CONTENTS

CHAPTER 7

WATERSHED MANAGEMENT PLAN COMPONENT(4)

The Development Study on Environmental Conservation of Phewa Lake in Pokhara, Nepal

CHAPTER 7
WATERSHED MANAGEMENT PLAN COMPONENT (4)

7.1 BASIC POLICY

7.1.1 Objective of Basic Concept Formulation

The objective is to prepare integrated watershed management plan and manage it through participatory approach and institutionally and financially sustainable way.

7.1.2 Basic Policy

The basic policies for preparing master plan for watershed management are summarized as follows.

- Since 70-80% of the Nitrogen and Phosphorus load flowing into Phewa Lake originate from nonpoint sources, a watershed management plan that would ensure effective reduction of load from nonpoint sources is necessary.
- Soil erosion not only reduces land productivity but also supplies pollutants to the water area and promotes rising of river bed and reclamation of swamps and marshes. The reduction of soil erosion, therefore, should be the most important issue in the watershed management plan.
- Phase-wise soil erosion mitigation should be adopted in accordance with soil erosion hazards.

Chemical fertilizers (TN/TP) used in agriculture terraces at vicinity of the Lake finally flows in to the Lake along with top soil causing nutrient load and sedimentation of the Lake

- For areas prone to soil erosion but where agricultural activities thrive, an agricultural structure geared towards environmental conservation, which is not only effective for soil erosion prevention but also for the reduction of agricultural chemical and fertilizer use, should be planned and promoted.
- For areas prone to soil erosion but where agricultural activities do not thrive, soil erosion prevention project mainly focusing on afforestation should be implemented. In particular, considerations should be given to conservation and restoration of riverine forests to effectively prevent soil flowing into the river.
- Strengthen financial assistance, technical guidance and environmental education and income generation activities for farmers as an incentive in helping to promote the establishment of an agricultural structure geared towards environmental conservation.
- Regularly monitor the effects of soil conservation, reduced agricultural, chemical and fertilizer use, and improved land productivity brought about by the establishment of an agricultural structure geared towards environmental conservation.
- Functions of conservation/watershed committees along with relevant agencies should be strengthened as well as the shared use of information to expedite implementation of plans and measures for watershed conservation should be promoted.

- Extension of community forestry.
- Declare Phewa Lake watershed area 'Protected Watershed' under Soil and Watershed Conservation Act, 1982 and its rules and regulations, 1986 to ensure appropriate land use practices and watershed management measures.

7.2 BASIC CONCEPT OF WATERSHED MANAGEMENT IN PHEWA LAKE WATERSHED

The basic concept would be to

- reduce sediment flow into the river system and sedimentation in the Lake, since the Lake would be silted up in 190 years at the present sedimentation rate (Sthapit et. al. 1998).
- ensure the sustained and economic productivity of land through introduction of proper land use practice.
- reverse the trend of watershed degradation by rehabilitation of erosion prone areas.

7.3 CONSTRAINTS AND ALTERNATIVES FOR MASTER PLAN

The problems and constraints in watershed management are summarized as follows:

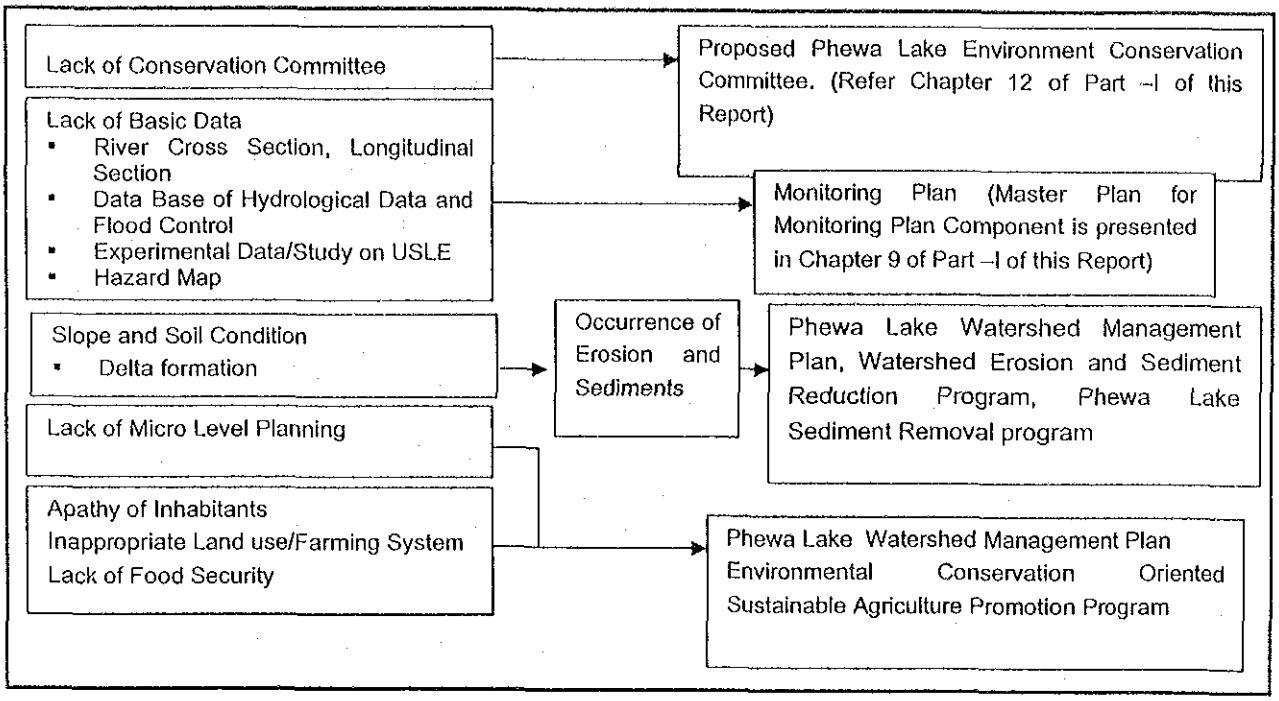
- Lack of Conservation Committee
- Lack of Basic Data
  - no information on cross and longitudinal sections of main rivers
  - few data on hydrology and flood records
  - few experimental data and studies on the USLE erosion
  - lack of hazard map
- Presence of slope and soil condition
  - erosion due to fragile soil and steep slope
  - delta formation in the Lake
- Lack of micro level planning
- Apathy of inhabitants
  - soil erosion by inappropriate land use and farming practice, due to lack of knowledge
  - inadequate awareness and skill regarding watershed management activities
  - lack of food security

Considering the above mentioned constraints and problems, the following plans have to be formulated for an effective watershed management in the Study Area:

- Strengthening of governmental organizations and integration of information regarding integrated watershed management (IWM). The NGOs/CBOs in the project area (Rural/Urban) have to be strengthened with training on skill and knowledge enhancing for conservation purpose. The activities to be undertaken for watershed management by INGOs/ NGOs /CBOs is presented in **Chapter 11** of **Part I** and **Part III** of this Report.
- Promotion of participatory environmental conservation oriented sustainable agriculture and sediment reduction program.

The casual relationship between constraints and alternatives is illustrated in **Fig. I-7.1.**

Fig. I-7.1: Relation Between Constraints and Alternatives



7.4 ENVIRONMENTAL CONSERVATION ORIENTED SUSTAINABLE AGRICULTURE PROMOTION PROGRAM

7.4.1 Background

Approximately 33% of the watershed is classified as hill agriculture land. The average land tenure of bari land and khet land per household is estimated to be 0.15 and 0.32 ha respectively and the cropping intensity is more than 200%, which is quite higher than national average. It indicates that farmers are under pressure to use their farmland as intensively as possible to meet the increasing demand of food production. More than 70% of the Households are suffering from food deficit for more than 9 months.

In absence of increased/productivity the present grass and shrub lands will be converted to marginal agricultural land leading to more soil erosion, and present food supply levels will decrease.

The existing land use of Phewa Lake watershed is shown in **Table I-7.1**, and **Fig I-7.2**.

The I-7.1: Land Use in Phewa Lake Watershed Area

Land-Use Category	Area (km^2)	Per cent
Hill agricultural land	40.26	32.73
Lowland and tar agricultural land	7.02	5.73
Forest area	54.31	44.32
Shrub forest	3.45	2.82
Pasture and barren land	4.49	3.66
Urban land	5.75	4.69
Lake	4.43	3.62
Rivers and Others	2.82	2.30
Total	122.53	100.00

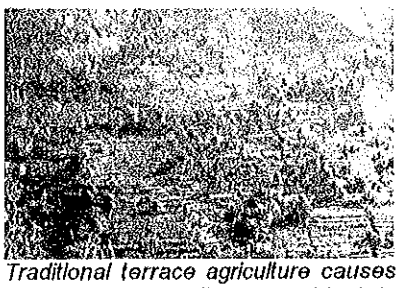
Source: The Land-use Map of Leminen, K.et.al., 1991, IWMP and Sikrikar et.al., 1996 and the Areal Photos of 1996.

7.4.2 Objectives and Strategies

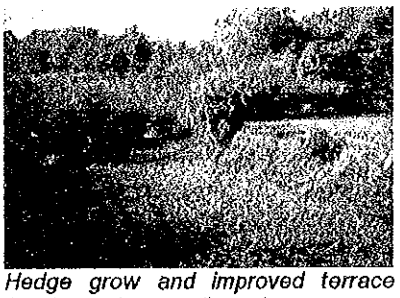
The objectives of this program are as follows

- to strengthen environment management capacity of institutions
- to reduce soil erosion and agro chemical contamination
- to apply environmental conservation oriented agriculture and sustainable agriculture productivity
- to set up farmers group for soil conservation

To accomplish above mentioned objectives, the following strategies should be considered.



Traditional terrace agriculture causes soil erosion and flow of nutrient in natural drains.



Hedge grow and improved terrace farming reduces soil erosion.

(1) Integrated Watershed Management Approach

Since watershed management plan involves agriculture, pasture, forestry, water resources and other green line agencies, integrated watershed management and package approach would be necessary.

(2) Participatory Approach

Farmers are the key persons in making decisions related to land use and management. However the field survey found that there is lack of knowledge for land use planning either for agricultural farming practices or the management of natural resources including watershed management in the rural areas of Phewa Lake. Thus, watershed management program through a "bottom-up" participatory approach eliciting their participation from planning to implementation/follow-up and monitoring. Activities should be initiated with the farmers need, backed up by technical and economic feasibility and implemented through community/users' group.

(3) Economy Diversion

Agriculture in the hills has been saturated; economic diversification will be necessary to release pressure on land for cultivation. Hence, alternative income-generating activities should be promoted along with watershed management program. For this purpose, the beneficiaries can be encouraged for cultivation of non-timber forest product, which will provide cash income to the rural households.

(4) Phased Development and Implementation

For successful execution of this program, the phased development should be adopted and implemented. The community from users' groups can be mobilized for improved soil management and improved terrace agricultural practices.

7.4.3 Countermeasures and Improvement Area

Additional package for this program can be implemented as a combination of agronomic, vegetative and mechanical measures. Proposed supplementary measures are summarized in **Table I-7.2** considering the project area. The areas for improvement through this program based on recommended land use map (**Fig. I-7.3**) has been anticipated to be 60% total arable area and 40% of pasture, shrub land and forest as shown in **Table I-7.3.** HMGN, Department of Soil Conservation and Watershed Management, District Soil Conservation Office and JICA has also implemented watershed management activities, as shown in **Table I-7.4** and **I-7.5.** JICA assisted 'Community Development Forestry Watershed Conservation Project V' implemented in some VDCs of Kaski district has contributed immensely towards watershed conservation and protection of soil erosion, and can be taken as good example for replication.

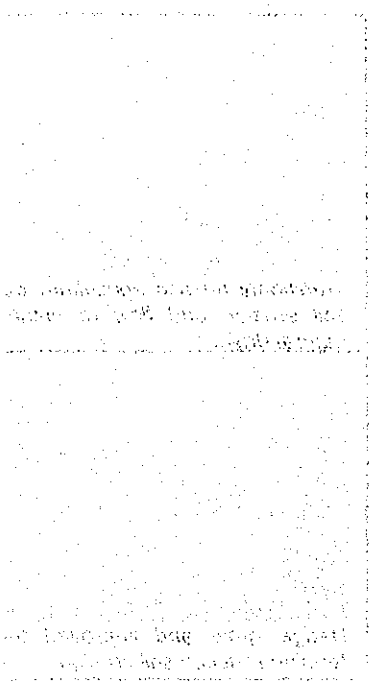


Table I-7.2: Proposed Countermeasures

Recommended Land Use	Zone	Countermeasures
Bari Land (Up Land) C-4	2	On farm conservation including: Bench terrace Contour cultivation Cover crop Crop rotation with introduction of leguminous plants/cash crop Minimum tillage
C-5	3	Agro forestry/non timber forest products (NTFP)
Khet Land (Terraced Land) T-2/3	1	Maintenance of terraces/irrigation channels Maintenance of soil fertility Construction of ponds Improvement of trails
T-4	2	Terrace improvement /drainage disposal Maintenance of soil fertility Maintenance of irrigation channel
TPF	3	Plantation of fruit/fodder trees/NTFP
Grass Land G-1	1	Grassland management Introduction of improved grass variety Rotational grazing Grazing restriction at eroded area
G-2	2	Silvi pasture Introduction of leguminous plants/fodder trees/NTFP
GPF	3	Reforestation with multipurpose trees
Shrub Land S-1	1	Shrub land management Reforestation with fodder /fuel wood/NTFP
S-2	2	Same as above
SPF	3	Reforestation with multipurpose tree species
Forest Land PDF	1	Forest management
LUF	2	Reforestation with fodder/fuel wood/NTFP/cash groups (in low crown density eg. coffee, ginger, farm grass)
PRF	3	Forest preservation

Table I-7.3: Net Project Area

Land Use	Existing Area (ha)	Implementation	Net Project Area (ha)
Agriculture	3,924	0.6	2,354
Grassland	371	0.6	223
Shrub land	262	0.4	105
Forest	4,570	0.4	1,828
Total	**9,127**	-	**4,510**

Table I-7.4: Major Achievement During Fiscal Year 1974/75 to 1998/99 and Proposed Activities for F/Y 2000/01-2003/04 in Phewa Lake Watershed Area

S. No.	Major Activity	Unit	Assistance From					Total
			HMGN	UNDP/ FAO	FINNIDA	JICA *		
			1974/75 to 1980/81	1981/82 to 1985/86	1986/87 to 1990/91	1994/95 to 1998/99	2000/01 to 2003/04 (Proposed)	1974/75 to 1998/99
Preventive Measures								
1	Conservation Plantation	ha.	90	345	108			543
		No.				3	5	3
2	Terrace Improvement	ha.	72	70	37			179
3 a.	Fruit Tree Planting	ha.	20	-	-			20
3 b.	Fruit Tree Distribution	No.	-	-	13,000			13,000

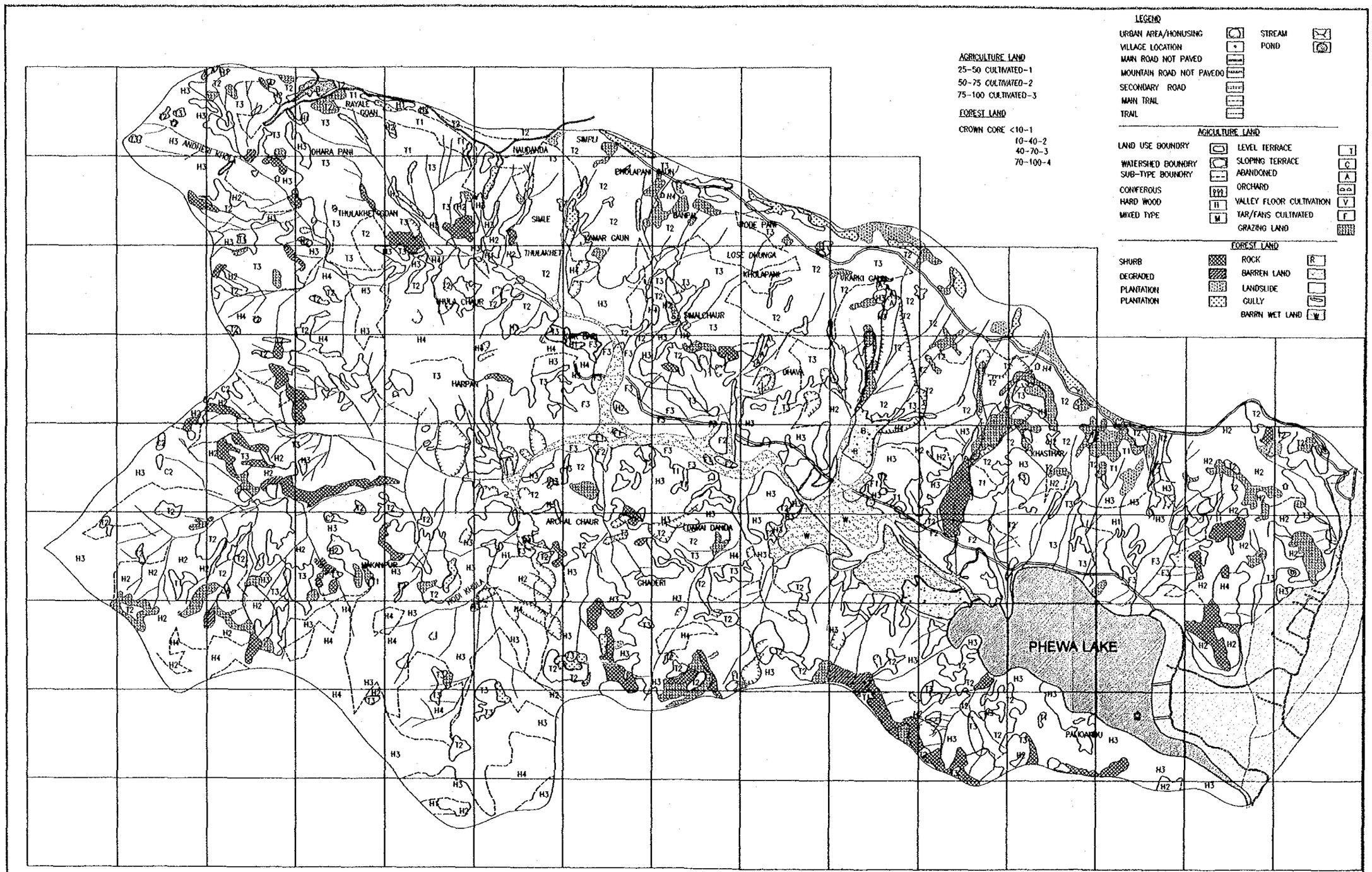
S. No.	Major Activity	Unit	Assistance From					Total
			HMGN	UNDP/ FAO	FINNIDA	JICA *		
			1974/75 to 1980/81	1981/82 to 1985/86	1986/87 to 1990/91	1994/95 to 1998/99	2000/01 to 2003/04 (Proposed)	1974/75 to 1998/99
4	Pasture (Grass Planting)	ha.	35	31	52			118
5.a	Conservation Pond	No.	-	36	21	1		57
5.b	Maintenance	No.				1		1
6	Water Source	ha.	-	6	-			6
	Protection	No.	-	-	19	2	7	21
7	Nursery Establishment	No.	-	3	5			8
Rehabilitative Measures								
8	Gully Treatment	No.	-	8	15		5	23
		km	-	9	-			9
9	Landslide Treatment	No.	-	14	15	4	3	33
10	Trail Improvement	km	-	26	17			43
		No				21	24	21
11	Irrigation Channel	ha.	100	-	-			100
	Improvement	No.	-	4	3	2	2	9
12	Torrent Control/Check Dam	No.	206	-	-		5	206
13	Stream Bank Control Embankment	m	620	-	680			1,300
14	River Training	No.					3	3
15	Bridge Construction	No.				1	1	1
16	Toilet Construction	No.				1	1	1
17	Farmers Training	No.	-	20	72			92
18	Household Training	No.	-	25	-			25
		Time	-	-	6			6
19	Study Tour	No.	-	-	154	24		178
20	User Groups Capacity Building	No.					340	340
Income Generation								
21	Bee Hive Distribution Bee Keeping	No.	-	-	10	1		11
22	Mushroom Training	No.	-	-	90			90
23	Potato Cultivation	No.				15		15
24	Goat Raising	No.				19		19
25	Pig Farming	No.				1		1
26	Orange Farming	No.				1		1

*Note: *1994/95-1998/99 activities were implemented in Chapakot VDC., 2000/01-2003/04 activities planned to be executed in Bhadaure Tamagi VDC by JICA*

Table I-7.5: Areas Handed Over as Community Forests Upto 1998

S. No.	VDC	Area (ha)	Household
1	Bhadaure Tamangi	181	816
2	Dhikur Pokhari	597	2,570
3	Kaskikot	317	1,257
4	Sarangkot	337	1,553
	Total	**1,432**	**6,196**

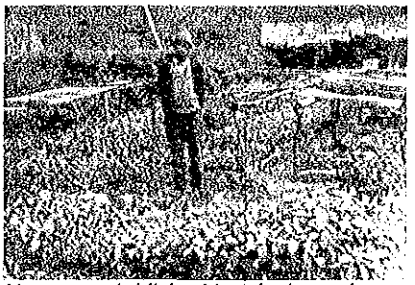
Land use critical areas are shown in **Fig. I-7.4** in the following page.



JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	THE DEVELPOMENT STUDY ON THE ENVIRONMENTAL CONSERVATION OF PHEWA LAKE IN POKHARA , NEPAL	DRAWING TITLE: *PRESENT LANDUSE MAP*				SCALE 0 500 1000 1500 2000 2500m	SHLT Consultants (P.) Ltd. Baneswor,Kathmandu,Nepal P.O Box: 2724 Fax: 977-1-473573 Phone: 473573 ,470866 ,487598, 495163 E-mail:shl@mos.com.np Web:www.shl.com.np	Fig. No. 1-7.2 SHEET No.

7.4.4 Project Cost

The major components considered for the cost estimation comprises of farm management, agro-forestry, terrace improvement (level), grass land improvement, silvi pasture, reforestation with fodder/fuel wood/NTFP-cash crops, forest management, irrigation channel improvement, water source protection and pond construction/renovation. The potential for pond construction and renovation in the rural areas has been considered for potential for providing spring and drip irrigation for off-season vegetable cultivation, fish farming to supplement cash income as well as to reduce nutrient flow in the streams. These activities can be consolidated within the environmental education awareness campaign program. The cost of other measures are considered small compared to that of main measures. The total estimated cost is summarized in **Table I-7.6**.



Nursery established in private scale, Dhikur Pokhari

Table I-7.6: Cost Estimation

(Unit: ,000 NRs)

Countermeasures	Amount to be Covered	Unit Cost	Cost
On-Farm Conservation	20 ha	40	800
Agro-Forestry	3 ha	5	15
Terrace Improvement/Drainage Disposal	2295 ha	10	22,950
Grassland Improvement	40 ha	4	160
Silvi Pasture	180 ha	5	900
Conservation Plantation	39 ha	10	390
Reforestation	1681 ha	5	8,405
Forest Management/ Community Forestry	252 ha	2	504
Water Source Protection	16 nos.	15	240
Pond Construction/Renovation	20 nos.	40	800
Irrigation Channel Improvement	16 km	200	3,200
Total			**37,464**
Annual O/M Cost (3% total cost)			**1,124**

7.5 WATERSHED EROSION AND SEDIMENTATION REDUCTION PROGRAM

7.5.1 Background

Phewa Lake, the locally, regionally and nationally important Lake is being filled up by 180,000m^3 of sediments annually. Delta formation at the mouth of the Harpan Khola, a main river feeding the Lake has continued at the rate of about 2 ha annually since 1973 (Sthapit et. al. 1998). Meanwhile the river is meandering its course within the delta and its tributaries in the low land of watershed areas leading to the loss of valuable agricultural lands of poor farmers. The Lake sedimentation has encouraged the people to encroach and convert the sediment deposited area of the Lake into paddy fields, and with the present sedimentation rate the Lake would be silted up in next 190 years.

Although, much of the sediment load reaching the Lake is carried by Harpan Khola, the ultimate sources of sediment are stream/river bank cutting, landslides, irrigation channels, road and trail construction with out slope stabilization and drainage, and agricultural practices further upstream

(Refer Fig I-7.4). Besides the Harpan, the major tributaries are Andheri, Lauruk, Betani, Khahare Khola, Khapaundi, Orlang, Sedi, Phirke (in the Study Area); and Handi, Tora, Marse (outside the Study Area) responsible for carrying sediments in the Lake (refer **Fig I-7.5**).

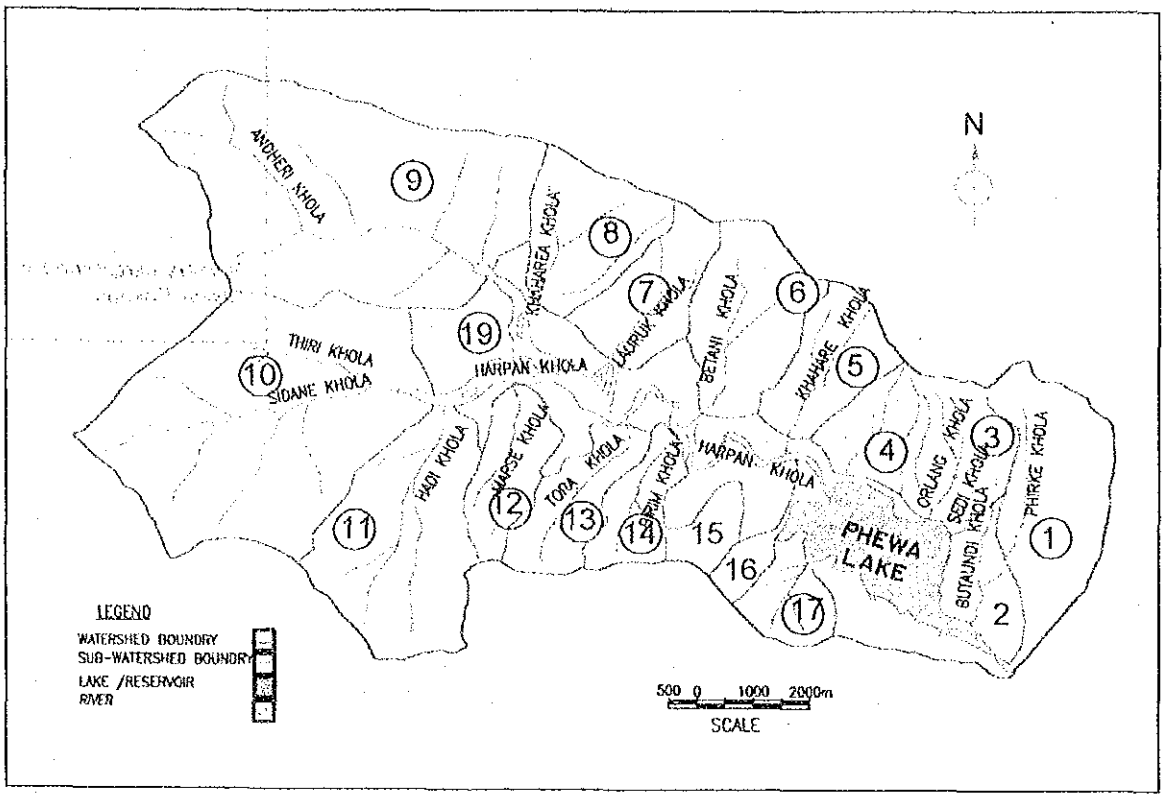


Fig. I-7.5: Map of Sub-watershed with Tributaries

Some streams directly flow into the Lake. Among them, the Phirke Khola is a major source of transportation of garbage and pollution load into the Lake from the urban area of PSMC.

7.5.2 Objectives and Strategies

The objectives of this program is to promote erosion control and reforestation to recover environmental conditions in the Phewa Lake watershed and to reduce sedimentation in the Lake. To accomplish these objectives, the following strategies are considered.

(1) Participatory Approach

The program will adopt the concept of "Participatory Approach" eliciting the farmers participation from planning to implementation/follow-up and monitoring. Activities should be initiated with the farmers' need backed up by technical/economic feasibility and implemented through community/user's group

(2) Phased Development and Implementation

Phased development and implementation must be carried out at village development level.

7.5.3 Countermeasures and Improvement Area

Countermeasures for this program needs to be implemented as a combination of erosion prevention/bio-engineering, reforestation programs, sediment removal from the Lake and other proposed countermeasures. The net improvement area for the Master Plan is as shown in **Table I-7.7**.

Table I-7.7: Countermeasures and Improvement Area

Countermeasure	Net Improvement Area	Remarks
Landslide Treatment: Large	2 no	
Medium	13 no	
Small, Gully	20 no	
Lakeshore Buffer Belt Plantation	70 ha	10 m wide plantation
River Embankment	29 km	
Stream Bank Erosion Treatment	10 km	
Road Improvement (drainage, slope stabilization)	44 km	(i) Bindabasini-Sarangkot - Naudanda (ii) Kande-Bhadaure Deurali (iii) Pame -Thulakhet
Trail Improvement	92 km	
Riparian Afforestation	8 ha	2 m wide belt

It is proposed that watershed conservation can also be initiated through pilot projects at micro-watershed level. Agriculture terrace land improvement and riparian buffer belt plantation at the bank of small tributaries/gullies will be effective for 'Peak Cut' during heavy downpour. Construction of small ponds as sediment / nutrient trap at the mouth of tributaries will control sedimentation as well as minimize nutrient load in the streams, which flows into the Lake. The ponds can also be used for fish cultivation, thus generating extra income.

7.5.4 Project Cost

The project cost estimation is presented in **Table I-7.8**.

Table I-7.8: Cost Estimation

(Unit : ,000 NRs)

S. No.	Countermeasures	Amount to be Covered	Unit Cost	Cost
1	**Landslide Treatment:**			
	Large	2 no	1000	2,000
	Medium	13 no	200	2,600
	Small/Gully	20 no	100	2,000
2	Lakeshore Buffer Belt Plantation	7 ha	10	70
3	River Embankment	29 km	7,000	203,000
4	Stream Bank Erosion Treatment	10 km	3,000	30,000
5	Road Improvement	44 km	150	6,600
6	Trail Improvement	92 km	150	13,800
7	Riparian Afforestation	8 ha	10	80
	Sub-Total			**260,150**
	Annual O/M Cost (3% of the total)			7,804
	Total			**267,954**

7.5.5 Effect and Benefit

This project is closely related to the agricultural production concerning stability of production, recovery of the productivity and reduction of sediment transport. The following effects and benefits are expected, which are summarized in **Table I-7.9.**

Table I-7.9: Effects and Benefits

SN	Item	Unit	With Project	Without Project	Improved Area/No.	Effect/Benefit
1	Agriculture Land Improvement	(ha)	2533	179	2354 ha	1) Sustaining agriculture productivity
2	Pasture / Grazing Land Improvement	(ha)	341	118	223	2) Conservation of forest resources
3	Forest Land Improvement	(ha)	1933	-	1933	3) Improvement of water quality
4	Landslide Treatment	(ha)	68	33	35	4) Reduction of production cost
5	River/Stream Bank Erosion Treatment	No	40.3	1.3	39	5) Mitigation of landslides flood damage
6	Road/Trail Improvement	km	179	43	136	6) Reduction in maintenance cost
7	Irrigation Channel Improvement	km/No	16 km+9 no	9 nos.	16 km	7) Increase of Lake surface area
8	Reforestation Area	ha	223	543	1696	8) Reduction in sediment and pollution load
9	Water Source Protection/Pond	no	114	78	36	
	Renovation					
10	Sediment Trap		1	-		
11	Dredging	ha	20	-		
12	Land					
13	Forestland					
14	Nitrogen (kg/ha/yr)					
15	Nutrient Loss of Potassium (kg/ha/yr)					

7.6 SEDIMENT REMOVAL PROGRAM

Considering the serious consequences of sediment intrusion into the Lake, it has become essential to protect the Lake in terms of its size and quality of water. The removal of such huge quantity of annual sediment can be done by two methods viz. (i) Gravity Hydraulic Removal Process, and (ii) Mechanical Removal Process.

7.6.1 Gravity/ Hydraulic Removal System

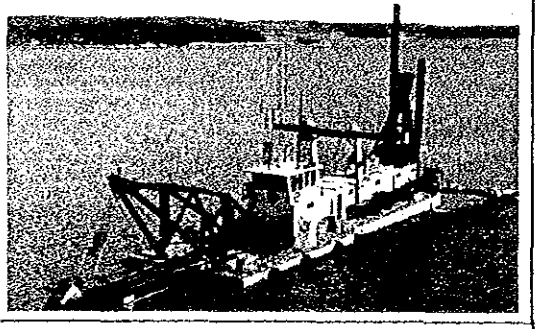
The gravity hydraulic removal process can be applied in Phewa Lake by constructing a sediment deposition chamber, where settling velocity of inflowing water will be created at the mouth of Harpan Khola. This will allow only sediment free water into the Lake. A tunnel connecting the sediment deposition chamber to Phushre Khola near Ukali passing under Bhimdhara, Thulimari etc. can be constructed (refer **Fig. I-7.6**). The sediment chamber will be provided with two regulating gates. The annually deposited sediment in the sediment chamber will be flushed under gravity flow during monsoon season into Phusre Khola through the tunnel by regulating the gates. This alternative will have minimum operation and maintenance cost, and will be a long-term solution to save Phewa Lake from sedimentation.

7.6.2 Mechanical Removal System

The sediment intruded into the Lake can be mechanically removed by (i) dredging, and/or (ii) excavation.

(1) Dredging

Dredging is a process by which a machine excavates the deposited sediment from the bottom of lake through hydraulic or electric power driven cutter and removes the sediment by suction tubes. The soil is then pumped to the disposal site via floating and shore pipeline. It will then be further transported to disposal location by involving other mechanical equipment.



Ship Dredger on Lake Water Surface

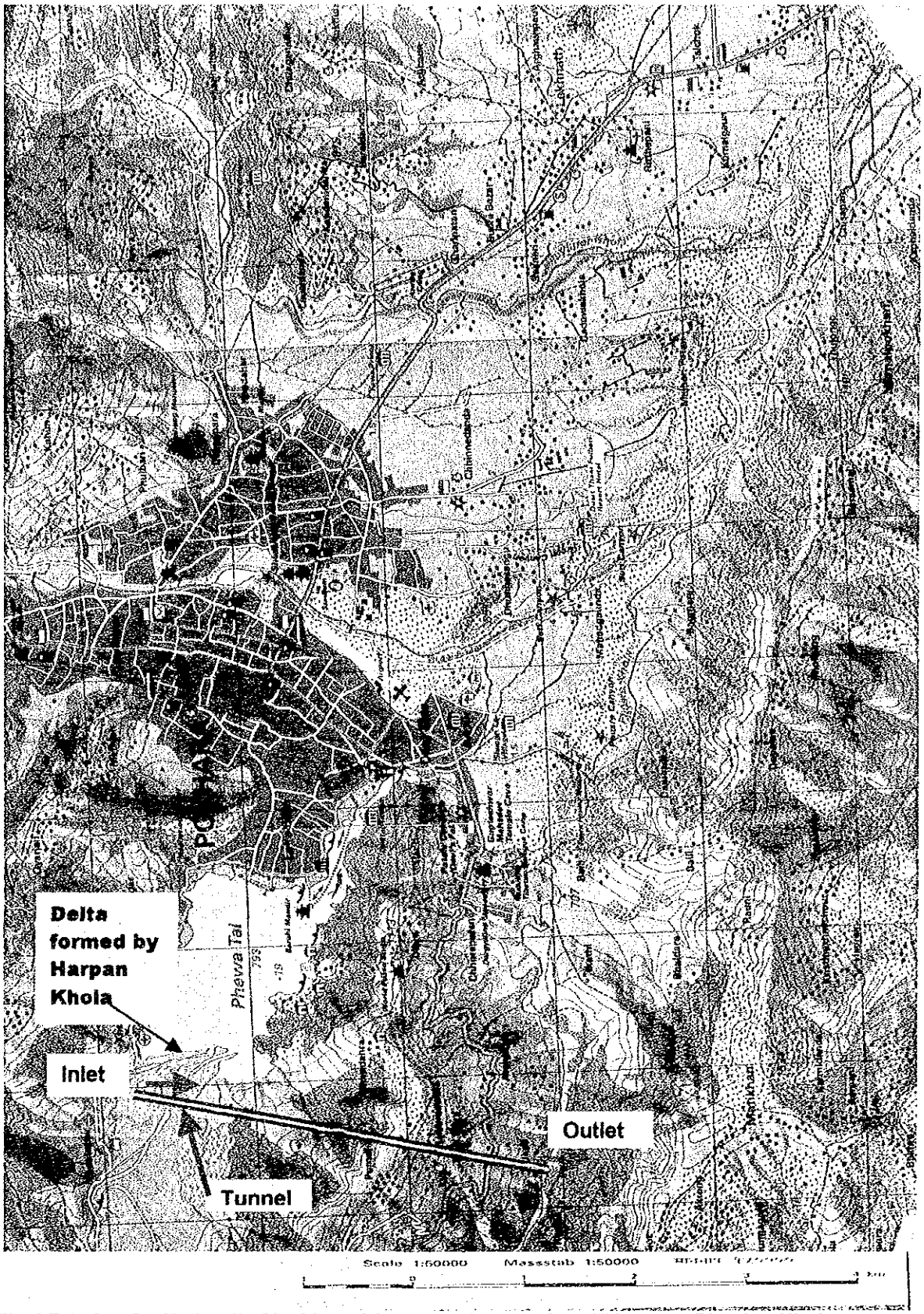
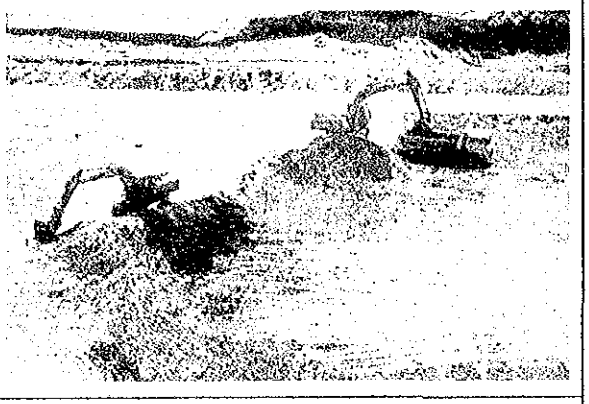


Fig. I-7.6: Gravity Hydraulic Flushing of Sediment from Delta of Phewa to Phushre Khola

(2) Excavation

The excavation of sediment and its disposal can be done by applying excavator (back hoe). In case of Phewa, a sediment deposition chamber at the upstream of confluence of Harpan Khola can be constructed to trap the sediment deposit annually during monsoon. The deposited sediment can be excavated by excavator and transported to disposal location. The deposited material at already formed delta of Harpan Khola can also be excavated and transported through mechanical equipment in order to reclaim the Lake surface area.



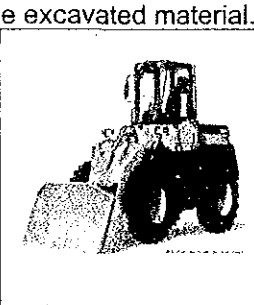
Back hoe excavating sediment

7.6.3 Transportation Mechanism

The sediment generated in the Phewa watershed, which is likely or already intruded in the Lake can be removed either by hydraulic flushing mechanism or by mechanical means. The hydraulic transportation can be done only through tunnel as discussed in above Sub-section 7.6.1. Similarly, the already intruded sediment can be pumped to the downstream of Lake with the help of dredger or it can be further transported by using earth moving and transporting equipment. This alternative is a combination of mechanical and hydraulic processes.

The mechanical means of sediment transportation can be done by excavating sediment either from sediment deposition chamber as stated earlier or from the delta. The excavated materials can be transported by involving dump trucks for transportation, loader for loading the excavated materials, and bulldozer for handling the excavated material. These machines can be operated in dry season.

Back hoe



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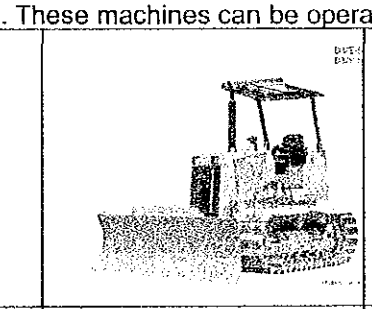
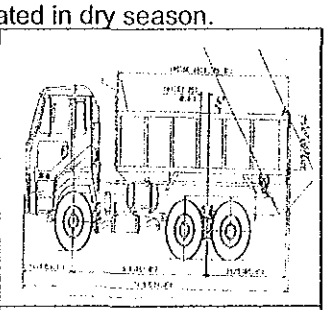


Bulldozer



Dump Truck

7.6.4 Extent of Excavation and Volume

The total volume to be excavated is estimated to be of about 123,000 cubic meters in a year. The depth to be excavated in the delta will be 4 meter. The area to be covered to remove this volume of earth is about 3 hectare. For this, suitable number of machines for excavation, handling and transportation needs to be procured under the proposed project.

7.6.5 Suitable Earth Moving Equipment and Methods to be Applied

The suitable earth moving equipment for the removal of sediment from the delta needs to be:

- Hydraulic Excavator with 18-meter digging reach and bucket capacity of 0.4 cubic meter, (2 numbers), considering that the per hour out put of excavator is 57 cubic meter, and annual working hour will be 2000 hours
- Bulldozer with 80 HP engine capacity, (1 number)

- Front wheel loader with 110 HP engine capacity (2 numbers), considering that per hour out put of loader is 75 cubic meter, and annual working hour 2000 hours
- Dump Truck with dump capacity of $10m^3$ (10 numbers) considering 6 trips in a day for 200 days

7.6.6 Estimated Cost

(1) Equipment Cost

The cost estimation for the equipment is presented in **Table I-7.10.**

Table I-7.10: Investment Cost for Equipment

Description	Cost in NRs. (,000)
Excavator 2 nos.	25,848
Bulldozer 1 no	7,602
Loader 2 nos.	15,087
Dump Trucks 10 nos.	56,467
Sub-total	**105,005**
Miscellaneous Work	5,250
Engineering Cost	1,050
Contingencies	10,500
Grand Total	**121,806**
In Million NRs.	**121**
In Million US$	**1.6**

(2) Operation and Maintenance Cost

The operation and maintenance cost for the above equipment has been estimated considering the salary of operator, helpers, fuel, lubricant, servicing and major repair and maintenance. The estimated annual operation and maintenance cost of above equipment is presented in **Table I-7.11.**

Table I-7.11: Annual Operation and Maintenance

Description	Amount in NRs. (,000)
Hydraulic Back Hoe/Excavator	2,580
Loader	2,000
Bulldozer	2,000
Dump Trucks	10,000
Total	**16,580**
Contingencies 10%	**1,658**
Grand Total	**18,238**
Million NRs	**18.2**
In US$	**0.24**

The unit cost per cubic meter sediment excavation and disposal comes out to be about NRs. 150.

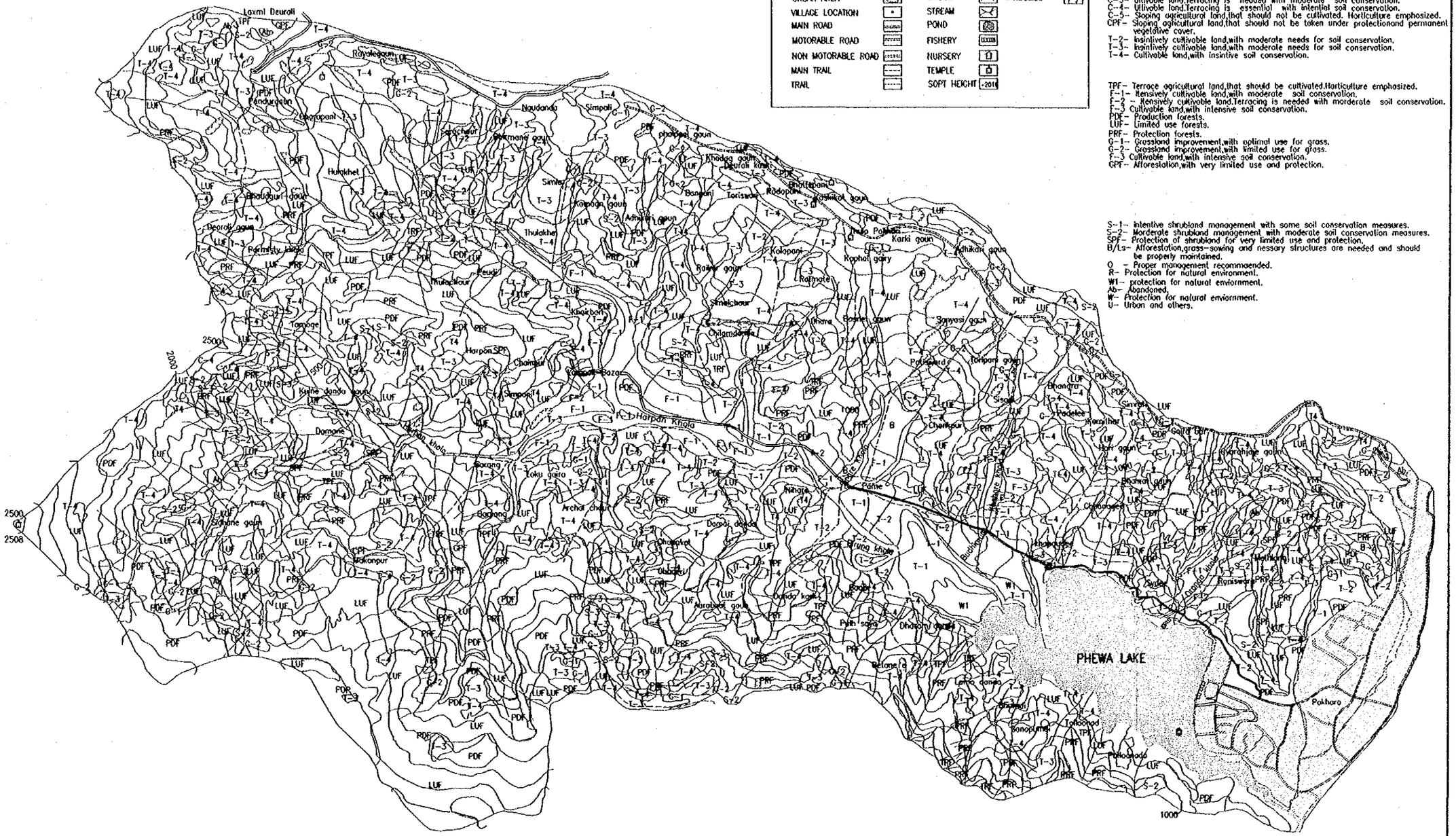
7.7 PRIORITY PROJECTS

The following project is prepared as priority project in Action Plan format.

(1) Project 1:

Project Title 3: Lakeshore Buffer Riparian Plantation

Aim : (i) To reduce the soil erosion and pollution load on Phewa Lake; (ii) To beatify the Lakeshore area for recreational purposes; (iii) To ensure its function as habitat of varied birds and insects.



PROPOSED LAND USE LEGEND

C-2- Itensively cultivable land,with moderate needs for soil conservation.
C-3- Ultivable land,Terracing is nedded with moderate soil conservation.
C-4- Ultivable land,Terracing is essential with intential soil conservation.
C-5- Sloping agricultural land,that should not be cultivated. Horticulture emphosized.
CPF- Sloping agricultural land,that should not be token under protectionand permanent vegetative cover.
T-2- Insintively cultivable land,with moderate needs for soil conservation.
T-3- Insintively cultivable land,with moderate needs for soil conservation.
T-4- Cultivable land,with insintive soil conservation.

TPF- Terrace agricultural land,that should be cultivated.Horticulture emphasized.
F-1- Itensively cultivable land,with moderate soil conservation.
F-2 - Itensively cultivable land,Terracing is needed with morderate soil conservation.
F-3 Cultivable land,with intensive soil conservation.
PDF- Production forests.
LUF- Limited use forests.
PRF- Protection forests.
G-1- Grassland improvement,with optimal use for grass.
G-2- Grassland improvement,with limited use for grass.
F-3 Cultivable land,with intensive soil conservation.
GPF- Afforestation,with very limited use and protection.

S-1- intentive shrubland management with some soil conservation measures.
S-2- Morderate shrubland management with moderate soil conservation measures.
SPF- Protection of shrubland for very limited use and protection.
B/Ls- Afforestation,grass-sowing and nessary structures are needed and should be properly maintained.
O - Proper management recommaended.
R- Protection for natural environment.
W1- protection for natural enviornment.
Ab- Abandoned.
W- Protection for natural enviornment.
U- Urban and others.

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	THE DEVELPOMENT STUDY ON THE ENVIRONMENTAL CONSERVATION OF PHEWA LAKE IN POKHARA , NEPAL	DRAWING TITLE: RECOMMENDED LAND USE MAP					SCALE 0 500 1000 1500 2000 2500m	SILT Consultants (P.) Ltd. Baneswor,Kathmandu,Nepal P.O Box: 2724 Fax: 977-1-473573 Phone: 473573, 470866, 487598, 495163 E-mail:silt@mos.com.np Web:www.silt.com.np	Fig. No. 1-7.3 SHEET No.

Phase : I

Project Duration : 1 Year

Justification: People have long since occupied most of the immediate Lakeside area as their individual property. With the sedimentation of Phewa Lake, the adjacent landowners gradually encroached and occupied the Lake fringe land developed from sedimentation of the Lake. Such exploitation of the physical surroundings of the Lake will exert a growing economic and social pressure in diminishing resources and increasing pollution. Therefore, emphasis should be accorded to the Lakeside conservation of the plain urban areas. The acquisition of land is being awaited after DDC has recently demarcated the legal and original area of the Lake. The Study has proposed a buffer strip around the Lake which will keep the Lake safe from any encroachment in the future. The maintenance of green buffer belt is crucial to sustain ecosystem as well as to reduce soil erosion and nonpoint pollution load in Phewa Lake.

Scope : The project will cover the following activities

- Identification of buffer belt plantation site and area
- Planning of the planting site, specification, species selection
- Raising of the seedlings
- Preparation of planting site
- Planting and maintenance
- Casualties replacement
- Monitoring.

Location : Around Lakeshore acquired land

Responsible Agency : Pokhara Sub-metropolis (PSMC) and Pokhara Valley Town Development Committee, District Soil Conservation Office, District Forest Office.

Budget : Plantation Cost	NRs 70,000
Total Cost	**NRs 70,000**

INCLUSION FOR TERRACE
25-50 % CULTIVATED-1
50-75 % CULTIVATED-2
75-100 % CULTIVATED-3

LEGEND

URBAN AREA/HONUSING
VILLAGE LOCATION
MAIN ROAD NOT PAVED
MOUNTAIN ROAD NOT PAVEDO
SECONDARY ROAD
MAIN TRAIL
TRAIL
BRIDGE
STREAM
POND
GRAZING LAND

FOREST LAND

SHURB
DEGRADED
PLANTATION
PLANTATION
ROCK
BARREN LAND
LANDSLIDE
GULLY
BARRN WET LAND

RAYALE GOAN
ANDHERI KHOLA
DHARA PANI
THULAKHET GOAN
THULA CHAUR
HARPAN
ARCHAL CHAUR
DAMAN DANDA
MAKANPUR
KHUDI KHOLA
GHADERI
PHEWA LAKE
PALIGANDU

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	THE DEVELPOMENT STUDY ON THE ENVIRONMENTAL CONSERVATION OF PHEWA LAKE IN POKHARA , NEPAL	DRAWING TITLE: CRITICAL LAND USE AREA					SCALE 0 500 1000 1500 2000 2500m	SILT Consultants (P.) Ltd. Baneswor,Kathmandu,Nepal P.O Box: 2724 Fax: 977-1-473573 Phone: 473573, 470866, 487598, 495163 E-mail:silt@mos.com.np Web:www.silt.com.np	Fig. No. 1-7.4 SHEET No.

CONTENTS

CHAPTER 8

ECOSYSTEM CONSERVATION PLAN COMPONENT (5)

The Development Study on Environmental Conservation of Phewa Lake in Pokhara, Nepal

CHAPTER 8

ECOSYSTEM CONSERVATION PLAN COMPONENT (5)

8.1 ECOSYSTEM CONSERVATION PLAN

8.1.1 Objectives

Objectives of ecosystem conservation plan includes:

- Restoration of healthy lake ecosystem conditions thereby tackling root cause of problems
- Conservation and sustainable utilization of aquatic and wetland biodiversity with an emphasis on threatened species
- Long term sustenance of aquatic and wetland habitat condition

8.1.2 Basic Policy

- The ecosysytem of Phewa Lake area comprising of air, water, soil, and biodiversity including human socio-cultural system is under stress of environmental degradation. Restoration of its several components requires an integrated and ecosystemic approach.
- Conservation, sustainable utilization and fair sharing of benefits out of utilization of its substantially rich aquatic /wetland resources is essential to maintain ecosystem health of Phewa Lake.
- Conservation of threatened species such as 3 native fish species , 1 wild rice species and 1 wild relative of rice species along with their ecologically sensitive habitat is necessary to maintain genetic and habitat diversity in Phewa Lake.

*Wild rice **Oryza ruflpogon** found in Phewa Lake is one of its rich bio-diversity*

- Lakeshore represent entry point of most point and nonpoint sources of pollution. Hence to check pollution load, area should be managed as a buffer zone with more stabilization and less human disturbance.
- Eco-zoning based land use planning is required all along the Lake perimeter with an emphasis on urban and agricultural land area which are more degraded than rural forested land use areas.
- Adoption of relevant eco-friendly mitigation measures, minimum impact codes and provision of alternative options is required to reduce human pressure on the fragile ecosystem of Lake from local community and visitors.
- Wetland ponds serve as sediment and nutrient trap thereby reducing sediment and nutrient loads into the Lake. Thus, provision of constructed wetland at upstream of delta of Harpan Khola is necessary to maintain a healthy lake ecosystem.
- Environmental problems are of interrelated nature and their mitigation require an integrated, strategic and both urban and rural community based collaborative approach.
- So far, watershed of Phewa Lake does not feature high pollution prone chemical based manufacturing industry with the exception of prevalence of "smoke less" tourism industry. To conserve Phewa Lake

from complex problem of industrial pollution load, there should be legal restriction on establishment of large chemical based industry at its watershed.

- For long-term sustenance of ecosystem health of Phewa Lake, there is need of declaring its' watershed as a conservation area by the government. There also exist need of protection of its extensive wetland through checking encroachment and developing it into a sanctuary park in the long run.

8.1.3 Contents of the Plan

In line with the basic policies, project areas are proposed in the ecosystem conservation plan. Major contents of the proposed plan includes:

- Formulate a framework of regulatory measures for project activities such as conservation of threatened habitat, aquatic biodiversity, and buffer zoning along Lakeshore
- Demarcate the Lake area and acquisition of encroached land
- Develop the 65 m width at urban area and 30 m at rural area from Lakeshore, that is restricted areas as per the land use By-laws of HMGN for Phewa Lake area, and develop it as buffer strip with proper drainage facility
- Propose river training works along banks of Harpan Khola and protection of wetlands of Phewa delta area. Due emphasis will be taken to improve conservation status of some locally threatened species such as wild rice and their habitat.
- Improve dissemination of information on norms and ways of sustainable use and fair sharing of conservation benefits out of use of biological resources of Phewa Lake.
- Propose multiple species riparian buffer strip along both sides of river channel.
- Propose control through utilization of weedy aquatic macrophyte such as "Jalkumbhi" water hyacinth (*Eichhornia crassipes*) and use it as organic manure by composting.

Chuche Bam ***(Xenentodon cancila)*** *from Phewa Lake*

The above stated contents of the plan will be supplemented by carrying out environmental education program so as to disseminate public environmental awareness on conservation of soil/water, wetland and relevant monitoring activity to ensure their effective actions as per the proposed plans.

8.2 SELECTED PRIORITY AREAS FOR CONSERVATION

Priority action and action area for ecosystem conservation of Phewa Lake is presented in **Table I-8.1** Most of these prioritized activities are substantiated by several previously proposed action plans and programs for environmental preservation of Phewa Lake (IUCN 1997, SAIC 1994).

Table I-8.1: Characteristic Features and Priority Action Area for Ecosystem Conservation of Phewa Lake

Projects	Need of Regulatory Measures	Need of Structural Field Conservation Measures	Need of Public Awareness Measures	Priority Area
Land use planning and buffer zonation along Lakeshore	*	**	**	Entire periphery of Phewa with an emphasis on urban settlement area and agricultural land area

Projects	Need of Regulatory Measures	Need of Structural Field Conservation Measures	Need of Public Awareness Measures	Priority Area
Conservation of threatened habitat and aquatic biodiversity	**	**	**	Anadu and Sano Tal area for threatened rice habitat/species area
Control through utilization of water hyacinth	**	**	**	Whole Lakeshore area for clearing of water hyacinth mat
River training works along the Harpan Khola	**	**	**	Phewa Phant (delta)
Constructed wetlands at Phewa delta	**	**	**	Phewa Phant (delta)

Note: * : moderate need as already some works carried out
** : high necessity as less work done previously

The justifications on selection of priority actions from ecological importance, socio-economic uses and danger of further environmental degradation are presented in **Table I-8.2.**

Table I-8.2 : Justifications on Priority Area and Actions

Priority Area	Ecological Importance	Socio-Economic Importance	Risk of Degradation	Need of Conservation Measures
1.Eco-land use planning/buffer zoning and beautification along Lakeshore	H	H	H	H
*2.Construction and protection of wetlands having aqua culture value	H	M	M	H
3.Conservation of threatened species and sustainable utilization of biodiversity	H	H	H	H
*4. Control of water hyacinth mat through utilization	H	M	M	H
5. River training works along Harpan Khola	M	M	M	M

Note: H = high, M = moderate and *= conservation plan already exists

8.3 WETLANDS OF RELEVANCE WITH THE RAMSAR CONVENTION

On the basis of requisite parameters related to Waterfowl and Fish, limited area of wetland of Phewa Lake *does not come under Ramsar site of international significance.* However, relevant objectives/guidelines of Ramsar Strategic Plan (1997-2002) having conservation significance are also relevance in Phewa Lake. These include followings;

- Formulate guidelines on wise use of wetlands
- Undertake EIA of projects which lie nearby wetlands
- Raise awareness on wetlands values and functions
- Promote human capacity building on sustainable use/management of wetlands
- Promote international cooperation

8.4 AWARENESS AND CAPACITY BUILDING FOR ECOSYSTEM CONSERVATION

To promote capacity building at institutional and individual level on conservation of ecosystem, there should be relevant curricula in schools and colleges, provision of international exchange, refresher training and monitoring activities.

This is dealt in detail in **Chapter 11** of **Part I** of this Report.

8.5 INSTITUTIONAL FRAMEWORK FOR CONSERVATION OF ECOSYSTEM

Nepal suffers from weak institutional capability for implementation of environmental management related policy, plan and program. In this context, institutional arrangement required for conservation and development of Phewa are as follows:

- Legal support to establish proposed PLECC
- Check registration and land revenue of land within proposed Buffer Zone
- Encourage formation of more User Groups, Functional Groups and their mobilization
- Institutionalize an efficient monitoring system
- Apply land use and building By-laws
- Strengthen inter VDC/Sub-Metropolis cross-border mutual cooperation
- Strengthen inter and intra institutional coordination

The proposed Phewa Lake Environment Conservation Committee will be the appropriate institution to undertake, monitor and manage ecosystem conservation efforts. This is dealt in more detail in **Chapter 12** of **Part-I** of this Report.

8.6 PROJECT IMPLEMENTATION

This Study has proposed for establishment of Phewa Lake Environment Conservation Committee, which will act as an umbrella organization for coordinating with different agencies to undertake various activities related to environmental conservation of Phewa Lake.

The different environmental conservation activities to be carried out by the proposed PLECC may include:

- Biodiversity and Ecosystem Conservation
- Technical Services and Planning
- Monitoring of Ecosystem Health of Lake and its Watershed
- Phewa Lake Conservation Center

8.7 ZONING GUIDELINES FOR WISE USE OF PHEWA LAKESHORE

8.7.1 Zoning

Phewa Lake is a multiple use lake. Use of aquatic resources has direct impact on the natural and other physical environment of the Lake and its vicinity. Use of this area has to be done in a wisely manner. The limited land resource available at Lakeshore has made it an important economic and ecological commodity. Tourists, landowners, tourism related enterprises and community dependent on the Lake for their livelihood are the beneficiary of the Lake. Lakeshore which represent a connecting zone between terrestrial and aquatic ecosystems should be managed in planned way as an integral part of the Lake.

Land use zone of the shore of Phewa Lake is proposed to have the following components:

- 65 meters wide buffer zone around the Lakeshore at urban area and 30 m at rural area (as depicted in HMGN By-laws)
- Natural forest preservation area
- Planned tourism development area

- Open spaces and landscaping with gardens
- Boating yards
- Camping and picnic spots
- Roads, parking space, trail, and public utility facilities

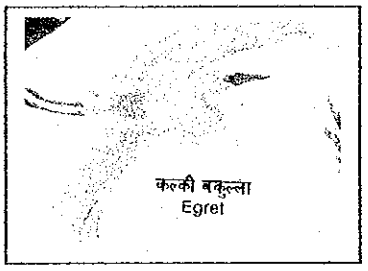
Broadly, Lakeshore of Lake Phewa is proposed to be divided into 3 zones

- **Recreation zone**: Boating, Swimming, Angling, Fishing, Camping, Strolling
- **Conservation zone:** Forest preservation, habitat protection of wild rice, fish spawning site, religiously important site.
- **Control zone**: Covers no fishing zone at Ratna Mandir area and no hunting/poaching at Rani Ban forest area

8.7.2 Guidelines

Following guidelines hold relevance for sustainable management of Phewa Lake from an integrated conservation, development and participatory approach.

- Improvement of commercially and socio-economically important sites into recreational zones especially in northern shoreline
- Retention of ecologically significant/ threatened site for species /habitat conservation as conservation site especially along southern shoreline
- Adopt eco-tourism and eco-friendly village tourism in watershed
- Production, processing and marketing component should be taken together for promoting income generating activities.



- Watershed conservation activities should be integrated with income generating activities
- Tourism development activity should also be integrated with local agriculture and cottage industry development
- Organic farming and SALT (Slope Agriculture Land Technology) approach of terrace improvement should be encouraged.
- Monitoring mechanism should be institutionalized.
- Pokhara town land use zoning and By-laws of HMGN should be strictly adopted in the present case, as per relevance with due modification.
- Buildings or shades construction in tourism development area will abide by the building By-laws of the Pokhara Sub-metropolis. Similarly, sanitation By-laws prepared by PSMC should also be followed.
- A separate By-laws needs to be formulated for construction of structures in the Lakeshore of the VDCs.
- Transportation Plan for vehicular movement in the Lakeshore area also needs to be formulated. Restriction of vehicular movement or one way movement in the Lakeside area may also be the part of this plan.
- Greeneries should be maintained and developed/encouraged in the Lakeshore area
- Sub-metropolis and VDCs will manage the solid waste and maintain cleanliness of the Lakeshore.
- Proposed PLECC, also having representation from PSMC and VDCs will monitor the implementation of the zoning regulation.
- Environmental awareness program will support the Lake Conservation activities

- Well demarcation of both Lake, wetland and shoreline, and
- Conserve wetland as sediment and nutrient trap through constructed ponds and sideway channels.

8.8 PRIORITY ECOSYSTEM CONSERVATION PROJECTS

Some of the important and priority projects for conservation of ecosystem of the Phewa Lake are presented below in Action Plan format.

(1) **Title: Lakeshore's Wise Use Project**

Objectives:

- Conservation and sustainable utilization of threatened habitat and aquatic /wetland floral and faunal resources
- Use of the Lakeshore land through proper land use planning, conducive to the better environmental conservation of the Lake.
- Eco-tourism development in surrounding areas of the Phewa Lake

Phase: I

Duration of Project: 4 years

Justification: The Phewa Lake is state owned, while most of the land along surrounding Lakeshore area is privately owned. As it is a multiple use Lake, there exist human pressure and cases of conflict among beneficiaries on the issue of use of Lake resources. One of the root causes of problem includes lack of eco zoning based land use planning of the Lakeshore. This has not only hindered sustainable utilization of the Lake resources but also mismatch and interfere with the of recreational /touristic values of the Lake. In order to maximize economic benefit of the Lake in an environmentally sound way, there should be an allocation of land use zones corresponding to ecological and socio-economic benefits. Wise use of the Lakeshore thus holds high ecological and economic importance.

Scope: For the wise use of Lakeshore of Phewa Lake, there should be implementation of following programs

- Demarcation of Lake boundary in legally sound way. Eco-zoning based land use planning of shoreline will facilitate sustainable use of lake resources.
- There should be clear-cut delineation of buffer zone as per recommended 65 m and 30 m width at urban and rural areas respectively.
- Implementation of green belt and multiple species buffer strip in buffer zone along with slope stabilization works at the Lakeshore.
- Public orientation/training on ways and means of sustainable utilization, better processing and market intelligence of aqua- cultural products. The PLECC will be the coordinating and monitoring agency and Phewa Lake Conservation Fund as financing support agency.
- Mutual coordination on fair sharing of responsibility and benefit among different Lake user groups e.g. fishermen, boatmen through supervision from management agency.

Location: Entire Lakeshore area.

Responsible Agency: PLECC, Pokhara Sub-metropolis, Pokhara Valley Town Development Committee, relevant VDCs and DDC.

Budget: *(In NRs '000)*

- Mapping and fixation of Lake boundary --included in 11.7 of **Chapter 10** of **Part I** of this Report
- Delineation of buffer zone along Lakeshore-- " " "
- Green belt and multiple species buffer strip in buffer zone -- " "
- Orientation/training on ways of sustainable utilization of Lakeshore area - 1,000
- Manpower for monitoring/ surveillance activity - 100

Total **1,100**

(2) Title : **Conservation and Sustainable Utilization of Biodiversity**

Objectives:

- Conservation and sustainable utilization of biological resources with an emphasis on threatened species.
- Conservation of human disturbed but environmentally sensitive and ecologically important habitats with an emphasis on threatened and commercially important species.

Phase: Medium-term

Duration of Project: 5 –10 years

Justification: Natural aquatic biodiversity represent an integral component for the maintenance of healthy ecosystem of any lake. The biodiversity in moderate quantity serve several ecological and economic benefits, but in case of excessive growth, these pose ecological problems such as deterioration in water quality, aesthetic beauty as well as loss in fish production and recreational/touristic value of the lake. Due to advancing water pollution in Phewa Lake, the species composition pattern changes as manifested by decline in species diversity. Phewa Lake features a number of aquatic plant and fish species and their threatened habitat condition. To maintain its health from an ecosystem function as well as genetic diversity and evolutionary perspectives, there exist need of conservation of biological species in general and threatened species in particular .

A big snake holding its catch, a fish in its mouth. The Lake and it's watershed area are very rich in biodiversity.

Scope:

For the conservation and management of threatened habitats and biodiversity found along the shore of Phewa Lake, following activities should be undertaken:

- Identification and conservation of threatened habitat along the Lakeshore
- Identification and conservation of threatened and commercially important floral and faunal species. Control of alien invasive species such as water hyacinth in the Lake through periodic harvesting and utilization in terms of processing and production of useful natural products
- Skill training works and marketing management support to promote entrepreneurship on sustainable utilization of commercially important but under utilized aquatic/wetland biodiversity of Phewa Lake
- Establish a museum/aquarium display of important floral and faunal species of Phewa Lake to provide scientific information to the public at large on its biodiversity wealth and bio-prospects

- Restriction on application of banned pesticides e.g. DDT, BHC, Aldrin in the farmlands of the Phewa watershed
- Ban on destructive fishing practice as per the coverage on Aquatic Lives Protection Act

Location:

Responsible Agency: Pokhara Sub-metropolis, Pokhara Valley Town Development Committee, relevant VDCs and DDC.

Budget:	**(NRs. ,000)**
Field survey to map ecological and economic significances of shoreline habitats-	760
Documentation of information on biodiversity of Phewa Lake	760
Collection and display of museum/aquarium specimens	760
Establishment of processing plant for production of useful products	1,140
Total	**3,420**

(3) Title: Fish Conservation and Fisheries Development Program

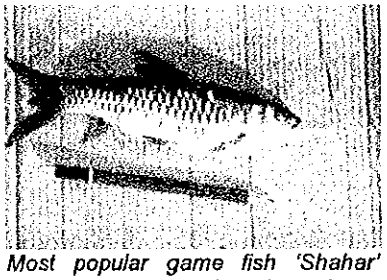
Objective: Conserve the faunal diversity of fish and provide livelihood opportunity for traditional fishers community through aquaculture and fisheries enhancement.

Phase : Medium-term

Project Duration : 10 Years

Justification :

There are about 200 fishers folk families in the Phewa Lake of Pokhara valley. Out of total, more than 60 households totally depend on the fishing and cage culture activities. Annual fish catch for the year 2000 /'01 was 98 MT. 65 MT was produced from cage fishing and 33 MT from open Lake water. Out of this, large portion is contributed by exotic fishes. In value, it is equivalent to NRs. 6.9 million.



Most popular game fish 'Shahar' which is also a threatened species.

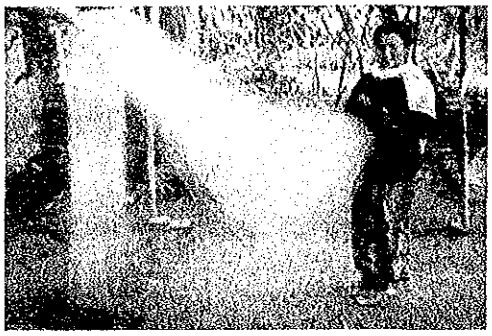
The species of fish raised in the cages are mainly silver carp and bighead carp. Both these species are planktirvorous and feed on phytoplankton and zooplankton, thus helping to reduce the plankton population if stocked at reasonable densities. Other species are grass carp which depends on aquatic weeds and help in the Lake cleaning. Some popular native game fishes like "Sahar" "Asla," &, "Katle" are greatly threatened due to over-fishing, pollution and introduction of exotic fishes. Besides these species common carp *(Cyprinus carpio)*, rohu *(Labeo rohita)* and naini *(Cirrhinus mrigala)* are also found in the Lake, which feed on detritus and other wastages at the bottom of the shallow parts of the Lake.

The conservation of indigenous fish fauna and environmentally friendly cage fish farming management practices are required for the sustainable livelihood of fishers community living around the Lake, which are dependent on fishing for their livelihood. Conservation of indigenous fish like Sahar will generate extra income through sport fishing.

Scope:

- Declare Phewa Lake area between Varahi temple and Fish Tail Lodge as fish sanctuary
- Prohibit fishing during the spawning season

- Allocate appropriate sites for sport fishing such as Khapaudi, Sano tal etc.
- Cage fish culture in shoreline area of Khapaundi, Sedi Danda and Gaira Chautara.
- Strengthen Phewa Fish Growers Association which should be and made responsible for overall fisheries activities in the Lake, such as Lake stocking, cage farming & marketing and collecting revenue
- Water quality of the Lake should be monitored regularly at the lab of Fisheries Research Center
- Conserve threatened 3 spp. of fish: Himalayan Trout "sahar" (*Tor putitora*); "Asla" (*Schizothorax richrdsonii*); and "Katle" (*Accrocheilus hexagonolepis*) by control of Lake water pollution, reintroduction of the species and protection of their spawning grounds.
- Enforce Aquatic Lives Protection Act 1969 (amendment 1999) of HMGN.
- Fish Growers Association should represent in the proposed Phewa Lake Environmental Conservation Committee
- Establish aquarium of local fishes found in Phewa Lake at the Sub-center of Fisheries Research Center, Baidam.
- Organize net weaving training for fisher women
- Establish net screen near the outlet dam at Pardi.



Fisher women preparing her gill net for setting

Location : Phewa Lake

Responsible Agency: PLECC, District Agriculture Development Office, Fisheries Research Centre, Phewa Fish Growers Association, District Administrative Office, PSMC

Budget (NRs) :

S.No	Description	NRs. (,000)
1	Stocking of fish fingerlings	10,00
2	Net screen at Pardi before the dam	20,00
3	Laboratory equipments, glass wares and chemical (at FRC, Begnas)	10,00
4	Strengthening of freshwater fish aquarium centre	10,00
5	Establishment of net weaving training centre	10,00
6	Establishment of fish collection centre	10,00
7	Awareness about fish conservation	5,00
8	Miscellaneous	10,00
	Total	**8,500**

(4) Title: Constructed Wetlands Project

Objectives:

1. To reduce sediment load in Phewa Lake from watershed through construction of small sized ponds to act as sediment trap
2. To promote local economy through aqua cultural practices in terms of fishery development in constructed ponds
3. To improve water quality through settling of sediments at base
4. To check encroachment of wetland and develop it into a sanctuary park in long term

Phase: I

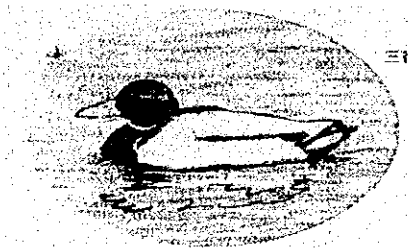
Project Duration: 5 years

Justification: Phewa Lake is situated in agricultural watershed and fed by several Kholas of which Harpan is the major inlet with high sediment load (70%). The drastic decline in total area of Phewa from 10 sq.km in 1950s to 4 sq.km in 1990s is related with high sediment load and encroachment . At present rate of sedimentation, 2 ha. of Lake area is converted into wetland by every year. The Lake water body is getting converted into rice paddy field. To check further loss of open water portion of Phewa Lake it is necessary to check sediment load. This can be achieved through rehabilitation of landslide area and micro level watershed management work at watershed area supplemented by constructed wetlands near mouth portion of major inlet stream. The constructed wetlands will contribute as sediment and nitrogen trap from the major inlets. It will provide multiple uses such as promotion in fish farming, and visit of waterfowls which will pose positive impact on improving local economy through better fish production and eco tourism. To protect the wetland in long term basis for the sake of conservation of Phewa Lake, its development into a sanctuary park will be relevant.

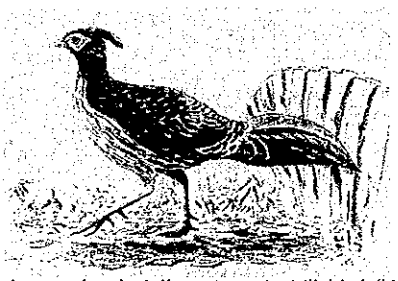
Scope:

For the conservation and management of constructed wetlands at Phewa phant (delta) wetland area, following activities should be undertaken

1. Construction of ponds at 3 strategic places at Phewa phant area, at nearby inlet at middle and near tributary of Harpan and Andheri Khola
2. Fish farming at constructed ponds without external feeding
3. Installation of poles for resting platform of waterfowls
4. Periodic removal of deposited silt after every rainy season from these ponds and use in filling depressions or dispose beyond Lake
5. Construction of open ditch along the wetland, so as to check its encroachment



Siberian Duck seasonally visit Phewa Lake



A popular but threatened hill bird 'Kalij Pheasant' found in nearby hill forest of Phewa Lake

Location: Phewa Phant wetland area

Implementing Agency: VDCs, Kaski DDC, Local Fishermen User Group, Fisheries Research Center, local NGOs, Credit Banks etc.

Budget:

	NRs. (,000)
Construction of ditch and other structures around the wetland Perimeter	200
Plantation of multiple species in buffer strip	100
Total	**900**