimes triggers urban expansion. But this kind of (large?) infrastructure has the possibility of making the urban layout more compact.

This shows the benefit derived based on the prediction. This includes the environment improvement benefit.

I will quickly give the discussion on environment.

…shows the discussion on air environment. As you can see, this is a (???) covered by black smoke. And this is a very familiar picture, the lady masking her mouth. As Prof. Tanhueco said, the rate of population growth is 3 % annually, in comparison, the growth in the number of automobiles is 3 times more than the population increase. There is a big gap between population increase and average increase. And also the second cause is excessive attraction of automobile traffic to (CVD?). Here, marketed (CVD?) makes up only 1% in the area but it attracts more than 10% of the whole or total traffic in Metro Manila.

We conducted traffic survey, including jeepneys, which are the biggest factors of air pollution. We conducted some kind of a simulation of traffic environment. This is a picture of an environmental survey conducted in Ayala.

Out of a simulation conducted by Dr. Kanda of TIT, the left picture shows the (window?) and the formation of clouds. The light side shows the transport and diffusion of pollutants/emission. Each morning, the convergence line is (drawn?) in the east of Manila and the pollutants are transported high up over the Manila Bay.

This is a morning scene, between 9:00 am and 12:00 noon. Pollutants are transported over the Manila Bay and in the afternoon, convergence stops. In the late afternoon, the pollutants are transported to a lower altitude. A high concentration is predicted near the surface. In the evening, the convergence line moves to the west, the very high concentration of the pollutants will be just over the Makati area.

This shows some kind of evidence that this simulation has good conformity with the actual situation. The patterns of clouds are very similar. This is out of our integrated studies, but it must be elaborated, to include details on geographical data and base station cover (?). We are now making the city dimensional building maps, which will explain the (largeness?) of the land surface and the vulnerability of (?) infrastructure to natural disasters.

This ends my presentation, thank you very much.

Prof. Peter Castro
Department of Civil Engineering
University of the Philippines
Diliman, Quezon City

….some amount of environmental management, infrastructure, with profound effects on the environment and I hope to just take up the issues rather than the details on the structures. So we have the Laguna Lake interacting with Manila Bay through the Pasig River. The Lake is connected to the Pasig River through the Napindan River. It must have been discussed yesterday that this Lake is very large and outflows through the Napindan River is rather slow. The energy between Laguna Lake and Manila Bay being very small, so these rivers are very flat. The flash floods come from the Marikina Watershed. Laguna Lake acts as an attenuator of floods.

There is the Mangahan Floodway, built and operational since 1986. Here at the junction of Napindan River and Pasig River, we have what is called the Napindan Hydraulic Control Structure. It is supposed to regulate the flow between Laguna Lake and Manila Bay. The original purpose of the Napindan Hydraulic Control Structure was to prevent salt water from going into the Lake so as to turn the Lake into a fresh water lake, reduce the salinity eventually to levels where we can tap the Lake for water.

That was one of the original intents of the control structures. But, at about the same time, the fishpen industries developed in the Lake. They cultured milkfish, which need some amount of salinity. So although the hydraulic control structure was meant to check the Lake's salinity level, it was used to control floodwater instead as it does now. It cannot be operated as a salinity control structure because of the demand for salt water in the Lake.

On the other hand, the Mangahan Floodway is intended to divert a major part of the flash flood coming in from Marikina River into the lake. When the storm dies down some amount of back flow goes into Marikina River to join the regular outflow through the Napindan Hydraulic Control Structure and out here. This is the major flood control system for Metro Manila. And since Pasig River passes right through the heart of the City, this system is very effective in reducing over backflow.

This is the flooding characteristics of this area. North Manila and South Manila are low areas, so they need a drainage system that is akin to what the Dutch call poldering which means pumping out the water.

San Juan River Basin includes Quezon City. It is relatively high, relatively steeper, so water should travel faster down.

This is the flood plain of the Pasig Marikina system, floods here are caused by over bankflow. The Mangahan floodway helps a lot in reducing the floods here. If water levels are lowered here, then pumping into the river will be easier.

Flood is also caused by the tilting of the Lake. The surface area of the Lake is very large, about 40 to 50 kilometers from this point to that point. When the eye of a typhoon passes over the Lake, high winds traverse the whole length of the Lake creating a wind surface shear that tilts the Lake. Tilting causes sudden floods in the northwestern portion of the Lake. To counteract that, a lakeshore dike will be built to protect the towns of Taguig, Pateros, Taytay, Cainta and Pasig. The dike will be connected to the dikes on both sides of the Mangahan floodway. The project is already in the pipeline.

I am going to discuss how drainage in Metro Manila is done. The system for both north and south Manila is the same. I am showing the north Manila's. Drainage laterals go into drainage mains and out into pumping stations. There are 15 major pumping stations and three floodgates all over north and south Manila. The system of pumps is needed because these are very low areas. The problem however is that water does not come to the pumping stations because waterways are clogged by garbage, solid wastes and slums. This system is currently being expanded into the

KAMANAVA area (Kalookan, Malabon, Navotas, Valenzuela), these are in the north of Manila. Additional poldering will be built, sort of ring dikes to pump floodwaters out.

Although my discussion is focused on the Pasig River, there is one other river that has a profound effect on the environment of Manila Bay; the Pampanga River up north is one of the major river basins of the country.

Pampanga River goes all the way to the boundary of Region 2 traversing most parts of Region 3 and at its northern fringe is the Pantabangan Dam, which detains the largest man-made reservoir in the country.

To see some of the effects of the River on Manila Bay consider the development going on in Pampanga, consider also the fact that Metro Manila is already expanding towards this area. For instance, San Fernando City is becoming to be a satellite industrial-residential-commercial hub north of Manila and it is right in the middle of the floodplain of Pampanga River. Moreover, Mt Pinatubo dumps its sediment in the Pasac Delta, which is contiguous to the Pampanga Delta. All these developments make the rivers and the Bay shallower.

There is an on-going improvement program for the Pampanga Delta. Waterways will be dredged and diking systems will be built, but activities are being delayed by acquisition of right of way.

These are just some of the projects of the Department of Public Works and Highways.

Thank you very much.

VII. GOVERNANCE AND INSTITUTIONS

Speakers:

Kenji Doi, Tokyo Institute of Technology
Eduardo Manalili, Department of Science and Technology, Government of the Republic of the Philippines

Topics Discussed:

Government agencies involve in Manila Bay and Laguna Lake affairs
Institutional arrangements, jurisdictions and governance
Coordination among national government and local governments including
private or non-government organizations
Political, cultural and social dimensions and agenda

VII. GOVERNANCE AND INSTITUTIONS

Mr. Ed Manalili
Department of Science and Technology
Philippines

I will discuss the coordination among government agencies and state colleges and universities regarding the conduct of studies funded by the Department of Science and Technology.

Right now, we are implementing an integrated action program for the rehabilitation of Laguna de Bay that was started in July 1997

The Program aims to improve the water quality and management of water resources for sustainable development. We are aware that the Lake is a multi-purpose resource. But in 1993 and 1994, the water quality of the Lake started to decline, this prompted the DOST to implement rehabilitation and R&D projects. The program was called "Basin Approach to Environmentally Sound Management of Water Resources: Laguna de Bay", and we learned that rehabilitation of the Lake requires an integrated approach.

In January 1995, we started a four-pronged program sponsored by DOST. It comprises the Lake Environment Information System, the Lake Environment Monitoring System, the Lake Environment Technology and the Lake Environment Policy Systems. We set up a data bank where we have a collection of all kinds of information about the Lake dating back to 1907.

There were several projects relating to the Lake that DOST was funding, but activities were not concerted as each project was being implemented independently of each other. With the creation of the Mount Makiling Reserve Area Master Plan and Laguna de Bay Master Plan, we learned that the studies funded by DOST were not addressing the needs of the Lake. That is why the Program was re-focused toward an integrated approach. It is now known as the "Integrated Action Program for the Rehabilitation of Laguna de Bay"

We have already completed the following tasks under the Program: computerized management tool for the sustainable and optimum utilization of Laguna Lake water resources; water balance model made by NHRC, installation of hydrometric instrument for data generation and telemetering station at Matang Tubig in Cabuyao, Laguna; plans for the rehabilitation and protection of the major river systems currently implemented by the LLDA Community Resource Division; information, education campaign materials on environment conservation for schools and municipalities; the domestic water minimization scheme implemented by the different municipalities of Laguna; and, publication of a handbook on environmental plans for Laguna and Rizal.

We have also developed an internet web server and home page for Laguna de Bay being implemented by the National Mapping Resource Information Authority (NAMRIA).

These are the projects we have this year as well as the water balance model project with NHRC.

The third one is the fisheries development program, and the fourth one is the institutional development program.

DOST is supporting the various R&D projects under the Laguna de Bay Master Plan currently being implemented by LLDA. Activities like pollution management of selected industries of Laguna Lake and the lake environment social mobilization program are being implemented under the Plan. In the course of implementing the social mobilization program in communities around the Lake, we found out that information and education are important tools in making people become aware of proper solid waste disposal.

We also have the following projects: monitoring of the biotic communities in Laguna de Bay and assessment and control of toxic and hazardous substances; rehabilitation and management of Mulawin Creek, San Cristobal River, San Pedro River, Tanay River and the Pagsanjan Lumban River System.

San Cristobal and San Pedro are two of the most polluted rivers, while Tanay and Pagsanjan Rivers contribute most of the silt and sediments to the Lake.

Let me present some data gathered by the LLDA themselves, I think these are important information.

In 1993 and 1994, water quality of the Lake declined to 4.6 milligram per liter. However, after LLDA started its intervention program, water quality began to improve. In 1996, 1998 and 1999, it registered at 12.5, 10.14 and 10.4, respectively. The figures are quarterly averages (?) all level throughout 1995 to 1999. Laguna Lake's water is classified as Class C, which is set at 5 millimeters per liter. The average BOD levels have not exceeded the range for Class C water which is 7 to 10 milligrams per liter. The classification of the Lake as Class C water is valid up to now.

We noticed that water quality greatly improved with the decrease of fish pens and fish cages in the Lake. In 1995, 15,139 hectares of the Lake were covered with fish pens, it decreased to 6,159 hectares for fish pens and 5,000 hectares for fish cages in 1999. Many of the structures were destroyed by strong typhoons that blew over the Lake between 1997 and 1998.

With the zoning and management plan under the Laguna de Bay Master Plan, LLDA has allocated only 15,000 hectares for fish pens and fish cages (10,000 hectares for fish pens and 5,000 hectares for fish cages). Right now, only 6,159 hectares are registered with the LLDA.

These are some of the pictures….. fish pens near Binangonan…the top picture, and the bottom ones, fish cages near Talim Island. Thank you.

VIII. DATA MONITORING AND NEEDS

Speakers:

Kazuo Nadaoka,Tokyo Institute of Technology, Tokyo, Japan
Guillermo Q. Tabios III, University of the Philippines, Diliman
Kenji Doi, Tokyo Institute of Technology, Tokyo, Japan
Yahuo Nihei, Science Technology of Tokyo, Tokyo, Japan

Topics Discussed:

Importance of information and data collection.
Types of environmental data available.
Existing data collection network and practices.
Sampling period or frequency in time and space interval, instrumentation, etc.
Data gaps and needs.
Identification and possible improvements in data monitoring.

VIII. DATA MONITORING AND NEEDS

Dr. Guillermo Tabios III
Department of Civil Engineering
University of the Philippines
Diliman, Quezon City

I want to present a general view of data monitoring and needs just to put things in perspective. Data monitoring and needs has four characteristics: 1) it may be used to explore and analyze information ; 2) it may be used as a tool for discovery in water quality monitoring and ground water pumping; 3) It may also be used as a planning and management tool to regulate activities in the Lake; and 4) as a tool for research.

In network design, we have to consider the amount of effort and resources needed for data monitoring, how the sources are to be allocated to get the most information and the inferences that can be drawn based on the data collected. A major consideration also is the uncertainties associated to the data being collected. And finally, design parameters include variables to be sampled, sampling frequency in time depending on the variability of the data as well as sampling in space. Again, it has something to do with the variability of the data. And the duration of sampling program depends on those different objectives. Perhaps for exploratory, short-term; for detection and management, long term; research may be short term.

In doing objective analysis or objective network design or optimal design planning, we should consider trading in time and space against the variability of data. Accuracy and uncertainty vs. cost may also be one of the criteria where one could either compromise or trade off options such as spending more money for data monitoring if accuracy is desired. On the other hand, we can also accept a certain level of accuracy for a minimized cost.

Dr. Leonardo Liongson
Department of Civil Engineering
University of the Philippines
Diliman, Quezon City

Good morning.

This is a very brief presentation of the existing hydrometric system. I will start by describing the system being implemented for flood control – the so-called EFCO system.

There are existing rain gauges (water level gauges) and new ones under the EFCOS. EFCOS is Effective Flood Control and Operation systems being implemented by DPWH.

We have here a conglomeration of PAGASA rainfall stations, as well as the newer telemetry stations. We have quite a few concentrated in the Metro Manila area. From as far north as Malabon and Novaliches to as far south as Angono and few major towns of Laguna, like Los Banos, Sta. Cruz, and in Rizal, Muntinglupa.

This is another picture of the EFCOS warning system showing the relay communication systems in addition to the hydrometric system. The green ones are the multiplex. The duplex, the double bars, single line, simplex and so on. Operation of the flood control operation systems is coordinated with PAG-ASA. Because PAG-ASA is still the lead agency for flood forecasting and warning although, infrastructure for flood control is the responsibility of Public Works.

Moving to the Laguna Lake region; there are only five long-term stations being maintained by the Bureau of Research and Standards of the Public Works. Many of these stations were installed in the early 60s; a few in the 70s. Somewhere in the Pagsanjan River is a stream flow gauging station. There is one each in Mayor and Siniloan and another one in San Cristobal River in Canlubang. The fifth station is in Sta. Cruz. The five water level stations record only decent discharge rating curves, we have no reliable way of converting water level data to discharge/water flow.
In addition, upon the inception of the water balance study conducted by NHRC for LLDA with funding from DOST PCMARD. We, right away, noticed the gaps in the rainfall information being provided by the PAG-ASA stations. We realized that we did not have a reliable rainfall station to represent mid-lake precipitation. As a result, LLDA installed five new rainfall stations starting in 1999 in Jalajala point, Caliraya, Canlubang, Cove Verde in Cardona , and in Liliw, Laguna. Before 1999, there was not any good station to collect rainfall information about Mt. Banahaw. There was one in Tayabas but not on the side of the mountain facing Laguna de Bay.

So, LLDA established five new continuous rainfall recorders. And here is one installed at the back of the Canlubang Country Club. This is San Cristobal River near the Matang Tubig Spring. Fortunately the Cabuyao Water district operates a field office in this area, their staff keeps track of the records.

The rainfall recorders in Liliw and Caliraya are installed in Liliw Elementary School and Caliraya Elementary School, respectively. The principals of both schools supervise the collection of data.

As previously mentioned, there are stations in only four out of 22 sub-basins. Discounting the one in Marikina, there are only four stations in the Laguna-Rizal side.

To see the magnitude of data monitoring problems, we only have to look at the rivers themselves. There is no upper station for Marikina River; although there is a lower station in Sto. Niño, very close to the Mangahan floodway. We also do not have a river station in Montalban or in Nangka River in Marikina where mudslides occur from time to time.

Aside from the station in Cardona there is also a lake gauge station. We have data on the Mangahan floodway under EFCOS as well as on Napindan. We also do not have a lake level station in Taguig.

The small river basins in Los Baños, Cabuyao, Majayjay and Liliw in Laguna are all ungauged. The following urban rivers are also ungauged; Cavinti River, a major river that branches off from Pagsanjan and Balanak River, the so-called longer brother of Pagsanjan, it is the biggest river in

the system after Marikina. There are also some intermittent streams that temporarily hold water during storms such as the Kabayo Creek in Jalajala Peninsula

This is Sapang Baho in Antipolo, it literally means, smelly creek. The blue color of the water is due to dissolved matter. This mixes with the water in Mangahan floodway that flows into one of the locally drained area there.

This is Sta. Rosa Creek right in the heart of Sta. Rosa town where the local chapter of the Lion's Club headed by Mr. Ramon Cariño installed nets to catch floating garbage on the Creek. This is a typical example of a community project mentioned by Mr. Manalili.

Another success story is that of Morong. The town and its rivers are relatively clean by urban standards.

That is the end of my presentation.

Dr. Yasuo Nihei
Science University of Tokyo
Tokyo, Japan

…in this respect, the band ray processor which has four elements; ocean, atmosphere, (?) and land are quite important in my opinion.

For example, in this map we can see the exchange of water and material with the water at Manila Bay; the discharge from the Pinatubo area containing sediments and nutrients; and the huge amount of environmental load coming from Metro Manila and the surrounding watersheds. Patent is the strong linkage between the Laguna Lake and Manila Bay in terms of hydro dynamics and biochemical process.

This diagram shows the situation in Manila Bay and Laguna Lake and their surrounds. There are physical and biochemical processes occurring inside the Lake and the Bay. But we do not know exactly the amount of environmental load coming from atmospheric processes and how they affect the Bay-Lake area. For instance, air pollution materials like SPM may be discharged in the atmosphere, and to assess the environmental situation in Manila Bay-Laguna Lake area, we have to evaluate the possible effects of this discharge. This is one example to show the importance of coupled processes between surrounding factors.

Another example of the importance of coupling between the bay area and ocean is the survey conducted of the Tokyo Bay and Okinawa area. This picture shows a snapshot of the SST of (noimich?). The brighter region shows the warmer area, approximately corresponding to the (cross shore?) area. In this instance, the warm water current, (cross shore?) is far from Tokyo Bay, but it occasionally gets closer to the mouth of Tokyo Bay and successively intrude farther inside the Tokyo Bay. That is a typical episodic event. We did the survey by deploying sensors along the vertical lines of the buoys and for a more intensive examination, we used vessels along these lines.

This picture shows an example of vertical deployment of sensors at three different buoys. We put the (?) and a (conductivity?) sensor, depth sensors and current meters.

This picture shows the (temporal?) variations of current at two different buoys, and also the (temporal?) variations of temperature counters. At the bottom diagram, the temperature shows such a dramatic change in time. This is one of the good examples to show the importance of defining the dynamic variations of physical quality like water temperature.

This instance shows warm water current(cross shore?) getting closer to the bay mouth. For example these three sets of (?) show the instance when the (cross shore?) water currents are closer to the bay (mouth?). The left bottom diagram in this picture shows the cross sectional distribution of temperature contour and also longitudinal variations of the contour. Looking at the longitudinal distribution of the temperature contour, the right side corresponds to the inside of the Bay, we can see that some portion of the warmer current may intrude into the intermediate layer of the depth.

This figure shows the cross sectional distribution of the temperature's (?), density, turbidity and current.

In summary, based on our field data, we can depict such a 3-D picture of the current system by knowing the physical quality of the bay mouth region. We can assess the exchange of the mass between the Bay and ocean and the heat exchange or heat transport through the (mass?).
This picture shows the heat budget in Tokyo Bay based on our field survey data. Looking at the situation in the Bay mouth we can see the importance of the heat transport by horizontal circulation.

This is another example to show the intrusion of the warm water (ocean?) current and the Tokyo Bay at the intermediate depths.

Anyhow, we must emphasize the importance of getting continuous data from sensors deployed in buoys because we can find the dynamic change of those physical qualities based on field data gathered from this source.

IX. MODELING AND RESEARCH NEEDS

Speakers

GuillermoQ. Tabios III, University of the Philippines, Diliman
Kazuo Nadaoka, Tokyo Institute of Technology, Tokyo, Japan
Gaku Hanada, Tokyo Institute of Technology, Tokyo, Japan
Leonardo Q.Liongson, University of the Philippines, Diliman
Y. Shimizu Hokkaido University,Hokkaido, Japan
Saturo Oishi, Yamanashi University, Kufo City, Japan

Role and importance of models and modeling tools
Existing modeling efforts of Manila Bay and Laguna Lake
Model developments and improved modeling techniques
Modeling needs and research imperatives and priorities
Possible future project and research proposals

IX. MODELING AND RESEARCH NEEDS

Dr. Guillermo Q. Tabios III
Department of Civil Engineering
University of the Philippines
Diliman, Quezon City

The Manila Bay/Laguna Lake system is an interactive that they should perhaps be modeled as one system and I think that this is one of the first models combining the two, Laguna Lake and the Manila Bay. There are many models nowadays in fact there are a lot of modeling efforts in this system such as the Laguna Lake model developed by various researchers of MSI, NIGS and NHRC by our project with LLDA, and more recently the Delft group. Way back then, there was the MIKE 11 in Pasig River. There were some models of Laguna Lake and Manila Bay that were purely wind driven. But we thought that perhaps a more comprehensive model should really include all the different factors driving the circulation patterns of the Lake and the Bay system.

I mentioned that there were available models and we just incorporated ideas from these models, applied them to the system and ended up with a link model.

Yesterday, Professor Eric Cruz mentioned that the three major factors driving the circulation patterns of Laguna Lake and Manila Bay are: 1) discharges from watersheds surrounding this system into the Bay and Lake system; 2) tidal forcing from China Sea that enters south of Manila Bay; and, 3) wind stress. Other minor factors are the fish pens and cages in the Lake and stratification/temperature effect in the Manila bay that crease density driven currents. Taking all these together, we created a preliminary version of a link model of Manila Bay patterned after the Princeton Ocean model. It is a three-dimensional model modified by Professor Nadaoka. The link model for Laguna de Bay was developed at NHRC in a project funded by LLDA and PCMARD.

The watershed model defines the inflows in the surrounding watersheds of Laguna-Manila Bay. Since there are only four river basins that are gauged, we really have to come up with inflows to get the real state inflows into the Laguna Lake. And to find the wind stress, which we think cannot just be a simple uniform, fixed value of wind speed and direction; we adopted this regional atmospheric model by Professor Pelke of Colorado State University.

Details of this model will be presented by Professor Nadaoka and Mr. Hanada.

Dr. Kazuo Nadaoka
Tokyo Institute of Technology
Tokyo, Japan

As I said before, there is a lot of linkage between these factors. All these are (???) linkage and its directions. In other words, if we want to try to describe the entire system, we probably have to know those (?) linkages. Unfortunately, the data that are necessary to establish these linkages are not available. This, in a sense is the obstacle in describing the entire integrated system.

The work of coupling between atmosphere and Manila Bay and Laguna Lake is the first step to make the proper linkage of such different parts.

As Dr. Tabios said before, the Manila Bay and the Laguna Lake systems are surrounded by very complicated geo-physical topography. For example, Laguna Lake has a caldera and that would require very complicated 3-D features and topological aspect.

That means that we may have the appreciable inference of topography on the possible atmospheric airflow on those lake areas.

What we are aiming at is to properly introduce the topological effect to assess the wind stress that is the driving force of circulation into the Lake and the bay area systems.

I want to show you another aspect and that is the (spatial?) non-uniformity of the wind system. These three pictures show the example of the wind distribution. In the left hand figure is the divergence pattern, the convergence pattern in the middle and the front type convergence system in the right hand figure.

For a variation of the wind stress, we have to incorporate such non-uniform effects. By taking account of such (spatial?) non-uniformity of the wind, we introduced the regional atmospheric model (RAMs) computation and RAMs introduced the so-called (?) system, and for the (dimension?), the assimilation method (results of?) data that was provided by ECMWF (European Centre for Medium-Range Weather Forecasts) .

In times of (?) (grade?) system into the largest grid that is named grid 1. It covers the middle part of Honshu Island of Japan. The middle scale grid, grid 2, covers almost the southern part of Kanto plain and grid 3 corresponds to the area covering the Tokyo Bay.

I will show you the special pattern/distribution of surface layer of (?) distribution. Case 1 is the result of a previous model. Previous model means the sample integration of wind (?). Case 2 is the result using our new methodology.

As we can see, there is a big difference between these two cases. And also this is another picture showing the (particular?) tracking that depicts the larger movement of the neutral (??). The left column shows the result of using the previous model, and the right column shows the present model's results.

The figures show the result of the particles about one day after the (accent?). So there rise again the big difference between these two cases. In the actual process of the (?), it was observed by using the aero-photograph and the as (??) image glow, so it shows the migration (or ?) of the oil spill northward. But if we look at the (?) results by using the previous model, it shows the migration southward. But ours shows that (???) so in this sense, this demonstrate the validity of our model.

From here, one of my students, Mr. Hanada will show the result for Manila Bay computation.

Mr. Gaku Hanada
Department of Mechanical and Environmental Informatics
Tokyo Institute of Technology
Tokyo, Japan

This talk is on atmospheric simulation and hydrodynamic simulation. Atmospheric simulation is composed of three steps at different horizontal resolution. Grid one is like this, and horizontal resolution is sixteen kilometers and grid 2 is like this and grid 3 is like this. Grid 3 and grid 4 wind data introduced to ocean current computation.

This animation presents computer wind in dry season. This animation presents spatially and temporarily complex distribution of wind.

To understand this wind, I will show the divergence and rotation of wind. This line is near the seashore of Manila Bay and divergence of… blue color presents a convergence area and a convergence in the center of Manila Bay. And (??), blue color presents counter clockwise and rotations are made around the high mountain, starting here, and translate to the center of Manila Bay.

(???) of 3-D hydrodynamic simulation. Computation is like this. Horizontal resolution is 1 kilometer driving forces is surface wind stress varying spatially and temporarily and (?)
discharge from surrounding waters.

I computed two cases: case one is spatially (uniform?) wind and case 2 is spatially and temporarily barring wind.

In case one, initially surface (?) is almost uniform but, … spatial and temporary…case 2 is barring….and it presents circulation, but in case 1 there is no circulation. There is a big difference. Spatial barring wind affects significantly saturation in the Manila Bay.

I will show Laguna Lake simulation results. No animation, only results.

This is a water surface (?) animation. At the northwest is the Pasig River linking Manila Bay and southeast there is a water gate, that is the Laguna Lake simulation results.

Thank you.

Dr. Leonardo Liongson
Department of Civil Engineering
University of the Philippines
Diliman, Quezon City

This was published last year in the proceedings of the Annual American Geophysical Union Hydraulics and the editor of the publication is actually the originator of the so-called swatch model.

Second slide. This is the paper, it was described in theory by Professor Morel-Seytoux, applied by Liongson at NHRC and calibrated by Mr. David Roxas at NHRC.

The second paper is on application, which we wrote together and the originator became the listed author there.

It was developed for two basins, Siniloan River in Laguna and Maragondon River in Cavite.

So with that brief background I will proceed to the demonstration of the model. I will be quite fast here given our time limitation.

Essentially, the swatch model considers these components of the hydrologic cycle. There are 600 polygons encompassing the set of several polygons all over the Laguna Lake Basin and each half of the polygons dissected by a river were modeled in the vertical and horizontal directions. Some of the inputs were land use data, vegetation data, soil data, and rainfall data. A soil moisture accounting sub-model, retention storage and evapo-transpiration depending on land use, vegetation and over land flow were also included. Since rainfall was an input, potential evapo-transpiration was considered in the climatological inputs. The root zone soil moisture accounting was also incorporated.

The possibility of introducing interflow process above which there could be local saturation that is intersected by the stream bringing about inter-flow. This is a particular model of inter-flow considered. And then, farther down, at least if there is an aquifer in contact, and saturated in contact with the channel during this base flow condition lower water level, then even return flow or base flow. So three components of river channel flow are considered.

That ends each type of simple components (?) on hydrograph signature in the output.

I will demonstrate how the model works for a small basin and describe how the inputs are brought into the model. I am simulating the Siniloan River, which is in the town of Siniloan, Laguna, northeast. Its climate is between type 1 and type 4.

This is a demonstration of stream flow for a period of one year. We have very little data on rainfall and where there is no data at all, we put the number zero. But we can easily change that to a rainfall data fill-in algorithm. The rainfall stations that were utilized were those in Sta. Maria and Pakil. There are only two evaporation stations in the entire region; one is in Quezon City and the other one is in Los Baños.

This is the topology of the Siniloan River. We start at zero, although we usually impose a constant base flow that cannot be accounted for by rainfall. This could be due to regional ground water flow that shows up in the streams not accounted for by rainfall ran off modeling. The spikes are the overrun flow and the smooth shape is the characteristic of the inter-flow model. It is actually a mathematically kinematic wave of seepage flow. For an entire year, a mean of 1.38 CMS was obtained for Siniloan River. This procedure can be done for the rest.

This is an example of what might appear for the entire basin. Data were taken in November 1995. During that time, Markina had a mean of 15 CMS for one month. To determine the water supply, we multiplied the figure by 86.4 MLD. We can see how much water eventually goes out to the sea. Right now, there is a plan is to extract 300 MLDs from Laguna de Bay.

There is also a finite difference model and this is one year older than the finite volume model. This photo shows the relative locations of the fish cages. Fish cages are built near the shore, while fish pens are built in midlake. The areas in gray indicate the flood plains of Taguig.

What is the effect of hydraulic structure like a fish pen? If we apply (high roughness?), then this is the pattern we get. It is driven not by a very high wind field, but by advection. Advection from the river flow and the effect on the circulation of water by the presence of rough fish cages and fish pens in the finite difference model. It can be quite complex in certain aspects.

That is the end of the short description.

Dr. Yasuyuki Shimizu
Hokkaido University
Hokkaido, Japan

I am going to show some numerical model of flow simulation in northern island of Japan, Hokkaido. This is Abachi River, it has a drainage system and a catchment area. And this is the detail of this watershed. It has lots of inputs of rivers and lakes. It is somehow similar to the Philippine situation.

This is connected to (?) about seven kilometers. And here is band in (?) of the river. And here is an input to the river and the lake. Lots of nutrition is coming in to the farm lands. So the environmental program is going on. The people are worried about what is going on in this lake.

There are lots of field surveys going on in and out of the lake. Lots of measurements done.

Today I will talk about the research on the model. I think one of the interesting or important thing about this lake system is the density current due to the sea level. We found out that during high tide season, according to sea level changes, the sea water is going in to the lake, like this, and coming out from…like this. The front is going out to the sea. This is the sea, and river, this is the lake. Sea water stays in the bottom of the lake and after a long period, it loses oxygen. We call it dead water.

I will show the result of the model. The sea water is coming in to the lake….and going out.. like this. This is a plain view of the movement of the seawater coming into the lake and going out.

I will talk a bit about the model. The question is three-dimensional; continuity, momentum and density diffusion. We use this kind of code name system. In order to check the validity of the model, we first did a simple experiment. Heavy water and light water are moving like this. This is the result of the (?).

We are using a CIP method whereby we can calculate the density very accurately. And this is the comparison, (?) wave, or an internal (?) is produced like this.

With this model, we can do various calculations like the heavy water and the light water is going into the……like this.

we can also calculate the current caused by the very high temperature in the water. This is like light water or light (stoppage?) going up to the region.

If we put a heavy one on the top, we can calculate like this. This is the three dimensional view of the same experiment. As far as it is (right?), it is two dimensional, but when the density current hit, this place becomes three dimensional. This is the result.

Another interesting thing about this is that the cold water from snow melt goes into the lake. It has a density stratified layer, and the very cold and the warm water are going into the lake. So that the density front is going on the temperature of the water.

We did an experiment with heavy water, light water and intermediate water penetrating into the two layers. This is the experiment. This is the calculation, again, this is a three-dimensional model. When it hits the other side of the pond, it comes back like this. This is the side view of the calculated results. It shows the eddies. Its shape is sort of like a (?) vortex from this view.

This is the comparison of the experiment and calculations in the same time period, like these shapes of the vortices, it becomes thick and very well produced.

I have some example of the wind driven flow. When a strong wind blows like this, dead water is generated from under the water that causes fish kill.

Strong winds happened in May 1997. What happens when the wind blows like this……the red line (plane?) means intermediate over the stratified layer. When the wind blows like this, this place goes up to …… like this. This is the result, blue is the clear water and red is the salty water.

When the wind blows like this, the water is….. at the opposite side, this side is going up. Lots of fish are damaged in these areas.

I tried to make my report very short, so that is all.

Dr. Satoru Oishi
Yamanashi University
Kofu, Japan

I used satellite imaging to look at the Pasig-Potrero and Pasac delta system and introduced its application to IMSWES.

The conduct of the Integrated river-based management system of Pasig-Potrero and Pasac delta system was decided on October 5,2000 at UP Diliman. The investigators are Tabios, Liongson, Castro and Japanese professors Ikeda, Shimizu, Oishi and myself.

The Pasig-Potrero and Pasac delta as we all know are clogged with sediments. To compute the amount of sediment at the mega dike and Pasac Delta we will go through three stages: 1) observation and data collection at the site as well as satellite images of Mt. Pinatubo taken 10 years ago; 2) modeling which will be made by Professors Tabios, Liongson and Shimizu; and, 3) model calibration. I will contribute to the observation and data collection mainly by satellite image.

I will use the data of IKONOS, a US based spacing imaging company because of their high resolution images. The company sells their data at 180,000 Yen per 25 square kilometers or approximately 72,000 pesos.

This is a 5 kilometer by 5 kilometer RGB image from IKONOS of the Kanagawa River in Shizuka Prefecture. We can get the base station index by using (near?) infrared. The space imaging co. limited opened the web site where they can get the elevation model from IKONOS data using one short and two short. So by stereo photograph and that company showed the image of three-dimensional web site. The web site says that horizontal across is one meter and vertical accuracy is 1.5 meters. However, I asked them to get the distribution model from IKONOS data and Japanese agency cannot do that because they do not have the technique from satellite image to digital elevation model. So I selected the other method which is SAR interferometry and this is the foot of SAR interferometry which moves from big (outbreak?) at the Japan and Kobe area. Maximum is 11.8 difference from before (outbreak?) to after (outbreak?). We can get this land movement from SAR interferometry technique and apply it to IKONOS RGB photograph.

This is the 3, 5 years project and I would apply it to IMSWES. By using the result of that project, transportation of (?) can be obtained and I would like to apply it to transportation of chemical substitute. Materials from Pinatubo are discharged in the atmosphere and goes down to Manila Bay. I myself am doing an acid rain modeling using my own model no hydrostatic incompressive and cloud micro-physical processes is B method. B method is my own method which is not given distribution method. Given distribution method uses (rams?), (aps?) or other atmospheric model. But B method is cloud particles classified in diameter and we can calculate the diameter development, one by one. I introduced nitrogen sulfate and dioxydes and ions in cloud particles. Now I am doing this model making and I will show the result next time so I have to make a variation of the atmospheric material transportation. I have no idea, I think after surface flow process and mountain residue we will be doing in this project.

I strongly hope to monitor the Manila Bay as well as the Laguna Lake. Yesterday I learned that Laguna Lake is well investigated,, and I would like that this (?) will be done in Manila Bay. Thank you.

X. OPEN FORUM ON SOCIO-ECONOMIC DEVELOPMENTS AND INFRASTRUCTURE; GOVERNANCE AND INSTITUTUIONS; DATA MONITORING AND NEEDS; AND, MODELING AND RESEARCH NEEDS

Dr. Leonardo Q. Liongson (Moderator). We will discuss socio-economic development, infrastructure, governance and institutions from 1:30 pm to 3:00 pm. We'll have a 15 minute break then we will discuss data monitoring, data needs, modeling and research needs until 5:00 pm.

We would like to request the participants to sit closer to the front. We have plenty of vacant chairs and may I also request speakers to first identify themselves and their affiliations.

The floor is now open for questions and comments on the topics presented this morning by our speakers, Professors Tanhueco, Castro Doi, and Mr. Ed Manalili. We already discussed data needs yesterday, but we will talk about this topic again after the break.

There is no question about infrastructure? No comments about the West Mangahan flood way,,, diking system rather? Which is supposed to close the Taguig delta from the so-called foreshore area once the diking system is in place. Yes? I recognize Professor Ping Lopez chairman of the GE (Geodetic Engineering) Department of UP. Professor Lopez is also in charge of the GIS and remote sensing laboratory, image processing and remote sensing laboratory of the Geodetic Engineering department. He also does photogrammetry and geodesy.

Prof. Epifanio D. Lopez (Department of Geodetic Engineering, UPD). Thank you Mr. Chairman, my comment is addressed to Prof. Castro. I think he is the expert on this. We are familiar with the flooding in the Pasig and Taguig area, may we request your expert opinion on why the floods continue to this date when there are no more rains?

Prof. Peter P. M. Castro (Department of Civil Engineering, UPD). I mentioned earlier that we experience extreme flooding during a typhoon because very strong wind shear causes the lake surface to tilt. It is usual during the month of November to have a high lake stage. Every year, the lake starts at about elevation 10.3, this figure is based on the benchmark of DPWH wherein the mean sea level is elevation 10.34. During the dry season, water level goes all the way down, below mean sea level in Laguna Lake. Depending on the number of typhoons occurring within a year, water level goes up to elevation 13 by the end of the rainy season, which is November. At this time, the depletion process begins all over again. Since the only outlet of the Lake is Napindan River, which has already become very flat, water flows out of the lake very slowly and would usually take the whole of the dry season. This causes flooding not only in Taguig, but also in Pilippla, Angono and Sta. Cruz.

Moderator. Are there follow up questions regarding flooding? Yes, Professor Tanhueco of de La Salle.

Prof. Renan M. Tanhueco (De La Salle University). Just how strong a storm is needed to flood the area, say in terms of a return period. I mean, for example, the strongest in two years, 10 years,….how strong?

Prof. Castro. I can not answer in quantitative terms with respect to the lake but we have been given a figure of about 3,300 cubic per second on a 100 year flood for Pasig River. Mainly the flood comes from the Marikina River. In the lake, the extreme flooding as I mentioned occurs during a typhoon when the lake tilts. For example, in 1995, I think Typhoon Rosing passed north of Laguna Lake and the flood level in Taguig rose by 1.5 to 1.8 meters in a span of about four hours. From this experience, we can say that no amount of rainfall is sufficient to raise the level of the Lake at that rate because of its vastness, it is 900 square kilometers. The only conclusion we can draw is that tilting causes the flood. When Typhoon Reming passed south of Laguna Lake, Sta. Cruz suffered flooding, Typhoon Seniang, on the other hand, caused tilting in the northeast flooding Pililla and Angono. It was also on the occasion of typhoon Seniang that flood in Metro Manila rose to a meter in one hour. We can neither attribute the flood to tributary inflow because as I already said, the Lake is so vast, it is like a sea,

Moderator. Please introduce yourself.

Dr. Rosa Perez (PAGASA). I would like to add to Prof. Castro's comments. Tropical cyclones like Typhoon Seniang occurs every five year. Five years prior to Typhoon Seniang, we had Typhoon Rosing. They are similar in terms of wind strength and track, i.e., pathway and direction.

Moderator. I suppose the models that you will develop could portray this wind driven flooding. Yes, Professor Nadaoka

Dr. Kazuo Nadaoka (TIT, Tokyo). Generally speaking, on the occasion of a storm caused by a typhoon water level rises because of two possibilities, one is the tilting of the water level due to water shear and the other is the (sucking?) up by the atmospheric pressure. But we have to look at its effect on the Manila Bay- Laguna Lake area? My question is, how did you operate on the occasion of such typhoon appearing…was the gate closed or opened?

Prof. Castro. There are gates at the Rosario weir to control the inflow from Marikina River. They are usually left open. When the river stage rises, the gates are closed to speed up the flow of receding water in Marikina and Pasig Rivers. Water is temporarily stored in the Lake. After the storm passes and the river stage has become very low, the gates are again opened to allow backflow. Meanwhile, Napindan hydraulic is always kept closed during a storm and whenever Pasig River is higher than Napindan River. It is opened after the storm has passed.

Upstream is the Sto. Niño gauge, the oldest gauge in the Philippines. That gauge is the basis for the operation of this… the gauge of that…. the river stage at that gauge versus the lake stage measured somewhere here, and that is the decision point for opening or closing the gates.

Moderator. Dr. Tabios?

Dr. Guillermo Q. Tabios III (NHRC-UPD). I did not have so much opportunity to listen to people who spoke about governance and institutional arrangements this morning. But we have a representative from MMDA to whom I would like to address my question. MMDA has a mandate on traffic, flood control and solid waste management, but does it have any environment program or project related to Pasig or Manila Bay?

Miss Grace Ranjo (MMDA). MMDA has a charter, which is strong on environment. Urban protection and pollution control are also among the concerns of the Agency. We have the mandate to manage sanitary landfills. And we share urban greening with DENR. Rehabilitation of the Pasig River, which was funded by DANIDA and supervised by DENR was transferred to a commission which we are a member. Executive Order No. 54 created the Pasig River Rehabilitation Commission two years ago under the leadership of the Department of Budget and Management. They put DBM on top of the project because everybody thought that it would cost money to rehabilitate the river and it does, because we eventually agreed to an ADB loan of several billion pesos. The PRRC is made up of 12 government agencies and three private sector representatives, ERAP-PPFI, GMA Network and PLDT. The vision for Pasig River is to restore it to its historic pristine condition. Although nobody has defined the meaning of historic pristine condition.

A private company is drawing a master plan for Pasig River; it is now doing the final draft. The planners envision a paradigm shift , which is to stop treating the Pasig River as the backdoor. They want to preserve historical sites along the River, remove the slums, sunken derelicts and navigational hazards in the river and recover the easements. DENR is in charge of environmental management, i.e., pollution control and abatement to improve water quality. The sticky socio-economic issue, however, is recovery of easement. There was a 1981 zoning ordinance providing for a 10 meter easement along the banks, but even then, dwellers had already encroached the banks and the then MMC failed to implement the zoning ordinance. Right now, there are commercial, industrial and formal sector occupants on the banks, we are often sued for enforcing the ordinance, but each time, we are upheld by the court

We have already relocated 50% of the settlers, and we are fortunate that the President is very much in the forefront, in fact Pasig rehabilitation is one of his flagship projects.

The Department of Public Works is in charge of the infrastructure and aesthetics. It is dredging and building access to the River. The ADB loan requires riverside communities to learn basic solid waste management, this way, the River becomes cleaner and conducive to wholesome community activities.

I am doing public information and advocacy, and I was hoping that somebody would discuss the role of Pasig River. I've always asked why Pasig River is taken by itself, considering that the water that flows to it is not its own. We know that it only serves as a channel for other water bodies. I wonder how come that it is not mentioned as often.

The five priority projects planned for Pasig River are essentially physical development such as urban renewal areas. When the Physical Framework Plan first came out, EPAs or environmental areas were not mentioned until later when ADB required its inclusion. With EPA, people would be kept out of the banks and the markets would have to be set back and that should result to improved water quality.

The Metro Manila Development Authority co-chairs the PRRC and it leads the public information and riverbanks development.

Moderator. Thank you. Although I am the moderator, allow me to make a short comment. The Water Code requires only a three-meter easement. The 3-meter easement was meant to allow public works equipment easy access to the River for dredging or clean-up. But MMDA is enforcing an ordinance imposing a wider easement for riverside development. It appears that the purpose for the easement has shifted from maintenance to development and I think that it is something worth looking at. A similar situation has happened in Marikina, the Mayor of the city is likewise developing the riverside

Yes? I recognize Professor Lopez of Geodetic Engineering.

Prof. Lopez. Yes. Thank You, Mr. Chairman. Grace, the bone of contention of the occupants along the Pasig River is actually the easement. I understand they insist that the three-meter easement provided by the Water Code should be followed, but there is now the ten-meter zoning ordinance easement. Can the zoning ordinance supercede the Water Code?

Miss Ranjo. That should have been raised years ago. They were saying that the ordinance was defective and being a special law, has less weight than the Water Code, yet we have often been upheld by the court even in situations where the complainants have titles to the land. I guess the reason why the court is convinced is due to the nature of the areas, which by definition are danger zones. Hopefully we keep on winning our cases, but we also hope that we can get a good legal opinion. Anyway we are expropriating the land and the ADB loan provides fund for that purpose.

Moderator. Yes, Professor Castro.

Prof. Castro. Yes, may I add my comment on easement but to another area which is Laguna Lake. I remember a presidential decree defining the Lake boundary as any place reached by elevation 12.5. So taking the elevation of Taguig or Pateros, which is 11.8, that means Taguig or Pateros is within the Lake or inside the Lake. That is one kind of governance or institutional problem because of its implications such as, is the government bound to protect a person's property right if it is within 12.5.

Moderator. I have a very short comment. That question about the 12.5 water stage that defines the limits of the jurisdiction of the LLDA will be given a de facto answer once the West Mangahan flood way is constructed. Because the West Mangahan flood way will cut the Taguig area away from the Lake. And the 12.5 contour line is above the dike. We may look at it either

from the view of LLDA or Public Works. It does not only raise property rights issues, but also physical management and lake management issues.

Okay, Professor Lopez of Geodetic Engineering.

Prof. Lopez. There is also another structure that Professor Castro is well aware of, the C6 circumferential road on the west side of Laguna Lake. How will it affect the flooding? Will it exacerbate or will it be a measure to prevent flooding on the west or east side of Laguna Lake?

Moderator. Professor Castro.

Prof. Castro. Relative to the lakeshore dike, C6 will be on the land-side of the dike, just beside it. That is the proposed alignment. There are proposed alignments for C6 and there is already a master plan but until the detained designs are made, we can not be sure of the exact alignment.

But I do not know the alignment of C6 south of the lakeshore dike. It might turn out that C6 would be built on top of the dike because flooding in that area is not as bad as it is in Taguig-Pateros. That is just a guess, anyway, it will turn westward, south of Taguig.

Moderator. Any further comment about easement, lakeshore, or foreshore as LLDA likes to call it?

I'd like to comment. I got hold of a brochure of Pasig Rehabilitation Program that Unilever Company, a sponsor of the Program, put out in the Hague World Water Forum that showcased the Program. It stated that from the period 1991 to 1993, the BOD loading of the River was reduced from 330 metric tons per day to 230 metric tons per day. Moreover, it stated that they are approaching 200 tons per day, that is the limit that the River can tolerate to sustain aquatic life. To do this, they got the cooperation of at least 75 companies located along the riverbanks to reduce their BOD. The brochure painted a rosy picture of the river rehabilitation; do you think this reflects the current impression on the condition of the River? Is there really an improvement in terms of BOD loading?

Dr. Tabios. MMDA has to restore the River to its historically pristine condition and I want to know how we should come up with the criteria to define what is historically pristine condition. Yesterday, we heard Dr. Catalan said that turbidity and salinity affect the population of tilapia in the Lake, and those are quite objective measures that will be useful for modeling. We can also look at velocities and try to model velocity or stages, but these might be irrelevant to decision makers compared to turbidity and how it affects tilapia. They could also be interested in some other measures that would define ecologically pristine or historically pristine such as the hydrologic patterns of variations of velocities and flows and flooding and recession rates. It would be interesting to hold a conference with policy makers to discuss what might be the ecological criteria and also the technical, environmental, social, political and economic constraints.

Moderator. Will the lady from MMDA prefer to answer?…no more?

Miss Ranjo. I talked to a former LLDA general manager and he got all these data and he said that we can define historically pristine as the condition of the River in the 1920s or 1930s. He described the lifestyle on the River during those periods, the species of fish living in the River, how they had been replaced through the years, species that have already disappeared and the species that are now in the River. We have targets that are not different from those set by DENR, one of them is that we want to see glassy water, we want people to be able to go rowing but not swimming, to be able to fish but not to eat their catch.

There should really be good technical bases for our policies, and we can say that of the Pasig rehabilitation program. Way back in 1981 when it was still under DENR's supervision, DANIDA (Danish Development Assistance), the funding organization helped DENR and other government agencies make a feasibility study describing in detail the conditions of the River. We learned how polluted the River was in terms of BOD loading and who the polluters were. From then till now, many things have changed, whereas before the polluters were the industries, now, it's the households. All these things were properly documented by DENR and they gave us a wealth of information about the River

Lately, people are noticing that the water of the river is not as black as before or as smelly. And these are the signs that tell a layman that the condition of the River is improving. We can also see rowers and people fishing in the River. DENR has data showing that there are improvement, so whatever Unilever wrote in its brochure has some truth in it. Unilever is not a formal partner in the rehabilitation of Pasig but it is very active in promoting clean water ways and is doing a really good job in advocacy.

DENR reported that they have obtained good ratings for water quality but they could not trust their data because of limitations in terms of the location and number of their monitoring stations. For instance, data on water quality taken from monitors at the junction of San Juan River and Pasig River are totally different from those taken from the junction of Marikina River. They have not yet released the data formally, but overall, at least it would be easy to appreciate that the water has indeed improved.

Moderator. I wonder who is in charge of rehabilitating Napindan River. I took an open boat ride on Napindan and there were all kinds of floating objects. The River looks septic. Pasig is surely a lot cleaner.

Prof. Castro. I am part of the flood control and sabo engineering center and our office is located at the Napindan hydraulic control structure so I think I am in a position to answer Dr. Liongson's comment. This flood control and sabo engineering center was formed in January 2000. DPWH is the proponent and JICA provides a project-type technical cooperation to support the formation of the sabo center. A research laboratory will be built with a grant aid from the government of Japan. The overall goal is primarily to enhance the capability of the DPWH and LGUs (Local Government Units) in flood control and *sabo* engineering. *Sabo* is a japanese word meaning sediment control.

We will update technical standards for planning, design, construction and operation of flood control and sabo engineering. We will train engineers at three levels. We will establish an

information system for monitoring flood and sabo disasters and their effects on facilities. We will also conduct applied research in pilot sites like Pasig-Potrero, Daanang-Maputik River in Mindoro Occidental and the Dalton Pass in Nueva Vizcaya. UP's role is to provide faculty members for training and research and help administer and provide guidance on technical aspects.

I would venture to comment on Dr. Liongson's statement that the Napindan River is septic. I guess this condition is caused by a small river, the Pateros River, which directly goes against the gates of Napindan hydraulic control structure itself. This is a small river that harbors all kinds of waste. Most of the garbage in Napindan comes from this small river.

Moderator. We have seen with our naked eyes all the floating garbage reaching down to the Angono and Binangonan area. But the portion of the River close to the Napindan River is relatively cleaner. There were also garbage coming from the Pateros side, so I guess it could be the fault of the local government. There was a plan to have a tourist boat line from Pasig to Laguna Lake passing through the Napindan River. But the condition of the River prevented the planners from pushing through with the river tourism. The River is not very wholesome not only because its water is dirty but because of the solid waste floating on the river. I don't know whose responsibility it is, but the local government has an important role to play in keeping away pollutants from the River.

Any comment? I recognize Mr. Ed Manalili from PCMARD.

Mr. Ed Manalili (PCMARD – DOST). May I add some comments to Grace Ranjos' comments a while ago. In 1992 and 1993, DANIDA set up a base in DAP, San Miguel Avenue. They conducted a series of seminars and workshops between 1994 and 1996. In early 1997 until 1998, they transferred office to DENR Visayas Avenue. (end of tape)

Moderator. Let's have the mike for Grace from MMDA.

Miss Ranjo. *Wala na yung* Pasig River Rehab Program (Pasig River Rehab Program doesn't exist anymore). But there was a shift from DENR to DBP and MMDA. DBM is now the chairman of the Pasig River Rehabilitation Commission. It holds office at the PMS building. There is a PRRC-PMO (Program Management Office). Its Executive Director is Bingle Gutierrez. You can address all your inquiries there. Mr. Ato Cruz remains very active because he heads the Environmental Management Committee and they are coordinating all the evinronmental work.

MMDA is being mentioned the Environmental Management Committee only because we are supposed to be on top of solid waste collection from the River. I am just reacting because I would like to update you on how to get to whom.

There is no more PRRP because the program drawn up under the DANIDA assistance program are being continued under the ADB project loan which is centered on waste water treatment and urban renewal. So the loan given by ADB is supposed to be spent on things like….we all know that the MWSS has concessionaires, now two of them. One problem there is that the schedule for

the setting up of sewage treatment and septic treatment are not…they don't match the water supply schedule.

We all know how much or how little we have in terms of sewerage in Manila. That is one of the targets of the ADB loan for the Pasig River and that is one of the projects that we hope will be done because it should improve the Pasig River very significantly, the sewerage component. So the ADB is working on the gains of the PRRP-DANIDA and we will get the rosy picture reality if nothing goes wrong in between.

Moderator. So Napindan is covered by this Program?

Miss Ranjo. Unfortunately, when we go on a river tour we don't distinguish which is the Napindan River section. I know that there is a Napindan River on the way out to the Laguna Lake, but when we measure Pasig River, it is 27 kilometers from the mouth of Manila Bay to the Laguna Lake. I am not aware of any specific program for the Napindan River.

Moderator. Before I give it to you, I would like to recognize the presence of our participant from PIDS.

Dr. Carlos (UPD). I am Dr. Carlos from UP Diliman. I used to be heavily involved in bio-remediation studies of Pasig River.

Prof. Castro. I would like to supplement Miss Santos' account of what is going on with the Pasig River projects. The DPWH still has a project management office for that Pasig River Improvement Project. In fact there are on-going…I think Miss Santos already mentioned that DPWH is doing the hardware part of the improvement program. So there are on-going constructions of rivetments, construction of parapet walls and some of the projects have right of way problems, meaning that there are some informal dwellers that they have to relocate. So part of the budget is spent on relocation. But I guess these types of project fix the boundaries, you know building a parapet wall would make it obvious to anybody building his house on the riverside, it would show them blatantly violating the boundaries.

It also has some bearing on what Dr. Tabios has mentioned earlier about returning the river back to its historical. I think we are past that already. We are doing some hardware permanent works, permanent changes to the river, hopefully for the better.

Dr. Tabios. Just to add up on that. That is the problem or question, to bring back or to restore to this historical pristine condition. Now you have improvement and changes in the physical configuration system then you have to consider the constraints if ever those are constraints or rather the undoable interventions that were already in place. For example, if you bring it back to some historical hydro-period, then could you do it realistically. Maybe not so you have to compromise somehow.

Moderator. We have around 10 minutes left for comments and questions on socio-economic developments, infrastructure... Yes, please state your name again.

Dr. Taro Urase (TIT, Tokyo). I am Taro Urase from Tokyo Institute of Technology. I am a sanitary engineer. I hear some of the projects are on-going in the Pasig River for sewage treatment or wastewater treatment. But in Manila City region are there any projects regarding (avant?) drainage which are…..I Japan the sewage system plays an important role (post avant?) drainage improvement and water quality improvement. So are there any project on sewage construction or improvement of sewage system in inhabited area? I want to know the current situation of the public sewage system.

Moderator. Although I don't have the details but right now the service area of the Metropolitan Water Supply and Sewerage system (MWSS) has been given to two concessionaires who will among others, aside from operating and maintaining the treatment plants and the distribution system for water supply are under contract to develop and modernize the sewerage system of the service areas in Metro Manila. We have an old sewerage system operating in old Manila, but for the rest of the Metropolis in the suburbs there is none. This very important question that you raised is the problem now of the two concessionaires, the Maynilad Water Services Inc. on the west side and the Manila Water Company on the east side, more or less. The government for decades has neglected the sewerage of Metro Manila. So the two now hopefully will be able to develop…this will be their investment. They have not really place much investment in water supply development because there is one already in place. But they will make major investment. in sewerage as far as we know although I don't have the technical detail.

Prof. Castro. To support Prof. Liongson's statement about the concessionaires doing this sewerage system. Although its is not a sewerage project, there is something going on at the Napindan hydraulic control structure compound, the Manila Water Company, the concessionaire for the eastern side is putting up a sludge loading facility. They probably will be tracking the sludge from septic tanks. Their trucks will be moving around getting the sludge from septic tanks. They will load these into barges at the Napindan hydraulic control structure. They are building a sludge loading facility. The project is in full blast. It seems to be moving quite fast.

Moderator. Dr. Tabios?

Dr. Tabios. For the interest of some people, there is actually this sewage outfall in Manila Bay. It is coming out of, I think, Malabon and goes all the way to 2 or 3 kilometers from the shore. I was talking to Joma Lim of the Environmental Engineering, they don't know exactly how far away. But it would be an interesting problem to see the plume of the sewage outfall. I think it has been there for 20 years or so? More than 20 years and it is still there and very functional. That would be an interesting process to look at as part of this Manila Bay pollution source.

Mr. Eric Ferrancullo (Philippine Coast Guard). I am Eric Ferrancullo from Philippine Coast Guard. I think the Maynilad Water Services is establishing a sewage treatment plant near the reclamation area. They are digging some sort of a river kind of system there. Right now, I believe they are conducting a feasibility study within the Bay. Because we accompanied them during their sampling in those outfalls that you mentioned a minute ago. I think there are six outfalls in the Manila Bay area. The most polluted I think is the one in Tondo, where you can see the fecal matters that are being discharged there.

Moderator. I think our first session in the afternoon is over. How long is out allotted break, 10 minutes? So can we continue with questions and answers? Comment from Prof. Tanhueco of De La Salle University.

Prof. Tanhueco. I think we should be concerned of landfills, or so-called landfills which are actually open dumps which are placed coasts. So besides the wastewater, the leachate from this area are to be of concern.

Moderator. Prof. Tanhueco is starting a new (thread?) which could lead us to the hills of Payatas.

Prof. Lopez. I know of a detailed engineering design project funded by JVIC of Japan which is being undertaken now by Nippon Engineering. This is a pilot project for the Kalayaan, Lanuza and Vargas interchanges. And they are preparing separate sewage and drainage plans parallel to the C5. This is a five kilometer stretch parallel to C5 but the exit will be at the Marikina River and Pasig River. I think this should be a very good model, this should be submitted to the DPWH for approval.

Moderator. Who is the proponent of this project?

Prof. Lopez. Nippon Engineering

Moderator. On the government part?

Prof. Lopez. DPWH-URPO

Moderator. I wish to recognize the return of Dr. Kelvin Rodolfo and Dr. Siringan from NIGS. We are having our break but we can continue with our questions.

Prof. Castro. While we are here I'd like to take the opportunity to ask Miss Grace Santos one sensitive issue regarding the relationship of MMDA and DPWH. I believe in the charter of MMDA, it is given the authority for flood control over its area of jurisdiction. How do we reconcile that with DPWH functions on flood control and are you aware of plans in the future regarding this. MMDA's charter is a law but what is going on right now is still DPWH's responsibility with regards to flood control.

Miss Ranjo. You are right, it is in our charter. We even have sewerage in our charter which is MWSS'. The situation now is that we don't do real flood control project implementation. We do de-clogging of canals, we only do what we can with our little Ramjets. But that is not what flood control is all about.

Our past bosses talked and what would normally have happened is that there would be turn-over of equipment, personnel and budget, but that has not happened. Therefore, we were not able to do our mandated functions. So when people are angry, they get angry at us, at DPWH and that is not nice.

However, one of the reasons why it is not so easy for us to accept and for DPWH to give up their projects is because they are foreign funded. And you know how foreign funded projects are. Maybe if we have to do it, we'd have to re-negotiate the whole thing which is not going to be easy nor would it be beneficial to the project. So we are not sensitive to it. It is really unfortunate that it was contained in our charter. It was not one of the items we put there when we were the committee in charge of drafting the Act. It is not sensitive because at least our bosses are talking and they understand. We hope would understand the arrangement for the moment. It is really the foreign funded projects which are difficult to.. and most of our flood control projects are foreign funded.

Moderator. About three months ago there was a forum wherein Undersecretary Teodoro Encarnacion and MMDA boss Jejomar Binay had an exchange about flood control policy and Undersecretary Encarnacion said that Public Works is willing to give up operation and maintenance of all flood control systems in Metro Manila. But Public Works should retain the design and construction functions. It was really a long exchange that appeared in the press but that was the last statement which appeared in the news. And there is no response which we have read coming from MMDA about this proposal; that Public Works will take care of design and construction and after construction is finished, MMDA will get the budget for maintenance and operation of both existing and newly constructed flood control systems. What is the current position of MMDA here?

Miss Ranjo. They are intelligent comments, I am referring to Mr. Encarnacion's statements. However, as far as our chairman is concerned he was not speaking for the department.

Moderator. So, anyway do you have a validation from Public Works that this is in fact the position of Public Works, that flood control design and construction will be Public Works' function and after construction is finished, maintenance and operation, budget, personnel, expertise will be brought to MMDA. Although I have personal comments about that I will not say them yet. Because I think even MMDA should be part of design, planning. So did we open a can of worm here?

Prof. Castro. I take responsibility for opening that can of worm. It goes further than that, than between Public Works and MMDA. It goes even into MMDA versus LGU, or DPWH versus LGU. In the design of drainage facilities it is so difficult to separate drainage systems for major roads versus drainage system for minor roads, it is the same channel. Hydraulically it is the same channel, but the responsibility for minor roads is the LGUs', while for the national roads, it is DPWH. So who designs what and who constructs what, who maintains which drainage facilities. There is, I believe, some institutional problem regarding the urban drainage network that has to be ironed out. I use the word ironed out rather than resolved because there may not be a resolution in sight for a long time.

Moderator. By the way, if some of the participants are interested in pursuing this matter further, there is a publication put out by the UP Center for Integrative and Development Studies which we edited. It is a collection of essays from government, scientists in government service, academe public works people about the flooding in Metro Manila. It touches on the hydrological, engineering, sociological and institutional aspects of flood control.

It is available at UPCIDS for P200 I think. We are not promoting this for ourselves, we want to promote the idea of cooperation among the academe and government as far as putting out in the open the issues.

I hope that we have heard something positive about Pasig River rehabilitation. I hope that soon we'll have something positive about the continuing debate on local government, MMDA versus Public Works. I want to call it a z*arsuela* which has been going on for decades. Water supply has been privatized. Can we privatize flood control? We have privatize hydropower, water supply, irrigation to a certain extent, but we have not privatized flood control.

On that note probably, since you have become silent about this, is it time to move on to modeling data needs.

Prof. Tanhueco. Because when we get the data, it is usually not in the form that we want. Sometimes it is not referenced or not validated or been checked. So may be we can work on something that will standardize the data that is usable for everybody. Our needs may be different for somebody's needs, for example, one agency may need this aspect only and they have to purchase so much information but they only need just a few.

Moderator. What kind of data are you referring to? Because we have many kinds of data.

Prof. Tanhueco. Not the processed data, probably just the raw data. Probably coming from say the meteorological stations.

Moderator. Can PAGASA comment about data standards. Please introduce yourself.

Dr. Perez. I am not sure I understand what kind of standards you are referring to. Because in PAGASA especially in meteorology, we follow the standards set by WMO (World Meteorological. Organization). Our data usually go through the data exchange all over the world.

Dr. Flaviana Hilario (PAGASA). I want to ask if you are referring to spatial data or tabular data. If you are speaking of spatial data, there is an inter-agency task force headed by NAMRIA that takes care of standardization of spatial data. The aim is to have a standard map or a common map to be used by all the agencies doing mapping. But as Dr. Perez has said, at PAGASA, in terms of meteorological data we are using the WMO standard. But in terms of processed data, e.g., rainfall map, right now we are trying to use the map which is digitized by NAMRIA as standard base map for the Philippines.

Moderator. So that is standards for PAGASA. How about standards in other sources of government data.

Prof. Lopez. I head the working group for the inter-agency task force on geographic information (IATFGI) and there are around 22 national agencies (involved). The standards mentioned by Flavy have been prepared on a final draft in preparation for the signing of what we call a National Geographic Information Council. All agencies will be furnished with these standards,

The Council will monitor the compliance by the different agencies of the standards. The executive order has not been signed yet by the President. We are not sure when he will sign it.

Moderator. That question is about standards. How about questions on data themselves.

Prof. Lopez. There is a meta data base that the council will also prepare. This is data about the data which NAMRIA will spearhead. NAMRIA is the secretariat. We expect all holdings to be monitored by NAMRIA also. Right now, we have a temporary meta data base and this is available at NAMRIA. We also have another set at the University. Those who are interested can contact us at NAMRIA or at the University. All data from topographic, to meteorological, socio-economics, soils, etc.

NAMRIA has set some internal rules for this and the agency who will be furnishing the data will set a minimal price for the private or other government agencies. Mura lang yan. But the NGIC (National Geographic Information Council) will put up a small mark up for the operation of the Council.

Moderator. Who has question about stream flow data? Or water quality data? Geologic data? Soil, land use? Time series data? We already have rainfall. Stream flow quality sediment data are being collected by the Bureau of Research Standards of DPWH. Who wants to comment on river data?

Prof. Tanhueco. My experience with getting data particularly water quality is that the time or interval of getting the data is quite far. For example, in Laguna Lake it is one month. They just average their samples and that is representative for the month. They said that it is a matter of funding, they don't have much logistics for this, so probably the group can help somehow in improving this data collection.

Moderator. I think you are referring to LLDA's regular measurements of water quality indices in at most five stations which are quite far apart inside the Lake. So much so that it is even quite hard to construct a preliminary contour map of water indices because there are very few points. To this extent, probably the project can help at least during the…to what extent is the data collection plan of this modeling project to be able to augment the present sparse network?

Dr. Tabios. Perhaps Prof. Nadaoka can answer that. But before that, I think these were data monitoring and then modeling can complement each other. As I remember, LLDA has about 95 to 97 water quality data collected for a 2-3 year period with an interval of once or twice a month. (Spatially?) five points and (temporally?) twice a month. Then there was a big gap. I saw a report but I do not know the coverage. I think the major constraint is really cost. I don't think we can afford to just get continuously monitored data. If you look at it from a purely design of network point of view, perhaps, supposedly, if you want to have a certain level of accuracy, you have to look at the variability of the data. If it is a uniform data, then maybe you need only once a year. That is a purely non-variable data. If it is a very variable data, perhaps the sampling interval may be hourly, or daily, depending on the variability of the data to be able to get the proper temporal and spatial variability or description of the variability of the data.

But when you really have constraints with sampling perhaps the model can get in. While there is a little bit of which comes first that you can (?) problem here, while to develop the model properly you must have the data, but if you don't have the data, somehow you can get away with some calibration based on that scarce data you have. But then already use the model to fill in the variability. For instance, you may have data twice a month only but let the model describe, fill up the daily variations of the process. It is like data complement the model or data helps in the modeling. On the other hand, the model can already fill up some of the gaps for you data to come out. Because what we are interested in is perhaps really to describe the spatial and temporal variability of the process and help us make our policies or intervention.

Dr. Nadaoka. I can agree with the importance of the fusion of the development process, between the field survey and data monitoring and the development of numerical simulation tool. Before doing that however, we need the data itself to validate the model. Otherwise we can not say anything about the data variation. In that respect, there are no sufficient data set to show the temporal variation or spatial variation of the country concerned.

In that sense, in my opinion, it is one of the feasible plan to do an intensive field survey for one particular period e.g., one month on the Laguna de Bay or Manila Bay. Then you can validate your model by doing this intensive data set, then you can extrapolate. You can proceed further to interactive process of development between the numerical tool and the data itself.

Moderator. I think that while you are putting that in your modeling effort, part of the modeling effort is the intensive collection of primary data. We will not rest merely on the availability of secondary data which have lower quality. Although we have more long term secondary data, but they don't have the quality, frequency and resolution needed by our calibration needs for the model.

Yesterday, the chairman of the DENR task force for water resources, Ric Javelosa, was trying to push the development, to the minimum standards, of the hydrometric network for the entire country. This is one of the mandates of the task force created in the previous administration. It may also be a function of the National Water Resource Board. Being able to install hydrometric network for water levels, discharges, sediment, water quality involve at least two departments, DENR and Public Works. But still the same standards, still the same rivers. That kind of project, installation of a minimum hydrometric systems for our rivers, is still pending. To a certain extent, there are still gaps in our rain gauge network, but the gaps in the stream flow and sediment data are really very wide. They are not good enough for research, I have to resort to intensive primary data collection just to be able to calibrate our model.
This brings us closer to the other issues that we have to talk about and that is possible proposals for research that should include primary data collection, if we want to make a scientific dent in our studies.

Dr. Tabios. I want to add to my comments. We have this experience with Laguna Lake for example. I think Prof. Liongson mentioned that to model Laguna Lake, there are these 22 river basins flowing into the lake and only four are gauged. So we really have to develop this watershed model, given rainfall to come up with those inflows for the remaining 18 major rivers. I think there are 39 major outlets. But there are some watersheds where there are two or three.

We are only able to calibrate based on those four outlets out of forty. So only 36, we have to come up, based on watershed model.

Since we have to have those inflows, we just have to live with those four gauges, we cannot do otherwise. That is one example of exercise where the model came in. I do not under emphasize the importance of data, but in the absence of data we have no choice but to live with that. The models come in handy but I don't want to under emphasize the importance of model calibration and validation.

Moderator. That is true. Although we already have this hydrologic models for the 22 river basins. The work has hardly started, because we were able to calibrate just four of the rivers among the 22.

Moderator. There is still continuing work left to the young people, the graduate students and researchers to carry on the research effort of collecting primary data from all donors and sponsors and to do the modeling. Modeling without primary data collection is a self defeating exercise. Every good research must include primary data collection. There are good research without modeling which are primary data collection and analysis of data.

Prof. Nestor Sy (University of San Carlos, Cebu). Is there a way that you can quantify the uncertainty? It seems like that it is the trend nowadays among modelers to quantify the uncertainty so that one is able to say that for this level of available data, this is how certain the results are.

Moderator. The more modern textbooks in hydrology would contain chapters on special data network and spatial interpolation, Kriging methods. You can tell uncertainty from the density of your network. This has been a development of the last twenty years. This was initiated by geologists, Kriging, stochastic analysis of spatial data. From there you can tell whether your network has sufficient density needed to achieve the minimized error that you want. This methodology has been transferred to hydrology, because most of the hydrological variables are spatial in nature.

Dr. Tabios. It is important to make distinction between natural variability in a given process and then you will have the modeling error once you start processing the data. And also you'll have measurement errors and systematic errors that you want to separate. When we talk about data collection networks in the design of networks to begin with, from how you design consider temporal and spatial variability of process. And on top of that you might have systematic errors. But when you develop prediction models then you'll have to reckon with the variability of the process, and then the modeling errors and measurement errors. When you do validation, perhaps measurement errors will come in.

Moderator. Professor Sy?

Prof. Sy. I've another question. For instance on the issue of upscaling or downscaling, many of our data are point data and when you upscale you either average it or aggregate it and there is

already a certain level of error there. For the modelers, how do you go about with the error in upscaling or downscaling specially if the model is distributed?

Moderator. I don't exactly understand what you mean by the word upscaling? Please state upscaling.

Prof. Sy. For instance, if you have a distributed model you divide it into grids. Sometimes, you only have soil data and you only got one point. And then you have what we might call an effective soil characteristics…

Dr. Tabios. Again, it depends on the spatial and temporal variability of the process. For example, if you have an island which is homogeneous, and it is all sand and the hydraulic activity is this, then on a field scale, I could say that this is all uniform. But when it is heterogeneous, once I do an aggregation, that is perhaps what you mean by upscaling, or when I disaggregate, because in the interest of coming up with a more discretize or more distributed model, either I lose or gain information by the aggregation process or disaggregation. It is again a function of the variability of the process. You either lose or gain information by disaggregating. Like for example, if it is so variable and so spatially heterogeneous then it will call for a distributed model. On the other hand, to what level I disaggregate, at some point, maybe I do not gain information anymore, in fact I may lose information by disaggregating too much. I am not only talking of spatial aggregation, even in temporal aggregation. Like rainfall, there are always studies I've seen. In fact, in the last 5 or 10 years, there were several papers in hydrology where they talked about scales of fluctuations, rainfall process, stream flow process, where once you aggregate, you average in time or in space, you lose some information. There were statistical approaches to quantify these. On the other hand, later on, there were people doing very physically-based description of what you lose when you aggregate or disaggregate depending on the scale of fluctuation of the process.

Dr. Nadaoka. Regarding the uncertainty of the data, you can raise such a theoretical argument by supposing the uniform probabilistic nature of the data itself. But the actual thing is a lot of different. Especially if you look at the water quality data. The significant uncertainty or error of the data may come from the difference in the degree of training of the person who is supposed to get the data. That is the cause relating to the issue of standardization of data collection. My question is, is there any system of training of data collection? Do we have an institute that trains people who are in charge of collection of data? Because then you can insure the uniform level of the quality of data. Those things are important in the actual data acquisition.

Moderator. I quite agree. A lot of people have been raising their hands. I wish to recognize the first once whom we notice. The gentleman from the Coast Guard.

Eric Ferrancullo. I agree with Dr. Nadaoka when he cited the importance of the buoyed multi-parameter sensors in gathering continuous real time data. But the problem there is that you can not let an instrument worth about P200,000 floating in the middle of Manila Bay and expect it to be there the next day, unless you moor it in a boat manned four 24 hours.

Moderator. That is the over time factor. We have to pay the person looking after the instrument for working overtime. Our participant from NIGS, Please state your name.

Dr. Cesar Villanoy (MSI- UPD). To follow up what Prof. Nadaoka said. That has been our problem specially when you combine data from different sources. There has bee no comprehensive attempt to do intercalibration of water quality (lapse?). It would be nice if the project can help in that regard. Aside from data collection procedure, in the laboratory itself, there are also differences even if you give them the same sample, they will come up with different values. In some regional laboratories of DENR, even if the instrument is blank, it would still come up with some concentration of particular parameters. So training is very important, also the intercalibration between laboratories, so you can at least get some idea of uncertainties.

Mr. Ed Manalili (PCAMRD - DOST). That problem has been discussed in one forum, two or three year ago. We had problems reconciling data from different institutions, e.g., state colleges and universities, government laboratories. They have come up with an informal solution, that is, most laboratories doing wet chemical analysis have to be accredited by the Environmental Management Bureau. I think some of the research laboratories from where we gather some of our water quality data have been accredited by EMB, like the Industrial Technology Development Institute of DOST. It has to be accredited also by the DENR-EMB.

Moderator. So maintaining the standards for water quality is the responsibility of EMB?

Mr. Ed Manalili. Yes. They also follow the APHA (American Public Health Association) standards.

It has been going on for two or three years now under this Laguna de Bay R&D program.

Moderator. Of course, in the case of construction materials, we have the Bureau of Research Standards of Public Works.

The gentleman is recognized. Please introduce yourself and your agency.

Prof. Danilo Terrante (De La Salle University). This is just a comment. I agree with professors Nadaoka, Tabios and Liongson that really modeling helps a lot in the analysis specially when we correlate. We have been talking about meteorological and rainfall data, etc., but it has been a fact that a lot of river basins in the Philippines are actually ungauged. Sometimes we resort even to simple statistical models which are physical based, we use physical attributes of the river basin. We rely on the topographic maps supplied by NAMRIA and I have apprehension. I talked to somebody from NAMRIA yesterday, and I learned that the most recent base maps or topographic maps they reproduce are dated 1935. It would be difficult to update the calibration of our data because the maps have not been updated yet. This is just a comment.

Moderator. What you said is true. Without changing the (Hold?) contour information developed in 1935, we can draw new roads like C5 and C6, but the contours at scale of 1:57 are as old as 1935. It is almost impossible to draw watershed areas at the scale of barangays.

Prof. Tanhueco. We've been talking of models and I just want to know if these models will be used for decision making. Is it a objective of the group to make use of these models to, for example, redefine standards? or criteria?

Dr. Tabios. I think that is one of our goals. Although we come from the modeling group we have to think how we could make these models as tools in decision-making. I think that should always be at the back of our minds. Yesterdays, I asked for the parameters that we could include in the model as an output so that it is relevant to decision making. May be by just presenting the results of the modeling effort in some form it is easy for decision makers to appreciate. With graphical outputs I think a lot of decision makers can easily relate to what they perceive or conceive the world to be and translate those easily in terms of policies, e.g. a 10-meter or 3-meter easement.

I've seen some work in San Francisco Bay. For example, they have put some ecological criteria just on the position of 2 parts per thousand salinity (front?). That is an indicator of the ecological integrity of the Bay. And that position based on the San Francisco Golden Gate Bridge all the way down to the Delta is about 55 kilometers. The position of 2 parts per thousand salinity front which they call the X2 parameters should be around 35 kilometers from the Golden Gate Bridge between June to August of the year. Perhaps when the freshwater inflows come in, sometime between December and January, they don't care if it's beyond that, because after all there is already freshwater coming in from rain and snow melt. Although this is simplistic, but to come up with the X2 parameter, they really ran bay delta model which is a full hydrodynamic model. They translated the result in just that X2 parameters. It is a very simplistic parameter but very a useful indicator. It took about 10 years to come up with that criterion, which is just one, to summarize ecological, the benthic communities; how they thrive, how the salmons spawning will not get confused so that they could go back to the rivers, things like that.

But these are the criteria which we could, perhaps, extract from decision makers and incorporate in the modeling or output from our models, for our models to be useful.

Moderator. We could probably approach the question from the point of view of possible users. For instance, is the model just going to be used as a research tool? Or as decision tool? Let us start by asking the following questions: Which agencies of government now are using predictive models/computer models? How many have been effectively using computers? I think the flood forecasting office of PAGASA is using a flood forecasting model for Pampanga, Agno River and other river basins. This model was developed within PAGASA, a transfer of technology from AUSAID expertise.

What about those coming from the academe? What we did for Laguna de Bay was a contract research for LLDA. LLDA has responsibility to approve water rights application for water diversions, water supply and irrigation. And they need a good water balance model, where before there was none or only pockets of studies. They want to have a decision tool for granting water rights.

I also know that the Bureau of Designs of DPWH has been purchasing quite advance software on urban drainage, storm water drainage. I hope the BOD people are around to explain to what

extent they have been using the software from Wallingford, England. Some of the software may have been given to them through technical assistance.

We have cases in the past where software was turned over by consultants after initial training of people who will use them. But the problem is that when the personnel who were trained to use the software leave government service, the software is left to gather dust. So in goes back to people again. We have to retrain people to receive and maintain the technology. I don't think we have a shortage of qualified people to develop goods models, but I think we have a shortage of trained people within the agencies who will remain with the agencies to operate, make use and recalibrate and improve the models. That is a more general approach to the question. We can have a very sophisticated coupled model, the agency can acquire the hardware because computers are not expensive but people are more expensive to maintain.
It goes back to people, even in the case of data network collection, or cost of transporting people who will do the hydrometric measurement in far off stations. These are the hidden costs in every tabulation of minimum standards. This has been our pitfall in the Philippines. We start with a relatively better network, but through the years, operations budget dwindles per square kilometer of basin. We have not been able to maintain people who will reach out to far away places. All these things are connected, they go back to investment and training of people.

Dr. Hilario (PAGASA). Going back to the issue on data needs and as you have mentioned, we lack data on rainfall particularly in the watershed areas. PAGASA has difficulty in putting up more rainfall stations because of the government's current financial problem. My question is whether this project will put up more rainfall stations in the watersheds? I believe that however good your model is, you must need a very good primary data in order to calibrate your model. As you mentioned there are only five new rainfall stations in addition to the old 15 stations, but will these be sufficient particularly in the high elevation areas?

Moderator. No, they are not enough.

Dr. Hilario. Although PAGASA has plans for modernization, in fact it has a 6-year modernization plan wherein it is planning to put up a radar station in Bulacan which will cover Metro Manila and will be useful in rainfall forecasting and it has not yet been finalized.

Moderator. Who wants to comment. Professor Castro.

Prof. Castro. Yes you are right. There is rehabilitation in the works for EFCOS. Additional rainfall stations will be built and additional hardware for telecommunications and the like will be provided. This, hopefully will be implemented in 2001 with Japanese funding.

Moderator. I recognize Prof. Eric Cruz, UP CE Department.

Dr. Eric C. Cruz (Department of Civil Engineering, UPD). This is a simple query on data sources. We recognize that our country is an archipelago and it is exposed to various environmental forces. From the discussions for the past two days, I get the impression that we have bad data on hydrology, meteorology, also on rainfall water quality. Although these data are inadequate, I think this problem is already being addressed. But as far as data on waves, I do not

know if there is an agency that is trying to get them. We could use them in our study related to the coastal regions. These data could also be useful in our studies on the movement of the coastline.

Moderator. We still have the old Bureau of Coast and Geodetic Survey. Is it part of NAMRIA? It is under NAMRIA. Who can answer for NAMRIA about this wave height measurement and other coastal engineering measurements. Dr. Siringan of NIGS.

Dr. Siringan. I don't know of any wave height measurement work being done by NAMRIA. But there are satellites that can do that for us with excellent accuracy. If the project can bring in data that we can use, then that would be good.

Moderator. The gentleman from MSI.

Dr. Cesar Villanoy (MSI). This is a follow up. I think with the RAMS generated wind stress over the Manila Bay area or Laguna Lake, we could already look into wave models. This might be useful when looking at sedimentation along the coast.

Prof. Nadaoka. That is one of the subjects we are now trying to develop. With wind stressing, we have the development of the wave itself then the quotient of the track will be different, or was the different stages of the development of waves. That is the kind of data you will need to couple atmosphere and ocean. That is one of the important subjects to be developed.

Moderator. We have moved past the 4:30 deadline, but we shall continue. I recognize the JICA Expert.

Mr. Taizou Yamada (JICA, EMB-DENR). I am a JICA expert working with EMB. Going back to the issue relating to the question how this group can contribute to the decision making process in environmental management. I would like to suggest that you invite people from EMB, specially the (?) group. I think this has relevance to the question what kind of parameters should be there with the future model? For instance, now the EMB is preparing the clean water act, in which it plans to implement the kind of environmental user fee similar to the system currently being implemented in the Laguna de Bay area. But they want to expand that kind of environmental taxation at the national level. If it becomes a law, I guess the Manila Bay could be the pilot area for that kind of taxation because of there are lots of industries in the area and therefore more pollution.

So this model which will be built through your effort can contribute to that kind of policy instrument. I think a beautiful relationship between scientific research and policy implementation could be realized. That is one reason. For another reason, traditionally, DENR regional offices were supposed to monitor environmental quality including water and air quality. But now EMB is responsible for this job after the passage of the Clean Air Act. With the enactment of the law, EMB has become a line bureau, whereas it used to be a staff bureau responsible only for policy making. Now they are responsible for implementing policies including environmental monitoring.

My observation however, is that they do not have the capacity for such monitoring function. But still they are trying to do that. I hope that this group made up of prominent scientists could help them. This is just my suggestion.

Moderator. The points raised by the gentleman are quite significant. The first is the use of a model for setting standards for environmental fee. The second is the modeling requirements for the implementation of the Clean Air Act. This is a hot issue now and the national government through NEDA has been conducting dialogues and there are some inner debates going on whether government and the general public are really ready for the Clean Air Act. Or whether the stipulations of the law are realistic. This is one big thing that will require another two-day forum to debate the issues.

It is very true. I was fortunate to attend one meeting sponsored by NEDA that tackled the requirements of the Clean Air Act and one of them is modeling capability of the consultants and the government technologists to be able to project the pollution of any facility or industry being proposed. There is a need for models for dispersion, plumes, etc. Will the group respond to the comment?

Dr. Rodolfo (NIGS – UPD). I was listening with interest to the comments about the lack of precipitation gauging stations and stream stations. I thought that if you set up telemetering stations in the country you will have a problem. You can talk to PHILVOCS about telemetering stations being sabotaged and vandalized. On our part, we use fairly cheap rain gauges in Mt. Mayon. I think that after deciding on the number of new stations you want to set up, you can buy single clock driven tipping bucket rain gauges for about P15,000 a piece and put them up in a house where you can pay somebody to change the paper every day. This is not real time data. But how urgent is it to get real time data if you can get precipitation data cheaply and abundantly with thorough coverage.

This is a developing country and labor intensive. It is a lot cheaper than telemetering to hire somebody at a very modest cost to monitor your gauges.

Moderator. Yes. Are the tipping buckets your mentioned locally manufactured?

Dr. Rodolfo. No. these are available for about $300 in the United States.

Moderator. Okay. Comment from PAGASA.

Dr. Hilario (PAGASA). PAGASA has many rain stations called rain climatic stations wherein we hire part time observers. These stations are scattered all over the country and almost all provinces have these kinds of stations. However, for flood forecasting purposes, we need rainfall data in real time. In fact, we get the telemetered rainfall data every hour for 24 hours.

But for the watershed in this project, we have only inside the watershed, I don't know if you considered some of our rain stations.

Moderator. We did, like Boso-boso Tapac and so on.

Dr. Hilario. But we also have some problems with people who work for us part time. Because one time when I visited one of our rain stations, I found out that the rain gauge had been set up in the garage. Previously, it was on the roof. I checked if he had sent data during the time the gauge was in the garage and unfortunately he did. So these are some of the problems with have with part time observers.

That is why, PAGASA has built structures and full time observers for some of our stations where we get synoptic data.

Moderator. Despite this well recognized problem of lack of dedicated and trained personnel. Still for purposes of getting better estimates of water balance, not flood forecast, whether seasonal, annual or monthly, more rainfall stations are needed, the simpler non-recording types, the better. We can win by numbers, if 75% of the data are good then we win.

The tipping bucket we installed for LLDA is P70,000 per unit. Multiplied by five, it becomes a major buy for the agency. Five new brass-lipped tipping buckets cost P350,000. It had to be approved at the Bureau level.

More of the P15,000 tipping bucket will do.

It is good to have one more rain station no matter the quality. May be its quality is not as good as the synoptic stations standards but it is always good to have one more station. We can compare the quality anyway.

Mr. Christopher Lipas. I am Mr. Lipas from the Mt. Province State faculty trustee. I am quite interested in research funding. There are a lot of on going programs and project in the Manila Bay and Laguna Lake. In terms of resources it runs in big amount. I want to know if a research component is considered in the integration of the program of development.

As far as I can see, there are a lot of problems that can be addressed by the academe. My suggestion is to give some of the research problems to the academe or give the lead role of conducting researches to the academe. The research could be given to graduate students under the supervision of a faculty. Is it possible that in lieu of making a graduate student earn 30 units, he should be allowed to conduct research instead? Meaning to say that the agency that needs the data should provide the fund for the research. The graduate student could conduct the research study in coordination with the academe. In such a case, the community will also be benefited because some technical problems could be solved. Is that possible?

Moderator. Those kinds of set up are existing, to a certain extent, in UP and in other universities. There are fellowships being sponsored by DOST and by the private sector. Part of the fellowship is research towards a master's thesis or Ph.D. dissertation. With regards to community extension, there are also existing programs in some of the universities, wherein the results of researches made by the faculty and students are brought to the grass roots. There are also field work done in the grass root level. Of course, both activities require massive funding and students' researches are always funded from limited sources. Traditionally, the DOST provides funding for graduate

students' fellowship. We have encouraged sponsorship by agencies, e.g., PAGASA, DENR, if not in monetary terms, then in kind. There are also funds coming from the private sector. For instance, one of the Aboitiz companies, HeadCor, sponsored two scholars in UP to earn their MS in water resources. One in hydraulics another one in hydrology. One of these scholars is now occupying a senior operations and development role in the company. He is a mini-hydro pioneer in the Mt. Province. The other one is doing consulting work in the North.

In effect, this can be done. and we have to identify sources of funding from the public and private sectors. Even international sources. And bringing the results of the researches to the community at the grass root level. But we have to weigh academic content and scientific quality against immediate impact to community because there could be conflicts that have to be resolved first. Sometimes we only need simple science and the right combination of objectives, plans and people to be able to make an impact.

Mr. Lipas. This is a follow up question. How about incorporating the research component in the project or program. Allocating some resources….I am referring to the Manila Bay and Laguna Lake program.

Moderator. That is a macro-question. If you are spending billions on infrastructure, how many percent should be devoted to research? What is the experience of other countries, at least for the infrastructure sector? What percent of the cost building infrastructure is devoted to research on infrastructure? The more well-off countries are able to maintain 2% or 1%, I think?

Right now, by DOST's estimates .02% GNP is devoted to research and development.

But there are many ways of approaching this. One way is through the participation of the private sector. Focus research.

But then there remains the macro question. For instance, how many percent of the public works funds should be devoted to research and who will do the research?

Dr. Tabios. If you were a businessman what is the risk level you could tolerate? If you are going to spend 100 million, it is only worth to spend 2 million or 10 million or 20 million to make sure that your 100 million is worth the effort.

We have seen a lot of mistakes in the Philippines where you have a P50 million project and then only ending up the next season gone. Because people do not know proper investment just to come up with the design flow.

If you were a businessman running a government agency you would have this risk aversion mentality.

Moderator. Of course there is the issue of research leadership. That is another thing. Preparation of good proposals which DOST will approve with minimal questions. Research is another culture where you will need to have patience and good habits in preparing research.

May be it is time to thank everybody for their patience in listening to the discussions. We would like to thank you for the last two days. We would also like to thank our colleagues from the Japanese universities and co-workers in the research program.

XI. CLOSING REMARKS

Guillermo Q. Tabios III
Department of Civil Engineering
University of the Philippines, Diliman
Quezon City

I would like to thank everyone. We hope that this is not just a one shot deal or a *ningas cogon* kind of phenomenon. I think that it is important to have a continuous dialogue among the academics, the practitioners and government personnel. We will try to do this every now and then.

I think that it is always nice to be able to share information, ideas and knowledge. Perhaps when we get to another conference or a forum like this, we might be wearing a different hat. As individuals, I think we all have some ethical or moral obligation to have a clean environment. From an academic point of view, it is always nice and we will appreciate that someone is able to make use of our models or ideas.

I really think that this should not just end like this, rather I hope that this is going to be a continuing effort, from our side and from everyone.

Kazuo Nadaoka
Department of Mechanical and Environmental Informatics
Tokyo Institute of Technology
Tokyo, Japan

I have noted the Issues and difficulties and future possibilities for all those agencies and institutes.

You have raised quite an important issue about the data collection network system, but there is a more important network, and that is the network between us. I would like to suggest a simple idea and that is to set up the mailing list system where we all can communicate freely.

Anyhow the coverage is very important to advance our project. Our project is actually a long project and we will try to have extra research fund as much as we can. We could try to submit proposals to various organizations in Japan, Philippines or the UN. But to do this, accumulation of our activities is advantageous to get research fund. That is our hope.

Before closing this, I would like to express my thanks to Dr. Tabios, Eric, and Dr. Tanhueco and the other participants from the Philippines who have done a lot of preparation for this workshop. Thank you very much.

Appendix A.
LIST OF PARTICIPANTS

Melissa Agustin	MSI, UPD
Marlea Bauag	Marine Environmental Protection Command, Philippine Coast Guard
Alex Biasbas	BFAR
Charlene B. Blando	EIAPO, DPWH
Edilberto Brillantes	NAMRIA
Paolo C. Campo	Department of Geodetic Engineering, UPD
Anna Liza Casil	MSI, UPD
Peter P. M. Castro	Department of Civil Engineering, UPD
Zenaida Catalan	School of Environmental Science and Management, UPLB
Khervin Cheng Chua	Environmental Science Program - ADMU
Kristina Cordero	MSI, UPD
Laura David	MSI, UPD
Kenji Doi	TIT, Tokyo, Japan
Susan Espinueva	PAGASA
Belinda I. Fajardo	EIAPO, DPWH
Eric Ferrancullo	Marine Environmental Protection Command, Philippine Coast Guard
Gil Jacinto	MSI, UPD
Michael Jara	MGB
Zelpha Jeremias	BFAR
Akiko Kuroki	TIT, Tokyo, Japan
Christopher Lipas	Mt Province State University

Epifanio D. Lopez	Department of Geodetic Engineering, UPD
Arsenio Lucas	MARINA
Ed Manalili	PCMARD, DOST
Reynaldo Medina	DPWH
Kazuo Nadaoka	TIT, Tokyo, Japan
Albert Nauta	LLDA Consultant, Delft Hydraulics
Yasuo Nihei	Science University of Tokyo, Tokyo, Japan
Ed Norton	LLDA Consultant, Delft Hydraulics
Enrique Pacardo	School of Environmental Science and Management, UPLB
Romeo M. Pelagio	PAGASA
Rose Perez	PAGASA
Ignacia M. Ramos	EIAPO, DPWH
Grace Ranjo	MMDA
Kelvin Rodolfo	NIGS, UPD
Dennis Rosacay	NAPOCOR
Preciosa Samonte	PCMARD, DOST
Sofia Santiago	Bureau of Design, DPWH
Nathaniel Servando	PAGASA
Fernando Siringan	NIGS, UPD
Nestor Sy	USC, Cebu City
Guillermo Q. Tabios	Department of Civil Engineering, UPD
Danilo Terrante	DLSU, Manila
Abigail Torres	Environmental Science Program - ADMU
Taro Urase	TIT, Tokyo, Japan

Imelda Velasquez	MSI, UPD
Cesar Villanoy	MSI, UPD
Taizou Yamada	JICA Expert, DENR
Aletta Yniguez	MSI, UPD

Appendix B.
Program of the Workshop/Discussions on Integrated Manila-Bay/Laguna-Lake and Surrounding Watersheds

FIRST DAY (Thursday, November 23, 2000)

8:30 - 9:00AM - REGISTRATION

9:00 - 9:30AM B OVERVIEW AND OBJECTIVES
Speakers:G.Q.Tabios, K. Nadaoka
Purposes, goals and expectations of conference/workshop
Format, schedule and organization
Involvement of Japanese professors

9:30 - 10:15AM B PHYSICAL ENVIRONMENTS
Speakers: E. Cruz, C. Villanoy, L.Q. Liongson
Physical layout of Manila Bay-Pasig River-Laguna Lake and surrounding watersheds
Geography, geology, climate, hydrology, hydraulic characteristics of physical system
Issues, concerns and problems of physical system

10:15 - 10:30AM - BREAK

10:30 - 11:15AM B BIOLOGICAL ENVIRONMENTS
Speakers:F. Siringan, Z. Catalan
Inventory of natural and aquatic resources
Inventory of native, exotic and endangered species,
Food web and resources; benthic communities
Problems, issues and concerns

11:15 - 12:00AM B POLLUTION, SEDIMENTATION AND WATER QUALITY
Speakers:F. Siringan, Z. Catalan, L. David
Nature and behaviour of pollutant loads and transport
Human activities and man-made waste loads and pollution,
Industrial waste and pollution
Agricultural waste, soil erosion and sedimentation from surrounding watersheds
Lahars from Mt Pinatubo
Laguna Lake salinity and lake eutrophication
Problems, issues and concerns

12:00 - 1:30PM - LUNCH BREAK
Moderator: Dr. Eric Cruz
1:30 - 2:30PM B DISCUSSION ON PHYSICAL ENVIRONMENTS
2:30 - 3:30PM B DISCUSSION ON BIOLOGICAL ENVIRONMENTS
3:30 - 3:45PM B COFFEE BREAK
3:45 - 4:45PM B DISCUSSION ON POLLUTION

4:45 B 6:00PM B COCKTAILS

SECOND DAY (November 24, 2000)

9:00-9:30AM B SOCIO-ECONOMIC DEVELOPMENTS AND INFRASTRUCSTURE
Speakers: R. Tanhueco, K. Doi, P. Castro
History and chronology of significant socio-economic developments
Demographics, population dynamics, migration patterns
Implications of urbanization, overpopulation and resource scarcity to health, livelihood, traffic, pollution, etc
Infrastructure for flood and river control, hydropower and fisheries facilities
Problems, issues and concerns

9:30 - 10:15AM B GOVERNANCE AND INSTITUTIONS
Speakers: K. Doi, E. Manalili
Government agencies involve in Manila Bay and Laguna Lake affairs
Institutional arrangements, jurisdictions and governance
Coordination among national government and local governments including private or non-government organizations
Political, cultural and social dimensions and agenda

10:15 - 10:30AM B COFFEE BREAK

10:30 - 11:15AM - DATA MONITORING AND NEEDS
Speakers: K. Nadaoka, G.Q. Tabios, K. Doi,Y. Nihei
Importance of information and data collection,
Types of environmental data available
Existing data collection network and practices
Sampling period or frequency in time and space interval, instrumentation, etc
Data gaps and needs
Identification and possible improvements in data monitoring

11:15 - 12:00AM B MODELING AND RESEARCH NEEDS
Speakers: G.Q. Tabios, K. Nadaoka, G. Hanada, L.Q. Liongson, Y. Shimizu, S. Oishi

Role and importance of models and modeling tools
Existing modeling efforts of Manila Bay and Laguna Lake
Model developments and improved modeling techniques
Modeling needs and research imperatives and priorities
Possible future project and research proposals

12:00 - 1:30PM B LUNCH BREAK
Moderator: Dr. Leonardo Liongson
1:30 - 2:30PM B DISCUSSIONS ON SOCIO-ECONOMIC DEVELOPMENTS AND INFRASTRUCTURE
2:30 - 3:30PM B DISCUSSIONS ON GOVERNANCE AND INSTITUTIONS
3:30 - 3:45PM B COFFEE BREAK
3:45 - 4:45PM B DISCUSSIONS DATA MONITORING, DATA NEEDS, MODELING AND RESEARCH NEEDS

Appendix C.
LIST OF INSTITUTIONS' ACRONYMS USED

ADB	Asian Development Bank
ADMU	Ateneo de Manila University
BFAR	Bureau of Fisheries and Aquatic Development
BSWM	Bureau of Soils and Water Management
DA	Department of Agriculture
DANIDA	Danish Development Assistance
DENR	Department of Environment and Natural Resources
DLSU	De La Salle University
DOST	Department of Science and Technology
DOST	Department of Science and Technology
DPWH	Department of Public Works and highways (Public Works)
EIAPO	Environmental Impact Assessment Project Office
EMB	Environmental Management Bureau
IATFGI	Inter-Agency Task Force on Geographic Information
JICA	Japan International Cooperation Agency
JSPS	Japan Society for the Promotion of Science
LLDA	Laguna Lake Development Authority
MGB	Mines and Geosciences Bureau
MMDA	Metro Manila Development Authority
MSI	Marine Science Institute

MWSS	Manila Waterworks and Sewerage Sytem
NAMRIA	National Mapping and Resource Information Authority
NAPOCOR	National Power Corporation
NCR	National Capital Region
NEDA	National Economic and Development Authority
NHRC	National Hydraulic Research Center
NIA	National Irrigation Administration
NIGS	National Institute of Geological Sciences
PAGASA	Philippine Atmospheric, Geophysical and Astronomic Services Administration (Weather Bureau)
PCAMRD	Philippine Council for Marina Research and Development
PCCARD	Philippine Council for Agriculture, Forestry and Natural Resources Research and Development
PCIERD	Philippine Council for Industry and Energy Research and Development
PHIVOLCS	Philippine Institute of Volcanology and Seismology
PRRC	Pasig River Rehabilitation Commission
PRRP	Pasig River Rehabilitation Program
SEAFDEC	Southeast Asian Fisheries Development Center
TIT	Tokyo Institute of Technology
UPD	University of the Philippines Diliman
UPLB	University of the Philippines Los Banos
URPO	Urban Road Projects Office
USC	University of San Carlos