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MUD CRAB CULTURE

M. KATHIRVEL, S. SRINIVASAGAM,
P. K. GHOSH AND C. P. BALASUBRAMANIAN

CIBA BULLETIN No. 10
MARCH, 1997.

केन्द्रीय खारापानी जलजन्तु पालन संस्थान
(भारतीय कृषि अनुसंधान परिषद)
नं. १४१, मार्शल्स रोड, एगमोर, चेन्नै - ६०० ००८.
CENTRAL INSTITUTE OF BRACKISHWATER AQUACULTURE
(Indian Council of Agricultural Research)
141, Marshall's Road, Egmore, Chennai - 600 008.

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Published by: The Director
Central Institute of Brackishwater Aquaculture
Chennai - 600 008.

Edited by: Dr. Munawar Sultana
Senior Scientist
Central Institute of Brackishwater Aquaculture
Chennai - 600 008.

Cover Photo: Larger species of mud crab *(Scylla tranquebarica)*

Printed at: M/s. K J Grapharts,
5, Alagar Perumal Koil First Street,
Vadapalani, Chennai - 600 026.

PREFACE

It is well recognised that diversification of species and farming practices is one of the important approaches for sustainable development of brackishwater aquaculture. Shrimp farming has recently gone through a difficult situation of viral disease outbreaks and several farms lay idle for short periods for want of alternate species and technology. Interest had been evinced in crab culture as crabs form one of the export commodities among the seafood items, besides their demand in local domestic markets. Both frozen crab meat and live mud crabs are exported from India and during the last one decade the exports have shown an increasing trend. During 1994-95, 1,861 tonnes of frozen/canned crab meat valued at Rs. 22.9 crores were exported. In 1995-96, live mud crab export was 1,635 tonnes valued at Rs. 16.71 crores.

Mud crabs of the species Scylla tranquebarica and S. serrata are widely distributed in the Indo-Pacific Region and several countries are engaged in culture operations, although as a small scale and on extensive lines, as also in polyculture system along with milkfish, shrimp and seaweed. Realising the increasing popularity and importance of mud crabs in the region by virtue of its meat quality and large size, the FAO Bay of Bengal Programme organized a regional seminar on Mud Crab Culture and Trade at Surat Thani in Thailand in 1991 and discussed the issues of resources, seed production, culture and trade.

Mud crab culture as of now depends entirely on seed collected from the wild. Although controlled seed production has been achieved on an experimental basis, the technology remains to be scaled up to the hatchery level of production. Culture practices are of two kinds, namely, fattening of "water crabs" and growout starting from small seed crab and rearing them to marketable size.

The present Bulletin on Mud Crab Culture is an attempt to provide scientific information on the biology, culture and seed production of mud crabs for the benefit of the brackishwater culturists, which would also be useful for the fishermen to undertake small-scale operations. The scientists who have prepared this Bulletin have been working in the research project on Mud Crab Culture at the Central Institute of Brackishwater Aquaculture at Chennai and Kakdwip and have shared their experience in this publication. Indicative economics for small-scale operations have been included.

It gives me great pleasure to record my appreciation to Shri M. Kathirvel, Shri S. Srinivasagam and Dr. P. K. Ghosh, Senior Scientists and Shri C. P. Balasubramanian, Scientist of this Institute for bringing out this Bulletin with good illustrations, at appropriate time when information on technology of mud crab culture would help diversification of Brachishwater culture, although on a modest scale.

Chennai,
21-3-97.

K. ALAGARSWAMI
DIRECTOR

CONTENTS

1. INTRODUCTION

Among the edible shrimps, lobsters and crabs, the large-clawed mud crabs are considered as one of the important seafood items for aquaculture in South-east Asian countries due to their esteemed delicacy, medicinal value and demand for local and export trades. In India, two species of mud crabs, namely, *Scylla tranquebarica* (larger species) and *Scylla serrata* (smaller species) are caught from the coastal and adjacent estuarine areas and utilised for both local consumption and seafood export. The recent estimate has indicated an annual exploitation of 3,500 tonnes of mud crabs from India. The average annual foreign exchange by exporting frozen and canned crab meet (av. 964 tonnes) and live mud crabs (av. 684 tonnes) during 1987-88 and 1995-96 is Rs. 72.4 million and Rs. 44.2 million respectively.

There is no exclusive traditional farming for mud crabs in India. The juveniles of mud crabs enter the tide-fed perennial and seasonal brackishwater fish/shrimp culture fields of Karnataka (Khazan lands), Kerala (Pokkali fields) and West Bengal (Bheries) and grown-up mud crabs are harvested in small quantities along with fish and shrimp. Thus, for centuries, the mud crabs have constituted an important secondary crop in the tide-fed traditional fish farming. Nevertheless, monoculture or polyculture of mud crabs with milkfish, tiger shrimp and seaweed is practised in countries like China, Indonesia, Malaysia, Sri Lanka, Taiwan, Thailand and the Philippines, where mud crab production showed an increasing trend. Due to the greater demand for live mud crab export trade from India, many fish farmers have shown interest in taking up mud crab culture. In this context, information on biology and culture practices of mud crabs are presented in this Bulletin to help traditional fish farmers to adopt mud crab culture for increased production.

2. CANDIDATE SPECIES

Two species of mud crabs, namely, *Scylla tranquebarica* and *Scylla serrata* are suitable for culture operations. These two species belong to the family Portunidae and can be identified in the field by the following distinct colour and morphological features.

Scylla tranquebarica (Plate 1 A)	Polygonal markings on walking and swimming legs; 2 prominant sharp spines on the outer margin of wrist of chelipeds (Plate 1 C - *S.t.*)
Scylla serrata (Plate 1 B)	No polygonal markings; 1 spine on the outer margin of wrist of chelipeds (Plate 1 C - *S.s.*)

3. BIOLOGY

3.1. Distribution and habitat

Both the species of mud crabs are found in the shallow coastal waters, lagoons, estuaries, backwaters, brackishwater lakes, mangroves and inter-tidal swamps of east and west coasts of the mainland and the creeks and bays of Andaman and Nicobar Islands. They prefer sandy or muddy slush bottom. Both the species remain buried under the substratum during the day and are active in the night. While the largef species *(S. tranquebarica)* remains buried under the substratum, the smaller species *(S. serrata) usually makes burrows at the bottom and in the embankments of* brackishwater canals and fish farms. Both the species migrate into brackishwater area during their postlarval stage (megalopa stage). Early juveniles abound the intertidal region, while the adults occupy the deeper portions of the estuaries. After attaining maturity, adults migrate, especially the berried females to the sea for breeding. The life history of mud crab in different habitats is illustrated in Fig. 1. *S. tranquebarica* is free living and frequents open areas of estuaries, whereas *S. serrata* is more common in mangrove areas.

3.2. Sexual identity

Sex can be identified in juveniles measuring above 35 mm in carapace width (CW) by the shape of the abdominal flap. In male, the abdominal flap is slender and triangular (Plate 1 D), while it is broad and triangular in immatured (Plate 1 E) and semi-circular in matured and berried females (Plate 1 F). In both sexes, the abdominal flap in live crabs, is folded firmly against the ventral side of the body.

3.3. Food and feeding

Both the species of mud crabs are carnivorous. They feed on slow moving and bottom dwelling animals such as bivalve molluscs, small crabs and dead and decayed animal materials. These crabs are also called as scavengers. In fact, they cannot catch a live and moving prey.

3.4. Moulting

The growth in mud crabs is manifested with the shedding of outer shell. Before moulting, a new exoskeleton shell is formed below the old, hard and dead shell. During the moulting process, the old shell is cast off. The formation of new shell and casting of old shell is called as moulting process, which requires energy. The increase in size of the crab after moulting takes place due to the absorption of water by the tissues of the body and thus the moulted crabs are larger in size. Since the moulted crabs have utilised stored energy for moulting, they weigh less and they contain more of water. The newly moulted crabs with watery meat and soft exoskeleton are called as "water crabs". Such "water crabs" remain defenceless and become easy prey to other animals, particularly other hard mud crabs. The newly formed shell of the moulted crabs gets hardened after 3-4 days

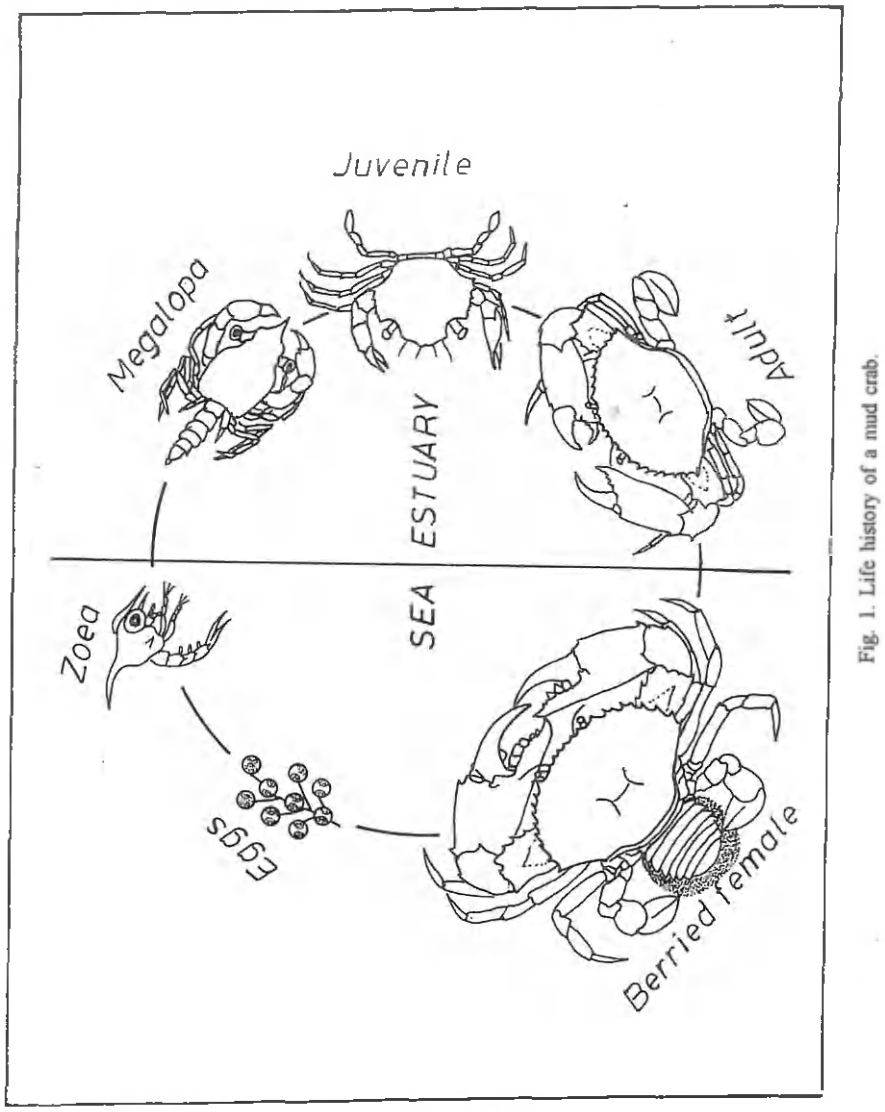

Fig. 1. Life history of a mud crab.

after moulting. The frequency of moulting is more in juveniles and sub-adults, while it is less in adults. The hard shelled crabs are called as "meat crabs", which fetch a higher price.

3.5. Growth

In the experimental field culture, the early juvenile crabs (15 to 60 mm in CW/3 to 20 g in total weight) grow at a rate of 7 to 12 mm / 3 to 13 g per month, while juvenile crabs (61 to 80 mm / 25 to 70 g) exhibit a monthly growth of 11 to 12 mm / 45 to 97 g. In the sub-adult and adult stages, the monthly growth works out to 8 to 10 mm / 100 to 130 g. The larger species *(S. tranquebarica)* attains a maximum size of 220 mm / 2.5 kg and the smaller species *(S. serrata)* 140 mm / 0.5 kg in the wild.

3.6. Maturity

Attainment of maturity in females can be easily noticed by the change in the shape of abdominal flap, from triangular to half-round/horse-shoe shaped (Plate 1 E & F). For males, there is no external character to identify the matured ones. The size at maturity for female is about 120 mm for larger species *(S. tranquebarica)* and 83 mm for smaller species *(S. serrata)*. After the onset of maturity, the development of ovary takes place internally. Initially, the colour of the ovary is bright orange which changes to deep yellow before extrusion of eggs. The inner ovarian development can be determined by pressing down between carapace and abdominal flap. The eggs, if matured, are visible by their yellow colour.

3.7. Mating

The copulation takes place between a hard male and a freshly moulted soft female. Prior to copulation, a hard male climbs over the back of hard female crab, clasping her by his chelipeds and first two pairs of walking legs. This formation is called as "doubler' or "premating embrace", which lasts for 2-3 days. The pair separates when the female reaches the verge of moulting. The female moults and it is called as "pre-copulatory moult". The male assists the female during the pre-copulatory moulting. A few hours after moulting, the male embraces the soft female again for the actual mating. The male gently turns the female over on her back using his chelipeds, while the female unfolds her abdominal flap and holds the male in position. The copulation lasts for 6-8 hours. During the copulation act, the male deposits spermatophores in the seminal receptacles of the female.

3.8. Breeding

When the eggs become ripe, they are fertilised by the stored spermatophores. Later, they are extruded and remain as "mass" or "sponge" and attached to the hair-like branches of four pairs of appendages of the abdominal flap. The egg mass as a whole, attached to the abdominal flap is

called as "berry" (Plate 1 G). The number of eggs in the berry vary from 2 to 3 million for larger species *(S. tranquebarica)* and 0.5 to 2.5 million for smaller species *(S. serrata)*. The eggs measure 0.28 to 0.38 mm in diameter. The incubation period is about 2 weeks, during which time, the colour of the eggs gradually changes from orange to brown and then to black. The stored spermatophores are used for more than two spawnings. The mud crabs are continuous breeders as evidenced by the occurrence of ovigerous and berried females throughout the year in the coastal and brackishwater regions. The peak breeding season varies from place to place. The major breeding season and juvenile abundance along the Indian coast is given in Table 1.

Table 1. Breeding season and abundance of juvenile crabs

Breeding		*Abundance of Juvenile*	
Region	Peek season	Region	Peek season
Kerala coast	Sep-Feb	Vembanad backwaters	May-Oct
Tamil Naducoast	Sep-Apr	Pulicat lake	
		Ennore estuary	
		Adyar estuary	Dec-May
		Kovalam backwaters	
		Pitchavaram	Jan-Mar
		Tuticorin	Apr-Jun &Sep-Oct
Andhra Pradesh coast	Oct-Feb & May-Jun	Kakinada	Dec-Apr & Jul-Aug
Orissa coast	Nov-Jan	Chilka Lake	Mar-Jun
West Bengal coast	May-Aug	Hooghly-Matlah estuarine system	Nov-Feb

3.9. Larval stages

Before releasing the larvae, the colour of the eggs becomes black, which is due to the formation of eyes of the larva. The larva which emerges after piercing the egg membrane is called as "zoea". There are 5 zoeal stages and one "megalopa" (postlarval) stage before attaining the first crab stage. The interval between zoeal stages is 3-4 days and the megalopa takes 11-12 days to become first crab stage. The size of first and fifth zoea is 1.2 mm and 3.5 mm in length respectively, while the megalopa measures 2.5 mm in carapace length. The next is the first crab stage, which measures 3.7 mm in carapace width. The zoeal larvae are highly carnivorous and feed on

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larvae/adults of zooplankton including zoeal larvae of its own and other crabs, indicating the existence of cannibalism from larval stages onwards. The duration between first zoea to first crab stage is about one month.

3.10. Salinity tolerance

In general, mud crabs occur in water bodies having a range of salinity from 0 to 45 ppt, indicating their euryhaline nature. Experimental studies on salinity tolerance have indicated that the crabs without acclimation tolerated 16-45 ppt, while the crabs with acclimation tolerated 5-50 ppt with 100 % survival. A salinity range of 15-35 ppt is the optimum level for better growth and survival of mud crabs in culture.

3.11. Diseases and parasites

The acorn barnacles are found attached over the carapace, walking legs and chelipeds of adult mud crabs caught from the sea, while the goose barnacles (cirripeds) are known to infest the gill regions of the crabs collected from estuarine and marine regions. The fungal growth has been observed on the egg mass of laboratory-held berried females of mud crabs. So far, no other diseases have been reported for mud crabs.

4. CULTURE PRACTICES

4.1. Types of culture

Two types of culture operations are practised:

- Grow-out culture in earthen ponds provided with proper fencing, where juvenile crabs can be raised to marketable size over a period of 3-4 months.
- Fattening process in which "water crabs" can be reared in earthen ponds with fencing, pens and cages for a period of 3 to 4 weeks to gain weight or for the full development of ovary in female crabs.

4.2. Grow-out culture operation

4.2.1. Suitable site

Ponds can be constructed in tide-fed estuaries, backwaters and creeks. The crab ponds are established in traditional fish/shrimp farms, by converting one portion adjoining the brackishwater canal, as shown in Plate 2 A & Fig.2 A., which would help increase the overall income of traditional fish/shrimp farmers.

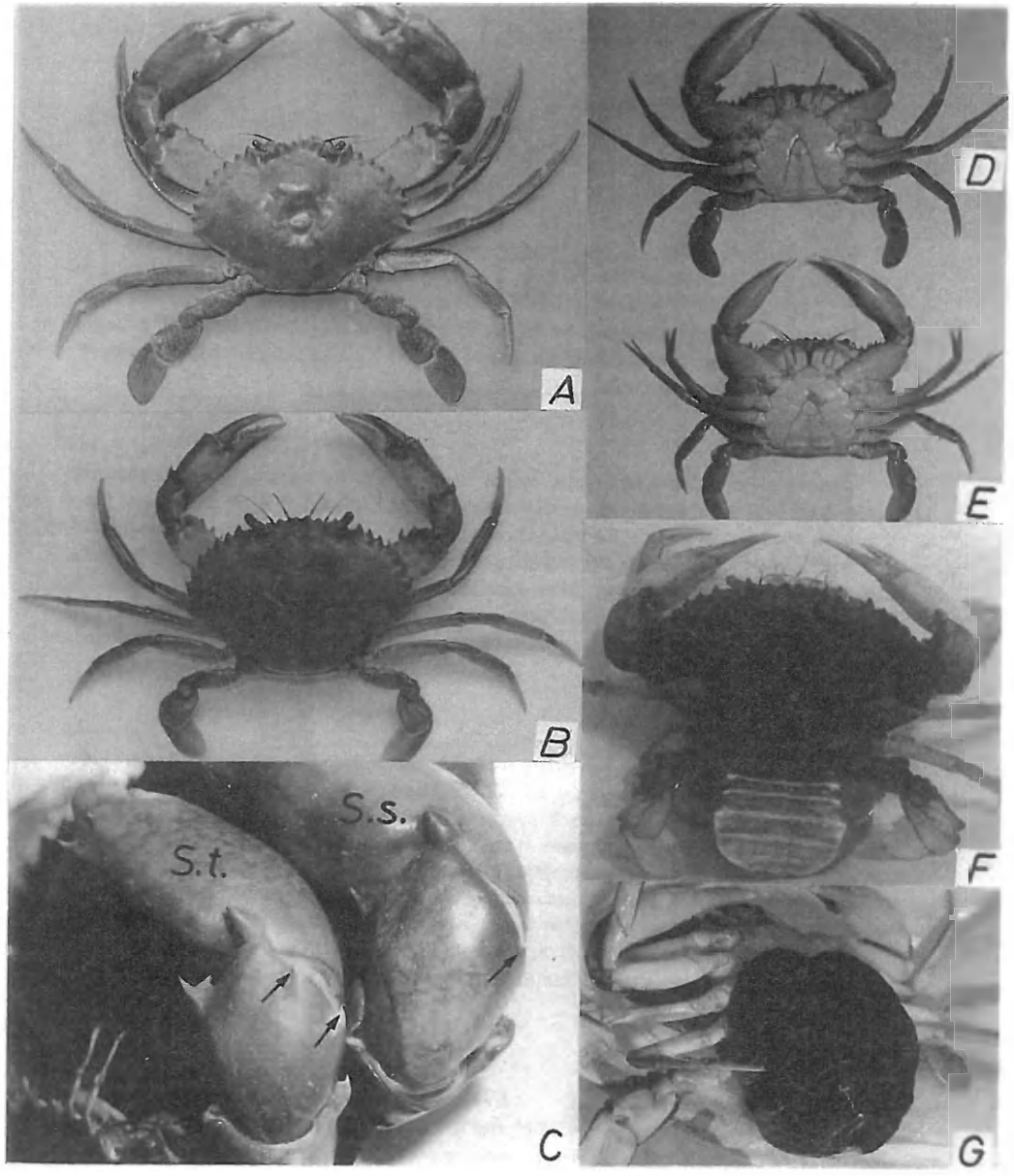

PLATE 1. A. Larger species *Scylla tranquebarica;* B. Smaller species *Scylla serrata;* C. Spines present in the wrist of chelipeds, indicated by arrows in S. t. (*S. tranquebarica*) and S. s. (*S. serrata*); D, E & F. Shape of the abdominal flap in male, immature female and matured / berried female; G. Egg mass -the "Berry".

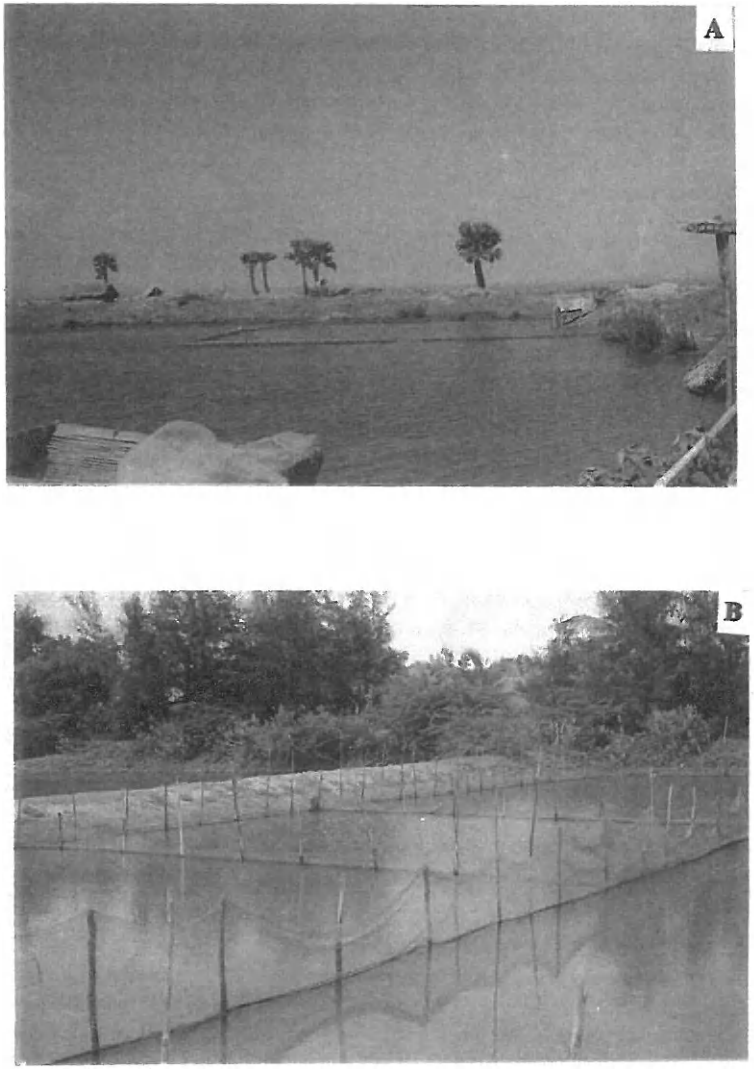

PLATE 2. A. Crab pond being constructed in one of the corners of the traditional fish / shrimp pond; B. Crab pond with nylon net fencing.

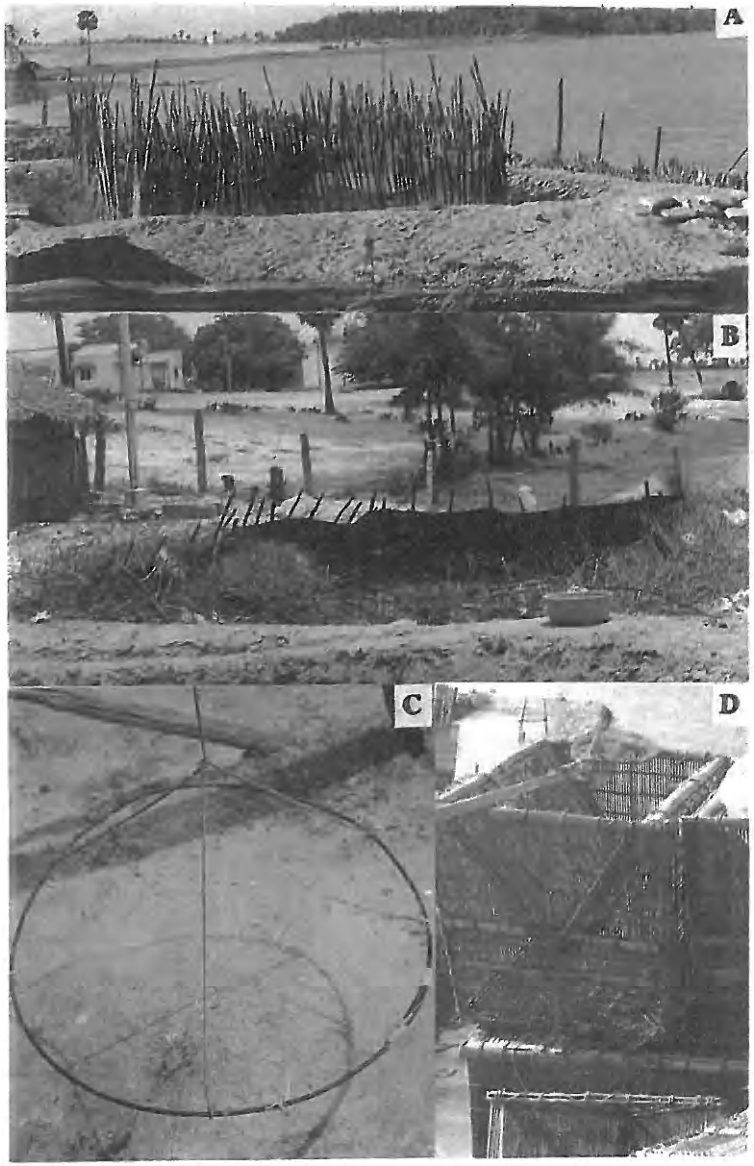

PLATE 3. A. Crab pond with nylon netting with support of casuarina poles fencing; B. Pond fenced with bamboo-split matting; C. Mud crab sampling/ harvesting gear - Lift net; D. Bamboo traps used for harvest of mud crabs.

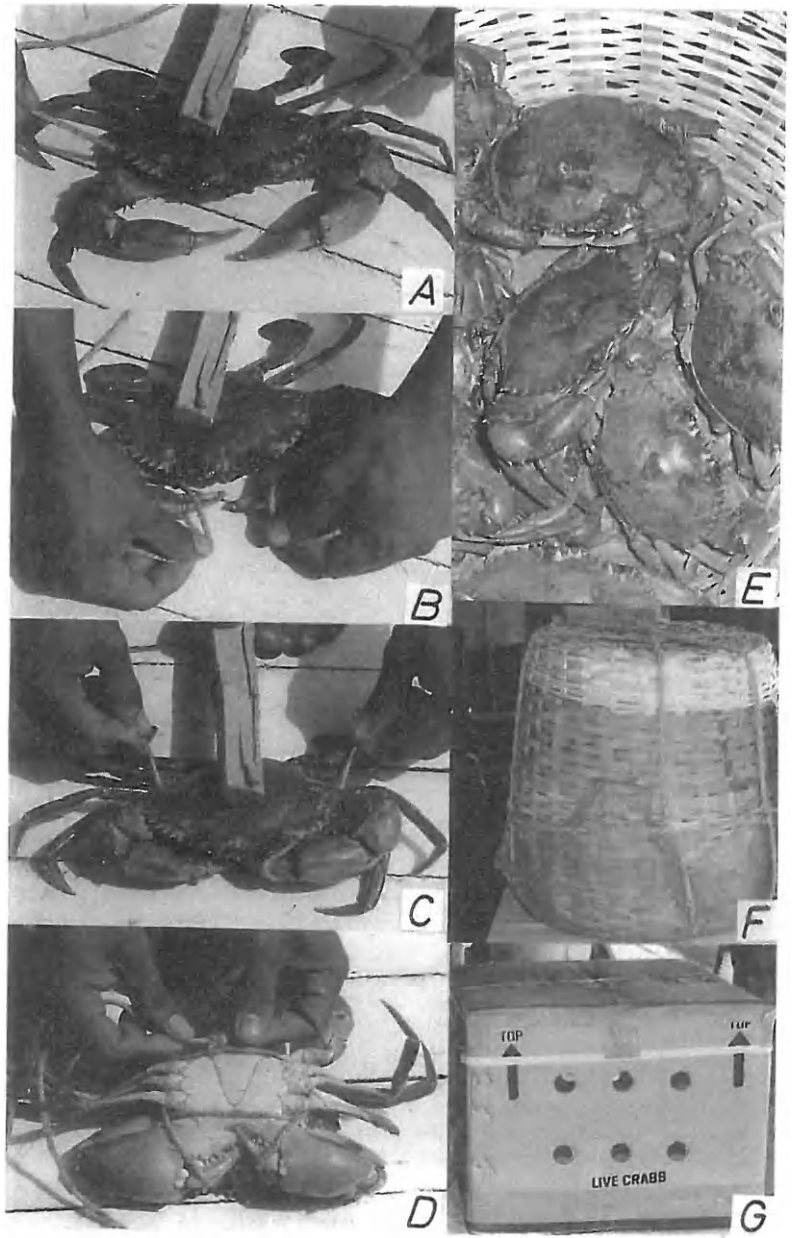

PLATE 4. A to E. Steps in tying a live mud crab; F & G. Bamboo basket and perforated thermocol box for live mud crab export trade.

4.2.2. Grow-out pond

Earthen ponds of 0.1 to 0.4 ha in size and rectangular in shape having a sandy or muddy or clay loamy bottom soil are constructed with a minimal digging, which provides ample soil for bund construction. The wider axis of the pond may face the backwater canal in order to have a greater tidal effect through a traditional wooden sluice. A model crab pond is illustrated in Fig.2 B.

4.2.3. Pond preparation

Before stocking, the ponds are prepared by removing unwanted organisms by netting. To prevent the escape of stocked crabs from the pond, fencing with suitable materials such as casuarina poles, bamboo split matting, G.I.chicken wire mesh, nylon netting and asbestos sheet to a height of 1 m is erected either in theinner edge of the pond (Plate 2 B & Plate 3 A & B) or on the top of the earthen bund. The fencing may be positioned at 45 degree angle towards the inner side of the pond, which will prevent the climbing and escape of small crabs. Since mud crabs are highly cannibalistic, earthen and PVC pipes and worn-out tyres may be placed as hide-outs/shelters to reduce the fighting among the normal hard crabs and mortality of the soft "water crabs". A row of earthen mounds may be constructed in such a way that they remain submerged during the high tide and exposed during the low tide, in order to serve as natural habitat.

4.2.4. Availability of stocking material

Since there is no dependable hatchery technology available for mud crab seed production, the stocking material at all sizes has to be collected from wild using nylon drag net, cast net, lift net and bamboo trap. The young crabs abound in estuaries, mangroves, backwaters, brackishwater lakes and creeks. The other source for small crabs and "water crabs" in live condition is from the commercial catches. The peak abundance of juvenile crabs from different regions along the Indian coast is summarised in Table 1.

4.2.5. Stocking

Crabs with a size range of 80 to 100 g may be stocked at a rate of 1 to 5 per square metre, depending upon their availability.

4.2.6. Feeding

The reared crabs are fed once in a day, preferably in the late evening either with trash fish or *molluscan meat (bivalve/gastropod)* at a rate of 5 to 10 % of stocked biomass, depending upon the observed feeding intensity and the size recorded at regular and periodical sampling of the reared crabs. The daily feeding rate for 4-month culture is expressed as:

Daily feed required = No. of crabs stocked X % of survival X Av. body weight X % of feed to be given

As a guide line, at a stocking density of 1 crab per square metre in 0.2 ha pond, the quantity of feed required for 4 months culture is worked out and presented in Table 2.

Table 2. Feed requirement

Day of culture	No. of crabs stocked	% of survival	Av. body weight (g)	% of feeding	Total quantity of feed required (kg)
1-30	2000	100	90	5	270
31-60	2000	90	150	6	486
61-90	2000	80	225	8	864
91-120	2000	70	300	10	1260
				Total	2880

4.2.7. Water management

- Exchange of water having a salinity of 10-35 ppt through the sluice gate
- The other parameters of water: temperature 28-32° C; disssolved oxyge: 5-7 ppm; depth 0.5-1.0 m; pH 7.5-8.5.
- Cleaning of screens of the sluice once in a week to ensure a free-flow of water
- When the crabs tend to come out of the pond, it is an indication of deterioration of quality of pond water. On such occasion, the option available is either to transfer the crabs to another pond or to prepone the harvest.

4.2.8. Monitoring of reared stock

The reared crabs are examined periodically by sampling to record their growth and health condition. By employing a lift net with bait, preferably in the evening hours, crabs can be obtained for sampling. Crabs should be handled with care and properly tied before measuring their carapace width and total weight. At stocking density of 1crab per square metre, crabs belonging to *S. tranquebarica* can grow from an initial size of 80-100 g to the final weight of 400-500 g in 4 months and 800-1000 g in 7 months rearing. During the sampling, those crabs found with ulceration on carapace should be removed as a precautionary measure. This ulceration may be due to chitin-destroying bacteria caused by lesser circulation of water in the tide-fed ponds. The mortality by cannibalism among the reared crabs can be minimised by sufficient feeding.

4.2.9. Harvest

The harvest of crabs can be effectively done in tide-fed ponds by letting in water through the sluice into the pond during the incoming tide (high tide). As the water flushes in, mud crabs tend to swim against the incoming water and congregate near the sluice gate and they can be caught with the help of a scoop net. The crabs are partially harvested by baited lift nets and bamboo cages/traps (Plate 3 C & D). Complete harvest is done by scoop nets at the sluice gate and also by hand picking at the lowest low tide levels. The expected survival rate would be around 70 to 80 %. The "water crabs" encountered in the final harvest are utilised for fattening purpose.

4.2.10. Packing

The first pair of largest legs with pincers (chelate legs) of each live crab should be firmly tied up with the body by jute/nylon thread to curb their movement and to avoid the fighting among *them. The method of tying a live mud crab is as follows:* A *wooden stick is firmly placed on the* body of the crab for instant arrest of its movement and a jute/nylon thread are placed in between the frontal portion of the body and chelipeds. After keeping the chelipeds in folding posture, the thread is coiled around their fingers and both the ends of the thread is put into a double knot at the rear end of the crab, as shown in Plate 4 A to E. Wet seaweeds are kept in between the packed layers of crabs to enhance their moist and cool conditions during the transport from place to place for local consumption. The tied-up crabs are washed with fresh seawater and packed either in bamboo basket or in perforated thermocole box for export purpose (Plate 4 E & F).

4.2.11. Marketing

Mud crabs are generally sold in live condition for both local consumption and live crab export trade. For the marketing purpose, mud crabs are graded as "extra large" (1 kg and above), "large" (500 g to 1 kg), "medium" (300 to 500 g) and "small" (200-300 g). The matured and berried female crabs are usually sold for a higher price. The meaty crabs weighing above 300 g are considered for live mud crab export, while the under-sized crabs (less than 300 g) and the crabs which have lost their limbs are sold by number in local markets. They are marketed only in live condition, as there is an aversion among the consumers for dead mud crabs

4.2.12. Export

The mud crabs and other portunid crabs are processed and exported in the form of frozen and canned crab meat from 1962. Since the export trade for live mud crabs has started in 1987-88, the demand for the same is ever increasing. The quantity of frozen and canned crab meat and live mud crabs exported from 1987-88 to 1995-96 is given in Table 3.

Table 3. Export of frozen and canned crab meat and live mud crabs from India

Period	Frozen & canned crab meat		Live mud crabs	
	Quantity (tonnes)	Value (Rs. million)	Quantity (tonnes)	Value (Rs. million)
1987-88	122	10.7	36	0.7
1988-89	216	16.0	412	7.4
1989-90	641	19.5	619	13.4
1990-91	1,699	55.2	654	16.0
1991-92	1,166	46.4	591	18.9
1992-93	695	57.0	550	28.7
1993-94	1,309	144.5	725	51.9
1994-95	1,861	229.9	934	93.5
1995-96	No data	No data	1,635	167.1

Source: MPEDA, Kochi

4.3. Fattening process

Fattening of crabs involves the selection of "water crabs" having a size of 200 g and above and rearing for 3-4 weeks in ponds (50 to 500 square metres), pens (100 to 500 square metres) and cages (4 to 10 square metres) with or without equally divided compartments. The pens with height of 1.5 m above the water level at high tide are usually fixed either in one corner of the traditional pond or in the open shallow backwater area, while the cages with top net cover are kept submerged in shallow area (1 to 1.5 m depth) of coastal lagoons, backwaters and canals (Fig. 2 C & D). The stocking density varies from 1 to 3 crabs per square metre. For the pens fixed inside the traditional culture pond, the management steps practised for grow-out culture should be followed. The pens and cages fixed in open waters should be cleaned once in a week to remove the attached algae and other plant materials to ensure a free-flow of water. The feeding rate is 10 % of stocked biomass and the feeds include trash fish, molluscan meat and the wastes from butchery shops. The "water crabs" of 150-500 g can attain a final weight of 230-650 g during 3-4 weeks of fattening.

5. SEED PRODUCTION

5.1. Procurement of berried crabs

Female crabs of both species carrying egg mass are caught in considerable numbers in the inshore region. However, berried females of smaller species *(S. serrata)* do occur in the brackishwater areas including the traditional fish/shrimp culture ponds and mangrove water bodies. Though they are available throughout the year in the wild, considerable number of berried females

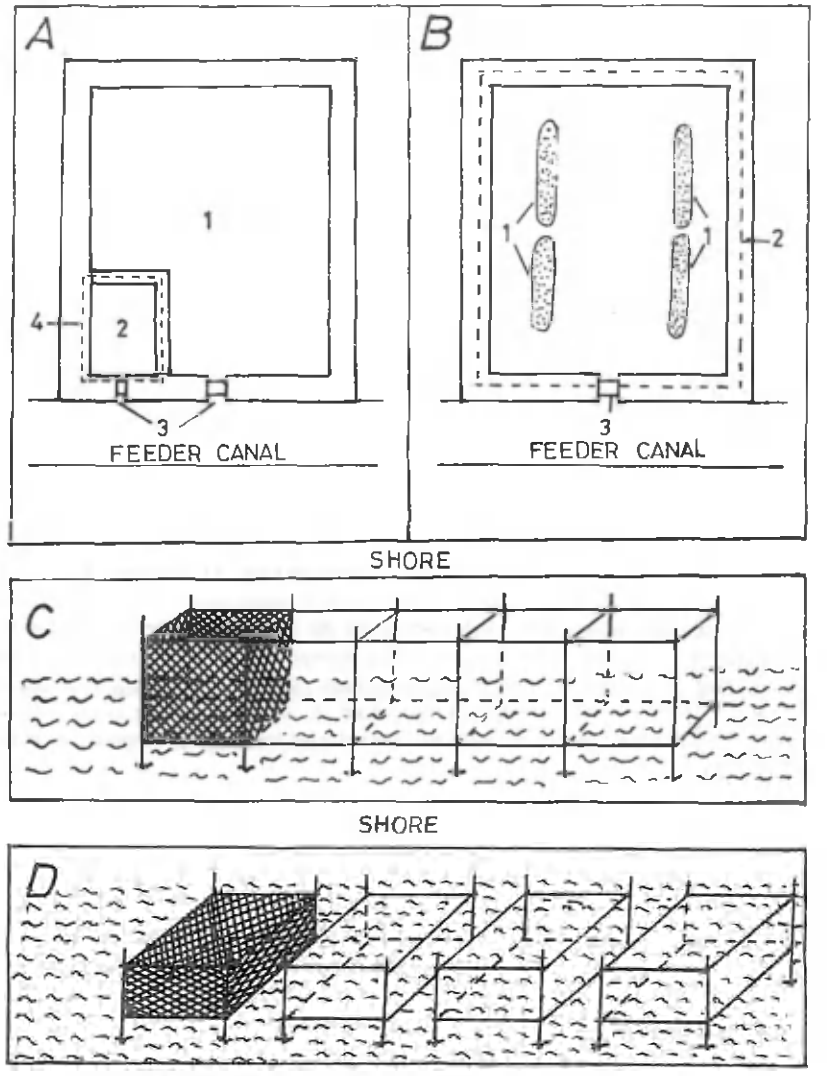

Fig. 2. A. 1. Traditional fish/shrimp pond; 2. Crab pond; 3. Sluice; 4. Fencing; B. A model crab pond; 1. Earthen mounds; 2. Fencing; 3. Sluice; C. Compartmentalised pen and D. Row of cages fixed in shallow tide flushed area.

are caught during the peak breeding season, as indicated in Table 1. The second source of berried crabs is from the crab culture ponds, where both the sexes of larger species *(S. tranquebarica)* and smaller species *(S. serrata)* mature, mate and female crabs become berried. The third source is by the inducement of maturation in the captive adult female crabs held in a hatchery complex. The removal of one of the eye-stalks by electrocauterisation would help in the development of ovary and subsequent appearance of berry within a period of 15 days from the time of eyestalk ablation.

5.2. Transport of berried crabs

For short-time transportation (1-6 hours), the berried crabs can be kept submerged in seawater (salinity: 30-35 ppt) / brackishwater: 15-25 ppt) and placed individually in 10-litre capacity containers such as plastic buckets and metal tins. For longer journeys of 7 to 24 hours, 50-litre capacity containers with proper provision for aeration are to be used. They can be sent safely by air/rail/road to their destination.

5.3. Hatching

As part of the health management, the berried crabs obtained either from wild or from the culture pond should be treated with 10 ppm malachite green/methylene blue dipping for 5 minutes, which would ensure the eradication of harmful bacteria from the eggs. This treatment would enhance the hatching rates. The berried females should be kept individually in 500-litre capacity fibreglass/cement tanks covered with black cloth to cut the light. Before liberation of larvae, the abdominal flap of mother crab makes frequent jerking movements and the egg mass gets loosened. Also, the jabbing of walking legs over the egg mass takes place, before hatching first zoea larvae from the eggs. Normally, the release of larvae occurs in the early morning hours, which is a continuous process, lasting for 3-5 hours. The liberated zoea larvae are phototactic, i.e. attracting towards the light.

5.4. Larval rearing

5.4.1. Stocking of larvae

The first zoea larvae should be stocked at a rate of 200-400 number per litre in 2-ton fibreglass/cement larval rearing tanks, which contain filtered seawater and aeration facility.

5.4.2. Rearing medium

The filtered seawater having a salinity range of 30-35 ppt and water temperature of 27-29° C should be used. Water should be exchanged daily at a rate of 80 %.

5.4.3. Larval feeding

The feeds and feeding rates for different zoeal and post-larval stages are indicated in Table 4.

Table 4. Feeds & feeding rates

Larval/post-larval stage	Duration (days)	Daily feeding rate		
		Rotifer (No. / ml)	*Artemia* nauplii (No. / ml)	Cooked clam meat (g / larva)
1st zoea	3-4	4-8	-	-
2nd zoea	3-4	5-10	-	-
3rd zoea	3-4	15-20	5-10	-
4th zoea	3-4	20-30	10-15	-
5th zoea	3-4	-	40-50	-
Megalopa	11-12	-	-	0.1-0.5
1st crab stage	6-7	-	-	1.0-2.0

The expected survival rate from first zoea to first crab stage would be around 5-15 %. However, suitable feeding and better water management are likely to enhance the survival rate.

5.4.4. Postlarval rearing

Fine sand should be spread at the bottom of postlarval tanks to a depth of 5 centimetres to facilitate the burying habits of the small crabs. The stocking rate should be 5-10 crabs per square metre. Boiled molluscan meat should be provided at a rate of 1-2 % of stocked biomass. By the end of 2 months laboratory rearing, the average size attained by larger species of mud crab (*S. tranquebarica*) would be around 30 mm in carapace width (4 g in weight).

6. COST AND RETURNS ANALYSIS

The approximate cost to be incurred for the fixed costs and recurring expenditure for grow-out culture in ponds and fattening process in ponds, cages and pens is presented in Annexure 1 to 4.

7. ACKNOWLEDGEMENTS

The authors are grateful to Dr. K. Alagarswami, Director, Central Institute of Brackishwater Aquaculture, Chennai, for his encouragement in preparing this Bulletin. Sincere thanks are due to

Dr. L. Hanumantha Rao, Senior Scientist and the scientist-in-charge, Crustacean Culture Division, for his critical reading of the manuscript.

8. FURTHER READING

1. **ANGELL, C.A.** (Ed.) 1992. Report of the Seminar on Mud Crab Culture and Trade. Bay of Bengal Programme, BOBP / REP / 51, 246 pp.

2. **CHEN, L.C.** 1990. Aquaculture in Taiwan, Fishing News Books, Oxford, 128 pp.

3. **COWAN, L.** 1984. Crab farming in Japan, Taiwan and the Philippines. Queensland Department of Primary Industries, Information Series Q 184009, 85 pp.

ANNEXURE - 1

Grow-out pond culture in 0.2 ha

		Rs.
A.	FIXED COSTS	
	Pond lease amount for one year	5,000
	Pond development	2,000
	Sluice gate, screens and fencing materials	10,000
	Watchman shed	2,000
	Miscellaneous	2,000
	Total	**21,000**
B.	OPERATIONAL COST FOR 1 CROP OF 4 MONTHS	
	2000 crabs; 80-100 g in size; total stocked biomass 180 kg; stocking rate: 1 crab per sq.m.; (Rs. 3 per crab)	6,000
	Feed - Trash fish; feeding rate 5-10% of stocked biomass; total quantity required for 120 days of culture: 2,880 kg; (Rs. 10 per kg)	28,800
	2 labourers for 4 months	6,000
	Pond maintenance	750
	Miscellaneous	500
	Total	**42,050**
C.	INCOME	
	Production at 70 % survival: 1,400 crabs; av. size 450 grams; 630 kg; Rs. 100 per kg	63,000
D.	GROSS PROFIT FOR ONE CROP (C - B)	20,950
E.	GROSS PROFIT FOR 2 CROPS PER YEAR	41,900
F.	NET PROFIT (after allowing 20% interest on capital cost)	**37,700**

ANNEXURE - 2

Fattening in 0.025 ha pond

		Rs.
A.	FIXED COSTS	
	Pond lease amount for one year	1,000
	Pond development	500
	Sluice gate, screens and fencing materials	2,000
	Watchman shed	1,500
	Miscellaneous	1,000
	Total	**6,000**
B.	OPERATIONAL COST FOR 1 CROP FOR 1 MONTH	
	500 'water crabs'; 250-350 g in size; total stocked biomass; 150 kg; stocking rate 2 crabs per sq. m.; (Rs.10 per crab)	5,000
	Feed - Trash fish; feeding rate 10% of stocked biomass; total quantity of feed required for 30 days: 450 kg; (Rs. 10 per kg)	4,500
	1 labourer	750
	Miscellaneous	750
	Total	**11,000**
C.	INCOME	
	Production at 80 % survival: 400 meat crabs; av. size 400 g; 160 kg; Rs. 100 per kg	16,000
D.	GROSS PROFIT FOR ONE CROP (C - B)	5,000
E.	GROSS PROFIT FOR 10 CROPS PER YEAR	50,000
F.	NET PROFIT (after allowing 20% interest on capital cost)	**48,800**

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ANNEXURE - 3

Fattening in a battery of 10 cages, each of 50 square metres (total 500 square metres)

		Rs.
A.	FIXED COSTS	
	H.D.P.E. knitted netting (2.0 mm dia & 50 mm mesh size); 350 kg for 10 cages; (Rs. 150 per kg)	52,500
	Fabrication of cages and fixing	20,000
	Total	**72,500**
B.	OPERATIONAL COST FOR 10 CAGES FOR 1 MONTH	
	1000 'water crabs'; av. size: 250-350 g; total stocked biomass; 300 kg; stocking rate 2 crabs per sq. m.; (Rs. 10 per crab)	10,000
	Feed - Trash fish; feeding rate 10% of stocked biomass; total quantity required for 10 cages for 30 days: 900 kg; Rs. 10 per kg	9,000
	2 labourers for 30 days	1,500
	Miscellaneous	2,500
	Total	**23,000**
C.	INCOME	
	Production at 80 % survival: 800 meat crabs; av. size 400 g; 320 kg; Rs. 100 per kg	32,000
D.	GROSS PROFIT FOR ONE CROP (C - B)	9,000
E.	GROSS PROFIT FOR 8 CROPS FOR 10 CAGES IN A YEAR	72,000
F.	NET PROFIT (after allowing 20% interest on capital cost)	**57,500**

ANNEXURE - 4

Fattening in 500 square metres pen (with 5 equal compartments; 100 sq. m. each)

		Rs.
A.	FIXED COSTS	
	H.D.P.E. knitted netting (2.0 mm dia & 50 mm mesh size) ; 370 kg for 500 sq. m. pen; Rs. 150 per kg	55,500
	Fabrication and fixing	20,000
	Total	**75,500**
B.	OPERATIONAL COST FOR 1 MONTH	
	1000 'water crabs'; for 500 sq. m. pen; av. size: 250-350 g; total stocked biomass; 300 kg; stocking rate 2 crabs per sq.m.; Rs. 10 per crab	10,000
	Feed - Trash fish; feeding rate 10% of stocked biomass; total quantity required for 30 days: 900 kg; Rs. 10 per kg	9,000
	2 labourers for 30 days	1,500
	Miscellaneous	500
	Total	**21,000**
C.	INCOME	
	Production at 80 % survival: 800 meat crabs; av. size 400 g; 320 kg; Rs. 100 per kg	32,000
D.	GROSS PROFIT FOR 10 CROPS (C - B)	90,000
E.	NET PROFIT (after allowing 20% interest on capital cost)	**74,900**

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