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WATER POLLUTION AND FISHERIES EXTINCTION: EVIDENCE FROM RIVER SWAT IN PROVINCE KHYBER PAKHTUNKHWA, PAKISTAN

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Abstract

District Swat is famous for its natural beauty throughout the world. Tourist visit here for recreational services. Revenue from tourism and fish market is the main source of livelihood for many of the local residents. The fish stock is continuously on the decrease and there are various factors which are responsible for this decrease. With this background, it is important to identify the causes of water pollution, suggest options to conserve fisheries and water and to assess the existing institutional arrangements. The findings revealed that the key causes of water pollution were waste from the marble and cosmetics industries, hotels, Municipal committee (TMA), auto workshops and service stations, households sewerage water, floods, land sliding, depletion of water resources and river mining. This study recommends to stop destructive fishing practices and strictly ban the fish catch in breeding season. The fishing and licensing policy should be revised. Reserved areas for both fishing and mining should be declared to conserve fisheries and reduce water pollution. The hatcheries should be extended and more plantation should be made to cope with the flood challenges. Awareness campaigns are required for reducing water pollution, illegal fishing practices and disposing solid waste. The need based and site specific water and fishing policy should be designed. The issue of solid waste can be tackled through recycling solid waste to produce energy or organic fertilizer. The capacity of the fisheries department should be increase through providing staff and financial resources.
Keywords: Water Pollution; Fisheries extinction; institutional arrangements; water quality; solid waste; river swat

1. INTRODUCTION

Fisheries is an important source of livelihood and play an important role in the economic development of a country (Fanning, Khan, Kidwai, & Macauley, 2011). It is an essential source of high quality protein, vitamins, essential minerals and long-chain poly-unsaturated fatty acids, to human beings (Jabeen & Chaudhry, 2011). Globally, fish provides about 3.0 billion people with almost 20 percent of their intake of animal protein, and 4.3 billion people with about 15 percent of such protein (Garibaldi et al., 2004). The livelihood of most of the people in the coastal areas are also dependent on the fish sector. The problem of decreasing fish stocks is often compounded for people whose earnings and food supplies are based on fish. In Pakistan, fisheries are in danger due to water pollution and use of banned trap nets. These nets do not even spare the fingerling fish (Government of Pakistan, 2013). The fish stock in the in many rivers in Pakistan are hunted and the catch rate is decreasing with the passage of time. Out of the total 200 species of the Indus River system, a total of 32 fish species are known to be endemic to Pakistan (Government of Pakistan, 2013).

There are various water bodies in Pakistan which face issue of fish extinction. Among these areas, the case of district Swat is most severe where the fish stock is continuously on the decrease and there are various factors which are responsible for this decrease. The local residents and fishermen are reluctant to catch fish, because the fish species has some health problems and they seems wounded/blooded in river Swat. These dead fish creating further risk for human health. The print media also reported highlighted the fish diseases in river Swat (Bureau Report, 2016; Khaliq, 2016; Reporter, 2016b). The local government then collected some water samples from the river Swat and tested in laboratories which concluded that "The fungal and bacterial species mentioned therein[1] alongwith massive contaminations of excreta alongwith heavy metals

[1] The laboratory report highlighted few observations "(i) The fish were infected with Saprolenia spp of fungas one of the fatal/mortal fungal disease of fish. (ii) The fish were infected with Aeromonos hydrophilia spp (An opportunistic pathogen) the causative agent of hemorrhagic septicemia Red Store (iii) Extensive hemorrhages in the musculature and fins are suggestive of heavy metals poisoning as reported in literature (conformation needed). (iv) Invasion of fecal

and chlorine aggravates the disease fish. The heavy rainfall along with excreta and pollutants when itinerate into the river causes pH changes, decrease in the level of dissolve oxygen. The lack of dissolve oxygen along with predisposing factors above is associated with high mortality rate of fish" (Center of Microbiology and Biotechnology, 2017). Besides, the Directorate of fisheries also explored that the diseased fish was due to the bacteria '*Flavobocterium Columnaris*'.

The local government imposed ban on fishing in river Swat and also on sale and coking of Swati fish in hotels and sale points in the entire of District of Swat (District Commissoiner, 2016; District Magistrate Swat, 2016; Reporter, 2016a).

With this background, it is important to study that what are the main causes of water pollution in river Swat which are responsible for the fish decline and diseases. What options exist to conserve fisheries and water resources in river Swat? What institutional arrangements are available to cope with the water pollution to save fisheries resources?

Many studies exist which analyzed the fish stock (Begg & Waldman, 1999; Methot Jr & Wetzel, 2013; Sparre & Venema, 1998), fishery economy (Hodgetts, 2017; Quaas, Reusch, Schmidt, Tahvonen, & Voss, 2016; Wilkens, 2017) and its marketing (Habib, Tasnin, & Abdus Salam Bhuiyan, 2016; Obayelu, Arowolo, Ibrahim, & Oderinde, 2016; Paul, Habib, Sarker, & Golam, 2016) in various part of the world. Some studies also focused on fisheries' extinction (Dias et al., 2017; Fischer, Bardet, Benson, Arkhangelsky, & Friedman, 2016; Luiz, Woods, Madin, & Madin, 2016). However, no attention has been made to assess the water pollution in connection fish extinction in river Swat. So strong justification exist to carry out study covering this issue. This is also fact that some of the issues are also common for fish species extinction in various parts of Pakistan, so the results can be generalized to other areas of the country properly. The implications of this research would be instrumental in saving the fisheries species and protecting the health of the local residents and its market economy.

2.DATA AND METHODOLOGY

The study is qualitative in nature and mainly based on primary data and secondary data. The primary data relevant to causes of water pollution, institutional arrangements and suggestions options to conserve water and fisheries resources was collected from experts of various institutions through interviews in district Swat. The interviews were recorded before taking permission from the interviewees. A total of 10 interviews were conducted, however, due to getting same responses from the interviewees, the survey was not extended further. During the interviews, the issues regarding causes of water pollution, options to conserve fisheries/water resources and current institutional arrangements to cope with the water pollution to save fisheries resources. The interviewees were taken from fisheries department in the study area. Besides, some secondary data was also used and obtained from various newspaper articles and directorate of fisheries, Khyber Pakhtunkhwa Province.

Study Area Profile

District Swat is rich in quality mineral resources (Khaliq, 2010) and is famous for its natural beauty throughout the world. Tourist visit here for recreational services. Revenue from tourism and fish market is the main source of livelihood for many of the local residents. The district produce a total of 1101.52 million tonnes fish with 17.42 million tonnes of trout fish and 1084.10 million tonnes of non-tout fish (Government of Khyber Pakhtunkhwa, 2016).

3.RESULTS AND DISCUSSION

Causes of Water Pollution in River Swat

Water pollution is harmful for all aquatic life (Laws, 2017). In district Swat, there are many industries which pollute water of river Swat causing fisheries resources extinction. There are many marble and cosmetics industries in the district which don't have their own waste disposal system and drains wastes into river Swat. It is the responsibility of the Environmental Protection Agency to take action and control such type of pollution.

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coliform (and other gram negative rods) is suggestive of extensive pooling of the waste and excreta of animals and human population from the city areas during the heavy rain spill, into the river" (Center of Microbiology and Biotechnology, 2017)

District Swat is the main tourist site and hotels to accommodate many national and international tourists. There are around 500 hotels in the district and more than 90% of them don't have septic tanks and their sewerage direct flow into river Swat (Khaliq, 2016).

The key cause identified by the fishery department and other experts is the solid waste mismanagement in the district. The solid waste has no specific collection points and no disposal system. The wastes were thrown into river swat causing water pollution in the river. According to the Fisheries and Training Institute, Lahore, the high values of the free CO_2 was found indicating the huge organic load in river (Table 1) Swat. This is mainly due to release of waste and polluted water added into the river (District Office Fisheries, 2017).

Table 1: Laboratory test results for Water quality in swat and their health implication

Type of the water pollutant (river swat)	Unit	Normal Range	Lab Test Result of the area					Health effects if exceeds the normal limits (with sources)
			Mingora	Landakay	Fizagut	Ningolai	Barikot	
Temperature	^{0}C		19.1 (18.9)	18.5 (18.9)	19.3 (18.5)	18.7 (18.8)	19.0 (18.9)	
Ph			7.43 (7.39)	7.21 (7.43)	7.99 (7.99)	7.28(7.29)	7.48(7.81)	
Free CO_2	mg/L		48(44)	20(28)	16(20)	20(32)	28(32)	
Total Carbonate Alkalinity	mg/L		266(257)	103(95)	67(70)	70(64)	98(98)	
Calcium Hardness	mg/L		188(188)	88(80)	86(64)	60(52)	76(88)	
Total Hardness	mg/L		260(252)	104(108)	88(88)	84(88)	108(88)	
Chlorides	mg/L		33(34)	18(20)	23(25)	25(23)	22(23)	
Electrical connectivity	µS/cm		481(478)	167(172)	109(106)	113(111)	160(159)	
Total Dissolved Solids	mg/L		408(406)	141(146)	92(90)	96(94)	136(135)	
Salinity	ppt		0.4(0.4)	0.1(0.1)	0.09(0.09)	0.09(0.09)	0.1(0.1)	

Source: (1) Fish Quality Control Laboratories, Fisheries Research & Training Institute, Lahore (2016). 01-12-2016 (2) District Office fisheries, Swat

There were also many auto workshops and service stations which releases wastes water drained into river swat.

There is also no proper system for disposal of sewerage water released from households which was directly drained into the river caused water pollution.

Floods also adversely affect the fisheries resources (Erman, Andrews, & Yoder-Williams, 1988; Islam, Islam, Akter, & Kundu, 2017; Rabuffetti et al., 2017). The Flood-2010 not only destroyed livestock, agriculture land and forests but also washed the fisheries resources in the river Swat.

The land sliding also impact fisheries resources (Bhusal & Chitrakar, 2017) particularly in those area which has more forests and mines on the bank of the rivers. There are many forests on the bank of river Swat with enormous mineral resources. The land sliding also pollute water and finally impact the fisheries.

The depletion of freshwater resources also impact fisheries resources (Gephart et al., 2017). Over the time, the fresh water resources have been depleted in district Swat due climatic variability. Due to low water availability followed by increasing water consumption, also impacted fisheries in the river.

The river mining also impact the fisheries resources (Abdel-Satar, Ali, & Goher, 2017; Pal & Mandal, 2017). District swat is famous for having best emeralds in the world. Many people search emeralds on the bank of river Swat polluting the water as well. This is also one of the threats for fisheries.

Options to conserve fisheries and water in river Swat

The main destructive fishing practices used in river swat were electric current, dynamite, thiodan, gillnet, water diversion, net, fishing rods etc. There is an urgent need to stop illegal and destructive fishing practices to conserve the fisheries in river Swat. Most importantly, the government must strictly ban the fish catch in breeding season. To this end, the fish protection committees at local level linked with fisheries department must be re-activated. The government should also revise the licensing policy which suggest nominal rates for issuing licenses

The government should also declare some reserved areas for both fishing and mining. This will help to conserve fisheries and reduce water pollution. The hatcheries should be extended which will help to conserve fisheries. There is also need to have more plantation on the bank of river Swat which will not only serve protect flood but will also help in restoring the hatcheries and different fish species.

The civil society should also play their role through awareness campaigns for avoiding water pollution and illegal fishing practices and disposing solid waste.

There is also need to have need based and site specific water and fishing policy. The available policies are more general rather designed tackling the need of the specific sites. This is evident from the fact that diseased fish was mainly found in river Swat rather other parts of the province. So, targeted policy actions are required to tackle such issues through effective local policies.

The main cause of water pollution in river swat is solid wastes which ultimately impact the fisheries in the river. This issue can be solved by recycling solid waste collected.. For this purpose, the organic and inorganic solid waste should be separated. Organic waste should be converted into organic fertilizer. There should be specific collection points and the dumping, collection and disposal must be strictly monitored. The private sector needs to be engaged and incentivized in recycling the solid wastes which will ultimately increase the job opportunities, reduce water pollution and conserve fisheries resources.

Institutional arrangements to cope with water pollution for fisheries conservation

Based on the information obtained from the experts, the capacity of the fisheries department is too low and needs to be strengthened. At the whole province level, there are only 534 positions active in the fisheries department (Directorate of Fisheries, 2018). Due to this low capacity, les staff and resources they can't cover and monitor all the regions effectively. The available staff also do not have uniform and rifles. Recently, the fishery department also established Fish Biodiversity Center in Nagoha area of Swat. The fisheries department is also following the West Pakistan Fisheries Ordinance (1961) which needs to be updated. Because according to this Ordinance, the penalty for fishing through electric current was PKR. 2000 which is a nominal charges at present. So, there is a need to update legislation and rules on priority basis.

CONCLUSION AND RECOMMENDATIONS

This qualitative research mainly focused on identifying the causes of water pollution and suggest options to conserve fisheries and water in river Swat. Besides, the existing institutional arrangements were also discussed. The findings revealed that the key causes of water pollution were waste from the marble and cosmetics industries, hotels, Municipal committee (TMA), auto workshops and service stations, households sewerage water, floods, land sliding, depletion of water resources and river mining.

This study recommends to stop destructive fishing practices and strictly ban the fish catch in breeding season. The fish protection committees at local level should be activated. The licensing policy needs to be revised to make it more inflexible. Furthermore, the government should declare reserved areas for both fishing and mining to conserve fisheries and reduce water pollution. The hatcheries should be extended and more plantation should be made to cope with the flood challenges. Awareness campaigns are required for reducing water pollution, illegal fishing practices and disposing solid waste.

The need based and site specific water and fishing policy should be designed. The issue of solid waste can be tackled through recycling solid waste to produce energy or organic fertilizer. The engagement of private sector would be the best option in recycling the solid wastes which will ultimately increase the job opportunities, reduce water pollution and conserve fisheries resources.

The capacity of the fisheries department should be increase through providing staff and financial resources. The legislation and rules followed by the penalty structures needs to be updated.

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