



Friends of Bharathapuzha: A Peoples' Collective for Strengthening and Protecting Bharathapuzha River, Kerala, India

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Abstract

Friends of Bharathapuzha (FoB), a peoples' collective, is formed in July 2019 to strengthen and protect Bharathapuzha River, one of the longest river of Kerala. FoB aims at integrating government policies, scientific research, local participation in decision-making and student participation in conservation activities. FoB activities now focus on three core areas - action, awareness and acquaintance (Knowledge management). Actions include proper management of regulator cum bridge and check dams, waste management and water quality analysis, collaboration with institutes to make a sound scientific base to the activities and to integrate government policies and legal actions. As part of this FoB have selected two areas Pattambi and Thrithala for initial conservation activities, and it will be model for other local self-government systems on the bank of the river. NGOs (Non-governmental Organizations) have a more crucial role in raising public awareness. FoB started the first youth team- 'Puzhayalikal' (The Brigades of Nila) to take the river actions forward and 'Puzhakootam' (The river groups) and 'Puzhapadashala' (The river school) on the banks of the river with participation from students for sharing knowledge with the local community which will help in the preservation of Bharathapuzha River. FoB conducted many social camps in schools and colleges, especially with NSS and NCC volunteers and formulated river module for students to create awareness. FoB has initiated a quarterly magazine 'Nilavrithandham', 'Nila Corner' to collect articles related with the River and constituted a technical expert group, a step towards 'River university/school' which includes all extension activities including training for local communities, academic research associated with river basin and establishing museum showcasing all scientific, cultural, social, economic and folklore works related to the river. Participatory activities of NGOs can make significant changes in society in order to inform and raise awareness on critical issues.

Keywords: Peoples' collective, River conservation, Participatory management

1. Introduction

Kerala is popularly known as 'Gods own country' for its greenery, copious rainfall and water resources giving the impression that the state has enough water resources for all its needs. However, due to the spatio-temporal variations in the distribution of rainfall and undulating topography with steep seaward slopes, most of the water in the rivers quickly drain to the Arabian Sea. Moreover, water resources especially rivers are threatened by multiple stressors, including changes in water flow, impacts on channel form, the reception of an increasing variety of pollutants, the overexploitation of natural resources, land-use changes and habitat depletion. Unsustainable exploitation of river water leads to the lowering of groundwater table (Shaji et al., 2008), saline intrusion (Shaji, 2011) and reduction of the base flow of groundwater to the rivers during periods of low flows (Ranede, 2005). This becomes even more alarming when it is realized just how scarce freshwater ecosystems are in the first place, covering for less than 1% of the Earth's surface (Litschauer et al., 2018). However, adequate and long-term policies to save rivers are yet to be formulated and implemented. Many NGOs and other initiatives were formed as a direct consequence of too little to no governmental action toward sustainable management of water resources. NGOs function as advocates for the integration of local, regional, and international water policies, for a proper science-

policy interface, and for adequate stakeholder involvement in decision-making to ensure that the needs of both nature and local communities are being met (Litschauer et al., 2018). Throughout the world, there is a growing interest in river restoration, and billions of dollars are being spent to address the problems that have arisen from our misuse of river and floodplain ecosystems (Palmer et al., 2005). River conservation is complex and requires a multidisciplinary, multi-stakeholder approach. Friends of Bharathapuzha, a peoples' collective, was formed in July 2019 with the objective of strengthening and protecting Bharathapuzha River, one of the longest river of Kerala. The Bharathapuzha River is the cradle of civilization as well as the lifeline of people of Palakkad, Malappuram and Thrissur districts of Kerala state. The river went through a series of challenges which saw its degradation that has reached a point of no return in many parts, mainly due to sand mining, pollution, changes in land use pattern in the catchment area and encroachments. FoB is planning to do a long term conservation activities to protect the river. This paper highlights the importance of an NGO (FoB) in bringing together people from different aspects of life, technical experts, scientists, students, social workers in a common platform to discuss and plan strategies like interfering in technical issues, Government policies, pollution control, restoring the flow rate of the river, with a scientific base for future conservation and

sustained health of Bharathapuzha River. The main objective of this paper is to discuss FoB activities and pursue support on our initiative to protect River Bharathapuzha.

2. Materials and Methods

2.1 Study area

Bharathapuzha River, also known as *the Nila*, is the longest river in Kerala with a total length of 250 km of which 41 km runs along Tamil Nadu. The river has a total basin area of 6186 Km² of which 4400 Km² falls in the State of Kerala and the rest in the Tamil Nadu State of India. The river basin lies between 75° 54'38" E & 77° 12'31" E longitudes and 10° 18'41" N & 11° 12'26" N latitudes, and it covers Malappuram, Thrissur and Palakkad districts of Kerala, and Coimbatore district in Tamil Nadu, India (Fig. 1). It originates from the Western Ghats at an elevation of 1963m, fed by its four main tributaries namely Kalpathypuzha, Gayathripuzha, Thootha and Chitturpuzha, which drain through highly varied geological and geomorphologic regions of Kerala. The geology of the study area is characterized by Archaean crystalline formation (gneiss, schist, charnockite), Tertiary formations, sub-recent laterite and recent riverine alluvium (CGWB 2007). The area experiences a tropical climate with an average annual rainfall of 1828 (+456.4) mm compared to Kerala state average annual precipitation of about 3000 mm (Nikhil Raj and Azeez, 2012).

2.2 Methodology

FoB reviewed the activities related to Bharathapuzha conservation and studied the pros and cons of action and output, to know the gaps and drawbacks in former activities. Studies and conservation activities are being initiated in these two sites Pattambi and Thrithala (Palakkad District). FoB plans to emulate and extend the

activities to all other parts of Bharathapuzha River based on the output from the two sites of Pattambi and Thrithala. Field surveys were conducted to know the present status of the river at the two sites and gathered basic information regarding encroachments, sand mining, waste management, water availability and its quality, aquatic diversity and socio-economic status. Structured questionnaires, focal group discussions and detailed interview were used to collect primary data. Survey report compared with published research reports available on Bharathapuzha River to get an overall picture of the river in order to plan the conservation activities. Quality and quantity of waste generated, sources of waste and waste disposal methods in the selected area was also surveyed.

2.3 Water quality analysis

Water quality analysis was done in the selected sites in 2019 to compare the results with the present status and the outcome after the conservation activities. The suitability of water for drinking and irrigation purposes was also assessed. Parameters such as biological oxygen demand (BOD), turbidity, total dissolved solids(TDS), nitrate, phosphate, sulphate, calcium, magnesium and hardness were determined as per standard methods (APHA, 1998). The pH, dissolved oxygen, salinity and conductivity were measured immediately after sampling using portable water analyzer (EUTECH multiparameter portable meter). Heavy metals in the river water were determined using inductively coupled plasma mass spectrometry (ICP-MS). Total coliforms determined by MPN method and other microbes, including pathogenic bacteria, were identified (APHA, 1998). Samples were directly observed for identifying microbes using a compound microscope, Olympus CKX41 and photographed using a Leica DM 2500.

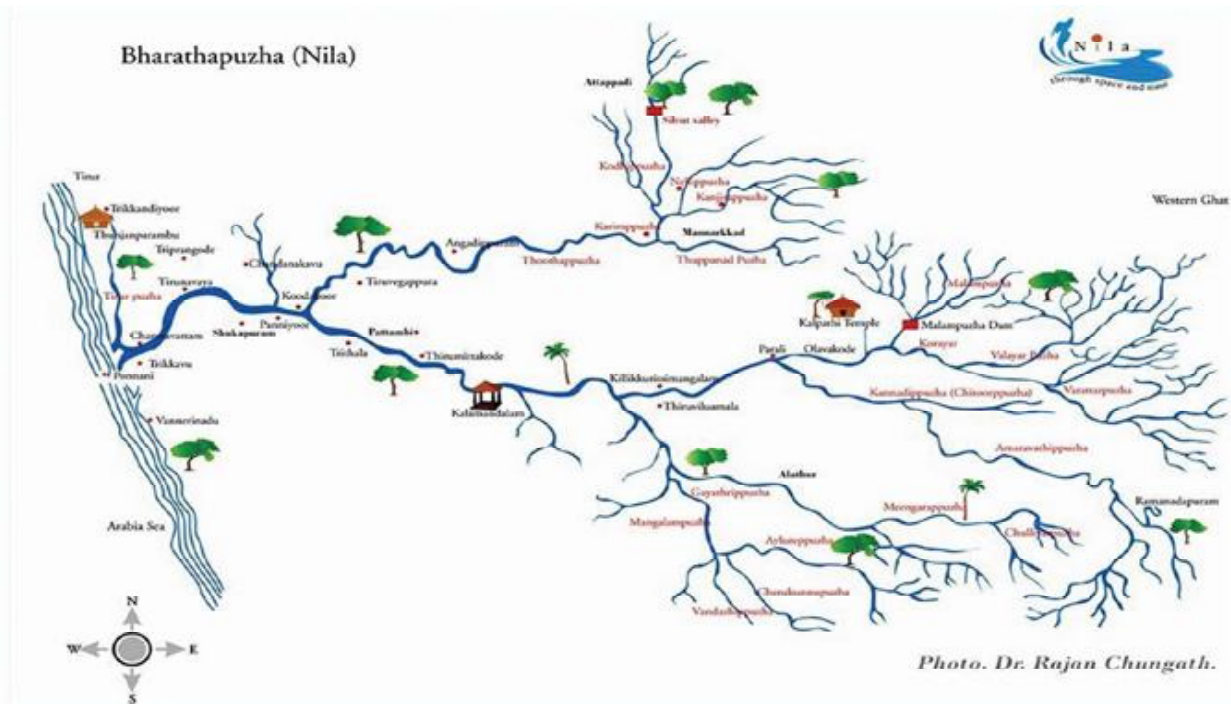


Fig. 1. Bharathapuzha River map (Courtesy: Dr. Rajan Chungath, FoB)

3. Results and Discussion

3.1 Evaluation of former conservation activities

NGOs are essential partners in promoting environmental protection and achieving sustainable development. Evaluation of earlier works by various NGOs and government authorities working towards Bharathapuzha conservation noticed that activities lack local participation, less involvement from youth, absence of consolidated ideas, fragmented planning, no cohesive platform for socio-cultural collaboration and distributed action. Former activities by the NGOs (Nila Foundation, Vayali Folklore Group, etc.) mainly focused on the cultural landscape of Nila. 'Bharathapuzha Samrakshana Samithy' was the prominent NGO started their works to conserve Bharathapuzha in 1988. Another NGO, 'Nilavicharavedi' initiated many conservation activities and successfully conducted two national river festivals to bring in national attention to the problems of Bharathapuzha. State government initiatives such as Punarjani by Malappuram district administration and Bharathapuzha revival plan by Palakkad District Panchayath was successful in catching the attention of people. Still, lack of follow up activities, fragmented activities and disruption of work mainly due to the transfer of concerned officials are obstacles in achieving the proposed goals. Many government initiatives, local people's collectives and individual attempts still going on the banks of the river to restore the cultural, social, economic and environmental landscape of Nila.

NGOs working for the protection of the river should formulate conservation strategies, should identify long term goals, specify results to be achieved over the planning horizon and specific, measurable targets to be achieved over the short term to long term. Lessons learned from the previous conservation works and research must be brought in a collaborative platform which must be collective in nature, locally rooted and distributed, at the same time grouped under common goals. In order to achieve long term and short term goals, NGOs should try to bridge the gap by making better connectivity with the government departments, integrate government policies, empower citizens and ensure the adequate local involvement in decision-making. Proper action plans with diversified activities, including awareness and acquaintance, should be planned to reach an outcome at the grass-root level. With this evaluation, an NGO called Friends of Bharathapuzha was conceptualized and formed in July 2019.

3.2 Evaluation of Friends of Bharathapuzha (FoB) activities

FoB, as an NGO initiated for the conservation of Bharathapuzha River, focuses on three core areas: actions, awareness and acquaintance (knowledge management).

3.2.1 Actions

Initial actions include waste management and water quality analysis of selected sites, integrating government policies and legal actions, proper management of regulator cum bridge and check dams and collaboration with institutes to make a sound scientific base to works.

3.2.1.1 Waste management

Primarily, FoB surveyed the present environmental status of the river in selected sites (Pattambi and Thrithala) and compared with earlier research reports. From the study, it is observed that the factors that are deteriorating the river are:

- The dumping of garbage and solid waste, direct sewage discharge (from houses, hotels and markets) and open defecation mainly, by migrant communities.
- Construction of the number of check dams without scientific management.
- Aquatic flora and fauna (mainly fish) in the river and alongside has gone up by 50-60% during the past 25 years. It will affect the health of this socioeconomically and ecologically important river ecosystem.
- Deforestation, the transformation of paddy lands for various purposes, and filling up of ponds, natural streams and canals in catchment area affected water quality and the perennial flow of the river.
- Constructed encroachments for urbanization and encroachments by villagers within river corridors and floodplains are frequent in the river bank affecting the healthy flow of the river.
- Due to the sand mining in the last 30 years, the thick sand bed has been completely vanished and has then been replaced with grasses and bushes, which is a severe issue throughout the river. Dry river bed for the majority of the year has forced some people to use the land for vegetable cultivation. Lots of grasses and bushes have started growing in the river bed and have become places for anti-social activities. There were incidences of fire to the dry vegetation in the river bed. At the same time, recent flood during 2018 and 2019 has increased the sediment load in many places.
- The controversial Parambikulam Aliyar Project (PAP) agreement signed between Kerala and Tamil Nadu to divert the waters of the river to Tamil Nadu for irrigation and drinking water supply also affected the water flow, especially in the summer season.

Availability of freshwater in adequate quantity and quality is a prerequisite for sustainable development. The ignorance and irresponsible attitude of people and government authorities has resulted in much of river water becoming not potable. As a result, FoB has selected two areas Pattambi and Thrithala for initial conservation activities, and it will be further replicated as a model for other local self-government systems on the bank of the river. A team from DMRC and FoB evaluated the sewage channels in and around Pattambi municipality and submitted a report with recommendations/solutions to the municipality. Eventually, Pattambi municipality has taken necessary action to stop septic drainage directly into the river and sanctioned new bio-toilet system for the municipal bust stand.

3.2.1.2 Water quality

Deteriorating water quality is an important problem affecting the river. So, FoB studied the water quality of selected sites of Pattambi and Thrithala regulator cum bridge area. Table 1 shows the analyzed physicochemical parameters of water collected from Pattambi and Thrithala

Table 1. The physico-chemical analyses of the water sample

Parameters	Pattambi	Thrithala RCB	Accessible limit	Permissible limit
pH	6.06	7.02	6.5-8.5	No relaxation
Conductivity(MS)	204.4	190.4		
Dissolved oxygen	4.68	5.32		
Turbidity(NTU)	28	14.5	1	5
Dissolved solids(mg/L)	189	276	500	2000
BOD	7.08	14.12	Drinking -2mg/L or less and bathing - 3mg/L or less	
Nitrate(mg/L)	0.002	0.002	45	No relaxation
Phosphate(mg/L)	0.02	0.03	-	
Sulphate(mg/L)	0.015	0.017	200	400
Calcium(mg/L)	0.68	0.61	75	200
Magnesium(mg/L)	0.34	0.46	30	100
Sodium (mg/L)	0.54	0.63		
Potassium(mg/L)	0.045	0.052		
Hardness(mg/L)	67.32	59.4	200	600
Salinity(mg/L)	71.34	66.53		

RCB. The pH, electrical conductivity, hardness, total dissolved solids, nitrate, calcium, magnesium, sulphate and salinity values of sites during the sampling period were within the prescribed limits as per Bureau of Indian Standards (BIS, 2012). The phosphate concentration measured was 0.02 mg/L (Pattambi) and 0.03 mg/L (Thrithala RCB) and fell under the mesotrophic condition (Lee *et al.*, 1981).

Many other parameters were higher than the desired limit as per Bureau of Indian Standards (BIS 2012). Turbidity observed was 28 NTU at Pattambi and 14.5 NTU at Thrithala RCB, and it is above the standard limit. Dissolved oxygen of the river water observed was 4.68 mg/L (Pattambi) and 5.32 mg/L (Thrithala RCB). The standard value of DO of outdoor bathing waters should be 5 mg/L or more. BOD is a measure of organic material contamination in water and the highest value of 7.08 mg/L was observed at Pattambi and 14.15 mg/L at Thrithala. It was found that both the sites were not meeting the water quality criteria for drinking and bathing with respect to BOD (as per BIS BOD 5 days 20°C for drinking is 2mg/L or less and bathing is 3mg/L or less). Results of the physicochemical and microbiological parameters indicated that water in Pattambi and Thrithala RCB region is highly contaminated and not safe for drinking, and it is also unhealthy for the aquatic life. The town of Pattambi receives a substantial amount of urban sewage, where much urban sewage drains open directly into the river, through which the waste is dumped. The permissible limit of BOD for natural waters is 3mg/L or less. The high value of BOD clearly indicates the high level of organic material. Such large scale pollution not only degrades the habitat but also causes severe health problems. Constructing regulator cum bridge at Thrithala may be effective for irrigation purpose. But, the natural flushing action of the river is lost due to the closing of shutters as water becomes stagnant, which can be attributed to the much higher BOD in the river.

From the study, it is observed that the concentration of metals in the river water is within the permissible limit or absent, except iron concentration at Pattambi (0.89ppm/L). The river enjoyed heavy rain from June to August 2019, and the rainwater would have flushed out heavy metals. Earlier studies have reported the presence of heavy metal pollution in river water (Nikhil Raj and Azeez, 2009; Sreelakshmi and Ramachandran, 2015; Venunathan and Narayana, 2016; Sreelakshmi and Chinnamma, 2018), especially from the industrial belt of Palakkad district. Metals can also become 'locked up' in bottom sediments, where they remain for many years.

Table 2 shows a very poor microbiological quality in the river water with high levels of *E.coli*. and confirmed the presence of *Faecal streptococcus*, *Salmonella* sp. and *Pseudomonas* sp. along with different fungal, algae and protozoan communities. *E.coli* and *Faecal streptococcus* in freshwater indicate the presences of pathogens from animal or human faeces. Total Coliform and *E.coli* count were so high, making the water not suitable for drinking, domestic and other recreational purposes. The higher number of coliform bacteria and organic pollution is mainly due to the discharge of septic waste, open defecation of migrant communities and wastewater directly drains into the river. Overall analysis shows that the river is highly polluted with organic pollutants. As per the 'Designated Best Use' (Central Pollution Control Board) of River Bharathapuzha from the water quality data, River Bharathapuzha at Pattambi and Thrithala RCB are falling below 'E' Class due to discharge of untreated sewage from LSGs and other human activities. The microbiological examination of river water has confirmed that the river water from the sampled site is unfit for direct consumption, bathing or any other domestic use. Polluted river act as a source of pollution to the groundwater as it percolates through the soil to the groundwater during the course of its flow. Eventually, the groundwater becomes unfit for drinking purpose. Rivers constitute the main

Table 2. Microbiological analysis of the water sample

Parameters	Pattambi	Thrithala RCB	Permissible limit
Total Coliforms	>1000/100 ml	>1000/100 ml	Below 50/100ml
<i>E. Coli</i>	59-62cfu/0.1 ml	50-61cfu/0.1 ml	Shall not be detectable in any 100 ml sample
<i>Faecal streptococcus</i>	18-20 cfu/0.1 ml	28-32cfu/0.1ml	
<i>Salmonella sp.</i>	5-9 cfu/0.1 ml	1-3 cfu/0.1 ml	
<i>Pseudomonas sp.</i>	5-8 cfu/0.1ml	3-5cfu/0.1ml	

water resource for inland irrigation, drinking water source, agriculture and industrial activities.

3.2.1.3 Government policies

A Expert Committee was appointed by Honourable National Green Tribunal, Circuit Bench, Kochi in connection with O.A. No.16 of 2016 (SZ) (Suo Motu) July 2016 based on news published in the newspaper, “The Hindu” dated 15.01.2016. The article stated that Bharathapuzha River is highly polluted in many places, and the primary cause of pollution of the river is the discharge of chemicals from industries, dumping of the solid waste directly to the river, large scale discharge of untreated effluents to the river, massive deforestation in the catchment area and encroachments into the river. The committee reported that there is bacteriological contamination in Bharathapuzha River and its tributaries are due to discharge of untreated sewage. The major polluting sources of River Bharathapuzha and its tributaries are Village Panchayaths/Municipalities/Railway Stations, and few industries in Kanjikode area situated on the bank of the river are discharging untreated sewage into the river. Main polluting LSGs include Pudussery, Palakkad, Ottapalam, Shornur, Pattambi, Thrithala, Kuttipuram and Kalpathi Village (part of Palakkad municipality). Majority of the governing bodies have not provided any sewerage system so far in their areas of jurisdiction. At present, these Authorities let its domestic wastewater into the drains. During monsoon, the rainwater flushes out these drains into the river. Whereas in summer, depending upon the flow the domestic wastewater may reach the river or may get dried up in the drain itself. As a result of discharge of untreated waste by Shornur municipality into the river, the water quality of Bharathapuzha at Shornur falls below ‘E’ class. This can be attributed to the discharge of water from train toilets, washing of platform, IOH shed coach washing of Shornur railway station (Prasad K Shoranur, 2020). Honourable National Green Tribunal recommended that the local/urban authorities shall not be allowed to pollute the Bharathapuzha River and other water bodies till they go for complete sewerage system and installation of sewage treatment plants. In this scenario, FoB intervened in the issue and advised the railway authorities to submit a time-bound action plan for providing sewage treatment plant to treat the wastewater generated to meet the standards stipulated by Pollution Control Board before discharging into the catchment area of Cheruthuruthy check dam.

Unscientific management of regulator cum bridge at Velliyanakallu has caused severe problems during 2018

and 2019 flood. So to rectify it, consistent follow-up and regular monitoring of Velliyanakallu regulator cum bridge is being done by FoB. Regular meetings, discussions and development of a scientific plan with the authorities of water resource ministry by the FoB team resulted in the release of fund worth 18.65 crore rupees for proper management of regulator cum bridge.

3.2.1.4 Collaborations

For any action, we need a good scientific base to understand the problems and find a sustainable solution to the environmental degradation. As a newly formed NGO, it is very difficult to perform scientific research on a long term basis to understand the scenario and plan action strategies. So, FoB made associations with Centre for environment and development (CED), Centre for water resources development and management (CWRDM), Kerala forest research institute (KFRI), Institute of forest genetics and tree breeding (IFGTB), and Universities for the possible collaborations and to take the Bharathapuzha River studies and actions forward.

3.2.2 Awareness

NGOs have a more crucial role in raising public awareness and building the capacities of different stakeholder groups on key environmental issues. Hence, FoB started the first youth team – ‘Puzhayalikal’ (The Brigades of Nila) to take the river actions forward and around 100 students joined as The Brigades of Nila. Group discussions on the known and unknown facts about the environmental, social and cultural ethos of river Nila are conducted regularly to take the river actions forward and to gain, apply and pass on knowledge about the river to next generation.

Imparting knowledge about ecological and conservation measures of rivers to the students and sharing this knowledge with the local community will help in the conservation of the river. With this view, FoB started ‘Puzhakootam’ (The river groups) and ‘Puzhapadashala’ (The river school) on the banks of the river with the participation of students and local peoples. Puzhakootam is a group formed with peoples living on the bank of the river to discuss and formulate actions for river conservation. Puzhapadashala is mainly for students for acquiring and sharing knowledge, including traditional and scientific aspects of the river. As a part of this FoB conducted school and college camps, especially for NSS and NCC volunteers and formulated river module for students to create awareness. River module is an activity-based curriculum which discusses the river ecosystem, including its environmental and cultural conservation.

3.2.3 Acquaintance

NGOs can play a crucial role in bridging gaps by conducting research to facilitate policy development, building institutional capacity, and facilitating independent dialogue with civil society to help people live in a more sustainable way. A new concept of 'River University/School' was conceived by FoB, which includes all extension activities to the Bharathapuzha River conservation including training for local communities, academic research associated with river basin and establishing museum showcasing all scientific, cultural, social, economic and folklore works related to the river. FoB has started a 'Nila Corner', a space for river studies with Ashtamgam Ayurveda College, Vavannur, Palakkad District and a quarterly magazine 'Nilavrithandham' for publishing all scientific, cultural, social and economic aspects of River Bharathapuzha. This is a step towards setting up a River University/School which is intended to provide one space for all river studies. FoB collected earlier study reports and research data from different institutions in all aspects of Bharathapuzha River and exhibited in the Nila Corner. FoB constituted a technical expert group to review all related works and formulated adaptation strategies with the long term goal of conservation of the river. The technical expert group constituted in the NGO helps to make reports, recommendation and suggest solutions on crucial issues based on available data

3.3 Recommendations

Nila groomed the incredible culture and life of southern Malabar. Now, the time has come to save the life of Nila and to reduce the environmental threats by adopting good techniques such as:

- Resolve issues through participatory dialogue and action to sustain the health of the river in the long run.
- Environmental education and awareness programs to the local communities and stakeholders who are the main contributors of pollution in the river to improve the conservation activities of Bharathapuzha River systems.
- Strict regulations must be given for hotels, hospitals, households and local markets for managing their waste. Establish suitable treatment systems based on the waste generated. Timely collection and proper management should be practised, which is an essential factor for scientific waste management to control pollution. Regulation has to be put in place and enforced for managing waste generated. Waste from slaughterhouse and market place should not be allowed to dispose of into the river.
- Proper measures must be taken for the treatment of sewage before discharge and restrictions must be made out on various anthropogenic activities.
- Proper toilet facilities with a septic tank should be established for inhabitants on the river bank, especially for migrant communities. This will help to reduce pathogenic bacteria in the river.
- Scientifically operated regulator cum bridge should be

established. Lack of sufficient flow of water and the presence of permanent check dams in the river are the reasons for enhancing water pollution. Arresting/altering the natural flow of the river increases water pollution, affects the biodiversity which was depending on the perennial flow of the river, changes in sediment loads and biophysical parameters of the river are changing to the extent that even the characteristics of the channel have been altered.

- Besides illegal sand mining, authorities have to take strict actions against those who are converting the river bed, which are dried up, especially during summer to vegetable farms. These farmlands will be a source of pesticide pollution and will further facilitate the growth of other plants in the river bed. Such actions should be restricted as it will ultimately lead to losing the river bed.
- Proper law enforcement and punishment should be given to those who violate the rules stipulated by the government. As per SuoMotu "The health Hazards created by Pollution of water from Bharathapuzha River as per news item in the Hindu" dated 15.01.2016, Green Tribunal stated that the major polluting sources of River Bharathapuzha and its tributaries are Village Panchayats/Municipalities/Railway Stations and few industries in Kanjikode area situated on the bank of the river. The Untreated sewage is discharged into the river from these sources.

4. Conclusion

Bharathapuzha River is a drinking water source for thousands of people living near its banks. Polluted river water, reduced or no flow rate in the river, sand mining, and the deteriorating catchment area are affecting the self-purifying capacity of the river. Water quality evaluation of the river found river water will cause health problems to the people if consumed. A coordinated effort by Government organizations, Non-Government agencies, local bodies and participation from the public is needed to restore the overall health and rejuvenation of the river ecosystem. FoB has initiated the conservation plan and action but has to tread long distance to achieve its long term goal. The concerns which require immediate attention are prioritized to short term goals. Actions are planned and initiated to achieve those short term goals. Long term goals have to be planned, and efforts should be initiated to environmental issues related to Bharathapuzha River such as sand mining, encroachments, loss of biodiversity, changes in land use pattern, changes in the flow pattern and integrating various environmental policies. River restoration refers to a large variety of ecological, physical, spatial and management measures and practices aimed at restoring the natural state and functioning of the river system.

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