STAR HYDROPOWER LTD.

# Fish Fauna Study

## PATRIND HYDROPOWER PROJECT

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# EXECUTIVE SUMMARY

## 1. INTRODUCTION

River Kunhar flows through Kaghan valley. Starting from Naran (2,362 m amsl) in Khyber Pakhtunkhwa and having a length of about 129 km up to weir site (755 m amsl). It is spread over a catchment area of 2,429 $Km^2$. The 13 Km reach of the Kunhar river from weir site to its confluence with Jhelum river at Domishahi has a catchment area of 256 $Km^2$. Temperatures prevailing at Muzaffarabad are more relevant to the project area. At Muzaffarabad the months of May to July are the hottest months with temperature ranging between 26°C to 30°C while December to February are coldest with temperature varying between 10°C to 11°C.

## 2. FISH SAMPLING

Fish culture study was undertaken for the river Kunhar reach of the project area. Fish fauna survey was conducted at three selected sites to find out the kind, number and quantity of fish available. Fish group consisted of Common Cyprinids, Snow Carp, Schistura group, Tripolysa group and Cat fish were found. The number found was between 0-12 and the weight was less than one (1) Kg in each case.

## 3. WATER QUALITY SAMPLING

The water samples were also collected at the selected three sites and analyzed for temperature (°C), pH, total dissolved solids (g/l), turbidity, dissolved oxygen (mg/l), total hardness(mg/l as CaC03), total alkalinity (mg/l as CaC03), BOD, COD,TSS, Ca, Mg, K, Phosphate, Nitrate etc.

Water quality was found conducive to fish culture except for turbidity and critical temperature regime for cold water fish.

## 4. IMPACTS AND MITIGATION MEASURES

Impacts of construction and operation activities on fishery would be insignificant. Minimum 2 cumecs of water from the head pond will be released as ecological flow throughout the year. This flow (2 cumecs) is in addition to substantial flow which joins river Kunhar in the form of large streams (Bio–da-Kath 0.6 cumecs and Salol Nullah 1.2 cumecs) and numerous small streams downstream of the weir thus providing mitigation measures for aquatic flora and fauna in the reach downstream of the weir.

However, the head pond can hold a considerable fishery potential after the

construction of the Project. With appropriate management of this potential, head pond fishery development during operation phase will substantially enhance the beneficial impact of the project on the local population.

## 5. FINDINGS OF THE STUDY

The netting data and discussion with people indicated that the occasional fishing in the project area is not an occupation but a hobby due to little availability of fish fauna. The fishing activity was practiced more in winter due to lower turbidity, lesser speed and depth of the river. The same position persists from the head pond area to the confluence of river Kunhar with river Jehlum as far as the availability of fish and angling is concerned according to local people. When asked about the availability of trout, the answer of majority of the public was no with occasional evidences of trout availability in the project area after many years. They revealed that the Trout was restricted mainly above the Balakot area of KP. The evidence supports the findings of the fish fauna survey.

# FISH FAUNA STUDY

## 1. INTRODUCTION

River Kunhar flows through Kaghan valley. Starting from Naran (2,362 m amsl) in Khyber Pakhtunkhwa, it has a length of 129 km upto weir site (755 m amsl). It is spread over a catchment area of 2,429 Km2. The 13 Km reach of the river from weir site to its confluence with river Jhelum at Domishahi has a catchment area of 256 Km2.

Being a river of cold water, the fish fauna of river Kunhar is limited and does not form the significant economical fishery. The following major fresh water fish species are available mainly in the upper portions of river Kunhar;

- Salmo trutta (Brown Trout)
- S.gairdneri (Rainbow trout)
- Schizothorax plageostimus (Swati)
- Garra gotila
- Glyposternum spp (Auyur)
- Namacheilus spp (Chitala)

### 1.1 The Study Area

The physical layout of the Patrind hydropower project extends from location of its weir on river Kunhar near Patrind village which acts as a boundary between Khyber Pakhtunkhwa and AJK to location of its powerhouse on river Jhelum at Lower Chattar in Muzaffarabad district, (AJK).

### 1.2 Objectives

The objectives of the study were to:

- Assess aquatic ecology (fish fauna) in river Kunhar between head pond and downstream to Jhelum confluence.
- Describe aquatic ecology (fish fauna) and existing water quality in river Kunhar.
- Describe the overall impact of the project on aquatic ecology in river Kunhar between head pond and downstream to Jhelum confluence.

## 2. METHODOLOGY

A survey of river Kunhar (head pond and downstream to Jhelum confluence) regarding aquatic ecology was carried out from 15-25 September, 2010 to assess aquatic biodiversity (fish fauna) and water quality.

Discussion with DFO Wildlife, Mansehra, DFO Jhelum valley, Deputy Director, Fisheries, Abbottabad and other officials of Forest/Fishery Department of AJK and Khyber Pukhtunkhwa were held for collection of information about the project area for the fish fauna. After discussion, a detailed programme for survey of fish fauna of river Kunhar falling in the project reach was chalked out. In addition to this, short interviews with community members and fishermen were undertaken to know the method of hunting, types of fishes found in the project area, quality and flow of water. Netting for fish catch and sampling for water quality was undertaken at following three sites of river Kunhar namely:

i) 7 Km length of the proposed submergence area to be created by head pond,

ii) Weir site near Patrind village, and

iii) Confluence point of Kunhar with river Jehlum at Domishahi.

## 2.1 Fish Sampling

Netting was done at three sites for one day each in river Kunhar between Head pond and downstream to Jhelum confluence for gathering details about fish fauna. The fishing methods used were simple and suited to the nature of the river reach. Cast nets, drag nets, bag nets were used. Seasonal variation information was collected through interviews with locals as well as from relevant Fishery Department of the project area. The weight of all fish collected was recorded.

## 2.2 Water Quality Sampling

Sampling was done for water temperature (°C), pH, total dissolved solids (g/l), turbidity, dissolved oxygen (mg/l), total hardness(mg/L as $CaC0_3$), total alkalinity (mg/l as $CaC0_3$), BOD, COD,TSS, Ca, Mg, K, Phosphate, Nitrate etc. for the mentioned three sites.

# 3. SAMPLING RESULTS

## 3.1 Fish Fauna

The results regarding fish fauna are summarised in the Table below:

| Fish Group | Area (Head pond Submergence) | | At Weir site (Patrind) | | At Domishahi | |
|---|---|---|---|---|---|---|
| | Numbers | Weight (kg) | Numbers | Weight (kg) | Number | Weight (kg) |
| Common Cyprinids | 00 | 00 | 00 | - | 01 | 0.95 |
| Snow Carp | 07 | 6.25 | 08 | 9.25 | 06 | 7.0 |
| Schistura group | 02 | 1.75 | 00 | - | 01 | 1.25 |
| Tripolysa group | 12 | 9.50 | 05 | 6.0 | 08 | 9.15 |
| Cat fish | 00 | 00 | 00 | - | 00 | 00 |

It is to be noted that the number of fish caught is small varying between 12 to zero. Also the weight of almost all fish caught is less than 1 kg per fish indicating that the conditions are not conducive to fish culture in the river reach under consideration.

### 3.2 River Water Quality

The results of water quality sampling are reproduced in the Table below. The Dissolved Oxygen (DO) saturation level at 12.48 °C is known to be 11.79 mg/l and therefore the river water DO level, being 8.21-8.55 mg/l, is below saturation.

**Table 2: Mean* water quality results at three sampling sites**

| Parameter | Head pond Submergence Area | Weir Site (Patrind) | At Domishahi | Average Values |
|---|---|---|---|---|
| **PHYSICAL** | | | | |
| Water temperature ($^{o}$C) | 12 | 12.5 | 13 | 12.33 |
| pH | 6.16 | 6.54 | 6.36 | 6.36 |
| Air Temperature ($^{o}$C) | 29 | 29 | 31 | 29.33 |
| Depth (m) | 2.16 | 1.85 | 3.21 | 2.4 |
| Total Suspended solids (mg/l) | 88.01 | 89.93 | 93.33 | 90.42 |
| Inorganic Suspended solids (mg/l) | 59.93 | 64.56 | 71.15 | 65.21 |
| Organic Suspended solids (mg/l) | 19.22 | 22.39 | 26.11 | 19.22 |
| Organic matter in bottom mud (ppm) | 28858 | 29765 | 26338 | 28320 |
| Rate of flow (cu.m/sec) | 34 | 36 | 41 | 37 |
| **CHEMICAL** | | | | |
| Dissolved oxygen matter (mg/l) | 63.28 | 64.88 | 66.97 | 65.04 |
| Dissolved oxygen (mg/l) | 8.21 | 8.55 | 8.34 | 8.33 |
| Salinity (ppm) | .017 | .019 | .018 | 0.018 |
| Total alkalinity (mg/l) | 1.98 | 1.60 | 1.52 | 1.7 |
| Total carbon dioxide (mg/l) | 2.12 | 2.42 | 2.51 | 2.35 |
| Total Ammonia- nitrogen (mg/l) | .015 | .023 | .031 | 0.023 |
| Biological Oxygen Dissolved (mg/l) | .076 | .081 | .086 | 0.081 |

*Mean values were calculated by averaging the results from three samples at each site, mixed together and a single sample

was taken for analysis at Pakistan forest Institute, Laboratory.

### 3.3 River Water Quality versus Fish Culture

- The color of the water usually remained muddy (July-September) due to suspended solids of mud and sand remained more transparent from October to December as told by the local people. During course of study at the Project area it was found light muddy to transparent.
- Fish is very sensitive to temperature. It can sense even 1-3$^{o}$C difference. It would move else where if the temperature exceeds its preference. Cold water fish remain in 0-12$^{o}$C temperature regime.
- Total suspended solids and Organic suspended solids comprised greater proportion during the monsoon season when each and every thing is washed down, coupled with greater water velocity. Dissolved organic matter which acts as food for aquatic organisms like algae for fishes was found suitable. The organic matter in bottom mud increases from July-December due to settlement of organic compounds in the bottom.
- Salinity tolerance varies with the fish species. Some scientist think that 0.6 -20 ppm is lethal while other considers 7 ppm to be lethal for freshwater fishes. At project site the value found was .017 +_.001 was harmless for fish life. It also affects other aquatic life causing migration of fish from fresh to salt water for growth and reproduction.
- Fish can survive the pH of 6-10 (Lone.1983).pH value of 6.36+_0.2 was considered suitable for fishes. Some scientist considers the 6-6.5 value as dangerous when aeration remains improper in water.
- Dissolved Oxygen remains lower in summer, increase up to December because cold water has great ability to hold Oxygen than warm water. Upper lethal levels 16.8-32.11 mg/l and lower lethal levels 3-4 mg/l (Rounsefell and Everhast, 1983).The value for the project area was found 8.33 +_ 0.2 mg/l and was not lethal.
- Biological oxygen demand (BOD) generally decreased from July-December because the organic matter and micro-organisms (Phytoplentention, zooplentention) activity remained rich during the summer and decreased up to December. It is inversely proportion to the dissolved Oxygen. The value of BOD calculated for Project site was 0.081 $\pm$ 0.05 mg/l and was found suitable for aquatic life.

- Alkalinity is not a pollutant. Total alkalinity value >20 mg/l is considered dangerous for fish and other aquatic life (Ahmad et al, 1983).The value calculated for the project area was 1.7 ± 0.3 mg/l so it was safer for aquatic and fish life.
- Upper dangerous limit total carbon dioxide is 6 mg/l (Lone, 1983).It was calculated as 2.35 ± 0.2 (mg/l) was considered fit for every kind of fish.
- Ammonia is much more toxic to fish and aquatic life when water contains very little dissolved oxygen and carbon dioxide. Ammonia nitrate has an upper dangerous limit of 0.1 mg/l (Lone, 1983).The calculated value was 0.023 ± 0.008 far below the danger.

## 4. POTENTIAL IMPACTS AND MITIGATION MEASURES

### 4.1 Upstrem of the Weir

The pond area behind the weir upstream will create a deep, still water aquatic habitat, replacing about 7km of existing reverine habitat. Water quality in the reservoir was found suitable for the protection of aquatic ecosystems. The most productive parts of the reservoir will be the shallower sections where light is able to penetrate to the bottom and allow the growth of attached aquatic macrophytes. Experience from similar projects shows that omnivorous and planktivorous species, such as Katle, are likely to be dominant after impoundment. The population of cold water species is likely to decline or completely disappear from the proposed reservoir. The creation of the pond behind weir will provide a large open water fish habitat that could be used for promotion of fish culture. The harvesting of fish culture, if it proves viable will be an offset to the lost production. This will also increase the fish fauna and their density to be exploited locally for the socio-economic uplift of local communities.

### 4.2 Downstream of the Weir

Changes in the flow regime of the river will affect the composition and abundance of plank-tonic and benthic communities, thus affecting the food supply of fish. These changes may eventually influence the species composition of the fish population in the project area but due to the nonavailability of fish fauna in the project area as shown by the study results seemed to remain unaffected by this kind of impact on significant level.

Furthermore, it should be noted that the topography of river Kunhar valley downstream of weir is characterized by high banks with relatively deeper bed

levels preventing use of river Kunhar for agricultural irrigation and drinking water supplies. The operation of the project for hydropower generation will result in reduction of flow downstream of weir. Minimum 2 cumecs of water from the head pond will be released as ecological flow throughout the year. This flow (2 cumecs) is in addition to substantial flow which joins river Kunhar in the form of large streams (Bio–da-Kath 0.6cumecs and Salol Nullah 1.2 cumecs) and numerous small streams downstream of the weir thus providing mitigation measures for aquatic flora and fauna in the reach downstream of the weir.

## 5. FINDINGS OF THE STUDY

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## 6. FISH MIGRATION PAST MANGLA DAM

The warm water regime exist in the river Jehlum below Domel (confluence of river Neelum with river Jehlum) and becomes unsuitable for snow carps during most of the summer months and they migrate either in river Neelum or in Kunhar due to the existence of cold water regime .It is true that 138 m high Mangla Dam reservoir with 10,300 feet (3140 m) length 97.7 square miles (253 km²) area has become home for many deep water fishes. But due to the existence of different water regimes at the Mangla Dam (Warm Water regime) and confluence of river Jehlum with river Kunhar (cold water regime) there exist no possibility of migration upstream that will be damaged due to reduced water regime in river Kunhar after the implementation of Patrind Hydro-Power project. Secondly if we assume that such a migration can take place then that can be compensated by the river Neelum and project impact in this case will also be negligible. Thirdly, due to the long distance of Mangla dam (about 155Km) from the project area in Muzaffarabad, the possibility of upstream migration coupled with variation in water temperature regime seemed to be insignificant as indicated by the availability of minimal fish fauna in the project area.

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