Profits and Perils of Farming Fish

Case Studies of Shrimp and Carp Aquaculture in West Bengal

Santanu Chacraverti
With support from
Debasis Shyamal and
Mridul Ganguly

Submitted to
The ICSF Trust

About the Study Team

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Profits and Perils of Farming Fish*: Case Studies of Shrimp and Carp Aquaculture in West Bengal*

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Photo 1 by Kaelyn Maehara (July 2017); Photo 2 by Sayan Dutta Bar (November 2021)

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Select Glossary of Terms

bagda	Tiger prawn
bhery (pl. bheries)	A large aquaculture pond
chanda (pronounced cāṃda)	Donation for a public event, including public religious events
chitegur	Sugarcane molasses (or blackstrap molasses)
crore	Ten million (10,000,000)
gheri	See bhery
gram panchayat	Tier of the local self-government below the Block Level tier
gugli	Freshwater snail
jheel	Large natural or artificial lake or pond
jhinuk	Clam, mussel, or oyster
khope	See bhery and khope
koi	Climbing perch, Anabas testudineus
lakh	A hundred thousand
lyata	Spotted snakehead, *Channa punctata*
magur	Walking catfish, *Clarias batrachus*
pakka	Usually means stable and secure; applied to housing (as in this report), it denotes houses built of brick/cement/concrete
Puja	Worship, both at the private or public level
punti	Pool barb, Puntius sophore
rupee	Indian Rupee (INR)
ryot	Peasant or tenant farmer
semi-pakka	Derivative of pakka; see pakka
zamindar	Traditional landlords whose main source of income was rent from the ryots

Acronyms and Abbreviations

₹	Indian Rupee (INR)
BJ	Baguran Jalpai
BL and LRO	Block Land and Land Reforms Office
CAA Act	Coastal Aquaculture Authority Act
CD Block	Community Development Block
CRZ	Coastal Regulation Zone
DISHA	Direct Initiative for Social and Health Action
DO	dissolved oxygen
DORB	De-oiled Rice Bran
EU	European Union
FAO	Food and Agriculture Organization of the UN
FEO	Fisheries Extension Officer
FGDs	Focus Group Discussions
GCRI	Global Climate Risk Index
ICSF	International Collective in Support of Fishworkers
IHHNV	infectious hypodermal and haematopoietic necrosis
kg	kilogram
km	kilometre
MPEDA	Marine Products Export Development Authority
NABARD	National Bank for Agriculture and Rural Development
PL	post larvae
SPF	specific pathogen free
sq m	square metre
TOR	Terms of Reference
US	United States
WBFIP	West Bengal Fisheries Investment Policy (2015) for Micro, Small, Medium & Large Enterprises in Fisheries Sector

This study—Preface and Acknowledgements

This study took off around 12 November 2021. Thereafter, it has been a bumpy ride. The three persons most closely involved with the investigations were in no position to give their full time to it and, more often than not, were being waylaid by other engagements. However, despite anxieties, the study was finally completed!

It is not unusual to cite the entire TOR underlying a study. However, I shall refrain from doing so in the hope that the preceding title page and the chapter contents that follow should give the reader an idea of the objectives of the study.

As the title and subtitle indicate, this work is a combination of two case studies—one on carp and another on shrimp aquaculture as practiced in specific areas in West Bengal. However, it is also slightly more. An attempt has been made to link the observations to a certain extent to present a composite picture.

The themes underlying of the inquiries are as follows:

- Development and cultural relevance of aquaculture in the area being studied.
- Changes in land use practices and land relations with the rise of aquaculture.
- The economic imperatives and local management practices.
- The workers—conditions, wages, benefits
- Role of women
- The economic, social, and ecological impacts of freshwater aquaculture and shrimp culture on the larger environment.
- The roles and situation of the diverse stakeholders and actors directly or indirectly dependent on the freshwater aquaculture and shrimp cultures and broadly indicate areas in which actions are necessary from the standpoint of environment and human rights.

Essential information collection was completed by mid-January 2022. Therefore, although the writing is being completed close to the end of March 2022, some of the information is slightly older. Let us hope that this does not make much difference.

I thank the ICSF Trust for supporting the study. I also thank them for being patient with the delays. I particularly wish to thank Venu, Ganga, and Manju for taking care of the administrative essentials.

I am grateful to Neena Elizabeth Koshy, Consultant, ICSF Trust, for conceiving the basic idea of the project and encapsulating it in a detailed TOR, and also for her very helpful comments on the draft and for preparing the lists (Glossary and Acronyms and Abbreviations) at the beginning.

Debasis Shyamal helped plan the fieldwork and investigation and continuously provided important inputs as the report evolved. Mridul Ganguly played an active and creative role in the first phase of the field investigation and prepared a preliminary draft of the report on Moyna and Nandakumar. They made the study possible. I must also profusely thank Sayan Datta Bar for participating in the visits to Moyna and taking the pictures.

I am grateful to Sujoy Jana for providing varied inputs on both freshwater aquaculture and shrimp aquaculture and organizing the visits in Baguran Jalpai. I am grateful to Siddharth Chakravarty for sending over some very useful photos of shrimp culture in Baguran Jalpai. The photos he sent were taken by Kaelyn Maehara and James Martin, who have also been mentioned in the report.

I am grateful to everyone in Moyna, Nandakumar, Sabang, Baguran Jalpai, and Nayachar who talked to us and received our numerous follow-up calls. Many of the names are mentioned in the case reports. However, special mention must be made of Rabindranath Bhuiyan, whose inputs have been extremely useful and illuminating. I must also make special mention of Gopal Sheet, Manas Midda, Dipankar Manna, and Gopal Hajra of Baguran Jalpai, Bapi Mondal and Raju Barman of Dakshin Ankha, Dipak Natuya of Shitalpur in Nandakumar, and Sahadeb Mondal of Nayachar. Special mention must also be made of Puja Basudeb of Bhagbanpur, Usha Mondal of Dakshin Ankha, and other ladies at the Annapurna Fish Market who were not particularly keen to be named.

I am grateful to my colleagues in DISHA for being there for an occasional question regarding issues that came up in the course of the study. I must specially mention Pradip Chatterjee for inputs regarding the overall tenor of aquaculture policy in West Bengal and my namesake and younger colleague Santanu Chakraborty for providing me with the verdicts of court cases against shrimp farms.

I ask the forgiveness of any person who I may have forgotten to name here or within the report.

Santanu Chacraverti
Kolkata, March 2022

1 Introduction

The Current Worldometer indicates that the global population is 7.9 billion and rapidly climbing[1]. The Indian population is presently at 1.4 billion[2]. Easily, half the numbers mentioned comprise of people with significant amounts of fish in their diet—understandably, as fish is a relatively inexpensive source of important nutrients. Moreover, as the population grows, the number of fish-eaters is expected to increase. Whether the growing demand for fish is at all sustainable is difficult to answer. But, if at all there is a chance of sustaining it, the route lies much more through aquaculture than through capture fisheries. The reasons are too well-known to elaborate here[3]. This is why government policies welcome improvements in aquaculture production.

In West Bengal

Traditionally, West Bengal has been identified with fish eating as well as fish culture in *bheries*. The development of freshwater aquaculture and brackish water shrimp culture has been the primary focus of many State-led policies. Many of these policies stress on the importance of suitable financial climates with the primary objective of increasing production capacities. The State Department of Fisheries in its goal statement speaks of "increasing fish production by optimum utilization of all water bodies, develop infrastructure for postharvest management and develop enabling ecosystem for adoption of scientific pisciculture...." The declared goal is to ensure availability of fish at affordable cost to the masses. There is also mention of socio-economic advancement of local communities[4]. However, the letter of the text and the reading thereof in the light of field experience make it clear that the main thrust is on increasing productivity and production. Where large-scale and intensive cultures are concerned, the main profits are being garnered by bigger investors who, more often than not, are non-locals with no ties to the fishing community. This will be evident in our study of shrimp aquaculture.

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[1] *Current World Population*, https://www.worldometers.info/world-population/#:~:text=The%20current%20world%20population%20is,currently%20living)%20of%20the%20world. (Last checked 28 March 2022.) The worldwide death due to COVID-19 is about 6 million, hardly a serious dent in the upward climb.

[2] *India Population (Live)*, https://www.worldometers.info/world-population/india-population/ (Last checked 28 March 2022.)

[3] Rise in global capture fisheries production from 1990 to 2018 = +14%; Rise in global aquaculture production from 1990 to 2018 = +527%; Rise in total food fish consumption from 1990 to 2018 = + 122%; Source: *The State of World Fisheries and Aquaculture 2020: Interactive story*, https://www.fao.org/state-of-fisheries-aquaculture.

[4] Departmental Portal: https://www.wbfisheries.in/

The *West Bengal Fisheries Investment Policy (2015) for Micro, Small, Medium & Large Enterprises in Fisheries Sector* (WBFIP) is targeted towards facilitating the availability of monetary support to fish producers. Interestingly, as the criteria for eligibility spelled out in the policy indicate, support is available only to fish farmers, in whose case "Modern/Hi-Tech Plant & Machinery is to be installed to confirm the standard productivity" [5]. Here, the key term is "standard". "Standard" in this context does not denote "usual" or "normal". As any Fisheries Extension Officer in West Bengal will explain, the term is to be understood as productivity towards the high end of the spectrum—namely that associated with intensive cultivation. So, the thrust is towards maximizing production.

The environmental concerns of aquaculture are very real and well-known[6], for example the polluting effects of aquaculture effluents.

The mention of *strict compliance* of pollution control norms in the Fisheries Investment Policy of West Bengal[7] is laudable. However, enforcement of these norms is weak and, indeed, largely non-existent, with drastic implications for the social, economical, and ecological sustainability of freshwater aquaculture farms.

The Union Government and Central Laws

Does the Union Government have any legally allotted role in monitoring aquaculture? Generally speaking, in terms of the distribution of responsibility as spelled out in the Lists in the Seventh Schedule of the Constitution, the Union Government's jurisdiction is restricted to Fishing and Fishery beyond the territorial waters, while Fishing and Fishery inside the country and on territorial waters is the concern of the State Governments.

However, the Environment Protection Act, 1986 is a central law that gives the Union Government *overarching* powers to protect the environment. Moreover, various other elements in the Indian Constitution and other legislations offer the Union Government sufficient opportunity to monitor any and every activity from the environmental (and other) concerns. Hence, the environmental monitoring of fisheries is automatically included in the mandate of the Centre.

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[5] WBFIP, Part I, p. 3.
[6] See, for example, "What Is the Environmental Impact of Aquaculture?", *Global Seafood Alliance: Best Seafood Practices*, 22 April 2019, https://www.globalseafood.org/blog/what-is-the-environmental-impact-of-aquaculture/ and "Aquaculture and its Impact on the Environment", *Debating Science*, 20 April 2016, https://blogs.umass.edu/natsci397a-eross/author/eross/
[7] WBFIP, Part I, p. 3.

In the case of the coastal areas, however, the Union Government has a clearly defined environmental commitment. The Coastal Aquaculture Authority Act (CAA Act) passed by the Indian Parliament in 2005 created a Coastal Aquaculture Authority under the Union Government and, further, charged the Central Government with the task of regulating coastal aquaculture in order to protect the "coastal environment" or the "livelihood of various sections of the people living in the coastal areas". Moreover, the Act defined "coastal area" as "the Coastal Regulation Zone" as per the CRZ Notification of 1991, plus "such other area as the Central Government may, by notification in the Official Gazette, specify".[8]

The two broad classes

Therefore, aquaculture in India may be divided into two broad classes—first, those that *do not* belong to coastal areas and *do not come* under the ambit of the CAA Act and, second, those belonging to notified coastal areas (i.e., the CRZ areas) and *come within* the purview of the CAA Act. The present report comprises of two case studies—the first deals with inland carp aquaculture, an instance of the first class mentioned above, and the second deals with coastal shrimp culture, belonging to the second class.

The present report

Most studies on aquaculture are concerned with the production efficiency of monoculture systems and oriented towards finding ways to increase production capabilities. There are very few that manage to bring out the environmental and human dimensions associated with these practices. For any aquaculture system to be truly sustainable ecologically, economically, and socially, it is important for its practices to be embedded within the framework of long-term human and environmental welfare. Such practices would take into account the internal and external costs[9] of a venture and would prioritize the long-term social wellbeing of communities.

This study tries to discuss issues relating to both internal and external cost. Through information gleaned from literature, onsite observation, and actual discussion with stakeholders, this study attempts to draw attention to the impacts of aquaculture on the environment, on the lives of the people dependent on these environments, and how aquaculture has impacted the social fabric at the site of production. Here, we will direct our attention to two areas. In the first, we will be looking

[8] The Coastal Aquaculture Authority Act, 2005: Act no. 24 of 2005.

[9] The term 'external cost' denotes a cost that is not captured in the price of the product and is borne by the society and environment.

at West Bengal's celebrated 'Moyna model', a production site known for its large-scale intensive aquaculture, which has lately become the mascot for the state government's idealized portrayal of fisheries in the state. The second area is that of shrimp aquaculture—a major economic activity along the coastline of West Bengal.

As mentioned in the Preface, we shall explore the development of aquaculture in each area of study. We will also try to briefly highlight the changes in land use practices and labour relations emerging with the rise of aquacultures, focusing on its impact on the social fabric of the landscape. Further, the discussion will attempt to unravel the market imperatives and draw attention to local management practices. The study also aims to bring out the economic, social, and ecological impact of freshwater aquaculture and shrimp culture on the larger environment and how far laws were being obeyed. It will also try and capture the conditions and role of the various stakeholders. In addition, more implicitly than explicitly, the reporting ought to reveal the areas in which actions appear necessary from the standpoint of environment and human rights.

2 The Study

Approach, means, methods, and the pattern of reporting

The present investigation is more an in-depth *reportage* than a study of the academic kind.

As mentioned, the mandate was to undertake two case studies—one on freshwater aquaculture as developed in Moyna and popularly known as the Moyna Model and the other on vannamei shrimp aquaculture. Given the overall resource constraints, it was clear that field visits would have to be limited to a total of about six days, and most follow-ups would need to be done over telephone.

Site selection

Dakshin Ankha, the village chosen as the site for studying the so-called Moyna Model, is situated in the south-eastern portion of the Moyna Block and close to its administrative centre. It is characterized by all those features that made Moyna a leading freshwater aquaculture hub of West Bengal. This will become evident in the course of our discussion on the area. Similarly, Baguran Jalpai, the destination for our second case study, shares a whole host of features with other shoreline villages in Purba Medinipur where intensive shrimp aquaculture has been gaining ground among the fishing and agricultural populace. It was understood that studying these sites would provide us with windows to phenomena we were seeking to understand.

In order to understand the phenomena at Dakshin Ankha, the study team also visited Shitalpur village in Nandakumar Block and Sabang in Pashchim Medinipur. The reasons of those visits will appear in their appropriate places in the narrative.

In search for a slightly different model of shrimp aquaculture, the team visited the Nayachar Island. It is likely that an account of the practises on that island would come as new information to many.

The time frame of visits and writing

The project took off on 12 November 2021. The first visit to Dakshin Ankha was undertaken on 13.11.2021 (Figure 1). On the same date, the team visited Shitalpur village. The team visited Sabang in Pashchim Medinipur on 14.11.2021. The visit to Nayachar was undertaken on 15.11.2021 (Figure 2). Another visit to Dakshin Ankha occurred on 20.11.2021. This was followed by a visit to

Baguran Jalpai on 22.11.2021 and 23.11.2021 (Figure 3; Figure 4). Subsequent inquiries in Baguran Jalpai were conducted *during the last few days of November*.

FIGURE 1: AT DAKSHIN ANKHA, MOYNA BLOCK, ON 13.11.2021

FIGURE 2: AT NAYACHAR ISLAND, ON 15.11.2021

FIGURE 3: DIPANKAR MANNA'S POND, PHOTO TAKEN IN THE LAST WEEK OF NOVEMBER 2021

FIGURE 4: A MEETING AT GOPAL SHEET'S RESIDENCE IN BAGURAN JALPAI ON 22.12.2021

A problem

A problem with the timing of the study was that the shrimp season was over when the study was being done. Therefore, the shrimp farms and the team did not witness them in action. However, this proved to have been not entirely a bad thing. With the season over, the farmers and others associated with the business had more time to talk.

Interviews and Focus Group Discussions (FGDs)

During the few days available, the team conducted several informal interviews and held several rounds of conversation and focus group discussions with multiple stakeholders—covering a range

of issues related to the aquaculture and its impact on the livelihood of the local community. There were follow-up interviews over telephone, which continued until the initial stages of report-finalization.

Examining the literature

Although, paucity of time prevented systematic perusal of the literature before commencing the study, some key materials were consulted. The rest was consulted in the period of visits and follow up interviews and while preparing the drafts. Some of the relevant literature has been mentioned in appropriate places.

Telling the tale

The narrative, in places, resembles journalistic storytelling. This is in line with our belief that the narrative should reflect the nature of the investigation—in this case a relatively less structured mode of inquiry. The story as told here tries to capture the learning from the visits and interactions, interwoven with bits and pieces picked up from reports in government publications, journals, newspapers, and online articles.

The *Observations* Sections

There are two major chapters—one devoted to each case study. The telling of the tale occasionally includes comments and observations. However, the narrative avoids overt comments—which are relegated to the *Observations* section at the end of each section. In addition, there is a separate chapter titled *Final Observations*.

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3 The Moyna Model in West Bengal: A Case Study

As mentioned in the chapter on *Means and Methods*, this chapter seeks to gain a window into the 'Moyna Model' through one village in the Moyna Block, namely, the Dakshin Ankha. Moreover, the story focuses largely on the activities of one group of 14 fish farmers—albeit the most important group of fish farmers in Dakshin Ankha owning the largest farm in the village. As to why Dakshin Ankha was chosen has been mentioned in the chapter on approach and methods and will also become apparent below. But, before zooming in on to the village, it would be desirable to present some basic information about Moyna Block and the system of aquaculture that developed there.

3.1 The 'Moyna Model': Preliminaries

The literature on the so-called Moyna model isn't large. Nevertheless, the little that has been published in journals and newspapers provide some useful information.

Moyna is a Community Development Block (CD Block) in Purba Medinipur District of West Bengal. Moyna Town, which is the Block headquarters, is less than 100 km from Kolkata via road. In 2017, this Block was declared as a fishery hub in West Bengal by the State Government and the 'Moyna Model' was touted around as a preferred example of freshwater fish culture throughout West Bengal. Moyna fish farmers have adapted some of the procedures utilized by Andhra farmers and blended it with their own experience, skills, and techniques. Its repute has spread to different parts of West Bengal and to the neighbouring states. This kind of pisciculture across vast tracts of water bodies was reportedly practiced in about 60 out of 81 villages across 11 Gram Panchayats of the Moyna Block and also in some neighbouring blocks (for example, in Tamluk and Panshkura) [10].

3.1.1 'Moyna Model': Historical Background and Geo-climatic Context

Once upon a time

Before the new millennium, there was no Moyna Model.

[10]Subrato Ghosh, "Moyna model of major carp farming in Purba Medinipur District, West Bengal, India", *Aquaculture Asia*, Vol. 24, No. 4, October-December 2020, pp. 18-19; "(Moyna Aquaculture Model) ক্রমশ বাড়ছে লোকসান, ব্যর্থতার পথে ময়না অ্যাকোয়াকালচার মডেল", *Krishi Jagaran*, 5 August 2020, https://bengali.krishijagran.com/news/the-moyna-aquaculture-model-is-on-the-way-to-failure/; Gurvinder Singh, "Flaws exposed in the Moyna aquaculture model", *The Fish Site*, 29 July 2020, https://thefishsite.com/articles/flaws-exposed-in-the-moyna-aquaculture-model.

As in most other villages in any other CD block in Purba Medinipur District, so also in a usual village in the Moyna Block, the cultivation of rice was the lifeblood of economic activity. The traditional rice varieties such as *raktapani kalas*, *sadapani kalas*, *gadahuta*, *banshkaati*, etc. were popular in Moyna, and propagation of naturally-grown fish such as koi (*Anabas testudineus*) magur (*Clarias batrachus*), tyangra (*Mystus sp.*), shol (*Channa sp,*), and tilapia (*Tilapia sp.*) were farmed simultaneously with rice, with fish harvested at the onset of winter. There were usually two crops of rice a year. In 1995, commercial farming of major carp started in conjunction with deepwater paddy in standing water fields during mid-June to December. In cultivated rice fields taken on lease for carp farming, fishes under culture did not harm the growing rice and fields were de-watered during their harvest. Both rice farmers and fish farmers benefited[11].

The shift to round-the-year fish farming

However, changes taking place on a planetary, regional, and local scale were to change the nature of living and working in Moyna. During the last two decades, West Bengal, in tandem with the rest of the world, has been seeing significant geo-climatic changes. The frequency of extreme weather events gradually increased in South Asia, with the states and countries adjoining the Bay of Bengal developing into high risk zones. The state of Odisha has been perhaps the most frequent target[12]. However, West Bengal, since the 2009 Aila, has not been far behind[13]. Moreover, West Bengal is drained by heavily silt-laden rivers sourced from the Himalayas. Besides it is far more densely populated and more subject to land use changes. All this makes it more vulnerable to flooding than Odisha. Some of the flood-causative factors have been captured in the 2019 *Annual Flood Report* of West Bengal. This report, significantly, marks out tracts in the Moyna Block as being among several zones in the State that are particularly prone to flooding[14].

[11]Subrato Ghosh, "Moyna model…" p. 20.
[12]Basudev Mahapatra, "Cyclones buffet Odisha as temperatures rise", *The Third Pole*, October 17, 2018, https://www.thethirdpole.net/en/climate/cyclones-buffet-odisha-as-temperatures-rise/. Abinash Mohanty, *Preparing India for Extreme Climate Events: Mapping Hotspots and Response Mechanisms*, December 2020, p. 23.
[13]Abinash Mohanty, *Preparing India…*, p. 23.
[14]*Annual Flood Report, 2019* (Kolkata: Irrigation and Waterways Directorate, Government of West Bengal, 2020), 114.

Studies on Moyna

Two slightly earlier studies specifically devoted to the geography and topology of Moyna investigates the reasons of Moyna's proneness to flooding[15]. From the results of the study, we learn that Moyna Block is bracketed by several major streams— Bakshi Canal in the north, River Kangsabati (Kasai) in the east, River Chandia in the west and south, River Kaliaghai (Keleghai) in the south (Figure 5). Much of the area is low-lying and saucer-like, inviting water-logging.

Moyna is crisscrossed by a multitude of sluggish canals. Heavy siltation of the rivers and canals has reduced their water-carrying capacity and even to a reversal of the channel beds, provoking large-scale inundation, particularly after persistent monsoon rains. The land slopes slightly towards the southeast. Two prominent depressions have been identified, one in the central portion and another in the south eastern portion of the block[16]. Of more decisive and sinister significance is the startling rise in the number of embankments over time, mostly around water bodies (Figure 6). All this has contributed to "drainage congestion", resulting in seasonal water-logging every year and even severe floods after heavy monsoon downpours and tidal influxes. Flooding, thus, is most frequent in those parts, particularly in the southern areas. All this led to the growth of areas waterlogged for several months and to traditional activities taking a hit[17].

[15]Abhay Sankar Sahu, "A Study on Moyna Basin Water-Logged Areas (India) Using Remote Sensing and GIS Methods and Their Contemporary Economic Significance", *Geography Journal*, 14 May 2014, http://dx.doi.org/10.1155/2014/401324; Sayoni Mondal, Ashis Sarkar, and Priyank Patel, "Causes of Drainage Congestion in the Moyna Block, Purba Medinipur, West Bengal", in *Application of Geospatial Technology for Sustainable Development* (Siliguri: North Bengal University Press, 2015).

[16] Sayoni Mondal et al., "Causes of Drainage Congestion…", op. cit. pp. 3-4.

[17]Sayoni Mondal et al., "Causes of Drainage Congestion…" pp. 7-9.

FIGURE 5: MAP SHOWING MAJOR RIVERS SURROUNDING MOYNA BLOCK

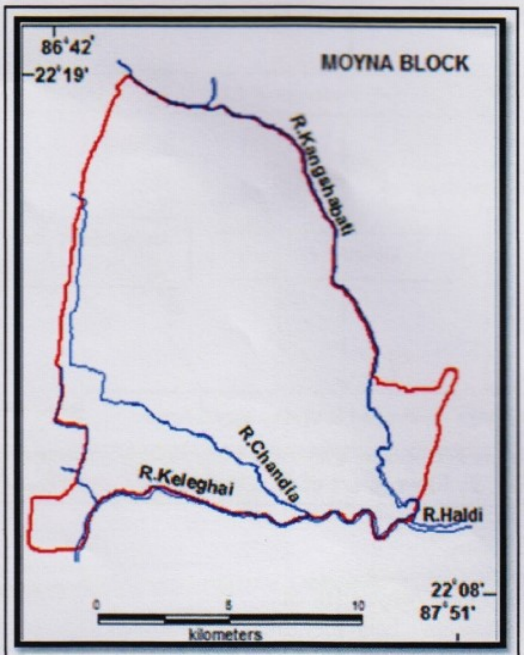
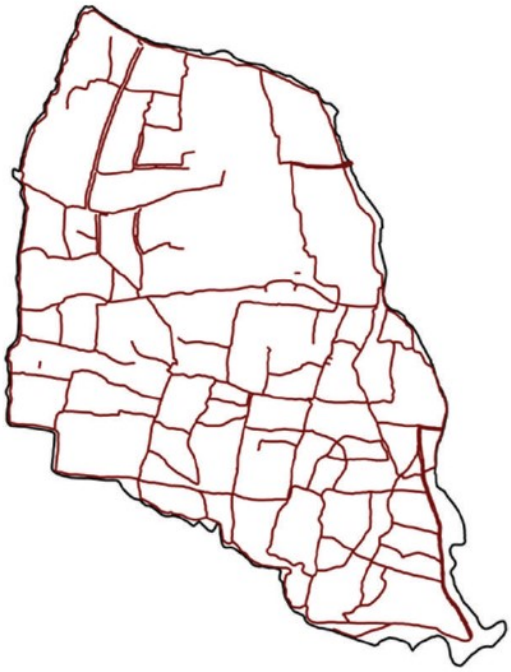


FIGURE 6: MAP SHOWING THE NETWORK OF EMBANKMENTS



The above suggests why in Purba Medinipur District it is the farmers of Moyna block who so readily shifted from cultivation to fish culture. As excessive inundation and the growth in waterlogged areas made livelihood from rice cultivation extremely difficult, farmers were attracted towards fish farming as a serious alternative.

From 2002 onwards, rice plots in Annapurna Village started getting leased out for three to five years solely for carp farming to the highest bidders. A number of farmers paid high lease rents for land and dug out the paddy fields to increase depth and hold more fish. Earlier, the flood-affected people of Moyna sought shelter in other districts. During the last decade, the majority of flood-affected villagers have found a new source of livelihood via fish culture in such areas, i.e., large lowlands with continuing rainwater stagnation[18]. The high profits in carp culture drew farmers across Moyna, and rice fields began to be turned into a 'bheri', 'gheri' or 'khope' (big freshwater ponds used for fish culture).

[18]Subrato Ghosh, "Moyna model…"

Interestingly, fish culture itself hastened and aggravated the process. As people invested more in fish culture, more high embankments (bund) were constructed around the ponds, thus generating new and formidable barriers to water flow in the landscape, further obstructing drainage and aggravating the problem of water logging[19]. Consequently, farmers in Moyna increasingly forsook rice cultivation in favour of fish culture, thus setting up a positive feedback loop. The process described above, which had taken off during the early years of this century, was transformed into large-scale spread across Moyna around 2011-12[20]. Around this time, the combined effects and consequences of the factors described above, including the possible effects of climate change, appear to have gathered serious momentum.

3.2 Dakshin Ankha—our study site in Moyna Block

The following sections attempt to illustrate the characteristics of the 'Moyna Model'[21] as practiced in Dakshin Ankha village. The aim here was to understand the 'Moyna Model' from the perspectives of those whose lives and livelihood are conjoined to it. It also included trying to highlighting how the advent of the 'Moyna model' led to the disappearance of old traditional livelihood practices and introduced new forms of land use practice. This had a significant impact on the social, economic and ecological conditions in this region. We shall try to weave together different narratives from multiple stakeholders in our discussion. This will not only help us construct a broader account of the issues associated with the 'Moyna model', but also shed light on the basic human issues and welfare aspects associated with large scale, intensive freshwater aquaculture practices.

Location

Dakshin Ankha village is situated in south-eastern Moyna, some 102 km by road from Kolkata and some 33 km from Kolaghat. The village is about three kilometres from the River Kangsabati—a river of great interest to students of local culture, history, and anthropology.

Quick basics about Dakshin Ankha

The village is situated very close to Moyna town and to the administrative heart of the Moyna CD Block. Almost adjoining the eastern border of Dakshin Ankha village is the Moyna BDO office and

[19]Sayoni Mondal et al.,,, "Causes of Drainage Congestion…, p. 5"
[20]Subrato Ghosh, "Moyna model…"
[21]Although spelled "Dakshin Ankha" in this report, in line with official documents, including the Census, it is important to bear in mind that the villagers themselves pronounce it as "Dakkhin Anokha" (pronunciation of the first word, of course, follows the customary Bengali pronunciation of 'Dakshin').

the Moyna BL & LRO office. Besides, the village is well connected with the neighbouring towns and markets. There are several large fresh water aquaculture farms in this village spread across hundreds of acres of land. The pisciculture practiced here is typically based on a production-intensive model. How intensive the system is and how it developed will be seen subsequently. There is also a wholesale fish market, the Annapurna Fish Market. It acts as the convergence point for all the fish that is produced in the village and nearby places[22]. From here, most of the fish is purchased, processed, and transported to different parts of the state. A large quantity of fish is also transported to the neighbouring States[23].

Demographics

As the Census 2021 was deferred, one has to fall back on the ten-year old census data of 2011. As per the figures from that Census, there were 363 families residing in the village. The total population of the village consisted of 1,464 adults, out of which 748 were male and 716 were female. Of the total population, 9.49 % were reported as being from the Scheduled Caste communities and 0.2% from the Scheduled Tribes. Naturally, the population has increased since then. Given the non-availability of the official figures, one might make a conjecture about the rates of population growth. The rate of population growth in Purba Medinipur from 2001 to 2011 was the compounded decadal value of 15.36%[24]. Taking the rate of growth in the village from 2011 to 2021 as about 15%, we get a total household number of about 414 and a population of about 1,684.

The Census data revealed that a large portion of the population was involved in agriculture and allied livelihood practices. One must assume that this includes fish farming.

Most of the houses in the village observed during field visits were of pakka and semi-pakka structures and all of them had access to electricity. The village has a primary school and a higher senior secondary level school. For graduate level courses, students have access to Moyna College and few other private institutes situated in the nearby area. Access to basic health care has improved over the years in the village. For any major health complications and emergencies, the villagers have access to Moyna Hospital, located in Garhmoyna village.

[22]In terms of administrative division and postal address, the market is situated in Gouranga Chak village. However, situated as it is close to Dakshin Ankha, it acts as the main market space for the latter as well.
[23]For example, Bihar and Jharkhand.
[24]https://www.census2011.co.in/census/district/19-purba-medinipur.html.

3.2.1 Aquaculture history and practice in Dakshin Ankha village

Subal's tale

Subal Mondal, a man of 78 years, is a local resident of Dakshin Ankha village. He was busy cutting grass from the bund (embankment) of a *khope* (pisciculture pond) for his cow when the research team approached him for a quick conversation. "All our fields and land has now gone under water. There is no place left in this village for the cows to open graze", he complains.

Subal is a native of the village and has lived his entire life there. Hence, he knew how the village as it had traditionally been and the changes that had taken place over time. Moreover, he seemed to have a good memory and was a fair to middling storyteller. The information he gave was corroborated by others.

FIGURE 7: SUBAL MONDAL, A FARMER WHO HAS LEASED OUT HIS LAND TO AQUACULTURE

Subal used to own a little more than a bigha[25] of land in which he cultivated paddy and vegetables. The land is now leased out for aquaculture. He receives a consolidated amount of ₹50,000 as rent every six months. He says this is more than what he once earned from selling rice and vegetables.

[25]In Dakshin Ankha and adjoining areas, it is taken to be 66 decimals or 0.66 acre. In this connection, it might be appropriate to explain the meaning of the *bigha* as a land measurement unit in the Bengal area. The bigha as a unit land area varies in *absolute size* across the state. In Kolkata and some adjoining districts, it measures 0.33 acres (equivalent to 33 decimals). In some parts of Purba Medinipur district 1 bigha measures 0.46 acres (i.e. 46 decimals). However, wherever it may be, a bigha is deemed equal to 20 *katha*—which is the next smaller unit of area. Thus, a katha is 1/20th of a bigha in size. Hence, since the bigha varies in area, so does the katha, and

Subal recalls how 20 years ago (around 2000-2001), most villagers cultivated rice, two crops of which they would harvest each year. During the monsoon, they raised fishes on their rice fields such as *koi*, *magur*, *lyata*, and *punti*. This was their traditional form of co-culture, where fish and rice were grown simultaneously; on the same field. This appeared to benefit both rice and fish. The rice needed no chemical fertilizer or pesticides and the fish seemed to need zero or minimal feed input. The, costs of fish farming remained minimal, and stocking densities were kept at low levels[26]. However, as compared to current aquaculture practises, fish productivity remained low and most of the fish produced was consumed locally.

Subal clearly said that, in terms of taste and quality, he preferred the fish grown through earlier practice. "Fish grown in our fields were much smaller than what you'll find in these big *jheel*s (lakes or large ponds), but they were delicious. The fishes now, they don't have any taste. They are fed with urea and other chemicals. I avoid eating Moyna fish."

FIGURE 8: SATELLITE IMAGE OF DAKSHIN ANKHA VILLAGE, NOVEMBER 2021

Source - Google Earth Pro

In time, people started growing one crop of rice a year and practiced aquaculture in the remaining six months. This was adopted by many and continued for a while.

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proportionately. For example, a Dakshin Ankha katha is 1/20th of a Dakshin Ankha bigha and, therefore, 3.3 decimals in size. On the other hand, a Kolkata katha will be 1/20th of 33 decimals, hence, 1.65 decimals in size.

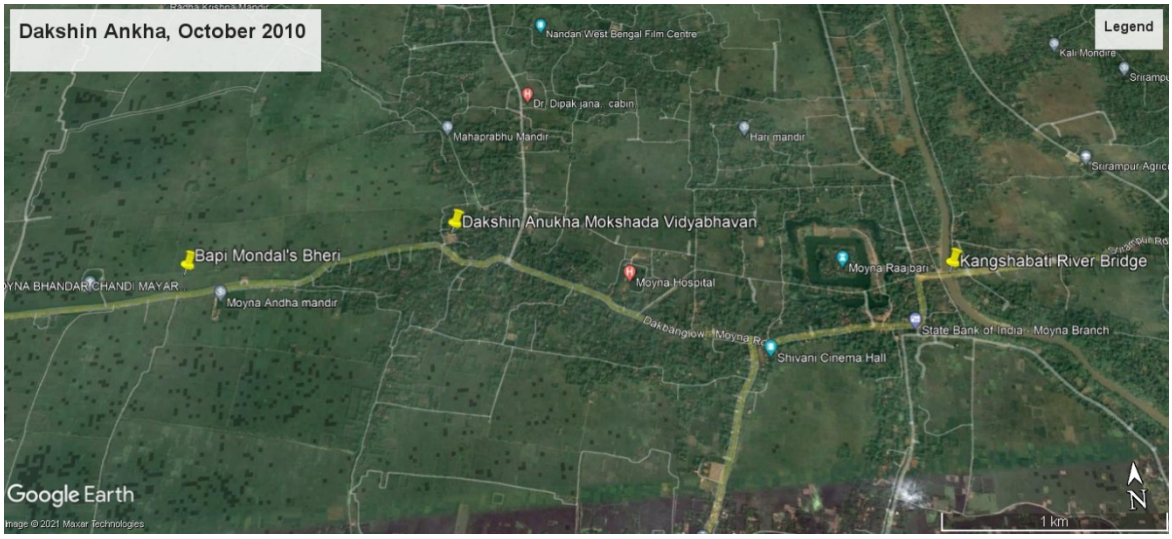
[26]The benefits to both fish and rice in the case of rice fish co-culture, as recounted by Subal Mondal, has been supported in scientific studies such as Jian Xiea, Liangliang Hua, Jianjun Tanga, Xue Wua, et al., "Ecological mechanisms underlying the sustainability of the agricultural heritage rice", edited by Stephen R. Carpenter, *PNAS*, 13 December, 2011, pp. E1381-E1387.

Lower rates of profit in rice cultivation, repeated floods, and consequent high risk of crop failure was an important reason why people started transitioning into intensive pisciculture, Subal explains. Fish culture attained priority.

Subal Mondal's tale (supported by that of others in the village, for example, Ranjit Barman, whom the reader will meet soon) indicates that the serious drive towards large scale aquaculture in Dakshin Ankha started in the early 2000s, and, as mentioned, picked up considerable pace around 2010-11.

Slowly, small but relatively successful fish farmers started to consolidate their funds and resources and started establishing large scale aquaculture farms. Large tracts of land were taken on lease and converted into big water bodies and used for fish rearing. The farm owners started to grow freshwater Indian major carp species on a commercial scale. Drawn by high returns on investment and relatively large profit margins, many people from other villages in Moyna and even from other Purba Medinipur Blocks were also attracted to invest in this business model.

FIGURE 9: SATELLITE IMAGE OF DAKSHIN ANKHA VILLAGE, OCTOBER 2011



Source: Google Earth Pro

Figure 8 and Figure 9 are of roughly the same slice of Dakshin Ankha across a gap of about 11 years. Of particular interest is the point indicating the *bheri* (khope or aquaculture pond) named here after Bapi Mondal.

Bapi Mondal and his colleagues

Bapi Mondal and the so-called Bapi Mondal's bheri are of particular interest in this narrative. This bheri, of 212 bigha (the largest in Dakshin Ankha) [27], does not really belong to Bapi Mondal, but to a team of farmers/investors, of which Bapi is a member. However, nowadays, Bapi is the more conspicuous member of the team, which is why the pond is locally often referred to by his name. In this narrative, the lion's share of the information *about aquaculture* practised in Moyna derives from conversations with Bapi Mondal, Ranjit Barman (the manager and a prominent member of the team), and the workers working for them. Bapi's group also has a few members from outside the village and even one member who is a Kolkata resident.

The GPS reading was taken on a bund separating two parts of the pond. We see the same point on Figure 9, in October 2011. The aquaculture pond no longer exists at that point (consequently, the label 'Bapi Mondal's bheri' is *fictitious and anachronistic* for that year).

The village transformed

Nowadays, Subal Mondal doesn't have to work hard on his fields round the year. Nor has he to worry about the rains. He now sits in the comfort of his home and takes care of his cow as he pleases. He lives with his son and daughter-in-law who take care of him. He receives a consolidated amount of ₹50,000 every six months for leasing out his 1.5 bigha (1 acre) of land. The rent, he says, is enough to run the household for the time being. He said that he is now building a pakka home. On being asked whether his son will return to agriculture in the near future, he replies,

> Even if one decides to do agriculture in this village, they will have to redraw the land boundaries all over again. Everything is immersed in water.

In Figure 8, it is difficult to detect any signs of agriculture in this village anymore. One sees stretches of water spread right across the land. Most of the villagers have leased their land to aquaculture farmers in the last few years. No one practices agriculture anymore as they find leasing the land a more profitable venture. There is no risk and little chance of loss. Like Subal Mondal, many other small-scale land holders in the village are now largely dependent on the rent they receive from aquaculture practice in this region to sustain their lives. However, for the sharecroppers and landless labourers, they had to devise new strategies to cope with these rapid changes.

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[27] If we remember the equation regarding bigha and acre for the Dakshin Ankha area, we will realize that 212 bigha means about 141 acres.

Landholding in rural West Bengal

In a typical village anywhere in West Bengal, the overwhelming majority of *rural landowning* is small. The State average of rural landowning is 0.5 hectare—i.e. about 1.24 acres[28]. However, this is not the median but the arithmetic mean. Moreover, this indicates the total land owned, including homestead, and not the total cultivable land owned, which would be less. Further, this is data from 2015-16. With the increase in rural population and the number of households, fragmentation has increased and current figures are likely to be smaller. The significance of this will become evident in the following paragraphs.

The lessors, fish production teams, and lease committees

Large scale fish farming calls for relatively large water areas. If such a farm area has to be leased, then, in the context of a usual West Bengal village, this means taking lease from numerous farmers.

In Moyna, the large farms are occasionally held by small partnerships of two or three, or perhaps even only by one individual. However, in many cases, farms are operated by groups of fish farmers. Such a fish production team is formed in a neighbourhood and gets the land by leasing it from the local farmers. In Dakshin Ankha, all the fish farms are operated by fish production teams.

Lessors in a neighbourhood who have given their land on lease to the neighbourhood fish production team deal with the team directly. They are represented in their dealings by lease committees (called "gram committee" in Dakshin Ankha), representing the community of lessors in that neighbourhood. In the case of the farm operated by Bapi Mondal's team, the community of lessors is represented by a lease committee of ten members. The duration of the lease differs from committee to committee. However, in most cases, the lease is for five years.

The farms and the nature of the lease

The study team learned that there were four aquaculture units in Dakshin Ankha. The farm operated by Bapi Mondal's team was the largest and measured 212 bighas (about 141 acres—given the rate of conversion for this area) [29]. The three other farms measured 150 bighas (100 acres), 70 bighas (about 47 acres) and nine bighas (6 acres) respectively. All the farms were managed by fish production teams. Oddly, the smallest has also taken its land from a *separate* lease committee!

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[28] NABARD All India Rural Financial Inclusion Survey 2016-17 (Mumbai: NABARD, 2018), p. 19.
[29] 1 bigha = 0.66 acre, i.e. 66 decimals.

The members of the lease committee are usually the most influential members in the neighbourhood—which means the ones owning most land or persons with some political influence. It is these committees that negotiate and settle terms with the farm operators.

We learned from Subal Chandra Barman (a prominent member of the lease committee that gave their lands to Bapi Mondal and team) that the lease committee gave out their lands through auction. Moreover, the lease committee was responsible for documentation, collection, and distribution of the rent amongst the land holders. However, the lease is *not a formal legal document*. For, this so-called lease document is written out on *unstamped paper* on which the lessor and lessee sign. However, this means that the business owners of fisheries cannot access banks and other formal credit institutions for loans. Most of them have to depend on the informal institutions and local money lenders, for which they have to pay relatively higher rates of interest (two to three per cent per month).

Tyranny of numbers?

In case of conflict, it is the duty of the lease committee to work towards conflict resolution. For example, there are occasional instances where a particular landowner is hesitant to lease out any portion of his or her land. In such cases, the lease committee takes the initiative to discuss and convince the landowner to lease out their land. Often, subtle means of coercion are used to persuade land holders to lease out their land. "The majority cannot suffer because of few individuals", is the rationale often employed in such instances.

There have been a couple of cases within the village in the past, where the land holders who were reluctant to lease out their land were asked to form embankments around their land while the surrounding land was leased to fisheries. Eventually, the reluctant few had little option left but to give up their land on lease as it became increasingly difficult to continue cultivation under such conditions.

The most unfortunate part of the tale is that this coercion works best and most effectively against the smallest farmer, who has little social power or influence. The more influential can negotiate more effectively about exactly how much and which portions of the land they are ready to give up. Both in Dakshin Ankha, as well as in Sabang (in Pashchim Medinipur), where a visit was undertaken to talk to lease committees for purposes of comparison), it appeared that the position of the family in the village hierarchy also plays a part in determining how much of their land would have to be given up, should they be reluctant about leasing out all of it.

Permission to convert

Here, there is another question. Change in land use in this State involves getting permission from the Block Land and Land Reforms Office. However, on inquiring, the study team found that, usually, no such permission for conversion from cultivation to aquaculture was obtained or even sought in this area. And, apparently, no action was ever taken against such lapse.

3.3 The Moyna Model in Dakshin Ankha

Google Earth images show the entire area as a patchwork of large water bodies—a perfect visual display of the so-called *Moyna Model*. An example is Figure 8, in which it is relatively easy to detect massive water bodies covering the landscape. These are now the sites for production of fish for large scale market consumption. The model marks a significant departure from how they were grown in traditional fresh-water ponds. The model undertakes mixed farming of the carp species of Rohu (*Labeo rohita*), Catla (*Catla catla*), Mrigal Carp (*Cirrhinus cirrhosus*), Silver Carp (*Hypophthalmichthys molitrix*) and the Common Carp (*Cyprinus carpio*).

The fish farms are about four to five feet deep with embankments on all sides of the farm. The lands are all erstwhile rice fields, leased to the fish farmers by lease committees of landowners. As mentioned, the unit owned by Bapi's team is the largest in the village. It measures 212 bighas, and is divided into five plots.

Usually three types of ponds are seen in carp culture; nursery ponds, fingerling rearing ponds, and the grow-out ponds[30], each with its own specific characteristics and functions. However, in Dakshin Ankha, the majority of aquaculture is carried out in what can be called grow-out ponds. The fish in these farms are stocked at different sizes, for example the Rohu and Mrigal stocks are introduced at 100-250 grams, while the Catla stocks usually come at around 500 gm to 1 kg. These fishes are sourced from other villages, far and near, which focus on rearing fishes up to the fingerling and young adult stage. These fishes are reared in the farm for a period of four to six months. In this period, the Rohu and Mrigal will grow to about 700 gm to kg in weight while the Catla to around two and a half kg. Once they reach the required weight range, they are ready to be harvested. Men are hired to catch, sort, and transport the harvested fish to the local wholesale market.

[30] *Catla - Fertilizers and fertilization*, FAO database, https://www.fao.org/fishery/affris/species-profiles/catla/fertilizers-and-fertilization/en/.

The production team at Dakshin Ankha

To reiterate, this study has focused largely on the practices in the farm run by Bapi Mondal's team of 14 fish farmers, which owns an aquaculture farm spanning some 212 bighas (about 141 acres) of land. The team of partners have equal share in the farm, and share equally in the profits or losses, as the case may be. However, the farm land itself has been leased in the name of 3 members (who are relatively senior)—Ranjit Barman and two others. However, this is no more than a formality and has no bearing on the sharing of profits in any way.

The season

The season begins from the end of the Bengali month of *Jaishtha* (mid-May to mid-June) or the beginning of *Ashadh* (mid-June to mid-July) and continues until the month of *Paush* (mid-December to mid-January).

Preparing the land for aquaculture

If there is no pond, then a pond must be dug (usually with excavators, nowadays). A depth of at least five feet is needed before the pond can be filled. The dug-out soil is placed along the embankments for reinforcement.

Once the embankments are reinforced, the pond is considered to be in place. Now, the soil is treated with lime and manure to reduce the soil acidity. A mix of manure[31] and synthetic fertilizers is used to fertilize the ponds. The fertilizers are usual ones—phosphates, potassium salts, and ammonium salts and urea. The amounts used are based on experience rather than on instructions in any fishery manual. Once these processes are completed, water is drawn in from the nearby canal (connected to the Kangsabati River) and released into the pond. However, the fish farmers reported that due to the immense scale of water that was being drawn, the local canals no longer had water (the study team found the water in the nearby canal at a very low level). Though rains have become unpredictable during last few years, overall precipitation levels were high. Hence, the main reason for depletion of water in the canals was the high rate at which water was being withdrawn.

Therefore, the main supplier of fresh water to the farms was the monsoon rains. In this situation, the farmers could no longer afford to drain and dry the fish ponds at the end of each culture year, and the ponds were allowed to retain the water for a longer period, often up to two years. This, admitted the farmers, affects the quality of the water and the taste of the fish.

[31] Comprising of chicken litter, cow dung, etc.

Initially, the water contains fish and other biota considered undesirable by farmers. Therefore, before stocking begins, Mahua (*Bassia latifolia*) oil cake is added to the water as an organic pesticide. This helps eradicate the "undesirable" fish and other biota. After about two weeks, the water is free of any biota. Mahua oil cake is a poison for 14 days from the date of its application, after which it serves as organic manure [32]. After Mahua loses its poisonous character, lime, manure, and fertilizers, are added. Thereafter, the fish stocks are introduced. Simultaneously, predator fishes, mostly Chital (Indian knife fish, *Chitala chitala*), are introduced as biocontrol to check the spread of unwanted species such as monosex Tilapia, which might come in with flood waters. After a period of six months, the stock will be ready for harvest. When Chital multiplies beyond the desired number, some of it is harvested and sold.

Stocking

The first stocking takes place during the month of *Ashadh* (mid-June to mid-July). However, as the harvesting continues through the year, stocks get depleted and plots in the farm must be restocked. Thus, both fish feed and fish stock are added to the plots at regular intervals throughout the year to maintain the stocking ratios. Understandably, plots do not get depleted at equal rates. Therefore, restocking also occurs at different times in different plots. The plots are periodically dried, at longer intervals nowadays. Before drying the plot, all the fish is transferred to other plots—one of the advantages of having several plots in an aquaculture unit. Only, how the various sizes and species would be distributed among the various plots is decided on the nature of the existing population in those plots and the overall farming plan. The water is also distributed.

Here, we notice that no water is pumped out into the external environment. Given the huge amounts of fertilizers and medicines added to the water, this is a good thing for the external environment (its effects on fish in the pond is discussed later). Each plot also loses water to other plots or to evaporation, which is considerable during dry months.

Given that these ponds are stocked not with spawns but with young adults, the density of stocking is far less than it would have been if the stocking were with spawns. But, even then the stocking density is about 2,500 fish per bigha (0.66 acres), which, for *stock-fish of this weight range* is,

[32]Once added to the water, Mahua releases saponin which causes haemolysis of red blood cells in fishes, leading to their death, *Catla - Fertilizers and fertilization*, FAO database.

reportedly, about thrice stocking density in household ponds[33]. Therefore, in comparison to household carp culture, this is an intensive mode of production.

According to the production team, the above stocking density was in the safe range and any higher than as mentioned above would increase the chances of disease and, in the end, result in lower profits or even loss.

A visit to Nandakumar

During our field visit on the first day, the study team also visited Shitalpur village in Nandakumar Block in Purba Medinipur district. The significance of Nandakumar lies in the fact that the farms here constitute an important source of stock for the Moyna farms. In this village, a few farmers practising the rearing of fish to young adult sizes were interviewed. It was learnt that the size of the fish farms in this area tended to be relatively small—the usual pond would be around three bigha, though an occasional farm could be as small as a little more than one bigha or as large as ten bighas[34]. The farmers procure spawns of major carp fishes such as Rohu, Catla, Mrigal, etc. from hatcheries located in Kalna in Bardhaman district in West Bengal. These fishes are reared until they reached an average weight of 150-250 gm. These owners usually sold their products to large growout aquaculture farms in Moyna and to similar farms elsewhere—for example, in Tamluk and Panshkura Blocks of Purba Medinipur.

Very often, the farms are on lands taken on lease. The cost of investment is relatively lower in this form of aquaculture largely because the lease rent is significantly lower than that in Moyna. The feed and medicines used in this culture are comparatively small when compared to Moyna. As per estimates given by the farmers, the total cost incurred is around ₹100,000 for a bigha (about 0.42 acre in this area). This includes all costs, including lease rent and labour costs. About five to six people are employed as labourers. They are often, though not always, permanent—working round the year. The net profit in a season is around ₹20-25,000 per *bigha*. This is not impressive as, occasionally, cultivation of the usual crops come up with comparable profits. However, according to the interviewees, this has been the prevailing rate of profit during 2020-21—with inclement weather affecting fish productivity and increasing costs on the one hand and lowering fish prices on

[33] This is based on the information from fish farmers elsewhere in Purba Medinipur who farm on a smaller scale and do not undertake stocking at rates as high as in farms as the one examined here.
[34]In Nandakumar, 1 Bigha = 0.415 acre, roughly taken as 0.42 acre.

the other. The farmers also blamed the pandemic for the economic slowdown that had kept prices low.

The fish produced in these farms mostly become input to growout farms with a small portion reaching local markets.

Aquaculture feed and rising costs

The fish feed used in the culture is a mixture of DORB (De-oiled Rice Bran), fish meal, and rice husk. A mixture of groundnut, soybean fishmeal, and oil cakes are also used as supplementary feed. One kg of rice bran costs nine rupees, whereas one kilogram of floating feed, which is a mixture of soybean and rice bran, costs around ₹42. The farmers here prefer to use rice bran for fish feed as it is comparatively cheaper. This allows them to cut down on their cost of production. As will be mentioned later, lease rents and other costs have increased sharply in recent years. Ranjit Barman explained that given the steep rise in costs, the main trick of aquaculture lay in devising a feeding strategy that would allow one to grow the fish both cheaply and rapidly. He said that the devising of feed and feeding methods followed in their farm was not one that followed the textbook prescriptions and had to be developed by farmers based on their experience. Both he and Bapi also clarified that *no successful farmer would share the actual details* of the methods they used and would only speak in generalities.

The food is put into perforated bags and strung from a hook at specific locations in the pond. This reduces food loss and allows the fish to avail the food more efficiently. Certain nutrients and immunity-boosting ingredients are also added to the feed. In the case of an outbreak of infections, antifungal and antibacterial medicines are administered.

Rotation and Harvesting

The fish are periodically moved from one plot to another. While moving the fish, potassium permanganate is added to prevent spread of infections and diseases.

Each plot is harvested at a different time. During the harvesting process (Figure 10), large nets are put up in certain sections of a plot to separate it from the rest of the pond. This temporary separation is put up in order to restrict fish movement within the plot. Nets are cast and drawn slowly towards one corner of the plot. Some 15-20 men are needed to pull the nets to one corner, where the fish in the net are sorted and collected in a harvest pile. The fish ready to be harvested are kept separately in nets that are partially submerged in water to keep the fish alive (so as to

fetch better prices). A few individuals remain in the water and sort the fishes according to their different sizes and species. The smaller fishes are released into a separate plot where they will be harvested once they reach the necessary weight range. [The study team noticed that the plot targeted for harvesting seemed to have most fish in the 1.2 to 1.5 kg range, with some smaller fish from the new stock being rather small and some outliers were large (usually Catla) in the four to five kilogram range].

FIGURE 10: HARVESTING OF FISH IN ONE OF THE PONDS IN DAKSHIN ANKHA

Workers, Wages, Benefits

In Dakshin Ankha, the system is that any member of the team of partners has to work at the farm himself or, if he chooses not to work, must provide a worker in his stead. For example, Bapi's team needed 14 men as farm labourers and four men to work as staff (manager, managerial assistant, cook, etc). Ranjit Barman and Bapi Mondal work as manager and managerial assistant respectively. Bapi is considered full time staff and does not have to provide any personnel. We learned that in Dakshin Ankha, co-owners who worked on the farm did not have to provide labour costs. Ranjit, nowadays, has other business and can only spare a small part of his time. Therefore, he does not take any salary, but, rather, pays half the wage of a worker to the common fund. The other 12 members of the team each provide a worker each. So, out of 18 workers (farm labour and staff), 14 are accounted for. The four remaining workers are hired from the common fund.

The farm labourer participates in looking after the daily duties at the farm and helps with the harvesting process whenever needed. Each labourer (and member of staff) is paid a monthly wage of ₹10,000, which amounts to ₹120,000 for the year for the regular workers. In addition, the workers get three meals a day. However, there is no regular system of bonus or payments in case of

higher profits. Nevertheless, as this is round-the-year employment, the income is way more than what these workers *could expect as agricultural labourers*.

However, for the harvesting process, more workers are needed. In that case, extra workers are hired on a daily wage, which is about ₹500 (or a little more) per day. Daily workers also get three free meals a day and a shelter near the farm (equipped with toilet facility). One single harvesting period can last up to four to five days.

However, in addition to wages and meals, the farm management usually pays the workers the cost of treating minor ailments or mishaps. This does not apply to any major ailment or accident, even if that were to happen to the worker in the course of their work on the farm. Normally however, there does not seem to be much chance of serious mishap in these shallow ponds, and nothing in that regard was reported. The workers did not receive any other benefit. There was no question of insurance or even bonus.

Farm to Market

Once the fish is harvested, the clock ticks rapidly. Live fish fetches a higher market rate. Moreover, live fish can be transported to larger distances without the need of investing on cold storage or ice. However, several logistical challenges are involved in moving the fish from the farm to the market. A large proportion of fish cultured here is consumed outside Moyna. The fish produced here is transported to different districts of West Bengal and to neighbouring states including Bihar, Odisha, and Jharkhand. There exists a large network of owners, wholesale shopkeepers, drivers, and helpers associated with the movement of fish from the farm to different market locations.

It was learned from the wholesale shopkeepers at the local wholesale fish market (the Annapurna Fish Market, where the most of the Moyna fish is auctioned) that the daily revenue generated across the entire market average was about Rupees Three Crore[35]. The dead fish fetched comparatively lesser price and were usually sold in the local markets. There are daily fluctuations of price in the rate of fish, caused by the usual factors that influence such fluctuations.

It is interesting to note the methods developed locally to bring the fish from the farm to the market. For instance, it is not possible for the pickup vans to access the farms and plots located at a distance

[35] 30 million rupees (INR).

away from the main roads. In such instances, the fish is carried on bikes to the markets (Figure 11). Huge pot-like vessels are welded behind the bikes in which the fish are carried.

FIGURE 11: FISH BEING TRANSPORTED FROM FARMS TO THE ANNAPURNA MARKET ON BIKES

Special pickup vans and the issue of groundwater

For transporting live fishes over large distances, specially customized pickup vans are used. The pickup vans are fitted with a motor pump on top for oxygenating the water. This practice has been in place at least since 2014. The drivers and helpers operating these vans[36] informed the study team that each van can carry up to one tonne of fish for which it requires 4 tonnes of water—pumped out from the ground through bore wells. Over long distances, a portion of the water is changed every two to three hours.

On an average, 300 to 400 pickup vans leave with live fish from Moyna each day to different markets located across West Bengal and its neighbouring states. This gives one an insight into the large-scale ground water extraction prevalent in this area.

During the evenings, the Annapurna fish market becomes the centre of all the action as fishes from the Dakshin Ankha and its neighbouring villages are brought here and auctioned. It is the biggest wholesale fish market in Moyna and is an important economic and livelihood generating space in this region.

[36] The study team spoke to several drivers and helpers, with the most significant conversations being with Indra Mondal (driver), Prasanta Barman (helper).

3.4 Concerns

3.4.1 Economic concerns, externalities, and socio-environmental concerns

The economics of business

Over the last decade, intensive large-scale fresh water aquaculture has grown rapidly in Moyna. This, the members of Bapi's team informed us, had resulted in an increase in competition amongst the fisheries in this region. Simultaneously, land values and lease rent had risen exponentially. The lease rent in Dakshin Ankha was now ₹3,500 per katha, which was equivalent to ₹70,000 per bigha. This was double of what it was only a few years ago. In some parts it was more. Feed prices had also continued to increase.

On the other hand, due to increase in overall fish supply, fish prices had not increased or had increased at a much lesser rate. The pandemic, resulting in economic slowdown and downslide in consumption levels, had worsened matters. Thus, there were serious difficulties with increasing the revenue, while costs continued to increase. This, naturally, resulted in the need to economize drastically. And, the merciless economics of doing business had serious externalities.

The quality of the fish

Ranjit Barman was categorical. He said that the main concern in their enterprise was producing as many fish as cheaply as possible within a given space and desired duration. This led to crowding of fish in the ponds, which, in turn, led to a much greater possibility of illness than would be the case in farms less frantically concerned with costs and profit margins. This, in turn, resulted in the use of antibiotics and antifungals in greater quantities. The consequences for the quality of fish as a food item, rather than just a commodity to be sold, may be well imagined—particularly in a situation where there was no monitoring of aquaculture products on behalf of either the environmental or health authorities.

It has been seen that nobody in Dakshin Ankha seemed to entertain high opinion of the quality of the fish produced by these aquacultures in terms of taste or food value. This is the reason that the huge increase of fish production in Moyna did not lead to higher consumption of fish in Moyna, at least not directly. The locals preferred fish from their household ponds as, up to now, these had been protected from all the changes. Of course, increase in incomes also allowed them to purchase more fish from more traditional cultures in neighbourhood areas.

The issue of groundwater

We have also seen that huge amounts of groundwater are daily pumped out for use in the pickup vans leaving Moyna. The owner of a local eatery on Annapurna Road mentioned this as a problem. However, right now, there is no crisis of groundwater in Dakshin Ankha and one easily gets good quality water if a tube well is sunk to 300-400 feet. However, the possible consequences of constant export of groundwater out of Moyna at a steady rate deserve investigation. The issue will come up again in the discussion section.

Food diversity and security

Moyna no longer grows rice in any large quantity. The traditional rice varieties, once the pride of Moyna, have disappeared from the fields. This is not merely a loss in food diversity—it is the shrinking of genetic diversity. Of course, increased incomes have brought access to *more and diverse food items from outside*. However, this food is not closely linked to local culture. Moreover, this food has had to travel large distances, thereby entailing large *carbon footprint*. The benefits of 'development' come with considerable costs.

Last, but by no means the least, is the issue of local food security. Given that the village had almost no cultivable field left, at the level of the village, local food security was a thing of the past. This was clearly stressed by locals such as Subal Mondal and Ranjit Barman.

'Where do women work in Moyna?'—Locating women in aquaculture

The shift in land use has completely changed the gender-distribution of labour and livelihood opportunities in this area. For instance, when rice cultivation was prevalent, women played a major role in the sowing, harvesting, and processing of rice. However, with the coming of intensive large-scale aquaculture, the participation of women in the main economic activity of the region has declined noticeably. Conversations with the women in the village indicate that this decline has a lot to do with the social conditioning and norms imposed on women and their bodies. For instance, it is relatively easier for men to work and waddle in water and pull nets while wearing pants or *lungi*s. Traditionally, women in rural parts of Bengal are accustomed to wearing saris. For a woman working in water while wearing sari can get awkward, particularly more so while she is working along with men and under constant male gaze. It is true that sari-clad women, particularly from the fishing community, have been working waist deep in water in the Sundarban area down generations. However, those are the Sundarbans and this is Moyna—which shares in the habits and usages common to rural Bengal.

Secondly, many households are now completely dependent on the income from the rent they receive from lease rents. The rent they receive every six month is easily two to three times their income earned in an entire year from rice cultivation. Most importantly, the lease-rent from aquaculture ponds proves to be a reliable source of income (at least, so it has been, up to now). This income has brought a lot of improvement in their lives in terms of higher income and economic stability. Hence, many women no longer felt obliged to work in the fields.

While it is easier for men to find livelihood opportunities in various spaces in culture fisheries, for women the space has remained largely restricted. Interestingly, during the visit to the Annapurna fish market, the team failed to notice even a single woman working there. This was quite a surprising experience, as women are known to play a major role in processing and marketing of fish in West Bengal.

On inquiring from members of Bapi's team, it was found that there were no women investors in their team. Moreover, there were none in Dakshin Ankha village as a whole. We learned that there were a few women here and there who worked in the fisheries and performed same duties as men. However, no such women were observed during the visits. With the transition from agriculture to aquaculture, the opportunity for women to participate and earn a livelihood seems to have become largely confined to very few spaces.

While women had limited opportunities to work in fisheries, many often had supplementary incomes from collecting clams, mussels, and snails from the shallow water beds (Figure 12, Figure 13). This particular space had not really shrunk. However, the collection process is highly labour-intensive and time-intensive, while the income earned was very low. For each kg of snails (*gugli*) they collected, they received only seven rupees. Clams and mussels (*jhinuk*) can fetch up to ₹12 per kg. To give an estimate, in a conversation with a couple of ladies who had been selling what they had collected by working from the early dawn that day, the study team learned that between them they had only earned a total of ₹720.

FIGURE 12: WOMEN OBSERVE THEIR BOUNTY COLLECTED FOR THE DAY BEING WEIGHED

FIGURE 13: THE CLAMS AND SNAILS COLLECTED AND SOLD BY THE TWO WOMEN

However, in the recent years, new opportunities had been opening up for women, who had been pushed into their homes by aquaculture. For instance, an increasing number of women are now earning supplementary incomes from sorting and cleaning human hair, which is later used in the making prosthetics wigs. Agents from Bhagabanpur (near Egra in Purba Medinipur) bring collected human hair which is then distributed amongst the women in the village who clean them and sort them out. The study team spoke to an agent from Bhagabanpur, Ms Puja Basudeb. For every 250 gm of hair they sorted and cleaned, the women received ₹100. This line of work is often looked down upon with disgust. Therefore, mostly households belonging to the scheduled castes are involved in this practice. The male members in these households, however, earn their living from working in aquaculture farms or allied activities.

3.5 Observations

As in the case of any process of change, the process of large-scale round-the-year aquaculture in Moyna has been complex and the outcomes are varied.

We have witnessed the positive feedback loop involving inundations and fish culture—an increasing number of embankments worsening drainage congestion and thereby promoting more

inundation, and more inundations gradually resulting in a large-scale shift to round-the-year aquaculture. We have seen how this gave rise to a situation where some enterprising individuals and groups take up large scale aquaculture, on lands leased from numerous farmers who give up their agricultural plots in favour of regular income from lease rent. This, no doubt, freed many to explore additional income opportunities. Thus, people chose options essentially forced on them by the situation and, as a result, money incomes appear to have increased on the whole, with concomitant and consequent benefits for the population. The limitations of the present study did not permit a survey of the population in this regard, but, as a *prima facie* result, the aforesaid conclusion appears compelling.

However, things aren't as rosy as it has been made to appear by the propagandist of the 'Moyna Model'.

First, things aren't easy for the fish farmers. Both Bapi Mondal and Ranjit Barman were eloquent in their depiction of the problems. Water was a huge problem, and so was loan. The government, though full of praise for the Moyna Model, provide little practical help to farmers.

Secondly, it is tragic and, indeed, somewhat weird, that the people of Moyna in general and certainly the entire fish farming community in Moyna, including the workers, were not too eager to consume the fish reared in the aquaculture ponds. The consensus seemed to be that in the overriding concern to produce the most biomass at the least cost, quality was being compromised.

Thirdly, one major environmental externality of the Moyna fish economics pertained to ground water. The hundreds of huge pickup vans going out from Moyna carried their fish in water and to this end drew gargantuan amounts of groundwater from bore wells. In a scenario of declining ground water levels in Purba Medinipur and, indeed, across the State, this regular drawing and export of huge amounts of water is a serious concern[37].

We have stressed on the shrinking of genetic diversity as, with rice fields having largely disappeared, the traditional rice varieties have been pushed to near extinction in the Block. Also, the consumption of more and diverse food items from outside are tied with environmental costs, including considerable carbon footprint. With the disappearance of cultivable fields, local food

[37] For trends in ground water levels in Purba Medinipur and in the various districts of West Bengal see, for example, *District Survey Report of Minor Mineral of Purba Medinipur District* (West Bengal Mineral Development and Trading Corporation Limited, 2021), pp. 51-54. *Ground Water Year Book of West Bengal & Andaman & Nicobar Islands* 2018-19, Technical Report: Series 'D', No. 283 (Kolkata: Central Ground Water Board, Eastern Region).

security has taken a hit. Naturally, with conversion of cultivable land to ponds, the villages are no longer as food sufficient as they once were. Once, such considerations were treated as merely academic. However, the pandemic lockdowns have provided us with a glimpse of how serious such an issue can be during an overall crisis, when the supply of goods from outside cannot be taken for granted.

Some of the abovementioned issues will come up again in the final section.

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4 Vannamei Shrimp Culture in West Bengal

A case study

In the Introduction, we mentioned that aquaculture in India may be divided into two broad classes—first, those that do not belong to coastal areas and are *outside* the purview of the Coastal Aquaculture Authority (CAA) Act and, second, those belonging to notified coastal areas (i.e., the CRZ areas) and *come within* the purview of the CAA Act. Our first case study belonged to the first of those classes. This case study falls squarely within the ambit of the CAA Act. A few implications of this will be explored as we proceed.

The case study of *Litopenaeus vannamei* aquaculture began on 12 November, at a time when the usual *vannamei* season was over. This prevented the study team from seeing the farms in action *in the course of the study*.

As mentioned in the prologue, the case study of shrimp was focused on Baguran Jalpai village. The researchers did make a trip to Nayachar, but that was a brief visit, followed by some clarification of information through phone calls.

4.1 Baguran Jalpai

Location

Baguran Jalpai is a village on the northern shores of the Bay of Bengal. It is situated in the Contai Block of Purba Medinipur District. According to the locals, the shortest distance to Baguran Jalpai from Contai is along the road via Soula (Figure 14; Figure 15). If Google's reckoning is to be trusted, then that distance is about 12.2 km.

Baguran Jalpai (BJ): A little about the past

The sea-dyke was built sometime in the colonial period, perhaps early in the nineteenth century. This is attested by the oral tradition of the locality which also confirms that the village of Baguran Jalpai (hereafter referred to as **BJ**) was first settled in 1905 with a very few settlers.

FIGURE 14: LOCATION OF BAGURAN JALPAI (BJ)

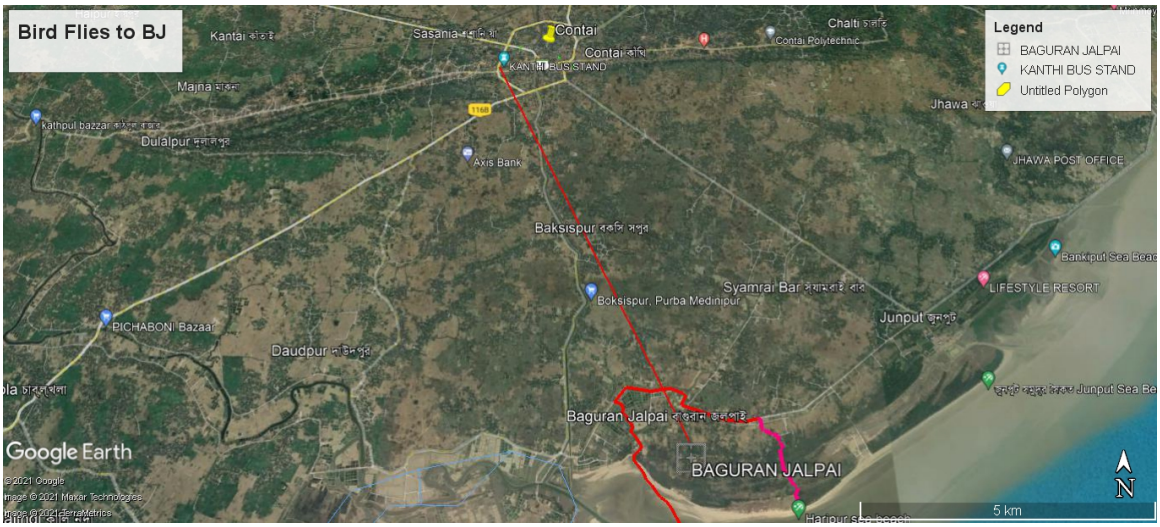


FIGURE 15: THE SHORTER ROUTE TO BAGURAN JALPAI FROM CONTAI

The devastating flood of October 1942 swept the Medinipur coast, amidst the horrors of a notorious drought ravaging Bengal[38]. Reportedly, BJ, although a seashore settlement, was saved, as it stood on relatively higher ground and well protected by its high sand dunes and beach vegetation. This prompted many households from nearby villages to shift to BJ, with the settlement acquiring the status of a village.

[38]16 October 1942. A clue to the callousness and downright cruelty of the British government in handling the devastation may be found in a speech delivered by Shyamaprasad Mukherjee, otherwise a staunch government loyalist at that time—see the report in Midnapore.in, at https://www.midnapore.in/drought/drought2.html.

Significantly, a few neighbouring Zamindar families bought land from the government in the village and settled the lands with sharecropping tenants. Not less than 45% of the households in the village are from the Mahisya caste, the chief agricultural caste in the Bengal area and, which, whatever its status in the Brahmanical caste hierarchy, enjoys some respect in the rural caste ladder. It is characteristic both of Bengal and the nature of BJ as an outlier settlement that, once settled in the village, many Mahisyas readily complemented their income from cultivation by fishing in the sea. If anecdotes are to be believed, the sea at the time was bountiful. Therefore, notwithstanding the dirt-cheap prices fetched by fish in those days in the coastal and riparian areas of Bengal, fishing contributed to improving the quality of life of all those who fished in addition to cultivating the soil. Though the presence of a little salinity in the soil was not particularly conducive to rice, it proved useful for cashew and not unfriendly to a wide range of vegetables. This was a boon to entrepreneurial and hardworking farmers with some land.

The year 1947 had brought independence and 1956 brought the Zamindari Abolition Act. However, sharecropping continued in BJ up to the 1970s. In that decade, even before the coming of the Left Front Government to power, the landowners sold their lands in BJ to the erstwhile sharecroppers, who now became independent *ryot*s.

Elements of demography

The 2011 census counted 1,573 persons and 345 households in BJ. There was no opportunity to count the number of persons in the village. However, based on an estimate of the *chanda* (donation) lists for *Puja*s for the various neighbourhoods in the village, a broadly reliable figure of 480 households was arrived at. This is a 39% increase in a single decade, two and a half times the rate of population increase that the district saw from 2001 and 2011. However, the growth in the number of households would be expected to exceed the rate of population growth because the rate at which new households are formed has increased, as more and more nuclear units now set themselves up as separate economic units, even while staying under the same roof.

The 2011 data indicates that the percentage of SC would be about 12%. No ST households were recorded and, as per local information, this seems to have remained unchanged.

Some of the basic information about BJ available in the 2011 census is as follows:

78% of the total workforce consists of main workers, the rest being marginal workers. 59% of main workers are cultivators. A total of 36 (8% of total workforce) persons are agricultural labourers. (Anecdotal evidence suggests that most agricultural labourers are from the Scheduled Castes.) It

might also strike the eye that in 2011, only 25 women were counted as workers (either main or marginal), slightly more than four per cent of the total workforce. But, for the moment, even ignoring the fact of women's work in their homes, this low figure conceals the enormous role that 'housewives' play in agricultural work. Interestingly, as will be seen, their presence isn't much noticed in shrimp aquaculture.

While the cultivators and the agricultural labour workforce are captured in the census, the fishing population is not. It is hidden within the 'other workers' category.

A rough estimate based on talking to various members of the village provides us with the following data (Table 1) about the main sources of income of households (total *480*):

TABLE 1: PRIMARY SOURCES OF LIVELIHOOD OF BAGURAN JALPAI

Primary Engagement or Primary Source of Livelihood of Households	Rough estimate of number
Households whose primary source of livelihood is agriculture	174
Households whose primary source of livelihood is fishing (capture—sea)	118
Households whose primary source of livelihood is L. vannamei aquaculture	46
Households whose primary source of livelihood is culture of mixed fish varieties (carp along with other, including scampi)	12
Households whose primary source of livelihood working in trawlers/mechanized boats	56
Households whose primary source of livelihood is daily labour	58
Households whose primary source of livelihood is business or salaried employment	16

4.1.1 The *L. vannamei* farmers and farming in BJ

The *bagda* prelude

The shrimp export economy proceeds to create a massive supply base, by roping in hundreds of thousands of producers, both big and small, into its net. In the coastal areas of West Bengal, this process had begun by the late 1990s.

It was not *L. vannamei* then but *P. monodon* (tiger shrimp/ *bagda* in Bengali). Intensive *bagda* aquaculture developed in BJ, with farms beginning to proliferate in the early 2000s. However, *P. monodon* farming tended to be plagued by illnesses at a greater rate than *L. vannamei* presently is, raising costs and bringing immense loss in its trail. In 2010-12, repeated epidemics struck *bagda* crops badly and farmers suffered huge losses. Those with large loans (i.e., most farmers) suffered badly, resulting in their moving away from intensive shrimp aquaculture. According to Dipankar Manna, a shrimp farm owner in BJ, after the collapse witnessed in *bagda* culture, it seemed that the

shrimp aquaculture sector would never revive. However, *vannamei* came in BJ in 2015 and seemed to bring in new hope (Figure 16).

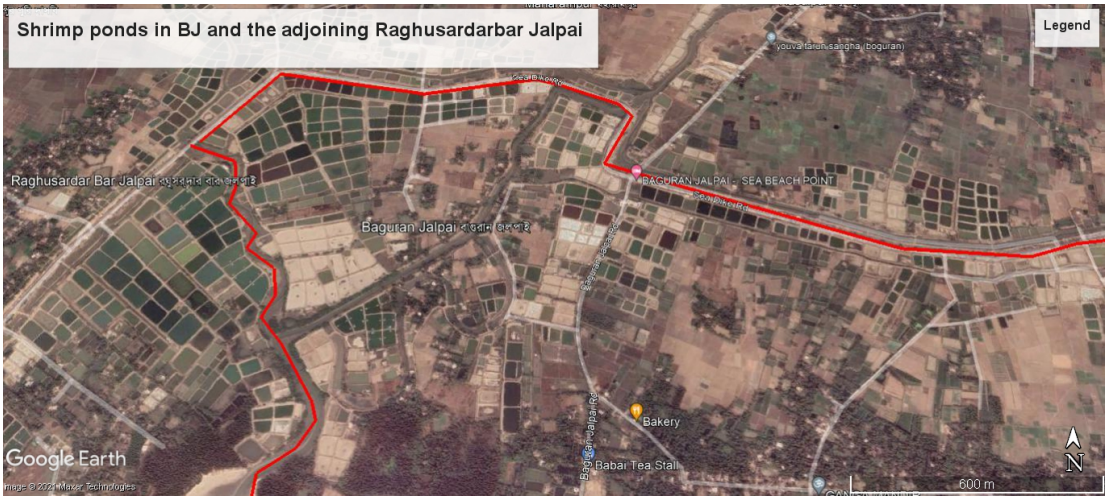
The farmers

At present, there are some 46 farmers in BJ undertaking *L. vannamei* cultivation as their primary occupation (Table 2). Their primary occupation *prior to* their becoming *vannamei* farmers were as follows:

TABLE 2: PRIMARY OCCUPATION PRIOR TO BECOMING VANNAMEI FARMERS

Primary occupation prior to becoming *vannamei* farmers	Number
Bagda (tiger shrimp) or other fish culture	9
Cultivation	33
Fishing	4

FIGURE 16: SHRIMP FARMS IN BJ AND RAGHUSARDARBAR JALPAI



Thus, a large number of *vannamei* farmers originally derived their income from cultivation. According to those interviewed, such cultivation was not a great option for generating good and reliable incomes. This is because the quality of land varied across the village. It ranged from excessively sandy and poor soil to good fertile soil containing plenty of loam. Now, even with the best of lands, intelligent planning, and careful application, it was difficult to raise an income of more than ₹60,000 in cash per year per arable bigha[39] from selling rice, vegetables, and anything else

[39]Bigha in BJ and, indeed, in other villages in Contai-1 Block is equal to 0.46 acre or 46 decimal. This is equivalent to 1861.55 sq m.

(e.g., cashew). Again, vegetable farming during the winter usually means taking water from one's own pond and usually this means a poor crop of fish. And, of course, most people have poor to middling soils and there is the occasional bad year, when weather or diseases (or both) stand in the way of earning even the measly yearly income of ₹20,000 per bigha. Given the fact that most of the present generation of farming households in BJ does not possess more than two bigha cultivable land in total, the income from farming was an enormous problem.

The above is a good reason why farmers have been attracted to *vannamei* farming. Next, we discuss its economic attractions.

Their ponds

Most farmers own two to three ponds each. The ownership statistics are as given in Table 3:

TABLE 3: POND OWNERSHIP/MANAGEMENT IN BAGURAN JALPAI

Ponds owned/managed by	Pond Number
Most farmers	1-2
7 farmers	5-7
5 farmers	8-10
5 farmers	>10

The five farmers owning more than ten ponds are from outside the village, while almost all other owners are insiders. It goes without saying that the ponds they own and run are on land leased from inhabitants of the village. There are some 13 households who have a sizeable income from lands leased out to *vannamei* farm owners.

Registration with the CAA

There are more than 40 households in BJ who have *vannamei* culture and many of them have several ponds. However the list of Registered Farms in the Central Database of the CAA shows only 19 farms from BJ. This indicates the fact that many *vannamei* culture units remain unregistered, a fact also confirmed by farmers.

The lease rent

The lease rent varies from ₹20,000 to ₹25,000 per year per bigha, mostly dependent on the quality of the soil. Rabindranath Bhuyian clarified that the soils best suited to cultivation of rice are also the ones best suited for *vannamei* ponds. Soils near the seashore, which are more sandy and saline, were relatively less suited. This mostly accounts the variation in the rate of land for ponds.

Pond size

The ponds range in area from 500 sq m area to 2000 sq m area with most ponds between 1,000 - 1,200 sq m in area. It was the opinion of several farmers that pond sizes should not be more than about 1,200 sq m, as aerating the pond, particularly the central portion, becomes a problem in the case of large-sized ponds. For two adjacent ponds of 1000-1200 sq m area, it was sufficient to have three machines for aeration, one ten horsepower machine in the middle of two ponds and two five horsepower machines at the two other ends (Figure 17).

FIGURE 17: PICTURES TAKEN OF BAGDA FARMS IN BAGURAN JALPAI, SOMETIME IN JULY 2017

(selected from a group of photos taken by Kaelyn Maehara and/or James Martin)

Ponds tended to be oblong rectangles, although many were close to being squares. Gopal Sheet, who was a medicine company technician and whose family owned five ponds, said that in his experience the vannamei crop was better in rectangular ponds with adjacent sides in the ratio 3:2. However, neither could he explain why this should be so nor there seems to be anything in the literature in support of this.

Some key features of the farming process

The vannamei aquaculture in BJ follows the usual pattern of vannamei farming. In the case of carp production in Dakshin Ankha in Moyna, we have heard a farmer claiming that some of the methods employed were innovations. But, none of the vannamei farmers in BJ made such claims. This is understandable, as undertaking vannamei farming involves following norms and methods developed elsewhere. Moreover, there is a huge amount of off-farm dependence. Farmers are completely dependent on companies to supply them with feed, medicines, mineral inputs, and even farming guidance. Except for the so-called homemade juice made from local rice husk (or wheat flour), yeast, and *chitegur*, all other feed are purchased by the farmer from companies. Employees

and agents of respective companies guide the farmer on feed ratios, medicines, and even on the level of salinity and pH. Further, soil pH and water salinity were tested free of cost by the medicine companies.

Thus, the farmer's methodological freedom at the most lay in deciding which standard prescriptions and readymade products were best suited to the conditions of his farm and purse and his extent of risk-acceptance. For example, based on their experience, ordinary farmers in BJ usually chose the stocking density of 60 PL[40] per sq m. There were a few that realized that a still lower stocking density of 35-40 reduced the possibility of infection and went with that. Those who felt that they could ensure better aeration and health monitoring or prepared to take more risk went up to 70-75 per sq m. However, not many, except perhaps the large investors (mostly outsiders having many ponds and equipment), were prepared to go much higher.

The CAA guideline pertaining to stocking intensity

It is clear that once one is talking of stocking density of 50 PL per sq m or above, one is moving beyond the semi-intensive range and with 60 per sq m one is in the intensive range[41]. This seems to be in flat contradiction to the original CAA guidelines, which clearly recommends traditional or, at the most, improved traditional methods, with low stocking densities. However, subsequent CAA regulations appear to have permitted stocking densities up to a maximum of 60 PL per sq m[42].

Nevertheless, as mentioned, the higher-investment farms, with more aerators, often stock 70-75 PL per sq m and more. Unfortunately, this issue and indeed other issues of CAA compliance are not monitored, as we shall mention below.

Labour requirement

Usually, *one* hired labourer can work two moderate-sized ponds, if they are adjacent to each other. The manpower required for farming can change in favour of the owner if the ponds close to the owner's home are worked by the owner and his family. Take, for example, the case of Dipankar Manna.

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[40] Post-larvae shrimp.
[41] *Penaeus vannamei Fact Sheet*, FAO, https://www.fao.org/fishery/docs/DOCUMENT/aquaculture/CulturedSpecies/file/en/en_whitelegshrimp.htm.
[42] Guidelines for according approval to the farms for spf litopenaeus vannamei culture, http://www.caa.gov.in/pdf/accordingapproval_spf_lvannamai.pdf.

Mr Manna, a resident of BJ, owns four ponds of various sizes. The smallest one has an area of 700 sq m. However, the largest is about 2000 sq m in area, i.e. equal to two average sized ponds. However, Mr Manna and his son suffice to take care of the farm work for all the ponds, which are situated near their home. Consequently, they can divide the supervision among themselves, stroll to their homes for meal and rest when necessary and visit, as needed, at any time of the day or night.

A short note on vannamei workers in the village

There are some 12-13 workers in the village working in vannamei ponds. They usually work in the ponds during the vannamei season and find other work during off season. In addition, some workers come in from nearby village to work the vannamei ponds. This number fluctuates. Full-time workers are usually needed only when the number of ponds is five or more.

As of now, none of the workers are women. In fact, there is some resistance to employing women in the ponds. This is somewhat out of tune with practices in coastal West Bengal and the Sundarban, where women are deeply involved in capture fishing and are seen working in the sea, creeks, and canals. However, in the vannamei ponds the resistance to women directly working in the ponds appears to originate in the notion that they might suffer accident by their saris getting entangled in the aerator blades.

The season in BJ

The season begins in the middle of the Bengali month of *Phalgun* (stretching from mid-February to mid-March) and ends in late *Aswin* (mid-September to mid-October). In that time, the farmer usually produces two harvests of vannamei. For each crop, from stocking to harvest takes about 90 days. Usually, vannamei is not farmed during winter as getting a crop is difficult in that season. For that very reason, however, the prices of vannamei tend to be higher in winter. Therefore, an occasional enterprising farmer will succeed in getting a crop that, despite its relatively smaller quantity, fetches a fair return.

4.1.2 Economics and beyond

Investment, Returns, Profits

It might be useful to look at the average cost of a standard *crop* of vannamei from a 2,000 sq m pond. This size is being chosen because most ordinary farmers have at least two ponds, the total

area of which is around 2,000 sq m. This is also due to the fact that 2,000 sq m is close to (and just a little more than) the size of a bigha in BJ[43]. and this unit that continues to be relevant in the village.

Below (Table 4), the costs have been shown for the *most favourable* situation—where no misfortunes affect the crop.

For the moment, it is assumed that the ponds have been taken on lease. (A farmer with only two ponds mostly does it on his own land. Nevertheless, including the lease helps in generalizing the results.)

TABLE 4: COST ESTIMATE OF A SINGLE CROP OF VANNAMEI REARED IN 2000 SQ M POND

Item	**Cost (in ₹)**
Lease rent (computed for *one crop period*)	10,000[44]
Depreciation of basic infrastructure (overseeing shed, biosecurity net for surrounding the pond to protect from monitor lizards, snakes, insects, crabs, thieves, etc., aeration equipment) and repair and maintenance thereof	10,000
Soil treatment	7,500[45]
Seeds from Andhra Pradesh / from Tamil Nadu (120,000)[46]	50,000/70,000
Feed	200,000
Medicine	50,000
Diesel	30,000
Total Labour cost (except during harvesting)	30,000
Harvesting (including that of labour)	5,000

Below, we begin with the economically most favourable situation, where the farmer farms on his land, i.e. *pays no lease-rent*, the seeds are from Andhra Pradesh, and the productivity is normal[47].

[43] As already mentioned, the bigha here measures about 1,861 sq m.

[44] ₹20,000 is the usual lease rent for *one year* for a bigha of land. Given the size of the BJ bigha, 2,000 sq m would be a little more than a bigha and the rent, as per strict proportional computation, should be ₹21,494. For convenience, a round figure has been taken and this small difference is of little importance, as will become evident.

[45]The soil treatment is done once a year, and at the beginning of the farming year. The total cost is around Rs 20,000 for a new pond and could be as low as ₹6,000 for a few-years-old pond. A middling figure of ₹15,000 per year has been taken and distributed over two crops, bringing the cost per crop to around ₹7,500.

[46]Following the common stocking density in BJ of 60 PL per sq m.

[47] The PL seeds from Andhra Pradesh (AP) are often described as "local" as these are usually from the local agents of the AP companies. These are being more used nowadays. This is because, the farmers affirmed, these are cheaper, equally productive, and no less safe or dependable than the somewhat costlier seeds from Tamil Nadu. On the order being placed, the agents have the seeds brought in from AP. It is true that there are a few hatcheries geographically that are registered for "import of SPF vannamei broodstock for seed production" that are nearer. One is at Tajpur, near Digha, in West Bengal and a few in Odisha. However, not more than three to four farmers in BJ bought PL from these companies and, comparative estimates of the performance of these seeds were hard to come by.

With seeds from Andhra, and *without* lease rent, the total cost amounts to ₹382,500. If one *allows for* lease rent, the cost *per crop* comes to ₹392,500. And, in *addition* to that, if the farmer gets his seeds from Chennai, the total cost would be ₹412,500. This would be the *maximum* cost of operating within the usual range of *favourable conditions*.

If all goes well, after 90 days the shrimp should have an average weight of 20 gm. Ninety percent of farmers sell the shrimp off not later than 90 days. At an average weight of 20 gm, the shrimp is expected to get a fair price. However, if there is an apprehension of disease of the shrimp, the farmer sells off the produce before 90 days. One good thing about the vannamei is that it fetches a price even when the average weight is well below 20 gm. This is because, unlike bagda that has a thick shell, the shell of the vannamei is thin and even the lighter ones have some flesh.

The stocking quantity is 120,000 seeds. With an expected loss of about 16%, one expects survival of around 100,000. At 20 gm per shrimp, one should get a crop of about 2 tonnes from 2,000 sq m pond area. If the shrimps are sold at an average weight of 20 gm, the revenue (at present rates) and profit (based on the costs indicated above) would be as follows:

At ₹300 per kg (the mean farmgate price around which the going rate is presently fluctuating), from two tonnes of shrimp one should get a revenue figure of around ₹600,000.

Thus, from a pond of 2,000 sq m, one can expect a profit ranging from about ₹190,000 to ₹210,000. If one does without external labour and manages with personal and unpaid family labour, one can reduce the labour costs by about ₹30,000, and get a profit of more than ₹240,000. In one year, with two crops with similar output and costing, the annual profit would be double, i.e. ₹480,000.

Less rosy than it looks

The above results are expected *only in the most favourable of circumstances*. Unfortunately, circumstances are usually never that favourable. Output might easily suffer due to disease or weather, while medicine and other costs increase. The disease might easily turn serious, when almost the entire crop is lost. Of course, whenever the farmer senses the possibility of disease, he starts selling off the crop much earlier. Unfortunately, at less than 20 gm weight, the price the farmer gets is much lower. In fact, discussions with farmers indicated that while a farmer might occasionally get very favourable conditions, the average profit margins computed over the years were actually much lower (a maximum of Rupees Three Lakh from a 2,000 sq m pond), due to years

in which there are serious losses due to disease (of the various diseases affecting vannamei, the *white faeces* disease seemed to be the most recurrent in this area)[48]. For, although, as of now, vannamei does definitely better than bagda in terms of disease susceptibility, that measure is only a relative one. In absolute terms, intensive vannamei aquaculture is fraught with both costs and risks and can be relatively safe only for those with deep pockets. In addition, there are natural mishaps. In 2021, a large number of vannamei ponds in BJ were inundated by the incoming sea surge due to the *Yaas* cyclone. (A more severe disaster struck villages towards the west, closer to Digha, where all ponds were inundated by the *Yaas* surge. But, as Dipankar Manna stressed, even in BJ some have been hit so hard that they would be moving away from vannamei for good. It is both deeply concerning that BJ, which, because of its high ground, was not inundated even during the dreadful flood of 1942, should be inundated again in 2021 and, that too, by a storm that made a landfall 70 km south and west. As the frequency and intensity of storms increase due to climate change, the question of the long term sustainability of coastal aquaculture remains an open one). In fact, as will again come up later, vannamei farmers live in a general state of anxiety until the crop has been harvested. Those who invest less and keep the stocking density relatively low (35-40 per sq m), run less risk but also earn lower profits.

Thus, after carefully taking account of the costs and revenues over several years, the average annual income of a vannamei farmer from a water area of 2,000 sq m would work out to be not more than an annual Rupees Two Lakh. This was confirmed by everyone interviewed.

Moreover, some farmers incurred such huge losses that they opted out completely. The study team could track six farmers in BJ who have opted out of vannamei completely as a result of heavy losses and have shifted to mixed cultures fish and shrimp[49].

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[48]At different times, various diseases have been reported to affect vannamei crops in India, some of them are black gill disease, IHHNV disease, white gut disease, and muscle cramp disease (also known as white muscle disease). See, for example, B. Gunalam, P. Soundarapandian, Anand T., Anil S.3 Kotiya, Nina Tabitha Simon, "Disease Occurrence in Litopenaeus vannamei Shrimp Culture Systems in Different Geographical Regions of India", *International Journal of Aquaculture*, 2014, Vol.4, No.04, pp. 24-28; and Lucy Towers, "Prevention of White Feces Syndrome, White Gut Disease and White Muscle Disease in Shrimp", 18 January 2016, *The Fish Site*, https://thefishsite.com/articles/prevention-of-white-feces-syndrome-white-gut-disease-and-white-muscle-disease-in-shrimp. In BJ and other villages in this area, nowadays, the white faeces disease appears to be the most common and feared.

[49] Namely, Subhash Shyamal, Shukdeb Bera, Apu Jana, Kanchan Payra, Khokan Bera, and Manas Midda.

Market and Prices

As far as the farmer is concerned, this is not a seller's market as sellers (farmers) are far too many in comparison to purchasers.

Most small-scale shrimp farmers take their feed and medicines on credit. Very often, the exporters themselves are *the agents of the feed supplying companies* and have selling counters not too far from the village. For example, two major exporters in the area, namely, Mamrej Ali (KNC Agro) and Chintamani Mondal (Kasturi Shrimps Ltd.), are also feed suppliers, KNC Agro being an agent of Avanti Feeds Limited, a Hyderabad-based major feeds company[50]. A farmer, who appeared to be knowledgeable about various aspects of the business and whom we shall not name, commented—"The exporters talk among themselves and decide the price they will offer. We have to accept that. For, unlike them, we are many, and, because we are too many, we cannot unite. Apart from our numbers, our very poverty stands in the way of our uniting—for example, a farmer dare not go against a dealer, as he might have to request the feed dealer for help and support in times of crisis. This explains why farmers do not put up a collective resistance to the exporters." In fact, during the heyday of bagda aquaculture, an association of bagda farmers had come up. However, it had fizzled out. Moreover, there is no apparent concern for this issue in the government.

Not all the shrimp is exported. A significant part of the produce is purchased by local traders who take it to the local market. However, and understandably, it is ultimately the exporters who decide the market price. Of course, it is possible for a farmer to avoid selling to an exporter and sell to a smaller trader instead for a slightly better bargain. As Rabindranath Bhuiyan reported, he was able to get slightly better purchase prices for his produce by selling to a small trader from another area. However, even this freedom can be missing for a farmer who regularly takes feed on credit from a feed counter owned by an exporter. The chief benefit that the exporter-cum-feed supplier gets from providing the credit is to commit the farmer to selling to the exporter[51]. This ensures that the farmer is bound to the exporter and will have to sell for the average price in the market. The farmer, in return, gets an advantage. If his stock starts getting a disease, he can get the exporter to buy the immature stock. The exporter, in his turn, in order to ensure that he is repaid the price of his feed, will try to relieve the farmer of his stock. The farmer, of course, gets a much lesser price for immature stock, but, if, at least, the stock is of the 10-12 gm range, he might just break even.

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[50]This works in collaboration with a Thai company.

[51] Usually, there is no formal agreement and word of mouth suffices. When, rarely, such document is created, it isn't shared and, therefore, we failed to procure a sample.

The nature of credit availability

One does not need much capital to take up vannamei farming. For, credit is easy—that is, *the most popular form of credit* is easy to come by. It developed during the bagda period and works as follows.

There are reportedly more than 40 companies who sell medicines for vannamei aquaculture. Some nine to ten are multinational companies. However, these rarely send their agents to the villages. Mostly, their products are marketed through local companies. There are some six companies who provide feed. Therefore, there is no dearth of competition. The dealers readily give feed and medicines on credit. This allows the farmers to begin with relatively far less capital than required. This is because feed and medicines together constitute the lion's share of the farming cost. For instance, in the example of vannamei crop discussed earlier, it can be seen that of the total cost coming around ₹400,000, feed and medicines account for ₹250,000.

Nowadays, some local agents of the Andhra Pradesh companies are also offering seeds on credit, which further reduces the requirements of initial liquidity.

In BJ, the rates given by the *local dealer* are as follows. If one takes feed on credit, one has to pay back an extra 2% on the price of the feed when the loan is returned. This is called 'credit charge'. If one takes medicine on loan, the *'credit charge' takes a different form*—the disappearance of or reduction in the usual discount. For example, usually, the dealer sells the goods at a 10% to 20% discount. However, if the farmer were to take the medicines on credit, the 10% discount would disappear and, if the discount is 20%, it would be reduced to 10%.

The relative ease of credit has one serious disadvantage. If a farmer avails of it and the crop fails, the farmer must pay the dealer back at a rate previously agreed upon—usually, principal plus interest at two per cent per month. The dealer is usually not prepared to wait for his payment for an entire year and might even prove unwilling to wait until the harvesting of the next crop.

The vannamei attraction

As mentioned earlier, 2,000 sq m is only a little more than a bigha. The highest annual income that a farmer can expect from cultivating rice or vegetables or even cashew on a land of that area would not be more than ₹60,000. If the soil quality is compromised then the maximum income expected for a bigha of land is just about ₹ 20,000. From non-intensive fish culture from a pond of the area, the maximum one could expect would be at the most ₹60,000 to ₹80,000.

Given these incomes, there is little wonder that enterprising or optimistic farmers reach out towards vannamei. Vannamei farming began in BJ in 2015 and most farmers who began then are continuing, while others have joined their ranks.

In addition, vannamei, in many ways, is more attractive than bagda. First and foremost for its reputation of lower disease vulnerability (especially in comparison to bagda); secondly, for the shorter crop cycle of 90 days, allowing farmers to get two crops in a year. Bagda, on the other hand, requires about 150 days for a crop to become marketable, which allows one crop per year. Thirdly, vannamei can be sold even before the usual span of 90 days. For, the vannamei shrimp, in contradistinction to bagda, has thin shells. Therefore, while bagda shrimp will offer little flesh even at 20 gm, vannamei shrimp is quite eatable at 15-16 gm weight and may fetch some market at 10-12 gm. Thus, even if one has to sell off his vannamei at an earlier stage of maturity, one has the chance of a market. This allows farmers to sell off their stock in case of any apprehension of disease. Even if one sells his stock at the weight range of 10-12 gm, it is possible he might just breakeven—at 15-16 gm, there is a fair chance of a profit, unless the overall harvest is rather poor. Moreover, with some luck, an enterprising farmer might even produce a winter crop. This crop will not be as large. Moreover, the average weight will be smaller (mostly 16-17 gm), but since, at that time, there will be much fewer crops from all farms combined, the prices can be better.

All these reasons work to draw farmers moving towards vannamei, often leading them to *convert prime agricultural land to vannamei farms*. But, there is another *reason*, *much more sinister*, why some farmers join the vannamei ranks.

The vannamei compulsion

The land in close proximity to the sea is prone to imbibe some salinity. Now, with ponds filled with brackish water right beside one's plot, salt water leaches into the neighbouring agriculture fields making them saline and gradually infertile. This leaves the owner with no option other than leaving the fields idle or converting them to shrimp culture. The same thing happened during bagda cultivation. Incidentally, unlike in West Bengal, bagda has continued in Bangladesh as the shift to vannamei has not quite happened[52]. A report from 2021 describes the problem of saline aggression due to bagda farming in that country:

[52] Shawkat Ali, "No greenlight for Vannamei shrimp production hurting exports", The Business Standard, 9 February 2022, https://www.tbsnews.net/dropped/trade/no-greenlight-vannamei-shrimp-production-hurting-

As shrimp farms surrounded smallholdings, the saline water leached into their land. This killed the rice plants in the paddies, even when the embankments were not deliberately damaged. Gradually, most farmers moved from rice to shrimp cultivation, many in the hope of making more money, some because they had no choice. In the village of Shoilkhali in Satkhira district, Mohammad Abdul Jalil, now 62, was the last farmer of his community to turn shrimp cultivator. Jalil told *The Third Pole*: "I was forced to shift to shrimp farming on my eight acres about 25 years back [in the late 1990s] because all the land surrounding my fields went under shrimp cultivation. Naturally, my farm also turned saline."[53]

It is the same story for West Bengal, only the culprit this time is vannamei. Given that it is relatively more disease-resistant than bagda, at least for now, the vannamei will spread further and gobble up more rice fields in the process (Figure 18).

FIGURE 18: ANOTHER PICTURE OF BAGDA FARMS IN BAGURAN JALPAI, JULY 2017

(selected from a group of photos taken by Kaelyn Maehara and/or James Martin)

The expansion of vannamei farming and attendant problems are promoted due to the lack of monitoring or even absence of any viable checks and balances. This is also due to the push given to aquaculture by the administration. Largely, vannamei farmers are small-scale farmers. As indicated

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exports-368497. Toan Dao, "Bangladesh government grants permission for vannamei pilot farms", 3 February 2020, https://www.seafoodsource.com/news/aquaculture/bangladesh-government-grants-permission-for-vannamei-pilot-farms; Dipankar Roy, "Experimental vannamei shrimp cultivation underway", *The Daily Star*, 6 April 2021,https://www.thedailystar.net/business/news/experimental-vannamei-shrimp-cultivation-underway-2072853.

[53]Abu Siddique, "How Bangladesh's shrimp industry is driving a freshwater crisis", *The Third Pole*, 19 November 2021, https://www.thethirdpole.net/en/livelihoods/bangladeshs-shrimp-industry-drives-freshwater-crisis/.

in table 3, when small-scale aquaculture farmers own a few ponds, outside moneyed investors own 8 or more ponds.. Thus, money and social influence is silently backing the vannamei aggression. Further, *there is no law preventing this* and, hitherto, no government, either Union or State, has shown any concern on the matter. In fact, as far as West Bengal is concerned, studies on saline intrusion from shrimp aquaculture ponds are sadly rare. Comparatively speaking, Bangladesh has produced a larger number of rather concerned studies[54].

Vannamei deterrents

In fact, as the vannamei farmer Manas Midda clarified, the only thing that holds the spread of vannamei in check is its vulnerability to disease, which keeps away risk-averse people. In any case, intensive culture, with high stocking densities, increases the chances of disease in any cultured species. Vannamei, though more apparently more robust than bagda, is no exception.

However, with climate change entering the scene, difficulties have increased. For, with higher incidence of storms and dangerous inundations, climate change poses a general threat to all productive activity along the coast, including vannamei aquaculture. But, not only extreme events; it also brings in its wake unseasonable weather, higher temperatures and humidity, excessive and sudden rains. All these threaten shrimp aquaculture[55]. It remains to be seen whether and how well vannamei culture can cope in these conditions.

The vannamei worker, wages, benefits

The vannamei farmer having a few ponds mostly does not need to employ a regular worker (usually, non-family labour is employed only during harvesting). However, the larger investors, those with seven or ten or more ponds need labourers. Not too many are required, As we have seen, one labourer can manage two ponds totalling 2000 sq ft, if they are adjacent to each other.

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[54]To just mention two, we have Tamanna Hossain Akhi, Md Modasser Hossain Khan, Raisa Bashar, Abdun Naqib Jimmy, Nazmul Ahsan Khan, "Land-Use Conversion, Shrimp Culture and Salinity Intrusion at the South-Western Regions of Bangladesh: The Cases of Koyra and Shymnagar", *Journal of Environment Protection and Sustainable Development*, Vol. 5, No. 4, 2019, pp. 132-137, http://www.aiscience.org/journal/jepsd; and Md. Manjur Morshed, Md. Sariful Islam, Heman Das Lohano, and Priya Shyamsundar, "Production externalities of shrimp aquaculture on paddy farming in coastal Bangladesh", *Agricultural Water Management*, Volume 238, 1 August 2020,https://www.sciencedirect.com/science/article/abs/pii/S0378377418319632;

[55]Sahya Maulu1,Oliver J. Hasimuna, Lloyd H. Haambiya, Concillia Monde, et al., "Climate Change Effects on Aquaculture Production: Sustainability Implications, Mitigation, and Adaptations", *Frontiers in Sustainable Food Systems*, 12 March 2021, https://doi.org/10.3389/fsufs.2021.609097; and Benedict Standen, and Roy Rosen, "Global Warming Promises to Change Fish and Shrimp Farming", https://www.biomin.net/science-hub/global-warming-promises-to-change-fish-and-shrimp-farming/.

Within the village there are some 15 persons who work as vannamei workers. Most of them work inside the village. Some five to six also take up jobs in vannamei farms outside the village. Working two seasons, these workers get about 180 days of work on vannamei farms. Most of them are landless or have marginal lands and, usually, need to find employment elsewhere.

The wages are usually monthly and range from ₹8,000 to ₹10,000, mostly depending on the skills, experience, trustworthiness, etc of the worker. Three meals are included as, during the 90-day spell, the worker has to be around throughout the day. Larger pond complexes, owned by large and outside investors, usually have night guards, to guard against possible theft or even poisoning. The smaller farmers from the village are more secure about their farm and usually do not employ night guards. However, they and their family try to remain alert and usually make two or three short visits. Their main concern for small farms is not so much security; rather, it is checking that the aerators keep running.

There are no real additional benefits for workers. Minor injuries and an occasional minor illness would usually be taken care of by the employer, but there is no question of medical benefit for serious ailments. Nor are there any insurances towards that end. Of course, one usually does not hear about major illnesses or accidents on these farms. There are also no onsite facilities such as toilets—the local worker can walk to his home or that of a neighbouring villager if necessary. And, of course, one can always take advantage of the cover offered by vegetation.

The women in vannamei in BJ or, rather, their absence

Neither vannamei investors nor workers in BJ are women. There is a notion that given aerators with blades operational in ponds, and women working in saris, the work can be dangerous. An early accident of this nature in a shrimp pond where a woman named Munmun Hajra working in a family shrimp pond was killed, buttressed this notion. Reportedly, there were also one or two incidents involving *sari*s and aerators, but of a relatively minor nature. There is no specific indication that the women themselves are unwilling to work in the farms. However, the overall atmosphere seems to be against it. One does not hear of women workers in neighbouring villages also.

4.1.3 Vannamei externalities—hope, anxiety, and environmental fallouts

A state-sponsored primary school teacher in West Bengal receives her pay check from the government. She draws an annual income of about ₹ 420,000. If she works for seven to eight years, she will also have assured post-retirement benefits. Only few households in BJ have access to such stable regular salaries in this range. Cultivation of two to three bigha of land or fishing, and even a

combination of both, after costs are deducted, brings liquid annual incomes *at best* to around ₹250,000.

Vannamei offers higher income *opportunities*. As Dipankar Manna, Gopal Sheet, and Gopal Hajra argued, the income opportunities offered by vannamei are superior to any other available in the village for people without considerable non-farm incomes.

Unfortunately, the opportunities, as we have mentioned earlier, can be seriously uncertain. Farm incomes or fishing incomes are relatively meager. Nevertheless, despite the increasingly chaotic nature of the climate, these continue to be somewhat more reliable. Moreover, the investments are comparatively small. In the case of vannamei, only those prepared to reduce both their sale revenues and costs (a small proportion of farmers) by bringing down their stocking density to the 25-30 PL per sq m range (semi-intensive) can look forward to their vannamei crops with some assurance, while others (even those with moderate stocking intensity (of 50-60 PL per sq m) must prepare themselves for 90 days of anxiety twice a year.

So, the move to vannamei farming isn't exactly what can be called an economically rational career choice. Actually, there are strong provocations propelling the farmer in the direction of vannamei. The provocations include environmental realities (such as increase in land salinity due to vannamei expansion) and constant allurement of higher incomes promised by the exporters (who also act as feed company agents) and medicine company dealers.

Moreover, once you are into vannamei, it is difficult to quit. For, if you are a small or middling farmer who has been at vannamei for a few years, the chances are you are in debt to the feed and medicine supplier, if also not to the seed supplier. As vannamei, if luck favours, can generate relatively high incomes—the farmer resorts again to vannamei culture to clear his debt. Moreover, it is difficult, if not impossible, to revert to rice and vegetables on the land utilized for shrimp culture on account of its salinity.

Hence, many households, who are more critical, more risk-averse, or simply more conservative, continue to look askance at this investment.

The environmental externalities of vannamei culture are also unquestionably disturbing.

Salinization of the neighbourhood and how it creates in its wake a self-reinforcing trail is only a part of the environmental malaise of intensive shrimp aquaculture.

At BJ, the ordinary farmers who steered clear of vannamei farming complained in unambiguous terms of the huge obstacles posed by the farms to normal drainage. The recent *Yaas* inundation was a case in point. Parts of the village had been inundated. After the immediate crisis was over, the villagers found that the flood waters did not recede into the canals as they should have. This is because right in their way stood the vannamei ponds with their high embankments. That shrimp farms, by changing the natural topography, were creating barriers to drainage had become apparent in recent years. With *Yaas*, the problem appeared on an aggravated scale. The other climate-concern related to shrimp aquaculture, and to intensive aquaculture in general, is the question of carbon footprint. Even those who have relatively low stocking densities (say 40-45 per sq m) must keep their aerators running round the clock. This means a significant carbon footprint in the present scenario of energy production[56]. Moreover, farming involves bringing in almost all the feed (and medicines) from outside. In contradistinction to carp culture (as witnessed in Moyna), in the case of intensive shrimp culture in West Bengal, the feed is from Andhra Pradesh and Tamil Nadu, thereby contributing to further increase in carbon footprint. As far as we know, no studies in this regard have been undertaken with respect to shrimp aquaculture in West Bengal.

There is also the major problem of shrimp waste. With intensive culture, a high amount of waste is generated every day. With some 100,000 shrimps (assuming a 15-16% decline in the original population) growing in a 2,000 sq m pond, defecating regularly as they gobble up *1.5 to 2 tonnes* of feed over a 90-days period[57], and medicines added on a regular basis over the same period, we have a huge amount of waste accumulating in the pond, particularly at the bottom. Once the crop has been harvested, the water and the mud at the bottom must be drained out. First, the water is pumped out into the canal. Then, water is pumped in again, the bottom mud (along with the deposited organic load) stirred and mixed in the water, and this water is pumped out into the canal which mixes later with the sea. Rarely some farmers attempt to use the bottom mud on their embankments, with majority of them dumping it out. This happens twice every year, usually in the

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[56]See, for example, Frank Belettini, Walter Quadros Seiffert, Katt Regina Lapa, Felipe do Nascimento Vieira, et al. "Carbon footprint in commercial cultivation of marine shrimp: a case study in southern Brazil", *Brazilian Journal of Animal Science*, 2018,
https://doi.org/10.1590/rbz4720160353.

[57] This is an estimate, based on what the farmers said, about the expected feed required by 100,000 shrimps in a 2,000 sq m pond. For an estimation of feed intake (and other information) of vannamei shrimp in a semi-intensive mode, see also Lucy Towers, "Feed Management for Improving Production, Economic Returns for the Semi-Intensive Pond Production of Litopenaeus vannamei", 24 October 2016, *The Fish Site*, https://thefishsite.com/articles/feed-management-for-improving-production-economic-returns-for-the-semiintensive-pond-production-of-litopenaeus-vannamei.

months of June and September-October and pump out thousands of gallons of waste-bearing water from farms in and around BJ into the local canals which lead to the sea. The fishers in BJ categorically reported that *fish and shrimp in the canals are almost wiped out*, as fish in the sea close to canal mouths are affected. With huge amounts of biodegradable waste put into the water, the DO (dissolved oxygen) levels drop, depriving the fish of oxygen. Unfortunately, there has been no bio-chemical analysis of the canal water or the seawater at the mouth of the canals. The ill-effects of shrimp pond effluents on the water and biota of canals and sea mouth should be probed for this area. The villagers, particularly the members of the sea-fishing community, were almost unequivocal in condemning the pond waste as a fish-killing 'toxic' pollutant being released into the canals.

The medicines the farms use include considerable amounts of probiotics, which, among other benefits, are supposed to help reduce the organic load. However, the present study did not focus on these biochemical aspects—for example, what were the specific bacteria species used in the ponds, whether the strains and quantities used were sufficient for making a serious dent in the organic load—nor were the researchers involved equipped to do so.

Another environmentally concerning aspect of vannamei culture is at the processing stage. The exporters purchase the vannamei from the farmers and send it off to the processing plants. There, the vannamei is beheaded, processed, and packed for Kolkata—from where it is exported. One such processing plant is at Pichabani, some 16 km west and north of BJ. The processing plant releases its effluents into the Pichabani River (more a stream, some two kilometres due west of BJ). The local residents testify to the fish-killing effect of the processing plant effluents.

And what about the law?

In all this, of course, CAA guidelines and regulations are being violated in a big way. For example, although the guidelines clearly state that agricultural lands should not be converted to shrimp farming, this is happening on a large scale. The Guideline and the regulations clearly state that wastewater should not be let out into the environment without proper treatment[58]. This is largely not adhered to and there is no monitoring. The farmers informed us that the registration process takes place through the Fisheries Extension Officer (FEO). But, no proper inspection takes place

[58] *Culture of SPF l. vannamei by shrimp farmers: Do's and don'ts*, http://www.caa.gov.in/uploaded/doc/lvannamei_do_dont.pdf.

before or after the application is put in. No application ever seems to get denied. There are other serious issues. However, the question as to whether and how far the laws of the land, including the CAA Act, are being obeyed with respect to coastal aquaculture is an area that calls for a full-fledged investigation in its own right, something that cannot be attempted here. One can end this discussion by indicating that the illegality of vannamei shrimp operations has led to a number of court cases and verdicts in the High Court of Calcutta[59].

Partly learning the shrimp lesson

The environmental effects of intensive shrimp farming are borne not only by the neighbours of the shrimp farmers. The farmers themselves often bear the brunt.

This is because the organic load from the first crop affects not only the ambient waters. It affects the pond itself. The effects are manifested most sharply in the second crop. As the second stocking is done shortly after the first crop is harvested, few farmers are able to clean out the wastes deposited at the bottom (mostly accumulating at the middle). This affects the water quality of the next crop. Thus, in the case of the second crop, the incidence of disease is much higher. The farmers find that if a pond produces only a single crop in the year, the chances of the crop suffering from disease are considerably diminished. Moreover, if one combines single cropping with modest rate of stocking, the chances of suffering a setback tends to be hugely lessened. In 2021, a small number of farmers in BJ were found voting in favour of a single culture in a year. Some farmers reported that this is the experience in other areas of Purba Medinipur as well, for example, in the Mahishadal area.

Obviously, a single crop in a year combined with relatively modest density stocking is more environmentally sound and also reduces the burden on the environment. The profits are modest but far more secure. Therefore, what regulations or social concerns have failed to achieve, the natural course of events might ensure, at least to a considerable extent. This, of course, does not take care of the other problems connected to shrimp farming in coastal areas.

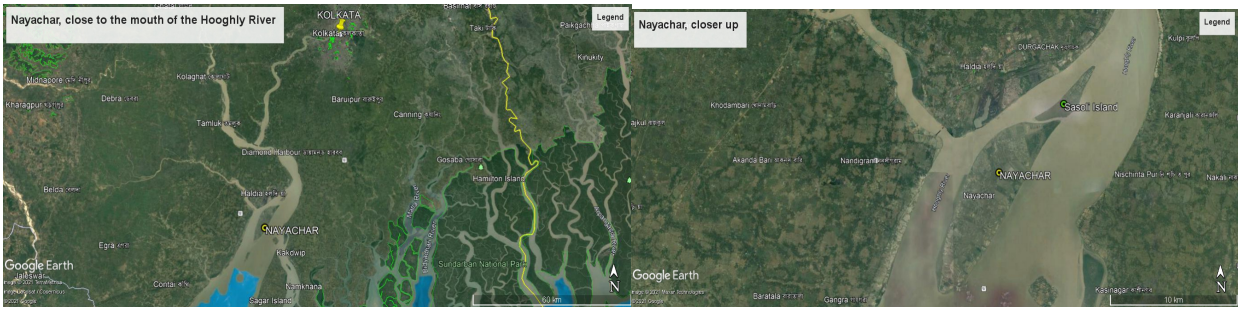
4.2 Vannamei at Nayachar—a different culture

Nayachar is an island on the Hooghly River, situated close to the point where the river flows out into the Bay of Bengal. It is longish, slender, and shaped like a dolphin (Figure 19). The island surfaced in the 1930s. At various times, it was known as Agunmanir Char and also Meendwip.

[59] For example, Dilip Kumar Mal & Anr vs The State Of West Bengal & Ors on 4 September, 2019 and Sri Swapan Kumar Patra & Ors vs The State Of West Bengal & Ors on 22 July, 2019.

For a long time it continued largely as a pristine island, visited by fishers and sparsely settled by people. It was targeted as the site of a petrochemical hub by the government sometime in 2008-09. However, the plans did not materialize mostly due to large-scale protests against having a petrochemical complex at the river mouth[60].

FIGURE 19: MAP SHOWING NAYACHAR ON THE HOOGHLY RIVER



From 2009 onwards, people from nearby areas, e.g. Sagar, Kakdwip, and Nandigram, started trickling into Nayachar and settling for parts of the year, mostly digging ponds for aquaculture. The process intensified around 2015. By 2016, large portions of the island had been dug up and subdivided into plots. Today, almost two-thirds of the island looks like Figure 20.

In Nayachar, all the land belongs to the government. No private individual owns or has legally valid claim on any land here (except for a few farmers in the northern part, who had received some land on lease from the Directorate of Fisheries).

The first settlers occupied lands, cleared them, and often dug ponds, which effectively became their property. Many enterprising latecomers often bought lands from the earliest settlers—none of these transfers having any legal validity. It is also alleged that many lands were simply held by politically powerful individuals and they also leased out their holdings to those who were prepared to pay the lease rent.

About 90% of aquaculture ponds in Nayachar are vannamei aquaculture ponds. The rest undertake mixed cultures of fish and shrimp. As we learned, the island had become a major centre of vannamei cultivation, with dealers setting up numerous counters for feed and medicines.

[60]For geographical information on the island and the controversies relating to the Chemical Hub Project at Nayachar, see *Nayachar o Chemical Hub—Ekti Parjyalochona* (Kolkata: TASAM and DISHA), 2009.

FIGURE 20: PICTURE SHOWING A PORTION OF SOUTHWESTERN NAYACHAR

The study team visited Nayachar Island on 15 November 2021. The vannamei season was over and ponds were dry with very few people around. Most of the discussion was with Mr Sahadeb Mondal (aged 55), contacted through the fishing community in Nandigram, and his neighbours Tapas Das and Sheikh Mosharraf.

Basically a Hilsa fisher on the Hooghly River, Sahadeb Mondal's farm is in Bablatala. This is situated in the south-western section of the central part of Nayachar, close to the western border of the island and opposite the Nandigram Block of Purba Medinipur, from which Sahadeb Mondal hails. He arrived in Nayachar three years ago, took ponds on lease and started vannamei farming. Presently, he owns 12 ponds.

Shrimp farming in Nayachar

Sahadeb Mondal follows a practice of vannamei culture also followed by others in Nayachar. The practice is as follows.

Nayachar has numerous creeks through which the estuarine water enters different parts of the island. Most of the farms are similar in size to those in BJ. They are situated along the creeks (as evident in Figure 21) and draw in water through inlets that have been dug. The ones away from the creek use pumps to draw in creek water. The estuarine water is brackish and the salinity levels prove to be conducive to shrimp cultivation during the shrimp season in Nayachar.

FIGURE 21: TWO POINTS ON SAHADEB MONDAL'S FARM

The season commences from the day of Maaghi (Maagha) Purnima. On this day, the full moon occurs when moon is in the constellation Maghaa (Regulus or Alpha Leonis). This day can occur in the Bengali month Maagha and almost as frequently in the first half of the Bengali month Phalgun. Thus, the date of the full moon can occur on any day from the last few days of January to the last few days of February. On this day, water from the creeks is let into the ponds.

Even if the water is allowed into the pond at January end or early February, the stocking usually begins in the month of Phalgun (from mid-February to mid-March). Notably, the stocking density is usually 50 PL per sq m. Hereafter, the vannamei culture follows the usual pattern and the crop is usually harvested after 90 days.

After the stocks are harvested, *the situation begins to differ from what happens in Purba Medinipur*. The water is not drained out at all but is allowed to stand in the pond and sediments are allowed to settle for a period of 7-10 days. Hereafter, the sluice gates to the ponds are opened and canal water is let in bringing in an assortment of fishes, including some shrimp species. Some fish, e.g. Tilapia, might be introduced independently. Hereafter, the water remains in the pond for about four-five months, after which, sometime in late December or January, the fish is harvested and water drained out, and soon the new cycle would begin.

Thus, two processes are used to manage shrimp waste. First, water is allowed to stand, undergoing sedimentation treatment. Thereafter, an assortment of fish is introduced in a non-intensive manner and they feed on any organic waste that might remain at various levels in the water. Therefore, unlike the situation in many areas of Purba Medinipur, farmers in Nayachar usually have just *one* vannamei crop in a year.

When asked why they followed this system, Sahadeb and his neighbours explained that it was the common understanding in Nayachar that:

i) Having two crops of vannamei meant releasing the hugely polluted water into the creeks after each crop
ii) This resulted in severely polluting the creek water and, ultimately, the river water
iii) Polluting the creek water meant affecting everyone around (many of whom were river fishers)
iv) Therefore, water was not released but allowed to stand and, thereafter, ordinary assortments of fish released and this culture continued for about four months
v) Additionally, as in BJ, the farmers in Nayachar have found that having a single crop a year was, in many ways, less troublesome than having two crops.

4.3 Observations

The aggressive expansion of intensive shrimp aquaculture along the coast is a creation of the export economy. This economy offers opportunities for even ordinary villagers to increase incomes substantially without having to leave their village.

Unfortunately, intensive shrimp farming imposes costs, borne by the shrimp farmers and by society and the environment as a whole. Indeed, as we have seen, incomes, though occasionally high, are hardly stable. Moreover, vannamei farming has resulted in numerous farmers continuing to operate with debt on their heads and farmers quitting after facing economic misfortunes.

With accelerating climate change, coastal tracts, more particularly the near-shore areas, are in peril. West Bengal is among the states in the Bay of Bengal region that have suffered the worst from cyclonic ravages. Moreover, it is most likely to continue to suffer that fate, possibly on a more aggravated scale. This means more than just extreme weather. This includes sudden and out-of-season showers and prolonged hot and humid temperatures. These harm shrimp crops.

Rising sea levels result in increasing salinization of coastal areas. The aquaculture farms aggravate the process alarmingly. As the maps and photos indicate, villages such as BJ have entire stretches under aquaculture ponds. And, as mentioned, the ponds with their embankments have altered the local topography and placed barriers to natural drainage. Villagers are helpless to change this situation. Moreover, the government sees intensive or semi-intensive aquaculture as a means to increasing production, generating employment, and, in the case of shrimp, enhancing export earnings. The introductory section of this study mentions that although the West Bengal Fisheries Investment Policy talks specifically about strict compliance with pollution control norms, no aquaculture farms included in the study were visited by officials of the pollution control board.. This poses serious questions on the government willingness to prevent further destruction of the coast.

The section, 'The vannamei compulsion', says,

> Vannamei farming and the vices of the same are furthered due to the lack of monitoring or even absence of any viable checks and balances in place. This is also due to the undue push given to aquaculture by the administration, thanks to its image as a good money earner. Largely, vannamei farmers are small-scale farmers. As indicated in Table 3, when small-scale aquaculture farmers own a few ponds, outside moneyed investors own 8 or more ponds. No wonder, there is money and social influence silently backing the vannamei aggression.

This is certainly something that must be addressed by aquaculture policy. The Coastal Aquaculture Authority Act 2005 as it stands today has limitations, which this report chooses not to discuss. However, notwithstanding limitations, the Act clearly declares its intention to regulate coastal aquaculture with the prime objective of protecting the coastal environment and people. It states:

> The Central Government shall take all such measures as it deems necessary or expedient for regulation of coastal aquaculture by prescribing guidelines, *to ensure that coastal aquaculture does not cause any detriment to the coastal environment* and the concept of responsible coastal aquaculture contained in such guidelines shall be followed in *regulating*

the coastal aquaculture activities to protect the livelihood of various sections of the people living in the coastal areas.[61]

In the light of what has been discussed, it seems that vannamei aquaculture as practised in coastal West Bengal might be in flat contradiction to the objectives of the CAA Act and with its specific Guidelines and Regulations. What are the Union Government and the State Government doing to implement this Act? Aren't there sufficient grounds to suspect that legal social and environmental concerns are being ignored in favour of increasing production and earning export revenues?

As in the case of intensive bagda aquaculture so in the case of vannamei, the shrimp export economy has created a supply source by drawing in hundreds of thousands of producers, big and small, into its net. We have seen that the net is so powerful in the case of shrimp aquaculture because, far more than in the case of carp, the production process leaves no freedom for the farmer. The latter has little control over the process of production, which follows a regime necessitating dependence every step of the way on those higher up in the chain of profits. Unlike Ranjit Barman of Dakshin Ankha, no vannamei farmer can take pride in having introduced any innovations in the production process.

In the case of the vannamei, as it was in the case of bagda, the changes in topography create massive hurdles to drainage. This has occurred also in the case of Moyna carp culture. However, the shrimp areas are nearer to the coast, which makes them vulnerable to storm surges in addition to usual flooding.

Another aspect, as mentioned, is the high carbon footprint of shrimp aquaculture. This, as far as can be gauged without conducting rigorous measurement of the entire process, is significantly higher than the carbon footprint of carp culture studied here.

Then there is the issue of food security. The vannamei farms have increased due to conversion of good, occasionally very good, agricultural land. More land gets harmed due to salinity intrusion. This impoverishes the locality in terms of *food security*.

Ignoring the damaging externalities of production with an eye for profit is the primary characteristic of the present system of ownership, income generation, and "wealth" creation, with their attendant structures of politics and law. A commonly used word for this system is 'capitalism'

[61] Italics mine-SC.

and, in the Marxian framework, an analysis of capitalistic phenomena involves a particular spectrum of analytical notions. A good example of such an analysis of vannamei production is to be found in Siddharth Chakravarty's article[62]. However, the present report refrains from subscribing to any particular overarching perspective, at least as a conscious exercise.

There seem to be two things standing in the way of endless vannamei expansion.

Firstly, the economics of intensive shrimp farming is palatable only to those with relatively deep pockets and/or preparedness to gamble. Therefore, except for compulsory transition to shrimp farming due to salinization, there remain many families in the village who are reluctant to invest in intensive shrimp farming. Secondly, as also mentioned earlier, climate change results in unseasonable temperatures, excessive rainfalls, and long spells of humidity increase the possibility of disease and, thereby, poses an increasingly serious threat to intensive shrimp culture.

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[62]Siddharth Chakravarty, "Who wins when shrimp booms?", in Siddharth Chakravarty and Savita Vijayakumar (eds.) *Occupation of the Coast, Vol. 2: The puzzle of shrimp production on the East coast of India* (New Delhi: The Research Collective, 2020), pp. 51-82.

5 Final observations

Perils and policy

We have the following information on cyclonic storms in the North Indian Ocean Basin (comprising of the Bay of Bengal and the Arabian Sea) (Table 5).

TABLE 5: STORMS IN THE NORTHERN INDIAN OCEAN (1891-2018)

Storm Category	Sea	Pre-Monsoon (March-May)	Post Monsoon (October-December)	Annual (which includes other months)
Cyclonic Storm	Bay of Bengal	37	124	286
	Arabian Sea	10	25	53
Severe Cyclonic Storm	Bay of Bengal	58	141	234
	Arabian Sea	24	30	73
		129	320	646

One can see that in the Northern Indian Ocean Basin, the Bay of Bengal is the more cyclonically threatened area. As the last column shows, in the 128 years of cyclonic activity in the region, out of a total of 646 major storms, 286 + 234, i.e. 520 storms occurred in Bay of Bengal, which is 80.5% of the total. Notice that 234 of the 520 are *severe* cyclonic storms[63]. In this region, *the coastline from Odisha to Bangladesh has emerged as the most vulnerable area*, attracting the most storms. The significance of this in a period of accelerating climate change needs no elaboration.

The following data could further help to put the above into perspective. The Global Climate Risk Index (Global CRI or GCRI) 2021 was calculated on the basis of data from 2000 to 2019. In that list, which measures the data for some 150 odd countries based on deaths and losses *for the year 2019*, India featured among the first (i.e., the most risk prone) ten, ranking *seventh*[64]*.* Interestingly, for the same year, Bangladesh was ranked the *tenth*. However, in the ranking for the Long-term CRI, calculated for the entire period 2000-2019, India does not make it to the first 10 while Bangladesh

[63] R. Krishnan, J. Sanjay, Chellappan Gnanaseelan, Milind Majumdar, Ashwini Kulkarni, and Supriyo Chakraborty (eds.), *Assessment of Climate Change over the Indian Region*, *A Report of the Ministry of Earth Sciences (MoES)*, Government of India (ebook, Springer Open, https://doi.org/10.1007/978-981-15-4327-2), p.158.
[64] *Global Climate Risk Index 2021*, Germanwatch e.V., Bonn, 2021, p. 8.

makes it to the *seventh*[65]. That is, for the year 2019, in a list of some 150 countries, India's position is rather high. However, in the long-term trend, Bangladesh holds a higher rank. Therefore, West Bengal, which borders Bangladesh and shares much of its topographical and climatic features, ranks among one of the most climate-vulnerable zones in the world.

Odisha has suffered mightily from cyclones and is acutely vulnerable to climate change effects. However, West Bengal and Bangladesh have an additional problem that Odisha has not. The rivers of the Bengal area rise in the Himalayas and carry a far greater water volume and silt load than do the rivers in Odisha, which mostly originate in the older hills in the Jharkhand area. The excessive siltation in the Bengal area causes radical diminishing of the capacity of the rivers to manage their huge water volumes. As events of excessive rainfalls over a short period increase, inundations threaten the Bengal area. Under these circumstances, the uncertainty of carrying on profitable business continues to increase. The study has attended to the fallout for both Moyna and the coastal tract of Purba Medinipur.

Ignoring irregularities, favouring the powerful

The *West Bengal Fisheries Investment Policy (2015) for Micro, Small, Medium & Large Enterprises in Fisheries Sector* reads in the business-as-usual mode without taking into consideration the consequences of expansive shrimp culture. Though government pronouncements pertaining to *aquaculture* or to *agriculture in general* mention climate change, clear instructions on adaptive and precautionary measures to be taken are not forthcoming. Indeed, the government policy of encouraging aquaculture, insofar as manifested in the *implementation regime*, has been largely insensitive to threats posed to society or environment. This is expected to encourage investment and production and, in the case of shrimp, improve export earnings. This blindness to the threats posed to society and the environment can harm aquaculture itself—e.g., in the case where ponds and embankments cropping up without basic attention to topography creates drainage congestion and promotes inundations, as witnessed during storm surges in the near past.

As indicated earlier in the report, social power of large investors proves to be an obstacle to local action against *aggressive salinization and drainage congestion*. This together with the inaction from the government in controlling these impacts, prove to be a major impediment in protecting the interest of the small-scale fish farmer. In Moyna, we have witnessed production teams of relatively

[65] Global Climate Risk Index, p. 13.

small fish farmers taking land on lease for aquaculture. However, elsewhere in Purba Medinipur and in other districts of West Bengal, big investors are the predominant players in aquaculture. They have the capital but, more often than not, have no links to the traditional fishing community. As they continue to move into aquaculture, lease rents go high beyond what small farmers can afford. What is still more unfortunate is that when government lands and wetlands are given out on lease and rents beyond the affordability of small investors. These *have not been* dealt with in this study and any detailed discussion will be avoided here. Mention has been made in order to lend perspective to the findings in this study.

Of food and variety

As humans become richer in technological might and material products, their planet becomes poorer in breathable air, potable water, pollutants-free food, forests, wetlands, greenery, and genetic variety. As the proportion of adults and children suffering from obesity increase in the population of even the poorer countries, not only does malnutrition stalk large tracts, but diabetes, endocrinal imbalances, and natural susceptibility to disease continue to increase.

In many ways, the 'advance' of aquaculture reproduces this trend on a smaller scale. Production figures have increased and incomes seem to have grown overall—assuming increased direct incomes of those directly associated with production along with linkage and multiplier effects impacting the larger economy. Yet, once externalities or external costs start being counted, the picture begins getting bleaker on the edges.

A number of fateful effects have been mentioned in our reports. One is local food security and, specifically in connection with Moyna, food variety—and, by implication, gene diversity. The report has spoken about traditional rice varieties disappearing from the scene. With equal justice one can mention the predominance of carp species in the overall fish production scene. A cardinal aspect of the modern notion of weal and wealth is the worship of quantity and the downplaying of other worthwhile elements.

Of law

We have witnessed shrimp farms violating the CAA and the majority of farms operating without registration. Indeed, mentioned specifically with respect to freshwater aquaculture in Dakshin Ankha, but equally applicable to coastal shrimp farms, is the avoidance of permission when converting from agricultural land to aquaculture ponds. In addition, as far as the aquaculture farms are concerned, the overall pollution control regime appears to be non-existent.

Final Remarks

In all this discussion, the reader should have sensed that the concern here is not to discourage economic activity that improves the quality of life. Rather, the stress has been to indicate where external costs to the environment and society are being concealed and overall quality itself is being compromised in the process.

An amalgam of two case studies constitutes an inadequate platform for providing specific suggestions. Hence, the report avoids a separate section on 'recommendations'. Yet, the narrative itself presses suggestions to our notice.

We can only end this report with the following hope—the findings of studies such as this, combined with the actual experience of the fish farmers and other villagers, will make their way into general awareness and will evoke concern among those in a position to influence policy. Perhaps it will be within our means to set matters right where we can.