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Assessment of the Environmental Impacts of the Nethravati River Diversion Project

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Abstract—*The Karnataka Government is planning to divert head waters of the Yettinahole River (a tributary of the Kumardhara, which is a tributary of the Netravathi) in the western ghat region (a UNESCO world heritage site & one of the 8 'hottest hotspots' of biodiversity in the world) and transfer this water to the other end of the state, in the eastern plains. This paper presents attempts made to critically examine the proposed project and explore the environmental and socio-economic impacts of the Nethravati river diversion thus contributing to a better understanding of the impacts of hydrological alterations. This was done through the analysis of the project reports, site visits to Yettinahole and surrounding catchments, study of the ecology of the area and discussions with the experts, opinions of the public. The findings infer that there are possibilities of profound impacts of the project like flooding of high-value habitats, aquatic ecosystem impacts, fragmentation of important habitats, increased siltation, displacement of human settlements etc. Many of the experts in the fields of water resources and environment and people of the Dakshina Kannada district perceive this as a menace to the pristine ecology of the western ghats.*

1. INTRODUCTION

Karnataka is blessed with major perennial rivers such as Krishna, Tunga, Bhadra, Kaveri and 13 more west flowing rivers. The rainfall is erratic and thereby there are several districts and taluks which fall under rain shadow area where there is acute water shortage for drinking, leave alone providing irrigation facilities. Increased industrialization and urbanization has its own impact on the water demand resulting in substantial disparity in supply and demand. Hence the existing rivers have not been considered a reliable and sustainable source to meet the demand as such. In most of the areas tapping the underground water has resulted in depletion of the water table in the majority of the districts and has affected the quality of the waterer to a great extent. One of the worst affected districts in southern Karnataka in view of the above constraints are Chikkaballapura and Kolar. With such background, the Government of Karnataka inferred that the existing east flowing rivers can no longer act as promising sources of water to their parched districts, and also because of the inter-state disputes that are linked with these rivers and is seriously considering the Yettinahole Diversion Project, which plans to divert head waters of the Netravathi in the west and transfer this water to the other end of the state, in the east.

Western Ghats are home to thousands of animal species. For ensuring ecological balance and sustainability of various species in the Western Ghats, it is of paramount importance that any scheme proposed should have least impact on the environment and also not affect its beneficiaries on the downstream side. In the recent past, environmental concerns have come to the fore in the Western Ghats region, and it is therefore desirable to assess the impacts of the developmental activities on the environment and limit them if they seem to pose a threat. While the proponents stress on the greater need to address the problems of parched districts through this project, many of the experts in the field of environment and people of the Dakshina Kannada district perceive this as a menace to the pristine Western Ghats. Amid the noise created by proponents and opponents, lies a lack of reason; and a heavy dose of prejudice, both scientific and ideological and also, plain confusion. What is missing is a critical examination of claims on both sides, and a serious exploration of impacts.

2. DETAILS OF THE PROJECT

The project involves diverting of 24 TMC of water by construction of 8 dams in 2 phases at the head waters of the West flowing Netravathi River, the lifeline of Mangalore and Dakshina Kannada districts. According to the Project Report, following are the beneficiaries of the project [5,6] : Selected parts in Hassan District, Bangalore rural and water to Chikkaballpura and Kolar District. In addition, water will be used to rejuvenate Rivers like Arkavathy. Two dams are planned across the Yettinahole stream, and two on its tributaries one across Hongadhalla stream. All these streams are rivulets which join at various points to make river Gundia. Rising mains (large pipelines that transport water under pressure) from these projects will pump water into three delivery chambers. Again the water will be lifted through a rising main and will culminate into a reservoir to be built at Devaranyadurga. The proponents have claimed that Devaranyadurga Reservoir will submerge 1200 hectares of land, of which 50% will be forest land and will also submerge at least two villages. Scheme envisages feeding 198 tanks in Chikkaballapur and 139 tanks in Kolar District and providing 14 TMC for Hassan, Chikkamagalore, Tumkur and Bangalore

rural and 10 TMC for Kolar and Chikkaballapur, through the dam at Devaranyadurga.

3. CATCHMENT AREA

A catchment area of size 3,300 sq.km. is drained by river Netravathi and its tributaries and the average annual rainfall received by this area is recorded to be 5000 mm. The streams Yettinaholé and Kempholé join to form Gundia River to which the streams Kadumaneholé and Hongadahallé join in the course. Extensive studies [4] re-affirms 'hottest hotspot' status of the Gundia Basin in central Western Ghats. Over 4,000 species of flowering plants, butterflies, fishes, amphibians, reptiles, birds and mammals are among the known biodiversity of the Western Ghats. This region harbours nearly 36% of plant species, 87% of amphibians, and 41% of fishes, which are endemic to Western Ghats. The presence of four critically endangered and 14 endangered animal species in the region further emphasize the need for conservation of this region on priority as it provides a unique habitat and ecological niche. There are two important Traditional Migratory Routes in the Southern India passing through the Gundia Basin.

4. ENVIRONMENT IMPACTS OF THE RIVER DIVERSION

It has been reported that worldwide impoundment of water has reduced sea levels. Also, the concentration of water in reservoirs at high latitudes has actually increased, albeit minutely, the speed of the earth's rotation and changed the planet's axis. 77% of the total discharge of the 139 largest river systems in the northern third of the world is affected by river channel fragmentation caused by dams, reservoirs, interbasin diversions, and irrigation [3]. Moreover, this fragmentation could profoundly affect biological populations over a substantial area of the world.

5. AQUATIC IMPACTS: RIVER CHANNELS BELOW DIVERSIONS EXPERIENCE LONG-TERM CHANGES IN THEIR HABITAT STRUCTURE AND VALUE (AND SOMETIMES SIZE) BECAUSE OF INTERCONNECTED REASONS, CHIEFLY

i. Reductions in width, velocity and depth, altering the amount, character and value of stream habitats;
ii. Reduced high flows that eliminate the cut and fill processes that maintain natural channel networks;
iii. Accumulation of fine sediments that fill in pool habitats and clog up gravels; and,
iv. An interrupted supply of channel-forming elements, including gravels, other sediments, and woody debris.

Floods that happen only occasionally (e.g., every one to two years) are described as "channel maintenance flows." These channel-maintaining floods define and maintain the channel banks, and move boulders, gravels, and woody debris into new configurations. While this can cause some destruction, it is also a form of renewal. In environments undisturbed by human impacts, river floodplains are dynamic environments that support a great amount of biodiversity. Generally, low gradient channels (below gradients of 1.5%44) experience greater problems as a result of dams or diversions. The project is by necessity in higher gradient stretches of river, though portions of the diversion reach may be at much lower gradients. In any case, harm to the diversion reach is still unavoidable given the dramatic reductions in flow through the diversion reach. When a major amount of flow is removed, fine sediment (silt and sand) can build up in the channel. Too much fine sediment can clog the river-bed gravels that fish use for spawning, reducing the survival of overwintering eggs and embryos. [8,13]Benthic invertebrates (bottom-dwelling insects) that live in these gravels may also be adversely affected or experience shifts in community structure (the relative proportions of different species and groups of species). This can affect juvenile fish through removing their prey. A recent study showed that channels downstream of diversion dams contain significantly more fine sediment and slow-flowing habitat than in similar unaffected areas [2]. In nature, "flushing flows" move this fine sediment downstream. Based on an analysis of several proposed and existing projects, the frequency of flushing flows will be reduced up to 10-fold, and the magnitude of the flushing flows will also be reduced in river diversion projects.

Interrupted supply of sediment and large woody debris: The structural elements of streams – large woody debris(trees, roots and branches) and sediment are partly delivered from upstream reaches. Changed seasonal timing of flows: Fish and other organisms respond to seasonal cues for parts of their life. Their Changes to flow timing could also affect the food web for instance, changing the time at which fish fry emerge from their spawning gravel relative to the availability of their prey, with consequences to the health or size of the local fish population(s). migration and spawning are often triggered by fall rains.

Changes to temperature: Water temperature directly affects habitat quality and quantity for fish and other aquatic organisms. Reductions to flow will affect temperature in both winter and summer. In one study the benefits of warmer waters led to earlier migration to sea, which then resulted in reduced marine survival. If summertime waters heat up too much as a result of reduced flows, fish can suffer stress or even death.

Changes to riparian vegetation: The tributaries of Netravati harbor rich riparian vegetation which typically provide high value terrestrial habitat while influencing river ecosystems in profound ways. For example, riparian vegetation provides nutrients to food webs, and also provides important fish food directly through terrestrial "insect drop."It provides shade, protects river banks from erosion, and helps provide river structure through "woody debris". Riparian vegetation and

ecosystems may be affected by reduced moisture levels due to reductions in instream flows. It is of concern when it is removed to make way for dams, roads, powerhouses and power lines.

Changes to the food web: Aquatic food webs are likely to be affected by the reduced habitat quality and quantity caused by river diversions. Benthic invertebrates are the most recognized part of the food web, because they are a primary food source for fish that are available in the region and are essential for the healthy functioning of aquatic ecosystems.

Downstream impacts: Within river ecosystems, downstream communities are dependent on upstream processes.Water from smaller streams provides a continual source of essential food and nutrients that support life downstream. These include dissolved nutrients, organic matter (i.e., from plants), as well as drifting aquatic and terrestrial insects[12].The elements that shape streams – large woody debris and sediment are also partly provided by upstream reaches. River diversion can interrupt the supply of sediment and large woody debris. It can also release large amounts of sediment into fish-bearing waters [11].

Effects of project infrastructure and project operations: Fluctuations in flow due to project operation (called "ramping" and "peaking") can cause fish kills. In fact, flow ramping is one of the biggest sources of environmental damage caused by river diversion projects.. The downstream reach is typically lower gradient habitat where fish stranding and fish kills are more likely. Flow ramping is a serious concern here, as water levels will immediately drop in response to reductions in diverted flow.[1]

Migration barriers: The weirs that would be built could often act as a barrier for fish. In many cases the dam will divide the local population in two. Long-term negative impacts like declining populations and loss of genetic diversity can result from the lack of connection and migration between upstream and downstream areas

Terrestrial impacts: The project proposes construction of low dams and pipelines to bring water to a powerhouse at lower elevation. The powerhouse would be several kilometers away, requiring extensive construction to install the connecting pipeline, which can be above ground, buried, or tunneled through bedrock.

Habitat loss through permanent vegetation clearing: Vegetation clearing of the thick deciduous forest area at the project location disturbs and fragments ecosystems and harms the species that live there. This part of the western ghats harbors rarer ecosystems that support sensitive species, hence changes to even small sites may be devastating. The region also has predators. Predators are a crucial part of healthy ecosystems, because they have major influences on many other species. As the project incur new land uses, it is important to consider the risk to large predators. Losing any of the remaining predator populations could affect genetic diversity, making the species less resilient to impacts like climate change**.**

Impacts of roads and transmission lines: Roads and transmission lines connect dam and diversion sites to population centres. For this river diversion project, these "linear disturbances" can form the greatest part of the project's footprint. Roads have serious, well-documented impacts [9] that include habitat fragmentation, habitat loss, barriers to movement and migration, wildlife-vehicle collisions, changes to habitat use, and changes to the way that predators interact with their prey. Increased hunting pressure, increased human-wildlife conflicts, erosion and drainage problems, and landslides are also common outcomes. Transmission lines and other linear corridors have most of the same impacts as roads, because vegetation is cleared and managed differently, creating a new habitat type. The impacts particular to transmission lines are electrocution, and collisions of birds and bats with the power lines. Some species are particularly prone to injury and death due to collisions with power lines.

During construction : The construction phase would last a few years and human presence and disturbance can be intense. There may be soil erosion, landslides, and accidental spills. There will be chainsaws used to clear vegetation, large machines would be used to build or improve roads, and rock blasting for roads or penstocks, leaving behind large "spoil sites". Major construction activity is required for the weirs, pipelines, raising mains, reservoir and powerhouse and the noise associated with this activity can be very disruptive to wildlife species

Blasting using dynamite: The project report and estimates state that hard rock will need to be blasted extensively with dynamite. Dynamite blasting will have severe negative impact on the wildlife of the region. Blasting also has documented harmful effects on groundwater aquifers and can affect the existing water sources and water holes of the wildlife.

Muck generation and disposal: As per the project report, muck generated for laying the rising mains alone will be to the tune of 13,02,837 cubic meters. All of this muck will be generated close to the rivers, in forest areas. Dumping of this muck will have a huge negative impact on water quality, forests and wildlife.

Climate change impacts : Carbon dioxide is permanently released when vegetation is cleared for roads, transmission lines, and the project site.260 This issue can be especially significant when long roads are built heavy equipment is required, many trees are removed, and fossil fuels are used for road maintenance. The kinds of forested ecosystems where most river diversion projects are proposed store 300 – 500 tonnes of carbon per hectare (about 100 tonnes of which is in vegetation), 261 and these ecosystems are net carbon sinks according to literature. This means that they are capturing additional carbon every year. River diversion project produces methane emissions, a serious issue usually associated with the

flooding of reservoirs. Methane is a potent greenhouse gas, with effects far worse than carbon dioxide. This in turn would pose a serious threat to the faunal species which are vulnerable to the changes in climate.

Socio economic impacts: Human - animal conflict - Further shrinkage of habitat and fragmentation of animal corridors will enhance human animal conflicts**.** Animals like tiger and elephants need large habitats for fulfilling their requirements and proper dwelling. But, the increasing unplanned developmental activities like construction of roads, railways, hydroelectric projects, cause disturbance in the natural ecosystem and lead to the breaking of large forest areas into small fragments which is referred to as Habitat fragmentation. As a result of this, the wild animals do not find enough resources in the fragmented habitats and often come in contact with human settlements leading to conflicts between humans and animals [8]

Displacement of human settlement: According to the project report two villages would be submerged for the construction of the reservoir. So the displacement of the people is a major issue. Restoration and rehabilitation measures have not been mentioned in the project report.

Valuation of Forests Goods And Services: Destruction of the forest area for the project would lead to the decrease of the eco-services provided by the forests in Gundia river basin which is worth greater than 200 billion R/year (with food and water security) while aiding the livelihood of ecosystem people. The rural people and the tribal people are also mainly dependent upon the wood obtained from forests as a source of fuel. The local values of fuel wood and charcoal can be highly important in terms of local economy. Apart from that non-timber forest products, edibles, medicinal products, animal products have also been of high economic importance.

Positive impacts

Addresses the Drinking water scarcity problem : The parched districts face a severe shortage of water as the levels of ground water have been depleting. The scheme envisages to provide 2.8TMC of drinking water to Kolar and Chikkaballapura regions, hence providing a solution for the water scarcity problems.

Water for human requirement and Industries - Electric Power generation: 125- 150 MW of power is generated accoding to the project report and the project would require 350 MW of power.

Water for Irrigation to the beneficiary areas : Much of the water according to the project report would be utilized for irrigation purposes. Hence the areas of the Bangalore rural and surrounding areas can utilize the water that would be filled up in the irrigation and ZP tanks for cultivation, for livestock and other purposes.

Employment Generation: The project would have a huge requirement of labour for construction purposes, laying of roads, transmission lines etc. Employment opportunities for the surrounding area population might increase.

Infrastructure development: Laying of roads to the project location would to some extent lead to developmental activities of the near by villages.

6. OPTIONS ASSESSMENT

The project raises pertinent questions about water management and water sharing like if diverting water from west flowing rivers, at a huge social, ecological and economical costs is the only option to provide drinking water to Kolar and Chikkaballapur regions. Other optimal solutions can be thought upon. An analysis of rainfall for the one hundred years between 1901-2001 indicates that rainfall in Kolar and Chikkaballapur has not shown significant fall. Kolar District, especially was once rich in water tanks and local harvesting measures. Average rainfall in Kolar is 750 mm, which is not low. According to the Karnataka Gazetteer, the district had, in 2012, only 2,095 tanks from the 35,783 tanks in 1968. Most of the tanks were a victim of siltation, encroachment and neglect. Organisations like Gramvikas and Dhan Foundation have demonstrated how desilting and management of tanks in Kolar can secure water for drinking as well as for irrigation, cattle rearing, etc. Some groups have worked on highlighting the positive impact of applying reservoir silt to crops, as an option to fertilisers and to facilitate desilting. Indian Institute of Sciences (IISc) has demonstrated that desilting these tanks in Kolar can not only help water security, but it can also reduce the incidence of fluorosis.

Long distance water diversion is not an answer to drying and dying rivers. Rivers like Arkavathy are dying due to persistent pollution from industries and urban areas and also due to catchment degradation. Local efforts, sound environmental and water governance however, can help this situation.

7. CONCLUSIONS

Netravathi river diversion project would have well-recognized environmental impacts, some of which have been summarized as follows: Flooding of high-value habitats, greenhouse gas emissions, Changes to nutrient levels (e.g., eutrophication), changes to downstream flow patterns, Increased siltation, sedimentation, barrier to fish migration, terrestrial impacts like destruction of vegetative cover, displacement of human settlements,construction impacts such as spills, erosion, siltation, noise pollution, carbon dioxide emissions and human disturbance of wildlife. Hence the recommendations of the Western Ghats Expert panel about avoiding inter-basin transfers in the Western Ghats should be adhered to. Options for reviving rivers and tanks in Kolar-Chikkaballapura need to be explored using traditional and appropriate technology practices. Appropriate cropping pattern and cropping methods should be a part of this exercise.

Kolar and Chikkaballapura regions have been facing severe water crisis, leading to hardships to local communities. But, for a long term and sustainable solution to these problems, Yettinahole Diversion does not look like a viable option, we not even know how much water will reach these regions. But the project has the potential to exacerbate ecological degradation, fuel man animal conflicts and further water conflicts between regions.

Drought affected regions may have better options, including better operation and maintenance of existing water infrastructure, more appropriate cropping and water use pattern, revival of existing water harvesting structures, recycle and reuse of water, among others. Attention needs to be paid to these options, rather than 'diverting' it.

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