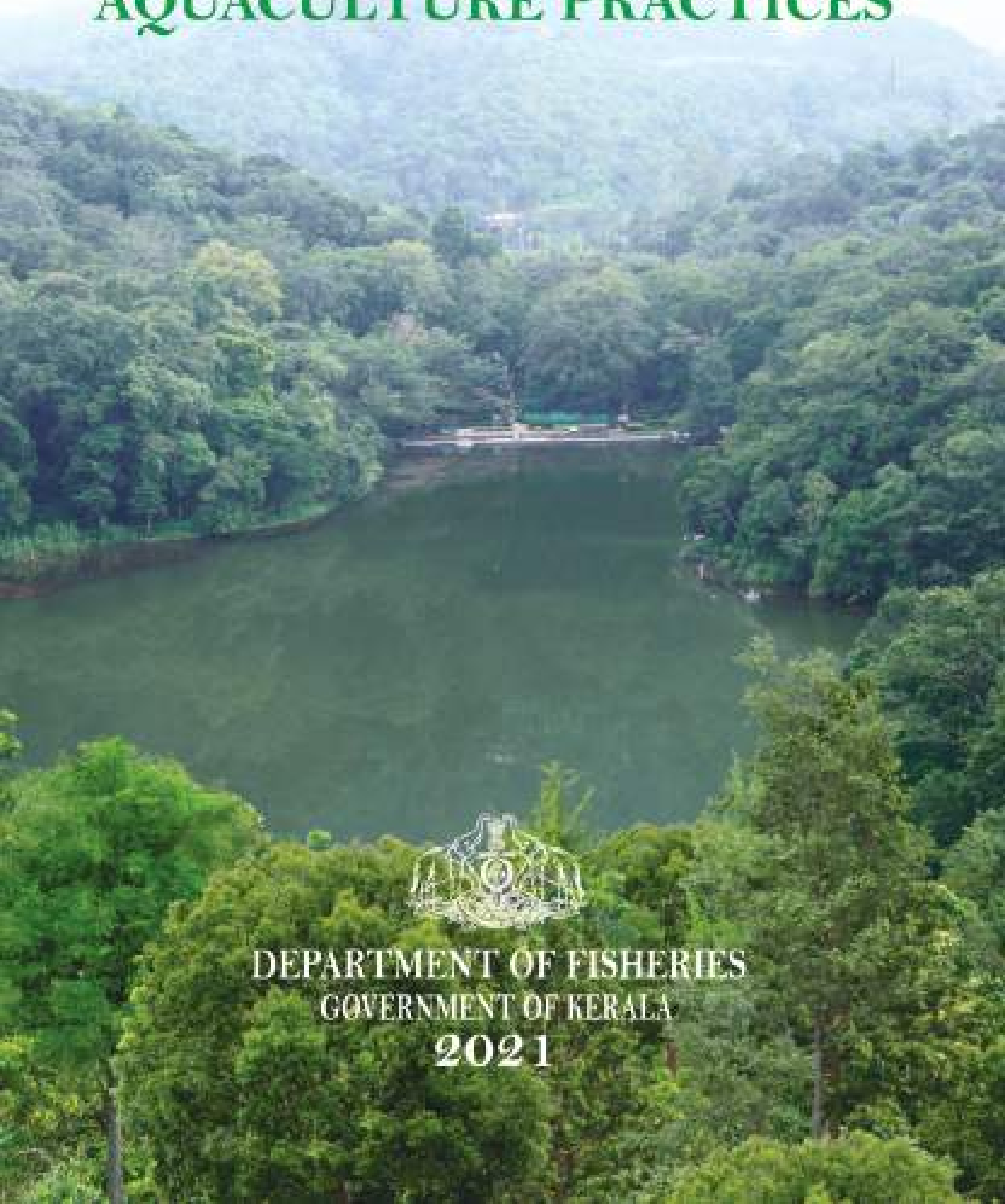
PACKAGE OF AQUACULTURE PRACTICES



DEPARTMENT OF FISHERIES

GOVERNMENT OF KERALA

2021

Package of Aquaculture practices

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Despite every effort, there may still be chances for some errors to have crept in unintentionally which may be communicated to the publisher so that it can be incorporated in the next edition.

Any views or directions expressed in this book are not of the institutes where the authors belong but of the Department of Fisheries, Government of Kerala.

J. MERCYKUTTY AMMA
Minister for Fisheries,
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Government of Kerala

03-02-2021

MESSAGE

It is indeed a great pleasure to learn that Department of Fisheries, Kerala is publishing a book on "Package of Aquaculture Practices". The State of Kerala is blessed with rich marine, brackish and fresh water resources, exporting considerable portion of its seafood to foreign countries to the tune of 1.78 lakh metric tonnes yearly valued at Rs. 5919.06 crores. The inland fishery is also an age old practice in the extensive network of backwaters and rivers of Kerala.

Aquaculture is not only a food production sector, but also a means of livelihood and economic development. The State has been undergoing a paradigm shift in terms of technology, species diversification and intensification, formulating specific action plans for achieving self-sufficiency in food production, which is considered as of utmost importance especially in the wake of covid-19 and its aftermaths. it is implicit that "Package of Aquaculture practices" can contribute very much in achieving this goal.

This book is the result of a collaborative approach and exchange of exhaustive information between scientists, administrators, extension personal and farmers, and this will definitely serve as a guide light for the sustainable development of aquaculture sector. I wish all success for this endeavour.

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03.02.2021

MESSAGE

The Department of Fisheries has successfully introduced highly intensive technologies like RAS, Biofloc, Cage culture, and Aquaponics, along with the introduction of promising new species like Pearlspot, Nile tilapia, Pompano, Asian sea bass, Cobia, Vannamei shrimp, crab, mussel and oyster etc. which have good consumer demand. The importance of fish in ensuring nutritional food security, as a rich source of essential amino acids, polyunsaturated fatty acids, vitamins and minerals is well known. The State is in the process of enhancing the aquaculture production from 0.25 lakh metric tonnes to 2 lakh metric tonnes by 2025.

Apart from this, serious adulterations are observed in the fish brought from outside the State, which also calls for the production of quality fresh fish locally. Culture fishery is a dynamic sector where technological innovations and interventions are a continuous phenomenon. The interventions in culture fishery focus at increasing both productivity and expansion of culture area and intensification practices hold the major key for enhancing productivity. It is essential to provide a strong base in the seed production and culture practices and also to standardize it, in order to achieve the goal of sustainable production. This book is a comprehensive approach for providing techniques of aquaculture in a uniform and concise way to achieve the objectives of production. I am sure this book will also be a reference for farmers as well as students and other stakeholders of aquaculture and provide extra support for technical staff of the Department of Fisheries. I wish all the best for this publication.

Tinku Biswal

TINKU BISWAL

EDITOR'S NOTE

Fish is considered as the most promising food and its high nutrient profile is very relevant at present, as it helps to develop immunity against the emerging diseases. Even though, considerable quantity of fish is produced in the State of Kerala, about 2 lakh tonnes of fish is brought annually from outside the State to meet the domestic requirement. Enhancing aquaculture production can bridge this gap; for which a shift from extensive to intensive farming practices is needed along with expansion of aquaculture area and diversification of culture species.

The state fisheries department has conducted demonstration farming for the past few years related to high intensive farming practices such as farming of fish in cages, biofloc, aquaponics and recirculatory aquaculture system. The carps and shrimp centered aquaculture have got diversified with the introduction of Nile tilapia, pangasius, pearlspot, seabass, pompano, cobia, vannamei shrimp, mussel, oyster etc. However, introduction of exotic species may add new pathogens into the system and large-scale intensification of aquaculture would lead to disease outbreaks. The prevalence of pseudo-consultants, minting money from fish farmers with their popularity, is another major emerging issue in the State. Ignorance of basic principles behind aquaculture practices often leads to excessive use of feed, chemicals, etc. and adoption of very high stocking density. Hence a standard guideline regarding the aquaculture practices to be followed by the stakeholders becomes relevant, which is obviously lacking in our country.

The lack of a standard procedure for aquaculture practices in the state was noticed during my intervention in the aquaculture sector initially, as the recommendations to the farmers by different extension staff varied with personnel, which leads the farmers in a dilemma. It was also noticed that there is a large disparity between the dosages and other practices which were successful in the field and those written in the publications while reviewing the recommendations of various eminent researchers. It might be due to the difference between the controlled farming conditions for research and the un-controlled conditions prevailing in the field and the differences in agro-climatic conditions prevailing in various parts of the country. Hence, it was decided to demonstrate various new technologies in actual field conditions at various farms under the State Government and collaborating with farmers belonging to various agro-climatic conditions of the State. The positive results received from the field especially in the case of breeding experiments made me interested to record the procedures in the form of a book.

The idea of preparing a Package of Aquaculture Practices was first conceived in 2014. As the past six years was crucial as far as aquaculture sector was concerned, due to the emergence of various intensive aquaculture systems and introduction of new species, and it took almost 6 years to include various innovative practices including biofloc technology in order to have a comprehensive book for aquaculture practices in the state of Kerala.

This "Package of Practices for Aquaculture" is prepared based on the already published results of research and development activities conducted by RGCA, KUFOS and ICAR institutes like CMFRI, NBFGR, CIFA, CIFE, CIBA, CIFRI and DCFR and modified to suit the agro-climatic and socio-economic conditions of Kerala State after conducting field trials, demonstration farming and hatchery operations at various locations in the state.

I acknowledge the Directors of Department of Fisheries, Kerala during last six years for being instrumental in providing institutional and personnel support and encouragement in developing this book.

I also acknowledge the scientists, academicians and officers who have provided photographs and technical details for this document. The contribution of all the resource persons for the book is deeply acknowledged. This book has been prepared to provide an overview of basic guidelines to be followed in aquaculture, presented in a lucid way, so that it is easy to comprehend and implement, not only by the specialist but also by the farmers.

B. Ignatious Mandro
Joint Director of Fisheries
Government of Kerala

FOREWORD

C.A. Latha I.A.S
Director of Fisheries

World aquaculture production of fish, crustaceans and molluscs by inland and marine waters is enhanced from 55.16 million tonnes (2009) to 82.1 million tonnes (2018) with an average annual growth rate of about 4.09%. In India, during the same period it is enhanced from 3.79 million tonnes to 7.07 million tonnes with an average annual growth rate of about 6.43%. Regarding major global aquaculture producers, India has second position behind China (47.6 million tonnes). In terms of value, India contributes USD 13.188 million to USD 250.16 million globally. Out of the total global production of aquatic animals, 21.89% is contributed by carps while in India it is almost 90%. At present considerable diversification in terms of species and systems for aquaculture is being witnessed in the country.

Aquatic ecosystems of Kerala are highly productive and provide significant contributions to food and nutritional security along with economic and social development by way of capture and culture fisheries. The culture fishery is considered as the important food production sector of this century and is placed as one of the high priority areas by many countries around the globe. The investment pumped into this sector for the past years stand as the testimony for the importance it is having in the present world. As fish acts as the largest single source of animal protein, its demand outstrips supply owing to the ever-increasing human population which has already crossed the level of 700 crores.

As far as Kerala is concerned, it is the land of fish consumers with highest per capita consumption. The annual per capita consumption of fish in Kerala is 19.59 kg compared to the national average of 3.24 kg. Capture fishery from sea and inland water bodies serve as the prime source of this delicious live food, for the State but now it is on a declining trend. Over exploitation with increased mechanization makes the capture fisheries production more or less stagnant during recent decades. The traditional practice of hunting and gathering of fish from these natural waters alone cannot meet the requirement of the State especially when there is global demand for our fishery produce. There is no scope for intensification of capture fishery, which would adversely affect the sustainability of the natural fishery resources. The culture fishery is the sole alternative to play an important role in meeting the deficit.

Culture fishery is the husbandry of commercially important aquatic organisms such as fish, crustaceans and molluscs etc under controlled conditions. Even though culture fishery is developed as a commercial business recently; it was practiced in Egypt and China since ancient times by collecting small fish from natural system and growing in ponds. The contribution of aquaculture to national fish production has enhanced from 48.9 % 2011 to 56.12% (2018).

Over the years various practices and methods have been developed

This package of practice is prepared by referring published literature, conducting field experiments and exhaustive deliberations involving experts of scientific communities from central institutes, academicians and officers of the State fisheries department who are well experienced in different aquaculture practices. It covers all the variety of culture practices prevalent in the state with up to date information regarding the procedures to be followed for a particular culture after considering the ground realities in the state.

I acknowledge the Chairman of RGCA, Vice-Chancellor of KUFOS, and Directors of CMFRI, NBFGR, CIFA, CIFE and DCFR, leading institutes in fisheries research and development, for providing technical and personnel support in developing this book. I am sure this will be an important step for the States path towards achieving self-sufficiency in fish production and I wish success for this endeavor.

Vikasbhavan,
3.02.2021

C.A. Latha I.A.S
Director of Fisheries
Government of Kerala

PREFACE

Kerala is endowed with abundant marine and inland water resources like rivers, rivulets, streams, estuaries and backwaters, which are well known for their biodiversity offering immense scope for aquaculture development and expansion. It includes 590 km of coastline, 44 rivers having 85,000 ha area, 49 reservoirs having 34180 ha area, 65213 ha brackish water area, 53 backwaters having 46,129 ha area and 12,873 ha prawn filtration fields. Aquatic biodiversity includes multispecies marine, brackish water and freshwater fin fishes, crustaceans and mollusks including various indigenous species. The Western Ghats of Kerala has the unique specialty of cold water fishery resources in a tropical belt.

Fisheries play an important role in ensuring the nutritional security of the state. Fish is not only a source of cheap protein but also a means of income, which can contribute, to livelihood of the low-income group people. Kerala not only feeds fish to its own people, but exports large portion of the fishery produce to foreign countries. As production from capture fisheries is stagnated, aquaculture can be a reliable alternate for fish production. Aquaculture is the emerging sector, which is considered as the alternative for compensating the deficit in fish production. The state, which has started aquaculture activities as extensive practices, is now gearing up for a quantum jump in aquaculture production. As part of this, high intensive farming practices were introduced for the past few years.

"Package of practices for aquaculture" is carved out of an idea of providing farmers and all stakeholders concise and comprehensive information related to various intensive scientific practices in fish farming currently implemented in the state of Kerala.

The book provides meticulous, yet concise descriptions of aquaculture practices in an exhaustive number of fish and shrimp species. This book contains 30 chapters covering almost all aspects of seed production technologies and hatchery operations necessary for successful management. It also describes farming activities right from pre-stocking management to harvest. The chapters cover essential information such as brood stock management, breeding technique, and nursery rearing. Regarding farming practices, it covers pre-stocking, stocking and post-stocking management to be followed in various systems. The contributors have put in their best effort to include the updated information at field level regarding new farming techniques like culture in biofloc tank, aquaponics and cage. Care has also been taken to consider the field level realities with respect to the existing agro-geographic conditions and other aspects prevalent in the State.

We hope that this book would be of valuable use to extension staff of the fisheries department as well as to students, researchers, academicians and farmers as a practical guide in field. This book includes culture practices for most of the potential species that can be cultured in the State.

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CHAPTER: 28

EDIBLE OYSTERS

Edible oysters are the most widely cultivated bivalves in the world. They are sedentary animals, which grow by permanently attaching the left valve (lower valve) to the hard substratum and the right valve (upper valve) act as a lid. Oysters occur naturally in the intertidal areas, backwaters, muddy bays, lagoons and creeks with salinities of about 10-25 ppt, though it can tolerate higher salinity. It forms dense aggregations, often called as beds.

In India there are four important species of edible oysters, namely Indian backwater oyster (*Crossostrea madrasensis),* West coast oyster *(C. gryphoides),* Chinese oyster *(C. rivularis)* and Indian rock oyster *(Saccostrea cucullata)* Among these, Indian backwater oyster is the most dominant one, which has irregularly shaped shell valves. The left valve is deep while the right one is slightly concave. Adductor muscle is kidney-shaped and the shell has a dark purple coloured adductor scar. The inner surface of the shell is glassy and white.

Fig. 28.1 Crossostrea madrasensis

Oysters are filter feeders, and they feed on phytoplankton, detritus and associated microscopic flora and fauna in the natural condition, whereas in captivity oysters are provided with a mixed culture of microalgae in different cell concentrations. The spawning season of oyster in the wild varies with region and in Kerala, it is during November-February. Edible oyster fishery forms the second important component of bivalve fishery after clams. The flesh of oyster is highly nutritious containing 8-10% protein and 2% fat, in addition to minerals like calcium, phosphorus, zinc and iodine. Though the technology of seed production and farming has been developed by ICAR-CMFRI, oyster culture is not yet developed commercially in India due to the lack of awareness regarding the nutritional quality, non-availability of seed and lack of entrepreneurship. However, it is one of the most preferred seafood items in Europe, USA and many south-east Asian countries. It has immense scope for export, if produced in substantial quantities.

HATCHERY TECHNIQUES

Throughout the world, source of seed is changing from natural spat collection to hatchery-produced triploid oyster spat eventhough hatchery-produced seed is expensive than wild-collected ones. The natural spat fall is unpredictable and low in quality. If the oyster seed is produced in hatchery, the availability of desirable stage (eyespot stage/spat) in the required quantity and quality throughout the year can be guaranteed.

Broodstock collection and conditioning

Adult oysters collected from the wild are brought into the hatchery, and their shells are thoroughly scrubbed and rinsed to remove epifaunal organisms and sediments. After that these brooders are rinsed with freshwater followed by 10 ppm chlorinated seawater and placed in broodstock conditioning tank, which should always be kept separately to prevent the transfer of pathogens and parasites to the culture system and also to avoid disturbance. In an FRP broodstock conditioning tank of 120-150 l capacity, 5 kg of live weight can be stocked. Effluent water discharged from conditioning tanks should be treated with 100 ppm free chlorine or ozone for a minimum period of 24 hours before releasing, if wild oysters are brought from far away places.

Oysters usually attain sexual maturity by the age of one year. In oysters, sexes are separate; occasional hermaphroditism is also seen. Males are smaller than females; 75% are presumed to be males among zero-year class (upto 78 mm length), while 72% to be females among one-year class and above (80-120 mm length). Oysters of length ranging from 60-120 mm are selected for breeding of which 30% within 60-75 mm to ensure the presence of males.

The broodstock is fed with a mixed algal culture diet of *Isocrysis galbana* and *Chaetoceros calcitrans and Pavlova sp*. Feeding schedule for most warm water bivalves are the same as explained for mussels. Mature females will have creamy white gonad whereas males will have white gonad with oozing milt. Maturity is checked by taking smear from the gonad and examining under a microscope. Mature eggs are pear-shaped and 48-62 µm in size.

Spawning

In India, induced spawning is mostly achieved by thermal stimulation, for which 20-25 numbers of oysters are selected and kept in seawater with aeration in air-conditioned room at 23˚C for 12 hours followed by transferring them to an FRP tank of 1 t capacity at 30-32 ^{0}C. The water temperature is usually raised with the help of immersion water heater. Mild aeration is also provided in the tank. Sudden rise in the water temperature induces the oysters to spawn. Chemical stimulation is another method where ammonium hydroxide, sodium hydroxide/tris-buffer is added to the broodstock kept in a tank, but here viability of eggs will be less. In another method, freshly stripped sperm is added to the broodstock tank, which in turn induces the female to release eggs. Among these, thermal stimulation offers less stress to the animal. A fully ripe animal may spawn just due to handling stress while cleaning and may not require any induction.

Generally, male oyster responds within 1-2 hours and releases sperm as a continuous stream of milky fluid whereas after 15-60 minutes, female releases eggs into the surrounding water with periodic shell closures. The fertilisation takes place externally in water and the eggs settle down to the tank bottom. The seawater should have salinity in the range of 32-35 ppt and pH in the range of 8-8.4. After spawning, the broodstock from the spawning tank is transferred to prevent accidental filter-feeding of eggs by themselves. Excess sperm in spawning tank can cause abnormal fertilisation of the eggs. Hence, the surface water with sperm is replaced with fresh seawater. If an adult doesn't respond within the period, it should be returned to the conditioning tank for further one week.

Fig. 28.2 Oyster spawning (release of milky fluid)

Initially, eggs of oyster are pear-shaped which measures 48-62 µm in diameter and become spherical in shape after water hardening. Eggs that do not round-off after 15-20 minutes should be discarded. When the fertilised eggs settle at the bottom, aeration is suspended. It is then siphoned and filtered through 90 µm mesh to remove the metabolic waste of adults from the egg. Then eggs are filtered-out with 20µm mesh and washed with fresh seawater. Cleaned eggs are transferred to a container of 10 l capacity. Eggs are gently mixed, 1 ml of sample is pipetted and placed on Sedgwick-Rafter cell for counting the number of fertilised eggs. Usually, the fecundity of oyster is 20 million, and the survival rate from egg to larva is 50%.

Incubation

FRP tank of 1 t is cleaned, disinfected by chlorination, filled with filtered seawater and stocked with fertilised eggs at a density of 500-1000 no./ml, and the tank is aerated gently. The first polar body is formed after 20-40 minutes of fertilisation. Fertilised egg undergoes cleavage within 45 minutes and reaches morula stage after 6th division. Gastrula stage is reached between 5-6 hours after fertilization.

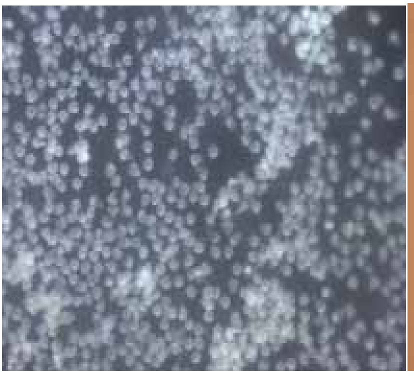

Fig. 28.3 Pear shaped eggs

Fig. 28.4 Two cell stage

Rearing of larvae

D shell or straight hinge larval stage is reached after 20 hours. Larvae are transparent, swim vigorously and measure about 66 µm. Water is drained slowly from the incubation tank through 40 µm size sieve which is kept partially immersed in seawater trough to avoid dry filtration. The larvae retained in the sieve are transferred to a beaker of a known volume of treated seawater (e.g., 10 L). One ml samples are taken and the larvae are counted in a Sedgwick-Rafter cell. The formula for calculating the total number of larvae is given below.

$$\text{Number of larvae} = \frac{\text{Average no. of larvae in a sub-sample x total volume (ml)}}{\text{Volume of subsample (ml)}}$$

The counted larvae are stocked at the density of 5-10 no./ml in the cleaned and disinfected larval-rearing tank of 1- 2 t capacity, filled with treated seawater. Mild aeration is also provided. Larvae are fed with culture of *Isochrysis galbana.* Every alternate day, process of filtering and cleaning of the tank is repeated till the settlement of larvae; sometimes larvae are transferred to a cleaned and dried new tank.

On the third day, the larva appears slightly oval (100 µm size) and reach the early umbo stage. Second sieving is also done using 40 µm mesh. On the seventh day, umbo will have concentric rings on the shell. Between 12-15 days, the larva will reach late umbo stage and measure 150 µm size. Eye spot develops between 13-17 days larval-rearing and larva measures 280 µm in size. From D shape larva to eyespot larva 40 µm mesh is used for filtration. From eye spot onwards 150 µm mesh is used for filtration. Larva reaches pediveliger stage between 14th-18th days, and a functional foot develops which can be seen. Larva measures 330-350 µm in size. Once the pediveliger larva loses its velum, it will start settling down, develop adult features and metamorphose into a spat.

The larvae are fed with mixed algal diet consisting of *Chaetoceros calcitrans*, *Isochrysis galbana*, *Pavlova spp*., and *Nannochloropsis spp*. The feeding schedule of oyster larvae at different stages is similar to that given for mussel culture. The daily requirement of algal cell upto eyespot larva stage is given in the Tabe 28.1.

Tabe 28.1. Feeding schedule

Stage	Day	No. of cells/larva
D- veliger	1-2	5,000
Umbo	3-14	10,000
Eyespot larvae	14-17	15,000

Fig. 28.5 D-Veliger stage

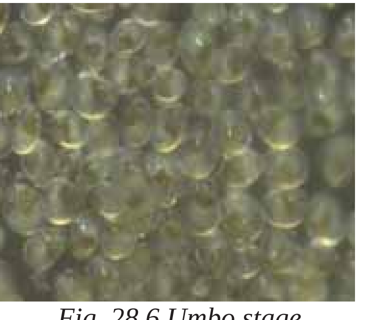

Fig. 28.6 Umbo stage

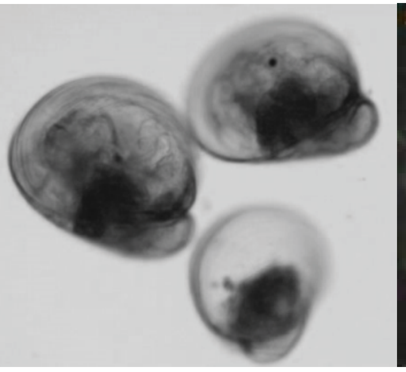
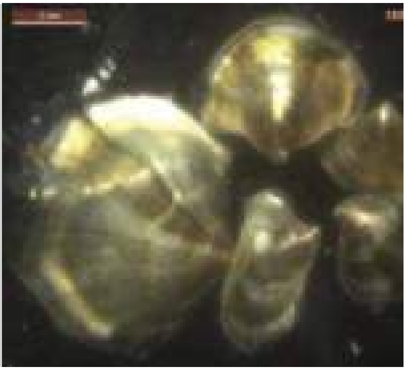

Fig. 28.7 Eye spot stage *Fig. 28.8 Oyster spat*

Settling of larvae and rearing of spat

Once eye spot develops, the larva is ready to attach to a surface and undergo metamorphosis into spat. The eyed pediveliger larva of more than 290 µm starts to settle and moves shorter distances. The process of settlement is prolonged for additional 2-6 days, and at this stage, finding a hard substratum is essential for survival. The settling of larvae can be done using different materials. The settling of larvae on 'cultch' (dead oyster shell) is the most common method. The shell is dried at least for a month to reduce the risk of pathogens, cleaned and aged in seawater for a few days for the formation of a biofilm on cultch, which enhances the settling of larvae. The daily requirement of algal cell to feed the bivalves from the pediveliger stage to spat is given in the Table 28.2.

Table 28.2 Feeding schedule

Stage	Day	No. of cells/larva
Pediveliger	17-19	20,000
Plantigrade	20-21	25,000
Spat settlement	24-29	30,000
Spat	30-60	50,000
Spat	60-90	>1,00,000

Oyster ren making

Oyster cultch is made either as oyster shell string or shell bag. In a 1.5 m length synthetic rope of 4 mm diameter, 8-10 shells are attached in regular intervals. These strings are suspended by hanging rens from plastic pipes or wooden sticks or prepared oyster shells are spread as a layer in 1 t FRP tank and then eye spot larvae are added to the tank. Cultch less spat can be produced in micro-nursery using upwelling downwelling systems as described for mussel culture.

Fig. 28.9 Settling of oyster larvae

Fig. 28.10 Oyster spat on the shell

Fig. 28.11 Oyster rens kept in the tank for settlement

Settling on a whole shell or other large cultch is done by placing the cultch in large mesh bags. These bags are transferred to the tank with treated seawater. Eyed larvae are introduced @ 100 no./shell which will settle within 2-3 days and attach permanently to the hard substratum and transform into the spat. Usually, 5-10 spats may get attached on a single oyster shell. Mild aeration should be given, and mixed algae is given as feed. Tank containing shell bags is cleaned to remove algae. Since this method occupies more space and labour, after 1 or 2 weeks, these shell bags are transferred to farming sites. Once spat attains 10 mm to 12 mm size, shell bags are opened and individual oysters are spread on the bottom for further growth. The eyespot stage larvae can be transported in moist cloth and used for remote settling near the farm. The larvae are released to the tank containing cultch near the farming area and fed by pumping natural water into the tank before transferring them to the grow-out area.

Algal culture

Sufficient quantity of algae is vital for any bivalve rearing, and the algal culture methods are same as that described for the mussel.

Water intake and treatment system

Water used for spawning and larval rearing tanks is filtered mechanically with the help of fine mesh bags, sand filters and cartridge filter and disinfected with UV radiation or by ozone. The other aspects of the water treatment system are same as that described for mussel culture.

FARMING METHODS

Site selection

The availability of vast expanse of brackish water area offers considerable scope for edible oyster farming in Kerala. The estuaries with clear water, rich plankton and free from strong wave and domestic, industrial or sewage pollution are ideal for oyster farming. Moderate water current brings the required plankton for feed and carries away the silt.

Water quality parameters

The optimum water quality parameters are given below:

Temperature	: 23-34^{o}C
Salinity	: 10-34 ppt
Water current	: 1-5 m/s
DO	: 3-5 ppm
pH	: 6.5-8.5
Wave turbulence	:< 0.5-1 m
Transparency	: 0.5-1.5 m

Rack and ren method

The rack and ren method is ideal for estuarine conditions where the water depth is in between 1.2-3 m. The ideal size of a fixed rack can be 7x7 m fabricated using bamboo or casuarina pole and tied together with nylon ropes. Sixteen poles having length more than the water depth (at maximum high tide) is driven into the bottom and spaced at a distance of 2.3 m apart and it is connected to each other in both directions by horizontally placed 8 poles of 7 m length which are above the water level during high tide, and the 'rens' (oyster shell strings) are suspended from these racks.

Fig. 28.12 Tying of the ren to the rack

On bottom culture

The on-bottom culture of oysters is ideal where the water depth is below 1.2 m where the oyster seeds attached to the collectors are directly planted on the bottom and allowed to grow. The tray unit having the size 60 x 45 x 30 cm with 3 horizontal shelves of 10 cm height, suspended in the water column using float and anchor is also used for oyster farming.

Seeding

The oyster spat is attached to the ‘cultch’ at hatchery itself @ 5 no./cultch which is then transported to the culture site. In rack and ren method, such 8-10 spat attached cultches are connected through a string of 1-1.5 m long to form a ‘ren’ and 80-100 such ‘ren’ are suspended from a rack of 7 x 7 m size. Here the survival rate is about 55-60%.

In the tray method, the nursery-reared single spat (cultch-free) measuring about 25 mm are kept in a tray unit of size 60 x 45 x 30 cm at an oyster-line density of 200-250 no./unit.

Care & Monitoring

The ren is periodically checked for replacement of broken structure and fastening of loosened ren, if it touches the bottom. If the ren falls on the ground, survival will be low. In the case of farming in the tray, once the oyster reaches 50 mm length, it is segregated, and slow-growing ones is culled and fast-growing ones are placed back on the tray. The barnacle that settles on the wooden structure, tray and oyster may add more weight to the ren or tray and competes for food. Crab and starfish, polychaete and gastropod are the primary predators of edible oysters. Hence, timely cleaning and due care should be given. The average growth rate of the oyster is 7 mm/month, and at the end of 12 months, the oysters attain an average length of 85 mm. Compared to the ren method, tray method gives more production, but the production cost is higher. Other aspects are same as explained for the mussel farming.

Harvesting

The ideal period for harvest in Vembanad Lake and Ashtamudi Lake is in May or September when the gonad is ripe before spawning. It attains a size of 50 g (shell-on) over 6-7 months and yields a production of 10 kg/m rope. The yield of the meat usually ranges between 7-20%. The farming of edible oyster with triploidy (all season oysters) or tetraploidy can give better meat yield, but they are not available in India.

Fig. 28.13 Oyster harvest

As oysters are filter-feeders, after harvesting, depuration is necessary to clean the animal from bacterial load, faeces, sand particles, silt and other contaminants in its gut. Initially, oysters are placed for 12 hours in a tank under a flow of filtered seawater. After draining the tank, oysters are then cleaned by a strong jet of water. The tank is again filled with filtered seawater, and the oysters are placed for another 12 hours. Then again, the tank is drained and flushed with a jet of filtered seawater. The oysters are held for about 1 hour in 3 ppm chlorinated seawater and then washed once again in filtered seawater before marketing. Oysters can be kept alive for upto three days under moist and cold conditions.

The oyster is subjected to processes such as, immersion in hot water, freezing, vacuum and steaming for 5-8 minute to make the oyster open their valves and facilitate the removal of the meat which is called the shucking process. A stainless-steel knife is usually used to shuck the live oyster. The edible oyster is even eaten fresh from the half shell in Malabar region.