



# Cost-Benefit Analysis of Crab Farming in Sundarbans Areas of West Bengal-A study

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**Abstract:** The Sundarbans mangroves areas are ideal habitat for the proliferation of zooplankton, fishes, shrimps, crabs, etc. Mud crab farming has the potential to support vulnerable coastal population of Sundarbans. It is an economically important species of crab found in the estuaries of the Sundarbans. Crabs have high demand in national as well as international market. Crab farming is of low labour cost, low production cost and fast growing agro business. Commercial crab farming business is developing the lifestyle of the people of coastal areas. We can earn more foreign exchange from crab farming business than shrimp farming. There are two methods of crab farming-grow out system and crab fattening system. Between these two crab farming methods, fattening system is more profitable than grow out system and has many advantages. Grow out crab farming system takes more time than fattening system. But fattening system is very popular to the farmer as it takes less time and highly profitable. This paper attempts to highlight the production pattern and cost benefit analysis of different crab culture methods of Sundarban areas of West Bengal.

**IndexTerms:** Mangroves, estuaries, mud crab, fattening, commercial production, sustainable

## BACKDROP

The Sundarban is a mangrove dominated deltaic ecosystem forming at the confluence of the Ganges, the Brahmaputra, and Meghna rivers that flow into the Bay of Bengal in South. This region is one of the richest biodiversity zones of India. Mangroves prevent erosion and stabilize the coastal ecosystem serving as a biological buffer between land and sea. Mangroves provide a favourable habitat for the proliferation of zooplankton, fishes, shrimps, crabs, etc. This unique ecosystem offers a nursery habitat for many juvenile organisms. Crab collection is a major livelihood of the people of Sundarban. Mud crab farming has the potential to support vulnerable coastal population thereby strengthening its resilience, flexibility, and adaptability in the dynamical coastal climate of Sundarban (Rahman *et. al.*, 2017, Ahmed, 1992; Kamal, 2002; Zafar, 2004; Zafar and Hossain, 2008).

The Mud crab, Green crab or Mangrove Crab (Scientific name: *Scylla Serrata*) is an economically important species of crab found in the estuaries and mangroves of the Sundarbans. In their most common form, the shell colour varies from a deep, mottled green to very dark brown. Crabs have high flesh content and rapid growth rates in captivity. There has been a huge interest in the aquaculture of this species due to their high demand and price. It has a huge market demand all over the world, particularly in South East Asian countries. High demand makes it as a potential candidate species for commercial level aquaculture. This seafood delicacy is considered as one of the tastiest of all crab species. This is available worldwide and is mostly sold live in international markets. This species is widely exploited from all along the coastal belt of India. In India, mud crab farming started during early eighties and now crab culture is developing very fast in the states of Andhra Pradesh, Kerala, West Bengal and Odisha.

The main benefits of crab farming are, labour cost is very low, production cost is comparatively lower and the crabs grow very fast. Commercial crab farming business is developing the lifestyle of the people of coastal areas. By proper care and management we can earn more from foreign exchange from crab farming business than shrimp farming.

Culture and fattening are two distinct operations. Culture is a grow-out operation that involves rising of young seed to marketable sizes of 500g or above over an extended culture period. Fattening refers to the holding of growers or water crabs (freshly moulted soft crabs) for short time to acquire maximum biological attributes so that maximum economic returns are gained. In this paper the costs of crab farming in Sundarbans areas and the profitability from Crab farming will be analysed.

**OBJECTIVES OF THE STUDY:**

1. On the basis of secondary data, this article tries to highlight the present trends of Crab farming in West Bengal.
2. The cost and profitability of different types of Crab farming will be computed with the help of primary cost data collected from experienced farmers of Sundarbans areas.
3. This article also attempts to know the prospects of Crab aquaculture in the Sundarbans areas in West Bengal.

**RESEARCH METHODOLOGY:**

This is an exploratory research. In this paper, an attempt has been made to explore the present trends of Crab farming the cost and profitability of different types of Crab farming and the prospects of Crab aquaculture in the Sundarbans areas in West Bengal. The necessary data analyzed in this study have been collected from some experienced farmers of Sundarbans areas and from different published journals, books and website articles. Percentage and graphical analysis have been done in this study to analyze the data.

**DISCUSSION:**

Mud crab can be found on estuaries, backwaters and coastal areas. They are member of Scylla genus. There are two species of crabs available that are suitable for commercial production. Two species of crabs are red claw and green mud crab.

**Green Mud Crab**

- [Green mud crabs](#) are larger in size.
- A green mud crab can grow to a maximum size of 22 centimetres carapace width and it can have weights about 2 kg.
- These are free living and distinguished by the polygonal markings present on all appendages.



Fig: 1: Picture of a Mud Crab

**Red Claw**

- Generally red claws are smaller in size than green mud crab.
- A red claw can grow up to a maximum size of 12.7 centimetres carapace width and it may have weights about 1.2 kg.
- It has a burrowing habit and there are no polygonal markings on it.

Both species are suitable for commercial crab farming business having good value and huge demand in the foreign market. In this paper, only mud crab farming methods and cost-benefit analysis of different methods will be analysed.

**Mud Crab Farming Methods**

Mud crabs can be raised in two systems-Grow out farming and fattening systems.

**Grow Out System**

In grow out farming system, young/juvenile mud crabs are reared and grown for a certain period of 5 to 6 months till they reach marketable size and weight. This type of crab farming system is generally pond based. The pond size depends on the nature of production. Generally the size of ponds for crab farming may be between 0.4 to 2 hectares. Proper dams/bunds and tidal water exchange is an essential task. Small sized ponds are very suitable for crab farming as they are easily maintained. A suitable fence is necessary if the size of pond becomes small. In larger sized ponds where natural conditions are prevailing, strengthening is necessary along the outlet area.

Juvenile crabs having weights around 10 to 100 grams may be stocked in the ponds. The duration of production may vary between 5 to 6 months depending on the size of crabs and available facilities. In commercial farming with supplementary feeding, 1-3 crabs per square meter may be stocked. The feed of crabs are low cost fish, shrimps, small sized crabs, rotted

fish and innards of birds and animals from slaughter house etc. Crabs are to be provided 5% feed daily of their total body weight. For example, if there are 100 kg crabs in the pond, then feed 5 kg food to be provided daily. Collecting some crabs to determine an average weight is a very urgent work for regular sampling and monitoring the growth and general health, and to adjust the feeding rate. Some pipes are to be kept in the pond for shelter and the purpose of reducing mutual attacks and cannibalism. Within 4 to 5 months crabs will reach marketable size and weight. Now they become suitable for harvest and selling.



Fig: 2: Grow out Pond (Source: Aquaculture, Volume 23 No. 3, July-September 2019, p20)

### Crab Fattening System

Raising moulted (soft shelled crabs) for a certain period until their exoskeleton gets hardened is known as crab fattening system. Hard shelled crabs have four to five times more value in the market than soft shelled crabs. Farming crabs in this system take less time and the process is very profitable. Fattening crab farming can be done in two systems described below:

- **Fattening in Pond:** Fattening can be done in any types of ponds sizes between 0.1 to 0.4 hector. Small tidal ponds with a depth of 1 to 1.5 meter are very suitable for crab farming. Before stocking crabs in the pond the pond is to be prepared well. Pond preparation can be done by draining the pond water, sun-drying and adding sufficient quantity of limes. A fence around the pond for fattening purpose is to be made because the crabs have a tendency to escape by making hole and digging the soil. The inlet areas with bamboo matting inside the bund are to be reinforced. For stocking, soft (moulted) crabs are to be collected from local fisherman or crab merchants for rearing in the farm. Morning is the better time to collect the soft crabs. Stocking density @ 1-2 per square meter is ideal for crab fattening purpose. The pond is to be divided into different compartments according to the size of crabs if it is big sized. Keeping male and female crabs separated from each other will make good results and reduce mutual attacks and cannibalism. Depending on location and crabs availability 8 to 12 fattening cycles can be done in a year. Generally, crabs having weight between 300 grams to 500 grams have high demand and price in the market. All the crabs are to be harvested and sold when they reach the marketable size and weight. The crabs are to be sold when they are in hard shelled condition. This will ensure high profit form crab farming.
- **Fattening in Pens or Cages:** Crab fattening can also be done in pens, floating net cages, and bamboo cages in shallow estuarine waterways and inside large shrimp ponds with good tidal water influx and in tanks. Bamboo splits, netlon or HDPE as netting material. 3 m \* 2 m \* 1 m (3 m long, 2 m wide and 1 m height) is ideal cage size for crab fattening. The cost per crab box is about Rs.200 to Rs.500. The cages are to be arranged in a row so that the crabs can be easily feed and monitored. Stocking density of 10 crabs per square meter in cage and 5 crabs per square meter in pens is ideal. Maximum stocking density can result mutual attacks and cannibalism. Fattening in cages or pens in only used in small sale production. For commercial production fattening in ponds is perfect and more profitable.

Water quality plays an important role in the production of crabs. Changing water occasionally and applying proper medicines or chemicals to maintain water quality is necessary to have good production. The ideal water quality for crab farming is shown in table 1.

**Table: 1: Standard Water Quality for Crab farming**

Sl	Parameters	Range
1	Salinity	15-25‰
2	Temperature	26-30 °C
3	Oxygen	>3PPM
4	pH	7.8 8.5 ppt

Source: <https://www.roysfarm.com/mud-crab-farming> on 04.04.2020 at 12.30 p.m



**BOX-CRAB CULTURE:**

Recently, a capital-intensive box culture method of crab grow out has gained popularity among mud crab farmers in the Sundarbans areas. In box cage systems, fattening is largely carried out and grow-out is also done in a lesser scale. In case of grow-out culture, the nursery reared crabs are stocked in boxes at the rate of one crab per box and cultured for 4-6 months attaining 300-900g for mud crab. The benefit of the system includes lower maintenance, predictability, easy assessment etc. It can also be employed in an indoor system where there is scarcity of land and water using flow-through or re-circulatory aquaculture systems (RAS). A high capital investment on boxes and related equipment is one of the drawbacks of box-culture system is that this culture requires a high capital investment on boxes and related equipment.



**Fig: 3: Box- Crab Culture (Source: Aquaculture, Volume 23 No. 3, July-September 2019, p27)**

**Poly Culture of Crabs, Prawns and Fishes:**

In an on-station experiment (Lalramchhani Christina et al), poly culture of mud crab was carried out along with different finfish and shellfish species such as milkfish, mullets, shrimp (*Penaeus indicus*). The combination of mud crabs (*S. serrata*) and milkfish and mud crabs and mullets at 0.5:0.5:0.5 ratio indicated a benefit-cost ratio (BCR) between 1.57 and 1.73 respectively. These results show that there is no negative interaction between the mud crab and other animals stocked in the poly culture pond. It indicated that poly culture provides an efficient and sustainable utilization of resources.

**Some Good Practices for crab farming:**

1. Pond to be prepared well so that no contamination or virus spread.
2. Crabs need 5-8% food of their body weight daily. All the feed should not be served at once; instead it is better to serve twice a day. Evening hours is ideal for giving major feeds.
3. After a certain period the crabs for their hardening are to be checked.
4. In grow out crab farming system crabs become suitable for marketing purpose within their 4 to 6 months of age. In fattening system the time depends on crab's size.
5. The crabs should be collected when they reach proper weight and when their price remains high.
6. Early morning hours or evening hours are ideal time to harvest crabs. Crabs can be harvested from pond by using scoop net or by using alluring bait.
7. The collected crabs are to be cleaned with good brackish water and remove all types of dirt and mud.
8. The crabs are very carefully tied without breaking its legs and kept in moist conditions. The collected crabs are kept away from sunlight before sending to market because direct sunlight has a negative effect on their survival.

**DATA ANALYSIS AND INTERPRETATION:**

On the basis some primary data collected from the experienced crab farmers of Gosaba, Sagar, Kummari, Tiplighery areas of Sundarbans regarding cost of crab farming and production and sale of crabs the following analysis is done. Annual yield from crab fattening was significantly higher than crab culture. About 5-6 crops could be obtained annually through crab fattening as against only 2 crops from crab culture. Average yield from crab culture was 6300 kg per hectare per year (2 crops) and that from fattening was 17400 kg per hectare per year (6 crops)(Table 2). Between these two crab farming methods, fattening system is more profitable than grow out system and has many advantages. Grow out crab farming system takes more time than fattening system. But fattening system is very popular to the farmer as it takes less time and highly profitable.

**Table 2: Production patterns of different mud Crab Culture systems**

Sl	Particulars	Crab Culture (per pond)	Crab Fattening (per pond)	Poly culture of Crab & fishes (per pond)
1	Pond Size(ha)	0.40	0.40	0.40
2	Crab culture Period	120-150days	20-30days	300 -360 days
3	Stocking density (per crop)			
	-Crab	2400	1600	800
	-prawns & fishes	-	-	2000
4	Survival percentage	70	85	70
5	Crab weight at harvest time (g)	800	900	800
6	No. of crops per year	2	6	1
7	Expected Production per crop (kg)			
	-Crab	1260	1160	3200
	-Prawns	-	-	850
	-Fishes	-	-	780
8	Assumed farm gate price(Rs.per Kg)			
	-Crab	500	600	500
	-Prawns	-	-	600
	-Fishes	-	-	200

Source: Aquaculture Economics & Management, 8(1/2), 2004

### Cost-Benefit Analysis:

#### Capital Investment:

Cost of land is the major item in capital investment for all types of crab farming systems, which accounted about 65% to 85% of the total capital investment. Other cost of investment includes pond construction, sluice gate, fencing, diesel pump sets and construction of watchman shed. Average purchase price of one pond (0.4 ha area) is approx Rs. 950000/ (table 3). Instead of investing much money in purchasing land, it may be better to take land on lease basis. In that case lease rent of land @ Rs 100000/- approx per ha per year is to be spent. Many of the farmers have erected strong net fencing around the pond supported by bamboo poles up to a height of 5-6 feet to avoid poaching and to prevent escape of crabs. Depreciation of fixed assets other than land is considered @ 20% per year and interest on capital investment @ 15% per year is also considered (table 4).

**Table 3 : Capital Investment for different mud Crab Culture systems (per pond)**

Sl	Particulars	Crab Culture Rs.	Crab Fattening Rs.	Poly culture of Crab & fishes (Rs.)
1	Cost of Land (per pond=0.4 ha)	950000	950000	950000
2	Watchman's shed	10000	10000	10000
3	Pond Construction	50000	50000	30000
4	Sluice gate	30000	30000	25000
5	Construction of dams	20000	20000	20000
6	Fencing nets	10000	10000	10000
7	Diesel Pump Set (5HP)	25000	25000	25000
8	Cost of crab boxes @ 250 per box	-	300000	-
9	Harvesting equipments and utensils	5000	5000	5000
	Total	1100000	1400000	1075000

Source: Self computation

**Table 4: Annual Fixed Cost of different mud Crab Culture systems(per pond)**

Sl	Particulars	Crab Culture Rs.	Crab Fattening Rs.	Poly culture of Crab & fishes (Rs.)
1	Lease rent of Land	40000	40000	40000
2	Depreciation on fixed assets @ 20% per annum excluding land	30000	90000	25000
3	Interest ( @ 15% on capital)	165000	165000	161250
	Total	235000	295000	226250

Source: Self computation

Pond preparation, seed cost labour charges and fuel charges are considered as operating or variable cost which depends on the size of ponds or size of production. In case of crab fattening operating cost is higher than other methods of farming as in this method soft shell crabs are reared to become them as hard shell crabs and in other two culture methods juvenile crabs are cultured (Table 5)

**Table: 5: Annual Operating costs of different mud Crab Culture systems(per pond)**

Sl	Particulars	Crab Culture Rs.	Crab Fattening (Rs.)	Poly culture of Crab & fishes (Rs.)
1	Pond preparation	20000	10000	5000
2	Crab seed cost	150000	1596000	300000
3	Prawn/fish seed	0	0	200000
4	Cost of Feed	70000	250000	60000
5	Labour charges	240000	240000	200000
6	Fuel/electricity charges	25000	25000	25000
	Total	505000	2121000	790000

Source: Self computation

In case of crab fattening as the period of culture is shorter than other two methods, production per year in this method is more than other two methods. Profitability in case of crab fattening is more than other two methods but ROI in case of poly culture method is higher than crab culture or crab fattening (Table 6 and Fig 4)

**Table:6: Revenue Statement of different mud Crab Culture systems (per pond per year)**

Sl	Particulars	Crab Culture Rs.	Crab Fattening Rs	Poly culture of Crab & fishes (Rs)
1	Sale of Crabs	1260000	4176000	1600000
2	Sale of Prawns	0	0	510000
3	Sale of Fishes	0	0	156000
4	Total revenue	1260000	4176000	2266000
5	Total costs	740000	2416000	1016250
6	Net Profit	520000	1740000	1249750
7	Net profit per hectare	1300000	4350000	3124375
8	Return on Investment (ROI)*	70.27	72.02	107.24%

Source: Self computation (\*Total cost is consider as investment here)

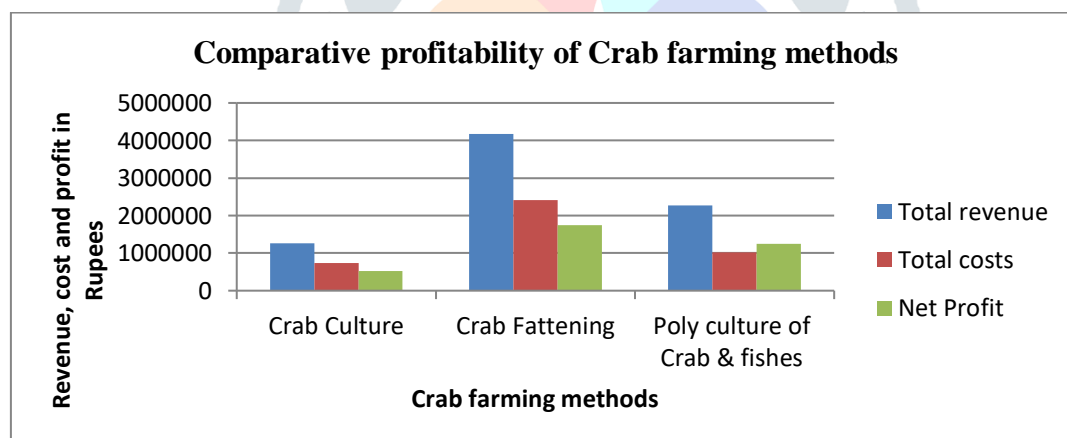


Fig: 4: Comparative profitability of Crab farming

### LIMITATIONS OF THE STUDY:

This study is completely based on secondary data available in the books, journals and websites and some expert experience survey. The cost and revenue data used here are estimated. The results may not reflect the actual picture in some cases and also it may differ from different place and times.

### CONCLUDING OBSERVATIONS:

It is observed, although mud crab farming is profitable agro farming, it has some problems.

1. The mud crab farming in West Bengal depends on collection of wild seed posing a threat to the wild population. Although hatchery seeds are available but it has limitations owing to the poor survival of larvae. To resolve the problems of the farmers it is suggested to improve modern hatchery technology.
2. The lack of commercial feed mill and manufacture of dedicated mud crab feeds compel farmers to use low-cost fresh feed. Low priced feed such as trash fish and molluscs remain the major feed fed to culture mud crab. The problem with these feeds is fast spoilage and the requirement of storage facilities.

In spite of limitations, commercial crab farming is gaining popularity day by day in many coastal areas of West Bengal and in India. Because it is a very easy, profitable and takes less time aqua farming. Mud crabs have huge demand and high value in national as well as in international market. So, the country may earn some extra foreign exchange and make employment opportunities by encouraging commercial crab farming business.

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