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Chandan Singh
Department of Fisheries Resource Management, College of Fisheries Science, CCS Haryana Agricultural University, Hisar, Haryana, India

Rajender Kumar Gupta
Department of Zoology and Aquaculture, College of Basic Sciences and Humanities, CCS Haryana Agricultural University, Hisar, Haryana, India

Tejpal Dahiya
Department of Zoology and Aquaculture, College of Basic Sciences and Humanities, CCS Haryana Agricultural University, Hisar, Haryana, India

Corresponding Author:
Chandan Singh
Department of Fisheries Resource Management, College of Fisheries Science, CCS Haryana Agricultural University, Hisar, Haryana, India

Impact of dams in fisheries: A review

Chandan Singh, Rajender Kumar Gupta and Tejpal Dahiya

Abstract
Barriers on lotic water bodies have both negative and positive impacts on aquatic flora and fauna with its different prospective like; change in water current, change in fish pattern and change in aquatic diversity respectively. The productivity of dams leads to economic wealth in the fishermen society and moreover, dams has great role in the development of fish productivity and biodiversity *via* providing new habitat and niche for their survival and growth with suitable environment. Besides this, dams have few darker sides with their negative impacts on aquatic ecosystem. On the other hand, dams have great potential of fisheries and play a significant role in the sustainable growth of inland fisheries. Reservoir and dams on water bodies not only providing the socio economic gain to whole world but also providing electric energy respectively. Therefore, the present study has emphasized on the fish diversity and potential of Indian dams and its negative impacts on Inland fisheries. Some strategies have been discussed here for the sustainable reservoirs productivity in all prospective.

Keywords: Aquatic ecosystem, biodiversity, dams, inland fisheries, productivity

Introduction
Inland fisheries major area comes under dams and which have great potential to hold the vast biodiversity of inland fisheries respectively. Regarded as a driving force in demands of water, food, and energy, the world's population has been increasing rapidly since the beginning of the 20th century, and will reach 9.7 billion by 2050 according to the medium-growth projection scenario of the United Nations (Shi *et al*., 2019) [25]. Reservoirs are man-made lakes created by impounding river water for the purpose of irrigation, power generation, flood control, and industrial water needs (Jhingran, 1988) [10]. Besides this, Dam is a barrier across flowing water that obstructs, directs or retards the flow, often creating a reservoir, lake or impoundment. Exploitation of rivers with installation of dams on them is very old system experienced worldwide and has been multiplied manifold up to the present (Bid *et al.*, 2018) [4]. Dams have become an integral part of basic infrastructure by offering in dispensable benefits like irrigation, hydropower, domestic and industrial water supply, flood control, drought mitigation, navigation, fish farming, and recreation. Moreover, Dam construction is an important engineering measure in dealing with the relationship between water and human being (McCartney *et al*., 2001) [16]. The Indian economy aptly called these dams 'Modem Temples of India (Shah, 1993) [24]. They have important social and economic benefits as a result of tourism and recreation, are culturally and aesthetically important for people throughout the world (Arain *et al.*, 2008) [2]. About 45,000 dams have been built worldwide with elevation of more than 15 meters and about 73% of them have been built within the last 50 years. The first known dam of the world was built in 2900 BC across the Nile River to protect the city of Memphis from flood. The tallest ever dam (305 meter) of the world is situated in China on the Yalong Jiang River, followed by the Tehri Dam (261 meter) in India on the Bhagirathi River near Tehri in Uttarakhand. The Hirakud dam is the longest dam in India which is about 26 km in length, built across the Mahanadi River in the state of Odisha (Dwivedi *et al.*, 2010; Siddique *et al.*,2017) [7, 26]. It is estimated that, worldwide, there may be 16.7 million human made reservoirs with a surface area larger than 0.01 mha (Laehner *et al.*, 2011) [14]. India has constructed large number of dams across the country for generating power and for Irrigation. At present the total reservoir area in the country is 3.15 mha, out of which small reservoirs occupy 1.49 mha, followed by large (1.14 mha) and medium reservoirs (0.52 mha). Even though large-scale groundwater recharge programmers have been operating in India for decades, the focus has been on water-scarce areas, with no real emphasis on flood risk management. Rivers are the major channels for the passage of water, nutrients, organic material and particulate matter from land to sea.

One important point is that river basin development, notably from the construction of dams, has an immediate, profound impact on river inputs to the oceans (Steffen *et al.,* 2002) [6]. Both hydropower dams and global warming pose threats to fresh water fish diversity. While the extent of global warming may be reduced by a shift onwards energy generation by large dams in order to reduce fossil-fuel use, such dams profoundly modify riverine habitats (Kano *et al.,* 2016) [11]. On the other hand, the increasing global demand for energy combined with the ongoing quest for clean, renewable energy has been a topic of perceived interest amongst countries of developed and developing status worldwide (Moran, 2004) [19].

As controversial as they have been during the last decades due to negative social and environmental impacts, the limited and uneven distribution of water at the global level has made the world realize that more dams, mostly large dams, are needed if development is to be promoted and if basic human needs are to be covered (Tortajada, 2014) [28]. Dams, built to change natural flow regimes, are one of the most significant human interventions in the hydrological cycle (McCartney *et al.*, 2001) [18] and to meet future angling demands, fishery biologists must employ all available effective techniques to increase the production and harvest of reservoir fishes.

Need for dams

Generally dams serve the primary purpose of retaining water, while other structure such as barricade are used to manage water flow in to specific land area. Purposes to be served by such a project usually include water supply, irrigation, flood control, hydropower generation, navigation, recreation, pollution abatement, industrial use, fish and wildlife conservation and other environmental considerations, salinity and sediment control, and recharge of groundwater and to meet these purposes, a number of dams are constructed to control and regulate the natural flows (Cakmak, 2001) [5]. On the other side, growing population and rising levels of economic activities increase human demand for water and related services. Development, technological change and income distribution affect the level of water demand (Altinbilek, 2002) [1]. Dams, many of them large dams, have become essential requirements for continuing economic and social development. Increasing water demands due to population growth, higher requirements for energy, food and bio-fuels, and concerns related to carbon emissions and their potential impacts to climate change (Tortajada, 2014) [28].

Impact of dams or reservoirs on fish diversity

Damming a river has a variety of effects on the freshwater ecosystem, more than just altering the flow of water. The impacts of dams on richness and diversity differed across biomes, with significant declines in the tropics, lower amplitude but similar directional changes in temperate reservoirs, and no changes in boreal reservoirs (Turgeon *et al.*, 2018) [29]. Moreover, nearly 50% of the 397 assessed freshwater eco regions are obstructed by large- and medium-size dams, and approximately 27% face additional downstream obstruction (Liermann *et al.,* 2012) [15]. The world is currently facing a freshwater biodiversity crisis and the key to preventing further extinction lies in understanding all the threats facing aquatic habitats. The large dams i.e., higher than 15 meters transform large rivers into storage reservoirs, changing at least part of the ecosystem from a lotic to a lentic one (Ward and Stanford 1995; Friedl and Wüest 2002) [30, 8]. Moreover, there are a number of different migratory patterns of river-dwelling species. These include the well known anadromous fishes e.g. salmon and hilsa and the catadromous fishes such as eels. Adults of anadromous species migrate up rivers to spawn and the young descend, while the reverse occurs with catadromous species (Kroger 1973; Zohary and Ostrovsky 2011) [13, 34]. On the other hand, effects of dam on fish (including aquatic mammals) included blocking migration route, habitat fragmentation, changing from lotic to lentic water in the impounded area, release of hypolimnetic cold water of reservoir, and changes of water flow in downstream reaches (Wu *et al.,* 2018) [33]. There is huge loss to our indigenous fish species due to construction of dams across the Nation. The frequent water level fluctuations in the reservoirs lead to deposition of silt and other suspended particles. Tehri dam on Bhagirathi is one example of loss of mahseer due to dams (Sarkar *et al.,* 2015) [23].

Dams negative impacts on fishes

Migratory fish require different environments for the main phases of their life cycle which are reproduction, production of juveniles, growth and sexual maturation. The life cycle of diadromous species takes place partly in fresh water and partly in sea water. Loss of natural habitat is one of major negative impact of dams so during a life fish/aquatic species face many problems related spawning for example on the Indus river, the construction of the Gulam Mahommed Dam has deprived the migratory *Hillsa ilisha* of 60% of their previous spawning areas and on the Columbia river and its main tributary the Snake river, most spawning habitat were flooded, due to the construction of dams creating an uninterrupted series of impoundments (Raymond, 1979) [21].

The passage through spillways may be a direct cause of injury or mortality or become an indirect cause of increased susceptibility of disorientated or shocked fish to predation (Bell and Delacy, 1972; Ruggles and Murray, 1983) [3, 22]. The most proximate impact of sediment starvation is the enhancement of erosion downstream of dams from out flow causing channel incision that can degrade within channel habitats for macro invertebrates and fish (Kondolf, 1997) [12].

Sounding a warning that over five billion people across the globe may run into water shortage, a United Nations report has pointed out that dams in India have done more harm than good to the cause of water security. A number of studies have documented that the upstream migration may be delayed for many weeks at man-made obstacles such as power station outlets, residual flow stretches, dams, weirs and fishways (Thorstad *et al.,* 2008) [27].

Physiochemical characterization of dams

Physiochemical condition of water in dams are vary and depends on condition of spillway such as when spillway was closed oxygen level in water lower and when spillway was opened oxygen level in water higher comparatively. Water quality in the downstream river of a hydroelectric dam may be affected by the structural design and operation (Ling *et al.*, 2016) [17]. Besides this, physicochemical parameters of water also have influences on domestic life while physical and chemical parameters of soil affect many processes such as microbial activities and also in the breeding of aquatic life (Rahman, 2015) [20]. Moreover, physical changes of damming leads to chemical changes within the reservoir, which alters the physical and chemical water quality, which in turn leads to ecological impacts on downstream rivers and associated wetlands. The physical change of damming leads to chemical

changes within the reservoir, which alters the physical and chemical water quality, which in turn leads to ecological impacts on downstream rivers and associated wetlands(Winton *et al.,* 2019) [31].

Role of dams in socioeconomic development

In India (mostly in rural region) most of the people which live along the river are depend on dams for earning money to fulfill their basic need by capturing fishes as well as other recreational fishing activities. Large dams, a tool for development in the past century, have changed the lives of millions, altered nations and had widespread environmental, economic and social effects (Wong, 2013) [32]. Beside this, dams are considered an important issue in the sustainable management of finite water resources. Those resources are subject to increasingly competitive demands as global population growth creates tensions over the water needed to produce energy and to ensure food security (Altinbilek, 2010) [1]. In China, overall the construction of dams has resulted in noticeable improvements in the socio-economic development. Construction of additional large dams will be considered as one of the best available options to meet future increases in water, food, and energy demands, which are all crucial to sustain economic development (Shi *et al.,* 2019) [25]. Moreover, dams have been a key component to adjust the spatial and the transient varieties in the water accessibility, appropriately taking advantage of which could bring human-being energy that is clean, efficient, dependable and renewable. For example, in the United States, dams have been a basic part of economic and societal improvement. Small dams and bunds also play an important role in reducing water loss. It is also anticipated construction dam short chain also usefully contributes to solve the problems of sediment (Heydari *et al.,* 2013) [9]. Dams are source of employment to the people living in the destitution and enhance the financial advancement of the urban and rural regions. Beside this, dam has provided a great contribution in the development of human beings, and this contribution will not change in future, Book Divine Providence. On the other hand, Punjab and Haryana that major dams have been the prime movers in triggering off a chain of economic activities leading to overall prosperity (Shah, 1993) [24].

Conclusion

It is crystal clear that, the modern large barrier on lotic water bodies has very significant role in the development of human beings but like coin has both sides' dams have also negative impact on the aquatic ecosystem on very large scale with its ecosystem. One side of dams which have positive impact play role to control flooding, irrigation and hydropower generation, opposite side of dams have antagonistic effect, including relocation of individuals, changes in water and sediment flows, and disruption to natural environments and livelihoods.

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