

A Study to Delineate Water Bodies for Farming of Green Mussel (*Perna viridis*) in Kannur District of Kerala (South India)

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ABSTRACT: Farming of green mussel (*Perna viridis*) in backwaters is very popular in North Kerala (South India) especially in Kannur and Kasargod districts. However farming is more or less restricted to a few water bodies viz., Valiaparamba backwaters in Kasargod district and Payangadi- Madakkara and Dharmadam-Thalassery region in Kannur district. Crowding together of a large number of farm units in a few water bodies is expected to result in adverse effects on the sustainability of farming operations. In the context there is a need to assess the carrying capacity of each water body, for mussel farming. However no such studies are known to exist on Kannur district. In the context, the present study is undertaken. The present study is to identify areas suitable for mussel farming in various backwaters and estuaries of Kannur district of Kerala, based on occurrence of suitable salinity for growth of mussel at least for six months in a year. It also intends to estimate the number of farming units that various water bodies can accommodate comfortably. Based on the results of the present study it was concluded that around 50 km stretch of the lower reaches of rivers/ back waters/ estuaries in Kannur district are suitable for undertaking mussel farming. The present study also indicated that around 1000 mussel farming units each of 100m² area (10mX10m) can be set up in these water bodies.

KEY WORDS: *Perna*, green mussel, mussel farming, backwaters, Kannur district

I. INTRODUCTION

Farming of green mussel, *Perna viridis* (Linnaeus) in backwaters is very popular in North Kerala (South India). More than 1200 farm units are currently under operation in Kasargod and Kannur districts, the Northern most districts of Kerala state, alone. Principally owing to the higher profitability and lower risks involved, many new units are being set up every year, in this part of the state.

The mussel farmers in North Kerala employ rack culture method. Racks are fabricated placing bamboo poles vertically and horizontally tying and lashing with nylon/ coir ropes. Bamboo poles are driven into the bottom spaced at a distance of 1-2 m. These stakes are connected horizontally with bamboo poles, which are positioned above the level of water at high tide, and seeded ropes are suspended from them. Mussels are not given any external feeds and they feed on the phytoplankton available in the surrounding water. The rearing period lasts for 6- 7 months.

Farming of mussel in Kasargod and Kannur districts of North Kerala is restricted to a few water bodies viz., Valiaparamba backwaters in Kasargod district and Payangadi- Madakkara and Dharmadam-Thalassery region in Kannur district [1]. Crowding together of a large number of farming units within a very small area is expected to result in adverse effect on the sustainability of farming operations. In the context there is a need for ascertaining the number of farming units that each water body can accommodate comfortably (carrying capacity) and for extending farming operations to new areas, in case the number of units exceeds the capacity.

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II. RELATED WORKS

Studies have been conducted in the past on various aspects of farming of mussel in back waters of North Kerala [2- 8]. In some of these studies water bodies suitable for farming of mussels have been identified. Recently a study was conducted to delineate water bodies for farming of green mussel in Kasargod district of Kerala [2]. However no such studies are known to have conducted on the extent of water bodies suitable for mussel farming in Kannur district. In the context, the present study was undertaken. The study was to delineate areas suitable for mussel farming in various backwaters and estuaries of Kannur district of Kerala. In the study an attempt was also made to enumerate the farming units functioning at present in each estuary/ backwater. An effort was also made to estimate the number of farming units that the water bodies can accommodate comfortably (carrying capacity).

III. METHODOLOGY

In the study the methodology adopted by Sahadevan [2] in the case of water bodies of Kasargod district is employed. As an initial step downstream portions of various rivers/ backwaters and estuaries of Kannur district (fig. 1) were visited in an out board engine fitted craft to study the nature of the area and to know whether they are being used for purposes other than mussel farming. The backwaters and estuaries visited included Mahe river, Koyyali river, Dharmadam river, Valapatanam river, Kuppam river and Perumba river. Some of these water bodies have more than one streams/ branches. In such cases all streams/ branches were visited and information collected. During the visit details regarding the number of farm units functioning at present, if any, in these water bodies were also gathered.

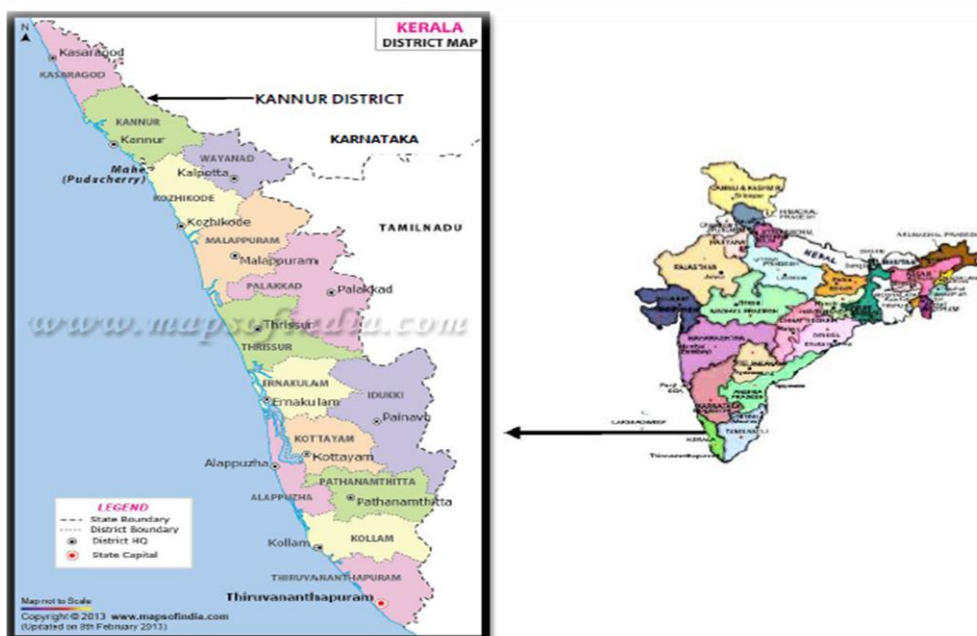


Fig. 1. Map showing the study area viz., Kannur district of Kerala

For an area to become suitable for mussel farming it should satisfy certain conditions which were discussed by Appukkuttan *et al.* [8]. A perusal of these indicated in unambiguous terms that salinity was the most important critical factor in determining the suitability of an area for mussel culture. For ideal growth green mussel requires a salinity ranging from 27ppt to 35ppt [9]. Similarly, discussion with the farmers undertaking mussel farming and perusal of

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available literature on the subject showed that green mussel requires 6-7 months for reaching marketable size in this part of the state. South-West monsoon in the region starts by the last week of May/ first week of June and harvesting in all cases have to be done invariably before this. Otherwise mussel would detach from the rope and the crop would fail. In other words, an area to be suitable for mussel farming should have a water salinity of 27ppt or above by the first week of December [2]. In view of this a decision was taken to measure the salinity of water bodies at different stations in the downstream portion of the water bodies mentioned above during the period of December - May. Salinity was measured at stations starting from the bar mouth in each back water/ estuary with an interval of one kilometer towards the upstream portion. To avoid duplication, in the case of main stream of the water body the bar mouth and in the case of the branches the point of deviation from the main stream were taken as the starting points. The stations were identified precisely with the help of a GPS (Geo Position System). The salinity was measured with the help of an ordinary refracto- salino metre. Water salinity at each station was measured twice during a month in the second and fourth weeks of each month with a gap of 15 days, almost at the same time of the day. The study was conducted for two seasons during 2014- 2016 (from December 2014 to May 2015 and from December 2015 to May 2016). For each station the average of the four observations viz., two observations in a month in each year was calculated and used for arriving at conclusions.

In each water body the distance (of the station) up to which the average salinity was 27ppt and above (for at least six months) and which was not in use for other activities were considered as suitable for farming mussel. Since for the conventional rack farming of mussel, a water depth of minimum one metre is required, only areas with more than one metre depth were considered. The number of units of mussel farming which the water bodies can accommodate were estimated considering the unit farm size as 100m² (10mx10m) and assuming that within a distance of one kilometer an average of 20 units (10 on each bank of the water body) could function comfortably [2].

IV. RESULTS AND DISCUSSION

The data on salinity at different locations in various rivers (downstream portions)/ backwaters of the district from South to North collected during the present study are presented below.

Mahe river lies at the southernmost boundary of Kannur district. The data on water salinity at different stations of the river are presented in fig. 2. It may be seen from the figure that suitable salinity for the best growth of green mussel (≥ 27 ppt) exists only in five stations during the period from December to May, in the river.

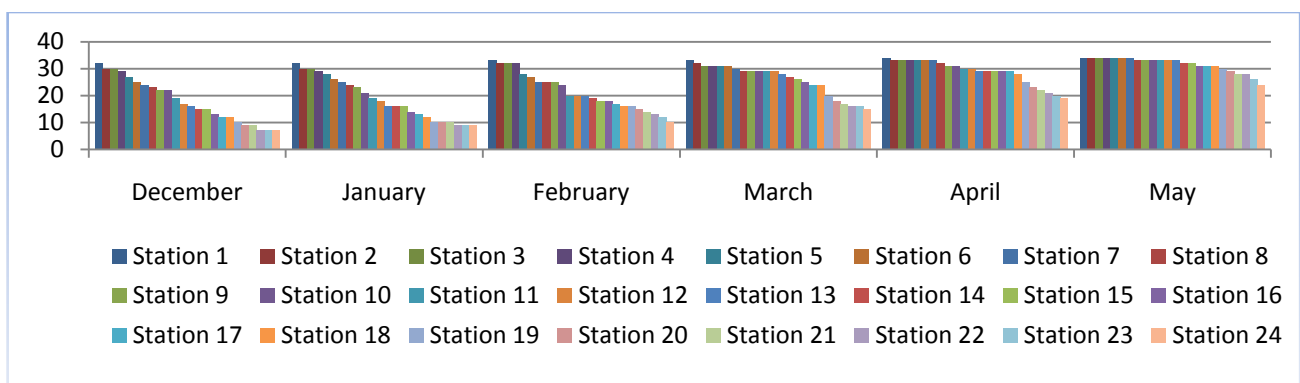


Fig. 2. Water salinity at different stations in the downstream portion of Mahe river

Besides the main course which flows towards Andallur region, Koyyali river has a principal branch flowing towards Koduvally area. The data on water salinity at different stations in the downstream portion of Koyyali river flowing towards Koduvally area are presented in fig. 3 and those related to the main stream of the river which flows towards Andallur region are presented in fig. 4. It may be seen from the figure that suitable salinity for the best growth of green

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mussel exists in nine stations during the period from December to May, in Koyyali river flowing towards Koduvally. In the main stream which flows towards Andallur, six stations have suitable salinity during the period.

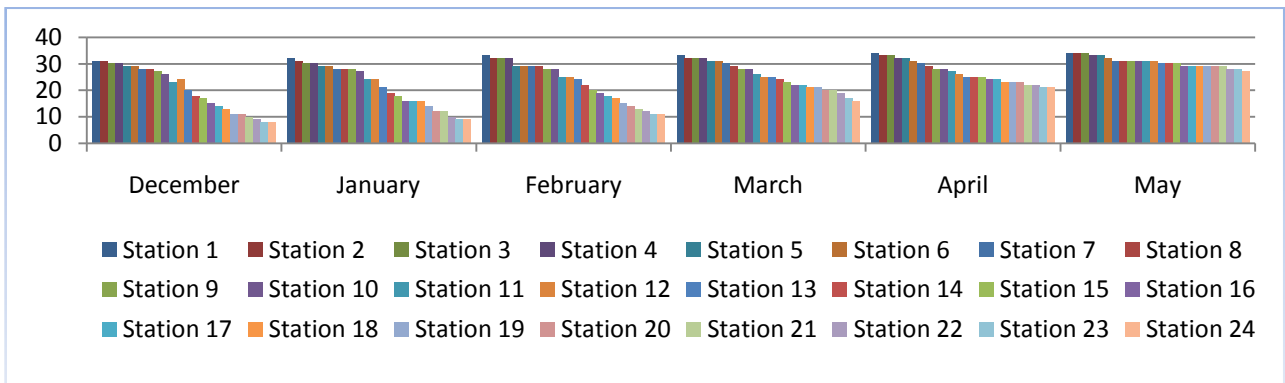


Fig. 3. Salinity of water at different stations in the downstream portion of Koyyali river (towards Koduvally)

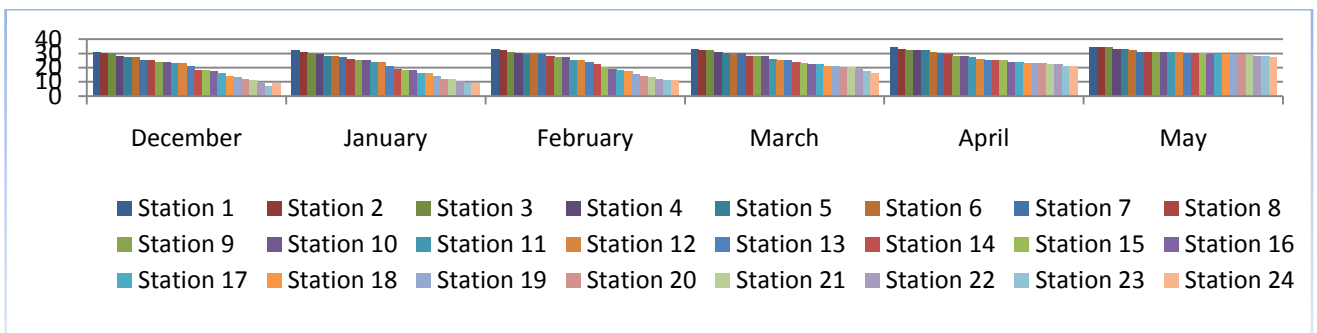


Fig.4. Salinity of water at different stations in the downstream portion of Koyyali river (main stream-towards Andallur).

The data on water salinity at different locations in the downstream portion of Dharmadam river are presented in fig. 5. It may be seen from the figure that suitable salinity for the best growth of green mussel exists in six stations during the period from December to May, in the river. .

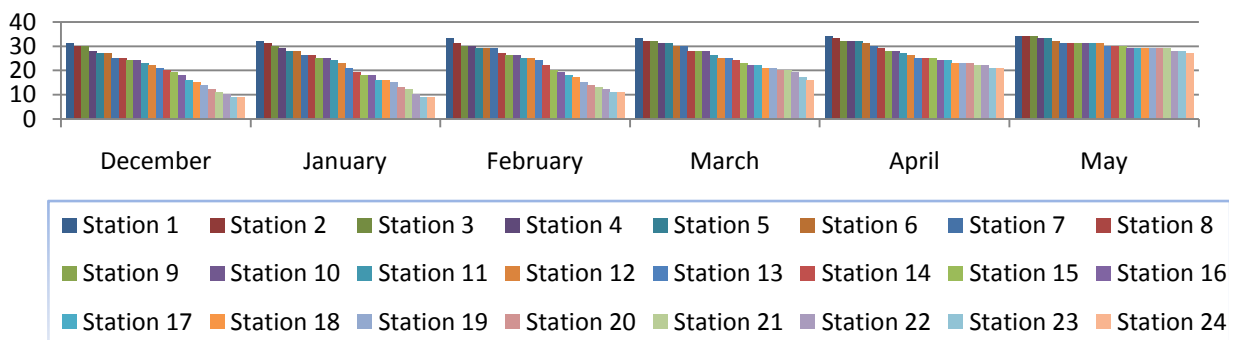


Fig.5. Salinity of water at different stations in the downstream portion of Dharmadam river

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Valapatnam river has two principal streams. The first one flows towards Kattampally region and the second one flows towards Kannapuram. The data on water salinity at different stations in the downstream portion of the river which flows towards Kattampally area are presented in fig. 6 and those related to the branch flowing towards Kannapuram region are presented in fig. 7. Suitable salinity for the best growth of green mussel exists in six stations during the period from December to May, in Valapatnam river flowing towards Kattampally. In the stream which flows towards Kannapuram, five stations have suitable salinity during the period.

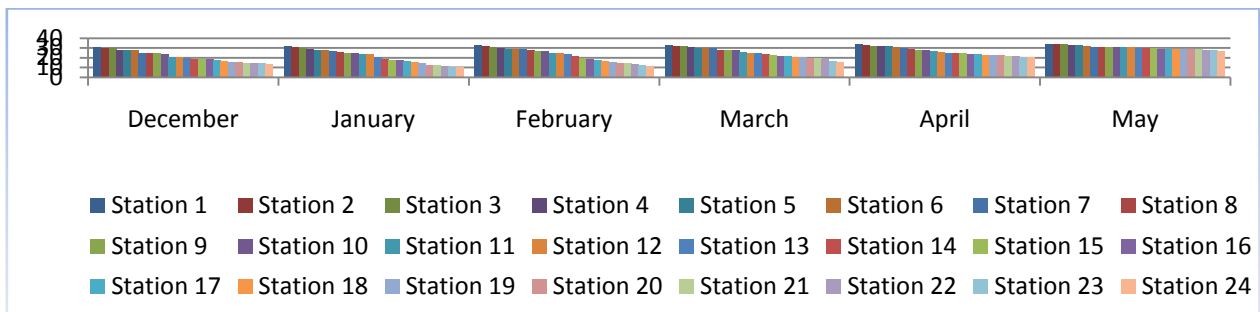


Fig. 6. Water salinity at different stations in the downstream portion of Valapatnam river (towards Kattampally)

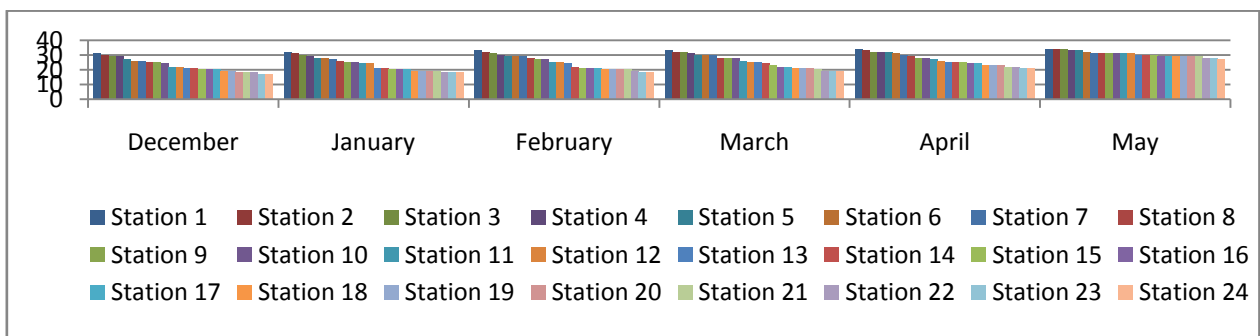


Fig.7. Water salinity at different stations in the downstream portion of Valapatnam river (towards Kannapuram)

The data on water salinity at different locations in the downstream portion of Kuppam river are presented in fig. 8. Suitable salinity for the best growth of green mussel exists in eight stations in the river.

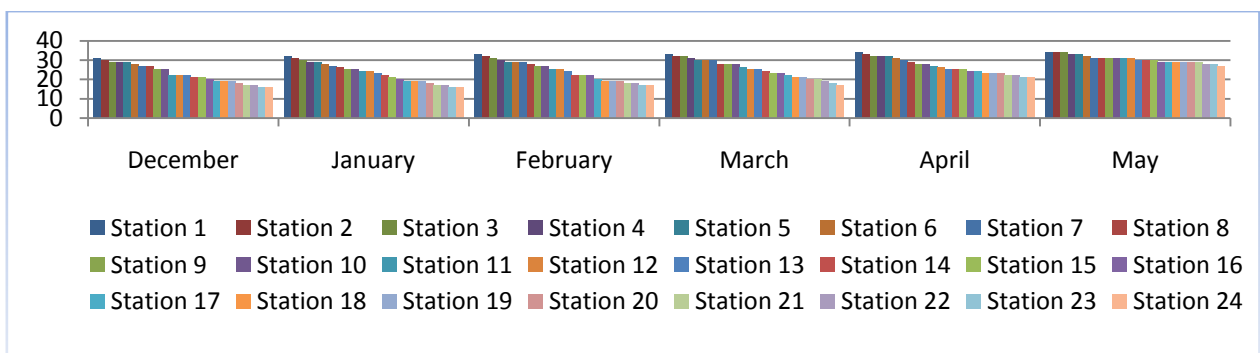


Fig.8. Water salinity at different stations in the downstream portion of Kuppam river (Payangadi)

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The data on water salinity at different stations in the downstream portion of Perumba (Palakode) river are presented in fig. 9. The river is the northern most river of Kannur district. Suitable salinity for the best growth of green mussel exists in five stations during the period from December to May, in the river.

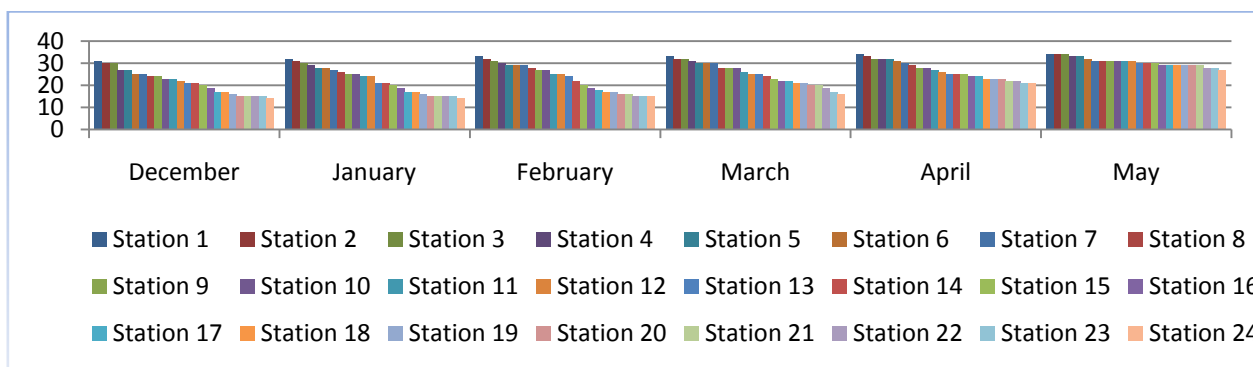


Fig.9. Water salinity at different stations in Perumba (Palakode) river

Water salinity at different stations in the back waters and estuaries (downstream portions of various rivers) of Kannur district in the month of December are presented in table 1.

Table1. Water salinity at different stations in the downstream portions of rivers/ back waters of Kannur district in the month of December.

Backwater/ estuary	Salinity at different stations (ppt)																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mahe river	32	30	30	29	27	25	24	23	22	22	21	17	16	15	15	13	12	12	10	9	9	7	7	7
Koyyali river (towards Koduvally)	31	31	30	30	29	29	28	28	27	26	23	24	20	18	17	15	14	13	11	11	10	9	8	8
Koyyali river (main stream-towards Andallur)	31	30	30	28	27	27	25	25	24	24	23	23	21	18	18	17	16	14	13	12	11	9	7	9
Dharma dam river	31	30	30	28	27	27	25	25	24	24	22	22	21	20	19	18	16	15	14	12	11	10	9	9
Valapattanam river (towards Kattampally)	31	30	30	28	28	28	25	25	25	24	21	21	20	19	19	19	18	17	16	16	15	14	14	13

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Valapatnam river (towards Kannapuram)	31	30	29	29	27	26	25	25	25	24	22	22	21	21	20	20	20	19	19	18	18	17	17
Kuppam river (Payangadi)	31	30	29	29	29	27	27	25	25	22	22	22	21	21	20	19	19	19	18	17	17	16	16
Perumba (Palakode) river	31	30	30	27	27	25	24	24	23	23	22	22	21	21	20	19	17	17	16	15	15	15	14

In each water body the distance (of the station) up to which the average salinity was 27 ppt and above (for at least six months) and which was not in use for other activities are presented in fig. 10. Based on salinity distribution studies it may be concluded that 50km stretch of the lower reaches of rivers/ back waters in the district are suitable for undertaking green mussel farming.

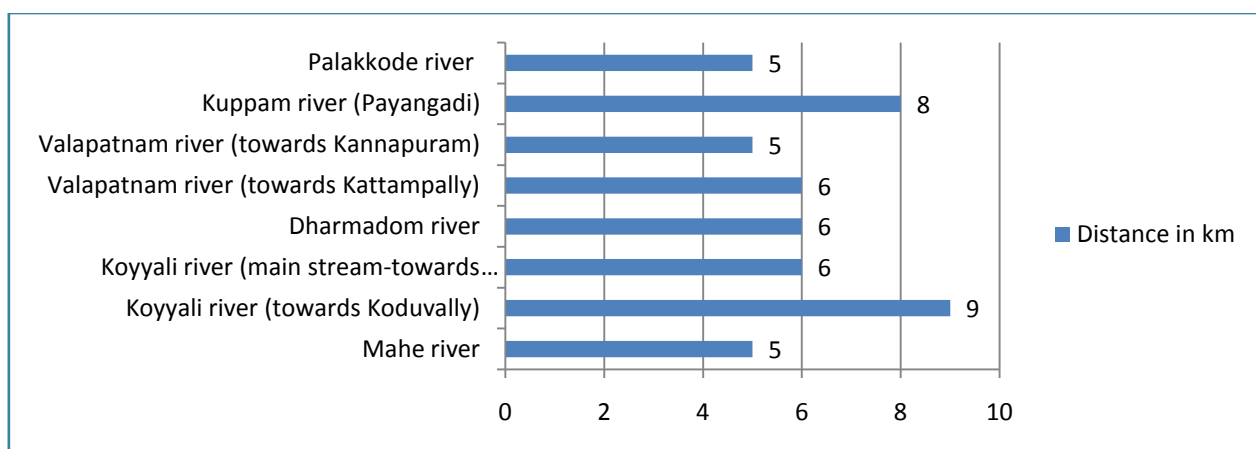


Fig. 10. Distance up to which mussel farming can be undertaken in various backwaters and estuaries in Kannur district.

Details regarding the number of mussel farming units functioning at present in different water bodies are presented in table 2. The table also contains the information on the estimated number of mussel farming units which can function comfortably in various water bodies. These were estimated considering the unit farm size as 100m² (10m x10m) and assuming that within a distance of one kilometer an average of 20 such units (10 on each bank of the water body) can function. Results of the present study indicated that 1000 mussel farming units each with 100m² area (10m x10m) can be set up in the back waters/ estuaries of Kannur district (table 2).

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Table 2. Number of mussel farming units functioning at present and the recommended number of mussel farming units in various estuaries and back waters of Kannur district.

Estuary/ back water	Number of units functioning at present	Distance from the bar mouth (km) up to which farming can be done	Number of mussel farming units recommended
Mahe river	Nil	5	100
Koyyali river (towards Koduvally)	9	9	180
Koyyali river (main stream-towards Andallur)	0	6	120
Dharmadam river	12	6	120
Valapatanam river (towards Kattampally)	Nil	6	120
Valapatanam river (towards Kannapuram)	21	5	100
Kuppam river (towards Payangadi)	18	8	160
Perumba (Palakode) river	5	5	100
Total	65	50	1000

Estuaries and backwaters in Kannur district of Kerala suitable for farming of mussels have been identified by various authors in the past [3, 4, 5, 8]. However no effort has so far been made to delineate the areas suitable for mussel farming in each water body in Kannur district and to estimate the number of units that the water bodies can contain comfortably (carrying capacity). For the first time, in the present study an attempt was made to mark out the areas in each estuary/ backwater suitable for mussel farming in the district and to estimate the carrying capacity of the water bodies.

In the present study the areas have been delineated based on the availability of water with a salinity range ideal for the best growth of green mussel at least for a period of six months. Although most species of molluscs tolerate a certain range of salinity levels and some species are truly euryhaline, the best growth is elicited only within a narrow range of salinity. Success in commercial farming can be achieved only by ensuring the ideal environmental conditions. *P. viridis* is reported to tolerate a high range of salinity. Sivalingam [10] observed that the species has 50% survival salinity tolerance at 24 ppt and 80 ppt for a period of 2 weeks in a laboratory experiment. However, for the best growth the species requires salinity between 27 and 35 ppt [8, 9]. When the salinity value falls below or rise above the range for prolonged periods high mortalities occur. In mussel farming, drop in salinity, mainly caused by the influx of large volumes of fresh water from rivers or land run off during the rainy season, is usually the most important reason for crop failure [11]. Under the situation, selection of salinity as the sole criteria for delineation of areas suitable for farming mussel is justified. In an earlier study Sahadevan [2] delineated water bodies suitable for green mussel farming in the adjacent district of Kasargod in Kerala using the same methodology.

There are many other factors which must also be satisfied to ensure the commercial success in farming of mussels. Various authors discussed these factors in detail [8-16]. Indeed, the factors like nature of substrate, depth of water, tidal amplitude, water movement, water turbidity, availability of food organisms, source of seed, water pollution, poaching, resource competition and economic factors must also be considered while determining the suitability of a site for green mussel farming. However such elaborate approach is beyond the scope of the present study and hence the results of the present study must be approached with reservation. The present study is the second of its kind in this part of the state, the first one being the one undertaken by Sahadevan [2].

Results of the study indicated that in the estuaries and backwaters of Kannur district 1000 units of mussel farming each of 100m² area can function comfortably. The estimate of the number of mussel farming units that can comfortably function in the various estuaries and back waters arrived at in the study is based on conservative assumptions but with the suitability of the site, competitive uses of the site and sustainability of the culture practices based on sound ecological and precautionary principles in mind. In view of these, the results have relevance in taking management decisions.

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The study also revealed that at present 65 mussel farming units are functioning in the backwaters of Kannur district. Considering the recommended number of units it may be assumed safely that there is further scope for setting up more number of units in these water bodies.

IV. CONCLUSIONS

The present study was undertaken to delineate areas suitable for mussel farming in various backwaters and estuaries of Kannur district of Kerala. The study indicated that in these water bodies, 1000 mussel farming units each of 100m² area can function comfortably. The number of mussel farming units was estimated based on the availability of water salinity suitable for the growth of green mussel, suitability of the site in terms of depth, competitive uses of the site and sustainability of the culture practices based on sound ecological and precautionary principles in mind. The study revealed that there is very good scope for setting up more number of units in these water bodies.

V. ACKNOWLEDGEMENTS

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