

Impact of Tsunami on the Ecology, Species Composition and Production in an Interior Prawn Filtration Field in Kochi.

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The impact of the tsunami of 26th December, 2004 on the ecology, species composition and production in the prawn filtration practice of an interior field of 0.75 hectare belonging to the Instructional Farm of the College of Fisheries, Panangad, Kochi, has been studied during the period from January 2005 to June 2005. Important physico-chemical and biological parameters in the field were monitored in relation to production at periodical intervals. The soil and nutrient profiles in the field have also been evaluated. The availability of the various shrimp/fish species in the field which depends on auto stocking is a reflection of the natural recruitment. A total production of 1066.07 kg/ha in 135 days was obtained during the year 2005. A comparison of the production of the current season with that of the previous three years has also been attempted.

Key words : Prawn filtration, Tsunami, Species composition, Production

The prawn filtration is a traditional, extensive culture, practiced in the low lying coastal paddy fields of Kerala in the districts of Ernakulam, Alappuzha and Thrissur in about 26,400 hectare (Tomy *et al.* 1984). Auto stocking is adopted in the fields wherein the seed of different species of shrimps and fishes brought in by the incoming high tides are let into the fields, while water is let out during low tides through meshed screen in the sluice gates installed at appropriate places. Stocking is a continuous process during the saline phase in the backwater extending from November-April/ May. During the rainy season from June to November, a crop of saline resistant Pokkali variety of paddy is raised in these fields (Rajendran *et al.* 1993). The extensive type of culture practice adopted in these fields is

environment friendly. It can be considered as an innovative type of organic farming since the culture is entirely dependent upon natural inputs and there is no use of hormones, chemicals, drugs, inorganic fertilizers or even extraneous feed at any point of time. The mangrove vegetation which abounds in the coastal areas adjoining these fields help in maintaining a rich nutrient status and forms a rich feeding pasture to the shrimp and fish larvae. The average yield from the interior filtration fields is reported to be 500 – 650 kg/ha, while the fields near the coast produce 700 – 1250 kg/ha (George, 1974; Unnithan, 1985; Mammen, 1984). The range of production in the prawn filtration field in the College of Fisheries is seen to be between 908.4 – 1095.1 kg/ha/season. The normal prawn filtration season as

well as stocking activities in the field were disrupted during the year 2004–2005 due to the unexpected natural catastrophe in the form of tsunami which was triggered by the earthquake off the Sumatra coast on 26th December 2004. The aftermath of the tsunami on the prawn filtration operations, general ecology, species composition and production in a field having an area 0.75 hectare belonging to the Instructional Farm of the College of Fisheries, Panangad, Kochi during the current season (2004 – '05) has been assessed and compared with the production scenario of the previous three years.

Materials and Methods

The prawn filtration field in the Instructional farm of the College of Fisheries is located adjacent to the Vembanad estuary between Kumbalam and Panangad islands, about 10 km south of Cochin bar mouth (Fig. 1). The effective water spread area in the field is 0.75 hectare, the south-eastern part of the field having a canopy of mangrove vegetation. The north-western border of the field adjoins the backwaters and a box sluice of dimension 3.1 x 1 x 1 m installed in the northern part is the main water exchange device. The western boundary is strengthened with stone masonry bunds about 1 m high, while the bund adjacent to the sluice is earthen. The preparation of the field which included removal of floating weeds, deepening of channels, strengthening of earthen bunds and installation of sluice gates with its lift shutters and screens was completed by the second week of December, 2004.

The stocking operation had just begun when the tsunami lashed on December 26, 2004, totally submerging the field with the surging tidal water. Water began to recede slowly after two days.

The prawn filtration was resumed from 20th January, 2005, after repairs to masonry

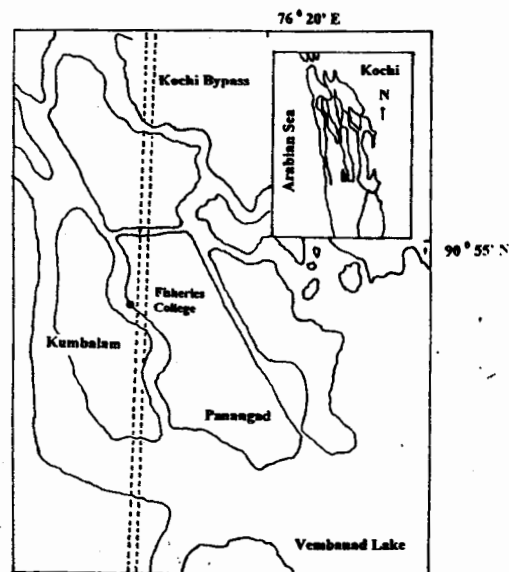


Fig. 1. Map showing the site of investigation

bunds and sluice gate. Important water quality parameters in the field *viz.*, water temperature, transparency, depth, pH, dissolved oxygen, salinity, silicate, nitrate, phosphate and total alkalinity were monitored at periodical intervals as per standard methods (AOAC, 2000). Zooplankton was collected using a standard plankton net while a van-veen grab was used for collecting benthic fauna at periodical intervals to assess their qualitative and quantitative composition. The soil profile in terms of the percentage of sand, silt and clay was determined by standard method. Harvest operations started from the last week of February, 2005, coinciding with the lunar phases when maximum water drainage was possible during low tides. Standard conical filtration net about 5 m long with mesh size of 5mm was used for harvesting the shrimps while fishes were harvested by cast netting and hand picking, during the first week of June when the filtration operation was concluded. Species composition and quantity of shrimps harvested periodically were computed while the total quantity and species composition of different species of fishes were worked out after the final harvest in the field.

Results and Discussion

The details of physical, chemical and biological analysis of water is presented in Table 1. The water depth of the field ranged between 30 and 85 cm during high tide, the depth being lowest in places where soil accretion had occurred. Shallow areas were also discernible in the south-eastern part of the field where a canopy of mangrove vegetation comprising *Avicennia officinalis*, *Acanthus illicifolius*, *Rhizophora mucronata*, *Bruguiera cylindricum*, *Acrostichum aureum*, *Kandelia candel*, *Soneratia caseolaris* and *Excoecaria agallocha* flourished. During low tide, the depth of water ranged between 15 and 40 cm. Water temperature in the field ranged between 29 and 32.5°C. The initial salinity in the field was observed to be 12.0 ppt during the current year, since the filtration activity started only in January, while in the previous year, the initial salinity in November at the start of prawn filtration was 3 ppt. The dissolved oxygen recorded during the current year was 4.20 ppm as against 2.4 ppm during the previous year which may be due to the death and decay of aquatic weeds present in the field with the onset of saline phase during November in 2003-04. During the post tsunami

filtration period, there was no trace of aquatic weeds due to the thorough flushing of the field which occurred with the heavy surge of water with tsunami. The nitrate values of 0.05 - 0.25 ppm and phosphate 0.22 - 0.35 ppm, and silicate 20.5 - 60.5 ppm were found to be higher during the current season, which indicates the higher fertility level in the field during the current season. Total alkalinity was in the desirable range (25 - 75 ppm) during the current year as against the minimum value of 15 ppm during 2003 - '04 (15 - 60 ppm). The percentages of clay, silt and sand in the field were seen to be 14.3, 15.25 and 70.45 respectively during the current season whereas in the previous year the percentage of clay was higher being 20.60 while that of silt was 14.3 and sand 65.2. Zooplankters were mainly comprised of copepods, nauplii of crustaceans, veliger larvae of molluscs, fish eggs, polychaete larvae, etc. The number of zooplankters per litre were minimum (10 no/l) in the initial collection in 2005, but it slowly built up to 35 no/l towards the end of April. The maximum density of benthic organisms of 183 no/ m² was also noticed during April (Table 1). Gopalan *et al.* (1987) have recorded a water temperature of 33 °C, salinity of 28.4 ppt, pH of 6.4 and dissolved oxygen of 5.44 ppm during the pre- monsoon season in the Vembanad estuary in Kumbalam region. The benthic organisms in the area, according to him were chiefly constituted by bivalves and polychaetes containing 157 no/m² whereas in the present study it was found to be 183 no/m² during the corresponding season. Aravindakshan *et al.* (1992) observed that in the prawn culture fields in the Cochin backwaters, substratum with more sand and clay was more conducive for faunal production. The comparatively higher production rates obtained in these field under study seem to support this since the percentage of sand is relatively high ranging between 65.20-70.45. Venkatesan *et al.* (2001) have reported that

Table 1. Range of physico-chemical and biological parameters in the prawn filtration field during pre-tsunami (2003-04) and post-tsunami (2005) period

Parameter	Range (post-tsunami) Year 2005	Range (pre-tsunami) Year 2003-'04
Low tide (cm)		
High tide (cm)	15 - 40	30 - 85
Water temperature (°C)	29.0 - 32.5	29.5 - 34.0
Transparency (cm)	30 - 35	30 - 40
pH	7.0 - 8.5	6.0 - 10.5
Salinity (ppt.)	12.0 - 26.0	3.0 - 27.0
Dissolved oxygen (ppm)	4.2 - 6.5	2.4 - 6.7
Total alkalinity (ppm)	25 - 75	15 - 60
Nitrate (ppm)	0.05 - 0.25	0.01 - 0.11
Phosphate (ppm)	0.22 - 0.35	0.02 - 0.20
Silicate (ppm)	20.5 - 60.5	8.1 - 50.5
Soil composition		
(%) Sand, Silt, Clay	70.45, 15.25, 14.30	65.20, 14.30, 20.60
Zooplankton (no./l)	10-35	6 - 30
Benthos (no./m ²)	nil - 183	nil - 215

the shrimp farming ponds located in Vypeen, Kochi are of silty clay type.

The prawn filtration operation which is usually concluded by the last week of April during normal years was extended up to first week of June during the current year since it was started only by January end due to tsunami. High recruitment of shrimp larvae and fish seed could be observed towards the end of April and by continuing the operation, the production could be enhanced. The yield from the field during the current season from 22 - 1 - 2005 to 7-6-2005 worked out to 799 kg with 699 kg of shrimps consisting of *Metapenaeus dobsoni*, *Fenneropenaeus indicus* etc. and 100 kg of assorted fishes from the 0.75 ha field. The details of the species composition and their percentage contribution during the current year and that of the previous three years are given in Table 2. A high recruitment of the Indian white shrimp, *F. indicus* was observed during the current year contributing to 131 kg (16.43 %) of small sized *F. indicus* (75 – 80 mm; 8 – 10.5 g), the corresponding figures during the previous years during 2003-'04, 2002-'03 and 2001-'02 being 60 kg (8.81%), 14.15 kg (1.87%), 94 kg (11.48%).

The relatively small size of the white shrimp during the current season indicates its late recruitment as compared to the previous years. The same phenomenon was noticed in the case of fishes too. Though a large number of fishes were brought in by the high tide water, they had attained a size range of only (50 – 100 g) due to the short duration available for their growth. The contribution of high valued brackish water fishes like *Etroplus suratensis* was also seen to be only 0.5% with a size range of 30 – 75 g as against its percentage contribution of 1.57 % in the previous year with size range of 50 - 150 g. During the year 2002-'03 and 2001-'02 the percentage contribution of *E. suratensis* were seen to be 1.88 and 1.26 respectively. Though *E. suratensis* breeds throughout the year

Table 2. Species composition and production in the Prawn filtration field in the Instructional Farm of the College of Fisheries, Panangad from 2001-2005

Species	2001-'02 Quantity (kg)	2002-'03 Quantity (kg)	2003-'04 Quantity (kg)	2004-'05 Quantity (kg)
<i>M. dobsoni</i>	480.3	560.9	488.5	563.75
<i>M. monoceros</i>	92.7	52.15	16.5	—
<i>F. indicus</i> -small	94.3	14.15	60.0	131.35
<i>F. indicus</i> -large	15.0	6.5	7.3	4.1
<i>P. monodon</i>	5.0	2.5	4.2	0.400
<i>L. parva</i>	16.2	11.3	14.35	12.3
<i>E. suratensis</i>	10.35	14.3	10.7	4.15
<i>Tilapia</i> sp.	45.55	32.2	18.15	11.35
<i>Caranx</i> sp.	7.0	2.0	9.3	9.15
Miscellaneous	9.0	4.0	5.1	11.55
Trash	40.0	54.4	45.5	50.45
Mud crab	6.0	3.5	1.7	1.0
Duration in days	150	145	145	135
Production in kg in 0.75ha.	821	757	681	799
Production in kg/ha	1095	1010.	908	1066

two peaks are reported, one from December – February and the other from July – April (Jayaprakas and Nair, 1981). The trend of *E. suratensis* production during the current year seems to suggest that the December –February breeding season of the fish has been affected. The contribution of *Tilapia*, another important component in the prawn filtration, was seen to be 1.45% as against 2.66%, 4.25% and 5.54% during the three previous years respectively. The numerous breeding pits of *Tilapia* which are usually seen as shallow excavations in the bottom of the fields were entirely absent during the current season. The contribution of mullets, another important group is 1.54% with a size range of 30-75 g (2005) as against 2.11 %, 1.49% and 1.97% in the previous years with a size range of 35 -120 g. The miscellaneous species included, juveniles of *Chanos chanos*, *Elops machnata*, *Megalops cyprinoides*, *Sphyrna* spp., *Gerres filamentosus*, *Platycephalus* spp. and different species of gobiids whereas the trash fish included *Ambassis* spp, *Oxyurichthys* spp., *Therapon jarbua*, *Scatophagus argus*, *Anadontosoma chacunda*, *Etroplus maculatus*, *Thriassocles malabaricus* etc. The contribution of miscellaneous species during the current season

was 11.55 kg (1.45%) and that of trash fishes was 50.45 (6.3%) in the total production which indicates the recruitment of these fishes in large numbers. The availability of the mud crab, *Scylla serrata* has been found to decrease and only small sized crabs could be obtained contributing to 0.12%. The corresponding % contribution of the crab during the three previous years was seen to be 0.24, 0.46 and 0.73 respectively.

The overall production from the field does not seem to have been affected and a production of 1066.07 kg/ ha/ 135 days is comparatively high in spite of the belated season of operation. An analysis of the production details of the three previous years (2001-02, 2002-03, 2003-04) reveals that it ranged between 908 kg- 1095 kg/ ha/135-150 days. This indicates that a high fertility had been built up in the inshore waters, as well as in the estuarine areas as a result of mixing of water due to the tsunami. According to George (1974) the average production of shrimps in seasonal fields is 903 kg/ha/season. Mammen (1984) while reviewing the status of shrimps in the pokkali fields has pointed out that the production has come down to 735 kg/ ha during 1977-78. According to George (1983) about 60-70% of the catch is contributed by *Metapenaeus dobsoni* and smaller sized *F. indicus* while the bigger size of *F. indicus* accounts to nearly 20%. The contribution of *M. dobsoni* during the current season in the present field is 70.51% whereas in 2002-03 it was 74 % and in 2001-02 it was 58.45%. Purushan (1993) has estimated the average yield of fishes and shrimps from traditional prawn filtration systems to be 1070 -1570 kg/ha/season. According to him, shrimps contribute only 33.3%, the rest being contributed by fishes such as mullets, pearl spot, tilapia, cat fishes and the mud crab (*Scylla serrata*). The percentage of shrimps in the present field during the current season works out to 87.4% out of which 70.51% is contributed by *M. dobsoni* in an overall

production of 1066 kg /ha/135 days. The percentage contribution of fishes during the current season was 12.5% whereas during the three previous years it was 15.3, 16.1 and 10.3 % respectively.

As per an estimate of FAO (2005), 24 shrimp farms (85.77 ha) were damaged in Ernakulam district, Kerala due to the havoc caused by the tsunami. Hundreds of meters of inland water areas above the typical high water level were also inundated. The presence of mangrove vegetation seems to have protected areas where this vegetation flourished, protecting the bunds and holding the soil firmly as was evident by the minimal impact on the south-eastern bund of the present field. According to Dehadrai (2005) the nutrient rich heavier cold water from the bottom has been thrust up due to tsunami and these waters, heavily loaded with mineralised nutrients, get mixed with the upper warm waters forming an ideal situation for prolific growth of aquatic food at the primary and secondary levels. Perusal of the data presented in Table 1 suggests that the higher values of nitrate, phosphate and silicate along with increased levels of dissolved oxygen and total alkalinity have favoured enhanced rates of primary and secondary production. But the havoc created by the tsunami crippled the fish/shrimp farming activities in these areas and it is doubtful whether the naturally enhanced productivity has been properly utilized in this sector.

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