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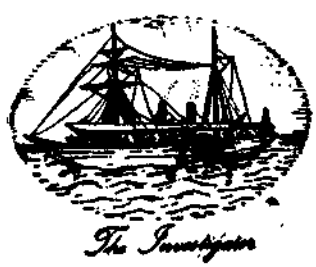

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THE CULTURE OF MILKFISH, MULLET AND PRAWN IN AN EXPERIMENTAL MARINE FISH FARM AT TUTICORIN

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ABSTRACT

Preliminary experiments were carried out in fish farm of salt pan reservoir for polyculture of *Chanos chanos, Mugil cephalus* and *Penaeus indicus*. The seeds were collected from nearby estuarine areas and stocked at different intensities. The important problem facing the experiment was the prevalence of competitors and the maintenance of quality of water. Of the three varieties cultured, mullet appeared to grow well with better survival rate resulting in an increased rate of production. Marketable size at 31 cm was attained in a period of 9 months. A marked difference in the rate of growth and production of the species under culture was well noticed in three sets of experiments carried out during 1977-1979. The estimated rate of production in polyculture increased from 499 kg to 731 kg/ha/year in the present status. Hydrological conditions of the farm were examined briefly. The results of the experiments appeared to be encouraging for extensive culture practices. Possibility of enhancing the production by increasing the stocking density and by resorting to intensive management procedures are

INTRODUCTION

MUCH has been said in the recent years about aquaculture in different ecosystems such as the 'pokkali' fields of Kerala, 'bheries' of West Bengal, 'gazani' farms of Karnataka and 'khazan' lands of Goa (Alagarswami, 1978; Muthu, 1978). However, importance for the productive utilisation of derelict salt water areas was recognised only in recent years in India. Information on the culture of fishes in salt pan reservoirs is very scanty. Suseelan (1975) studied in detail an elegant system of culturing *Penaeus indicus* in the salt pan reservoirs adjacent to Manakkudy estuary in Kanyakumari District. Nair *et al.* (1974) examined the possibilities of culturing *Chanos chanos* under controlled conditions in salt pan areas at Tuticorin. Subsequently, Bensam and Marichamy experimented on the culture of the milkfish in the salt pan areas at Veppalodai, Tuticorin. Realising the immense scope for salt water fish farming a series of three experiments were carried out, the first in 1977, second in 1978-79 and the third one during 1979. In the present pioneering work on polyculture, compatible, euryhaline and fast growing species like *P. indicus, Mugil cephalus* and *C. chanos* were selected in the context of augmenting income along with the normal production of common salt and effective utilisation of the available ecological niches. Another advantageous factor for culturing these species was the availability of seeds during the same period around March-May.

The authors wish to thank the authorities of the Veppalodai Salt Corporation for giving facilities to carry out these experiments. They are indebted to Dr. E. G. Silas, Director, Central Marine Fisheries Research Institute for his keen interest and encouragements. Thanks are also due to Shri K. Nagappan Nayar and Shri S. Madahadevan for encouragements given.

Area and Environmental conditions of the Farm

The location of the site selected for the experiments was adjacent to the spot shown in earlier publication by Nair *et al.* (1974). Veppalodai Salt Corporation is nearer to Kallar estuary and about 2.5 km from the sea. There are about 81 hectares of low saline reservoirs in the midst of vast area of salt producing pans.

The ideal period for the preparation of pond would be December-January since the northeast monsoon happened to be the off season for salt production. The entire reservoir was first completely drained and allowed to dry for a month until the clayey reservoir bed develops fissures. The sun drying aids in the mineralization of organic material left at the pond bottom, cracking of the soil allows release of noxious gases and greater penetration of oxygen into the bottom. A culture pond with an extent of 91.5 × 30.6 m (2800 m^2) was developed since the reservoir was too extensive for the present experiment (Plate I A). The pond was deepened to 1 m so that it can always retain a minimum of 0.6 m of water. Sufficient depth was an essential prerequisite in this area to keep away the predatory birds. The pond was connected by a feeder canal from the pumping station situated on the bank of the estuary. The pond was fitted with wooden sluice of 1.2 × 0.9 × 1.2 m made according to the shape of the bund. It had a wooden shutter as well as sliding frame of velon screen to regulate the flow of water inside the pond. While the sluice served as an inlet, two PVC pipes of 10 cm diameter were fitted on the other side of the pond to serve as outlets. No organic or inorganic manure were added to fertilize the pond as it was thought that the same would affect the quality of the production of common salt. Supply of sea water was normally regular from late January to September and suspended at the onset of NE monsoon. Special arrangements were made to pump sea water, particularly to feed the culture pond in the off season.

Data regarding the seasonal fluctuations in water characteristics gathered for the period of culture are given in Table 1. The monthly average values of surface temperature, dissolved oxygen and salinity of the experimental area were always higher than that of the open sea. The variations in salinity follow more or less the trends of temperature. An increase in temperature in summer months resulted in a rising salinity and this peak was uniformly noticed in all the three years. A secondary peak in temperature was noticed during September/October coinciding with the increased salinity of the environment. A fall in temperature and salinity was noticed after the onset of NE monsoon. The dissolved oxygen fluctuated in the range 3.8-6.9 ml/l. Significant difference in salinity was noticed during the three years. In 1977, the salinity was steadily increasing from 37.58‰ in January to a maximum of 50.32‰ in September. It remained high above 42‰ from May to October. In the following year 1978, high values of salinity in the range 44.94 -52.76‰ were recorded more or less during the same period, May to August. It should be noted that these corresponding months are the active period for the stock to grow well following their stocking in March/April. Although the cultivable species were euryhaline, better growth and production had been recorded in slightly low saline media. Salinity is an important factor of the environment in culture practices. In view of this efforts were made in the third experiment in 1979 to maintain the salinity of farm on the lower range. Adequate number of inlet and outlet pipes were laid at suitable levels for a continuous flow of sea water inside the pond to facilitate flushing. Consequently, the salinity was far below the average values of earlier experiments. Besides the peak noticed in two dry seasons, it varied from 29.76‰ to 39.78‰. The average value of pH

TABLE 1. *Hydrological observations* made at Veppalodai Fish Farm*

Months	1977				1978			1979		
	Temp.°C	O_2ml/l	S‰	pH	Temp.°C	O_2ml/l	S‰	Temp.°C	O_2 ml/l	S‰
January	26.0	4.6	37.58	8.08	—	—	—	27.7	5.7	38.48
February	26.2	4.7	38.18	8.10	—	—	—	28.0	6.8	73.30
March	26.2	4.6	38.90	8.17	28.9	4.3	52.76	30.0	7.1	36.31
April	28.9	4.6	39.87	8.13	28.8	3.8	44.94	33.0	4.5	39.70
May	28.2	4.8	46.70	8.20	28.9	4.2	49.76	29.2	4.4	42.68
June	27.9	5.9	44.80	8.35	28.1	3.9	45.9	30.3	4.4	39.78
July	26.9	4.9	42.20	8.28	28.5	6.9	50.79	29.7	4.4	39.00
August	27.3	5.5	42.23	8.30	26.5	6.6	47.98	26.0	4.8	38.37
September	30.1	5.8	50.32	8.35	28.0	5.6	40.56	28.0	3.8	35.14
October	30.4	5.0	42.28	8.30	27.5	5.4	29.37	31.0	5.9	43.72
November	29.8	5.1	36.87	8.30	29.5	4.9	34.34	27.0	5·5	29.76
December	26.6	4.6	27.18	8.25	27.5	4.2	31.24	28.0	4.8	32.52

*Observations at 0930 hours.

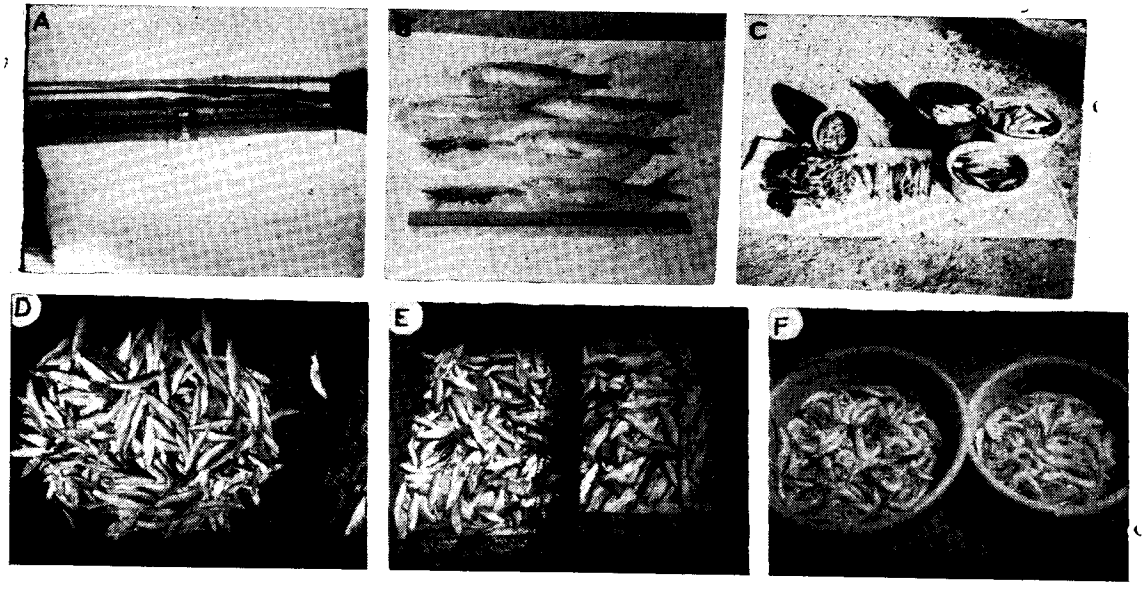

PLATE I. A. General view of fish farm; B. The average size of *C. chanos, M. cephalus and P. indicus* harvested in March 1979; C. Combined production of 2nd experiment; D—F. *C. chanos, M. cephalus* and *P. indicus* harvested in 3rd experiment.

was around the optimum requirement. Among the plankters, copepods, *Lucifer*, *Acetes*, and mysids were noticed. Phytoplanktonic organisms though scarce were comparatively more during August-November. The common diatoms were *Coscinodiscus*, *Thalassiosira*, *Asterionella*, *Pleurosigma* and *Nitzchia*. A low representation of planktonic organisms was noticed in the later two experiments.

Culture Experiment

Source of seed: The source of seed supply of the species used for culture was mainly from natural habitats. Seeds were available in this region from April onwards. Mullet seeds were collected from the intertidal flats, mud pools and mangrove swamp creeks of Tuticorin coast. Seeds of milkfish were collected from the estuarine regions of Kallar, Arasalodai and Tambraparani and also in backwaters near Tiruchendur and Vaninokkam. The shoal of milkfish fry was identified in their natural habitat with the clockwise movement in shallow regions. Collections were usually made in the mornings following the turn of tides. Simple drag nets of different sizes, made of mosquito netting cloth were used in the collection. After each haul the fry were scooped with a bowl and transferred into a bucket and then oxygen-packed in polythene bags, using clear water collected from the same area. Depending upon the size of fry, 500-1000 fry were packed in each bag. The rate of mortality due to transportation of seeds was negligible in the case of milkfish while mullet seeds had a mortality of 20-30%, probably due to the higher packing intensity and larger size of seeds. Seeds of *P. indicus* were collected from Kallar Estuary during March-May near sluice gat fitted in reservoirs near the pump house.

Stocking operation: Seeds of mullet and milkfish were released in separate 'hapas' of size 200 × 100 × 50 cm for acclimatization. This was necessary as the salinity of the area of collection differed from the conditions of the pond. Unwanted species were eliminated. The details regarding the period of stocking, number, their weight, the size range, the mode, the average length and weight of the seed released in 3 sets of experiments are given in Table 4. Single-size stocking method was followed. *P. indicus* seeds were also stocked with the above two non-predatory finfishes in the polyculture pond at a higher stocking rate of 1.5 to 7.6 seeds/m^2. Importance was given to culture of prawn than the others because of its commercial value. In order to see the difference in growth rate and production potential stocking intensity was increased from 1.5/m^2 in the first experiment to 4.3/m^2 in the second and 7.6/m^2 in the last experiment. However in the case of other species the stocking was according to the availability of seeds.

The modal size of mullet seeds was 40-69 mm while the dominant seeds of milkfish measured 29-47 mm during the three sets of culture. Stocking period was usually from March-May. To ensure good survival juvenile prawns with the mean size of 51-70 mm were stocked.

Farm management: The aim of the first experiment was to assess the production potential of the polyculture in confinement under existing conditions in the area and so artificial feeding of the stock was avoided or limited to the minimum whenever the supply of water was suspended. A variety of predatory birds like *Pelican*, *Flemingo*, stork, etc. were driven away by firing crackers. The depth of water in the farm was maintained by regular flow through sluices. Velon screens were cleaned with brush on alternate days to prevent clogging of meshes with silt etc. They were changed periodically when holes and tears were formed to prevent the entry of unwanted fishes into the pond and escape of the stock from the pond. Since the wooden sluice damaged the bund beneath it, the sluice wa

removed and in the subsequent experiments adequate number of PVC pipes were laid. Thus the problem of predatory fishes in the farm was minimised and with regular flow of water, the salinity also fluctuated only within a narrow range. Flowing water system would be advantageous for polyculture. Before carrying out the third experiment in 1979, the pond was drained completely and desilted. A silt layer more than 5 cm in thickness was considered to be detrimental to health of prawns (Muthu, 1978). Then the pond was allowed to bake in the sun till some cracks appeared in the bottom. Subsequently better results were obtained.

A major problem faced during the period of culture was the supply of sea water from October onwards. With the onset of monsoon, the Corporation stopped pumping the sea water. In the same period reclamation works in the canal was attended to. Only on special requests, estuarine water was pumped or otherwise managed to retain the water diluted by closing the outlets of the pond. However, no depletion in oxygen was recorded due to this arrangement. When the nearby reservoirs became dry or stored with high brine water a number of crabs like *Scylla serrata*, *Thalamita crenata* as well as sea snakes and eels migrate and find shelter in low saline culture pond causing damage to the stock. Crabs which were highly predaceous on newly moulted prawns, were eradicated by using hoop nets with suitable baits like gill rakers and other gutted wastes of fishes. One of the major jobs associated with the maintenance of farm was the removal of predatory fishes such as *Lates calcarifer*, *Elops saurus*, *Eleuthronema tetradactylum*, *Platycephalus* sp. and *Therapan* spp. with gill nets to some extent on the occasions of sampling.

The types of polyculture farming that depends solely or mostly on natural food have comparatively lower yield per unit area than those depending on artificial feeds. The availability of natural food in the farm was not sufficient since fertilization was avoided in the beginning. As pointed out by Jhingran and Natarajan (1972) detritus formed the dominant food of *M. cephalus* followed by algae, diatoms and occasionally zooplankton. Supplementary feeding was practised in the second and third experiments of culture which consisted of material readily and cheaply available, especially farm byproducts such as rice bran, wheat bran, groundnut oil cake, tapioca powder crustacean powder made out of dried *squilla* and prawn heads and fish meal powder. The last two combinations were specially added to prawns along with the paste of rice bran and tapioca powder. Occasionally chopped trash fishes were also supplied. For finfishes the above supplemental feed sprinkled with water was sprayed over the surface of the pond. During the last phase of the last experiment transportation to the farm was cut due to heavy rains and supply of feed was discontinued.

Harvesting was carried out by drag net fitted with stakes at intervals, after partly draining the water from the pond in the first year. In the following attempts a diesel pump was used to drain the pond completely and harvesting was effective when the stocks were removed by hand picking. Seine net was also used when the pond remained drained.

GROWTH

Growth rates of the species cultured in the farm have been studied by following the progression of modes in the size frequency distribution of samples sampled at different stages and at harvest. In Table 2, the overall growth of *P. indicus*, *M. cephalus* and *C. chanos* cultured in three different experiments during 1977-79 in salt pan experimental farm is presented. The actual period of culture for these three species was not uniform and hence monthly average growth rate was determined from

overall progress to see the difference in growth from year to year and species to species. A growth rate of 10.3 mm in *P. indicus* was attained in 1979 as compared to the earlier experiments, probably due to short period of culture. It may also be pointed out that in 1979, the quality of water particularly salinity remained in a narrow range of 35-39‰ in most of the months. *C. chanos* showed a fast rate of growth. The seeds stocked at 42 mm during April 78 progressed to 346 mm in March 79 showing a growth of 304 mm in 12 months. *M. cephalus* stocked at mean size of 40 mm progressed to an average length of 314 mm indicating an overall growth of 274 mm in 9 months during the second experiment. (Plate I B).

The monthly rate of growth between different stages was estimated and the growth pattern of cultured species for the year 1979 is presented in Table 3. In *P. indicus* the estimated average growth upto 83 mm size was 16.3 mm per month. Till it reached 123 mm the growth

TABLE 2. *Growth of different species cultured in salt pan reservoirs*

Species	Number of experiment	Modal size at stocking (mm)	Modal size at harvest (mm)	Period of culture (months)	Growth (mm)	Rate of growth mm/ month
P. indicus	1	70	130	9	60	6.7
	2	51	160	12	109	9.1
	3	58	126	6	68	10.3
M. cephalus	1	40.6	226.9	7	186.3	26.6
	2	40	314	9	274	30.5
	3	69	220	7.5	151	20.1
C. chanos	1	50.5	277	7	226.5	32.4
	2	42	346	12	304	25.3
	3	29	215	7.5	186	24.8

TABLE 3. *Growth pattern of species cultured during* 1979

Species	Initial observation		Subsequent observation		Interval between observation (days)	Growth (mm)	Rate of growth (mm/month)
	Sampling date	Modal size (mm)	Sampling date	Modal size (mm)			
P. indicus	3. 5.79	58	18. 6.79	83	46	25	16.3
P. indicus	18. 6.79	83	8.10.79	123	112	40	10.7
P. indicus	8.10.79	123	17.12.79	126	70	3	1.3
M. cephalus	22. 4.79	69	18. 6.79	122	57	53	27.9
M. cephalus	18. 6.79	122	8.10.79	192	112	70	18.7
M. cephalus	8.10.79	192	17.12.79	220	70	28	12.0
C. chanos	26. 4.79	29	18. 6.79	90	53	61	34.5
C. chanos	18. 6.79	90	8.10.79	200	112	110	29.5
C. chanos	8.10.79	200	17.12.79	215	70	15	6.4

rate was only 10.7 mm and very much low afterwards. *M. cephalus* exhibited a fast growth rate, 27.8 mm/p.m till it attained the size of 122 mm TL and thereafter at the rate of 18.7 mm upto 192 mm. Beyond that size the growth rate accounted to be was 12 mm only. *C. chanos* showed a still faster growth in the beginning. Upto 90 mm size the milkfish grows at the rate of 34.5 mm/p.m and declined to 29.5 mm/p.m to reach the size 200 mm and then it was very low. The slow rate of growth noticed in finfishes during the last phase may be due to irregular supply of supplemental feed in November-December.

Survival and Production

The results of the polyculture experiments carried out in fish farm in the salt pan reservoir during 1977-79 are presented in Table 4. In the first experiment the rearing period was 7-9 months whereas in the second experiment the culture period extended to a maximum of 12 months. Experimental period was very much reduced in the final observation to 6.5-7.5 month only resulting in a better survival rate for finfishes. Added to this, no predators were collected among the harvested stock in the third experiment whereas in the harvest in the year 1977, 2 snakes, eel fish, 2 crabs, 2 *Platycephalus* and 7 *Lates calcarifer* weighing about 3 kg were collected and in the second experiment 2 *Elops*, 1 *L. calcarifer*, 2 eels and crabs were found. The yield in the first experiment would have been better but for the entry of predators through the damaged wooden sluice. The survival rate of the prawns stocked in the rearing pond was affected obviously by many conditions among which the size of the seed at the time of stocking was of high significance. In the first experiment, *P. indicus* with average size of 70 mm at the rate of 1.5 seed/m^2 was stocked. The size was considerably big and stocking intensity was also low as compared to the later experiments and so a better survival of 22.4% was attained. In the second experiment the size of the prawn was only 51 mm and the period of earing was long (12 months) resulting in low survival rate of 8%. In the third experiment, although the rearing period was short, the size of the seed was small coupled with a high intensity of stocking at 7.6 seed/m^2 which ultimately resulted in poor recovery. Over stocking, that too when the quality of water was slightly above the normal, resulted in loss of stock as they are prone to cannibalistic tendency. In general, the survival rate depended upon the period of culture, size and stocking intensity of seed in the case of prawns. For assessing the rate of production, details of the number of prawns stocked and harvested during the three sets of experiments given the Table 4, were examined. A gradual increase in the species-wise production as well as combined production (Plate I C) was possible by improving the technique of management such as the preparation of pond, maintenance of water quality, control of predators, adjustment of period of culture, practice of supplementeal feeding etc. In the third experiment the annual production per hectare amounted to 731 kg (Plate I D, E, F) although the period of culture was less. Unfortunately, the water supply was suspended by the Corporation in October 1979, otherwise a still better yield would have been possible if the experiments with facilities had continued for some more months. Although the survival rate of prawn was poor, the increased production was due to the high rate of stocking. More over the rate of growth was better (10.2 mm/m) in the third experiment (Table 2). Among the three species cultured, the production of *M. cephalus* appeared to be good. Although the growth rate was better in *C. chanos*, gain in weight and rate of survival was better in *M. cephalus* and so a high production from 295-532 kg/ha was obtained.

TABLE 4. *Results of polyculture experiments carried out at Veppalodai Fish Farm during* 1977-79

No. of experiment	Species	Period of culture	Seeds stocked			Harvested fishes					
			Number and weight (kg)	Size range & mode (mm)	Average length (mm) & wt (g)	Number and weight (kg)	Size range & mode (mm)	Average length (mm) & wt (g)	Survival rate %	Production rate/kg/ha year	Total (kg)
	P. indicus	March 77-Dec. 77 (9 months)	4186 7.110	41-91 70-74	70 1.66	936 14.8	96-171 131-140	130 15.8	22.4	70.4	
1.	*M. cephalus*	May 77-Dec. 77 (7 months)	1395 1.325	30-49 35-39	46 0.95	357 48.2	164-300 241-250	226.9 135	25.6	295	498.9
	C. chanos	May 77-Dec. 77 (7 months)	1395 1.222	32-67 45-49	47 0.88	113 21.8	215-370 301-310	277 193	8.1	133.5	
	P. indicus	April 78-Mar. 79 (12 months)	12096 11	40-60 50	51 0.9	979 19.5	135-187 150-165	160 20	8.1	69.6	
2.	*M. cephalus*	May 78-March 79 (9 months)	2062 1.3	22-55 35-45	40 0.8	402 84.4	297-331 310-325	314 210	19.5	361.8	545.7
	C. chanos	April 78-Mar. 79 (12 months)	200 0.160	40-45 40-45	42 0.8	119 32	324-400 340-350	346 268	59.7	114.3	
	P. indicus	May 79-Dec. 79 (6½ months)	21387 19.2	52-64 53.63	58 0.9	1985 28.2	108-171 115-130	126 14.2	9·3	185.9	
3.	*M. cephalus*	April 79-Dec. 79 (7½ months)	680 1.360	60-75 65-70	69 0.2	583 61.8	210-240 220-225	220 106	85.7	353.1	731.0
	C. chanos	April 79-Dec. 79 (7½ months)	980 0.262	27-32 27-32	29 0.142	493 33.6	190-248 210-220	215 68.3	50.3	192	

Remarks

The problem of maintaining the salinity of the pond water within the favourable range was serious, especially when there was no dependable supply of fresh water to compensate for the high rate of evaporation during the two dry seasons. Juvenile penaeid prawns though euryhaline, would prefer the salinity in the range 10-35‰ and lower or higher salinities retard the growth of the prawns (Muthu, 1978). Suseelan (1976) reported on culture of *P. indicus* in the salt pan reservoirs of Manakkudy were the salinity fluctuated from 4.95 to 28.10‰ with a mean value of 23.22‰ Nair *et al.* (1976) explored the possibilities of culturing *C. chanos* and *P. indicus* in the present environment.

Gopalakrishnan (1970) worked out the salinity tolerance of *M. cephalus* as 0-75‰. Ling (1977) observed the optimum salinity range as 20-30‰ for the culture of milkfish and mentioned about the pumping of fresh water to bring the salinity to the proper level when it reached high levels. In the present experiments, the salinity was well above 36‰ during most of the months and at the time of stocking it was higher still.

In Southeast Asian countries when prawns are stocked with non-predatory fishes in a polyculture system, generally a low rate of stocking between 5,000-10,000/ha of juveniles 2-4 weeks old are used to ensure good survival (Ling 1977). Suseelan (1976) observed a high rate of survival (82%) when stocked with slightly bigger size (68 mm) prawns in ponds. Results of the present experiments also indicated a better survival rate when larger seeds (70 mm) were stocked at lower intensity. Earlier workers have observed a relatively faster growth in the juvenile stages under estuarine conditions only. Subramanyam and Rao (1968) observed a growth rate of 19.35 mm/month for juveniles reared in brackishwater pond near the mouth of Pulicat Lake. Suseelan (1975) recorded 30.5 mm/m in younger stages upto about 125 mm length. In the present observations a maximum of 16.3 mm/m was observed in early stages and the poor growth rate may be attributed to the quality of water.

Tampi (1960) has observed at Mandapam a growth increment of 220 mm by one year in *Chanos* with a survival rate of 9-11 % and production varying between 212 kg-455 kg/ha. Under existing environments at Veppalodai farm the growth appeared to be better *viz.* 304 mm in one year with a survival rate at 59.7%. The production figure of this species in polyculture system cannot be compared with the yield in monoculture experiments. Production would have been considerably more when the stocking intensity is more.

Growth and production of *M. cephalus* has been observed to be different under various environmental conditions. Hora and Pillay (1962) assessed a growth of 140 mm in first year. Jhingran and Natarajan (1969) reported that in Chilka Lake the fish attains an average length of 307 mm in first year. Patnaik (1966) has recorded growth of 325 mm in first year. Considering the high salinity and other environmental characters of the present experiments the growth rate of 274 mm in 9 months for *M. cephalus* appears to be encouraging.

Recent experiments on polyculture of mullet, milkfish and *P. monodon* and milkfish and *P. indicus* at Kakdwip have shown a total production at 1463 kg/ha/7 months and 2196 kg/ha/6 months respectively and relatively low production has been recorded in similar experiments conducted from other centres (Rao, 1978). Results of the present study indicated a steady progress from year to year to a maximum total production of 731 kg/ha/year despite a number of handicaps observed.

Conclusions and Suggestions

Through proper planning and construction of different types of large size ponds and application of sound techniques of manage-

ment annual production can be increased. Construction of ponds of 2-3 ha near the pump house in a slightly elevated level with provisions for flowing water system would pave way for increasing production in polyculture farming. Duration of the culture period can be altered and an early stocking of prawns around January would appear feasible. Special arrangements during January-February for the supply of fresh water to dilute the sea water of culture ponds from Kallar River may improve the growth of juveniles in the beginning period. The silt loam soil which contains little organic matter and low percentage of clay can be improved by heavy applications of less expensive organic fertilizers such as manure from poultry or other livestock. The use of fertilizers can be experimented without hindrance to the normal production of salt as it would be ideal for the growth of natural food organisms. Such practice is gaining momentum in Southeast Asian countries. Hunting of predatory birds in the area may be permitted for the development of fishing industry as it would minimise the cost on labour.

The success of freshwater aquaculture in Southeast Asia is principally due to the application of polyculture techniques. It should hold good in mariculture also and experiments conducted on the above lines are bound to find solutions to reach better harvest by resorting to polyculture.

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