

# A Step Towards Pollution Abatement of Karamana River by Constructing a Check Dam - A Case Study

Theres Charly, Shibu K, J Ansari

M.Tech Student, Department of Civil Engineering, College of Engineering, Thiruvananthapuram, Kerala, India

Assistant Professor, Department of Civil Engineering, College of Engineering, Thiruvananthapuram, Kerala, India

Senior Principal Scientist, National Institute of Interdisciplinary Science and Technology, Thiruvananthapuram, Kerala, India

**ABSTRACT:** Karamana River originates from the southern tip of the Western Ghats at Agastyar Koodam and it is an important water resource to meet the domestic and drinking water needs of the population in Trivandrum city. But it is highly polluted due to various activities. As part of management plan for pollution abatement, a proposal has been made to construct a check dam to prevent salt water intrusion from Poonthura Pozhi and sewage contaminated water from Parvathy Puthanar during high tide. This paper is a report on constructing a check dam at Kalady as a step to control pollution in Karamana River. The proposed location is at downstream of Karamana Bridge, at Dobhy Ghat Kadavu; 350 meters downstream of Karamana NH Road Bridge. The dam prevent up flow of water and sewage contamination to the upstream of check dam and enhances recharge of ground water to surrounding area.

**KEYWORDS:** Study; Environmental feasibility; Check dam construction; Karamana River;

## I. INTRODUCTION

Water is one of the most important natural resources of any country that decides socio-economic development of any civilization. Ready and sustained availability of water is one of the most important requirements for the development of the economic activities as agriculture, industry or domestic activities are heavily dependent on this resource.

Kerala state has an area of 38,863 km<sup>2</sup> and is bordered by Karnataka to the north and northeast, Tamil Nadu to the south and southeast and the Arabian Sea towards the west. This land is blessed with 44 rivers, however many of these are under the threat due to anthropological activities like pollution, wet land filling, sand mining and deepening of rivers along the river banks [4]. All 44 rivers in Kerala are highly polluted due to inflow of untreated domestic, industrial wastes and agriculture runoff. Most of the industries are near the thickly populated riversides, often near cities and towns. There is no efficient water treatment system in industries and city municipalities. Pollution level in some of the sites is far above permissible limits. Karamana is one of the major rivers flowing through Thiruvananthapuram district, Kerala State. Karamana River ranks 15<sup>th</sup> in the catchment area and 17<sup>th</sup> in stream length among the rivers of Kerala [3]. The River that originates from Western Ghats falls into the Lakshadweep Sea.

Karamana, the pride of Thiruvananthapuram and an important source of drinking water, is now dreaded and diseased. What was once a thriving river is now being used as a garbage dump. The Karamana river has two important dams where it originates from the Agatyakoodam mountains. These are the Peppara dam built in 1983, which lies upstream, and the Aruvikkara dam located below and built in 1930s. Both meet the irrigation and drinking water supply needs of Thiruvananthapuram city. The best-known tributary of the Karamana river in Killiyar, has its origin in the village of Panavoor, in Nedumangad Taluk. Killiyar runs parallel to the TS Road for most of the Nedumangad-Trivandrum route. The Karamana River joins the Killi River at Pallathukadavu (upstream of Thiruvallam) and wraps around the Edayar is and on its way to the Poonthura estuary. Both the rivers carry large quantities of raw sewage

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discharged from city drains. The heavily-polluted Parvathy Puthanar canals join the river at Munnattumukku near the Poonthura coastal village. As part of management plan for pollution abatement, Kerala State Council for Science, Technology and Environment (KSCSTE) proposes to construct a check dam at Kalady at downstream of Karamana bridge to prevent salt water intrusion from Poonthura Pozhi and sewage contaminated water from Parvathy Puthanar during high tide. This study deals with the environmental feasibility of constructing such a dam.

V.O. Palyakov et al [5] conducted a study on the effect of check dams on runoff, sediment yield, and retention on small semiarid watersheds and concluded that check dam can be used as pollution and sedimentation mitigation technique.

M. Sait Tahmiscioglu et al [2] conducted a study on the positive and negative impacts of dam on the environment. According to their study the dams have a great deal of positive and negative effects on the environment besides their benefits like controlling stream regime, consequently preventing floods, obtaining domestic and irrigation water from the stored water and generating energy.

Carolina Boix-Fayod et al [1] studied the impact of land use change and check-dams on catchment sediment yield and found out that the application of check dams to control sediment yields depends on the objective of the management and the specific environmental conditions of each area. As a result of dam construction and holding sediments in reservoirs, sediment feeding of downstream channel or shore beaches is prevented. As the transfer of sediments is avoided by this way, the egg lying zone of the fishes living in the stream ecosystem is restricted [2]. Temperature of water, salt and oxygen distribution may change vertically as a consequence of reservoir formation. This may cause the generation of new living species.

Y. D. Xu et al [6] made a study on the hydrological effect of the check dams in the Loess Plateau, China, by model simulations. Construction of the large number of check dams in the Loess Plateau has enhanced the region's capacity to control the runoff and sediment. In the Yanho watershed, the annual runoff was reduced by less than 14.3% due to the check dams and the sediments in rainy season was blocked by up to 85.5%. Thus, check dams are effective measures for sedimentation control in the Loss Plateau.

The aim of the study is to check the environmental feasibility of constructing a check dam at Kalady in Karamana River and to determine the various effects of constructing the check dam at that site. The study was conducted during February 2016.

**II. STUDY AREA**

The proposed location is at downstream of Karamana Bridge, at Dobhy Ghat Kadavu, 350 meters downstream of Karamana NH Road Bridge. The width of the river is about 6m. The proposed site has rocky bed for providing structural stability. There are many temples and four kadavus in this area. Location of check dam and Biodiversity Park is shown in Fig 1.

**III. METHODOLOGY**

Methodology adopted include field visit, detailed study of four kadavus, investigation of both positive and negative effects of constructing a check dam at Kalady in Karamana river and suggestions to improve the quality of water.

**IV. RESULTS AND DISCUSSIONS****A. THE FOUR KADAVUS**

The four kadavus located in the study area are Arattukadavu, Kancheepuram temple kadavu, Ganapathycoil Kadavu, and Dobhi Ghat and they experiences scarcity of water during drought.

**I) Arattu Kadavu**

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Arattu kadavu of Shiva shethram is located at 8° 28' 42.49" N latitude and 76° 58' 07.28" E longitudes.

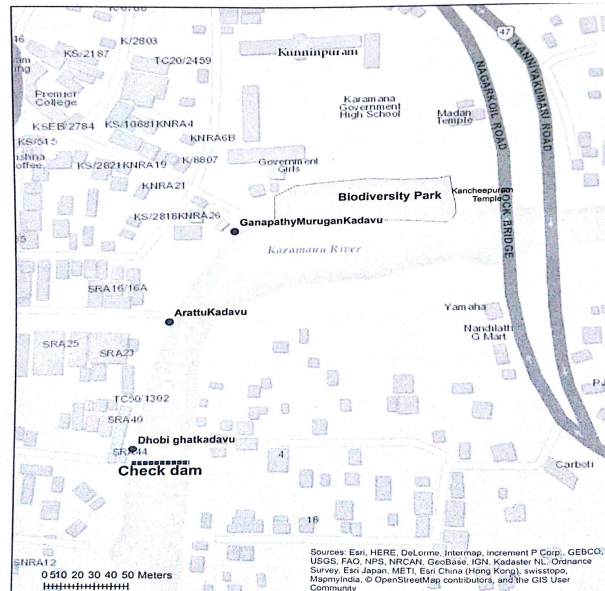


Fig 1 . Location of check dam and biodiversity park



Fig 2 Migratory birds visiting the area (at Arattukadavu)

Migratory birds visit this area and are shown in Fig 2. The biodiversity board along with irrigation department is planning to convert the nearby area into a biodiversity park.

### II) Dhobi ghat kadavu

The Dhobi ghat kadavu which is located at 8° 28' 39.18" N latitude and 76° 58' 07.32" E longitude. It is also known as parekadavu. About twenty five families with a total population of about 100 to 120 persons live near to this kadavu. These are encroachers living on the banks of the river. A sewer line is provided at 1.5 m (5 feet) below the road surface. But at the time of overflow, it gets discharged into the Karamana River. Other waste water including raw water is discharged into this river and is shown in Fig 3.

### III) Ganapathi murukan kadavu

Ganapathi murukan kadavu near Murukan temple is located at  $8^{\circ}28' 45.29''$  E latitude and  $76^{\circ} 58' 9.20''$  N longitude. The construction of gabion block is in progress on the left and right side of Ganapathy kadavu. The gabion block is constructed in three layers with biogardens in between. The speciality of the project is that the Gabion wall is constructed along the river bank for the first time. Earlier concrete wall were constructed instead of gabion walls. The gabion wall has the advantage of providing free movement of water without damaging banks. Unauthorized river sand mining was done in the earlier days and as a result pits are still found in this kadavu.

### B. PROPOSED LOCATION

The site for the proposed check dam is in Dhobi Ghat Kadavu and is shown in Fig 4. Majority of the people living in this area are Brahmins and the people living on the side of the Karamana River are encroachers.

The width of the section is about 6m and depth of water is about 2 to 3m. The bund level at this site is higher than that of maximum flood level. Therefore it is an ideal place for constructing a check dam.

The check dam will improve quality of life through multiple uses. The flow of water is high during morning and low at evening. There is a high upstream push during the time of high tide (afternoon). The water level rises about 2 feet at the time of high tide Line and is shown in Fig 5.

Almost 25 persons per day use this kadavu for washing their clothes. They use soap oil (a chemical) for washing the clothes. The detergent content in river water increases due to activity at Dhobi ghat, which ultimately results in growth of algae. This process reduces oxygen content in water after algae dies and decay.



Fig 3 Discharge of liquid waste to karamana river (near Dhobi ghatt)



Fig 4. Proposed site for constructing check dam at Dhobi Ghat Kadavu



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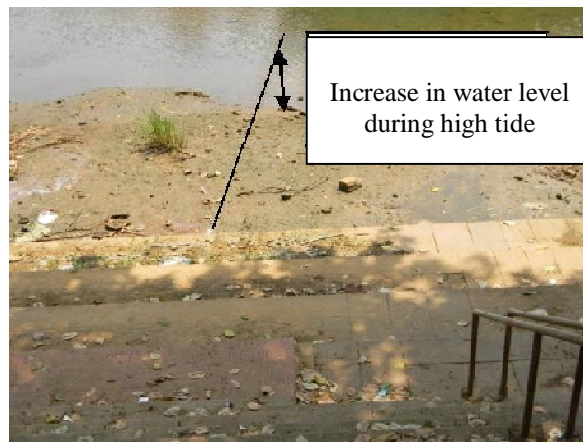


Fig 5 Increase in water level during high tide

Littering of sack and use of open ground for urinal etc causes unaesthetic view. A mangrove associate *Acrostichumaureum* which is adaptive in nature, were seen near to river bank and is shown in Fig 6. This plant indicates the presence of salinity, intrusion of saline water might be the reason for the survival of this species in the crevices of rocks which are seen projected over the water level.

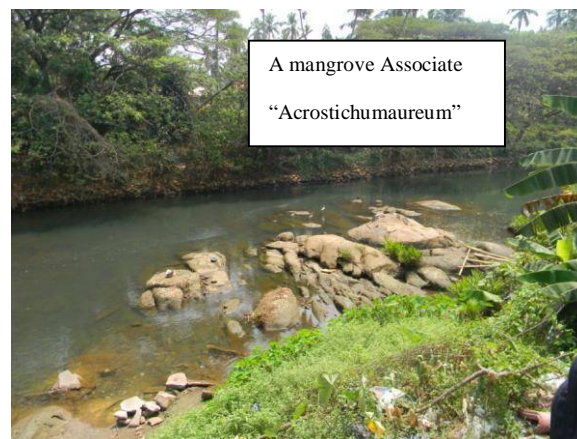


Fig 6 A mangrove associate seen in the crevices of rocks

The other species such as *Pennisetumso* (Grass), *Oryzasativa* (paddy), *Tridaxprocumbens* (weed), *Polygonumchinense* (Wetland species), *Ricinuscommunis*, *Enterolobiumsaman* etc were observed along the banks and is shown in Fig 7. No endemic species were observed in the area. The flora and fauna observed there are also seen in other places.

### C. POST PROJET SENARIO

The upstream stretch of Karamana River is getting used as a source of drinking water for the city. The present use of river water has got used due to pollution river water within the city limit. Still some of the people residing along the river are using this river water for bathing and washing the clothes. The source of river pollution is drain and house outlets. The major problem of the river pollution is due to high value of BOD, Bacteriological counts and Total

Dissolved Solids (TDS) in river water.

#### **D. POST PROJECT SCENARIO**

The quantity of water stored after the construction of the check dam will be around 12,000 m<sup>3</sup>. With the construction of cement concrete check dam, the aeration and dissolved oxygen content to the downstream water will be increased. The velocity of flow varies from 0.4m/s in the dry season to 1.4 m/s in the rainy season.

Waste water generated per dhobi is estimated to be 2000 litres per day. Total waste water generated will be around 40 m<sup>3</sup>/day. Water flow is 400 m<sup>3</sup> per sec during flood time and 13.5 m<sup>3</sup> per sec during dry season (March to May) i.e 1166400 m<sup>3</sup> per day during dry season. The wastewater generated could be easily flushed out to downstream.

The width of the proposed dam is 45 meters. It is suggested to give one weir notch of 20 m width and 0.4m depth covering two shutters on the left side and one of 10 meter width and 0.4 m depth covering one shutter on the right side viewing from downstream. The total flow through these weir notches during dry season will be around 13.5 m<sup>3</sup> per sec. The other two shutters will be closed during dry period. This arrangement can further augment higher flush out of wastewater from the Dhobi ghat side.

The check dam will also enable sufficient water level for all the Kadavus downstream of Karamana NH Road Bridge and will eliminate the reverse flow direction during high tide which could cause entry of saline water and polluted water from Parvathy Puthanar to these areas. The general public is in favor of construction of check dam.



Fig 7 General terrestrial ecology of the area

#### **V. SUGGESTIONS**

It is suggested to provide a comfort point (station) in Dhobi Ghat Kadavu. It is also suggested to provide ownership for the Kadavus to local association in the nearby area to protect the river from pollution. Awareness programmes should be conducted in the nearby schools, colleges etc. A pay and use washing machine, operated by the local housing society is also an additional option which the public can think off for preventing deterioration of Karamana river.

#### **VII. CONCLUSION**

It is well known that water bodies have played a crucial role in the growth and development of society. All settlements across the globe have started along water bodies and rivers. However it is true that the water bodies have

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undergone degradation in modern times. Urban growth, increased industrial activities, intensive farming and over use of fertilizers in agricultural productions are identified as drivers responsible for degradation. Increasing urbanization coupled with industrialization during past few years have resulted into depleting water ecosystems of major cities.

The water quality of Karamana River appears to have deteriorated as a result of various anthropogenic and local land uses. Since the River Karamana originates from the southern tip of the Western Ghats at Agastyar Koodam hills, considered to be a protected region under the Reserve Forest Area, the quality of water implies to be pristine in nature.

In early days, water was primarily used for domestic needs like drinking, washing, bathing and cooking etc. But due to industrial and urban development, requirement of water for these activities has increased along with domestic purpose. Water of good quality is required for living organisms. The deterioration of quality, loss of biodiversity and fast depletion of water resources are the main challenges, which need urgent attention. Construction of check dam will help to mitigate water pollution and thus improve the quality of water.

The construction of check dam has certain positive impacts. It prevents upflow of water and sewage contamination to the upstream of check dam and provides sufficient water to Kancheepuram temple kadavu, Ganapathycoil kadavu, Arattu kadavu and Dhobhi ghat kadavu. Check dam enhances recharge of ground water to surrounding area. It also promotes tourism and healthy ecology. The suggestion of providing comfort station, pay and use washing machine facility, preventing discharge of waste water into river, creating a sense of ownership among the residents and public shall further improve the general environment. The negative impacts of constructing check dam is that it prevents navigation of motor boats and canoes to the upstream of bund. There will be stagnation of water and accumulation of contaminants in the check dam reservoir. Considering the various positive impacts the construction of check dam at Kalady is very essential.

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