

Floating Garden in Puzhakkal River

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Abstract: Floating garden is a form of hydroponics using aquatic plants as the medium. It provides beauty and naturalization. Their valuable biological filtration helps to remove BOD, COD and minerals. Puzhakkal River is famous in Thrissur district and it is a tourist destination. The river is polluted due to the deposition of wastes and the uncontrollable growth of water hyacinth. The aim of this project is to determine the effect of floating gardens on polluted river water and provide a good use of water hyacinth.

Keywords: Key words: floating garden, Puzhakkal River, hydroponics

1. Introduction

Floating gardening a form of hydroponics using aquatic plants as the medium. In this hydroponics system vegetables and other crops are cultivated. Water is a transparent and nearly colourless chemical substance that is the main constituent on earth's streams, lake and oceans and the fluid of most living organisms. Its chemical formula is H₂O. Water is vital for all known forms of life. On earth 96.5% of planets crust water is found in seas and oceans. 1.7% in ground water, 1.7% in glaciers and ice caps of Antarctica and Greenland, 0.001% as water vapour and cloud. Only 2.5% of water is available as fresh water and 9 8.8% of this of this is in ice caps. Less than 0.3% of all fresh water is in river and lake. River has been used for the main source of water which can be used for drinking and irrigation. They are often a rich source of fish and aquatic life. There are 44 rivers in Kerala. The rivers in Kerala are small in terms of length breadth and water discharge. As earth's population continuous to grow, people are putting ever increasing pressure on the water resources and thus leading to pollution. Now water pollution is one of the human problems. Usually water pollution means one or more substances have built up in water to such an extent that they cause problems to animals and people. Water can be polluted by human activities such as use of fertilizers, sewage disposal, use of plastics; industrialisation etc. The major rivers in Thrissur district are Chalakkudi river, Manali river, Karuvannoor river, Puzhakkal river, and Kecheri river. Puzhakkal River is west ward flowing river in Thrissur district. Rivers and villages hold tremendous potential for development of rural tourism. Puzhakkal river is tourist destination popular for boating. Now a day's Puzhakal River polluted by various reasons. A floating garden in Puzhakal River, which gives natural beauty it also becomes a means for additional water filtration aeration and increasing the waters clarity. Floating garden cleans up the river by filtering the toxins and pollutants out of the water and putting oxygen back in to it. The project advantage is to provide floating gardens, reduce river pollution and improving the environment.

Puzhakkal also puzhakkal padam, is part of puzhakkal block of thrissur. a decade ago, Puzhakkal was a vast paddy feild situated in the two sides of state highway 69 (Kerala) going to Guruvayur. The place is named after puzhakkal river, which flows through this region. Now, it has become the most developed suburban area of thrissur city. many of the major nerve centers of thrissur city including the Thrissur Collectorate, vilanganhills, amala institute of medical sciences, government law collage and many more are in the block. Many major automotive companies have commercial spaces here, including hero motors, tata motors, ford, Hyundai, Toyota, Suzuki, Honda, and more. a national level tennis academy is also attracting tennis players here. India's second largest and keralas largest international conventional center, is situated in Puzhakkal. Sobha groups Sobha city mall and sobha city, Keralas first and currently biggest integrated township is here with villas and high – rise luxury apartments, the only one of same in state having helipad facilities. West fort hitech hospital a speciality healthcare center is also to be here. A transit terminal mobility hub also to be set up on lines of vytila mobility hub to reduce traffic congestion was recently approved to be realized soon. Having a railway terminal also at amala nagar just 3km away. the suburb town may have major development scope in near future. Puzhakkal is always famous for the "Dharmasasthra temple" where the presiding deity is lord ayyappa. The St. Mary's church in Puzhakkal is another notable place of worship. Puzhakkal River is west ward flowing river in Thrissur district. It originates from Killanoor hills and empties into Thrissure kole wetlands. The length of river is 29 km and a total of 234sq.km drainage area. The main tributaries are Parathodu, Naduthodu, Poomalathodu and Kattachirathdu. The unique river tourism project was first inaugurated in December 2008 and is organised and administrated by the Adat pannchayat. Locally known as Puzhakkal padam, this river tourism project is known for boating and has a restaurant on the banks. There is an industrial park in puzhakkal. The park would be set up

in 50 acres. the enterprises to be set up include units for ornaments, apparels and diamond cutting. the yellow bamboos provide shade and breeze to the visitors. Boating is the major activity in this tourism village. Pandal boats, row boats, and shikkaras are available for boating. Earlier bowl boats were operating in the river. at Pzhakkal one can also engage in bird watching and fishing. numerous water birds are spotted on the river bed. with its lush green paddy feilds and the three canals flowing through them as a part of the peechi irrigation project, Puzhakkal is a place of scientific beauty.

2. Methodology

2.1 Materials Used For Floating Garden Preparation

Material for floating beds locally called Baira In addition to water hyacinth, deep water rice straw and different types of aquatic vegetation and pieces of bamboo are required to make a *baira*.

2.1.1 Bamboo

Bamboos are collected from neighbouring home. Collected bamboos are *Bambusa vulgaris*, which is golden yellow colour. It is widely used as an ornamental plant, and is very popular as that. 0.5cm to 2.5 cm in diameter. It is cut in to 45 cm long pieces. Bamboo frame is constructed; its size is about 45cm X 25 cm. seal the open ends of the bamboo with wax. Doing this will make the bamboo float better and will prevent it from rotting in water.



Fig1: bamboo pieces

2.1.2 Water Hyacinth

Water hyacinth (*Eichhornia crassipes*), an invasive aquatic species, is used to build rafts for floating vegetable cultivation. The decomposing raft is used to increase the soil fertility of land. Water hyacinth contains elements needed for plant nutrition (N, P, K) at concentrations comparable to cow dung. Because of the fertilizing properties of water hyacinth, crops mature faster on the floating garden beds. Thus, multiple crop cycles are possible in one season on one raft. One of the most important properties of Water Hyacinth is waste water purification. The principle behind the use of Water Hyacinth for waste water treatment is Photo remediation. That is the roots of the Water Hyacinth naturally absorb the pollutants including heavy metals like Lead, Mercury etc as well as the organic compounds. The plants which attained the optimum growth cause pollution in river water. So these can be used for the production of furniture, hand bags, rope, organic fertilizers and paper.



Fig 2: Water Hyacinth collected in Poly-ethene bag

Table 1: other materials used

Coir pith	
Dried cow dung	
Seed(marigold and red spinach)	

2.2 Methods

- Preparation of floating garden
- Sample collection
- Test for water qualities
- Comparison with IS specification
- Treatment of polluted river water with Floating garden.
- Comparison of water quality parameters before and after treatment

2.2.1 Preparation of floating garden

The treatment tank is placed at a suitable place. Bed is created using matured water hyacinth. The immature water hyacinth decomposes earlier than the mature ones. Therefore, the mature water hyacinth layer is generally used as foundation and the comparatively, the immature ones, are kept at the top of the floating bed. There is no recommended size or shape of the traditional floating bed. Thickness of bed is about 4 cm. The bed is covered with a thin layer of dried cow dung and coir pith. When the top layer turns black, the raft is ready for vegetable production. Red spinach and marigold seeds are used for the preparation of floating garden.



Fig 3: floating garden bed

After seven days due to the decomposition of water hyacinth the top layer turns black. Then the raft is ready for vegetable production. The decomposing top layer of the raft should always be moist to facilitate the decomposition. Therefore, the raft should be watered if there is no rain.



Fig 4: bed is covered with a thin layer of cow dung and coir pith



Fig 5: floating garden

2.2.2 Sampling of River Water

For the collection of water sample for testing physio-chemical parameters 1 liter plastic bottles are used. It is cleaned by rinsing with distilled or de-ionized water. Samples should be collected as far as possible, from mid stream. Sampling to near the bank provide fictitious result. Sites should be selected preferably where marked quality changes occur and where there are important river uses such as confluences, Major river discharges or abstractions. Sampling location can be fixed by reference to significant features. Samples can also be taken from boats whenever feasible for rivers and lakes. Unsafe banks should be avoided. Necessary samples should be made. The starting point of sampling is opposite to the Puzhakkal Tourism Restaurant. Samples were collected at an interval of 50m in the direction of river flow. The total number of sample is 5 and stretch covered is 200m.



Fig 6 sampling bottles and samples

2.2.3 Initial Water Quality Parameters

Table 2: Sampling Point-1 (Starting Point-0m)

Sl. No	Parameters	Unit	Value
1	pH	-	6
2	Alkalinity	Mg/l	55
3	Hardness	Mg/l	96
4	Turbidity	NTU	78
5	Dissolved Oxygen	Mg/l	3.8
6	BOD	Mg/l	112
7	COD	Mg/l	212
8	MPN	MPN	2400

Table 3: Sampling Point -2 (50m)

Sl. No	Parameters	Unit	Value
1	pH	-	6
2	Alkalinity	Mg/l	59
3	Hardness	Mg/l	85
4	Turbidity	NTU	76
5	Dissolved Oxygen	Mg/l	3.8
6	BOD	Mg/l	112
7	COD	Mg/l	198
8	MPN	MPN	2400

Table 4 Sampling Point-3(100m)

Sl. No	Parameters	Unit	Value
1	pH	-	6.5
2	Alkalinity	Mg/l	64
3	Hardness	Mg/l	72
4	Turbidity	NTU	58
5	Dissolved Oxygen	Mg/l	4
6	BOD	Mg/l	103
7	COD	Mg/l	190
8	MPN	MPN	2400

Table 5: Sampling Point -4 (150m)

Sl. No	Parameters	Unit	Value
1	pH	-	6.5
2	Alkalinity	Mg/l	68
3	Hardness	Mg/l	56
4	Turbidity	NTU	56
5	Dissolved Oxygen	Mg/l	4.2
6	BOD	Mg/l	92
7	COD	Mg/l	110

Table 6: Sampling Point -5 (200m)

Sl.No	Parameters	Unit	Value
1	pH	-	7
2	Alkalinity	Mg/l	73
3	Hardness	Mg/l	45
4	Turbidity	NTU	25
5	Dissolved Oxygen	Mg/l	4.5
6	BOD	Mg/l	56
7	COD	Mg/l	85
8	MPN	MPN	2400

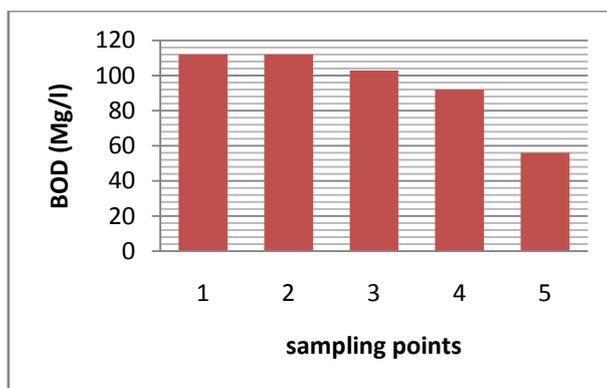


Fig 7: BOD in Different Points

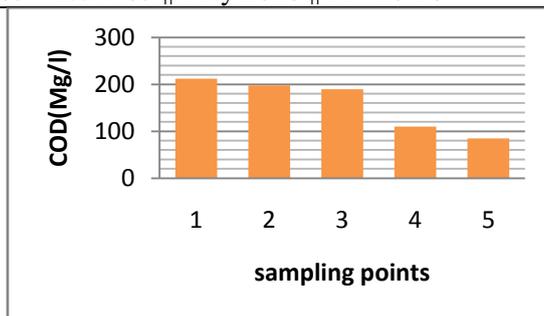


Fig 8: COD in Different Points

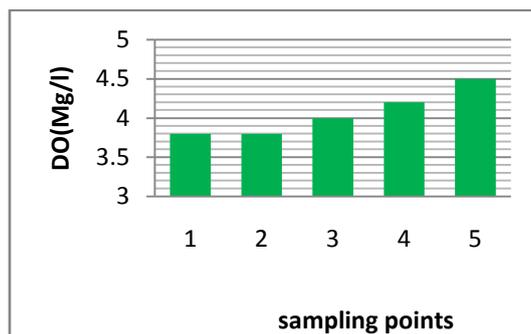


Fig 9: DO in Different Points

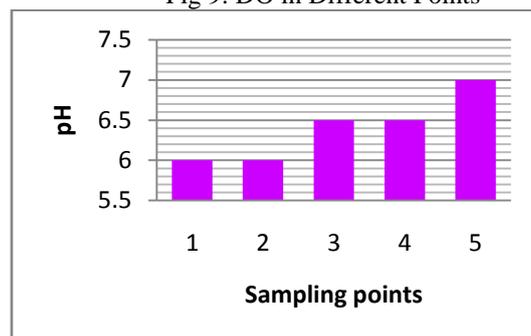


Fig 10: pH in Different Points

2.2.4 Comparison With Is Specification

The minimum dissolved oxygen content of potable water is 8 mg/l. For the existence of aquatic life in the river, the minimum dissolved oxygen content should be 4mg/l. From the above results we can see that alkalinity and hardness of river water is within the permissible limit. But pH, turbidity, dissolved oxygen, B.O.D, C.O.D, and MPN are not within the permissible limit. The values of B.O.D and C.O.D indicate heavy pollution in river water. River water contains coli form bacteria. But it can be observed that in the direction of flow of river the severity of pollution decreases. This property of river is known as self cleansing property. The Comparison of Results with the Is Code Specification indicates that the most polluted part is sampling point 1.

2.2.5 Treatment Setup

Quantity of river water taken for the experiment is 120 litres. It is taken from the most polluted part of the river (The water is collected from station-1).polluted water is treated with floating garden. The water quality parameters were analyzed after a pre determined time interval.



Fig 11: treatment setup

3. Results and Discussions

3.1 Parameters to Be Tested In Treated Water

Table 7: Water Quality Parameters before Treatment

Parameter	Value
pH	6
Dissolved Oxygen	3.8mg/l
B.O.D	112mg/l
C.O.D	212mg/l
M.P.N	2400

3.2 Water Quality Parameters after Treatment

Table 8: After 3 day's treatment

Parameters	Value
pH	6.5
Dissolved Oxygen	4.2mg/l
B.O.D	28mg/l
C.O.D	83mg/l
M.P.N	2400

Table 9: After 5 day's treatment

Parameters	Value
pH	6.5
Dissolved Oxygen	5mg/l
B.O.D	19 mg/l
C.O.D	65.1mg/l
M.P.N	2100

Table 10: After 7 day's treatment

Parameters	Value
pH	7
Dissolved Oxygen	5.9g/l
B.O.D	12 mg/l
C.O.D	32.3mg/l
M.P.N	2000

Table 11: After 9 day's treatment

Parameters	Value
pH	7.1
Dissolved Oxygen	9 mg/l
B.O.D	9 mg/l
C.O.D	16.8 mg/l
M.P.N	1600

3.2.1 Effects on Stabilization of pH by Floating garden

pH is one of the important factors which determines the presence of aquatic ecosystem. The pre-treatment analysis indicates that the river water is harmful to aquatic system. From the figure 12. It is seen that the pH value increases with increase in retention period. This revealed that the floating garden would directly influence the pH in the river water system.

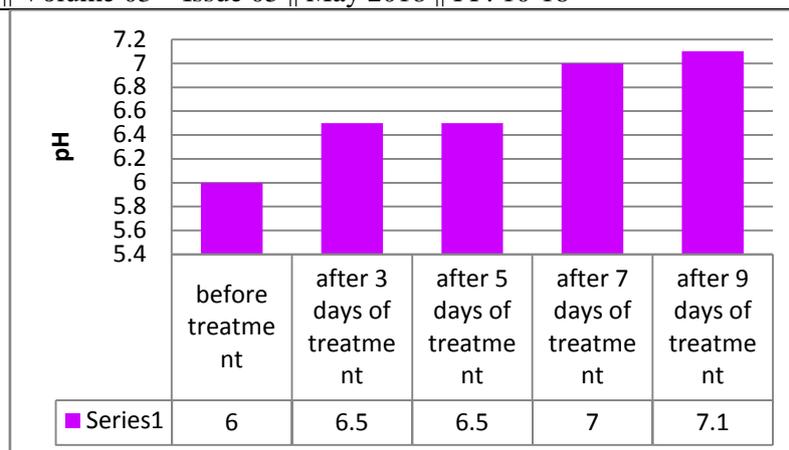


Fig 12: pH change after treatment

3.2.2 Effects on Stabilization of D.O by Floating garden

Aquatic organisms need dissolved oxygen to respire. It is necessary for the survival of fish, invertebrates, bacteria, and underwater plants. DO is also needed for the decomposition of organic matter. In the pre treatment analysis DO level is 3.8 mg/l, for the existence of aquatic life in the river, the minimum dissolved oxygen content should be 4mg/l. From the figure 13 it is seen that after 9 days of treatment DO value is 9 mg/l, that is DO value increases with increase in retention period.



Fig 13: D.O change after treatment

3.2.3 Effects on Stabilization of B.O.D by Floating garden

BOD (Bio chemical Oxygen Demand) was used to access the quality of river water system. BOD value of 112 mg/l depicts that the river contains some amount of sewage. After 9 days of treatment BOD level decreases to 9 mg/l. That is use of floating garden would enhance the aquatic life.



Fig 14: B.O.D change after treatment

3.2.4 Effects on Stabilization of C.O.D by Floating garden

Chemical oxygen demand (COD) is a measure of the capacity of water to consume oxygen during the decomposition of organic matter and the oxidation of inorganic chemicals such as Ammonia and nitrite. COD value of 212 mg/l depicts that the river is polluted. After 9 days of treatment COD level decreases to 16.8 mg/l.

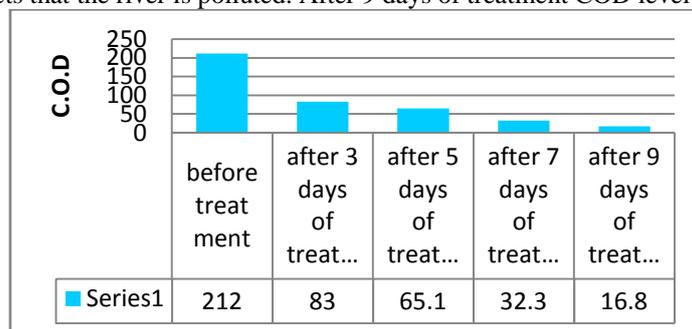


Fig 15: C.O.D change after treatment

4. Conclusions

On the basis of these analytical results the following conclusions can be drawn. According to the result obtained the alkalinity and hardness of Puzhakkal river water within the permissible limit. But the pH and turbidity of river water is not within the limit. The value of dissolved oxygen and BOD indicates heavy organic pollution of river water. The value of C.O.D is also very high indicating the presence of high concentration of biologically inactive pollutants. The river water contains coli form bacteria in high rate. Floating Garden project is a small scale experiment. Floating agriculture practices have minimal infrastructure and very little capital requirement. Costs can also be kept low because raw materials for the construction of floating beds are readily available from local waterways. Materials for floating beds are highly abundant. In particular, water hyacinth is usually classified as one of the worst invasive species. For that reason, farmers can easily use it as floating bed or composts without any additional cost. Floating gardens act as sponges, filtering and cleaning water, as well as helping to provide wildlife with a safe habitat. The efficiency of floating garden in treating the polluted river water was studied. The results of the study show that floating garden is effective in reducing the severity of pollution in river water. Percentage removal efficiency of B.O.D is 91.96%, COD is 92.07% and coli form bacteria is 33.33%. Most polluted area of Puzhakkal River contains large amount of water hyacinth. The reason for the fast growth of water hyacinths is pollution caused by waste disposal. The ever growing amount of water hyacinth has polluted and blocks the flow of water. Floating gardens in river provide a very good use of water hyacinth and an effective way to control this notorious weed. Floating garden technique is very cheap and environmental friendly process.

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