社会開発調査部報告書

No.1

HIS MAJESTY'S GOVERNMENT OF NEPAL
Ministry of Population and Environment
Kathmandu, Nepal

JAPAN INTERNATIONAL COOPERATION AGENCY
Nepal Office
Kathmandu, Nepal

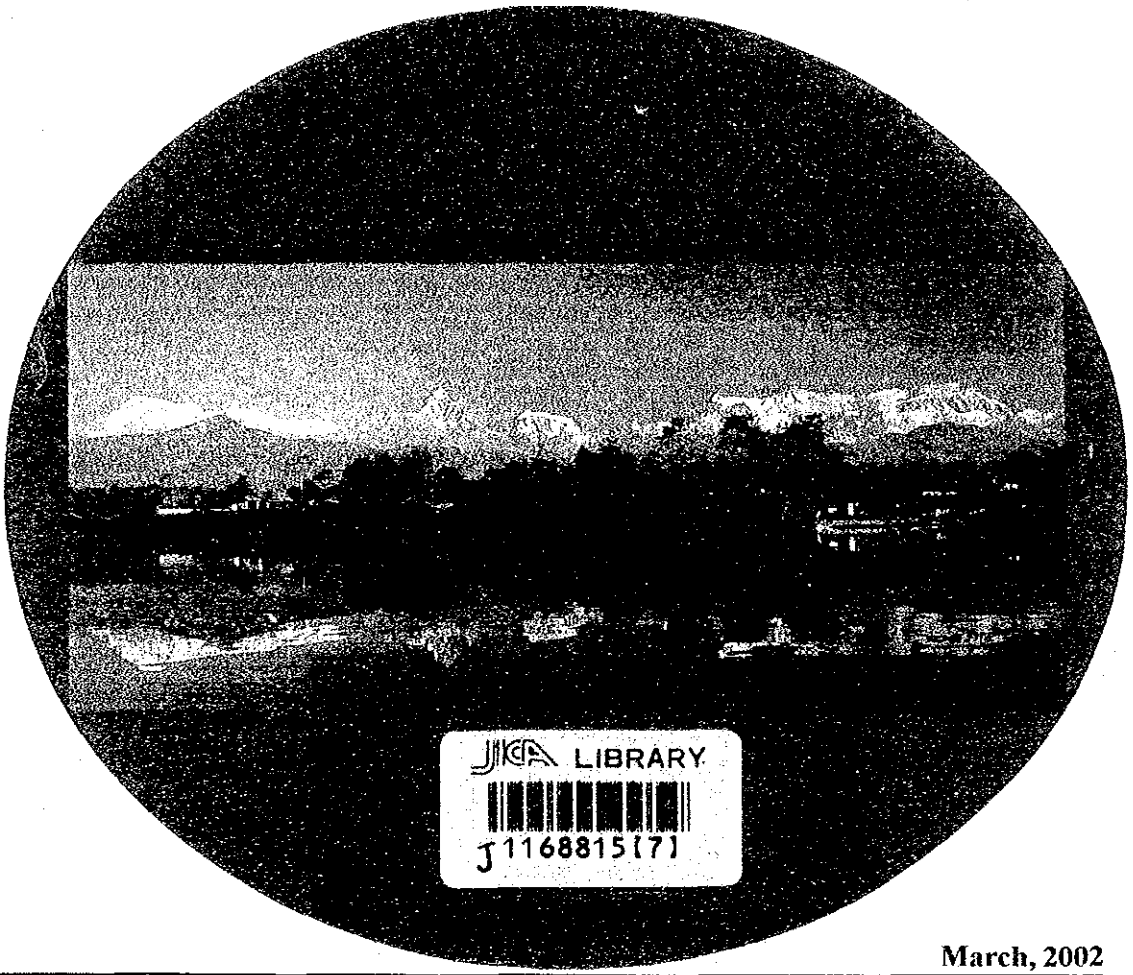
FINAL REPORT

VOLUME - I
EXECUTIVE SUMMARY

On

The Development Study on

THE ENVIRONMENTAL CONSERVATION OF PHEWA LAKE IN POKHARA, NEPAL



March, 2002

SILT *Consultants (P) Ltd.*
P.O.Box 2724, Baneshwor, Kathmandu
Tel. : 473573, 470866, 487598, 495163
Fax : 977-01-473573
Email : silt@mos.com.np
Website: www.silt.com.np

SSS
JR
02-89

HIS MAJESTY'S GOVERNMENT OF NEPAL
Ministry of Population and Environment
Kathmandu, Nepal

JAPAN INTERNATIONAL COOPERATION AGENCY
Nepal Office
Kathmandu, Nepal

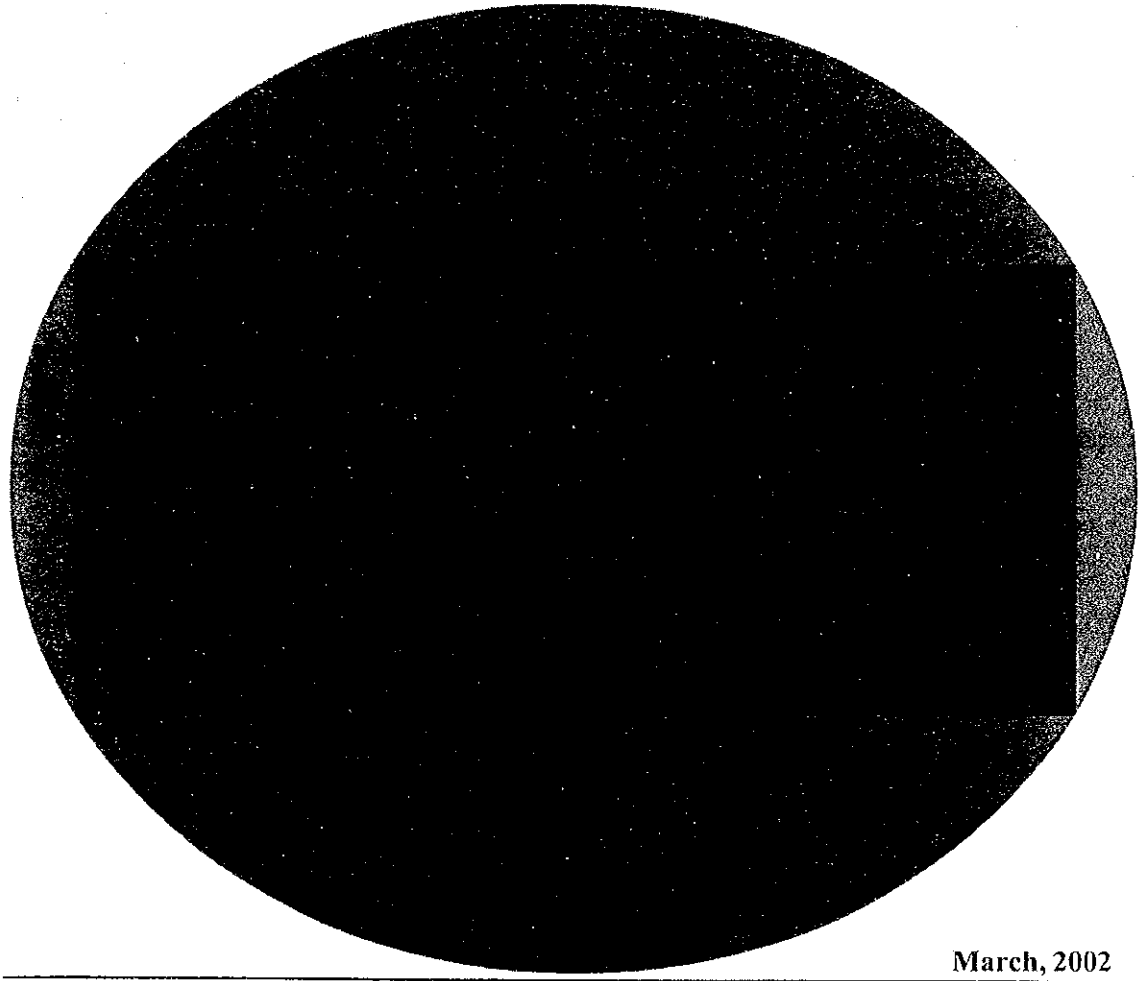
FINAL REPORT

VOLUME - I
EXECUTIVE SUMMARY

On

The Development Study on

THE ENVIRONMENTAL CONSERVATION OF PHEWA LAKE IN POKHARA, NEPAL



March, 2002

SILT *Consultants (P) Ltd.*
P.O.Box 2724, Baneshwor, Kathmandu
Tel. : 473573, 470866, 487598, 495163
Fax : 977-01-473573
Email : silt@mos.com.np
Website: www.silt.com.np

PREFACE

Nepal is renowned in the world on account of her natural beauty, biological diversity, and cultural heritage. But, due to inadequate conservation, these are being degraded to critical extent and are in dire need of sustainable management. One of such important natural heritage areas is Phewa Lake, lying in Pokhara Valley at the base of the Annapurna Himalayan Range.

Phewa Lake, which is a major tourist destination of Nepal is at present facing high human pressure at both its urban and rural watershed areas. In the absence of proper sewerage system in Pokhara city, the household wastewater and sewage is directly discharged into the Phewa Lake. Similarly, sub-surface seepage of septage from urban Lakeshore areas also pollutes the Lake. Large amount of sediment load is carried into the Lake by different Kholas (streams) flowing into it, the major one being the Harpan Khola. These streams and surface runoff from agricultural lands also add nutrient load into the Lake. All these are causing pollution of the Lake water making it beyond fit for recreational use. The nutrient load is causing eutrophication of the Lake with proliferation of water hyacinth and algal bloom, increasing rate of fish mortality and destruction of Lake ecosystem. High sedimentation rate of the Lake has half reduced its size since 1956.

In such situation, if the Lake continues to be polluted and filled up by sediment at present rate, it's recreational and aesthetic value will be diminished. Due to this, the tourism industry will sharply decline, which will have direct negative impact on local as well as national economy and livelihood of the people of Pokhara.

In the above context, the necessity of environmental conservation of Phewa Lake has been realized. The major issues includes immediate need for restricting further pollution of Lake water, minimizing sedimentation of the Lake, generating awareness among the people for it's conservation, and establishing mechanism and resources for carrying out routine developmental activities that contributes towards the conservation of the Lake.

Considering all these, His Majesty's Government of Nepal (HMGN) requested Government of Japan (GOJ) to assist through Grant Aid in environmental conservation of the Phewa Lake. Such request to GOJ was made based on the fact that GOJ has been a leading donor country, which has continually and immensely contributed in the development endeavors of Nepal.

The GOJ advised HMGN to address the environmental conservation of the Lake through an integrated study, where both technical intervention and educating people on sustainable environmental development should be interlinked.

An understanding was reached between the HMGN and GOJ, and an arrangement for implementing this **Development Study** was signed between Ministry of Population and Environment (MOPE) and Japan International Cooperation Agency (JICA) on July 13, 2001.

JICA appointed Japanese Technical Advisors for the Study and SILT Consultants (P) Ltd. (SILT) was appointed to carry out the Study in close cooperation and supervision of JICA Technical Advisors. An agreement in this regard was signed between JICA Nepal Office and SILT on September 28, 2001. A Steering Committee was formed for periodic review of the progress of the Study and give constructive advise to the Study Team. The Study was carried out between September, 2001 to March, 2002.

March, 2002 *SILT Consultants (P.) Ltd.*

This **Final Report** presents the findings of the Study and is organized in following three volumes in separate bindings:

(1) **VOLUME I : EXECUTIVE SUMMARY**

(2) **VOLUME II : MAIN REPORT**

PART I - MASTER PLAN FOR INTEGRATED CONSERVATION OF PHEWA LAKE

Chapter 1	-	Outline of the Study
Chapter 2	-	Present Environmental Condition of the Study Area
Chapter 3	-	Justifications and Components of the Integrated Environmental Conservation Plan
Chapter 4	-	Water Quality Control Plan Component (1)
Chapter 5	-	Sewerage System Plan Component (2)
Chapter 6	-	Solid Waste Management Plan Component (3)
Chapter 7	-	Watershed Management Plan Component (4)
Chapter 8	-	Ecosystem Conservation Plan Component (5)
Chapter 9	-	Monitoring Plan Component (6)
Chapter 10	-	Tourism Development Plan Component (7)
Chapter 11	-	Environmental Education and Capacity Building Plan Component (8)
Chapter 12	-	Institutional Plan Component (9)
Chapter 13	-	Project Implementation
Chapter 14	-	Project Evaluation
Chapter 15	-	Recommendations

PART II - FEASIBILITY STUDY OF PHEWA LAKE ENVIRONMENT IMPROVEMENT PROJECT

Chapter 1	-	Existing Conditions
Chapter 2	-	Alternative Plans of Lake Water Treatment / Purification System
Chapter 3	-	Planning Basis and Preliminary Engineering
Chapter 4	-	Sewage System Planning (Operational Phase)
Chapter 5	-	Implementation Program
Chapter 6	-	Institutional Consideration
Chapter 7	-	Environmental Assessment
Chapter 8	-	Project Evaluation
Chapter 9	-	Conclusion and Recommendation

PART III - FEASIBILITY STUDY FOR COMMUNITY EMPOWERMENT PROGRAM FOR PHEWA LAKE CONSERVATION

(3) VOLUME III – ANNEXES

TABLE OF CONTENTS

VOLUME I – EXECUTIVE SUMMARY

VOLUME II – MAIN REPORT

VOLUME III – ANNEXES

LIST OF TABLES

LIST OF FIGURES

ABBREVIATION/ACRONYMS USED

ADB	: Asian Development Bank
AI	: Appreciative Inquiry
amsl	: Above Mean Sea Level
CBD	: United Nations Convention on Biological Diversity
CBO	: Community Based Organization
CITES	: Convention on International Trade of Endangered Species of Wild Flora and Fauna
CRAMP	: Community Rules and Action Management Plan
DDC	: District Development Committee
DHM	: Department of Hydrology and Meteorology
DOF	: Department of Forest
EEP	: Environmental Education Program
EMMP	: Environment Management and Monitoring Plan
ESA	: Environmentally Sensitive Area
FAO	: Food and Agriculture Organization
FGD	: Focus Group Discussion
FRC	: Fisheries Research Center
GoJ	: Government of Japan
GO	: Government Organization
GTZ	: German Corporation for Technical Assistance
Ha	: Hectare
HMGN	: His Majesty's Government of Nepal
IEE	: Initial Environmental Examination
INGO	: International Non Governmental Organization
IWN	: Integrated Watershed Management
JC	: Japanese Consultant/Advisor
JICA	: Japan International Cooperation Agency
KAP	: Knowledge, Attitude and Practice
LC	: Local Consultant
LPAF	: Least Project Affected Families
lps	: Liter Per Second
m	: Meter
M/P	: Master Plan
MLD	: Million Liters Per Day
mm	: Millimeter
MOLD	: Ministry of Local Development

MOPE	: Ministry of Population and Environment
NARC	: Nepal Agriculture Research Council
NGO	: Non Governmental Organization
NTFP	: Non Timber Forest Products
NWSC	: Nepal Water Supply Corporation
PEIP	: Pokhara Environment Improvement Project
PERAMP	: Participatory Environmental Rules and Action Management Plan
PLACC	: Phewa Lake Area Conservation Committee
PLCC	: Phewa Lake Conservation Center
PLECC	: Phewa Lake Environment Conservation Committee
PLECF	: Phewa Lake Environment Conservation Fund
PSMC	:Pokhara Sub-metropolis
PTDC	: Pokhara Tourism Development Committee
PVTDC	: Pokhara Valley Town Development Committee
SALT	: Slope Agriculture Land Technology
SDC	: Swiss Development Cooperation
SILT	: SILT Consultants (P) Ltd.
SPAF	: Seriously Project Affected Families
sq. ft.	: Square Feet
STIDP	: Second Tourism Infrastructure Development Project
TL	: Team Leader
TN	: Total Nitrogen
TOR	: Terms of Reference
TP	: Total Phosphorous
UN	: United Nations
UNDP	: United Nations Development Program
USLE	: Universal Soil Loss Equation
VDC	: Village Development Committee
WB	: The World Bank
WHO	: World Health Organization
RRA	: Rapid Rural Appraisal
PRA	: Participatory Rural Appraisal

EXCHANGE RATE:

1 US $ = 78 NRs.

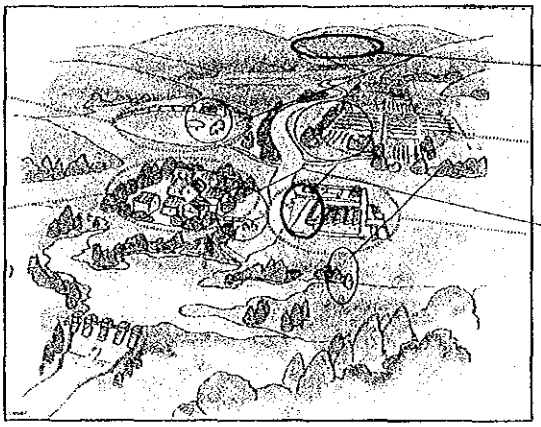
EXECUTIVE SUMMARY

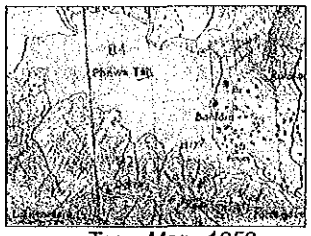
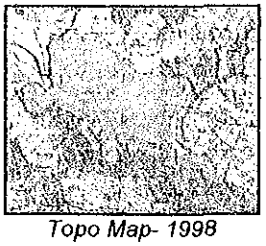
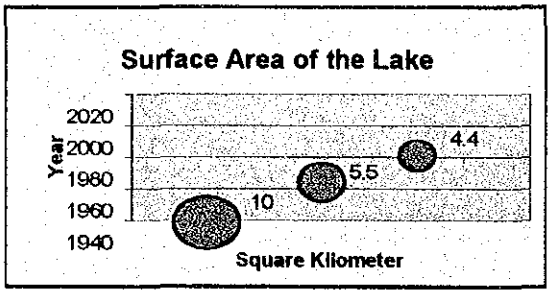
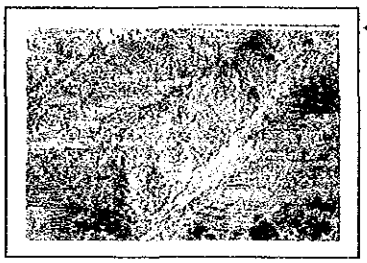
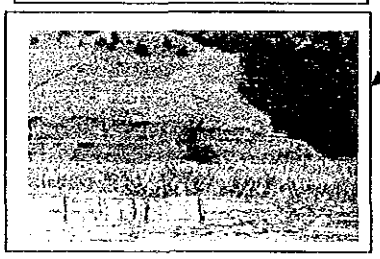
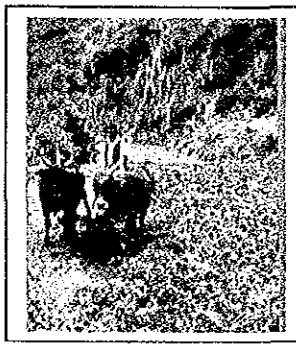
1. Background

Nepal is renowned in the world on account of her natural beauty, geographical / biological diversity, and cultural heritage. Inadequate management and unwise utilization of these resources, despite their high potential, has been undergoing severe environmental degradation. As a result, they may reach to a critically threatening point if adequate measures are not taken. One of such important natural areas is Phewa Lake in Pokhara Valley.

The Phewa Lake is one of the most beautiful places in Nepal and attracts a large number of tourists from all over the world. By the virtue of its natural beauty, the Lake contributes significantly in local and national economy through tourism industry. However, the Lake and its watershed has been under immense and exhaustive pressure due to excessive human interventions since last couple of decades. This has resulted in various environmental problems, as presented in following **Table 1**.

Table 1: Environmental Status of Phewa Lake

What is happening (ISSUE)	Why it is happening (CAUSE)
▪ **Lake Water Quality Deterioration Making It Unfit for Recreational and Aesthetic Use.**    	▪ Discharge of domestic wastewater and sewer into the Lake through point sources (Phirke *Khola, urban drain, Seti Canal etc.*) ▪ Nutrients / fertilizers from agricultural fields (nonpoint sources) **Nonpoint Source**: influenced by precipitation, runoff during rainy season, eg. agriculture land, forest, urban area etc. **Point Source**: not influenced by precipitation, discharge all year round eg. houses, factories and domestic wastewater etc. ▪ Seepage and overflow of septage from septic tanks into the Lake ▪ Direct discharge of toilet wastes into the Lake by Lakeshore residents squatters.  ▪ Runoff carrying organic pollution load and solid wastes into the Lake  ▪ *Laundry washing* by hotels and residents (100 kg of soap per day goes into *Lake water*) ▪ Pollution from freely wallowing buffaloes and pigs at Lakeshore

What is happening (ISSUE)	Why it is happening (CAUSE)
▪ **Sedimentation of Lake** – 175,000 – 225,000 m^3 of sediment deposits in the Lake per Year (DSCWM, 1994) – Lake area shrinking at the rate of 2 ha. per year	▪ High sediment load from Harpan, Andheri, Sasurke Kholas (steams) and Seti Irrigation Canal (refer the photos)
 *Topo Map- 1959*  *Topo Map- 1998*	*Aerial Photo 1956*   *Aerial Photo 1996*
	
 Landslide,	▪ Landslide and soil erosion at watershed areas – deforestation for fuel wood, fodder, encroachment ▪ Inadequately developed infrastructures (eg. Baidam-Pame road) at Lake vicinity ▪ Soil Erosion – improper hill slope terrace cultivation – over grazing by cattle
 Baidam-Pame Road	 
▪ **Lack of Environmental Education** - people activating all sorts of environmental hazards innocently/ without concern.	▪ Lack of incentive for improving daily habits that are detrimental to the Lake. ▪ Lack of commitment and leadership ▪ Indifference of the rural people towards Lake conservation as they do not get any benefit from the Lake
▪ **Lack of Lake Focused Integrated Environmental Conservation Program** ▪ **Lack of Resources to Undertake Such**	▪ Lack of an active Lake focused institution and sustainable utilization of resources ▪ The HMGN supported Phewa Lake Area

What is happening (ISSUE)	Why it is happening (CAUSE)
Program ▪ **Lack of Rural – Urban Linkage for Collective Endeavor for Environmental Conservation of the Lake.**	Conservation Committee does not have representation of beneficiaries hence more government dominated, and is grossly inactive. ▪ Benefits from the Lake not shared to rural community, which are equally responsible for its conservation.

The above issues and causes clearly presents various problems of much perplexity leading towards continual degradation of environmental health of the Phewa Lake. The pathetic state to which the Lake has reached due to these are presented below as 'Results' in **Table 2**.

Table 2: Result Due to Present Condition of Phewa Lake

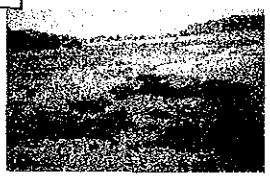
RESULT

1. Deterioration of Water Quality

- Algal bloom endangering ecosystem of Lake during rainy season
- Proliferation of water hyacinth causing pollution during rainy season

Hypertrophic - Frequent algal bloom with surface algal scum, fish death, water quality unfit for any use, becomes **Dead Lake**

Eutrophic- Deteriorated water quality, algal bloom, proliferation of water hyacinth, recreational and aesthetic value of Lake decreased



Mesotrophic – Starting of greenish water, water hyacinth, algae etc. on Lake water. Indicating gradual deterioration of water quality

Oligotrophic – No algae & water hyacinth, clean water fit for swimming

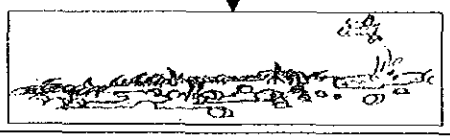
Higher Nutrient in the Lake ⟶

Higher Nutrient Inputs ⟶

Stages of Lake Water Quality Deterioration Due To Nutrient Input

- Skin and eye diseases due to swimming and bathing in polluted Lake water. Potential for outbreak of waterborne disease →

- Foul odor due to noxious gas and mass fish death during summer ↓



RESULT

The simulation study on major chemical parameters of Lake water during the Study also suggest gross decline of water quality below acceptable level with regard to international standards (refer Fig. 1). The situation will further deteriorate if countermeasures are not implemented.

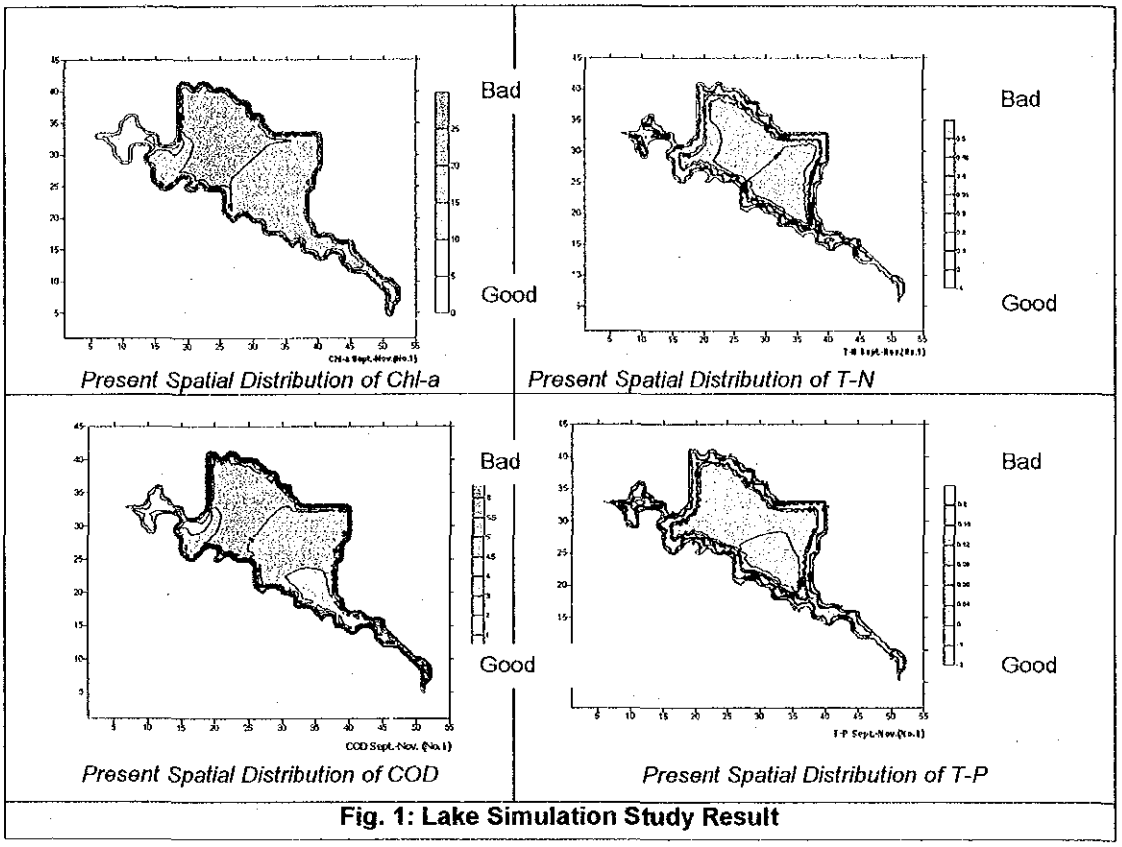


Fig. 1: Lake Simulation Study Result

This condition of Phewa Lake can also be compared with other major Lakes of Japan and China. The comparison indicates that the status of total phosphorus (TP) and total nitrogen (TN), which are the key nutrients for eutrophication are above danger level inviting algal bloom in Phewa Lake (see **Fig. 2)**.

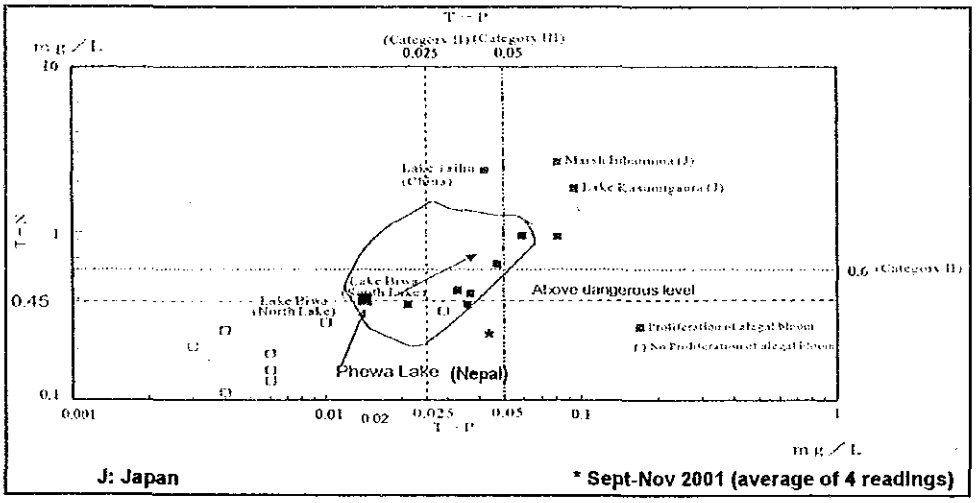


Fig. 2: Pollution Status of Phewa Lake (Comparision of Some Major Lakes of Nepal, Japan and China)

The above **Fig. 2** shows that based on TP and TN value, the Phewa Lake has crossed the dangerous level of pollution and is almost at similar pollution load status of the Biwa Lake of Japan. The situation is predicted to be worsening in near future as the recently constructed storm-water drain under Pokhara Environment Improvement Project will bring more concentrated amount of pollution load in the Lake as the people have already connected their wastewater outlet in the storm-water drain. There is also rapidly increasing population which will increase amount of wastewater. This needs mitigation measures as emergency intervention.

Pokhara, particularly the Lakeside area of Phewa Lake is attracting large numbers of tourist, and it is estimated that 16% of total income of Pokhara is contributed by tourism sector. In such situation, if the Phewa Lake continues to be polluted and filled up by sediment at present rate, thus resulting in it's diminished recreational and aesthetic value, the tourism industry will sharply decline and will have direct negative impact on local as well as national economy and livelihood of people of Pokhara.

In the above aspect, the necessity of environmental conservation of Phewa Lake has been realized. This includes immediate need for restricting further pollution of Lake water, minimizing sedimentation of the Lake, generating awareness among the people for it's conservation, and establishing mechanism and resources for carrying out routine developmental activities that contributes towards the conservation of the Lake.

Considering all these, His Majesty's Government of Nepal (HMGN) requested Government of Japan (GOJ) to assist through Grant Aid in environmental conservation of the Phewa Lake. Such request to GOJ was made based on the fact that GOJ has been a leading donor country which has continually and immensely contributed in the development endeavors of Nepal.

The GOJ advised HMGN to address the environmental conservation of the Lake through an integrated study, where both technical intervention and educating people on sustainable environmental development should be interlinked.

Subsequently, an understanding was reached between the HMGN and GOJ, and as a result of this the arrangement for implementing this **Study** was signed between Ministry of Population and Environment (MOPE) and Japan International Cooperation Agency (JICA) on July 13, 2001.

2. Objectives of the Study

The main objectives of the proposed Study is to formulate integrated plan for the environmental conservation of Phewa Lake, that will also contribute towards increasing the quality of life of poor people of its watershed area. To achieve these objectives, the Study will primarily focus on:

- water quality management plan including sewage treatment plan for checking water quality deterioration of the Lake by restricting inflow of polluted water from both point and nonpoint sources
- environmental education program for enhancing awareness of the urban and rural communities residing within the watershed area of the Lake

The Study also aims to formulate:

- watershed management plan to conserve the Phewa Lake watershed area and control rapid sedimentation of the Lake;
- ecosystem conservation plan of the Lake and its watershed area;
- monitoring system plan (including water quality, hydrological monitoring and soil erosion monitoring plan);

- institutional plan to assist in establishing a Lake focused umbrella organization for undertaking and coordinating all the activities related with the environmental conservation of the Lake, and interlinking urban and rural partnership for optimized utilization of Lake resources; and
- financial resource mobilization from increased tourism sector by developing Phewa Lake area as beautiful scenic place, which will assist in sustainable development of both urban and rural areas.

Accordingly, the main aim of the Study is threefold:

1. Study the feasibility of different alternatives for **Treatment of the Polluted Water of the Lake** and its sources.
2. Formulate an **Environmental Education and Community Empowerment Program** that will generate awareness among the urban and rural population residing at the Lake watershed area, and mobilize them for a collective endeavor for environmental conservation of the Lake.
3. Establish a **Phewa Lake Environment Conservation Committee** and a **'Phewa Lake Conservation Fund;** which will recycle the income generated from commercial use of Phewa Lake to the development of its urban and rural watershed areas, the ultimate result of which will contribute to its effective environmental conservation.

3. Study Area

The valley of Pokhara is located at 125 km west from Kathmandu, and at 28^0 10' N to 28^0 16' N Latitude and 83^0 58' 30" E to 80^0 02' 30" E Longitude. It is well connected with all season motorable highway and air routes, with more than half dozen flights daily from Kathmandu. Phewa Lake lies about one kilometer southwest of Pokhara valley, at an elevation of about 793 amsl. The Location Map of the Study Area is given in **Fig 3** in the following page.

4. Necessity of an Integrated Master Plan

The present environmental condition of the Lake is in poor state, and is continually degrading. If countermeasures are not taken immediately, then in future

- water quality of the Lake will severely deteriorate to an irreversible state, causing foul smell, fecal bacterial contamination, outbreak of water borne diseases, and eutrophication and algal bloom in the Lake.
- Lake will be completely filled-up by sediment in next 190 years,
- ecosystem and Lake biodiversity will be completely destroyed, and
- the Lake will soon become a **'Dead Lake'** with it's recreational and aesthetic value diminished.

Such deterioration in the water quality, size and ecosystem of the Lake will cause following:

- Decline in aesthetic beauty of the Lake
- Lake water quality become unfit for bathing, swimming, water sports
- Foul odor discourage people/tourist to visit the Lake
- Increase in rate of mortality of fishes and other aquatic animals
- Decline in income and employment from tourism and fishery development related activity dependent on Lake
- Decline in ecosystem health of the Lake and socio-cultural development of the area
- Urban decay at Lakeside area will initiate with decline in tourism industry

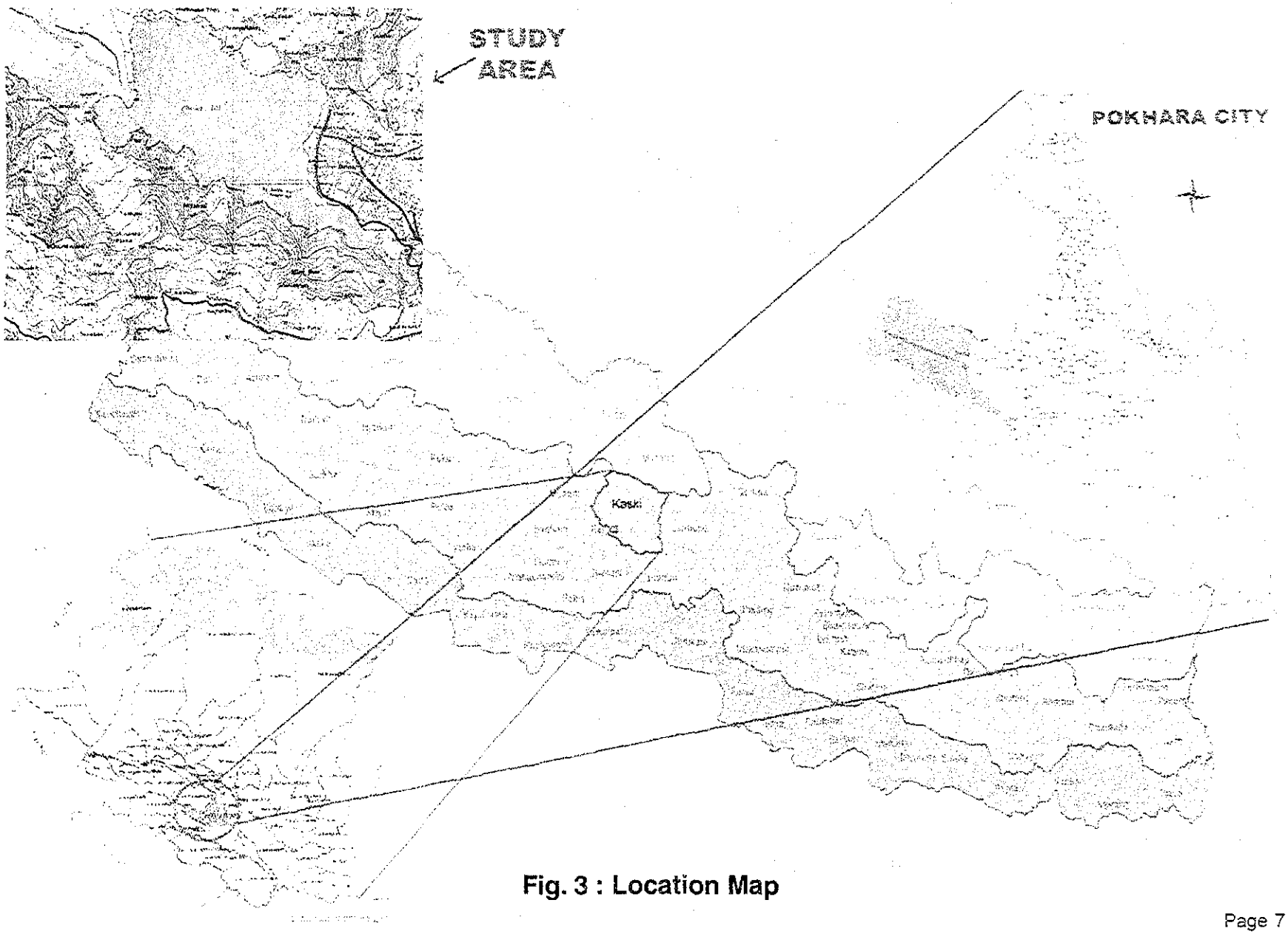


Fig. 3 : Location Map

A flow chart on Cause, Effect and Countermeasures is presented in **Fig. 4.** In the above condition of emergency status, an integrated **Master Plan** is needed, which will address all the necessary countermeasures to check any further deterioration of the Lake water quality and revive it back to its pristine condition. Such Master Plan needs to be of multi pronged and integrated nature to address each causes at its root, thus finally attaining the environmental conservation of the Lake in its totality. A diagram showing projected Environmental Problems, Recommended Countermeasures, Framework of Master Plan and Components of Master Plan is also presented in **Fig. 5.**

The objectives of the Master Plan are to:

- save the Phewa Lake through implementation of integrated strategy, which will assist to reverse the present trend of deterioration of the Lake water quality and it's sedimentation, and revive the ecosystem of the Lake;
- improve environmental condition of the Lake as well as its entire watershed area;
- urban-rural linkage for attaining collective effort for sustainable environmental conservation and lengthening life of the Phewa Lake, and in the process share benefit generated from the Lake capital for improving the quality of life of the people of both the areas;
- establish Lake focused, beneficiaries participated and legally supported institution with sufficient authority, as well as establish Phewa Lake Conservation Fund for generating resources for undertaking developmental activities at the rural and urban watershed area of the Lake; and
- launch environmental education and community empowerment and capability improvement program for generating awareness and commitment for environmental conservation of the Lake.

5. National Environmental Planning

The Local Self Governance Act, 1999 entitles DDC, Municipality and VDCs to undertake conservation and sustainable utilization of water bodies lying within its territory. Aquatic Lives Protection Act, 1999 provides legal protection of aquatic animals and their habitat. It bans application of harmful fishing gear. National Park and Wildlife Conservation Act, 1962 amendment, 1992 has provision of benefit sharing for community development. The Environment Protection Act and Regulation, 1997 categories lake/wetland habitat under environmentally sensitive area.

The National Conservation Strategy of Nepal, 1994 and Nepal Environmental Policy and Action Plan, 1994 has emphasized for generating public environmental awareness as a cost effective and long-term sustainable means for environmental education. The Charter of Pokhara Sub-metropolitan City (PSMC) deals on public responsibilities in general about the environmental conservation activity. PSMC has also adopted Solid Waste and Sanitation By-laws, 1999.

All these national level Acts, Regulations, By-laws, Plans and Program provide legal basis for the environmental conservation of Phewa Lake.

6. Scope of the Study

The scope of Study includes the preparation of following integrated plans to achieve the above-mentioned objectives:

1. Phewa Lake Water Quality Management Plan
2. Sewage Treatment Plan including Purification System
3. Environmental Education Plan and Community Awareness and Empowerment Program

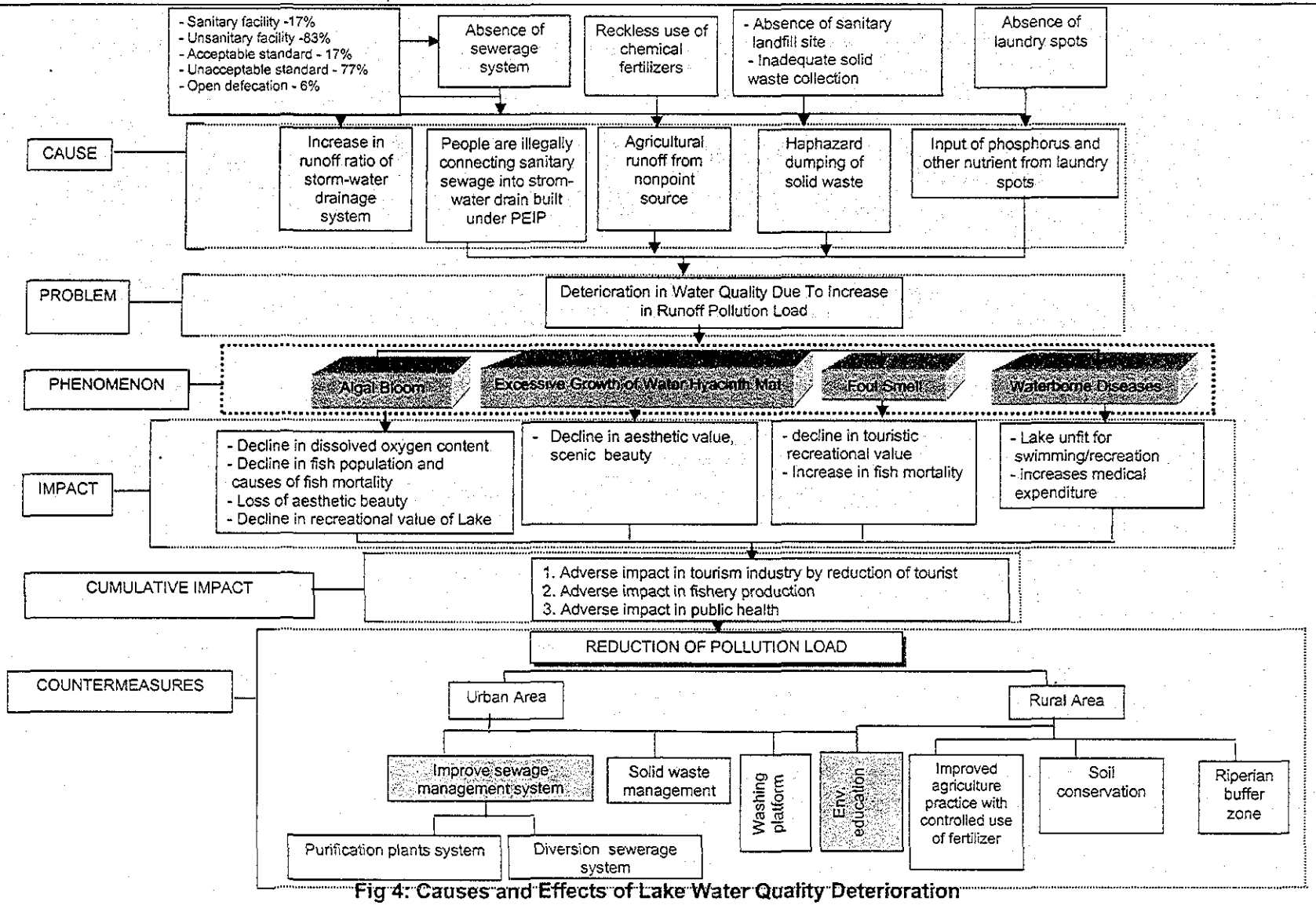


Fig 4: Causes and Effects of Lake Water Quality Deterioration

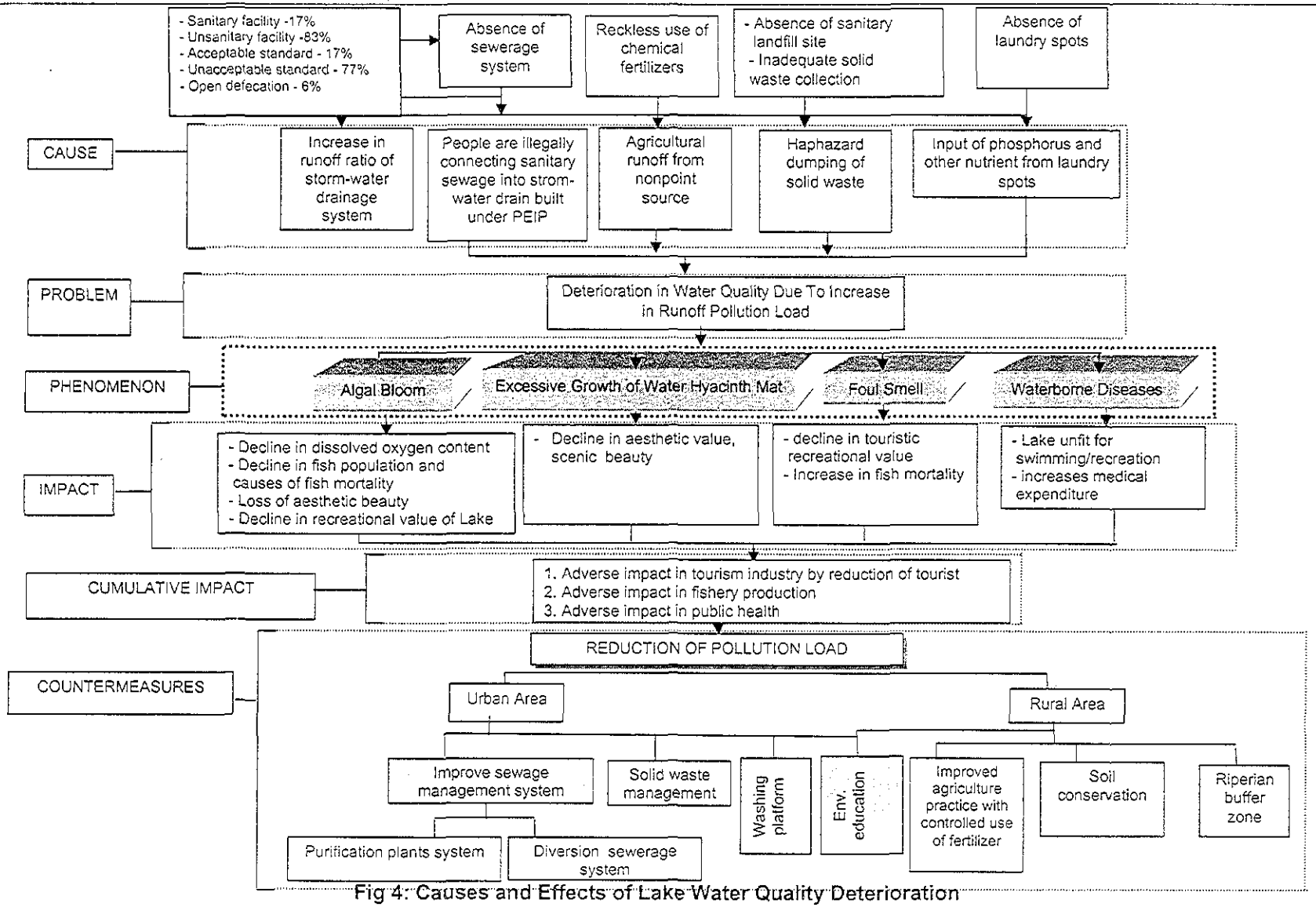
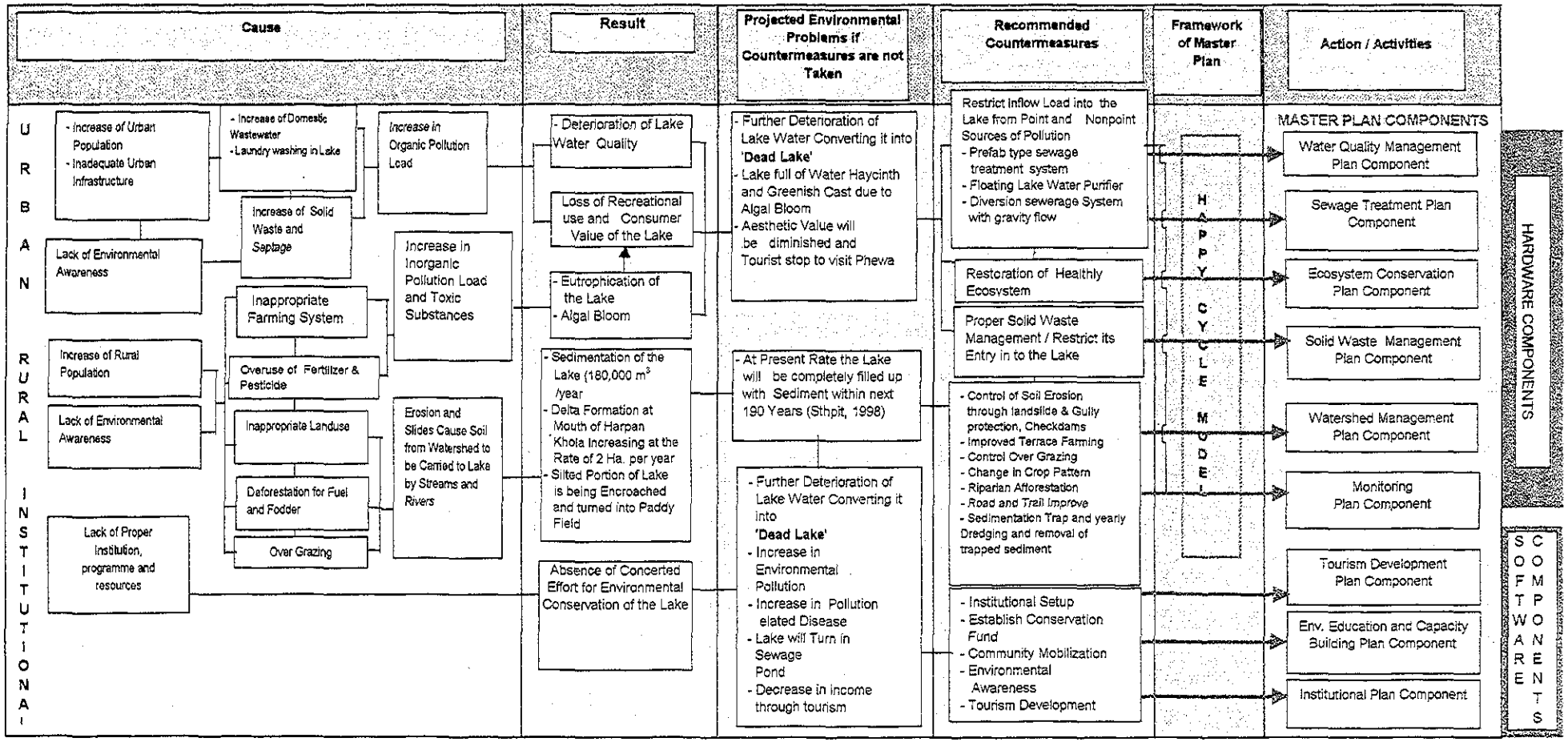


Fig 4: Causes and Effects of Lake Water Quality Deterioration

Fig. 5: Cause, Result and Countermeasures for Integrated Environmental Conservation of Phewa Lake



4. Organizational/Institutional Strengthening Plan to establish a Lake focused umbrella organization to undertake and coordinate Lake conservation related activities. Study on plan for establishment of a Phewa Lake Conservation Center and Phewa Lake Environment Conservation Fund
5. Watershed Management Plan
6. Ecosystem Conservation Plan of Lake Area
7. Monitoring Plan
8. Tourism Development Plan
9. Solid Waste Management Plan

7. Need of People

A public hearing, as a part of the Study for Environmental Conservation of Phewa Lake, was organized on December 25, 2001 in Pokhara.

The public hearing was participated by the **Chairman, Kaski DDC; Mayor, PSMC; Member, Nepal Tourism Board; Chairman of the surrounding VDCs; President, HAN Pokhara Chapter; President, Pokhara Hoteliers Association; Chief, Tourism Office Pokhara/ HMGN; District Forest Office, HMGN; Soil Conservation Office, HMGN; Chief and Engineer, Pokhara Valley Town Development Committee, Pokhara; and representation from Private Sector, NGOs and CBOs like Mothers Group, Boater Association , Fishermen Association** and others.

It was strongly recommended during the Public Hearing (refer Table 3) that the study should focus on long-term proposal and should be implemented at the earliest.

Table 3: List of Issues and Suggestion Made During Public Hearing, Dec, 25, 2001

S.N	Issues	Comments/Suggestion
1.	Water Quality Management and Sewage Treatment	▪ Every one is concerned on quality of Lake water ▪ Water hyacinth is decreasing aesthetic beauty of Lake ▪ Lake water stinks and also develop skin rashes when touched. ▪ Urban area through Phirke Khola, Seti Canal and laundry washing pollute the Lake. The storm-water drain constructed recently will further aggravate the situation as people have connected wastewater into the drain ▪ Based on the interaction, diversion of Phirke and other urban drains beyond the Lake is the most desirable and best alternate, although it does not coincide with the type of request of HMGN to GOJ for Grant Aid
2.	Watershed Management and Environmental Education	▪ Sedimentation of the Lake is the biggest problem, which has significantly decreased its size and volume ▪ Watershed management and environmental education is necessary and people are eager to participate ▪ River training of Harpan Khola is recommended
3.	Tourism Development	▪ The issues of negative impact on tourism due to the environmental degradation of the Lake is a concern for all ▪ Tourism should also be developed in the rural area as eco/village tourism ▪ Road to the rural area needs upgrading ▪ Attempt to lengthen the stay of tourist is necessary through improved infrastructure facilities
4.	Organisation/Institution	▪ An authorized and accountable committee for the conservation of the Lake is a must ▪ This committee should be well represented by beneficiaries rather than only HMGN agencies ▪ Member Secretary from HMGN is a good idea

5.	Phewa Lake Conservation Fund	▪ Such stable fund is necessary ▪ Most of the participants agreed and recommended to levy conservation fees from the tourists as sustainable source for the Fund ▪ Some prominent hoteliers expressed support if some tax for conservation of the Lake is also levied on local hotels, restaurants and business.

8. Basic Policy for Preparation of the Master Plan

The basic policy for preparation of Master Plan are:

- ***Establishment and Strengthening Rural – Urban Partnership***

Sustainable environmental conservation of Phewa Lake is possible only through a rural – urban partnership, in which also the economic benefit generated from Lake is judiciously shared between them for undertaking developmental activities in these areas. A conceptual model for this in the form of **'Happy Cycle'** is presented in **Fig. 6.**

- **Integrated Environmental Conservation through Integrated Approach**

The objective of the Master Plan is to be attained through implementation of several identified integrated and complimentary activities, which can be broadly grouped in to various components under a single Master Plan. The conceptual framework for integrated environmental conservation of the Lake is presented in **Fig. 7.**

The figure shows that the water quality and sediment management of Phewa Lake as its core of the issues to be addressed. Environmental education and community empowerment should be the assisting activity for sustainable use of the intervention on water quality and watershed management. All these will directly contribute for Lake ecosystem management and conservation of Lake biodiversity. A Lake focused and legally supported institutional setup with financial source can successfully coordinate, implement and monitor the conservation activities. These should be under the framework of Happy Cycle. All the data, information on Phewa Lake should be documented and disseminated by Phewa Lake Conservation Center.

- **Institutional Setup for Collective Effort**

The policy for developing Master Plan includes establishment of a Lake focused, autonomous and legally supported institution with sufficient authority, which is represented by all the levels of beneficiaries and stakeholders. A fund also needs to be set-up with sustained source of income, one of which may be charging conservation fee to the tourists.

- **Combination of Hardware and Software Components**

The hardware component includes technical intervention to attain certain target level, whereas software component relates with human sentiments, awareness and capability. The following **Fig. 8** represents this basic concept within the basic policy adopted by this Study. The implementation program for environmental conservation of Phewa Lake is a vehicle, which has hardware and software components as its two wheels, and successful environmental conservation of Phewa Lake as its integral body. An autonomous and lake focused institutional setup is its driver, which will drive the vehicle towards its goal. The fund raised from utilizing economic value of the Lake will be its fuel. The benefit ripped from the Lake will be resource of the fund, which will be shared by urban and rural watershed areas of the Lake for their developmental activities. The final output of these will be contribution for sustainable environmental conservation of the Phewa Lake.

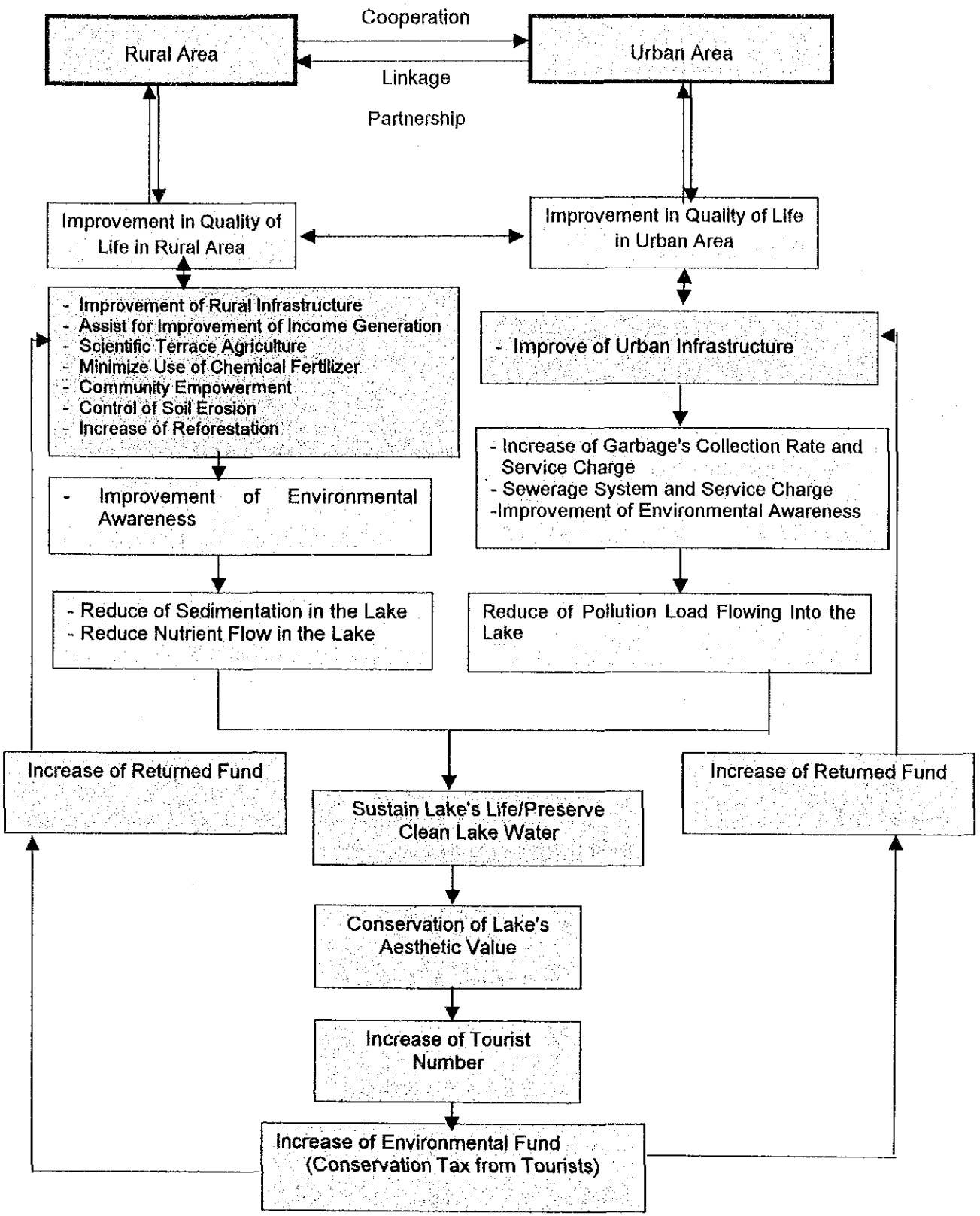


Fig. 6: 'Happy Cycle Model' for Sustainable Conservation of Phewa Lake

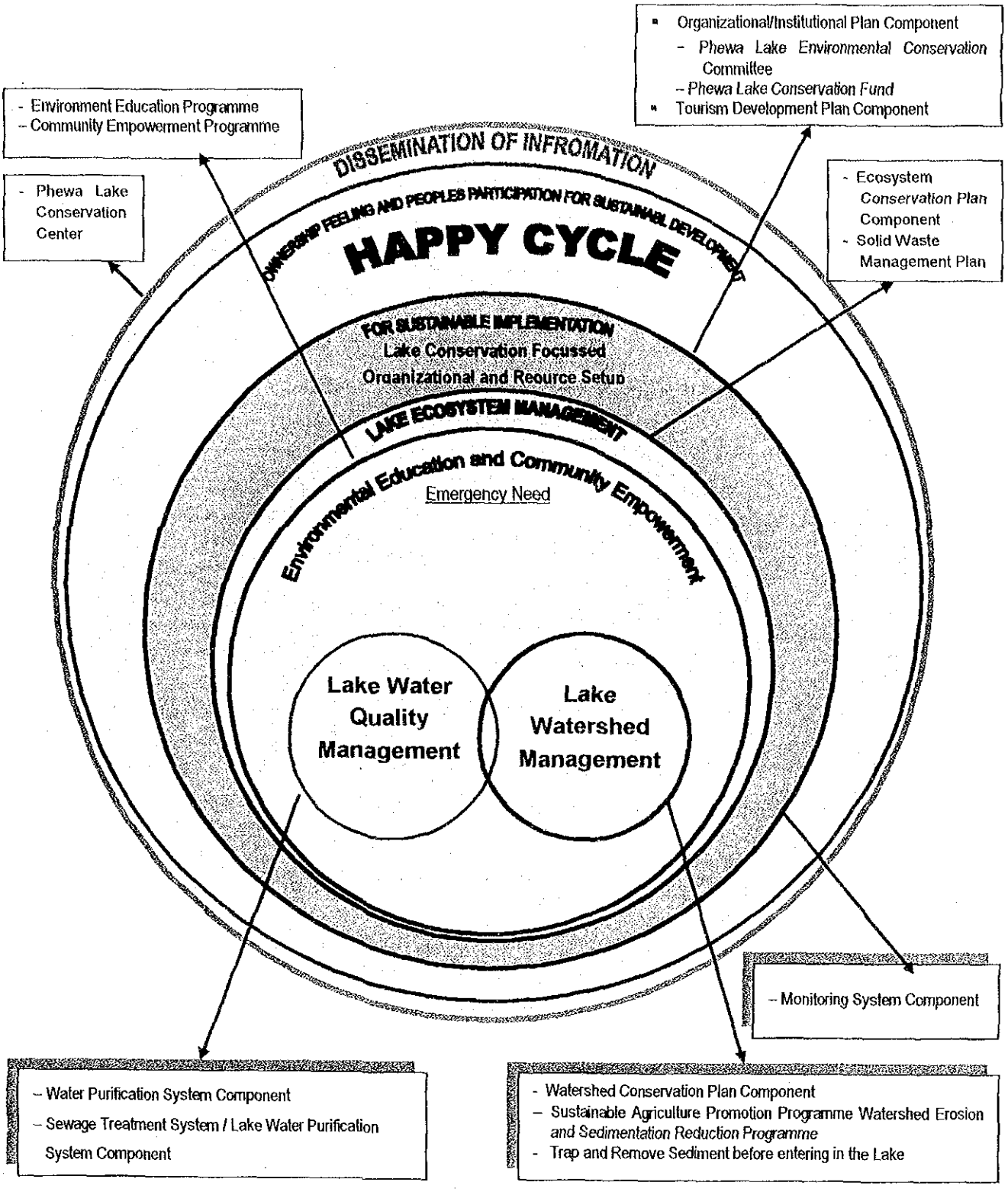


Fig. 7: Integrated Environmental Conservation Plan for Phewa Lake

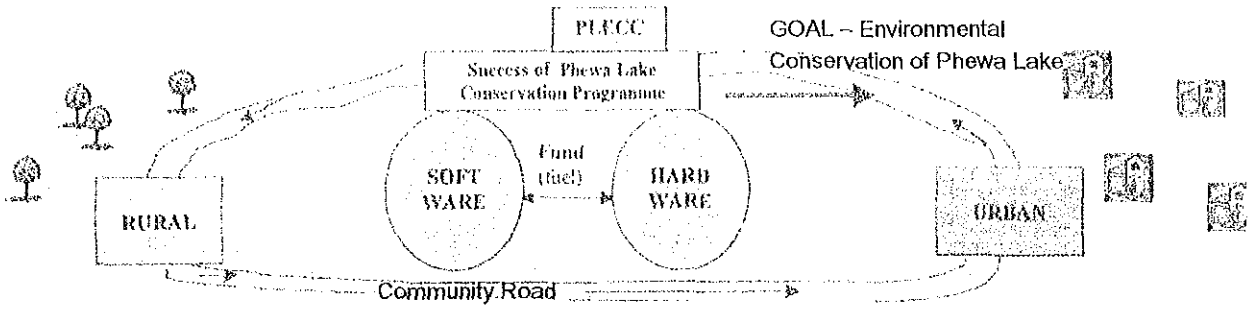


Fig. 8: Graphical Presentation of Basic Concept Within Basic Policy of the Master Plan

9. Components of the Master Plan

The **Master Plan** has been conceptualized by the Study with following nine numbers of Hardware and Software components, as presented in **Fig. 9**.

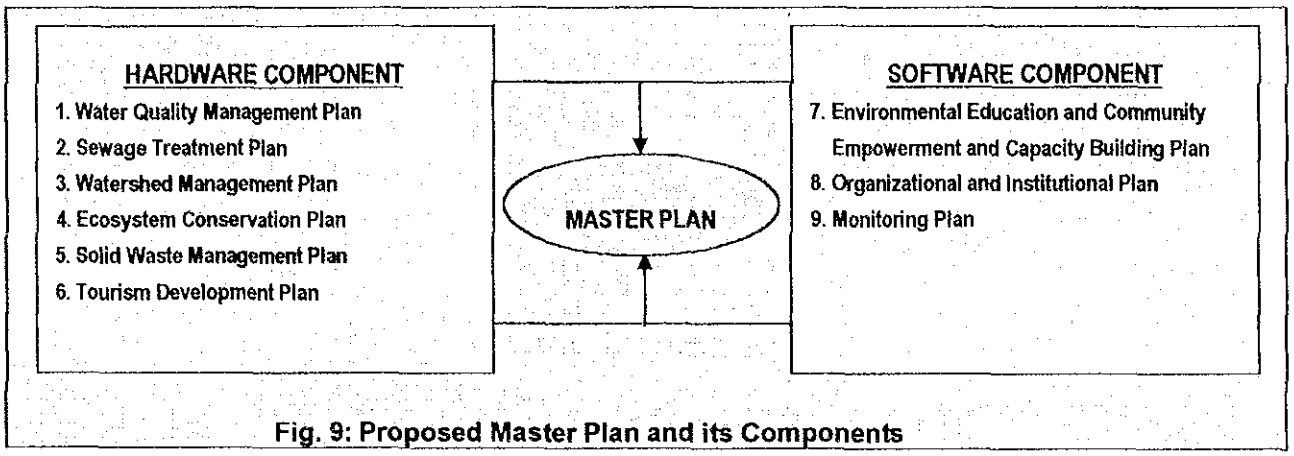


Fig. 9: Proposed Master Plan and its Components

The program and projects (strategic actions) to be undertaken in each of the components are *presented in following* **Table 4**.

Table 4: Components of the Master Plan

S. N.	Components	Programs	Project
1	*Water Quality* Management Plan	▪ *Establishment of conservation targets, water* quality standards, allowable inflow load, target reduction load etc. ▪ Principles for the distribution of the target reduction load (selection of important areas and generation sources) ▪ Selection and evaluation of load reduction measures ▪ Applicable scale of load reduction measures	▪ *Load reduction plan based on* simulation study finding ▪ Check entry of pollution load from point sources by construction of sewage treatment system ▪ Check entry of nonpoint pollution load by construction of buffer strip around the Lake ▪ Construction of laundry platform along Lakeshore
2	Sewage Treatment Plan	▪ Domestic and commercial (hotel, restaurants etc) waste water and sewage treatment plan	- Diversion sewerage system
3	Watershed Management Plan	▪ Important areas for the implementation of the soil runoff prevention measures ▪ Measures for environmental conservation *oriented agriculture* ▪ Selection and evaluation of soil runoff prevention measures	▪ Sustainable agriculture promotion program ▪ Agro forestry and reforestation ▪ Silvi pasture ▪ Water source protection

S. N.	Components	Programs	Project
			▪ Watershed erosion and sedimentation reduction program Landslide treatment ▪ Lakeshore buffer belt plantation ▪ Stream bank erosion treatment ▪ Road Improvement (drainage slope stabilization) ▪ Dredging
4	Ecosystem *Conservation Plan*	▪ Measures for conservation of wetlands	▪ Eco land use planning and buffer zone in Lakeshore ▪ Biodiversity protection and conservation of threatened species ▪ Protection of wetland ecosystem
5	Solid Waste Management Plan	▪ Basic policy for domestic solid waste management plan in urban areas ▪ Domestic solid waste management plan (basic concept) for rural watershed areas	▪ Solid waste management ▪ Reduce-Recycle-Reuse ▪ Environmental education and community mobilization
6	Monitoring Plan	▪ Specifications for Lake water quality monitoring ▪ Specification for hydrological monitoring ▪ *Measures for watershed monitoring*	▪ Lake water quality monitoring ▪ Hydrological monitoring of *inflowing streams* ▪ Watershed monitoring
7	Tourism Development *Plan*	▪ Policies for tourism development	▪ Promenade along lakeshore ▪ Monitoring building By-laws ▪ Phewa festival ▪ Lakeside community road ▪ Village tourism
8	Environmental Education and Community Empowerment and Capacity Building Plan	▪ Methods for implementation of environmental education program ▪ Capacity building method to create human resources that can contribute to the effective *management of environment*	
9	Organizational and Institutional Plan	▪ Institutional system for implementation of Master Plan ▪ Revitalize or establish institutional setup that is focused on Phewa Lake environmental conservation ▪ Environmental information collection, management and utilization system	▪ Establish Phewa Lake Environment Conservation Committee ▪ Establish Phewa Lake Environment Conservation Fund - Establish Phewa Lake Conservation Center

10. Prioritization of Components of Master Plan

The following **Table 5** presents the interrelation of various components under the proposed Master Plan in matrix format. The table also presents priority components of the Master Plan that needs to be implemented immediately as a short-term emergency measure, which will give maximum effect within short period of time and can also produce long-term sustainable impact for conservation of the Lake. It is predicted by the Study that in the absence of quick implementation of such components, the Lake will experience most threatening and devastating environmental degradation, as it is undergoing at present, and will further deteriorate in future.

Table 5: Rating of Selected Projects for Prioritization

Components	Hardware					Software		
Parameters	Sewage Treatment	Water - shed	Ecosystem	Solid Waste	Tourism	Env. Edu	Inst. Setup	Monitoring
Environmental								
Support Better Water Quality	10	8	6	6	4	8	8	8
Conserve Threatened Bio-Diversity/Habitat	8	8	10	6	4	8	6	8
Reduce Environmental Pollution	8	6	6	8	6	8	6	8
Ensure Long Term Sustainability	8	8	8	6	6	10	8	8
Technical								
Cost Effective	5	2	2	3	4	5	4	3
Easy O&M	5	3	2	3	3	4	4	3
Technical Suitability	5	4	4	4	4	5	4	4
Ecosystem Support	5	4	5	4	4	5	4	4
Economic								
Economic Return	4	4	3	3	4	4	3	3
More Targeted to Poorer People	4	4	3	3	4	5	4	3
Degree of Contribution For Increasing Number Of Tourist	4	4	5	3	4	3	3	3
Suitability of O&M	4	4	3	3	3	4	5	3
Social								
Number of Beneficiary	5	5	4	4	5	5	5	3
Degree of Request By Stakeholders	5	4	4	3	4	5	5	3
Easy to Implement/Low Resistance	4	4	3	3	3	3	4	3
Social Need /Emergency	5	5	3	4	4	5	5	3
Total	**93**	**76**	**71**	**66**	**69**	**87**	**78**	**70**
Ranking	**1**	**4**	**5**	**8**	**7**	**2**	**3**	**6**
Priority	**H**	**M**	**M**	**M**	**M**	**H**	**M**	**M**

Criteria of Rating: 1: Poor (<20%) 2:Fair (21-40%), 3=Moderate (41-60%), 4=Good (61-80%), 5=Excellent (>80%):, **Maximum Mark:** 100

Level of Priority: High Priority (H): Excellent Level; **Moderate Priority (M):** Moderate to Good level

Ranking for prioritization of projects indicated out of 8 selected plans, 2 numbers of plan belong to high priority and 6 numbers belong to moderate priority. The first category plan includes **Sewege Treatment Plan** in the first place followed by **Environmental Education Plan**; both scoring in the excellent range (80-100%) and verified as topmost priority projects (Table 3). Componentwise, the former and latter belong to hardware and software components respectively. The **Institutional Strengthening Plan** stood at first place in the second category and among the top 3 plan. The other 2 plans among top 5 plans included **Watershed Management Plan** and **Ecosystem Conservation Plan**. This was followed by **Monitoring Plan, Tourism Development Plan** and **Solid Waste Management Plan** successively. The **Water Quality Management Plan** has been excluded for rating as its major objective of restoration of water quality is met by sewage treatment plan and monitoring.

It is in this context; two of the components, namely **Sewage Treatment Plan** oriented for better water quality management and **Community Empowerment Program** have been studied in detail at Feasibility Level. They are also justified as they represent hardware and software components. The former will address short-term goal and the other the long-term goal. Their combination will be very effective. Other components are studied at Master Plan level. However, in each of the plan components, the prioritized activities are also identified and presented as Action Plan.

11. HMGN Requested Grant Aid from GOJ

11.1 Objective

The Objective of HMGN requested Grant Aid is to:

- restrict pollution load in Phewa Lake from urban and rural areas
- conserve Phewa Lake watershed area
- develop and conserve the Lake as attractive scenic spot
- enhance livelihood of local communities living in Phewa watershed area
- acquire foreign currency through sustained tourism promotion
- wise utilization of environmental resources of Phewa Lake and its watershed area for development of quality of life of rural and urban people

To achieve these objectives, the proposed ***Grant Aid*** aims to

- minimize water quality deterioration by restricting inflow of polluted water and purification through technical intervention
- improve water quality of the Lake by restricting eutrophication of the Lake water
- conserve water resources for habitants, who live at downstream of the Lake
- supply adequate water for irrigation and hydropower at downstream of the Lake
- remove sediment deposited in the Lake and keep enough Lake water surface area, as well as maintain water volume for irrigation purpose.

11.2 Scope

To achieve the above mentioned objectives and aim, the requested Grant Aid envisage immediate technical intervention to protect the water quality of Lake and its sedimentation through mechanical means. These include following:

- **Prefab Type Small Sewage Treatment Plant** to be installed at the discharging point of streams and urban drains into the Lake. It will lift the polluted water, treat it through contact aeration process and discharge treated water in the Lake. Three numbers of such plants are provisioned to be installed.

- **Floating Type Lake Water Purification System** to be installed on Lake water surface at various locations. The energy required for operation of the purifier will be generated through solar power. 25 numbers of such equipment are proposed to be installed on Lake surface at an interval of 20 m.

- Installation of two numbers of **Pump Dredger** to remove sediment deposited at the bottom of the Lake.