



SINDH IRRIGATION AND DRAINAGE AUTHORITY

WATER SECTOR IMPROVEMENT PROJECT PHASE – I (WSIP-I)

Preparation of Regional Plan for Left Bank of Indus

Proposed Project on

Brackish Water Fish Farming in LBOD Drainage Area



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In Association with
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Executive Summary

Background/Rationale

The province of Sindh is blessed with all kind of water resources i.e. marine, brackish and fresh water. The environmental conditions are favourable for culture of all kinds of fish, which can survive and thrive and specific water quality and scope of intensive farming but lack of supply of seed and technical assistance has prevented the development. Thousands of acres of waste and water logged land is available in the LBOD project area and surroundings which can be converted into productive fish ponds. The majority of this land though already owned by residents of the area is not being exploited for any purpose. Water logged areas usually don't have owner ship problem as their original users are still around.

Problem Statement

There is ample area and depressions in the command area of LBOD system which is un-utilized due to salinity problem of the water available in the depressions. In such areas it is not possible to grow fresh water fish. In addition, the LBOD drainage water is available in ample quantity in the spinal, lateral and tertiary drains where brackish water fish could be introduced and propagated.

Project Location and Boundaries

The proposed project is located in left bank of Indus in the command area of LBOD system. The districts in which the proposed project will be initiated are; Shahaeed Benazirabad, Sanghar, Mirpurkhas and Badin. The proposed area is located in the cultivated areas of above districts and along the LBOD system i.e. spinal drain, lateral and tertiary drains and natural depressions where drainage water is naturally or artificially collected within the farmlands.

Project Scope and Objectives

The scope of the proposed project is to introduce the brackish water fish in the LBOD system areas where the quality of water is saline/brackish. The proposed intervention will utilize this water for constructed fish ponds which ultimately be a productive resource both the drainage water and the saline/waterlogged area. With this the alternative opportunities for improved livelihood will enhance in the farming community and ultimately the poverty will be alleviated. The specific objectives of the proposed project are as under:

- To develop and utilize brackish water resources / area lying un used.
- To convert unproductive area into productive area.
- To utilize the drainage water of LBOD system for fish production.
- To increase production of brackish water fishes.
- To strengthen the fisheries resources of brackish water.
- To introduce species of brackish water fishes for culturing practices.
- To train people of area in culturing of brackish /saline water fishes on modern scientific lines.
- To provide alternate sources of livelihood.
- To increase income of fisher farmer.
- To alleviate poverty through production of fish

Description of the Project

Primarily the nature of proposed project is non-structural as it pertains to promotion of fisheries resource and no engineering structure will be constructed but some earthen structures i.e. ponds will be constructed for fish culture hence the project is designated as structural-cum-non-structural.

Keeping in view the problem of induction of high influx in the population /country as well as province every year the food resources are declining day by day and the prices are touching to sky and the purchasing power of the people is shrinking and allowing them to buy high protein products for protein requirement or consumption. To provide affordable animal protein to people the culture of the fish is the need of time. The LBOD project area does not have brackish water fish culture practices especially in Shaheed Benazirabad, Sanghar and Mirpurkhas districts. It is proposed to introduce following brackish and marine water fishes can be cultured to increase fish production from water not being used for any purpose and to elevate poverty and uplift socio economic life of the people of the area. *Tilapia noliticus* and *Lates calcarifer* (Dangri) will be introduced.

Tilapia has become the third most important fish in aquaculture after carps and salmonides because of their good size, rapid growth and palatability. Like other fish they are good resource of protein and a popular target for artisanal and commercial fisheries.

In *Tilapia* farming only male population is raised to avoid wild spawning and avoid small size of female. Most growers use hormones to convert female fries to male fries. *Tilapia* are also easiest and most profitable fish to farm this is due to their omnivores diet mod of reproduction (the fries do not pass through planktonic phase) Tolerance of high stocking density and rapid growth.

Lates calcarifer (Dangri) popularly known as the seas -bass is excellent table fish growing about 1500 mm lengths it is marine fish which is tolerant to brackish water and even fresh water environment lower salinity (10-20 ppt) promotes better growth. It is carnivores highly predacious feeding on fishes, crustaceans, molluscs and worms its growth rate is very fast. The only disadvantage with this fish in cultural operation is that it requires a lot of forage fish in environment it is cultured more in fresh water impoundments such as ponds, tanks, lakes etc then in marine farms.

Description of Technical aspects of intervention

Pre-requisites for the selection of project and technical aspects are as under:

Site Selection: Selection of suitable site plays important role in fish farming one has to keep following in mind for profitable fish farming

- Pond should be constructed on the soils which have water retaining capacity i-e land should not be sandy
- Pond should be at place where water should be available in sufficient quantity.
- Land should not be under agriculture
- Land should not be in the flood area
- Land should be near some road

Soil: The proposed land should have clay loam, silty loam and sandy clay type of soil.

Water Quality: For better *Tilapia* farming water quality parameters required are: Temperature (20-30 C), turbidity (01-105 feet), pH (7.5-12), dissolved Oxygen (5-12 mg/liter, Calcium Carbonate (75-300 mg/l), Salinity (15-20 ppt)

Shape: There s no binding of shape/area of fish farm. However it is observed that rectangular fish farms are easy to maintain and operate.

Depth: 5-6 feet

Inlet: Inlet (Water supply source) is made on the top of pond it should be simple made of pipe.

Outlet: It should be in the bottom of pond and simple monk.

Food: Being omnivorous fish they eat both phytoplanktons and zooplanktons, small insects and larvae.

Approach and Methodology

Suitable sites will be selected after conducting survey as per technical parameters. The project will use barren and water logged lands for construction of new farms and utilize available ponds if any near branch or main drains and use their water as such no extra water will be required. The fish seed will be obtained for already existing fish hatcheries and will be stocked and grown in the fish ponds constructed under the project.

Outcome/targets and scope

It is proposed to construct 80 brackish water fish ponds under the proposed project area on the private lands of Benazirabad, Sanghar, Mirpurkhas and Badin Districts. In each district 10 Tilapia farms and 10 Dangri farms will be constructed under this project. Thus the total number of Tilapia and Dangri Farms will be 40 each.

Implementation Arrangements

The farms / ponds will be managed by land owners. Sindh Fisheries Department will provide extension and advisory services.

Monitoring and Evaluation Mechanism

Monitoring and Evaluation is an important activity in project cycle. Since the proposed project is based on collaboration and participation of stakeholders, the monitoring will also be the same. A monitoring committee will be established constituting of members from each stakeholder with a clear mandate and monitoring mechanism. During the project execution and afterwards this committee will frequently monitor and evaluate the project outcomes, identify bottlenecks and address such bottlenecks through an interactive way. During the process of monitoring indicators and sub-indicators will be established and monitored.

Project cost

The project investment cost during the construction phase is estimated to be Rs. 91.4 million for *Talapia* component and *Dangri* component with following break up:

Investment Coast

Talapia Component	Rs. 44.70 million
Dangri Component	Rs. 46.70 million
Total	Rs. 91.40 million

Project Benefits

1) Social Benefits

Employment generation and livelihood

The project will generate employment opportunities for rural people especially fishing and farming communities during construction and execution phases and onwards. It will create direct and indirect jobs for both men and women.

Poverty, Distribution of Benefits

There are several social issues such as health and hygiene of farming community, income generation options, poverty and gender related issues in the project area. This project will address above issues through social benefits from success of the species for production at commercial or subsistence aquaculture levels, the project will generate income for poor inhabitants of project area and additional income for those fish farmers already active but not culturing species such as *Tilapia nolticus*. For those whose lands are not productive the project gives hope of the land being able to produce and use full output again.

2) Environmental Benefits

The proposed project will address existing environmental issues such as water logging and salinity, water quality aspects, degradation of agricultural lands, decline in fish resources, biodiversity loss and decline in natural resources habitats. Thus the project is environment friendly as it will not raise any environmental issue during construction and implementation phases.

The proposed project will not create any environmental issue during its construction and implementation phases but rather address the existing environmental issues such as water logging and salinity, water quality aspects, degradation of agricultural lands, decline in fish resources, and loss of biodiversity, and decline in natural resources habitats.

This is an environment friendly project as it will not create any adverse impacts on flora and fauna, soil, water, land use, climate etc. The proposed project will be executed in the command areas of LBOD system the care shall be taken to protect the existing wild vegetation of un-economic value. In fact such un-economic and un-utilized lands will be made productive due to introduction of brackish water fish.

It is concluded from the analysis of environmental, social and economic aspects that the proposed project is undoubtedly environment friendly, socially acceptable and economically beneficial as it will address the environmental and social issues and will generate income of farmers/fishermen, enhance the value of the degraded land and convert the un-economic and un-productive lands to productive as the proposed project areas are presently un-productive and the drainage water is creating other environmental problems.

Economic Analysis

The estimated IFRR for Talapia fish has been computed at 23.6%, hence the project is financially viable. The NPV at 12% is Rs.511.0 million. The sensitivity analysis presented in the above table shows that with 10% decrease in the benefits the IFRR is 14.7 % while with 10% increase in the cost the IFRR is about 15.5%. Both of these are above 12%. The simultaneous 10% decrease in benefits and increase in cost suggests the IFRR is 6.5%, it is viable but sensitive to price.

The switching value indicate that if the benefits decrease by 12.9 %, and costs increase by 15.5%, while even if both may change by 6.9% the project will still be viable.

The estimated IFRR for Dangri fish has been computed at 22.1%, hence the project is financially viable. The NPV at 12% is Rs.466.4 million. The sensitivity analysis presented in the above table shows that with 10% decrease in the benefits the IFRR is 13.6 % while with 10% increase in the cost the IFRR is about 14.4%. Both of these are above 12%. The simultaneous 10% decrease in benefits and increase in cost suggests the IFRR is 5.7%.

The switching value indicate that if the benefits decrease by 11.7 %, and costs increase by 13.3%, while even if both may change by 6.2% it will be viable but sensitive to price.

Resettlement Issues

Resettlement is no issue as evacuation does not take place.

Brackish Water Fish Farming in LBOD Drainage System

1 Background and Rationale

Fisheries are an important natural resource and source of nourishment and income. This resource is also a source of livelihood for the poor people and an important factor for poverty alleviation. In Sindh fish grows in sweet and brackish waters both in marine and terrestrial areas in public and private waters. Mostly the fish farming on the private lands is being practiced by using canal water from irrigation sources. Sindh fisheries department provide advisory and technical services to the farmers intended to establish fish farms. There is no organized fish farming on brackish water but people use depressions and ponds for brackish water fish. During the process of consultations with the stakeholders it was proposed by them that brackish water fish farming be established by introducing brackish water fish species.

The province of Sindh is blessed with all kind of water resources i.e. marine, brackish and fresh water. The environmental conditions are favorable for culture of all kinds of fish, which can survive and thrive and specific water quality and scope of intensive farming but lack of supply of seed and technical assistance has prevented the development.

Thousands of acres of waterlogged land is available in the LBOD project area and surroundings which can be converted into productive fish ponds. The majority of this land though already owned by the owners of the area is not being exploited for any productive purpose. Waterlogged areas usually don't have ownership problem as their original users are still around.

1.1 Problem statement

Stakeholders during consultative process in the districts of Shaheed Benazirabad (Nawabshah), Sanghar, Mirpurkhas and Badin proposed that due to shortage of fresh water allocated for agriculture the fish farming is dwindling and the number of fish farms established by the farmers on their lands has been reduced. Farmers prefer to use the available canal water for the cultivation of crops. There is ample area and depressions in the command area of LBOD system which is unutilized due to salinity problem of the water available in the depressions. In such areas it is not possible to grow fresh water fish. In addition, the LBOD drainage water is available in ample quantity in the spinal, lateral and tertiary drains where brackish water fish could be introduced and propagated. At present in Pakistan including Sindh focus is on carp fish culture, which is done in fresh water only. Less flow of water in Indus has changed the quality of underground water and lands in many districts are becoming saline besides including seepage especially in lower Sindh.

Although, fish farming on brackish water is already in practice but in an un-organized and un-scientific way. The main purpose of proposed project is to utilize brackish/saline water for fish farming by introduction of fish species who survive on and propagate on such waters available in the command area of LBOD and Kotri Left Bank drainage systems.

1.2 Physiographic features of the project area

The project area

The project area for this proposed project is located in Shaheed Benazirabad (Nawabshah), Sanghar, Mirpurkhas and Badin districts. The other climatic and physiographic features are as under:

1.2.1 Climate

Project area has a lot of arid climate, the hottest months being May and June when maximum temperature approaches at 43 degrees C. The coolest months are November – February when maximum temperature ranges between 18-27 degrees C. Frost is rare in the project area. The rainfall is sparse and erratic but most likely July and September. Average rainfall is about 175 mm to 125 mm. Evaporation rates may vary from 11 mm per day in hottest months to only 3 mm per day in winter.

1.2.2 Topography

The proposed project area lies in the irrigated zone of Sukkur barrage command area. The project area is relatively flat but there are scattered depressions and old ravines of Indus which used to flow before earthen were constructed. The general slope of the land is 0.75 feet per mile southward and away from the present course of river Indus.

1.2.3 Soils

The alluvial deposits by the river Indus in the project area consist mainly of fine to medium sand, Silt and Clay. The soils of the project area are basically very suitable for irrigated agriculture. The majority of the soils are within the range of fine sandy loam to silty clay, silty loam being most common. All soils contain calcium carbonate and most contain gypsum.

1.2.4 Demography

According to 1998 census total population of the project districts is as under:

Shaheed Benazirabad	1.072 million
Sanghar	1.453 million
Mirpurkhas	0.910 million
Badin	1.136 million
Total	3.752 million

Source: Bureau of Statistics Sindh (2008)

2. Description of the project

2.1 Project Name

Introduction of Brackish Water Fish in LBOD Drainage System

2.2 Project type

Primarily the nature of proposed project is non-structural as it pertains to promotion of fisheries resource and no engineering structure will be constructed but some earthen structures i.e. ponds will be constructed for fish culture hence the project is designated as structural-cum-non-structural.

2.3 Project location and boundaries

The proposed project is located in left bank of Indus in the command area of LBOD system. The districts in which the proposed project will be initiated are; Shaheed Benazirabad, Sanghar, Mirpurkhas, Badin and left side of Thatta districts. The proposed area is located in the cultivated areas of above districts and along the LBOD system i.e. spinal drain, lateral and tertiary drains and natural depressions where drainage water is naturally or artificially collected within the farmlands.

2.4 Project scope and objective – general and specific objectives

The scope of the proposed project is to introduce the brackish water fish in the LBOD system areas where the quality of water is saline/ brackish. The proposed intervention will utilize this water for constructed fish ponds which ultimately be a productive resource both the drainage water and the saline/waterlogged area. With this the alternative opportunities for improved livelihood will enhance in the farming community and ultimately the poverty will be alleviated.

The specific objectives of the proposed project are as under:

- To develop and utilize brackish water resources / area lying un-used.
- To convert unproductive area into productive area.
- To utilize the drainage water of LBOD system for fish production.
- To establish brackish water hatcheries especially *Talapia* and *Dangri* fish
- To increase production of brackish water fishes.
- To strengthen the fisheries resources of brackish water.
- To introduce species of brackish water fishes for culturing practices.
- To train people of area in culturing of brackish /saline water fishes on modern scientific lines.
- To provide alternate sources of livelihood.
- To increase income of fish farmers.
- To alleviate poverty through production of fish.

2.4.1 Approach and Methodology

Suitable sites will be selected after conducting survey as per technical parameters. The project will use barren and water logged lands for construction of new farms and utilize available ponds if any near branch or main drains and use their water as such no extra water will be required. The fish seed will be obtained for already existing fish hatcheries and will be stocked and grown in the fish ponds constructed under the project.

3. Due Diligence

3.1 Description of Intervention

Keeping in view the problem of induction of high influx in the population /country as well as province every year the food resources are declining day by day and the prices are touching to sky and the purchasing power of the people is shrinking and allowing them to buy high protein products for protein requirement or consumption (Fisheries Department Report). To provide affordable animal protein to people the culture of the fish is the need of time

The LBOD project area does not have brackish water fish culture practices especially in Shaheed Benazirabad, Sanghar and Mirpurkhas and Badin districts. It is proposed to introduce following brackish and marine water fishes can be cultured to increase fish production from water not being used for any purpose and to elevate poverty and uplift socio economic life of the people of the area.

1. *Tilapia nolitica* (Talapia)

Tilapia has become the third most important fish in aquaculture after carps and salmonides because of their good size, rapid growth and palatability. Like other fish they are good resource of protein and a popular target for artisanal and commercial fisheries.

In *Tilapia* farming only male population is raised to avoid wild spawning and avoid small size of female. Most growers use hormones to convert female fries to male fries. *Tilapia* are also easiest and most profitable fish to farm this is due to their omnivores diet mod of reproduction (the fries do not pass through planktonic phase) Tolerance of high stocking density and rapid growth.

2. *Lates calcarifer* (Dangri)

Lates calcarifer (*Dangri*) popularly known as the seas -bass is excellent table fish growing about 1500 mm lengths it is marine fish which is tolerant to brackish water and even fresh water environment lower salinity (10-20 ppt) promotes better growth. It is carnivores highly predacious feeding on fishes, crustaceans, molluscs and worms its growth rate is very fast. Fish weighing about 300-500 grams have been found to increase to 5000 grams at the end of the second year of the culture period. They attain maturity at 2 years of age and spawn in June July with supplementary spawning in January and March. The Eggs are demersal. The fry appear in appreciable numbers at the river mouths. They can be collected and stocked in any type of water free from pollution. The only disadvantage with this fish in cultural operation is that it requires a lot of forage fish in environment it is cultured more in fresh water impoundments such as ponds, tanks, lakes etc then in marine farms.

3.4 Description of Technical aspects of intervention

Pre-requisites for the selection of project and technical aspects are as under:

3.4.1 Site Selection

Selection of suitable site plays important role in fish farming one has to keep following in mind for profitable fish farming

- Pond should be constructed on the soils which have water retaining capacity i.e. land should not be sandy
- Pond should be at place where water should be available in sufficient quantity.
- Land should not be under agriculture
- Land should not be in the flood area
- Land should be near some road

3.4.2 Soil

The proposed land should have following type of soil:

Kind of Soil	Sand %	Silt %	Clay %
Clay Loam	20-45	15-50	30-40
Silty Clay Loam	0-20	40-70	30-40
Sandy Clay	45-65	0-20	35-55

3.4.3 Water Quality

For better Tilapia farming following water quality parameters is required.

Temperature	20-30°C (can survive from 10-45 c stop feeding below 15°C dies below 8°C.)
Turbidity	01-105 feet
pH	7.5-12
Dissolved Oxygen	5-12 mg/liter (can survive up to 2 mg)
CO ₂	not more than 3ppm
Calcium Carbonate	75-300 mg/l
Salinity	15-20 ppt

3.4.4 Shape and specifications of fish ponds

There s no binding of shape/area of fish farm. However it is observed that rectangular fish farms are easy to maintain and operate. One acre fish pond having 125 feet X 368.5 feet = 43562 sq. feet is proposed. In all 80 brackish water fish pond will be constructed, of which 40 will be for *Talapia* fish and 40 for *Dangri* fish. Each district will have 10 ponds for *Dangri* and 10 ponds for *Talapia*.

Following specifications of fish ponds is proposed:

Length (outer side)	368.5 feet with 1: 2 slope
Length (inner side)	348.5 feet
Width (outer side)	145 feet (1: 2 slope)
Width (inner side)	125 feet
Depth	10.0 feet (5.0 feet above ground and 5 feet below ground)
Inlet	Inlet (Water supply source) is made on the top of pond it should be simple made of pipe.
Outlet	It should be in the bottom of pond and simple monk.

Estimated cost of one pond will be as under:

Earth Filling: $348.5 + 125.0 \text{ feet} = 473.5 \times 2 = 947.0 \times 100$ 94,700 cft

Earth Cutting: $135 \times 358.5 \times 5$ 241,987 cft

Estimated Cost:

Site clearance and burning of debris	6 MD @ Rs.500/MD	Rs. 3,000
Earth Cutting:	$241,987 \text{ cft} \times \text{Rs. } 2575/1000 \text{ cft}$	Rs. 623,117
Earth Filling:	$94,700 \times \text{Rs. } 3635 /1000 \text{ cft}$	Rs. 344,235
Total Cost per pond for site clearance & earth work		Rs. 970,352
Cost of Inlet	LS	Rs. 12,000

Compaction and dressing: LS Rs. 24,484

Total Cost **Rs. 1,006,836 or say Rs. 1.007 million**

Food Being omnivorous fish they eat phytoplanktons, zooplanktons, small insects and larvae. It is essential that the ponds should have above kinds of food items so that healthy fish could be grown and the fish farmers get profit.

3.5 Outcome/targets and scope

It is proposed to construct 80 brackish water fish ponds under the proposed project area on the private lands as under:

District	No. Talapia Farms	No. of Dangri Farms
Shaheed Benazirabad	10	10
Sanghar	10	10
Mirpurkhas	10	10
Badin	10	10
Total	40	40

District-wise phasing of establishment of fish farms and their costs are as under:

District	Type of fish	Number	Amount (Rs. Millions)
Shaheed Benazirabad	Talapia	10	11.175
	Dangri	10	11.68
Sanghar	Talapia	10	11.175
	Dangri	10	11.68
Mirpurkhas	Talapia	10	11.175
	Dangri	10	11.68
Badin	Talapia	10	11.175
	Dangri	10	11.68
Total	Talapia	40	44.70
	Dangri	40	46.72
Grand Total		80	91.42

Year-wise phasing of establishment of fish farms and their costs are as under:

Year	Type of fish	Number	Amount (Rs. Millions)
1	Talapia	5	5.875
	Dangri	5	5.840
2	Talapia	10	11.75
	Dangri	10	11.68
3	Talapia	10	11.75
	Dangri	10	11.68
4	Talapia	10	11.75
	Dangri	10	11.68
5	Talapia	5	5.875
	Dangri	5	5.840
Total	Talapia	40	44.70
	Dangri	40	46.72
Grand Total		80	91.42

4. Implementation Arrangements

The fish farms will be constructed on the private lands. The farm owners will express their intension to the project authorities i.e. Fisheries Department, Government of Sindh. The farm site will be technically visited jointly by the farm owner and representative of Fisheries Department. The farms will be constructed under the supervision of Fisheries expert. The farms / ponds will be managed by land owners. Sindh Fisheries Department will provide extension and advisory services. Initial investment on the establishment of farms will be borne by the project authorities but its operation cost will be borne by the farm owners.

5. Project cost

The project cost during the construction phase is estimated to be Rs. 91.42 million for Talapia component and Dangri component with following break up:

5.1 Construction Phase

Talapia Component	Rs. 44.70 million
Dangri Component	Rs. 46.70 million
Sub-Total	Rs. 91.40 million

5.2 Project outlay (cost)

The total outlay of the project and year-wise investment cost for Talapia and Dangri components is detailed in Appendix- I

Source of funding

The sources of funding of the proposed project will be determined in the project authorities during the project cycle.

6. Project justification

Tilapia was recommended in 1976 to the world as the most promising cultured fish species. Since then the sector of *Tilapia* culture in the world has grown rapidly. In the last ten years. The global tilapia production has witnessed sharp growth ton almost 3 million tons in 2008. At present China are the biggest tilapia producer and exporter of the world. *Tilapia* tasty and less expensive fish has received warm welcome and become popular. While in the international market, with the sharp decline in ocean white flesh fish resources such as cod and trout, tilapia has been regarded as a substitute for white flash fish in traditional white flesh fish consuming countries such as USA. The United States is currently the largest market in the world of tilapia consumption. Besides USA, the tilapia market has also been expending in more and more countries and regions, for example Mexico, Russia, Dominica and United Arab Emirates etc. Thus “*Tilapia has become a fish of the 21 century*” and has broad development prospects in the world.

Originally majority of such fisheries were in Africa but due to introduction of *Tilapia* fish in freshwater lakes in Asia including Pakistan have led to outdoor Aquaculture projects in countries with the tropical climates such as Pakistan.

6.1 Financial Analysis

The estimated IFRR for Talapia fish has been computed at 23.6%, hence the project is financially viable. The NPV at 12% is Rs.511.0 million. The sensitivity analysis presented in the above table shows that with 10% decrease in the benefits the IFRR is 14.7 % while with 10% increase in the cost the IFRR is about 15.5%. Both of these are above 12%. The simultaneous 10% decrease in benefits and increase in cost suggests the IFRR is 6.5%, it is viable but sensitive to price.

The switching value indicate that if the benefits decrease by 12.9 %, and costs increase by 15.5%, while even if both may change by 6.9% the project will still be viable.

IFRR and Sensitivity Analysis for Talapia fish

#	Scenario	NPV @ 12% (Rs. 000)	IERR	Switching Value
1	Base Case	511.0	23.6%	
2	Decrease in Benefits (10%)		14.7%	12.9%
3	Increase in Costs (10%)		15.5%	14.7%
4	Simultaneous Change by 10%		6.5%	6.9%

The estimated IFRR for Dangri fish has been computed at 22.1%, hence the project is financially viable. The NPV at 12% is Rs.466.4 million. The sensitivity analysis presented in the above table shows that with 10% decrease in the benefits the IFRR is 13.6 % while with 10% increase in the cost the IFRR is about 14.4%. Both of these are above 12%. The simultaneous 10% decrease in benefits and increase in cost suggests the IFRR is 5.7%.

The switching value indicate that if the benefits decrease by 11.7 %, and costs increase by 13.3%, while even if both may change by 6.2% it will be viable but sensitive to price.

IFRR and Sensitivity Analysis for Dangri Fish

#	Scenario	NPV @ 12% (Rs. 000)	IERR	Switching Value
1	Base Case	466.4	22.1%	
2	Decrease in Benefits (10%)		13.6%	11.7%
3	Increase in Costs (10%)		14.4%	13.3%
4	Simultaneous Change by 10%		5.7%	6.2%

6.2 ICID evaluation

The project has also been evaluated as per requirements of International Commission for Irrigation and Drainage (ICID). The evaluation reveals that there is no negative impact of this project on the components of the environment.

The above evaluations reveal that the proposed project is environment friendly and also feasible both economically and financially.

6.3 Project benefits

6.3.1 Employment generation and livelihood

The project will generate employment opportunities for rural people especially fishing and farming communities during construction and execution phases and onwards. It will create direct and indirect jobs for both men and women.

6.3.2 Social benefits (poverty, distribution of benefits)

There are several social issues such as health and hygiene of farming community, income generation options, poverty and gender related issues in the project area. This project will address above issues through social benefits from success of the species for production at commercial or subsistence aquaculture levels. The project will generate income for poor inhabitants of project area and additional income for those fish farmers already active but not culturing species such as *Tilapia noliticus*. For those whose lands are not productive the project gives hope of the land being able to produce and use full output again.

6.3.3 Environmental benefits

The proposed project will address existing environmental issues such as, water quality aspects, degradation of agricultural lands, decline in fish resources, biodiversity loss and decline in natural resources habitats. Thus the project is environment friendly as it will not raise any environmental issue during construction and implementation phases.

It is concluded from the analysis of environmental, social and economic aspects that the proposed project is undoubtedly environment friendly, socially acceptable and economically beneficial as it will address the environmental and social issues and will generate income of farmers/fishermen, enhance the value of the degraded land and convert the un-economic and un-productive lands to productive as the proposed project areas are presently un-productive and the drainage water is creating other environmental problems.

6.3.4 Environmental Justification

The proposed project will not create any environmental issue during its construction and implementation phases but rather address the existing environmental issues such as water logging and salinity, water quality aspects, degradation of agricultural lands, decline in fish resources, and loss of biodiversity and decline in natural resources habitats.

This is an environmental friendly project as it will not create any adverse impacts on flora and fauna, soil, water, land use, climate etc. The proposed project will be executed in the command areas of LBOD system the care shall be taken to protect the existing wild vegetation of un-economic value. In fact such un-economic and un-utilized lands will be made productive due to introduction of brackish water fish.

6.3.5 Social benefits

The proposed project will have several socio-economic benefits for the society as under:

- Enhance productivity of lands in the form of food for nourishment.
- Provide livelihood opportunities to farm holders and associated workers through employment opportunities.
- Increase overall economy of the area by improving the productive capacity of degraded and unproductive lands.



- Fish products supplies outputs will improve socio-economic status of farming community and associated stakeholders.
- The knowledge of use of drainage and sweet water for fish production will transfer the technology from scientific community to rural agrarian society.
- The project will directly improve the poverty level of the land owners and the people working in the project

7. Monitoring and Evaluation Mechanism

Monitoring and Evaluation is an important activity in project cycle. Since the proposed project is based on collaboration and participation of stakeholders, the monitoring will also be the same. A monitoring committee will be established constituting of members from each stakeholder with a clear mandate and monitoring mechanism. During the project execution and afterwards this committee will frequently monitor and evaluate the project outcomes, identify bottlenecks and address such bottlenecks through an interactive way. During the process of monitoring indicators and sub-indicators will be established and monitored.

8. Resettlement Issues

Resettlement is not serious issue in this project as the project will be executed on private lands as per owners consent.

LINE PLAN OF FISH FARM

Estimated Cost

947.0 x 100 = 94700 cft (Fill)
= 241, 987 cft (cut)
say 242 thousands

Cut = 242x 2575 = Rs. 623,150
Fill = 95x 3635 = Rs. 345,420
968,570

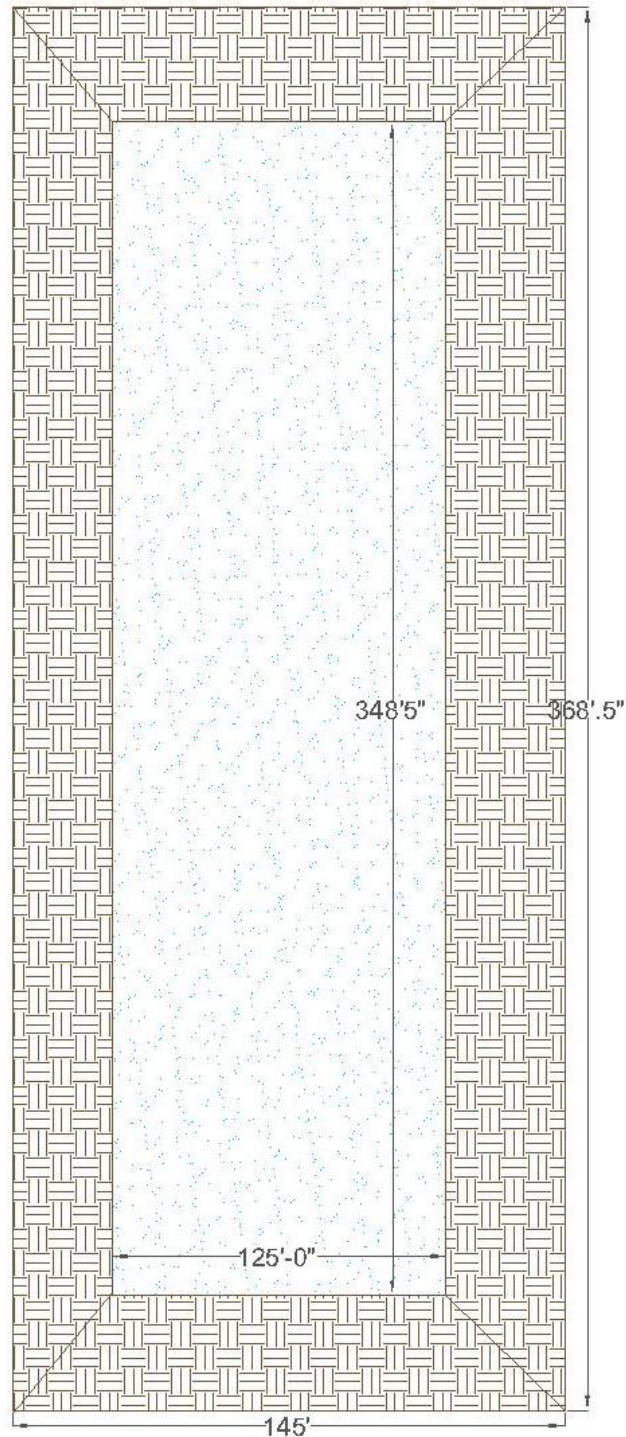




Table 1.1: Detailed physical targets and Investment plan

		Quantities						
	Unit	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Total
I. Investment Costs								
A. Talapia Fish Farms								
Site Clearance	acre	5	10	10	10	5	-	40
Earthwork (Cutting)	acre	5	10	10	10	5	-	40
Earthwork (Filling)	acre	5	10	10	10	5	-	40
Inlets	acre	5	10	10	10	5	-	40
levelling, Compaction, and Dressing	acre	5	10	10	10	5	-	40
Fish Seed	acre	5	10	10	10	5	-	40
Labor	acre	5	10	10	10	5	-	40
Water Charges	acre	5	10	10	10	5	-	40
Cost of feed	acre	5	10	10	10	5	-	40
Chemicals	acre	5	10	10	10	5	-	40
Manure	acre	5	10	10	10	5	-	40
Subtotal								
B. Dangri Fish Farm								
Site Clearance	acre	5	10	10	10	5	-	40
Earthwork (Cutting)	acre	5	10	10	10	5	-	40
Earthwork (Filling)	acre	5	10	10	10	5	-	40
Inlets	acre	5	10	10	10	5	-	40
leveling, Compaction, and Dressing	acre	5	10	10	10	5	-	40
Fish Seed	acre	5	10	10	10	5	-	40
Labor	acre	5	10	10	10	5	-	40
Water Charges	acre	5	10	10	10	5	-	40
Cost of feed	acre	5	10	10	10	5	-	40
Chemicals	acre	5	10	10	10	5	-	40
Manure	acre	5	10	10	10	5	-	40
Subtotal								
Total Investment Costs								
II. Recurrent Costs								



	Unit Cost	Base Cost (PRs Million)						
	(PRs)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Total
I. Investment Costs								
A. Talapia Fish Farms								
Site Clearance	3,000	0.0	0.0	0.0	0.0	0.0	-	0.1
Earthwork (Cutting)	280,000	1.4	2.8	2.8	2.8	1.4	-	11.2
Earthwork (Filling)	95,000	0.5	1.0	1.0	1.0	0.5	-	3.8
Inlets	12,000	0.1	0.1	0.1	0.1	0.1	-	0.5
leveling, Compaction, and Dressing	25,000	0.1	0.3	0.3	0.3	0.1	-	1.0
Fish Seed	350,000	1.8	3.5	3.5	3.5	1.8	-	14.0
Labor	168,000	0.8	1.7	1.7	1.7	0.8	-	6.7
Water Charges	10,000	0.1	0.1	0.1	0.1	0.1	-	0.4
Cost of feed	100,000	0.5	1.0	1.0	1.0	0.5	-	4.0
Chemicals	50,000	0.3	0.5	0.5	0.5	0.3	-	2.0
Manure	25,000	0.1	0.3	0.3	0.3	0.1	-	1.0
Subtotal		5.6	11.2	11.2	11.2	5.6	-	44.7
B. Dangri Fish Farm								
Site Clearance	3,000	0.0	0.0	0.0	0.0	0.0	-	0.1
Earthwork (Cutting)	280,000	1.4	2.8	2.8	2.8	1.4	-	11.2
Earthwork (Filling)	95,000	0.5	1.0	1.0	1.0	0.5	-	3.8
Inlets	12,000	0.1	0.1	0.1	0.1	0.1	-	0.5
leveling, Compaction, and Dressing	25,000	0.1	0.3	0.3	0.3	0.1	-	1.0
Fish Seed	400,000	2.0	4.0	4.0	4.0	2.0	-	16.0
Labor	168,000	0.8	1.7	1.7	1.7	0.8	-	6.7
Water Charges	10,000	0.1	0.1	0.1	0.1	0.1	-	0.4
Cost of feed	100,000	0.5	1.0	1.0	1.0	0.5	-	4.0
Chemicals	50,000	0.3	0.5	0.5	0.5	0.3	-	2.0
Manure	25,000	0.1	0.3	0.3	0.3	0.1	-	1.0
Subtotal		5.8	11.7	11.7	11.7	5.8	-	46.7
Total Investment Costs		11.4	22.9	22.9	22.9	11.4	-	91.4
II. Recurrent Costs								
		11.4	22.9	22.9	22.9	11.4	-	91.4



Totals Including Contingencies (PRs Million)							
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Total
I. Investment Costs							
A. Talapia Fish Farms							
Site Clearance	0.0	0.0	0.0	0.0	0.0	-	0.2
Earthwork (Cutting)	1.6	3.4	3.6	3.8	2.0	-	14.5
Earthwork (Filling)	0.6	1.2	1.2	1.3	0.7	-	4.9
Inlets	0.1	0.1	0.2	0.2	0.1	-	0.6
levelling, Compaction, and Dressing	0.1	0.3	0.3	0.3	0.2	-	1.3
Fish Seed	2.0	4.3	4.5	4.7	2.5	-	18.1
Labor	1.0	2.1	2.2	2.3	1.2	-	8.7
Water Charges	0.1	0.1	0.1	0.1	0.1	-	0.5
Cost of feed	0.6	1.2	1.3	1.4	0.7	-	5.2
Chemicals	0.3	0.6	0.6	0.7	0.4	-	2.6
Manure	0.1	0.3	0.3	0.3	0.2	-	1.3
Subtotal	6.5	13.7	14.4	15.1	7.9	-	57.8
B. Dangri Fish Farm							
Site Clearance	0.0	0.0	0.0	0.0	0.0	-	0.2
Earthwork (Cutting)	1.6	3.4	3.6	3.8	2.0	-	14.5
Earthwork (Filling)	0.6	1.2	1.2	1.3	0.7	-	4.9
Inlets	0.1	0.1	0.2	0.2	0.1	-	0.6
levelling, Compaction, and Dressing	0.1	0.3	0.3	0.3	0.2	-	1.3
Fish Seed	2.3	4.9	5.2	5.4	2.8	-	20.7
Labor	1.0	2.1	2.2	2.3	1.2	-	8.7
Water Charges	0.1	0.1	0.1	0.1	0.1	-	0.5
Cost of feed	0.6	1.2	1.3	1.4	0.7	-	5.2
Chemicals	0.3	0.6	0.6	0.7	0.4	-	2.6
Manure	0.1	0.3	0.3	0.3	0.2	-	1.3
Subtotal	6.8	14.3	15.1	15.8	8.3	-	60.4
Total Investment Costs	13.4	28.1	29.5	31.0	16.2	-	118.1
II. Recurrent Costs							
	13.4	28.1	29.5	31.0	16.2	-	118.1



Table 1.2: Financial Enterprise budget for 1 acre *TILAPIA* Fish

Nº	Detail	Unit	Rate (PRs)	Quantity	Years										
					1	2	3	4	5	6	7	8	9	10	15
A	Revenue (PRs 000)														
	Fish Production	kg		0	5,670	5,772	5,859	5,947	6,036	6,126	6,218	6,311	6,406	6,901	
	Rate	Rs/kg	110	110	110	110	110	110	110	110	110	110	110	110	
	Gross value of Output	Rs 000		0	624	635	644	654	664	674	684	694	705	759	
B	Investment Cost														
1	Site clearance labor	pd	6	500	3										
2	Earthwork/cutting	cft	2.575	108,900	280										
3	Earthwork/filling	cft	3.635	26,136	95										
4	Inlets	number	1	12,000	12										
5	Leveling, dressing, and compaction	ls	1	25,000	25										
6	Fish Seed	fingerlings	50	7,000	350	0	0	0	0	0	0	0	0	0	
	Subtotal	Rs 000			765										
C	Production Cost (000)														
1	Labor	per month	2	84,000	0	168	168	168	168	168	168	168	168	168	
2	Water charges	ls/year	1	10,000	0	10	10	10	10	10	10	10	10	10	
3	Cost of feed	ls/year	1	100,000	0	100	100	100	100	100	100	100	100	100	
4	Chemicals	ls/year	1	50,000	0	50	50	50	50	50	50	50	50	50	
5	harvesting cost	ls/year	1	50,000	0	50	50	50	50	50	50	50	50	50	
6	Manure	ls/year	1	25,000	0	25	25	25	25	25	25	25	25	25	
7	Mole Charges (10% of Revenue)	%	10.0%		0	62	63	64	65	66	67	68	69	70	
	Subtotal				0	465	466	467	468	469	470	471	472	473	
D	Total Cost	Rs 000			765	465	466	467	468	469	470	471	472	473	
E	Net Cash Flow	Rs 000			-765	158	168	177	186	195	203	213	222	231	
F	IFRR	23.58%													



Table 1.3: Financial Enterprise Budget for 1 acre DANGRI Fish

Nº	Detail	Unit	Rate	Quantity	Years										
					1	2	3	4	5	6	7	8	9	10	15
A	Revenue														
	Fish Production	kg			0	5,670	5,772	5,859	5,947	6,036	6,126	6,218	6,311	6,406	6,901
	Rate	Rs/kg	110		110	110	110	110	110	110	110	110	110	110	110
	Gross value of Output	Rs 000			0	624	635	644	654	664	674	684	694	705	759
B	Investment Cost														
1	Site clearance labor	md	6	500	3										
2	Earthwork/cutting	cft	2.575	108,900	280										
3	Earthwork/filling	cft	3.635	26,136	95										
4	Inlets	number	1	12,000	12										
5	Leveling, dressing, and compaction	unit	1	25,000	25										
6	Fish Seed	fingerling	50	8,000	400										
	Subtotal				815	0	0	0	0	0	0	0	0	0	0
C	Production Cost														
1	Labor	per month	2	84,000	0	168	168	168	168	168	168	168	168	168	168
2	Water charges	ls/year	1	10,000	0	10	10	10	10	10	10	10	10	10	10
3	Cost of feed	ls/year	1	100,000	0	100	100	100	100	100	100	100	100	100	100
4	Chemicals	ls/year	1	50,000	0	50	50	50	50	50	50	50	50	50	50
5	harvesting cost	ls/year	1	50,000	0	50	50	50	50	50	50	50	50	50	50
6	Manure	ls/year	1	25,000	0	25	25	25	25	25	25	25	25	25	25
7	Mole Charges (10% of Revenue))	%	10.0%		0	62	63	64	65	66	67	68	69	70	76
	Subtotal				0	465	466	467	468	469	470	471	472	473	479
D	Total Cost	Rs 000			815	465	466	467	468	469	470	471	472	473	479
E	Net Cash Flow				-815	158	168	177	186	195	203	213	222	231	280
F	IFRR	22.05%													

Table 1.4: ICID Environmental checklist for the proposed intervention

For each environmental effect place a cross (X) in one of the columns		Positive or very likely	Positive impact Possible	No impact Likely	Negative impact possible	Negative impact very likely	No judgment possible at present	Comments
Hydrology	1.1 Low flow regime			X				
	1.2 Flood regime	X						
	1.3 Operation of dams						X	
	1.4 Fall of water table			X				
	1.5 Rise of water table	X						
Pollution	2.1 Solute dispersion			X				
	2.2 Toxic substances			X				
	2.3 Organic pollution			X				
	2.4 Anaerobic effects			X				
	2.5 Gas emissions			X				
Soils	3.1 Soil salinity		X					
	3.2 Soil properties		X					
	3.3 Saline groundwater			X				
	3.4 Saline drainage	X						
	3.5 Saline intrusion			X				
Sediments	4.1 Local erosion			X				
	4.2 Hinterland effects			X				
	4.3 River morphology			X				
	4.4 Channel regime			X				
	4.5 Sedimentation			X				
	4.6 Estuary erosion			X				
Ecology	5.1 Project lands	X						
	5.2 Water bodies	X						
	5.3 Surrounding area		X					
	5.4 Valleys and shores						X	
	5.5 Wetlands and plains		X					
	5.6 Rare species			X				
	5.7 Animal migration		X					
	5.8 Natural Industry	X						
Socio-economic	6.1 Population change	X						
	6.2 Income and amenity	X						
	6.3 Human migration	X						
	6.4 Resettlement	X						
	6.5 Women's role	X						
	6.6 Minority groups	X						
	6.7 Sites of value	X						
	6.8 Regional effects	X						



For each environmental effect place a cross (X) in one of the columns		Positive or very likely	Positive impact Possible	No impact Likely	Negative impact possible	Negative impact very likely	No judgment possible at present	Comments
	6.9 User involvement	X						
	6.10 Recreation	X						
Health	7.1 Water and sanitation	X						
	7.2 Habitation	X						
	7.3 Health services			X				
	7.4 Nutrition	X						
	7.5 Relocation effect	X						
	7.6 Disease ecology			X				
	7.7 Disease hosts			X				
	7.8 Disease control			X				
	7.9 Other hazards			X				
Imbalances	8.1 Pests and weeds			X				
	8.2 Animal diseases			X				
	8.3 Aquatic weeds			X				
	8.4 Structural damage			X				
	8.5 Animal imbalances			X				
Number of crosses								

¹ Adapted from International Commission on Irrigation and Drainage (ICID)

Concluding Remarks: The proposed intervention does not pose any significant threat to the environment and ecology of the project area. The main aim of the intervention is to utilize the drainage effluent for the development of saline fish farms in the vicinity of the LBOD branch drains. Although the water of the branch drains shall be moderately saline above the permissible limits but a few fish ponds in a district will not create salinity in already unproductive soils and this intervention will also not have any significant effect on the surrounding soils. The intervention shall create livelihood opportunities for the people of the area and also make the unproductive lands as productive.