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Impact of Kishenganga Hydroelectric Project on Susceptibility and vulnerability of Brooder population of different fish species of the Kishenganga river in Kashmir (India)

Nasrul Amin[1], Salma Khan[2] and Mohammad Farooq Mir[3]

[1]Department of Applied Aquaculture, Barkatullah University Bhopal 462 026, India
[2]Department of Bioscience Rani Durgavati University of Jabalpur, India
[3]Hydrobiology Research Laboratory S.P. College Srinagar, India

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ABSTRACT

The present Research was carried out in Kishenganga River Where damming of River Was done for generation of 330 MW hydroelectricity. Since the damming of river will have impact on aquatic life of the river. In this research an attempt was made to investigate the impact of hydroelectric dam on Susceptibility and vulnerability of Brooder population of different fish species of the river.

Key words : *Brooders, Susceptibility, Vulnerability, Hydroelectric project, Kishenganga River, Kashmir (India)*

Introduction

River, as the source of the social development, is the most active part of the topographic process and ecosystem (Mmopelwa, 2006). There are two major factors influencing rivers. A) Flow – the flow pattern will affect the physical form and the ecology of a waterway and is very much driven by climate. B) Catchments – the slope, geology, soil, vegetation and land use will all have some effect on river condition, either through influencing stream flows, water quality, channel features, energy supply or riparian and floodplain vegetation (Naiman *et al*., 1995; McCully, 1996; McAllister *et al*., 1997).

International interest in the socio-economic impacts of dam is on the rise among the scientists and the policymakers, as evidenced by the growth of organizations such as the World Commission on Dams and the International Rivers Network. In addition to the ecological impacts associated with the construction of the dam and associated works, a dam has upstream and downstream social impacts. The social impacts may be direct or indirect. A direct social impact might be that the boatmen who ferried passengers across the river are now unemployed because the reduced width of the river meant that people can cross the river by other means. An indirect impact might be that the reduced flow and/or increased turbidity has changed fish breeding habitats and there are no longer fish to catch, severely affecting the people who depends on fishing (Baruah *et al*., 2009). Another indirect social impact might be that the reduced flooding of the downstream floodplain has led to major ecological and hydrological changes, which have caused salinization of the downstream plains. This salinization has then reduced agricultural productivity, or has necessitated a change of crop type, which has had eco-

[2] Ex Professor, [3]Head

nomic and/or cultural changes. As rivers change because of the dam development those dependent on a range of their resources may lose not only land, but also their primary protein sources, their main sources of wild vegetables, herbs, medicines, construction material and firewood (WCD, 2000). Many more could lose valued recreational and conservation areas, and attributes of the river that have immense cultural and religious significance. If, in the past, these costs had been foreseen at the feasibility stage of planning, many schemes might have been deemed unviable or would have required extensive modification in order to mitigate unacceptable impacts.

The Kishenganga Hydroelectric Plant is part of a run-of-the-river hydroelectric scheme that is designed to divert water from the Kishenganga River to a power plant in the Jhelum River basin. It is located 5 km north of Bandipore in Jammu and Kashmir, India and has an installed capacity of 330 MW. Dams built on tributaries of the river also pose a serious threat to biodiversity, especially when they are built on large tributaries (Roberts, 1993; Kottelat and Whitten, 1996). The following five fish species were reported from the Kishnganga river system

a) *Oncorhynchus mykiss* (Rainbow trout)
b) *Salmo trutta fario* (Brown trout)
c) *Schizothorax plagiostomus* (Snow trout)
d) *Triplophysa marmorata*
e) *Glyptothorax pectinopterus*

Therefore understanding a river ecosystem and the impact of dam is clearly a challenging and complicated task.

Materials and Methods

The present research work on Impact of Kishenganga Hydroelectric Project on Susceptibility and vulnerability of Brooder population of Kishanganga river was carried out from November 2014 to June 2016. For the present investigation, six sampling sites were selected on the basis of accessibility, vegetation, and nearness below and above the dam site. Two sampling stations were selected from each site.

Study Sites

For the present investigation, six sampling sites were selected on the basis of accessibility, vegetation, and nearness below and above the dam site. Two sampling stations were selected from each site. The description of study sites is given as under:

Above Dam Site

Sampling site –1

It was located above the dam site on the left bank. The site is about 6 kms downward from Astan Nallah (a tributary of Kishanganga River). The site is marked by clear surroundings without any dense forest cover at the coherence of tributary with the main river course.

Sampling site – 2

It was notified on the right bank of the river Kishanganga above the dam site. The site is around 9 kms down from the Barzil Nallah (a tributary of the Kishangangariver). The confluence is minimum because of dam spread area.
At Dam Site

Sampling site – 3

The site was notified at the Malikpora Bridge, which is near the out flow of the dam. The site is located on the left bank of the dam outlet. The flow is minimal pertaining to diversion above the dam site towards turbine.

Sampling site – 4

The site was notified at the right bank of the Malikporabridge, which is near the out flow of the dam. The flow at this site is also minimal pertaining to diversion above the dam site towards turbine.
Below Dam Site:

Sampling site – 5

The site was notified at Kazarwan, which is around 5 kms down the dam site. The site has a confluence of tributary, where Kurbul Nallah meets the main course of river

Sampling site – 6

The site was notified on right bank at Kazarwan, which is around 5.5 kms down the dam site. The site has free ends, without dense forestation

Results

The impact of the construction of dam along the Kishenganga River has been assessed during the present research period and damming impact on Brooders of potential and other non commercial fish species. The analysis undertakes the issues of susceptibility, vulnerability and productivity of the fish species present in different stretches of the river. The projected assessment is based on the literature survey as well as the perimeters studied during the collection time. The perimeters were assigned the attribute scores and data quality scores, which were then automatically converted to weighed scores to represent the three characteristic parameters: productivity, susceptibility and vulnerability

The productivity and susceptibility analysis of brooders of all the target fish species in Kishenganga river is present in Table 1 and graphically in Figure 1. In case of *Oncorhynchus mykiss* (rainbow trout) brooders, the productivity was calculated as 1.90, susceptibility as 2.10 and vulnerability as 2.10, marking it a high risk age group and species. The overall data quality 2.50, productivity data quality 2.30 and susceptibility data quality 2.66 was observed for the rainbow trout species. In case of *Salmo trutta fario* (brown trout) brooders, the productivity was calculated as 1.70, susceptibility as 2.40 and vulnerability as 2.10, marking it a high risk age group and species. The overall data quality 2.50, productivity data quality 2.40 and susceptibility data quality 2.58 was observed for the brown trout species.

In case of *Schizothorax plagiostomus* (snow trout) brooders, the productivity was calculated as 2.10, susceptibility as 2.20 and vulnerability as 1.90, while as the overall data quality of 2.54, productivity data quality 2.60 and susceptibility data quality 2.50 was observed for the said species, marking it a moderate risk age group and species. In case of *Triplophysa marmorata* brooders, the productivity was calculated as 1.70, susceptibility as 1.90 and vulnerability as 1.60, while as the overall data quality of 2.86, productivity data quality 2.90 and susceptibility data quality 2.83 was observed for the said species, marking it a low risk age group and species. In case of *Glyptothorax pectinopterus* brooders, the productivity was calculated as 1.60, susceptibility as 2.20 and vulnerability as 1.10, while as the overall data quality of 3.40, productivity data quality 3.70 and susceptibility data quality 3.16 was observed for the said species, marking it a low risk age group and species.

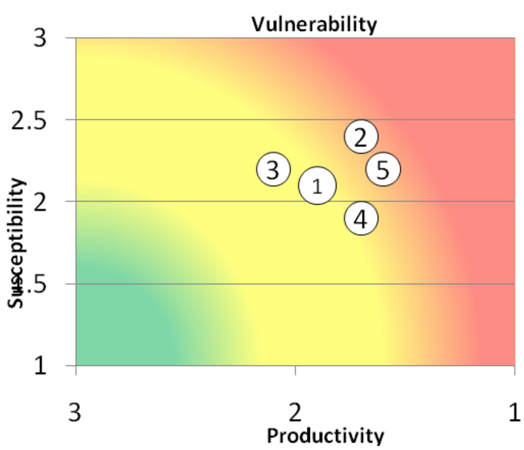

Fig. 1. Susceptibility and vulnerability of Brooder population in Kishenganga River

Table 1. Susceptibility and vulnerability of Brooder population in Kishenganga river

Target ID	Target	Productivity	Susceptibility	Vulnerability	Risk	Overall Data Quality	Productivity Data Quality	Susceptibility Data Quality
1	*Oncorhynchus mykiss*	1.90	2.10	2.10	High	2.50	2.30	2.66
2	*Salmo trutta fario*	1.70	2.40	2.10	High	2.50	2.40	2.58
3	*Schizothorax plagiostomus*	2.10	2.20	1.90	Moderate	2.54	2.60	2.50
4	*Triplophysa marmorata*	1.70	1.90	1.60	Low	2.86	2.90	2.83
5	*Glyptothorax pectinopterus*	1.60	2.20	1.10	Low	3.40	3.70	3.16

Discussion

Water is extremely valuable and all life depends upon it. Reservoirs are constructed to store water for drinking, agriculture and industry, as well as for power generation, flood control, navigation, and recreation (UNEP, 2010). Terrestrial as well as aquatic biodiversity is dependent on water networks and their flow characteristics. Waters and freshwater biodiversity constitute a valuable natural resource in economic, cultural, aesthetic, scientific and educational terms. The goods and services provided by fresh water ecosystems include the hydroelectric power generation, due to which, of all the world's global ecosystems, freshwater ecosystems may well be the most endangered ecosystems in the world.

Animal and plant life are impacted significantly by the dam construction. The large scale flooding destroys a large area of habitat for animals and destroys an equally large number of plants. In addition, in very cold climates such as Kashmir, deterioration of fully submerged trees occurs very slowly – increasing the likelihood that the trees must be removed first (Biswas, 1981). Animals tend to get the most attention from the press and public in general when dam projects are proposed. The creation of the dam does however create a new larger habitat for some species of fish. For example when the Lake Nasser dam was created fish production increased nearly four- fold (Biswas, 1981).

For some kinds of fish the building of a dam makes completing their life cycle nearly impossible. Anadromous fish, such as trout, are hatched upstream in a freshwater environment but spend their adult lives in lower stretches of river (Biswas, 1981). Since these fish rely on streams and rivers to get to and from different environments, creating a dam makes a large roadblock for these animals to overcome.

The Kishenganga river stretch has been obstructed by damming the water along the water stretch. Since the project has been started a few years back, the impact on the flora and fauna is not assessable to the maximum extent. With the passage of time, there will be changes unfavorable for the aquatic inhabitants, the migratory species and different life forms of the inhabitant species.

Conclusion

The results during the present research work yielded results pertaining to the higher life stages of fishes, with brood stock at very high risk. As such it can be concluded that the damming of water and the water flow disturbance through distribution will impact the life forms which may be fatal for the ecosystem in future.

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