

Organic Prawn Farming: A way of reducing environmental costs of prawn culture in West Bengal: A study

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ABSTRACT

West Bengal is enriched with 2.1 lakh hectares of potential brackish water. Prawns having high demand in international market, rapid growth of prawn aquaculture were observed during last three decades. Private entrepreneurs rushed in to the practice of prawn farming converting thousands of hectares of agricultural lands vicinity to the source of saline water into prawn fisheries. With an objective of earning maximum profit, they intensively cultured prawns with high stock density, artificial feeding, using antibiotics and chemicals to improve survival rate and better growth. As a result of extensive prawn cultured practices, prawn virus broke out and there was a fall in production as well as export after 2005-06. The other externalities of prawn culture are reduction of cultivation work, threatening food security, ecological imbalance, diminishing fertility of land, environmental degradation, salination of drinking water, ill health, skin diseases, social pollution etc. These costs destroy the socio-economic balance of the coastal area. So these costs need to be accounted for in environmental Accounting. Primary data are used for this exploratory research. Some good management practices should be followed to make sustainable prawn farming reducing externalities.

Keywords: Shellfishes, Prawn culture, Social Costs, Sustainable, organic prawn farming

INTRODUCTION

Prawns are the most valuable shellfishes having good domestic and international market. Demand of prawns may be satisfied partly by culturing prawns in brackish water. Juvenile prawns of different species are cultured in confined brackish water ponds or in 'bheries' or 'ghers' until they are marketable. Prawn culture is carried on three districts in West Bengal such as North 24 Parganas, (45%) South 24 Parganas(30%) and Purba Mednapore(25%). Prawns can provide adequate nutrition for the people of West Bengal. More over prawn culture may provide employment for four lakh rural people. Due to its heavy demand in the international market, the culture of prawns may become a lucrative vocation for earning foreign money and developing economy. The overall export of shrimps of India during 2019-20 was to the tune of 652253 MT worth Rs.34152.03 crores. West Bengal,s share of export is about 19.65% (128150 MT and value in Rs.5308.02 crores)

But prawn culture has some bad effects on environment or externalities or social costs. Prawn fishery as an entity takes some environmental elements like air, water, sunlight, land, soil, fertility, seeds from natural sources, zooplankton, phyto-plankton etc. These are indispensable materials of prawn farming. A measure of the cost of environmental resources used by an entity during its activities may be considered as the social cost whether paid or not. Environmental pollution due to use of pesticides and discharge of dangerous wastes is the cost born by the society and not by the prawn fishery. Social cost of environment represents the cost of damage to the environment. Social costs arise from externalities. It can be sub divided into three major groups such as;

- i) Private expenditure to get rid of environmental damage
- ii) Public expenditure to avoid environmental damage
- iii) Welfare damage suffered due to non-prevention

Objectives of the study:

This study attempts to highlight the environmental externalities caused by the prawn culture. It also tries to find out some good practices of prawn farming so that externalities may be reduced to some extent.

RESEARCH METHODOLOGY

This is an exploratory research. In this research study, ‘Judgment Sampling’ method is used for selecting prawn fisheries in three districts in West Bengal. Six prawn fisheries of different sizes (i.e. two large, two medium, two small) have been studied from each of these three districts in West Bengal considering as representatives of the population. The primary data are collected from the Bheries of North, South 24 Parganas and Purba Mednapore through direct communication with prawn farmers and through personal interviews. The secondary data used for this study are collected from the Handbook Fisheries Statistics 2020 and other books, journals and websites. For the analysis of data and drawing graphs, Microsoft excel software is used.

Present Status of Prawn Farming in West Bengal:

Prawn farming is locally known in West Bengal as ‘bhery or gheri’. The brackish water fisheries development is high in West Bengal particularly because of the extensive saline soil-water resource, human resource, favourable agro-climatic conditions, productive estuarine ecosystem including the Sundarbans and abundance of prawns and other brackish water fin fishes. Based on the management practices viz. traditional, improved traditional/ extensive, semi-intensive and intensive methods of culture systems are in vogue in the State. The traditional shrimp farming practices are also commonly known in West Bengal as “Bhasa Badha” fishery.

Table: 1: Production Of Prawns In W.B (IN MT)

Year	Tiger prawn	Scampi	L. Vannamei	Total
2001-02	26,800	2,270	-	29070
2002-03	28,270	2,140	-	30410
2003-04	29,714	2,435	-	32149
2004-05	35,432	3,193	-	38625
2005-06	42,336	3,751	-	46087
2006-07	42,006	4,471	-	46,477
2007-08	28,000	4,516	-	32516
2008-09	27,418	2,698	-	30116
2009-10	33,685	1,725	-	35410
2010-11	40,725	2,258	-	42983
2011-12	45,999	2,906	-	48905
2012-13	52,581	1,740	-	54321
2013-14	53,528	2,744	479	56,272
2014-15	53921.26	3448.51	395	57369.77
2015-16	68774	3780	6776	72554
2016-17	44966	2441	26085	73492
2017-18	43319	5024	22191	70534
2018-19	47842	2784	29846	80472
2019-20	27585	3307	31376	62268
2020-21	19190	3373	35392	57955

Source: MPEDA website

It is seen from table & fig.1 that after 2006-07 production has fallen structurally, the reason may be the outbreak of prawn virus in the fisheries of West Bengal. After that production of prawns gradually tried to recoup its place but from 2016-17 tiger prawn culture reduced greatly and the culture of L. vannamei gradually increased. From 2019-20 total production of prawns in West Bengal again began to fall. Social costs also create hindrances to prawn farming and also production.

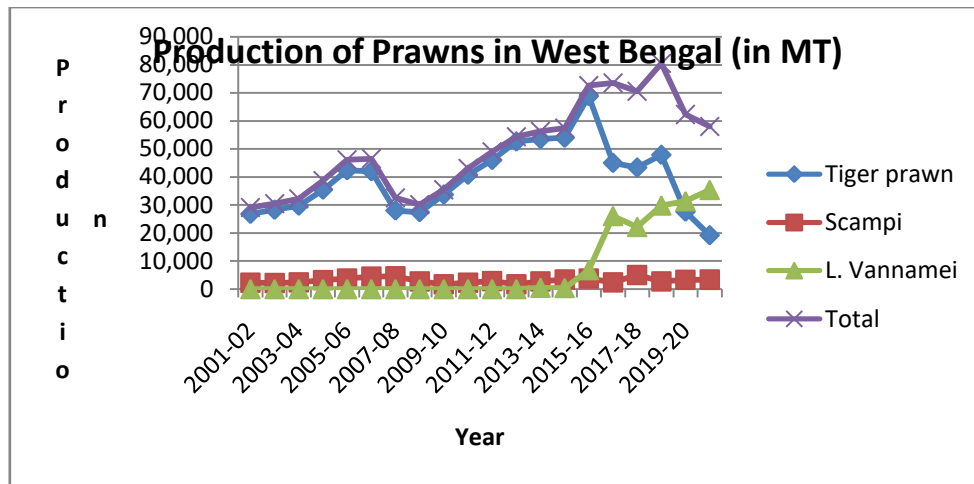


Fig: 1: Production of Prawns in W.B. during last 15 years

Environmental Costs:

Prawn farming destroys the environment in the following ways:

Reducing cultivation works and threatens food security:

The people of West Bengal are cultivators by occupation. To make prawn fishery, the low-lying lands are surrounded by dams and salt water is let into the impoundments through canals. Salt water, which is let into the impoundments, is not conducive to paddy culture and as a result, the paddy culture is reducing gradually in prawn culturing areas of West Bengal. The cultivators who used to engage in paddy cultivation are now losing their works. Prawn culture threatens food security as it has damaged paddy and vegetables cultivation. It has also been seen from a study that prawn farming creates less employment opportunities than agriculture.

Table: 2: Labour For Paddy Production And Prawn Culture

Type of labour	Paddy cultivation	Prawn Culture
Family labour	60	-
Hired Labour	115	144.55
Permanent Labour	5	-
Total	180	144.55

Source: Data collected by personal interview

On an average 144.55 person-days employment opportunities are generated per hectare per year from this prawn fishery against 180 man days for paddy culture (Table 2). It shows that 35.45 man-days per acre are required more in paddy cultivation than prawn culture.

Destruction of unwanted seeds:

After separating the economic seeds, they just throw out the rest ones. Separating prawn seeds from the gathered varieties takes some time when other unwanted seeds such as seeds of less valuable fishes, frogs, crabs and other insects die without care. It is estimated that for every kilo of prawn larvae collected from the wild to stock prawn ponds, between 15 and 20 kilos of other types of fish fry are killed and thrown away as waste (Eileen Maybin & Kevan Bundell et. al. 1996). These are fishes, which could become food for people. This practice results in an ecological imbalance of biotic community.



Fig:2: Net set by bank of the River Icchamati(Hasnabad, North 24 Parganas) to collect prawn seed (Source: R. Arthur)

A sample survey was done at Goureshwar river near Vill: Barunhat, P.S: Hasnabad, Dist: North 24 Parganas for a week during May 2010 to count the killing of unwanted seeds at the time of collecting prawn seeds (fig.2). The result of the survey is shown in Table 3.

Table:3: Sample counting of prawn seed collection and unwanted seed destruction on the bank of Goureswar River, Barunhat

Days	Prawn Seeds /collector	Unwanted seeds (Avg.)/collector	Unwanted seeds killed(Avg.)/collector	Average Death Rate (%)
Day 1	23	205	75	36.58
Day 2	18	1000	180	18
Day 3	30	700	135	19.28
Day 4	32	610	101	16.55
Day 5	46	900	187	20.77
Day 7	37	750	201	26.8
Total	200	4965	879	17.70

Source: Data collected by personal interview

It is seen that unwanted seeds are collected at twenty to twenty five times than prawn seeds collected and the collectors though throw the unwanted seeds to the river after separating the prawn seeds at least 17% of the seeds are killed at this collection process. It is seen from the table 2 that the ratio of destruction of seeds is: $1079/5165 \times 100 = 20.89\%$ of the total collection and $879/200 \times 100 = 439.5\%$ of prawn seed collection. The prawn seeds are also reduced day by day and its prices are increasing at higher rate due to non availability of prawn seeds in the Sundarbans Rivers (Goutam Kumar Das, Sundarbans, Man & Environment, P.50)



Fig: 3: Segregation of prawn larvae from other larvae
 (Source: Self collection from Lebukhali River, Hingaljanj, North 24 Parganas)

Diminishing fertility and degradation of fishery lands:

During preparing soils of the prawn fisheries limes, pesticides, insecticides are applied to kill the insects. Salty water for prawn culture gradually diminishes the fertility of the lands of the prawn fisheries and the lands are being degraded. Where ever prawn farms were formed did not continue for long period for pollution, prawn diseases etc. The abandoned prawn farms may not be usable for agricultural or other production purpose. For the reason the prawn culture is called ‘Rape and run industry’ (source: C.A.S.I-1997).

The percentage of degraded lands in North and South 24 parganas (excluding forestlands) is maximum i.e. 69.2%, next comes to Purba Medinipur i.e.65.9%. These degradation rates are much more than the average degradation rates of West Bengal (28.77%). 3% of the total land of 24 parganas and Purba Medinipur are being degraded due to salinity.

Salination of drinking water:

The pumping of river or creek’s saline water into prawn fisheries has caused salination of the water table in many places of North and South 24 pgs. Agricultural land is being ruined, trees are dying and village well water is becoming undrinkable. For bringing good drinking water, the villagers of sundarban areas have to travel 3 to 5 kms.

Ill health and skin diseases:

The workers who work in the prawn processing section is liable to get certain lesions and skin eruptions and diseases due to constant contact with prawn, ice and water where the prawns are processed for export. Continuous bad smell emitting along with flies, rat create an unhealthy environment.

The prawn factories of West Bengal are situated near Madhyamgram, Barasat, Ganganagar, Rajarhat, Basirhat, Kharibari, Haroa area of North 24 Parganas and Garia, Narendrapur, Bye-pass area of South 24 Parganas and Ramnagar, Khejuri and contain area of Purba Midnapore. Harvested prawns of different prawn fisheries are purchased by different local factors (Aratders) and these are brought to the prawn processing factories for head and claw less. After headless, the prawns are washed by different chemicals and then packed in boxed for export. The wastes of these chemicals along with the disposable portion of prawns make such a bad odor that cannot be tolerated side by the population. It also spreads diseases. During an examination by the Pollution Control Board, Govt.of West Bengal, the solid wastes of prawns contain chlorine, fluoride, cyanide, ammonia, sulphur etc that are harmful to the environment.

The people, who catch prawns, including children and women, spend many hours immersed in polluted water of the fisheries. Children remove the delicate prawn seedlings from their nets by sucking them into their mouths along with the dirty water before splitting them into a container. The use of antibiotics on prawn fisheries creates resistance in diseases organism affecting humans.

Prawn Virus:

Prawn virus is a fatal disease, which kills the whole of the prawns of the aquaculture prawn farms within a day. After thirty years of continuous culture, West Bengal’s prawn culture was to experience its negative impact during 20014-05 onwards. Disease swept through the prawn farmers of west Bengal. The major diseases causing mass mortality are White Spot Syndrome Virus (WSSV), vibriosis (vibrio bacterial disease) soft shell, black gill, muscle necrosis, fungal and infestations, Metamorphosis, molt mortality syndrome, bacterial necrosis and larval mid-cycle diseases are specific for the prawn. Among the diseases the white spot disease (WSD) or WSSV, locally known as prawn virus has been attacking the prawns massively and its repeated occurrence has demoralized the prawn farmers of West Bengal .The disease did not spare any prawn farmers of West Bengal from North to south 24 parganas and of the purba Midnapore. Repeated loss of prawns due to virus attacking makes small prawn farmers of West Bengal (80%) bankrupt.

To study an affect of Prawn virus, production of the five fisheries are observed (Fishery no: 1: Haroa, Fishery: 2, Hasnabad at North 24 parganas, Fishery no:3: Namkhana &F 4: Gosaba at South 24 Parganas and Fishery No: 5: Contai & F-6-Ramnagar at Purba Midnapore) before attacking prawn virus and after attacking prawn virus.

Table: 4: Hypothesis Testing

	Production (kg/ha)				
	F1	F2	F3	F4	F5
Without attacking virus(X)	425	400	350	450	500
After attacking virus (Y)	136	148	09	05	168

T-test for Dependent Samples (new.sta)								
Marked differences are significant at p < .05000								
	Mean	Std.Dv.	N	Diff.	Std.Dv.	t	df	p
X vs.	425	55.902						
Y	93.2	79.528	5	331.8	72.627	10.216	4	0.001

Proble m no	Test statis tic	Variables	Null hypo- thesis	Alternat e hypo- thesis	d.f	Calculated value of Pair-t	p	Conclusions
	pair- t	X vs.Y	$\mu_x = \mu_y$	$\mu_x \neq \mu_y$	4	10.216**	0.001	Prawn virus decreases prawn production. It is the main obstacle of prawn culture in West Bengal and in Bangladesh.

Critical region for both the tails of t at 5% level ≥ 3.18 (for $df=3$), 2.78 for $df=4$

Source: Self computation through statistica software.

To save the prawn farming industry, some sustainable prawn farming techniques such as organic prawn farming may be followed by the prawn farmers

WHAT IS ORGANIC PRAWN FARMING?

It is a prawn culture farm management practice that is based on the holistic agriculture management, environmentally friendly and sustaining biodiversity. All input materials shall be natural products, avoid using synthetic products and any genetically modified organisms. This management shall be practiced throughout the production chain.

The organic aquaculture project in India was implemented as per the standards stipulated by Naturland, Germany as well as EU Organic norms. The standard principles of organic prawn farm management in over all respects of this agribusiness are summarized below:

Table: 5: Standard Principles Of Organic Prawn Farm Management

1	Production Principle
	<ol style="list-style-type: none"> 1. Working Instruction of organic marine shrimp production manual shall be available. 2. Restore and maintain good qualities of soil and water in shrimp production pond. 3. Maintain the ecosystem in farm and overall sustainability. 4. Maintain the biodiversity of overall ecosystem. 5. There shall be a buffer zone for protecting contamination from conventional farms. 6. Protect and avoid all activities that may pollute environment. 7. Observe energy saving principle. 8. All inputs shall not be derived from genetically modified organisms. 9. Shrimp shall be grown under organic farming condition at least two-third of their production cycle.
2	Location and water sources of the prawn farm
	<ol style="list-style-type: none"> 1. Farm shall not be located in prohibitive area 2. The area shall be appropriate for organic shrimp farming. 3. Farm shall not be located in an area affected by contamination. 4. Water sources shall be without risk from hazardous substances and other contamination.
3	Prawn Farmers
	<ol style="list-style-type: none"> 1. Farmer shall register with the competent authority as required by regulation. 2. Farmer shall acquire knowledge or proper training in organic shrimp farming.
4	Prawn Farm Management
	<ol style="list-style-type: none"> 1. Farm layout shall be done according to farm management principle. Proper reservoir/treatment pond shall be adequate for intensive shrimp farming system. 2. Use organic or natural products free from prohibitive substances 3. Water pump or aerator in production ponds shall be complied with principles of water and energy saving. 4. All equipments shall not be contaminated so as to affect shrimp health and ecosystem. 5. All workers shall have a good health with no contagious disease. 6. Restroom and bathroom shall be constructed with good hygiene to prevent contaminations from sewage disposal to production ponds. 7. All litter and waste shall be collected. 8. Biodiversity shall be maintained in farm by appropriate plantation or natural vegetation
5	Prawn Feed Management
	<ol style="list-style-type: none"> 1. Feed shall be produced from natural raw or organic materials 2. In case of unexpected situations such as natural disaster exemption for using of natural feed sources in composition may be allowed at lower than standard level 3. Feed should be free from chemical substances and anti-biotics.
6	Prawn Health Management
	<ol style="list-style-type: none"> 1. Shrimp health and water quality in production pond shall be regularly checked. 2. Prevention and curative measures shall be complied with organic farming regulation. 3. Anti-biotics or chemical substances for pest and disease control are not allowed
7	Effluent Treatment System
	<ol style="list-style-type: none"> 1. Quality of effluent shall be complied with relevant regulations. 2. Effluent shall not be discharged to natural fresh water sources and arable land of the surrounding

	environment.
8	Harvesting and Distribution
	<ol style="list-style-type: none"> 1. Harvesting and distribution plan shall take place when shrimp are in good health and be as quick as possible in order to maintain freshness of shrimp and organic status. 2. Randomly check chemical and anti-biotic residues in shrimp before harvesting in case of possible contamination risk. 3. Use proper sedative measure by freezing in clean and cold water. 4. All inputs used during harvesting and post-harvesting period shall be derived from natural substances
9	Training and Information
	<ol style="list-style-type: none"> 1. Group organization shall be set up for regularly exchange of technical knowledge farm management. 2. Conduct meeting and training program in order to gain knowledge on farm management, inputs usage and relevant laws
10	Accounting & Records
	<ol style="list-style-type: none"> 1. All important activities in shrimp farming shall be recorded. 2. All data and record shall be kept for traceability at least 3. Accounting books should be maintained for proper inspection
11	Social Responsibility
	<ol style="list-style-type: none"> 1. Participation in social activities. 2. Use local resources with careful manner and support mangrove conservation activity. Labor hiring shall comply with labor law and welfare shall be appropriately provided

Source: THAI Agricultural Standards: Royal Gazette Vol.124 section 78E dtd 26.6.2007

JUSTIFICATIONS FOR ORGANIC FARMING:

The observations for many studies from different countries regarding prawn farming are as follows:

1. Production cost has decreased tremendously, since farmers do not use fertilizers, additives, supplementary feeds or vitamins any longer. Organic farmers depend on processed cow dung, compost and the exchange of natural water to maintain water quality.
2. Maximum farmers exchange water from natural sources and 10% do not exchange water not having the necessary facilities. The sources of saline water are river and canal. The tidal flows of saline water are regulated by the sluice gates. Most farmers receive post larvae from nurseries on credit, because they usually negotiate payment to take place after harvest started.
3. The studies reported that organic agriculture farmers with high levels of academic education, to be younger, have less farming experience and urban backgrounds having purchasing power. They are more likely to purchase organic foods. Education and experience can play important roles in transforming information, to enhance knowledge and skills, and in inspiring to choose appropriate technology.
4. Organic farming is environmentally friendly and less prone to production failures.
5. Organic farming is basically labor-intensive because it is not utilizing heavily mechanized growing techniques. Organic shrimp farming relies on local labor work
6. Organic agriculture farms provide health benefits to laborers as synthetic chemicals are not allowed in this farming system.
7. Organic farming is generating employment and promotes local resources as well as locally adapted production methods. It has generated substantial employment for educated people, as well as ensuring several diversified working opportunities. Women are also employed in the *gher* of organic farmers, especially for removing weeds and clearing embankments. Various new types of working opportunities have been generated by the shrimp industry, such as production of bamboo-made screens, traps and baskets, net making, sluice gate building, cock-sheet box supplying, post larvae trading, van pulling, *etc.* Various industries such as hatcheries, nurseries, ice plants and processing plants have been established, centering on shrimp cultivation.
8. Organic farming allows antibiotic-free hatchery post larvae to cultivate in *gher* system. Hatchery post larvae are reared locally to ensure their better adaptation to site-specific conditions, and then they are distributed to farmers according to demand. Organic farming does not allow the use of natural post larvae, because of its negative impact on the local biodiversity.
9. Conventional aquaculture is often criticized for environmental degradation such as habitat destruction, waste disposal, exotic species and pathogen invasions, huge requirements of fishmeal, and fish oil to produce aquatic feed. The method of organic shrimp aquaculture has lowered production costs, as fertilizers, supplementary feeds, feed additives and hormones, antibiotics, *etc.* are not allowed. This

method is also environmentally friendly and decreasing production cost, in another sense it is contributing to reducing CO₂ emissions by not using fertilizers and feeds. Organic shrimp farming uses 30–40% less energy than conventional practices do.

10. Globally, the demand of organic products is increasing robustly. Organic shrimp farming is attractive for developing countries due to high prices and protection of environment.
11. Organic aquaculture in India (IOAP) was initiated by MPEDA in 2007 availing consultancy and technical collaboration from the Swiss Import Promotion Programme (SIPPO).
12. The brackish water area available in India (1190900 including the vast traditional prawn filtration fields located in West Bengal (46100 ha) and Kerala (10700 ha). The traditional type of prawn filtration system is highly environment-friendly as they use no chemicals, drugs or antibiotics. Organic aquaculture ensures that the farming activity is in harmony with the nature, with due care for the good health and welfare of the cultured organisms. Organic products have become very popular of late due to the rising awareness in health and food safety.

CONCLUDING OBSERVATIONS

Consumers, importers, Governments, society, environmentalists are interested in organic prawn farming but it is the farmers who have to implement it. The farmers, hatcheries, feed mill and processors must be motivated for organic conversion to produce organic products. This needs some basic assistance to the farmers such as:

Financial assistance for Organic Prawn farming

The small prawn farmers are marginal and poor. They are suggested to avail various schemes from MPEDA (Marine products Exporting Development Authority), W.B. State Government Fisheries Department and Sundarban Development Board. MPEDA is implementing a financial assistance programme to assist the farmers to adopt organic farming @ 50% of costs on organic seed, organic feed and inspection/certification charges subject to a maximum of Rs. 50,000/- per ha

Licensing to the Prawn Farmers

It is mandatory that all persons carrying on coastal aquaculture shall register their farm with the Coastal Aquaculture Authority (CAA). The farmers intend to culture SPF L. Vannamei in the country have also to obtain permission from CAA. Registration is made for a period of five (5) years, which can be renewed further. CAA issues licenses on recommendations from the District level and State level committees.

Advice for low risk brackish water aquaculture options:

The poly culture of fishes such as Mulletts and milkfish, with native species of shrimp such as *P. monodon* and *P. indicus*, culture of seabass, mudcrab, periphyton based fish and shrimp farming are the low risk and sustainable aquaculture options. The culture protocols are available with CIBA (Central Inland Brackish Water Aquaculture).

Supply of Poly Culture Seeds:

Rajiv Gandhi Centre for Aquaculture (RGCA), ICAR, and CIBA have been successful in breeding and production of seabass seeds. The seabass seeds are available from CIBA hatchery, Chennai at a nominal price after booking with requirements. Breeding and seed production protocols have been transferred to a few commercial hatcheries which will produce seeds at large scale in near future.

Low Cost Feed:

CIBA has developed low cost feeds using locally available ingredients. Feed mills for production of organic feed and organic seafood processors for processing organic shrimp and scampi have been established in India

Advice for management of Diseases:

All Penaeid shrimp species and *P. vannamei* are also prone to infections of viral and bacterial diseases, such as, white spot virus disease, slow growth syndrome, vibriosis, etc. All bio-security protocols and other guidelines, recommended by the would minimize the chances of diseases. Organic prawn culture and its related agribusiness can bring millions of dollar and change the villages and living standard of the people of North 24 parganas, South 24 parganas, and Purba Mednapore districts of West Bengal. But, all these require a long-term vision and depth of understanding the problems.

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