

**FISHERY RESOURCES IN RIVER SWAT, KHYBER
PAKHTUNKHWA: INFLUENCING FACTORS AND
INSTITUTIONAL ARRANGEMENTS**



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ABSTRACT

This study is an attempt to know about the influencing factors behind fishery loss in the River Swat, Khyber Pakhtunkhwa. The study used primary data applying multiple linear regression model alongside descriptive statistics for the analysis. Study finds that pH of water, ammonia level, hotel waste, cities garbage and destructive fishing practices are the main factors behind fishery loss in river Swat. The result reveal that pH of water, ammonia, hotel waste and cities garbage have negative impact on fisheries resources. Besides, institutional arrangements for the conservation of fisheries resources in district swat are limited. The water quality must be protected from wastes generated from households, hotels and Mingora city. Fishers should be given education regarding tools and methods used for fishing. There should be awareness campaign to control illegal fishing and water pollution in river Swat.

Keywords: *Influencing factors, Conservation, Institutional Arrangements*

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Table of Contents

ABSTRACT.....	i
Acknowledgment	iv
Table of Contents.....	v
List of Tables	vii
List of Figures	viii
List of Abbreviations	ix
Chapter 1.....	1
INTRODUCTION	1
1.1. Background of The Study	1
1.2. Study Area.....	3
1.3. Problem statement.....	4
1.4. Significance of the Study	5
1.5. Research questions	5
1.6. Objectives of the study.....	5
1.7. Organization of the study	5
LITERATURE REVIEW	6
2.1 Contribution of the present study.....	9
DATA DESCRIPTION AND METHODOLOGY.....	10
3.1 Data Collection and Sampling Design	10
3.2 Data and Measurement of Variables	10
3.3 Methodology	11
3.4 Theoretical justification of variables.....	13
3.4.1 Average catch of fish and Ammonia	13
3.4.2 Average catch of fish and Turbidity	13
3.4.3 Average catch of fish and pH.....	14
3.4.4 Average catch of fish and Experience	14

3.4.5	Average catch of fish and License	14
3.4.6	Average catch of fish and Hotel waste	15
3.4.7	Average catch of fish and Garbage	15
3.4.8	Average catch of fish and DFP	15
Chapter 4	.....	17
RESULTS AND DISCUSSION		17
4.1	Descriptive Statistics	17
4.2	Reason of Catching fish in Swat	18
4.3	Fishing Methods adopted by fishermen in Swat	19
4.4	Distribution of Fishers by Types of Fish in Swat	20
4.5	Issuing license to fishermen in Swat for Legal Fishing	21
4.6	Causes of Increasing Fish prices in Swat	22
4.7	High rate of Fishing Month in Swat.....	23
4.8	Fishers who know about breeding season of fish in Swat	23
4.9	Responsible factors for fishery extinction in study area	24
4.10	Suggestions for saving fishery resource in the study area.	25
4.11	Econometric Analysis	26
4.12	Institutional Arrangements for Fisheries Conservation in Swat	27
Chapter 5	.....	29
CONCLUSION AND POLICY RECOMMENDATIONS		29
5.1	Conclusion.....	29
5.2	Recommendations	30
References	.....	31
Appendix (A)	.....	34
Appendix (B)	.....	38
Appendix (C)	.....	40

List of Tables

Table 3. 1 - Sample size and Sampling Design.....	10
Table 3. 2 - Sources of data and abbreviations.....	11
Table 4. 1 - Descriptive statistics.....	18
Table 4. 2 - Reason of Catching Fish in Swat.....	19
Table 4. 3 - Fishing Methods.....	20
Table 4. 4 – Catch of Fish by Type.....	21
Table 4. 5 – Distribution of Fishers by type of holding Licenses and penalty.....	22
Table 4. 6 - Causes of Increase Fish Prices.....	22
Table 4. 7 - Responsible Factors.....	25
Table 4. 8 - Suggestions of Saving Fishery.....	26
Table 4. 9 - Regression Result of the Influencing Factors of Fishery Loss.....	27

List of Figures

Figure 1-High rate of Fishing Month in Swat.....	23
Figure 2-Information About Fish Breeding Season.....	24

List of Abbreviations

ACFD	Average catch of fish per day
Am/mgl	Ammonia milligram per liter
DFP	Destructive Fishing Practices
GDP	Gross Domestic Product
Exp	Experience
EPA	Environmental Protection Agency
Grb	Garbage
Hw	Hotels waste
Lice	License of the Fisher
pH	Potential hydrogen of water
Turb	Turbidity level of water

Chapter 1

INTRODUCTION

1.1. Background of The Study

Human survival depends on their surrounding physical environment and natural resources. Globally, over 41 million people are involved in fish production and majority of them live in developing countries (FAO,2010). Throughout the world fish is cheapest form of animal which contain a lot of protein and also important source of nutrients for poor. According to millennium development goals (MDGs) fish is “rich food for poor people” and fisheries are key tools for improving productivity, ensuring food security and livelihood, fisheries sectors occupies a very important place in the socio economic of the country.

It has been recognized a powerful income and employment generators as it simulates growth of a number of subsidiary industries and is a source of cheap and infamous food besides being a foreign exchange earner (Resistance, 2012).Eighty percent of inland capture fisheries are reported to be operating in devolving world (Kapetsky 2003). Many of these fisheries are conducted by the rural poor, often for subsistence and small-scale economic security. While inland capture fisheries account for less than 14 percent of the global harvest, these fisheries supports at least 21 million fishers (36% of all capture fishers worldwide) and over 36 million more are employed in post-harvest activities, indicating that inland fisheries have a proportionally higher influence on livelihood than marine fisheries particularly in Asia and Africa (FAO and Worldwide center 2008; FAO 2014).

Recreational fisheries are a large sector of inland services. However, inland fish also support non-fishing sectors including diving, snorkeling, boating, and the public and private aquarium trade. In industrialized countries, the economic value of recreational fisheries exceeds subsistence and commercial fisheries in inland waters (FAO 2010). These expenditures are not

limited only to those enterprises directly linked to fishing activities; they generate jobs in other sectors including the tourism industry, restaurants, and hotels, recreational services directly link inland fish to much more than just recreational fisheries.

Fish has the largest traded agriculture commodity all over the world, and it is the major source of export of the poor countries. According to Food and Agriculture Organization, fifty percent of the world poorest and undernourished people are living in Asia (FAO, 2016b). They provide two third of fish supply to the global market and consume large portion domestically. China has the largest fish exporter country in top ten countries of the world, providing jobs to the people over 14 million in this sector with annual production of fish as 58.8 million metric tons (The daily record, 2010)

Pakistan supports a wide range of ecosystems. Total coastline of Pakistan has 1050 km and total fishing area is approximately 300,270 sq km. At the time of independences, Pakistan was based on small scale marine fisheries industry after the partition (Nazir et al., 2015). There are 531 species of fish in Pakistan in which 233 of them live in freshwater and the others live in warm water and semi cold water. The well know fish species are Trout, Mahasheer (National fish of Pakistan), Rahu, Mori, Thaila are Gourami. A sustainable approach to fisheries and aquaculture will help to protect our natural resources and ensure that fish stocks are available for future generations (Ahmad.,2015). Currently, overfishing, ineffective management practices, industrial development and agricultural pollution, water pollution have reduced fish stocks.

Fisheries play an important role in the economy of Pakistan by employing 400,000 people directly and another 600,000 in the additional industries (Ebrahim, 2014). With a coast line of 1050 km (pernetta, 1993) Pakistani marine as well as inland waters hold a large variety of aquatic animals. This aquatic diversity includes various species of fish, crustacean and

Mollusca. It is noted that a number of different types of aquatic animals are found along side of Makran coast (Gondal et,2012). Marine fisheries sector in Pakistan fisheries plays a vital role in national economy by adding value to the agriculture sector. The GDP contribution of agriculture sector of Pakistan was 17300 million USD in 2006 and while fisheries GDP contribution was 232.5 million USD. Among marine and inland sectors, the former is the main sector contributing nearly 60 percent of the total fish production. Deep water fish capture in Pakistan from exclusive economic zone (EEZ) contributed 1.3 percent to total Marian capture (FAO,2009).While sustainable fisheries management is a challenge, solid global and reginal governance of these vital resources will ensure that we can produce enough fish those living in poor regions, but this is also a well-known fact that the increasing consumption, water pollution and overfishing putting the fisheries resources into risk everywhere (Conserve Energy Future).

1.2.Study Area

District Swat is located in the Khyber Pakhtunkhwa province of Pakistan, in the middle of foothills of the Hindu Kush mountains range and it is one of the famous and major tourist attractive valley and is also known as the Switzerland of Pakistan. The total area of swat is 5337 square kilometers with the population of about 2, 3095, 70 (Pakistan Bureau of Statistics, 2017). Majority of people living in the rural areas and approximately 695900 people living in the urban areas. Local people of swat approximately 38% depended by tourism and 31% on the agriculture sector. Swat valley is full of natural resources such as water, forest, minerals, fisheries and wildlife and it is also one of the abounded waters areas in the Khyber Pakhtunkhwa where there are many beautiful lakes (Mahudand lake, kandol lake, khapero/pari lake and spen khwar lake, Daral lake and Bashigram lake). The valley also has one of the main rivers which is known as “Swat River” the total length of the river is 250 km from kalam to river Kabul. It irrigates 16000-acre land and also accommodate fish resources.

River Swat plays an important role in the economic life of the valley. Its aesthetic value can never be underestimated. The river is one of the main sources of tourist attraction and a source of recreation for the local people. The pleasant climate of the valley and its rich fertility is also due to the river. It provides water for irrigation and domestic use and is a habitat for, besides other flora and fauna, a number of fish species and waterfowl. River Khialay and Jindai in District Charsadda are the two main offshoots of river Swat. It is diverted near Batkhella for power generation and irrigation. The upper Swat canal flows under Malakand through Benton tunnel. Below Dargai the upper Swat canal is divided into two branches, one supplying Charsadda and the other Swabi and Mardan.

There are 50 different species of fish in the study area. Khan and Hasan (2011) identified these species in the river Swat from Kalam to river Kabul. Some other species disappeared due to flood 2010. Two species trout and Mahasheer are the high valued fishes in the river Swat.

1.3. Problem statement

The population of fish decreased significantly due to various factors such as illegal fishing, water pollution and floods etc. Besides, the water quality has been deteriorated which severely affected the fish species. The government also instructed the local people to stop eating and catching due to some fish diseases which may be injurious for health. There may be various factors responsible for such fish diseases. The local people also stopped using the river Swat water for drinking purpose and also it has been observed that sewerage water, hotel wastes and city solid waste alongside destructive fishing practices are the key responsible factors in the study area. So with this background, this study evaluates factors affecting fisheries in river Swat, in province Khyber Pakhtunkhwa. There is also no study available which evaluates the institutional arrangements for fishery in district Swat. So, in the institutional arrangements to conserve the fisheries resources have also been evaluated.

1.4. Significance of the Study

Globally rivers and lakes provide 30 million tones fish annually, and also generating approximately 60 million full and part time jobs in which half of the labor is women (The Fish Site, 2010). Fish are an important renewable natural resource. But unfortunately, these resources disappear day by day. General public and fisherman use destructive fishing methods causing fisheries extinction. Many people in district Swat depend on fisheries resources. So, their conservation is critically important for the local community. The institutions also play significant role in the conservation of fishery resources.

1.5. Research questions

1. Is the water quality and existing fishing practices threat for fishery loss in district Swat?
2. Is management the real constraint for the fisheries conservation in Swat?

1.6. Objectives of the study

This study aims:

1. To analyze the responsible factors of fisheries loss including hotel waste, garbage and destructive practices in district swat.
2. To evaluate the existing institutional arrangements for fisheries conservation in Swat.

1.7. Organization of the study

This study is organized in different chapters. Brief introduction of the study has been given in first chapter. In second chapter relevant literature has been reviewed and contribution of the present study also mentioned. Chapter third contained about data collection and methodology of the study and chapter fourth completely explained result and discussion, and chapter fifth contained policy recommendation and conclusion.

Chapter 2

LITERATURE REVIEW

The importance of fisheries resources cannot be denied. Fisheries resources play a key role in the development of livelihood, ensuring food security and providing recreation and economic benefits. (Allison et al., 2009; Barrett, Reardon, & Webb, 2001). At national and international level a few studies have been conducted on fisheries resource. Some studies focused on fisheries in connection with eliminating poverty and providing jobs to the rural population in developing countries (Allison et al., 2009; Béné, 2003, 2006; Teh & Sumaila, 2013; The daily record, 2010). It has also been observed that fish is the largest traded agriculture commodity all over the world and it is the major source of export of the poor countries (FAO, 2016a; Sargent et al., 1999).

Some previous studies have showed that most of fish species are vanishing and some of them are being extinct forever by anthropogenic activities and environmental degradation. Petreire Jr (1989) and Pickett, Parker, and Fiedler (1992) studied that with the passage of time, population increases putting pressure on the demand for fisheries. Pethiyagoda (1994) examined that freshwater fish of the Sri Lanka is threatened by deforestation, pesticides and other pollutants dumped near water. But this is also well known fact that water pollution, overfishing, increasing consumption is the main cause of putting fisheries resources into risk (Conserve Energy Future; Toufique, 1997).

Some researchers concluded that most of fish species are being affected by pesticides use in agriculture (Altinok, Capkin, Karahan, & Boran, 2006; Angermeier, 1995; Parvez & Raisuddin, 2005; Pethiyagoda, 1994; Thomson, 1971; Verma, Rani, Tonk, & Dalela, 1983). Ricciardi and Rasmussen (1999) and Musick et al. (2000) reported that North America freshwater fisheries are being disappeared by water pollution. Fish survival depends on clean

environment and they need suitable condition with natural quality of water. Reynolds, Dulvy, and Roberts (2002) and Allan et al. (2005) analyzed that all over the world fish species are going towards extinction due to water pollution.

Some past study concluded that most of fish affected by presence of the higher level of ammonia and also the lower level of ammonia in the water (Conserve Energy Future; Toufique, 1997). Ammonia is more toxic to aquatic life at higher temperature and pH values. As pH increases, so does the fraction of unionized ammonia and the toxicity to fish (EPA 1999). The ratio of NH_3^0 to NH_4^+ increases by 10 times for each one unit rise in pH, and by approximately 2 times for 10°C rise in temperature from $0-30^\circ\text{C}$ (US EPA, 2009). Fish that are exercising and exposed to ammonia have decreased swimming performance and increased susceptibility to acute ammonia exposure (Wicks et al. 2002, referring to Beaumont et al. 1995; and Day and Butler 1996). It has been shown that swimming performance is reduced in Coho salmon exposed to ammonia levels higher than $0.04\text{ mg per l NH}_3^0$ (Wicks et al. 2002). Salmonids to the ammonia levels promulgated by the EPA may not only reduce swimming performance, but could be lethal (Wicks et al. 2002). Some fresh water species tolerate the high amount of ammonia in the water but mostly fish do not tolerate the presence of ammonia in the water, for the survival of fish ammonia required neither high nor lower but average rate is necessary for aquaculture because the high amount of ammonia makes water poisoned and the lower amount of ammonia also affect fish stock in the water.

pH is important indicator for the measure of acidity in the water or soil as well as for aquaculture, different fish species have different and specific range of water quality aspects (temperature, pH, oxygen concentration, salinity, hardness etc.) within which they can survive, grow and reproduce, within these tolerance limits, each species has its own optimum range within which it perform best, fish production can be greatly affected by excessively low or high

pH, extremely pH values can even kill fish, and fish are more susceptible to extreme pH during their reproductive seasons, and eggs and juveniles are more sensitive than adults, some researchers concluded that fish survive above pH 4 and below pH 11 for long period for different water but acceptable pH for fish survival is 6.5 to 9, above 9 pH it convert ammonia into toxic(Allan et al 2005). Freshwater fish require high pH but some other fish like warm water, semi cold-water fish do not support high pH for their eggs and small population of fish.

The presence of turbidity in the water consider the main source of feeding for aquaculture. The huge amount of turbidity indicates that fish survival easily in the water within the interval between 0 to 640 NTU, it means that fish get more food in this water and more fish come into this region from other regions (David K. Rowe and Tracie L. Dean 1997). Turbidity in the streams varied by season and was influenced by rainfall, stream size, local soil conditions, farming and highway construction. The importance of quantity, quality and timing of in stream flows for maintaining fish populations in regulated rivers has long been recognized and has led to the development of various methodologies that attempt to determine through modeling how to be left in a particular stream or stream reach for fish (Gillian and Brown 1997).Turbidity is one of the important property of water, and aquaculture ecosystem need more level of turbidity in the water for their survival, they get food from this type of water and increasing their population due to suitable condition and food.

Climate change has a serious threat for living things and for their survival on earth. It affects almost every sector of the economy; fish body temperature is moderated by water temperature. Increasing sea temperature can affect important biological processes of fish including growth, reproduction, swimming ability and behavior, Reproduction is only possible in a narrow temperature range, and therefore could be affected by the forecast temperature rises associated with climate change. Temperature also influences the sex of fish, which may have an effect on population dynamics. Xenopoulos et al. (2005) and Rahel (2002) reported that climate change

reduce the freshwater flora and fauna. Besides, the increasing temperature and reduction in rainfall affect fisheries resources causing fisheries' extinction. Dudgeon et al. (2006) found that the major threats which facing the freshwater fauna and flora are overexploitations, water pollution, and degradation of habitat and invasion of exotic species. Solid waste and liquid waste both make water poisoned, liquid waste increase the level of ammonia in the water and its affects aquaculture and their survival become dangers in this region where liquid waste ratio become high. The main source of this waste to drain into water is cities and hotels, some organizations collect waste from the cities and they also dump into water and it makes a big threat for aquaculture, some past studies showed that solid waste as well as liquid waste are the main source of water pollution in developing countries (Bukola et al 2015)

2.1 Contribution of the present study

After studying existing literature on fisheries resources, it is evident that fisheries resources are being affected by different factors. However, district Swat is not the exceptional where fisheries resources are also affected by various factors. To the best of my knowledge there is no academic research which focus on the influencing factors of fisheries resources followed by institutional arrangements have been focused on. Hence, this study will bridge this gap.

Chapter 3

DATA DESCRIPTION AND METHODOLOGY

The chapter contains on the following sections.

Section 3.1 provides information about data collection and sampling design, and section 3.2 data and measurement of variables. Section 3.3 deals sources of data and abbreviations and 3.4 Explains detailed methodology conducted to gain the targeted objectives of the study. Section 3.5 provides detail information about analytical tools used for this study while estimation technique is given section 3.5

3.1 Data Collection and Sampling Design

The study is based on both Primary and secondary data. The primary data was collected through questionnaires and interviews. However, some information required for water quality analysis was collected from official documents of fisheries department. Two types of questionnaires were designed for data collection; One for fishers and Second for Hotel managers/owners.

Table 3. 1 - Sample size and Sampling Design

Respondents	Research Instrument	Sampling method	Sample Size
Fishers	Questionnaire	Simple Random	90
Representatives of fisheries department in Swat	Interviews	Purposive	10
Hotels	Questionnaire	Purposive	15

3.2 Data and Measurement of Variables

The study used secondary data for the ammonia, turbidity and pH of water taken from fisheries department of Swat.

Table 3. 2 - Sources of data and abbreviations

Variables	Unit	Source	Abbreviations
Ammonia	Milligram liter(mg/l)	Department of fisheries	Amm
Turbidity	Nephelometric turbidity unit (NTU)	Department of fisheries	Turb
pH	..	Department of fisheries	pH
Experience	Annually	Survey	Exp
License		Survey	Lice
Hotel waste	Kgs	Survey	HW
Garbage	Kgs	Survey	Grb
Average catch of fish per day	Kgs	Survey	ACFD
Destructive fishing practices	Electric current, Thiodan, Dynamite, water diversion, cast net, Gillnet, Fishing Rod, Other	Survey	DFP

3.3 Methodology

One of the objectives of this study is to analyze factors of fishery loss in the study area, so the following econometric linear regression model was used.

$$ACFD_i = \alpha + \beta_1 Ammo_i + \beta_2 Turb_i + \beta_3 pH_i + \beta_4 Exp_i + \beta_5 Lice_i + \beta_6 Hw_i + \beta_7 Garb_i + \beta_8 DFP_i + \mu$$

Where,

ACFD = Average catch of fish per day (kgs) during in month data collected from individual fisherman.

Amm = Ammonia level (mg/l) in water for different points

Turb = Turbidity (Nephelometric turbidity unit, NTU) level in water for different points

pH = pH value of water (Potential hydrogen) for different points

Exp = Experience of fisher about catching of fish (years)

Lice = License for fishing provided by fisheries department. It has been used as a dummy variable taking value 1 if fisher have fishing license and 0 otherwise.

Hw = Hotel waste (kg's). It has been used as a dummy variable taking value 1 if fisher perceives that hotel waste affect fish in the river and 0 otherwise.

Garb = Garbage. It has been used as a dummy variable taking value 1 if fisher perceives that garbage/solid waste affect fish in the river and 0 otherwise.

DFP = Destructive Fishing Practices. It has been used as a dummy variable taking value 1 if the fisher used at least one destructive fishing practice (Electric current, Dynamite, Thiodan, Gillnet, Water diversion, Cast net and fishing with Rod) and 0 otherwise.

α = intercept term

μ = Error term

$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7, \beta_8$ = Slope Terms

3.4 Theoretical justification of variables.

The expected relationship of the dependent and independent variables in the above-mentioned model is discussed as follows.

3.4.1 Average catch of fish and Ammonia

Ammonia is an important gas which is present in water in two forms one is ammonium hydroxide and the other one is ammonium ion. Ammonia is a toxic compound that can adversely affect fish health. The nature and degree of toxicity depends on many factors, including the chemical form of ammonia, the pH and temperature of the water, the length of experience, and the life stage of the exposed fish. Ammonia is directly toxic to aquarium fish. It causes chemical burns to fish tissue. It generally hurts the gill first. Even as ammonia burns the gills, fish absorb it into their bodies, where it can damage other tissues.

The damage to the gill also causes other problems. This damage makes it harder for the fish to respire. At the same time, damage to the gills makes it harder for fish to expel ammonia, causing it to build up future, for the survival of fish it would be require in normal level. Neither it would be high nor too low, because due to high amount of ammonia presence makes water poisoned. The low and high presence of ammonia in water affect the survival of fish (Albert 2002). The Ammonia is expected to impact the fish catch negatively.

3.4.2 Average catch of fish and Turbidity

Turbidity is the condition resulting from suspended solids in the water, including silts, clays, industrial wastes, sewage and plankton. Such particles absorb heat in the sunlight, this raising water temperature, which in turn lowers dissolved oxygen levels, they also prevent sunlight from reaching plants below the surface. This decrease the rate of photosynthesis, so less oxygen is produced by plants. Turbidity may harm fish and their larva. It is caused by soil erosion, excess nutrients, various wastes and pollutants, and the action of bottom feeding organisms

which stir sediments up into water. This is the most important property of water and consider the main source of feeding for fish in the interval between 0 to 640 NTU, the presence of this property in the water increase the number of fish and more fish come from other regions (David K. Rowe and Tracie L. Dean 1997). A positive relationship between average catch of fish and turbidity is expected.

3.4.3 Average catch of fish and pH

The pH of river water is the measure of how acidic or base the water is on a scale of 0-14. It is a measure of hydrogen ion concentration. The optimum pH for river water is around 7.4. Water acidity can be increased by acid rain but is kept in check by the buffer mineral. Extremes in pH can make a river inhospitable to life. Low pH is especially harmful to immature fish and insects. Acidic water also speeds the leaching of heavy metals harmful to fish. pH is important for the measure of acidity of the water or soil as well as for aquaculture, fish survive above pH 4 and below pH 11 for long period. The acceptable pH for fish survival is 6.5 to 9. It kills fish when pH reached above 9 and it convert ammonium into toxic (Application notes). So, the expected relationship of this variable with average catch of fish is negative.

3.4.4 Average catch of fish and Experience

Experience of the fisherman plays a key role in the fishing, the more have experience he/she will catch more fish, it means that experience of the fisher changes his/her per day catching, probably it will increase his/her income. So, the expected relationship between average catch of fish and experience of the fisher is positive.

3.4.5 Average catch of fish and License

Fisheries sector plays a key role in the economy and provide a million full and part time jobs to the people, most of people livelihood only based on this sector, for that concerned department provides them license for legal fishing. If fisher have license he can fishing for long

time and will catch more fish, and without license watchman will fine him, so the expected relationship of this variable with average catch of fish is positive.

3.4.6 Average catch of fish and Hotel waste

Water is an important element for all living things most of water is found in the oceans and the remaining one percent only accessible for use. The whole world faces water crisis like both quality and quantity due to the rapid growth of population, industrialization, food production practices, use huge amount of pesticides and wastewater management, these factors directly affect aquatic eco system and indirectly affect health (Toufique,1997). Most of hotels drain wastewater into the surface water it directly affects the life of aquatic ecosystem, so the relationship of this variable with average catch of fish is expected negatively.

3.4.7 Average catch of fish and Garbage

Already two third of aquatic life is considered to be an endangered species because of improperly disposed chemical and other waste of the cities in the water bodies. When a toxic waste harms one organism, it can end up destroying an entire food chain of aquatic life. Improperly disposed chemical pollute marine life and kills sea mammals, corals, and fish. At the same time, sea birds are affected because they eat the fish. In a matter of fact. Any organism that digests affected marine life can have adverse effects.

Waste in the form of solid or liquid dump into the water bodies it will change the composition of water property this is called water pollution. This pollution will affect the life of existing ecosystem within the water (Environmental service). The expected relationship of this variable with average catch of fish is negative.

3.4.8 Average catch of fish and DFP

Fishing is the oldest activities of the world, for that several destructive fishing methods are adopted by fisherman, everywhere fisherman and local people follow these methods for fishing. These practices have two aspects in context of fisheries resources stock and income of

the fisherman, the relationship between DFP and stock of fish is negatively while between income of the fisherman and DFP is positive. However, here the expected relationship between DFP and average catch of fish is positive.

Chapter 4

RESULTS AND DISCUSSION

This chapter contained analysis of the results and their interpretation. This chapter further divided into three sections, section 4.1 explained descriptive statistics and section 4.9 contained econometric analysis. In the last section 4.10 interpret institutional arrangement in District Swat.

4.1 Descriptive Statistics

In this study five continuous variables have been taken which were mentioned in the table (4.1). When ammonia accumulates to toxic level, fish cannot extract energy from feed efficiently. If the ammonia concentration gets high enough, the fish will become and eventually fall into a coma and die. The safe level of ammonia in freshwater is from 0.001 to 0.020 mg/l. Fish can easily live within this interval (The Fish Site). The mean value of ammonia (0.88) in table (4.1) showed that water quality affects fishery in the river Swat.

The optimum pH level for river water was around 7.4. Water acidity can be increased by acid rain but it is kept in check by the buffer mineral. The extreme pH can make the river inhospitable to life, the low pH is especially harmful to immature fish and insects. The acidic water also speeds up the leaching of heavy metals which is harmful for fisheries. pH is important for the measure of acidity of the water or soil as well as for aquaculture, fish survive above pH 4 and below pH 11 for long periods. The acceptable pH for fish survival is 6.5 to 9 above 9 it will kill fish in the river (Fish Biology). The given pH value (7.51) below in table shows that it affects fishery resources in river Swat.

Similarly, turbidity is also the most important property of water and is considered the main source of feeding for fish in the interval between 0 to 640 NTU, the presence of this property in the

water increase the number of fish and more fish came from other regions (David K. Rowe and Tracie L. Dean 1997). Experience of the fisherman also affect per day catch of fish; the fishers data showed that with a larger experience, they can catch a big amount of fish, which increases their average fish catching. In the study area average per day catch of fish is 2.15/ day which is mentioned below in table (4.1).

Table 4. 1 - Descriptive statistics

Variables	Definition	Mean	Standard deviation
Per day catch fish (Dependent)	Quantity of catch by individual per day in kg during in month	2.15	0.84
Explanatory variables			
Ammonia/mgl		0.88	0.79
Turbidity (NTU)		1.14	0.35
pH		7.51	0.31
Experience	Fishing experience of fisherman	13.54	5.19

Source: Computing by author

4.2 Reason of Catching fish in Swat

As fishery sector plays a key role in the economy and provide full and part time jobs opportunities to people. Throughout the world fish is cheapest form of animal, which contained a large quantity of protein and important source of nutrients. This sector also provides recreational opportunities, recreational fishing for the people. It is an economically and culturally important activity for the visitors as well as for the local people. In the below table (4.3) tells us about the reason of fishing, why people are fishing in the study area. About 33 percent people were fishing due to unemployment because they have no alternative source for earning. While 66 percent people said that we are fishing for refreshment. Swat valley is one of the well-known area people visit there from other cities and they also fishing there for enjoyment. The great number of fishing show that it provides recreational opportunity to the

local people. It also attracts more people into the area. Where they can do fishing easily and enjoy the fishing activity in Swat.

Table 4. 2 - Reason of Catching Fish in Swat

Reasons	Frequency	percentage
Unemployment	29	33%
Refreshment	60	66.7%
Other	1	1.1%
Total	90	100%

Source: Computing by author

4.3 Fishing Methods adopted by fishermen in Swat

Fishing is one of the world oldest activity, but unfortunately everywhere several destructive fishing methods adopted by fishermen. All these destructive fishing methods directly affect fish and indirectly affect stock of the fish in the water. The greedy fishermen have no respect for fishery resource to earn money like “greed rather than need” in this context they follow DFP. The below table (4.4) shows that in the study area fishing rod is the most following method. Which fishermen used for fishing and cast net is the second most use method. Some people or fishermen use other methods like hook, hand fishing etc.

Table 4. 3 - Fishing Methods

Methods	Frequency	percentage
Electric current	0	0%
Dynamite	0	0%
Thiodan	0	0%
Gillnet	2	2.1%
Water diversion	0	0%
Cast Net	24	26.7%
Fishing Rod	38	42.2%
Other	26	28.9%
Total	90	100%

4.4 Distribution of Fishers by Types of Fish in Swat

There are 50 different species in the study area. Khan and Hassan (2011) identified these species exist in the river swat from Kalam to river Kabul. Some species disappeared due to flood 2010. Three species Trout, Mahasheer and Swati are the high valued fishes in the river Swat. The recent study identified that fishermen catch 68 percent Swati fish and 24 percent Trout fish in the study area. The stock of Mahasheer is declining towards extinct due to pollution. All these fish mostly affect from pollution as well as from Destructive fishing practices. The declining number showed that Mahasheer is the most affected fish in river Swat and going to be extinct. China Paplate is another type of fish, it is found there in less amount as compare to other indigenous fish in the river Swat. According to local fishermen this is the only fish which is not affected by this fatal disease in Swat.

Table 4. 4 – Catch of Fish by Type

Kind of Fish	Frequency of fishers	percentage
Swati	62	68.9%
Swati+Mahasheer	4	4.4%
Swati+Trout	22	24.4%
All	2	2.2%
Total	90	100%

Source: Computing by author

4.5 Issuing license to fishermen in Swat for Legal Fishing

Fisheries department is responsible for check and balance and work for the conservation of fisheries in Swat. Under the ordinance of 1961 fisheries department provides license for legal fishing and collect fee from the fishermen. Watchmen and inspectors of fisheries bound to penalize those fishermen who are fishing without license. The Fishery Department of Swat provides license for legal fishing only for ninth months. If inspector found any fisher who fishing without hold license, he will fine him according to the given rules. In the given data show that which is mentioned below table (4.6) number of without fishing license fishermen is greater than those who have fishing license. In addition, the ratio of not fine fisher is also greater than those fishers who have been fined by inspectors. The result showed that there was a high frequency of fishers who did not hold fishing license, it indicated that governmental institution are not properly functioning in the river Swat. According to the given data about 80 percent fishers were fishing without license and they never got any penalty by inspector.

Table 4. 5 – Distribution of Fishers by type of holding Licenses and penalty

Penalty	Frequency	Percentage	License	Frequency	Percentage
Yes	18	20%	Yes	35	38.9%
No	72	80%	No	55	61.1%
Total	90	100%	Total	90	100%

Source: Computing by author

4.6 Causes of Increasing Fish prices in Swat

About 60 percent fisher claimed that prices of the fish over the past five years have been increased in District Swat. According to them the main reason of prices increasing is the non-availability of fish stock in the river Swat. The stock of fish has been decreased in Swat valley by flood 2010. In addition, overfishing, illegal fishing, and destructive fishing practices followed by fishermen were the main cause of low stock in the river Swat. Some fisher said that the taste of Swati fish is different from other fish, that's why people demand more of this fish in the market. Supply of less quantity in the market also increase price. All these statistics mentioned in below table (4.6).

Table 4. 6 - Causes of Increase Fish Prices

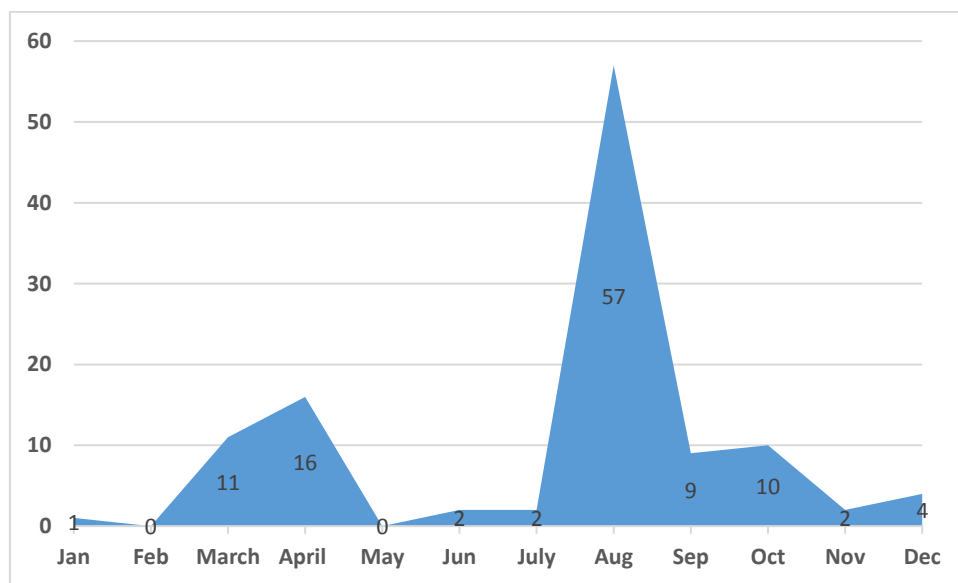
Causes of increasing fish prices	Frequency	Percentage
Tasty	17	18.9%
Flood	13	14.4%
Stock decreased	60	66.7%
Total	90	100%

Source: Computing by author

4.7 High rate of Fishing Month in Swat

The below figure shows that the high rate of fishing in terms of month in the study area. August is found the high rate of fishing month throughout the year. According to focal person of Fishery Department of Swat, we do not allow fishermen for fishing in the months of June, July, and August. These three months have for breeding season of fish in the District Swat. Despite, data shows high number of fishing in month of August. Legally, they are not providing license for these three months, but fishermen are fishing illegally brock in the area. It showed that Fishery Department did not keep proper check and balance. If this trend of fishing continues in the study area, soon the fish species will extinct in the river, which ley eggs and maintain stock for the future.

Figure 1-High rate of Fishing Month in Swat



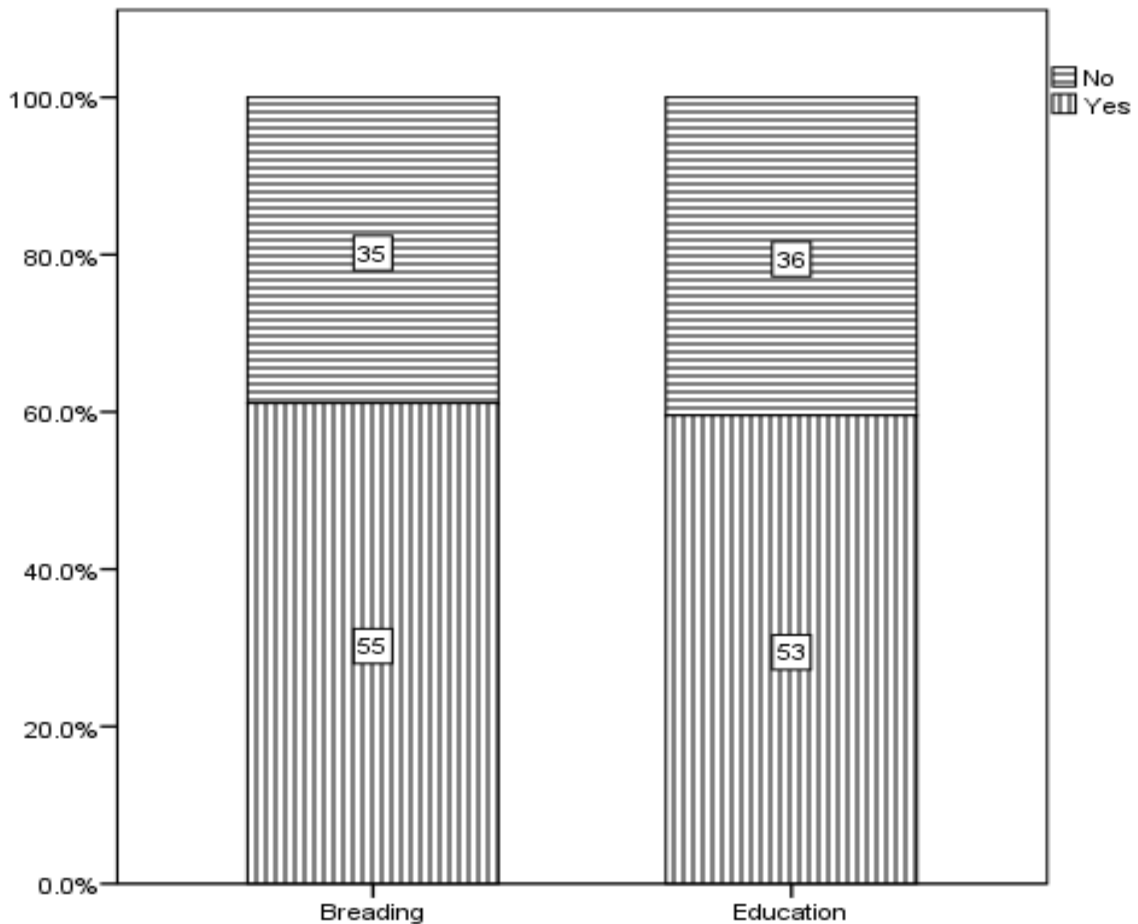
Source: Computing by author

4.8 Fishers who know about breeding season of fish in Swat

Under the ordinance 1961 Fishery Department of Swat provided license to fishers for 9 months, other three months have selected for fish breeding (it depends on area climatic condition and vary area wise). License issuing authorities mention that these months at the time of issuing license to fishers, and they told them about these months. It has been only selected for fish

breeding in Swat. According to the given data below in figure (2) 53 percent fishers are educated in District Swat, and they know about fish breeding season. But majority of fishers do not know about fish breeding season and they are fishing during breeding season. If fishers still continue fishing during breeding season, probably fishing stock will decrease in river Swat. Otherwise fish population will vanish soon from river Swat.

Figure 2-Information About Fish Breeding Season



4.9 Responsible factors for fishery extinction in study area

In the study area fisheries resources are about to extinction, there are many causes of this loss. During survey many people told that waste water, illegal fishing, and water quality are the main causes of extinction of fisheries resources in the river Swat. They also added that hotel waste and garbage of cities extremely affect the fisheries resources in the river. In below table (4.8)

data showed that waste water and illegal fishing was the high response factors in Swat. In District Swat ammonia level was recorded in high level and it poisons water.

Table 4. 7 - Responsible Factors

Causes of extinction fisheries resources	Frequency	Percentage
Waste water	32	35.2%
Illegal fishing	32	35.2%
Water quality	26	29.7%
Total	90	100%

Source: Computing by author

4.10 Suggestions for saving fishery resource in the study area.

All over the world fish is cheapest form of animal which contain a lot of protein and also important source of nutrients for poor. Local people of swat approximately 38 percent depended by tourism and 31 percent on the agriculture sector, swat valley full of natural resources such as water, forest, minerals, fisheries and wildlife. Fishery sector plays a key role in the local economy of Swat because most of tourist visit there only for fresh water and fish but unfortunately this resource is going towards extinction day by day. 22 percent respondents suggested that gov't should control pollution to save fishery resources in the river Swat. They also added that fisheries department of Swat does not play an active role in the area. Most of people fishing illegally and there are no rules for fishing, government should define rules for fishing spots. Increasing the stock of fish in the river Swat because due to flood 2010 a number of fish species have been disappeared from the river swat.

Table 4. 8 - Suggestions of Saving Fishery

Suggestions	Frequency	Percentage
Control pollution	20	22.2%
Active Staff	18	20.0%
Increase fish stock	4	4.4%
Policy	15	16.7%
Define rules	20	22.2%
Control illegal fishing	13	14.4%
Total	100	100%

Source: Computing by author

4.11 Econometric Analysis

The results (Table 4.9) showed that pH of water has negative and significant impact on average catch per day of fishes. It means that if pH of water increases by one unit the average catch per day fall by 1.79 kg. Previous studies showed that suitable pH value for fish survival is 6.5 to 9 below or above this level it converts ammonia into poisoned and it will affect fish stock in the water. The result in table (4.9) also indicate that water turbidity has positive and significant effect on average catch per day which means that with increasing turbidity the average catch per day rise. Ammonia effect average catch per day negatively and significantly. It means that increasing ammonia level by 1mg/l on average the average catch per day goes down by -0.422 kg. The coefficients of experience and license both are positive and significant at 10% level of significance. It indicates that with increasing experience of fisherman and issuing of license by government authority on average the average catch per day increase by 0.049kg and 0.44kg respectively. As expected, hotel waste and garbage both have negative and significant effect on average catch per day. It means that if both hotel waste and garbage increase by one kg on average the average catch per day fall by 0.654kg and 0.4487kg respectively. The effect of destructive fishing practices (DFP) on average catch per day is positive and significant. It

shows that with increasing DFP on average the average catch per day of fish rise by 0.415kg. All these values are mentioned in below table.

Table 4. 9 - Regression Result of the Influencing Factors of Fishery Loss

Avg/day fish catch	Coef.	Std. Err.	T	P>t
pH	-1.794	0.645	-2.78	0.007
Turbidity/ntu	1.417	0.710	2.00	0.049
Ammonia/mgl	-0.423	0.185	-2.28	0.025
Experience	0.0494	0.030	1.64	0.106
License	0.438	0.263	1.67	0.100
Hotel waste	-0.654	0.319	-2.05	0.044
Garbage	-0.448	0.185	-2.41	0.018
Dfp	0.415	0.135	3.07	0.003
_cons	14.462	4.645	3.11	0.003

Source: Author own survey

4.12 Institutional Arrangements for Fisheries Conservation in Swat

There are some institutions work for conservation of biodiversity in study area. The main institutions are:

1. Khyber Pakhtunkhwa Agriculture, Livestock, Fisheries and Cooperation Department.
2. District Department of Forest and Wildlife Swat.

These departments are mainly working for the conservation of biodiversity in study area. According to Fisheries Department of District Swat, there are only two institutions working for conservation of fish biodiversity:

1. Mahasheer Sub Research Station at Nagova Swat

The Department is mainly working for conservation, developing and enhancing different varieties of fish species in District Swat including Mahasheer fish (National Fish of Pakistan). This department also provide fish seeds to Districts Swat, Shangla, and Bunner to maintain the fish stock.

2. Central Research Center for Trout Fish

This center was established at Madyan upper Swat working for the conservation of Trout fish which is the most expensive fish found in “River Swat”. The Department also provide Trout fish seeds to the private sector on subsidized rates.

According to the focal person of fishery Department of District Swat, only these two institutions are working for the conservation of fishery. They are facing some hurdles in the conservation of fishery in the study area.

Firstly, the prevailing law “1961 Act West Pakistan fishery Ordinance’ has no provision for identifying selected spots for fishing. Fishery Department proposed that there should be selected spots for fishing to maintain fish stock.

Secondly, the Department has less than fifty watchmen for the whole District, performing their duties without arms. They also do not have proper uniform during duty timings. Fishery Department demanded that staff should be increased to control illegal fishing in the study area.

Thirdly, this fishery sector has meager financial resources to perform their functions in the District. Provincial government should increase budget for the development of this sector. In addition, government should start campaign on media to aware people to stop water pollution and dumping waste material into the river. There should also be selected tourist spots for fishing along the river Swat.

Chapter 5

CONCLUSION AND POLICY RECOMMENDATIONS

5.1 Conclusion

This study focuses on identifying the influencing factors of fishery loss followed by evaluating the existing institutional arrangements for fishery conservation in district Swat. It was found that pH of water, ammonia, hotel waste and garbage have negative impact on fish catch while experience of fisher, turbidity, license and DFP has positive impact on fish catch. Besides, there are very limited institutional arrangements for the fishery conservation in district Swat. There need proper strategies to conserve fishery resources in the District.

About 33 percent of the fishermen are attached with the fishing profession due to the prevailing unemployment situation in the district. It is also worth mentioning to note that majority of the fishers catch fish for refreshment only. The fishers are also using some destructive fishing practices which may impact the fishery stock in the river Swat. Three species Trout, Mahasheer and Swati are the high valued fishes available in the river Swat in which Swati is the most abundant fish in the study area. Other species are going towards extinction due to water pollution and destructive fishing practices. Majority of the fishers don't have the fishing licenses.

Although the breeding season of the fisheries is June to August, but the fishers still catch fish in these months which cause fishery extinction in the study area. The increasing prices of fishery is mainly due to the decreasing stock of fishery in river Swat

5.2 Recommendations

Fishery sector play an important role in the livelihood of the local fishermen in District Swat. However, water pollution not only impact the fishery resources directly but the livelihood of the local fishermen indirectly. There are various reasons for the water pollution in District Swat. There is a need to strictly monitor the wastes generated from various sources and are dumped in the river Swat. These sources are household waste, automobile workshops on the bank of river Swat and hotel wastes. There should be proper waste collection system specifically in Mingora urban area and arrangements should be made to recycle these wastes for productive purposes. The hotels should be strictly monitored from throwing wastes into the river Swat.

The prevailing law needs to be updated and should cover fishing points, extraction of concrete for building, distribution of water and monitoring spots in the District Swat.

Government should extend the function of environmental protection agency in overall Malakand Division. Currently, there is only one office working in this division which cannot cover the whole area.

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Appendix (A)

Questionnaire for Fishermen

Part A General Information.

1. Name of the Fishermen _____
2. Area Belongs to: _____
3. Age: Please specify (in years) _____
4. Gender
 - a) Male
 - b) Female
5. Educational Qualification: (Number of years in schooling) _____
6. No. of Family Members: - Please specify _____
7. No. of other Household earners: _____

Part B about fishing

1. Why do you fishing?
 - a) Traditional/ancestral
 - b) Un-employment
 - c) Poverty
 - d) Low waged alternative jobs
 - e) Refreshment
 - f) other specify please _____
2. How long have you been fishing? (In years) _____

3. Annual Income (from all Sources)

Income source	(Rs. Per month)
Income from Fishing	
Income from all other sources	

4. Normally, which method do you use for fishing?

- a) Electric current b) Dynamite c) Thiodan d) Gillnet
 e) Water diversion f) Cast Net g) Fishing Rod h). Other

5. Did anybody fishing from your household?

- a) Yes b) No

If yes then How many _____

6. Total cost on fishing inputs/single visit?

Input type	Usage (yes/No)	Cost in Rs.
Nets		
Rod		
Seines		
Hooks		
Gillnets		
Other		

7. In which month do you catch fish? _____

8. On average, how much fish do you catch per day? (kg) _____

9. Do you know about fish breeding season (mating season)?

- a) Yes b) No

If yes then what is the breeding

Seasons/months? _____

10. How much fish do you retain for your personal consumption (in kg/per week) _____
 and how much do you sell in the market (in kg/per week) _____

11. Where do you sell fish?

- a) In the community b) Markets outside (Bazar) c) Both a and b
d) Any other

12. The prices you get for fish catch over the past five years has:

- a) Increased b) Decreased c) Not changed

13. If the prices of fish increased then state the reason
(s)_____

14. Normally, which kind of fish do you catch? (Multiple options are possible)

- a) Trout b) Mahasheer c) Swati d) All of these
e) Any other (Specify their name) _____

15. Do you have fishing license?

- a) Yes b) No

16. If yes for Q-15 then which type of license you got for fishing? (Multiple options are possible)

- a. Daily trout angling b) Seasonal rod
c) General d) any other_____

If no: how many time you fined_____ and how much in Rs._____

Part C about water pollution.

1. Do you know about environment for fish survival?

- a) Yes b) No

If yes: which kind of environment necessary for fish survival?

- a) Clean b) polluted c) Any other (please specify)

2. What quality of water necessary for fish survival?

- a) Pure/Naturally b) Purified c) Any other (please specify)

3. Does the water of Swat River adequate for fish survival?

- a) Yes b) No

If No: why it is not adequate for fish survival? _____

4. What is the main source(s) of water pollution in river swat?

- a) Hotels b) Local community c) solid waste (TMA) d) All of these

e) Any other source (please specify) _____

5. Do you perceive that hotels waste affect the fisheries in the river swat?

- a) Yes b) No

6. Do you perceive that garbage affect the fisheries in the river swat?

- a) Yes b) No

7. Do you know about fisheries extinction?

- a) Yes b) No

8. If yes for Q-9 then specify the factors which are responsible factors for fishery extinction (multiple options are possible)

a) Increase in the amount of wastewater b) Increase in the number of fisherman

c) Increase the rate of illegal fishing d) Deterioration in the quality of water

e) Increase the number of license f) Increase in the market prices of fishery

g) Any other _____

9. Any suggestion to save fisheries in the river swat _____

Appendix (B)

Questionnaire for Hotel

1. Name of the manager (Owner) _____
2. Name of the Hotel: _____
3. Address of the Hotel: _____
4. What is the status of your hotel?
a) Own b) Rented
5. Number of visitors per annum _____
6. Monthly revenue of the hotel (Average): Rs _____
7. Number of Kitchen: _____
8. Number of Staff: _____
9. What is the Size of your hotel? _____ marlas.
10. Number of rooms in your hotel: _____
11. How much garbage (solid waste) your hotel release (per week)? _____ Tones.
12. If you dispose waste in open space, does the local people made complaint against it?
a) Yes b) No
13. Is there any penalty of throwing garbage and releasing wastewater in your area?
a) Yes b) No
- If yes, then specify it _____
14. How do you discharge sewerage water of the hotel?
a) Underground b) River c). Any other (specify please)

15. Who collect the garbage (waste) of your hotel?
a. Municipal committee b) Self disposed in open air c). Self-disposed in river.
d. Scavengers e) any other
16. Do you think that the waste generated by your hotel can be recycled?
a) Yes b) No

17. What type of waste your hotel release? Can you provide it the break-up?

Type	Quantity (tonnes)
Total	

18. Why you do not recycle the hotel waste by yourself?

- a) Quantity is little b) Can easily be disposed in the river
 c) No recycling system is available in the area d) any other specify please.

19. If a proper facility of free collecting garbage and recycling system starts in your area, would you be willing to provide the hotel waste?

- a) Yes b) No

20. If yes then how much you would charge? _____Rs. /ton

21. Do you guide visitors to keep environment clean?

- a) Yes b) No

If yes what type of instructions you give to the visitors _____

22. Do you know that the fisheries in the river swat are going towards extinction?

- a) Yes b) No

If yes, then specify the reasons (Multi-options may be possible):

- a) Increase in the number of tourist's b) Increase in the amount of wastewater
 c) Increase in the amount of garbage d) increase in the amount of fish catch by fishermen
 e) Increase in the amount of fish catch by people f) Use of destructive fishing practices
 d) Any other _____

23. How the hotels can play its role to save fisheries in river swat. _____

Appendix (C)

List of the interviewee

S.no	Name of the interviewee	Designation	Address
1	Ibrar Ahmad	AD Fishery Department	Saidu Sharif
2	Akbar Zeb	Ex Director EPS	Saidu Sharif
3	Zakir Hussain	AD EPA	Mingora
4	Farhan Habib	TMO	Mingora
5	Shah khan	Assistant Commissioner	Babozai
6	Jafar Yahya	AD Fishery Department	Madyan
7	Gul Zada	Inspector of fisheries	Behrain
8	Iqbal khan	TMO	Behrain
9	Azam Khan	President of hotel association	Behrain
10	Murad khan	Monitor of fishery	Kalam