

## 9. FISHERIES MANAGEMENT PLAN

### 9.1 OBJECTIVES

The overall objectives of the Fisheries Management Plan are:

- To maintain the stock abundance of migratory fish stock,
- To develop new fisheries potentials created by the reservoir of the dam,
- To increase the livelihood of local communities.

### 9.2 OUTPUTS

The following outputs are proposed to achieve the objectives for fisheries:

#### **Site Clearance Phase**

- Soil erosion and silt runoff is reduced
- Illegal fishing is controlled

#### **Construction Phase**

- Breeding place and feeding area is sustained
- Obstruction of fish migration is controlled
- Use of explosives is managed
- Heavy fishing by construction work force is restricted
- Spillage of petrochemicals are confined
- Waste are effectively managed
- Breeding and spawning ground is maintained

#### **Operation Phase**

- Pollutants, sediments, and nutrients from watershed areas are appropriately managed
- Thermal stratification phenomena is minimized
- Fish diversity in the reservoir is maintained
- Reservoir fisheries is promoted
- Infrastructure and marketing facilities are developed
- Ecotourism is developed

#### **9.2.1 Site Clearance Phase**

##### **9.2.1.1 Reduce Soil Erosion and Silt Runoff**

Silt runoff and turbidity into the river due to site clearing and excavation period (downstream of Saryu – Mahakali confluence upto high dam area of Rolghat affect fish breeding and nursery area in the river. The present fish habitat of the river will be disturbed

due to silt, quarrying activities and construction of access road during site clearing phase. The workers need to be aware about rules and regulations established to maintain biodiversity and to adapt environmental friendly technologies as far as possible. And further monitor the fish habitat, spawning area, and its aquatic biodiversity during site clearing phase.

#### **9.2.1.2 Control Illegal Fishing**

Heavy fishing by construction workers will be strictly prohibited. Contractors will ensure that their construction worker will not indulge in any illegal means of fishing through diverting the river flow, by dynamiting, electro fishing or by poisoning and selling and transportation for personal benefits. Construction workers will be given awareness programs about aquatic life protection act.

### **9.2.2 Construction Phase**

#### **9.2.2.1 Sustain Breeding Place and Feeding Areas**

Disturbance in breeding place and feeding area of the river due to production of silt during construction of the coffer dams and the main dam, quarrying activities and construction of access road is minimized with the adoption of environmental friendly technologies. Activities such as deposit of soil, boulders, digging, blasting activities that may cause disturbances will be carried out in sustainable manner. Further, contractors will ensure that the construction workers will comply with the rules and regulations established to maintain bio-diversity after the training. And further monitor the spawning place and feeding area during construction phase.

#### **9.2.2.2 Control Obstruction of Fish Migration**

Diversion of river for the construction of coffer dam could hinder migration up and down stream of the river of the migratory fish species due to fast water current (faster than the present river water current) in the diversion canal. There need to establish environmental flow sufficiently all the times for upwards and downwards migration of fish. Locals will be motivated to establish fish spawning sites and artificial ponds at the project areas in order to maintain fish diversity. Later on the spawned fish could be transferred into upstream of the high dam. Locals will be further motivated towards the sustainable utilization of fish and they will be provided with aqua-culture trainings during the time of construction phases to maintain fish biodiversity. Fisheries will further help in maintaining livelihood of the local people.

#### **9.2.2.3 Manage Use of Explosives**

Explosives will be used at the rock quarry and for tunnel and bedrock excavation during high dam construction. Any blasting near high dam in Mahakali River will be hazardous to the aquatic life. Explosives will not be used in the river and need to be carefully controlled. Blast shocks may cause lethal or sub-lethal damage to fish stocks.

The Environmental monitor will be advised of any on site blasting. The Environmental Monitor will be advised of blast charge size and location so that distance to waterways can be calculated to ensure a safe distance from fish bearing waters is observed. Awareness program for construction worker regarding the use of explosives and management aspect is needed.

#### **9.2.2.4 Restrict Heavy Fishing by Construction Work Force**

Excessive fishing activities could cause severe depletion of these species in the reservoir. Locals will be motivated to establish fish spawning sites and artificial ponds in project areas in order to maintain fish diversity. Later on the spawned fish could be transferred upstream of the high dam. Locals will be further motivated towards the sustainable utilization of fish

and they will be provided with aqua-culture training during the time of construction and operation to maintain fish biodiversity. Fisheries will further help in maintaining livelihood of the local people.

#### 9.2.2.5 Confine Spillage of Petrochemicals

Construction activities will require the use of a large amount of heavy equipment which contains fuels, lubricating oils and hydraulic fluids. The migration of these compounds either from spills during construction or later through seepage from saturated soils can negatively impact aquatic environments. Uncontrolled spillage of petrochemicals, cement slurry, explosive slurry and other hazardous substances in river near project site may be lethal to fish.

To reduce the risk of these fluids entering Mahakali River near project site, the following procedures will be employed:

- The Spill Response Plan will be posted on-site, and all personnel made aware of its content and location of response materials;
- Oil spill response materials and equipment such as sorbent pads, booms and leak proof containers will be kept on-site in sufficient quantities and in an easily accessible location;
- Used spill response materials will be bagged in heavy-duty polyethylene bags and disposed of as a special waste as soon as possible;

#### 9.2.2.6 Manage Waste Effectively

All waste, debris and other construction related materials (wood forms, hardware, plastics, etc.) will be removed from the project site (high dam area) and disposed of in an appropriate manner. However, a review of all sites will be conducted and any soil, sediment or groundwater contamination issues associated with construction work will be resolved prior to start of construction. Effluent generated by camps and office facilities will have negative effect on the fish in the river system.

#### 9.2.2.7 Maintain Breeding and Spawning Ground

Quarrying from the river bed in construction site (high dam area downstream Saryu Mahakali confluence) will increase erosion and disturb breeding grounds and spawning ground such as mid migratory and resident species. (*Shizothorax* spp., *Garra* spp., *Glyptothorax* spp and etc). Adequate attention must be given to protection of nursery and spawning areas. Where needed, additional measures should be taken;

- Deposition of Gravel to increase spawning habitat
- Manipulating angular and large boulders to create pools for spawning
- Using large boulders to alter flow pattern down stream
- Keeping gravel and boulders together to create spawning riffles to attract resident stock to rapids
- Enhancing the habitat by tree planting to increase shelter cover, shade and drift food.

### 9.2.3 Operation Phase

#### 9.2.3.1 Manage Pollutants, Sediments and Nutrients from Watershed Areas

Pollutants imported from watershed affect environmental quality in reservoirs. Reservoirs effectively trap suspended solids, sedimentation increases turbidity to limit primary production, and decreases depth and thereby storage capacities, all of which affect various physical and chemical processes that eventually influence the biotic community.

Excessive inputs nutrients result in rapid eutrophication in the Pancheshwar High Dam reservoir, which cause decreased water clarity, wide dissolved oxygen fluctuations, and dense littoral beds of aquatic vegetation. Through effects on water physical and chemical

characteristics, dense algae blooms make reservoir environments unsuitable for many fish, reducing diversity of fish assemblages and fisheries. Sediments, excessive nutrients, organic matter, and contaminants may be kept out of reservoirs through proper agricultural and waste management practices

### 9.2.3.2 Minimize Thermal Stratification Phenomenon

Thermal stratification of reservoirs during warm season can result in deoxygenating of hypolimnion. Methods to destratify or prevent stratification include hypolimnetic discharges, air bubble/injection to generate water movement, and mechanical pumping between the hypolimnion and epilimnion to either generate water movement, or to aerate hypolimnetic water by passing through baffle systems (Ruane *et al.*, 1986). A bubble column produced with compressed air will create upwelling in a reservoir that, in combination with wind energy, can be used to prevent stratification or to destratify (Pastorok *et al.*, 1982). Mechanical pumping can also be used to avoid oxygen stratification without disrupting temperature stratification, by lifting hypolimnetic water to the surface where gases such as methane, hydrogen sulfide, and carbon dioxide are dispersed, and then water is returned to hypolimnion without substantial increases in temperature (Wirth, 1981), which may allow maintaining both warm water and coldwater fish communities and fisheries. Aeration of hypolimnion through injection of oxygen has been reported to be more cost effective than through lift systems (Mauldin *et al.*, 1988). Potential benefits of artificial destratification include expanded habitat for invertebrates and fish, improved quality of water stored and released, retarded eutrophication, and avoidance of catastrophic turnovers.

### 9.2.3.3 Maintain Fish Diversity in Reservoir

#### Habitat Enhancement for Fish

Dam construction can dramatically affect migratory fish habitat. The consequence of river impoundment is the transformation of lotic environment to lentic habitats. Due to the reservoir formation all spawning and rearing areas of Mahakali River (upstream from high dam area) will be submerged. Therefore upstream of PHD around the tributaries and having shallow water regions within indirect impact zone area habitat enhancement shall be under taken approximately about 1.5 km<sup>2</sup> in three places (upstream of Chameliya – Gokuleshwor, Lali Gad and Vartula Khola) with help of some structures such as check dams (deepen shallow reaches of stream by creating plunge pools), weirs (habitat quality by enabling adjacent positioning of pool and riffle habitat), logs, rock veins and cross veins (stabilize laterally eroding banks, restore natural channel geometry and retain proper channel width to depth ratios), boulder clusters (hydraulic relief from water current and strategic feeding zones for fish) and flow constrictors (decrease width to depth ratio for higher carrying capacity, movement and refuge benefits).

#### Hatchery Establishment for Migratory and Resident Fish Species

The proposed dam will restrict the migratory routes for the fishes upstream and downstream of river Mahakali River. The possible and favorable options for conservation of indigenous species such as; long distance migratory *Tor spp.*, short distance migratory *Neolissocheilus hexagonolepis* and other resident indigenous fishes, fish hatcheries need to be developed.

The conservation measures and fisheries development can be achieved through establishment of fish farms, reservoir fishery and hatchery development. The rights of the local affected families over the fish resources in the reservoir should be secured, with minimal inner interferences. The most pragmatic and holistic approach to save the germplasm of commercially viable fish species from the blink of further deterioration and bring back to possible optimum population levels could be through artificial propagation in captivity.



The stocking material (fingerling size), so produced, could be ranched in a phased manner to replenish and repopulate in proposed reservoir and tributaries in the surrounding area. Nursery farmers will be developed for rearing fry and fingerlings. Steps in this direction have already been taken by Directorate of Fisheries Development, Fisheries Research Division and other related agencies in the country.

#### **Establishment of Indigenous Cold Water Hatchery**

There are two suitable proposed sites for indigenous cold water hatchery in Vartula Khola of Dattu and upper reaches of Gokuleshwar for the production of around 600,000 fingerlings. Total land required for cold water hatchery is 8 ha. The brooders of Mahseer, Asla, Katle and indigenous fish species (50%) will be collected from the wild and stripped down at Hatchery and will be released back into the rivers. After rearing the spawn in the hatchery for a stipulated period of time, the young fishes shall be restocked both upstream and downstream of Pancheshwar dam site of Mahakali River. This shall be monitored by developing an effective monitoring mechanism to gauge the efficacy of survival of fish in the water bodies. The seed produced in hatchery will also be supplied to the private nursery entrepreneurs and fish farmers in the region to promote fish culture. Thus, it will not only help in generating employment and income but will also help in reducing the pressure on the natural fish stocks.

This program will be implemented through public private partnership. Therefore, it is suggested to develop hatcheries, fish ponds, seed collection centers, reservoir management and reservoir stocking cells along the river near proposed sites for hatchery. It is also strongly recommended that fish conservation and management strategies be strengthened in river Mahakali through improved surveillance.

#### **Open Water Stocking in Reservoir**

Fish stocking is perhaps one of the oldest management practices. It has been controversial because in many instances it has disrupted fish communities, contributed to the loss of wild strains, and reduced genetic diversity (Schramm and Piper, 1995). Nevertheless, stocking has a significant role in reservoir management when used in the right manner and in the right location. If reproductive success is limited by the absence or poor quality of spawning habitat, stocking of juveniles can supplement those produced naturally, thereby increasing fish abundance and fisheries yields. Some fish populations in reservoirs are maintained solely by stocking because reproduction cannot occur within the reservoir environment. Stocking to restore threatened and endangered species has been successful in many instances. Size of fish stocked is often an important consideration, with fish survival increasing directly with size (Welcome and Bartley, 1998). Economics often dictate the size and quantity of fish stocked. Many reservoirs provide the opportunity to diversify fish stocks available to fisheries. Where the fisheries are maintained largely to produce food, such as in most developing countries, quick growing, self-propagating herbivores with short food chains are preferred (Sugunan, 1995).

Perhaps the most successful introductions, from a fishery development in Nepal perspective, have been those of Silver, Bighead, Grass and common carp and Major carp. Various species of Chinese and Major carp have been successfully introduced into Kulekhani reservoir and lakes of Pokhara Valley of Nepal.

Formation of reservoir/s will result in increase in volume and surface area of water that will enable the water body/s (reservoir/s) to accumulate more fish population and increase fish production in proportion with the increase in water surface and volume. Formation of reservoir is expected to accumulate nutrient load drained from its water shed area and rise in water temperature of the upper column of the reservoir (Epilimnion) due to the absorption of solar heat by the expanded water surface area of the reservoir is expected to

accommodate more fish species of warm water habitat that could help increase the productivity of the water body.

The total reservoir area, expected to be created by high dams at Pancheshwar is 3,850 ha only on Nepalese side. The average fish productivity of reservoirs, in Nepal, is estimated as 0.26 Mt/ha/year (MOAC Stat. 2010/11). While regular fish stocking is one way on enhancing reservoir fish stock. The total fingerling required for open water stocking is 5,775,000 (1,500/ha.). The detail of stocking ratio is in Appendix G. Estimated total production from 3,850 ha is 989 MT/year.

#### **9.2.4 Promote Reservoir Fisheries**

##### **9.2.4.1 Cage Culture in Reservoir**

In Nepal, successful cage culture is being practiced in Kulekhani Reservoir and Lakes of Pokhara Valley. Cages have been used to produce commercial aquacultural crops within the reservoir and in the heated effluents of power plants. Growth and survival of fish is affected by the density of fish per cage, the density of cages per unit of volume, the species of fish cultured, and the quality of the feed. In Nepal, culture of silver carp (*Hypophthalmichthys molitrix*) and bighead carp (*H. nobilis*) fingerlings is conducted in cages without supplementary feed. Problems associated with cage culture include biological fouling of the mesh material, loss of fish to predators and disease, poor water quality, theft and vandalism, loss of cages during severe weather, deterioration of cage materials and conflict with navigational and recreational uses of public waters.

However, guidelines will be set about the cage landing programs. Total of 10% reservoir area is proposed to be covered by production and nursery cages. General practices for stocking density in production and nursery cages are 10 and 100 per cubic meter cage respectively. Total number 154,000 cages of 50 m<sup>3</sup>. Total of 36,960 metric ton will be produced from cage culture programs (6 kg. per cubic meter DoFD, 2010/11). In general, floating net cage aquaculture can be used as a sustainable enterprise in PMP reservoirs only if adequate training for reservoir aquaculture is provided to prospective culturists, and there is adequate enforcement of regulations on cage numbers to prevent environmental degradation.

##### **9.2.4.2 Hatchery Establishment for Aquaculture**

Fish seed of variable size is needed for cage culture and open water fish stocking programs. Therefore it is visualized to establish two warm water fish hatcheries one in Patan of Baitadi and other in Kanchanpur district for the production of required 82,198,000 numbers of fry/fingerlings for cage culture. Besides the fish hatcheries, private fish nursery farmers need to develop in Baitadi, Dadeldhura and Darchula districts where there is a potential area. Therefore it is better to encourage private fish farmers for nursery development. The basic requirements for hatchery unit include hatchery shed, breeding, incubation and rearing tanks, brood, rearing and nursery ponds, holding and stocking ponds, quarantine room, office building, food storage yard, laboratory, different gears, etc.

##### **9.2.4.3 Organize Community Based Fish Farming**

Community based fish farming programs should be initiated for cage culture and nursery farmers in the project area. Concept of community water bodies in the proposed reservoir need to be initiated to empower the fisher community. Fisher communities should be organized. Technical, financial, and other supports need to be provided to them for fishery activities. Fisher groups of reservoir areas need to organize into cooperative groups, subsidized initially by government organizations, might provide a more stable market, allow fishers to retain a larger fraction of the profits, and improve their quality of life. Awareness, training and observation tour are needed in these activities.

### 9.2.5 Develop Infrastructure and Marketing Facilities

#### 9.2.5.1 Improving Infrastructure and Marketing

Improved infrastructure is needed to prevent or limit post-harvest losses in developing countries. Facilities must be adequate for landing, chilling, storage and processing of fish and for distribution. Inadequacies in these facilities and in arrangements for distribution cause the most visible post-harvest losses, particularly of fresh fish. Estimated total fish production in PMP reservoir from cages and open water 101 and 2.7 MT/day respectively. Therefore it is essential to establish chilling facilities and marketing network.

Fisher groups of reservoir areas need to organize into cooperative groups, subsidized initially by government organizations, might provide a more stable market, allow fishers to retain a larger fraction of the profits, and improve their quality of life. Awareness, training and observation tour are needed in these activities. Total income from Reservoir fisheries is estimated to be Rs. 5,791 million/ year.

#### 9.2.6 Develop Ecotourism

Tourism industry could be developed in these areas with proper planning. Most of the people are fond of swimming, boating and fishing for recreational purpose and facilities like hotels, lodges, restaurants etc, could be developed in the area and train people (displaced people) for providing required services to the tourists. Many income generating job opportunities could be created to provide services for the tourists.

Game fishing (Angling) could possibly be an attraction for the tourists for Mahaseer fishing (*Tor sp.*) in Mahakali River and its major tributaries. There are two types of game fishing that people enjoy in fishing. One could be called as passive fishers who enjoy fishing some specific fishes like Asla (*Schizothorax sp.*), also called Himalayan trout and Mahaseer (*Tor sp.*) also locally known as Sahar. These types of fishes are expected to be mostly for domestic tourists. However, international tourists could also be attracted by the provision of required essential services for them. Mostly senior citizens of USA, Japan and other developed countries could be attracted in this type of fishing.

The second type is for adventure seeking fishers who like to go for sport fishing. Fish like Mahaseer is considered as one of the best fish for sport fishing. Because, Mahaseer fishing needs special skills to tackle and fight for catching, particularly, when the fish are of larger size. A group of retired officers of British Gurkha Regiment in Dharan, Sunsari district of eastern Nepal organize fishing trips of one or more than two weeks to the major Tributaries of Koshi river system like Dudhkosi, Arunkoshi, Tamur and Sunkoshi.

World famous game fishing equipment producers like 'Shakespeare' of England and Abu Co. of Sweden organize international fishing competitions every year. Major Wills of Ghopa Camp, Dharan one of the British pension camps in Nepal, is said to have received second prize in international fishing competition by catching a Mahaseer of 23 kg. from Nepal (NTB, 2001).

Formation of reservoir/s will create demand of boats for fishing, transportation of commodities and people of the community as well as tourists for recreational purpose for which boat making and repair industries of appropriate sizes need to be established.

### 9.3 ACTIVITIES

#### 9.3.1 Site Clearance Phase

Reduce soil erosion and silt runoff

Activity 1.1. Conduct awareness program to minimize disturbances in the present fish habitat

Activity 1.2. Adopt environmental friendly technologies, habitat enhancement in sustainable manner

Activity 1.3. Monitor fish habitat spawning areas and its aquatic biodiversity

Control illegal fishing

Activity 2.1. Prohibit illegal fishing by work force,

Activity 2.2. Conduct awareness programs regarding aquatic life protection act for site clearing worker

#### 9.3.2 Construction Phase

Sustain breeding place and feeding area

Activity 3.1. Conduct environment friendly technologies for breeding and feeding area

Activity 3.2. Reduce quarrying, deposition soil and boulders

Activity 3.3. Monitor spawning place and feeding area

Control obstruction of fish migration

Activity 4.1. Release of environmental flow sufficiently all the times,

Activity 4.2. Encourage to establish fish spawning sites and artificial ponds at the project areas in order to maintain fish diversity

Activity 4.3. Provide aquaculture training as well as importance of fish biodiversity,

Activity 4.4. Motivate sustainable utilization of indigenous riverine fish.

Manage use of explosives

Activity 5.1. Minimize the use of explosives in construction site

Activity 5.2. Conduct awareness training program about rules and regulations of aquatic life to construction workers.

Activity 5.3. Monitor blast charges size, locations and safe distance from fish bearing water

Restrict heavy fishing by construction work force

Activity 6.1. Prohibit the fishing activities by construction work force and laborers in the river,

Activity 6.2. Prohibit illegal means of fishing (diverting the river flow, dynamiting, electro fishing or by poisoning and selling and transportation for personal benefits),

Activity 6.3. Conduct awareness programs on bio-diversity conservation.

Confine spillage of petrochemicals

Activity 7.1. Prohibit direct disposal of petrochemicals substances in the river

Activity 7.2. Dump uncontrolled spillage of petro chemicals in certain confined area and disposed in environment friendly manner.

Activity 7.3. Spread awareness about spill response plan and its content.

Manage waste are effectively

Activity 8.1. Prohibit direct disposal of solid waste substances in the river

Activity 8.2. Dispose solid waste in appropriate manner

### Maintain breeding and spawning ground

- Activity 9.1. Protect spawning and nursing grounds areas (upstream of confluence points of Goriganga, Chameliya, Saryau, Gokuleshwor and other confluence areas )
- Activity 9.2. Deposit gravel to increase spawning habitat
- Activity 9.3. Manipulate angular and large boulders to create pools for spawning
- Activity 9.4. Conduct awareness program regarding breeding ground, spawning and rearing areas

### 9.3.3 Operation Phase

#### Manage pollutants, sediments, and nutrients from watershed areas

- Activity 10.1. Manage agricultural and other waste - sediments, excessive nutrients, organic matter, and contaminants
- Activity 10.2. Reduce loads of sediments and nutrients entering rivers and reservoirs (conservation tillage, terracing, crop rotation, vegetative cover, crop residue, nutrient management, streamside management zones)
- Activity 10.3. Construct structural devices such as retention basins, sediment dikes, and erosion control weirs
- Activity 10.4. Stock palnktivour, hervivour and omnivourfish species (Silver, Bighead, Grass carp and Common carp, Rohu, Naini, Bhakur) for utilization of increased nutrients loads from watershed and reservoir formation.

#### Reduce fish mortality due to thermal stratification phenomenon

- Activity 11.1. Minimize thermal stratification phenomena as far as possible (appropriate methods to destratify or prevent stratification include hypolimnetic discharges, air bubbling/injection to generate water movement, and mechanical pumping between hypolimnion and epilimnion to either generate water movement, or to aerate hypolimnetic water by passing through baffle systems)

#### ***Output 1. Maintain fish diversity in the reservoir***

#### Habitat enhancement for fish upstream of PHD around the tributaries in shallow water regions within IIZ

- Activity 12.1. Create check dams with the help of weirs
- Activity 12.2. Create 1.5 km<sup>2</sup> plunge pools by deepening shallow reaches of stream and establishing riffle habitat and log veins, rock veins, cross veins and boulder clusters in 3 places (0.5 km<sup>2</sup> in each place)
- Activity 12.3. Stabilize laterally eroding banks
- Activity 12.4. Restore natural channel geometry and retain proper channel width to depth ratios
- Activity 12.5. Provide hydraulic relief from water current and strategic feeding zones for fish and flow constrictors (decrease width to depth ratio for higher carrying capacity, movement and refuge benefits)

#### Hatchery establishment for migratory and resident fish species

- Activity 12.6. Carry out detail survey for hatchery development
- Activity 12.7. Establish two cold water hatcheries to produce around 600,000 fingerlings of long distance migratory *Tor spp.*, short distance migratory *Neolissocheilus hexagonolepis*, *Schizothorax spp.* and other resident indigenous fishes for mitigation purpose

- Activity 12.8. Ranch the stocking material (fingerling size) to replenish and repopulate in proposed reservoir and tributaries in the surrounding area in a phased manner
- Activity 12.9. Collect brooders of Mahseer, Asla, Katle and resident fish species from the wild and also stripped down at Hatchery and release back into the rivers.
- Activity 12.10. Promote nursery farmers to get large size fingerling for stocking in Reservoir.
- Activity 12.11. Coordinate with the Directorate of Fisheries Development, Fisheries Research Division and other related agencies in the country.
- Activity 12.12. Establish fish conservation and management unit.
- Activity 12.13. Restock fingerling both upstream and downstream of Pancheshwar dam site after rearing the spawn in the hatchery for a stipulated period of time
- Activity 12.14. Develop effective monitoring mechanism to gauge efficacy of survival of fish in water bodies.
- Activity 12.15. Promote private nursery entrepreneurs to establish fish culture to generate income and employment and to reduce the pressure on natural fish stock.
- Activity 12.16. Provide financial and technical support to farmers to develop nursery and rearing ponds

#### Open water stocking in reservoir

- Activity 12.17. Stock fish seed to enhance for reservoir fish stock
- Activity 12.18. Control over fishing to maintain sustainable population of fish.
- Activity 12.19. Conduct Limnological and Biological study

#### Promote reservoir fisheries

#### Cage culture in the reservoir

- Activity 13.1. Establish of 25 mesh size 6,930,000 m<sup>3</sup> production and 5 mesh size 700,000 m<sup>3</sup> Nursery cage (10% of the reservoir area).
- Activity 13.2. Stock appropriate fish species in cages
- Activity 13.3. Aware and training for community/fisher group
- Activity 13.4. Observation tour on cage culture area
- Activity 13.5. Provide financial and technical support to farmers / communities to develop cage culture

#### Hatchery establishment for aquaculture

- Activity 13.6. Establish warm water hatchery for cage culture (hatchery shed, breeding, incubation and rearing tanks, brood, rearing and nursery ponds, holding and stocking ponds, quarantine room, office building, food storage yard, laboratory, different gears, etc), one in Patan of Baitadi and one in Kailali/ Kanchanpur to supply required number of fry/fingerling to the project area for cage culture and open water stocking)
- Activity 13.7. Encourage private fish nursery/rearing farmers for fingerling supply in project area.
- Activity 13.8. Provide financial and technical support to nursery and rearing farmers / communities.

#### Organize community based fish farming

- Activity 13.9. Initiate community based fish farming programs for cage culture and nursery farmers in the project area.

Activity 13.10. Initiate concept of community water bodies in the proposed reservoir to empower the fisher community.

Activity 13.11. Form fisher group cooperatives.

Activity 13.12. Provide technical, financial, and other supports to the cooperatives.

Activity 13.13. Provide awareness and training programs

Activity 13.14. Conduct observation tour programs.

***Output 2. Develop infrastructure and marketing facilities***

Activity 14.1. Establish cold storage and processing unit with landing, chilling, storage and fish processing facilities to prevent post-harvest losses of fish in proposed reservoir area.

Activity 14.2. Establish marketing network

Activity 14.3. Conduct awareness, training and tour program

***Output 3. Promote ecotourism activities***

Activity 15.1. Promote ranching program for recreational angling

Activity 15.2. Promote Mahaseer (Sahar) game fishing

Activity 15.3. Promote boating for recreating and transportation

Activity 15.4. Establish boat house for tourist

Table 9-1: Implementation Schedule

S N	Program /Activities	Unit	Quantity	I Five year					II Five year					III Five year					IV Five year				
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
<b>A</b>	<b>Site Clearance Phase</b>																						
1	<i>Soil erosion and silt runoff is reduced</i>																						
1.1	Conduct awareness program to minimize disturbances in the present fish habitat	No.	25																				
1.2	Adopt environmental friendly technologies, habitat enhancement in sustainable manner	No.	5																				
1.3	Monitor the fish habitat spawning areas and its aquatic biodiversity	As required																					
2	<i>Illegal fishing is controlled</i>																						
2.1	Prohibit illegal fishing by work force	As required																					
2.2	Conduct awareness programs regarding aquatic life protection act for site clearing worker	No.	25																				
<b>B</b>	<b>Construction Phase</b>																						
3	<i>Breeding place and feeding area is sustained</i>																						
3.1	Conduct environment friendly technologies for breeding and feeding area	As required																					
3.2	Reduce quarrying, deposition soil and boulders																						
3.3	Monitor spawning place and feeding area	As required																					
4	<i>Obstruction of fish migration is controlled</i>																						
4.1	Release of environmental flow sufficiently all the times																						
4.2	Encourage to establish fish spawning sites and artificial ponds at the project areas in order to maintain fish diversity	No.	25																				
4.3	Provide aquaculture training as well as importance of fish biodiversity	No.	30																				
4.4	Motivate towards the sustainable utilization of indigenous riverine fish.																						
5	<i>Use of explosives is managed</i>																						
5.1	Minimize the use of explosives in construction site	As required																					
5.2	Conduct awareness training programme about rules and regulations of aquatic life to the construction workers.	As required																					
5.3	Monitor the blast charges size, locations and safe distance from fish bearing water																						
6	<i>Heavy fishing by construction work force is restricted</i>																						
6.1	Prohibit the fishing activities by construction work force and laborers in the river	As required																					
6.2	Prohibit illegal means of fishing (diverting the river flow, dynamiting, electro fishing or by poisoning and selling and transportation for personal benefits)	As required																					



S N	Program /Activities	Unit	Quantity	I Five year					II Five year					III Five year					IV Five year				
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
6.3	Conduct awareness programs on bio-diversity conservation.	As required																					
7	<i>Spillage of petrochemicals are confined</i>																						
7.1	Prohibit direct disposal of petrochemicals substances in the river	As required																					
7.2	Dump uncontrolled spillage of petro chemicals in certain confined area and disposed in environment friendly manner.	As required																					
7.3	Aware spill response plan and its content.																						
8	<i>Waste are effectively managed</i>																						
8.1	8.1Prohibit direct disposal of solid waste substances in the river																						
8.2	Dispose solid waste in appropriate manner																						
9	<i>Breeding and spawning ground is maintained</i>																						
9.1	Protect spawning and nursing grounds areas (confluence points of Goriganga, Chameliya, Saryau, Gokuleshwar and other confluence areas )																						
9.2	Deposit of Gravel to increase the spawning habitat																						
9.3	Manipulate angular and large boulders to create pools for spawning																						
9.4	Conduct awareness programme regarding breeding ground, spawning and rearing areas	No.	10																				
<b>C</b>	<b>Operation Phase</b>																						
10	<i>Pollutants, sediments, and nutrients from watershed areas are appropriately managed</i>																						
10.1	Manage agricultural and other waste - sediments, excessive nutrients, organic matter, and contaminants	As required																					
10.2	Reduce loads of sediments and nutrients entering rivers and reservoirs (conservation tillage, terracing, crop rotation, vegetative cover, crop residue, nutrient management, streamside management zones)	As required																					
10.3	Construct structural devices such as retention basins, sediment dikes, and erosion control weirs	No.	35																				
10.4	Stock palnkktivour, hervivour and omnivour fish species (Silver, Bighead, Grass carp and Common carp, Rohu, Naini, Bhakur, Asla, Sahar and Katle) for utilization of increased nutrients loads from watershed and reservoir formation. (1,500/ha)	No.	5198 '000																				
11	<i>Fish mortality due to thermal stratification phenomenon is reduced</i>																						
11.1	Minimize thermal stratification phenomena as far as possible(appropriate methods to destratify or prevent stratification include hypolimnetic discharges, air bubbling/injection to generate water movement, and mechanical pumping between the	As required																					

S N	Program /Activities	Unit	Quantity	I Five year					II Five year					III Five year					IV Five year				
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	hypolimnion and epilimnion to either generate water movement, or to aerate hypolimnetic water by passing through baffle systems)																						
12	<i>Fish diversity in the reservoir is maintained</i>																						
	<i>§ Habitat enhancement for fish upstream of PMP around the tributaries in shallow water regions within indirect impact zone area</i>																						
12.1	Create check dams with the help of weirs	No.	6																				
12.2	Create 1.5 km <sup>2</sup> plunge pools by deepening shallow reaches of stream and establishing riffle habitat and log veins, rock veins, cross veins and boulder clusters in 3 places (0.5 km <sup>2</sup> in each place)	No.	3																				
12.3	Stabilize laterally eroding banks	No.	6																				
12.4	Restore natural channel geometry and retain proper channel width to depth ratios	No.	6																				
12.5	Provide hydraulic relief from water current and strategic feeding zones for fish and flow constrictors (decrease width to depth ratio for higher carrying capacity, movement and refuge benefits)	As required																					
	<i>§ Hatchery establishment for migratory as well as resident fish species</i>																						
12.6	Carry out detail survey for hatchery development	Time	1																				
12.7	Establish two cold water hatcheries to produce around 600,000 fingerlings for long distance migratory Tor spp., short distance migratory Neolissocheilus hexagonolepis and other resident indigenous fishes	Time	2																				
12.8	Ranch the stocking material (fingerling size) to replenish and repopulate in proposed reservoir and tributaries in the surrounding area in a phased manner	No. '000	578																				
12.9	Collect the brooders of Mahseer, Asla, Katle and resident fish species from the wild and also stripped down at Hatchery and release back into the rivers.	Mt.	14																				
12.10	Promote nursery farmers to get large size fingerling for stocking in Reservoir, and brood stocking	Ha	4																				
12.11	Coordinate with the Directorate of Fisheries Development, Fisheries Research Division and other related agencies in the country.	As necessary																					
12.12	Establish fish conservation and management unit.	No.	1																				
12.13	Restock the fingerling both upstream and downstream of Pancheshwar dam site after rearing the spawn in the hatchery for a stipulated period of time																						
12.14	Develop effective monitoring mechanism to gauge the efficacy of survival of fish in the water bodies.	Time /yr.	3																				
12.15	Promote private entrepreneurs to establish fish culture to generate income and employment and to reduce the pressure on natural	No	3																				

S N	Program /Activities	Unit	Quantity	I Five year					II Five year					III Five year					IV Five year				
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	fish stock.(Baitadi, Dadeldhura and Darchula Districts)																						
12.16	Provide financial and technical support to farmers to develop nursery and rearing ponds	No	3																				
	§ <i>Open water stocking in the reservoir</i>																						
12.17	Stock fish seed to enhance for reservoir fish stock	No. '000	5197																				
12.18	Control over fishing to maintain sustainable population of fish.	As required																					
12.19	Conduct Limnological and Biological study	No/ yr	12																				
13	<i>Reservoir fisheries is promoted</i>																						
	§ <i>Cage culture in the reservoir</i>																						
13.1	Establish of 25 mess size 6,930,000 m <sup>3</sup> Production and 5 mess size 700,000 m <sup>3</sup> Nursery cage (10% of the reservoir area).	M3. '000	57750																				
13.2	Stock appropriate fish species in cages																						
13.3	Aware and train program for Community/fisher group	As required																					
13.4	Observation tour on cage culture area	As required																					
13.5	Provide financial and technical support to farmers / communities to develop cage culture																						
	§ <i>Hatchery establishment for aquaculture</i>																						
13.6	Establish warm water hatchery for cage culture (hatchery shed, breeding, incubation and rearing tanks, brood, rearing and nursery ponds, holding and stocking ponds, quarantine room, office building, food storage yard, laboratory, different gears, etc), one in Patan of Baitadi and one in Kailali/ Kanchanpur to supply required number of fry/fingerling to the project area for cage culture and open water stocking)	No	2																				
13.7	Encourage private fish nursery/rearing farmers for fingerling supply in project area.	No. '000	19,250																				
13.8	Provide financial and technical support to nursery and rearing farmers / communities.																						
	§ <i>Organise community based fish farming</i>																						
13.9	Initiate Community based fish farming programme for cage culture and nursery farmers in the project area.																						
13.10	Initiate concept of community water bodies in the proposed reservoir to empower the fisher community.																						
13.1	Form fisher group cooperatives.																						

S N	Program /Activities	Unit	Quantity	I Five year					II Five year					III Five year					IV Five year				
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1																							
13.1	Provide technical, financial, and other supports to the cooperatives.																						
2																							
13.1	Provide awareness and training programmes																						
3																							
13.14	Conduct observation tour programmes.																						
14	Infrastructure and marketing facilities are developed																						
14.1	Establish cold storage and processing unit with landing, chilling, storage and fish processing facilities to prevent post-harvest losses of fish in proposed reservoir area.																						
14.2	Establish marketing network																						
14.3	Conduct awareness, training and tour programme																						
15	Ecotourism activities is promoted																						
15.1	Promote ranching progrmmae for recreational angling																						
15.2	Promote boating for recreating and transportation																						
15.3	Establish boat house																						

**Table 9-2: Summary of total tentative cost for fisheries management plan implementation**

S N	Activities	Total (Million)
A	Site Clearance Phase	7.50
1	Reduce soil erosion and silt runoff	5.25
2	Control illegal fishing	2.25
B	Construction Phase	34.35
3	Sustain breeding place and feeding area	2.10
4	Control obstruction of fish migration	5.70
5	Manage use of explosives	5.95
6	Restrict heavy fishing by construction work force	5.85
7	Confine spillage of petrochemicals	7.85
8	Manage waste effectively	2.40
9	Maintain breeding and spawning ground	4.50
C	Operation Phase	5,428.15
10	Managed pollutants, sediments, and nutrients from watershed areas appropriately	14.30
11	Reduce fish mortality due to thermal stratification phenomenon	2.00
12	Maintain fish diversity in the reservoir	330.32
13	Promote reservoir fisheries	4,991.53
14	Develop infrastructure and marketing facilities	70.00
15	Promote ecotourism activities	20.00
	Grand Total	5,470.00

Table 9-3: Detail Tentative Cost for Fisheries Management Plan Implementation (NRs. In Millions)

S N	Programs /Activities	Unit	Quantity	1st Five year					2nd Five year					3rd Five year					4th Five year					Total
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
A	Site Clearance Phase																						7.50	
1	Reduce soil erosion and silt runoff is																						5.25	
1.1	Conduct awareness programme to minimize disturbances in the present fish habitat(fisher group and other relevant)	No.	25	3.75																			3.75	
1.2	Adopt environmental friendly technologies, habitat enhancement in sustainable manner	No.	5			0.75																	0.75	
1.3	Monitor the fish habitat spawning areas and its aquatic biodiversity	As required		0.75																			0.75	
2	Controlled illegal fishing																						2.25	
2.1	Prohibit illegal fishing by work force	As required		0.30																			0.30	
2.2	Conduct awareness programs regarding aquatic life protection act for site clearing worker	No.	13	1.95																			1.95	
B	Construction Phase																						34.35	
3	Sustained breeding place and feeding areas																						2.10	
3.1	Conduct environment friendly technologies for breeding and feeding area	As required			0.30																		0.30	
3.2	Reduce quarrying, deposition soil and boulders				0.90																		0.90	
3.3	Monitor spawning place and feeding area	As required				0.90																	0.90	
4	Controlled obstruction of fish migration																						5.70	
4.1	Release of environmental flow sufficiently all the times	As required				1.3																	1.30	
4.2	Encourage to establish fish spawning sites and artificial ponds at the project areas in order to maintain fish diversity(fisher community and farmers groups)	No.	5						2.5														2.50	
4.3	Provide aquaculture training as well as importance of fish biodiversity(fisher community and farmers groups)	No.	4								1.00												1.00	

S N	Programs /Activities	Unit	Quantity	1st Five year					2nd Five year					3rd Five year					4th Five year					Total
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
4.4	Motivate towards the sustainable utilization of indigenous riverine fish.	No	6				0.90																	0.90
5	<i>Manage use of explosives</i>																							5.95
5.1	Minimize the use of explosives in construction site	As required							1.00															1.00
5.2	Conduct awareness training programme about rules and regulations of aquatic life to the construction workers.	As required							0.15			0.15			0.15									0.45
5.3	Monitor the blast charges size, locations and safe distance from fish bearing water	/yr	3						4.5															4.50
6	<i>Restrict heavy fishing by construction work force</i>																							5.85
6.1	Prohibit the fishing activities by construction work force and laborers in the river	/yr	1			1.95																		1.95
6.2	Prohibit illegal means of fishing (diverting the river flow, dynamiting, electro fishing or by poisoning and selling and transportation for personal benefits)	per yr	1			1.95																		1.95
6.3	Conduct awareness programs on bio-diversity conservation.	/yr	1			1.95																		1.95
7	<i>Confine spillage of petrochemicals</i>																							7.85
7.1	Prohibit direct disposal of petrochemicals substances in the river	As required							1.50															1.50
7.2	Dump uncontrolled spillage of petrochemicals in certain confined area and disposed in environment friendly manner.	As required							5.00															5.00
7.3	Aware spill response plan and its content.	pyr	1						1.35															1.35
8	<i>Manage waste effectively</i>																							2.40
8.1	Prohibit direct disposal of solid waste substances in the river	As required							1.20															1.20
8.2	Dispose solid waste in appropriate manner	As required							1.20															1.20
9	<i>Maintain breeding and spawning ground</i>																							4.50

S N	Programs /Activities	Unit	Quantity	1st Five year					2nd Five year					3rd Five year					4th Five year					Total
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
9.1	Protect spawning and nursing grounds areas (confluence points of Goriganga, Chameliya, Saryau, Gokuleshwar and other confluence areas )	No.	10								1.50													1.50
9.2	Deposit of Gravel to increase the spawning habitat	No.	10											1.50										1.50
9.3	Manipulate angular and large boulders to create pools for spawning	No.	10											1.50										1.50
C	Operation Phase																							5428.1
10	Manage pollutants, sediments, and nutrients from watershed areas appropriately																							14.30
10.1	Manage agricultural and other waste - sediments, excessive nutrients, organic matter, and contaminants	As required													1.35									1.35
10.2	Reduce loads of sediments and nutrients entering rivers and reservoirs (conservation tillage, terracing, crop rotation, vegetative cover, crop residue, nutrient management, streamside management zones) Demonstration	As required												1.50										1.50
10.3	Construct structural devices such as retention basins, sediment dikes, and erosion control weirs Demonstration	No.	35								5.25													5.25
10.4	Stock palnkтивour, hervivour and omnivour fish species (Silver, Bighead, Grass carp and Common carp, Rohu, Naini, Bhakur, Asla, Sahar and Katle) for utilization of increased nutrients loads from watershed and reservoir formation. (1,500/ha)	No. '000	5,198													6.198								6.20
11	Reduced fish mortality due to thermal stratification phenomenon																							2.00
11.1	Minimize thermal stratification phenomena as far as possible (appropriate methods to destratify or prevent stratification include hypolimnetic discharges, air bubbling/injection to	As required														2.00								2.00



S N	Programs /Activities	Unit	Quantity	1st Five year					2nd Five year					3rd Five year					4th Five year					Total	
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
	generate water movement, and mechanical pumping between the hypilimnion and epilimnion to either generate water movement, or to aerate hypolimnetic water by passing through baffle systems)																								
12	Maintain fish diversity in the reservoir																								330.32
	▪ Habitat enhancement for fish upstream of Panchesware Hydropower Project around the tributaries in shallow water regions within indirect impact zone area																								
12.1	Create check dams with the help of weirs	No	6																	6.00					6.00
12.2	Create 1.5 km² plunge pools by deepening shallow reaches of stream and establishing riffle habitat and log veins, rock veins, cross veins and boulder clusters in 3 places (0.5 km² in each place)	No	3																		15.00				15.00
12.3	Stabilize laterally eroding banks	No	6																	6.00					6.00
12.4	Restore natural channel geometry and retain proper channel width to depth ratios	No	6																	3.60					3.60
12.5	Provide hydraulic relief from water current and strategic feeding zones for fish and flow constrictors (decrease width to depth ratio for higher carrying capacity, movement and refuge benefits)	As required												0.50											0.50
	▪ Hatchery establishment for migratory as well as resident fish species																								
12.6	Carry out detail survey for hatchery development	Time	1								5.00														5.00
12.7	Establish two cold water hatcheries to produce around 600,000 fingerlings for long distance migratory Tor spp., short distance migratory Neolissocheilus hexagonolepis and other resident indigenous fishes	No	2								80.00				80.00										160.00

S N	Programs /Activities	Unit	Quantity	1st Five year					2nd Five year					3rd Five year					4th Five year					Total
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
12.8	Ranch the stocking material (fingerling size) to replenish and repopulate in proposed reservoir and tributaries in the surrounding area in a phased manner	No. '000	578															5.78						5.78
12.9	Collect the brooders of Mahseer, Asla, Katle and resident fish species from the wild and also stripped down at Hatchery and release back into the rivers.	Mt.	14					3.50																3.50
12.10	Promote nursery farmers to get large size fingerling for stocking in Reservoir, and brood stocking (Under PPP)	Ha	8					3.20																3.20
12.11	Coordinate with the Directorate of Fisheries Development, Fisheries Research Division and other related agencies in the country.	As necessary		5.00																				5.00
12.12	Establish fish conservation and management unit.	No.	1	50.00																				50.00
12.13	Restock the fingerling both upstream and downstream of Pancheshwar dam site after rearing the spawn in the hatchery for a stipulated period of time																							0.00
12.14	Develop effective monitoring mechanism to gauge the efficacy of survival of fish in the water bodies.	Times /yr.	3		5.70																			5.70
12.15	Promote private entrepreneurs to establish fish culture to generate income and employment and to reduce the pressure on natural fish stock(Baitadi, Dadeldhura and Darchula Districts)	No	3								5.00				5.00					5.00				15.00
12.16	Provide financial and technical support to farmers to develop nursery and rearing ponds	No	3						0.05				0.05					0.05						0.15
	■ Open water stocking in the reservoir																							
12.17	Stock fish seed to enhance for reservoir fish stock	No. '000	5,197													2.60								2.60
12.18	Control over fishing to maintain sustainable population of fish.	As required					3																	2.50

S N	Programs /Activities	Unit	Quantity	1st Five year					2nd Five year					3rd Five year					4th Five year					Total
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
12.19	Conduct Limnological and Biological study	No/y	12				40.80																	40.80
13	<i>Promote reservoir fisheries</i>																							4991.5
	▪ <i>Cage culture in the reservoir</i>																							
13.1	Establish of 25 mess size 6,930,000 m <sup>3</sup> Production and 5 mess size 700,000 m <sup>3</sup> Nursery cage (10% of the reservoir area).	No of cage	154,000																4,620.00					4,620
13.2	Stock appropriate fish species in cages (in 000)	No	69,300																138.60					138.60
13.3	Awareness and training programs for Community/fisher group	As required										0.90												0.90
13.4	Observation tour on cage culture area	As required																		1				1.00
13.5	Provide financial and technical support to farmers / communities to develop cage culture															0.53								0.53
	▪ <i>Hatchery establishment for aquaculture</i>																							
13.6	Establish warm water hatchery for cage culture (hatchery shed, breeding, incubation and rearing tanks, brood, rearing and nursery ponds, holding and stocking ponds, quarantine room, office building, food storage yard, laboratory, different gears, etc), one in Patan of Baitadi and one in Kailali/ Kanchanpur to supply required number of fry/fingerling to the project area for cage culture and open water stocking)	No	2							100.00						100.0								200.00
13.7	Encourage private fish nursery/rearing farmers for fingerling supply in project area.	No. '000	19,250										0.12						0.12					0.24
13.8	Provide financial and technical support to nursery and rearing farmers / communities.											0.13					0.13							0.26
	▪ <i>Organize community based fish farming</i>																							0.00
13.9	Initiate Community based fish farming program for cage culture and nursery														5.00									5.00

S N	Programs /Activities	Unit	Quantity	1st Five year					2nd Five year					3rd Five year					4th Five year					Total
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
	farmers in the project area.																							
13.10	Initiate concept of community water bodies in the proposed reservoir to empower the fisher community.														5.00									5.00
13.11	Form fisher group cooperatives.												5.00											5.00
13.12	Provide technical, financial, and other supports to the cooperatives.												10.00											10.00
13.13	Provide awareness and training programs																							0.00
13.14	Conduct observation tour programs.						5.00																	5.00
14	<i>Develop Infrastructure and marketing facilities</i>																							
	Establish cold storage and processing unit with landing, chilling, storage and fish processing facilities to prevent post-harvest losses of fish in proposed reservoir area.																50.00							50.00
14.2	Establish marketing network													10.00										10.00
14.3	Conduct awareness, training and tour programs													10.00										10.00
15	<i>Promote ecotourism activities</i>																							20.00
15.1	Promote ranching programs for recreational angling																5.00							5.00
15.2	Promote boating for recreating and transportation																5.00							5.00
15.3	Establish boat house																10.00							10.00
Total																								5,470
Human Resource (Technical only)																								356
Grand Total																								5,826

Table 9-4: Tentative Income from Fisheries sector

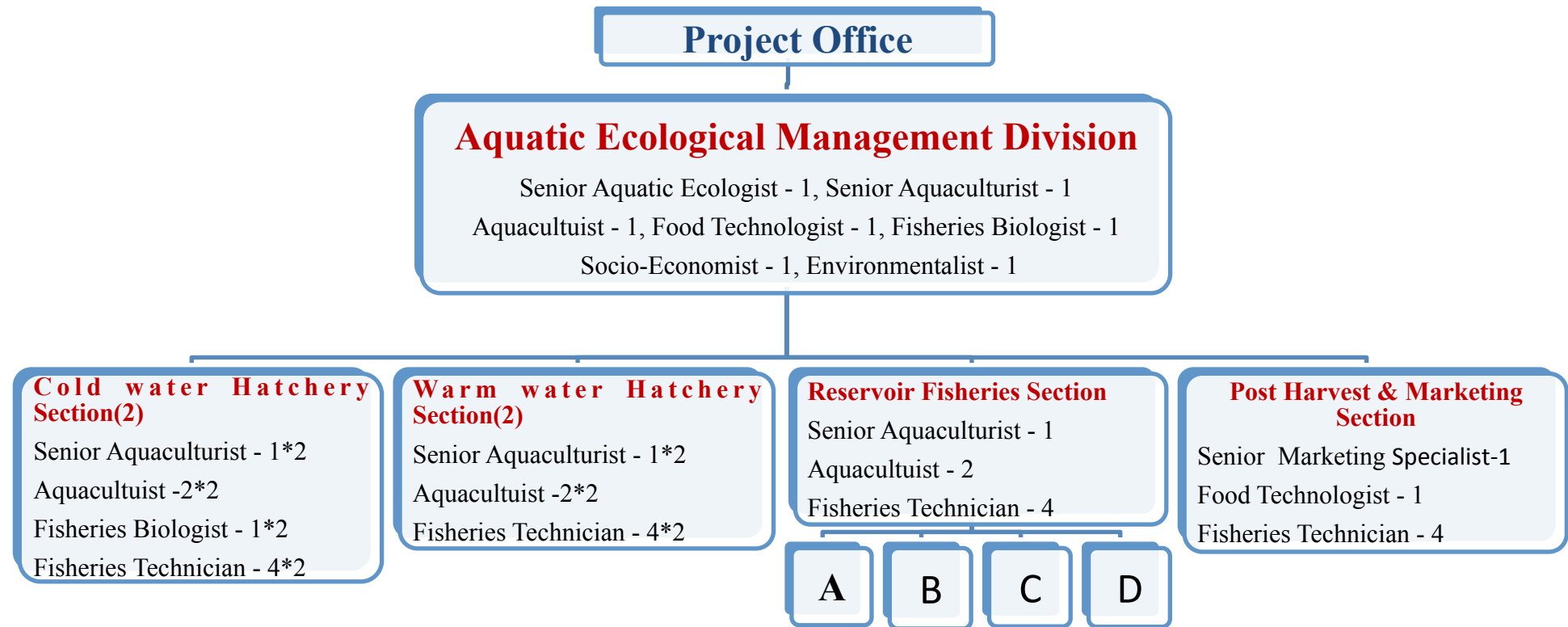
S.N.	Item	Unit	Tentative production in Final year	Rate of the Fish/kg.	Income NRs. In Million
A	Fish catch from open water stocking from 3,850 ha)	Mt.	989	250	247
B	Fish Production from Cage culture (25% cage use in Nursery cage for production cage) /m3 = 6 kg fish Cage 6,160,000 m <sup>3</sup>	Mt.	36,960	150	5,544
C	Ecotourism	NRs.			20
	Total		37,949	400	5,811

Table 9-5: Monitoring Plan

Parameters	Schedule	Indicators	Responsibility
Compliance monitoring Integration of fisheries management plan into the project administration, management, and implementation of mitigation measures.	During site clearance, construction and operation phases	The project complies with the national fisheries law and regulations (Review of project progress reports, periodic and annual reports, and Compliance monitoring report) The mitigation measures suggested by the plan is fully implemented (Review of project progress reports, periodic and annual reports, and Compliance monitoring report, periodic monitoring report)	Project Consultants DoFD/GOVN
Impact monitoring Minimal disturbance to fish breeding and nursery area (fish habitat) Fish breeding area Fish nursery ground area Water Quality (Temperature, turbidity, Silt load, DO, pH, Alkalinity, Total Hardness, Planktons)	During site clearance and excavation	Record and observation	Project unit/Consultant DoFD/ DoAD, NARC, MoPE
Quantity of explosives materials	During site clearance, construction and operation phases	Record	Project unit/Consultant/ DoFD/ DoAD, NARC, MoPE
Breeding and Rearing area	During Construction and operations phases	Observation planktons and Insects density record	Project unit/Consultant DoFD/ DoAD, NARC, MoPE
Obstruction of fish migration	During Construction and operations phases	Catch assesment of long and mid migratory fish species Record number of fingerling stocking	Project unit/Consultant/ DoFD/ DoAD, NARC, MoPE
Quantity of Spillage of petrochemicals and solid waste	During Construction and operations phases	Record	Project Unit DoFD/ DoAD, NARC, MoPE
Pollutants, sediments, and nutrients from watershed areas	During Construction and operations phases	Record Sampling	Project Unit /Consultant/ DoFD/ DoAD, NARC, MoPE

Parameters	Schedule	Indicators	Responsibility
Fish mortality due to thermal stratification phenomenon	During operation phase	Temperature fluctuation Sampling	Project Unit DoFD/ DoAD, NARC, MoPE
Hatchery establishment for resident species	During construction and operation phase	Seed production Record Observation	Project UnitDoFD/ DoAD, NARC, MoPE
Open water stocking in the reservoir	During operation phase	Observation and number of fish seed	Project Unit, DoFD/ DoAD, NARC, MoPE
Fish Diversity	During operation phase	Sampling	Project Unit, DoFD/ DoAD, NARC, MoPE
Total Number of Cage culture	During operation phase	Record inspection	Project UnitDoFD/ DoAD, NARC, MoPE
Hatchery establishment for aquaculture	During operation phase	Seed production	Project Unit, DoFD/ DoAD, NARC, MoPE
Number of Community	During operation phase	Observation and Record	Project Unit, DoFD/ DoAD, NARC, MoPE
Infrastructure and marketing facilities	During operation phase	Record	Project Unit, DoFD/ DoAD, NARC, MoPE
Ecotourism	During operation phase	Record	Project Unit, DoFD/ DoAD, NARC, MoPE

#### 9.4 PROPOSE ORGANIZATIONAL CHART AND STAFFING



4 (ABCD) Cage culture Inspection Unit (Per Unit 2 Fisheries technicians)

**Supporting Staffs (lower staffs and secretarial with administrative) will be managed from Project Office**



Table 9-6: Tentative Cost for salary (NRs. in Millions)

S N	Manpower	Nos.	Rate/annum	per Year	Year(1-20)	NRs. (Millions)
1	Senior Aquatic Ecologist	1	0.975	0.975	17	16.58
2	Senior Aquaculturist	6	0.975	5.85	1-17, 5-10	65.33
3	Senior Marketing Specialist	1	0.975	0.975	10	9.75
4	Aquacultuist	11	0.65	7.15	1-17, 10-10	76.05
5	Food Technologist	2	0.65	1.3	1-17, 1-10	17.55
6	Fisheries Biologist	3	0.65	1.95	1-17, 2-10	24.05
7	Socio-Economist	1	0.65	0.65	17	11.05
8	Environmentalist	1	0.65	0.65	17	11.05
9	Fisheries Technician	32	0.39	12.48	10	124.80
		58		31.98	Total	356.20