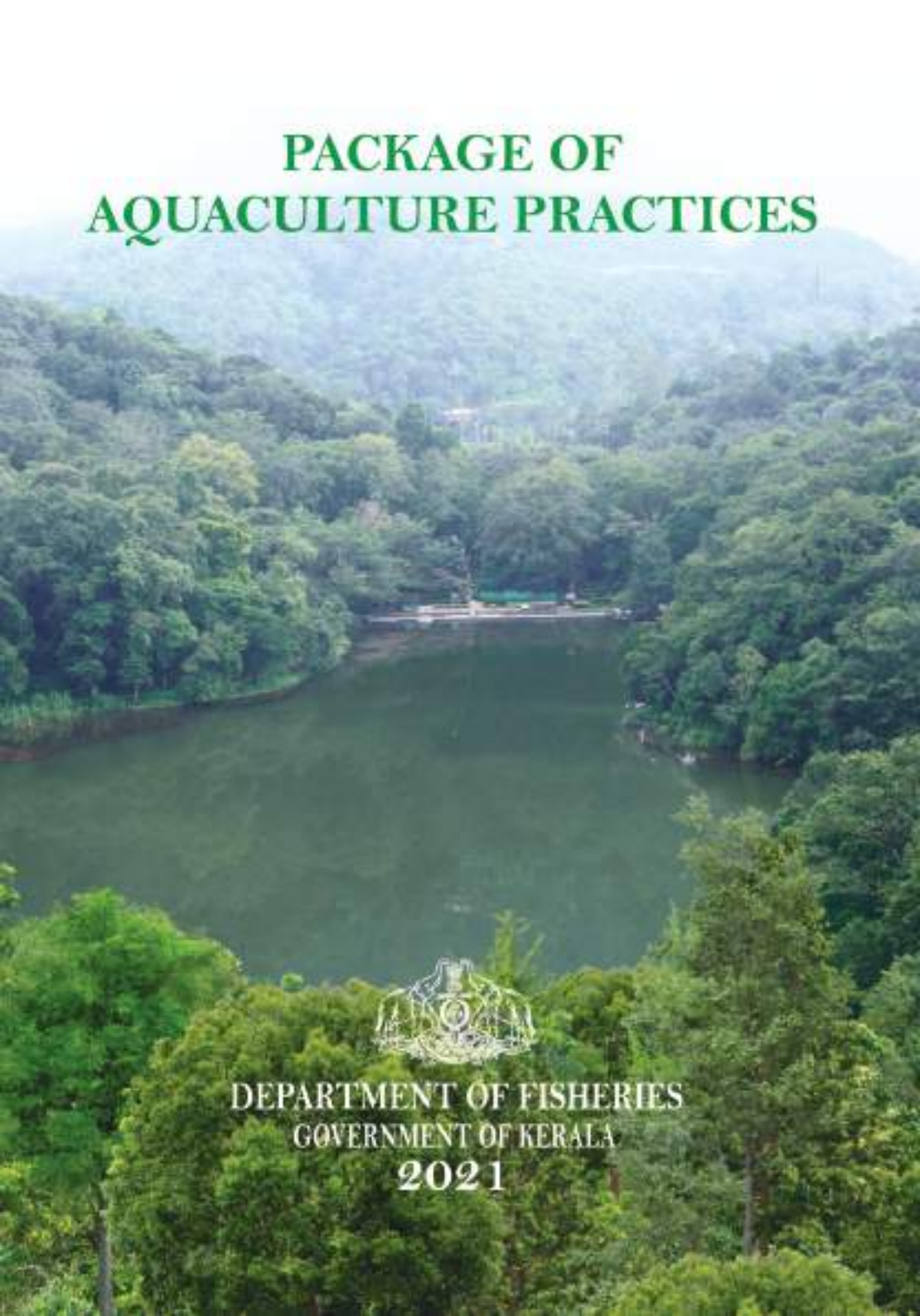
PACKAGE OF AQUACULTURE PRACTICES



DEPARTMENT OF FISHERIES
GOVERNMENT OF KERALA
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Package of Aquaculture practices

Edited by

B. Ignatious Mandro
Joint Director of Fisheries, Kerala

M. K. Anil
Principal Scientist, ICAR-CMFRI

Asha Augustine
Joint Director of Fisheries, Kerala

Department of Fisheries
Government of Kerala

Published by

C. A. Latha
Director of Fisheries
Government of Kerala

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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,
Harbour Engineering and
Cashew Industry
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.

J. MERCYKUTTY AMMA

Res : 'Ushas', Nanthancode, Thiruvananthapuram, Phone : 0471-2725671, 2725673

TINKU BISWAL IAS
SECRETARY TO GOVERNMENT

ANIMAL HUSBANDRY, DAIRY DEVELOPMENT
ZOO, FISHERIES & SPORTS DEPARTMENT
GOVERNMENT SECRETARIAT
THIRUVANANTHAPURAM-695 001

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

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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LIST OF AUTHORS/ CONTRIBUTORS

Name of the topic	Name of authors/ contributors
1. Major carps	Ignatious Mandro B., Joint Director of Fisheries, GoK Saji M. Rajesh, Joint Director of Fisheries, GoK Smitha R. Nair, Joint Director of Fisheries, GoK
2. Nile tilapia	Ignatious Mandro B., Joint Director of Fisheries, GoK Babitha Rani A. R., Senior scientist, ICAR-CIFE Abdu Rahiman K. P., Fisheries Extension Officer, GoK
3. Murrels	Ignatious Mandro B., Joint Director of Fisheries, GoK BeenaSukumar, Deputy Director of Fisheries, GoK
4. Pangasius catfish	Ignatious Mandro B., Joint Director of Fisheries, GoK Joice Abraham, Assistant Director of Fisheries, GoK Pradeep B., Subject Matter Specialist, ICAR-IISR
5. Walking catfish	Ignatious Mandro B., Joint Director of Fisheries, GoK Neetha Susan David, Fisheries Extension Officer, GoK Nisharaj R, Principal, VHSE, GoK
6. Stinging catfish	Thulasikumari S., Deputy Director of Fisheries, GoK Raghunath Ravi, Principal, VHSE, GoK
7. Butter catfish	Jayasree S, Deputy Directorof Fisheries, GoK Anwar Ali, Assistant Professor, KUFOS
8. Yellow catfish	Divya P. R., Senior scientist, ICAR-NBFGR Basheer V. S., Principal scientist, ICAR-NBFGR Simi Rose Andrews, Fisheries Extension Officer, GoK
9. Anabas	Anwar Ali, Assistant Professor, KUFOS Jomol C. Baby, Assistant Fisheries Extension Officer, GoK
10. Mahseer	Saju M. S., Joint Director of Fisheries, GoK Akhtar M. S., Scientist, ICAR- DCFR Chitra M., Deputy Director of Fisheries, GoK
11. Miss Kerala	Santhosh Kumar, Deputy Director of Fisheries, GoK Suhair, Deputy Director of Fisheries, GoK
12. Malabar labeo	Basheer V. S., Principal scientist, ICAR-NBFGR Divya . R., Senior scientist, ICAR-NBFGR Benson, Assistant Director of Fisheries, GoK
13. Pulchellus carp	Hemaprasanth, Principal scientist, ICAR-CIFA Gangadhar Barlaya, Principal scientist, ICAR-CIFA
14. Cauvery carp	Gangadhar Barlaya, Principal scientist, ICAR-CIFA Hemaprasanth, Principal scientist, ICAR-CIFA
15. Pearlspot	Santhosh Kumar, Deputy Director of Fisheries, GoK Manju S., Fisheries Extension Officer, GoK
16. Milkfish	Pramod Kiran R. B., Assistant Professor, KU Manju S., Fisheries Extension Officer, GoK

17. Grey mullet	Pramod Kiran R. B., Assistant Professor, KU Manju S., Fisheries Extension Officer, GoK
18. Cobia	Johnson D. Cruz, Project Manager, RGCA Anilkumar P., Joint Director of Fisheries, GoK
19. Asian seabass	Shiny C. K., Deputy Director of Fisheries, GoK Ganesh, Project Manager RGCA
20. Pompano	Manju S., Fisheries Extension Officer, GoK Johnson D. Cruz, Project Manager, RGCA
21. Grouper	Ritesh Ranjan, Senior Scientist, ICAR-CMFRI Biji Xavier, Scientist, ICAR-CMFRI Sekar Megarajan, Scientist, ICAR-CMFRI Subhadeep Ghosh, Principal Scientist, ICAR-CMFRI
22. Tiger shrimp	Ignatious Mandro B., Joint Director of Fisheries, GoK Dinesh K., Associate Professor, KUFOS Manu R., Assistant Fisheries Extension Officer, GoK
23. Indian white shrimp	Dinesh K., Associate Professor, KUFOS Paulraj, Technical Assistant, Fisheries Dept., GoK
24. Vannami shrimp	Ignatious Mandro B., Joint Director of Fisheries, GoK Dinesh K., Associate Professor, KUFOS Aneesh P., Assistant Director of Fisheries, GoK
25. Freshwater prawn	Dinesh K., Associate Professor, KUFOS Anitha, Fisheries Officer, GoK
26. Mud crab	Salim H., Joint Director of Fisheries, GoK Dinesh Cheruvat, Executive Director, ADAK
27. Mussels	Anil M. K., Principal Scientist, ICAR-CMFRI Gomathi P., Senior Scientist, ICAR-CMFRI Sophia Margaret, Assistant Director of Fisheries, GoK
28. Edible oysters	Anil M. K., Principal Scientist, ICAR-CMFRI Gomathi P., Senior Scientist, ICAR-CMFRI Mahesh S., Joint Director of Fisheries, GoK
29. Clams	Vidya. R., Scientist, ICAR-CMFRI Laxmilatha P., Principal Scientist, ICAR-CMFRI
30. Seaweed farming	Asha Augustine, Joint Director of Fisheries, GoK Benson, Assistant Director of Fisheries, GoK

CHAPTER: 29

CLAMS

Among the bivalve resources of India, clams are undoubtedly the most widely distributed and abundant. The clams of the estuarine and backwater regions provide livelihood to those who exploit them for meat and shell. Being a rich and cheap protein source when compared to other aquatic food varieties, clam is regularly harvested and meat is sold in local as well as export markets for consumption. The clam shell also holds commercial importance being the raw material for the manufacture of cement, calcium carbide and sand lime bricks. They are also used for lime burning for construction, in paddy field and fish farms for neutralizing acid soil and as slaked lime.

Fig.29.1 Black clam

Fig.29.2 Short-neck clam

The black clam, *Villorita cyprinoides* and short-neck clam, *Paphia malabarica* are the commercially important clam species found especially in Vembanad Lake and Ashtamudi Lake respectively. The black clam is the most important clam species landed in India which contributes about two-thirds of the total clam landings of Kerala. It spawns twice a year, from May to August, and from January to late March.The short-neck clam is a fast-growing species with a peak spawning season of December to February and has a maximum lifespan of around 3 years.

SEED PRODUCTION

The hatchery technology for the large-scale production of their seed has been developed by ICAR-CMFRI.

Broodstock management

The black clam and short-neck clam attain sexual maturity in its first year at a shell length of 15-20 mm and 30 mm respectively and mature ones are procured from wild for hatchery seed production. Adult clams are conditioned at a density of 30 no./m^2 in a tank of 50-70 l capacity having unfiltered seawater at 22-24^{0}C and fed intensively with mixed microalgae reared in outdoor tank. After about 3 weeks of conditioning, the clams attain full gonadal development and are subjected to thermal stimulation by slowly raising the water temperature to 32^{0}C. If spawning does not occur, they are transferred back to 22-24^{0}C seawater and the process is repeated every two hours. Spawning can also be induced by placing the clams in the buffer solution of 9.0 pH for 1-2 hours and later transferring them to normal seawater. The optimum salinity for spawning is 10-12 ppt for black clam and 25-30 ppt for short-neck clam.

Rearing of larvae

The fertilised eggs settle at the bottom and are reared in FRP tank (70-100 l capacity). After a series of cell divisions, they develop into veliger larvae. The unicellular microalgae, *Isochrysis galbana* is given as food to the larvae from day 2 onwards. In the clam hatchery, biological filtration of the sea water which allows the nanoplankter and smaller algae, measuring upto 10 µm is found to be beneficial since supplementary feed is available to the larvae and spat. After passing through the umbo and pediveliger stages, the larvae settle on the tank bottom as spat in 7-10 days depending on the clam species. The larvae are reared at a density of 5 no./ml of seawater. Spat settlement at 20-30% of the initial stock of veliger larvae is considered as satisfactory. The freshly set spat measures about 300 µm and reach 2-5 mm length in the next 4-6 days. The spat are fed with mixed microalgae.

Transportation

The spat of clam is transported in wet condition under shade.

CLAM FARMING

Clam can be cultured on the bottom of protected coastal waters such as backwaters, bays, creeks and estuaries scientifically by adopting proper site selection, relaying, stocking and monitoring.

Site selection

The occurance of natural clam population in the vicinity generally indicates the suitability of the site for its farming. Water quality parameters like salinity, temperature, pH, DO, chlorophyll-a, TSS *etc*. and sediment characteristics like percentage of sand, silt, clay *etc*. of the sites are analysed. Clam farms are located in areas having 70-80% sandy substratum. The shallow waters with moderate water flow and little wave action is preferred. Strong water currents may dislodge the clam from the burrow. Areas prone to frequent changes of the contour and vulnerable to pollution are avoided. Tidal exposure at low tide for 1-2 hours is desirable as it helps in the management of the farm, particularly to remove the predators, but the prolonged exposure of the clam farm during the tidal cycle results in poor growth due to reduced feeding and in summer there may be mortality due to dessication. Also, the usual fishing grounds should be avoided.

Water quality parameters

The salinity tolerance limits and type of substratum preferred varies with the clam species. Black clam prefers low saline waters and occurs in salinity range of 3-16 ppt while that of short-neck clam is 20-34 ppt.

Water current	: 1-5 m/s
Temperature	: 23-34^{o}C
DO	: 3-5 ppm

Farming structure

Clam farming with on-bottom pen system is the best for both species in which usually 2 ha area is demarcated with bamboo poles or floats with net as markers. At first the ground is levelled and cleared from predators. Eventhough the movement of the clam is limited and fencing is not necessary, synthetic fibre net pen can be erected to hold the clams within the farming area.

Seeding

In the commercial culture of clams, seed requirement is mostly met by collection from the natural bed, because the heavily accumulated wild baby clam during breeding season may naturally get destroyed during a period of time due to overcrowding and stunted growth on one hand and the production cost of hatchery produced seed is expensive on the other hand. The spat fall season of black clam is mainly during June and November and that of short-neck clam is January to February.

The baby clam of 10-12 mm size (1 g) is collected during early morning with a hand operated scoop net or a dredge (*Kolli*) having 2-5 mm mesh size, kept in country craft under wet condition, tugged to the site and relayed immediately or by the late afternoon of the same day. Optimum stocking density for both species is 500-600 g/m^2. Seeds are planted in the farm by evenly dispersing them as far as possible.

Care & Monitoring

After seeding, 10 mm synthetic netting is laid on the bottom and is held in stretched position by stakes; this net cover offers protection against predation and strong water current. As clams are filter feeders which thrives on natural food available in the water, no artificial feeding is required.

Harvesting

It reaches a size of 28-30 mm (10-12 g) within a culture period of 7-8 months and is harvested either by handpicking or by a hand-operated dredge. The anticipated production is 3.5-5 kg/m^2 with an expected survival rate of 70%.