LETTER TO THE EDITOR



## Hydro-electric power in the Panjkora basin at the expense of environmental deterioration and biodiversity loss—immediate action required for mitigation

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Received: 19 March 2018 / Accepted: 26 October 2018 © Springer-Verlag GmbH Germany, part of Springer Nature 2018

Dear Editor,

South Asian countries including Pakistan, Bangladesh, India, Nepal, and Sri Lanka fall short of their electricity requirement and are faced with energy crisis (Ahmed 2015). This very specific region is bestowed with widespread large water bodies; therefore, hydro-electric power projects have been initiated on a very wide scale to cover up the shortage of electricity. Of these, Pakistan is an under-developing country, swiftly stabilizing its economy, and has been listed as one of the fastest growing economies in Asia. Pakistan has initiated hydropower projects on a very large scale, enrolling it among top 5 countries of the world investing that much in private participation infrastructure (Chaudhry 2017). The provincial governments have initiated hydropower projects in different parts of the country as well, such as the government of Khyber Pakhtunkhwa has initiated hydropower projects on quite a huge scale, more specifically in the northern and northwestern part of the province. In a long run, these projects will be definitely beneficial for the local masses by providing them cheaper and readily available electricity but at the cost of some unrecoverable environmental losses and miseries, wildlife biodiversity loss being the most prominent. These projects have been initiated without considering its impacts on local wildlife fauna, although the negative impacts of the effluents/ discharge and thermal/hydro-peaking are as evident as bright

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<sup>1</sup> School of Life Sciences, Nanjing University, Nanjing 210023, Jiangsu, People's Republic of China daylight (Shi et al. 2015; Bai et al. 2017; Hesthagen et al. 2017; Negi and Punetha 2017; Wang et al. 2018). As revealed by recent studies regarding the ill effects of the hydropower projects on wildlife fauna and more specifically on aquatic animals, these projects will compensate electricity shortage at the cost of environmental degradation, biodiversity loss, and habitat loss of different aquatic animals including fish and macro-invertebrates (Schülting et al. 2016). The indigenous aquatic fauna of the area is therefore under severe threat of extinction and needs to be conserved on a priority basis.

Koto hydropower project is one of these projects (underconstruction at district Lower Dir), which will produce > 40-MW electricity and will generate approximately Rs. 1970 Million (about \$18.7) annually (TmgDir 2015) (Fig. 1 shows the satellite image of the project at/around Koto). The effluents and wastes from the project such as the disposals from the two exit tunnels (>272 m) are dispatched directly into the main river of the district, the river Panjkora, home to a very diverse community of fish. In our recent research on the effects of the project on the level of heavy metals in the water, sediments, bioaccumulation in fish tissues, and ichthyofaunal diversity, it was observed that the level of heavy metals got increased drastically and the fish diversity declined extensively. Previously, 25 fish species were reported at Lower Dir district and 11 fish species at Upper Dir district from the river Panjkora (Muhammad et al. 2014; Hasan et al. 2015). Tragically, our present study found 15 fish species from the river only, although the study duration and total fish catch were higher than those of the previous studies. The construction and effluents from the said hydropower project resulted in a very drastic decrease in the fish fauna in the river Panjkora in just slightly over two years (started since February 2nd, 2015) (TmgDir 2015). Table 1 shows a comparison of the current study (after the construction of the dam) with the study of Hasan et al. (2015) conducted in 2012 (before the construction of the dam).



Fig. 1 Satellite image of the Koto hydropower project

The hostile effects of the project on the environment and wildlife/biodiversity were overlooked while initiating it. Currently, there is no risk assessment, environmental monitoring, and environmental health and safety appraisal in the region by the local/provincial government or environmental protection agencies. Therefore, a specific team/ environmental protection group should be recruited to look deep into the pros and cons of the hydropower projects in the region, and present an accurate comprehensive report on the hostile effects of the projects. However, it will be very difficult to compare the effects of the project as there is very fewer data available on the biodiversity/wildlife of the region. The key challenges to design and implement environmental measures were/are overlooking the hostilities of the project on wildlife, ignoring associated environmental concerns/issues, and less or no interest of the stakeholders in the environment.

The most economically valuable fish in the river including *Cyprinion watsoni*, *Ctenopharyngodon idella*, and *Tor macrolepis* were missing in effluent discharge sites as well as downstream, which affects more than 50 families dependent on the river for their living. The other missing fish species were *Triplophysa microps*, *Schistura macrolepis*, *Schistura alepidota*, *Schistura prashari*, *Triplophysa naziri*, *Glyptothorax sufii*, and *Glyptothorax naziri*. The number of *Schizothorax plagiostomus*, *Schizopyge esocinus*, *Racoma labiata*, *Crossocheilus diplocheilus*, and *Garra gotyla* was observed to be on decline alarmingly. The diversity indices

of the river got decreased substantially as compared to the study of Ullah (2013). Moreover, over 300 of the collected fish specimens were hemorrhagic, colorless, scaleless, or attacked by a secondary infection such as saprolegniasis, because of being rendered vulnerable after exposure to the elevated level of heavy metals in the river.

Despite these critical conditions of the fish fauna in the river Panjkora and other rivers in the northwestern province of Pakistan, no proper attention is being paid to the conservation of the aquatic animals. The riverine coasts are being used for dumping of wastes from homes, hotels, and markets all along for more than two decades (Ullah et al. 2016). Now, the scenario has been worsened by the effluents/disposals/discharge/wastes from these projects, leading to the extermination of different fish species in these water bodies, some highly prized game fish species. The fisheries and wildlife departments have been inactive for very long. Therefore, before the extinction of other fish species in the river, immediate mitigating actions are required.

The abovementioned study is a single case, and many such cases are still unexplored around Pakistan and other South Asian countries. Keeping in view the current study and deleterious effects of the poorly managed hydropower projects (on the water quality of the river, fish diversity, and bioaccumulation of heavy metals at a threatening rate in the tissues of the highly prized game fish), it is proposed that the governmental/ local/provincial funding bodies/organizations should impose

S. no.	Order	Family	Fish species	2012 (Hasan et al. 2015)	2017 (current study)
1	Cypriniformes	Cyprinidae	Schizothorax esocinus	++	+
2			Schizothorax plagiostomus	++	+
3			Racoma labiata	++	+
4			Cyprinion watsoni	++	_
5			Cyprinus carpio	++	++
6			Tor putitora	++	++
7			Tor macrolepis	++	_
8			Barilius pakistanicus	++	++
9			Barilius vagra	++	++
10			Barilius modestus	++	++
11			Crossocheilus diplocheilus	++	+
12			Garra gotyla	++	+
13			Ctenopharyngodon idella	++	_
14		Nemacheilidae	Schistura alepidota	++	_
15			Schistura prashari	++	_
16			Schistura macrolepis	++	_
17			Triplophysa naziri	++	_
18			Triplophysa microps	++	_
19	Siluriformes	Sisoridae	Glyptothorax punjabensis	++	++
20			Glyptothorax stocki	++	++
21			Glyptothorax sufii	++	_
22			Glyptothorax naziri	++	_
23	Channiformes	Channidae	Channa punctata	++	++
24			Channa gachua	++	++
25	Mastacembeliformes	Mastacembelidae	- Mastacembelus armatus	++	++
			Total	25	15

 Table 1
 A comparison of the fish fauna of the river Panjkora before and after the construction of the Koto hydropower project at district Lower Dir (effluent discharge sites)

++ = highly prevalent; + = less prevalent/declining rapidly; - = missing

developers to comply with the international state-of-the-art environment and safety rules, similar to the rules of the international financial institutions (i.e., world bank, AFB, etc.), even if no such international funds are directly attached to the project.

To mitigate the current scenario, it is suggested that the fisheries departments/organizations should stock fish in an appropriate amount and assess fish diversity and water quality at regular intervals to avoid further deterioration and diversity loss. The wildlife departments/organizations should ensure the safety and conservation of wild fauna at any cost. Strict environmental protection and fishing laws should be implemented. As a remedy to the current scenario, the nearby approachable water bodies having no or comparatively less stress may be used for stocking and conservation of the fish fauna, to ease migration of fish among these water bodies (Ullah et al. 2018). Furthermore, the hydraulic stress (thermal and hydro-peaking) after completion of the projects should be planned in a proper way to avoid further

biodiversity loss. Safety to biodiversity and animal conservation should be prioritized by the local, provincial, and central governments before initiating hydropower projects; otherwise, the coming generations might not see the amazing animals' diversity in the local hydrosphere in South Asian countries, which is the real beauty of nature. Keeping in view the current scenario, the slogan should be "biodiversity and animal conservation, we do care."

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