

A STUDY OF AGRICULTURAL LAND CONVERSION INTO BHERI FARMING AND SIMULTANEOUS CHANGES OF SOCIO-ECONOMIC CONDITION OF PEOPLE LIVING IN GARBHERA VILLAGE OF PURBA MEDINIPUR DISTRICT, WEST BENGAL, INDIA

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Abstract: The present study investigates the nature of the decline in agricultural land and trends of Bheri farming and its impact in Garbhera village under the Bhagwanpur-1 block of Purba Medinipur which is one of the major shrimp-producing districts in West Bengal. It enquires why agricultural land has been converted to bheri. In this village, now various types of fish such as Ruhi, Catla, Mrigal and different species of shrimps are cultivated in bheri. For this cultivation, the bheri owners lease agricultural lands from the farmers. The farmers lease out the lands for more profit than their paddy cultivation or some other reasons. As a result of this cultivation, the lifestyle and economic conditions of the farmers have changed as well as the environment and health have been affected. As a methodology, this work includes land use and land cover classification done by Landsat series of Satellite images and ARC GIS 10.8 software to show the dynamics of agricultural land and bheri farming in 10 years intervals between 2002-2022 (i.e., 2002, 2012, and 2022) and interviews of farmers have been conducted to find out the reason behind the conversion of agricultural land to bheri farm. According to the data obtained from satellite images, the amount of agricultural land in 2002 was 1.26 square/km and in 2022 it decreased to 0.11 square/km. Similarly, the extent of bheri farming in 2002 was almost zero but in 2022 it increased to 1.11 square/ km. That is, the amount of agricultural land in the total area of this village has decreased by about 6% while the amount of bheri farming has increased by 62.71%. On the other hand, due to Vannamei farming, the amount of agricultural land is decreasing. Farmers are getting involved in some alternate occupations such as human hair workers, migrant labourers, small shop owners etc.

Keywords: Bheri farming, Bheri owner, Paddy farmer, Lease, Satellite image, Land use and land cover.

Introduction

Bheri fishery is an ancient system of fish cultivation in West Bengal (Ghosh, 2010). Bheri is a large but shallow body of water, bounded on all sides by earthen banks. In West Bengal, the bheri is called *Bhasabadha*. It is a kind of saltmarsh. According to CMFRI, Cochin, out of about 1.19 million hectares of wetland in India, 0.88 million hectares of wetlands are cultivated as bheri farms mainly in ten coastal states of India (Johny and Madhusudana, 2007). Out of which, 33918 hectares area comes under bheri cultivation in West Bengal mainly in North 24 Pargana, South 24 Pargana and Purba Medinipur districts (Nandy, 2023). There are different types of bheri in West Bengal such as – High salinity bheri, with salinity greater than 20 ppt,

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medium salinity bheri, with salinity between 10-20 ppt and low salinity bheri, with salinity below 10 ppt (Ghosh, 2010). Seasonal bheri is generally found in medium and low-salinity regions. Various types of fish such as Ruhi (*Labeo rohita*), Katla (*Catla Catla*), Mrigal (*Cirrhinus mrigala*) and different species of shrimp etc. are cultivated in bheri. As a result of this farming i.e., inland fisheries and Vannamei (*Litopenaeus vannamei*) farming, the amount of bheri in the Garbhera village is currently increasing as well as the amount of agricultural land is decreasing. Farmers are leasing their land to bheri owners. Farmers who used to have earning by cultivating paddy, are getting more profit by leasing their land to bheri cultivation than that of cultivating paddy without labour. So nowadays some farmers are showing apathies to paddy cultivation, as a result, paddy lands are being converted into bheri farms. Fishermen are doing fisheries by infiltrating river or canal water, extracting groundwater from farmers' land and changing land cover and land use. Farmers seem to pay scant attention to the future character of the land in the hope of getting more profit. As a result, when the bheri owners leave the lease ends, and the land will become almost uncultivable. Therefore, in the present study area, due to increased bheri cultivation, paddy cultivation is decreasing and at places, paddy cultivation is almost disappearing. According to satellite image data in 2002, the agricultural land area in the study area was 1.26 square kilometres and in 2022, the agricultural land area has decreased to 0.10 square kilometres. Similarly, in 2002, bheri farming was almost non-existent but in 2022, bheri farming increased to 1.11 sq. km. Therefore, satellite images and Arc GIS software have shown the extent of agricultural land in the study area between 2000-2022 through Remote Sensing and GIS technology. An attempt has been made to find out the factors behind the conversion of agricultural land to bheris as reflected from the satellite images in the increase of area under bheri and decrease of agricultural land.

Objectives

My present study has the following objectives.

- i) To show the trends of change in agricultural lands and bheri` farming.
- ii) To identify the reasons for the conversion of agricultural lands to bheri farming.
- iii) To show the changes in the way of life and economic status of the farmers.

Study area

The present study area is Garbhera village under Gurgram Gram Panchayat of Bhagwanpur – 1 Block in East Midnapore District of West Bengal. Vannamei shrimp farming began in East Midnapore in 2012 and now occupies approximately 90% of the total land area (Maity, 2019). Shrimp farming is practised over an area of approximately 3342 hectares in this district (Handbook of Fishery Statistics,

2017-2018). This village is located between $22^{\circ}08'20''$ N to $22^{\circ}09'10''$ N longitude and $87^{\circ}45'50''$ E to $87^{\circ}46'40''$ E latitude (Figure:1) . The total area of this study area is 1.77 sq. km. The soil of the study area is generally alluvial in nature and medium to fine in texture. About 60% of soil composition is dominated by clay particles and the topography in this region is flat (Mondal, 2012). The major river in this area is Keleghai. This river and its associated canals are important in Vannamei cultivation or bheri farming. The Adequate saline water required for bheri farming in the area is supplied by tidal water injection through the Keleghai river and adjacent canals located within two kilometres of this area. As of the 2011 census, the total population is 2260 out of which the male population is 1189 and the female population is 1071(Census of India, 2011). The main livelihood of the residents in the study area was agriculture but nowadays the amount of agricultural land has decreased due to bheri farming.

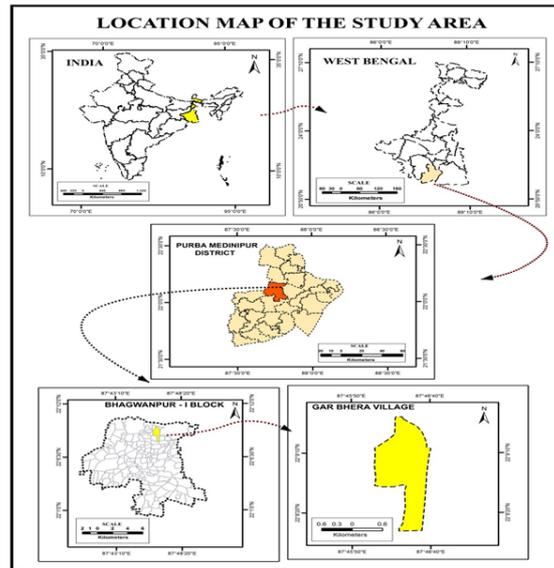


Fig- 1: Location Map

Methodology

The study includes the methods namely Remote Sensing and GIS technology, interviews with farmers, household survey Schedules and Case Study. Satellite images were used for this work and Landsat series of 2002, 2012 and 2022 satellite images collected from <https://earthexplorer.usgs.gov> website. ARC GIS 10.8 software was used to show the land use and land cover classes, i.e. how much agricultural land has been converted to bheries. The nature of land use and land cover change was shown through comparative processing of satellite images over

ten years 2002, 2012 and 2022 and interviews with farmers to explore the reasons for the conversion of agricultural land to bheri. However, the methodology of identifying bheri areas from satellite images is shown in the flow chart in Figure 2.

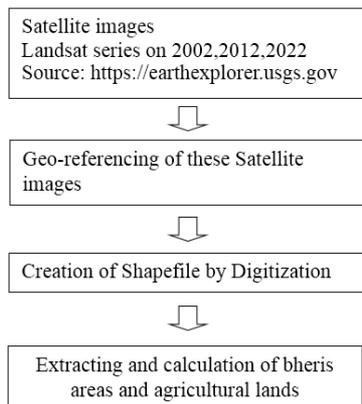


Fig -2: Flow chart of Map preparation

Trends of change of agricultural land to bheri farming

Land use is the most important aspect by which we can know the actual use of land at the present level. Landsat series of satellite images show the amount of agricultural land converted to bheri in the current study area every ten years between 2002 and 2022. Where land use and land cover are mainly divided into four categories namely agricultural land, aquaculture, rural settlements and ponds or tanks. Statistics and mapping of the category are given in (Table:1).

| LULC -2002 | | LULC - 2012 | | LULC- 2022 | |
|------------------|---------------|------------------|---------------|------------------|---------------|
| Class | Area (sq. km) | Class | Area (sq. km) | Class | Area (sq. km) |
| Cropland | 1.2614 | Cropland | 0.9088 | Cropland | 0.1099 |
| Pond/Tank | 0.0060 | Aquaculture | 0.3528 | Aquaculture | 1.1138 |
| Rural Settlement | 0.5078 | Rural Settlement | 0.5083 | Rural Settlement | 0.5465 |
| | | Pond/ Tank | 0.0053 | Pond/ Tank | 0.0050 |
| Total | 1.7752 | Total | 1.7752 | Total | 1.7752 |

LULC – Land use Land cover

Table -1: Class statistics of land use and land cover area (sq/km) in 2002, 2012 and 2022 in Garbhera

Source: Landsat -5 TM of Satellite image: 2002]

Landsat – 5 TM of Satellite image: 2012; Sentinel – 2B Satellite image: 2022

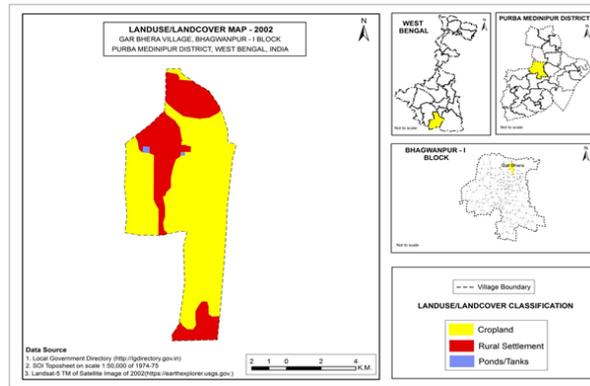


Figure – 3: Land use map showing the cropland and water bodies in the village in 2002

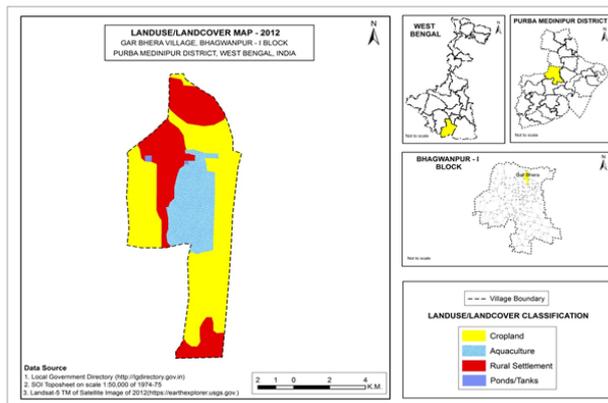


Figure –4: Land use map showing the cropland and water bodies in the village in 2012

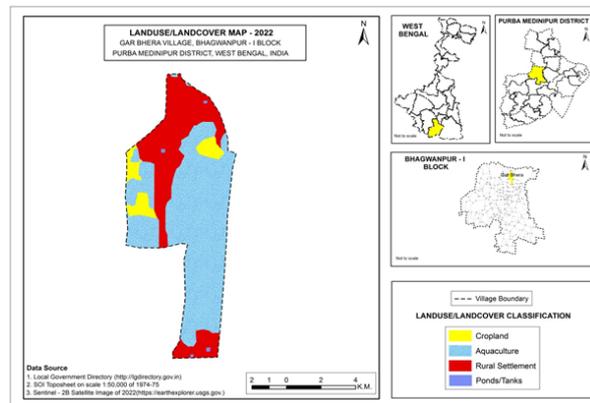


Figure- 5: Land use map showing the cropland and water bodies in the village in 2022

Changing land use pattern

Satellite imagery has been used to find out the dynamics of bheri farming and the current agricultural land of Garbhera village under Gurgram gram panchayet under Bhagwanpur-1 block of Purba Medinipur district of West Bengal. Where more importance is generally given to agricultural land and aquaculture. The land area of the present study area is 1.77 Sq. km. Whereas in 2002 satellite imagery showed 1.26 square kilometres of agricultural land, aquaculture land was almost non-existent. On the other hand, in 2012, the agricultural land area was 0.91 square kilometres and the aquaculture land area was 0.35 square kilometres, according to data obtained from satellite images for ten years. Similarly, according to the data obtained in 2022, the quantity of agricultural land is 0.11 square kilometres and the quantity of bheri farms is 1.11 square kilometres (Table:1).

Comparing the satellite images of the above three years shows that in 2002, the amount of agricultural land was the highest, accounting for 70 % of the total area, and aquaculture was almost non-existent (Figure:6) . But in 2012, the amount of agricultural land decreased to 0.91 square kilometres, which is 51 % of the total area, and aquaculture increased to 0.35 square kilometres, which is 20 % of the total area (Figure:7). On the other hand, in 2022, the amount of agricultural land further decreased to 0.11 square kilometres and the amount of bheri land increased to 1.11 square kilometres, which is 63 % of the total area (Figure:8). Bheri farming is more profitable than paddy farming. Some bheri owners lease land from farmers while some farmers cultivate bheri independently without leasing land.

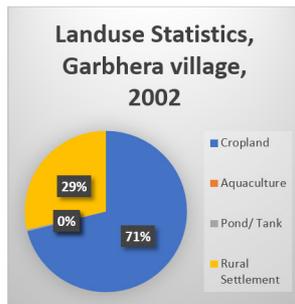


Figure-6

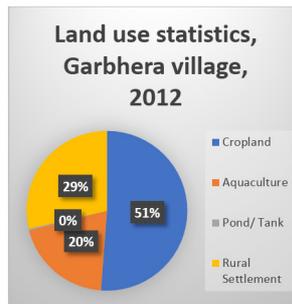


Fig.-7

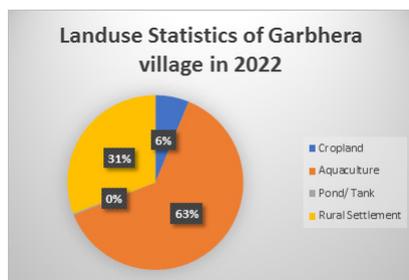


Figure-8

Figure- 6, 7, 8: Comparison of Land use statistics of 2002,2012, &2022

Socio-economic profile of the farmers

Interviews were conducted and data was collected from 70 farmers who had leased land and those engaged bheri farming. Those who are financially sound are cultivating bheri on lease from the farmers. Almost all types of farmers of Garbhera village such as marginal farmers, small farmers, and middle-class farmers are leasing land for bheri (Ministry of Agriculture & Farmers Welfare, 2019). But only a few middle-class farmers know about bheri farming and are farming bheri themselves without leasing their land.

Social and economic information of the farmers is given in (Table:2)

| | | | | | | | | |
|----------------------------|--------------------------|-------|-----------------------------|-------|--------------------------|-------|--|-------|
| Age | 20-30 yrs. | % | 31-40 yrs | % | 41-50 yrs. | % | Above 50 yrs. | % |
| | 12 | 17.14 | 20 | 28.57 | 18 | 25.71 | 20 | 28.57 |
| Caste | General | % | Obc | % | SC | % | ST | % |
| | 24 | 34.28 | 12 | 17.14 | 34 | 48.57 | 00 | 00 |
| Family Size | Joint family | % | Nucleated family | % | | | | |
| | 12 | 17.14 | 58 | 82.85 | | | | |
| Education | >Upper primary | % | MP | % | HS | % | <Graduate | % |
| | 34 | 48.57 | 18 | 25.71 | 06 | 8.57 | 12 | 17.14 |
| Occupation | Agriculture | % | Fishing-cum Agriculture | % | Employee | % | Others (Human hair business,shopkeepers, migrant laboures) | % |
| | 11 | 15.71 | 18 | 25.71 | 07 | 10.00 | 34 | 48.57 |
| Land Holding | >1 bigha | % | 1-2 bigha | % | 2-3 bigha | % | <3 bigha | % |
| | 17 | 24.28 | 24 | 34.28 | 18 | 25.71 | 11 | 15.71 |
| Occupation shift | Yes | % | No | % | | | | |
| | 50 | 71.42 | 20 | 28.57 | | | | |
| Reason for land conversion | More profit without risk | % | Land not suitable for paddy | % | The land middle of Bheri | % | Political pressure | % |
| | 42 | 60 | 14 | 20 | 08 | 11.42 | 06 | 8.57 |

Table-2: Socio-economic data of the farmers of Garhbhera village

Fishermen and lease farmers were interviewed about bheri farming and the conversions of agricultural lands to bheri. According to data, farmers age group 31-40 and above 50 yrs. have leased more land which is about 58%, farmers aged group 41-50 yrs. have about 26% and farmers in the age group 21-30 yrs. have relatively less tendency to lease land about 17% (Figure:9).

The proportion of Schedule caste farmers is highest in terms of bheri farming and conversion of agricultural land to bheri which is around 49%, followed by the General castes at 34% and other backward castes at around 17% (Figure:10).

The educational data suggest that a significant portion of farmers (74%) have education limited to the secondary level or below, they are not aware of the negative effects of bheri farming on their agricultural lands and 17 % of farmers with graduation or higher education could be a potential leader in adopting scientific farming methods and administrative roles in the shrimp farming industry (Figure-11).

From the above information, it has been seen that the amount of lands of the farmers of one and two bighas are the maximum at about 34% and the amount of more than three bighas are the lowest at about 16%.

Interviews were conducted to find out the occupational composition of the farmers in Garbhera village and they are mainly divided into four categories viz. Agriculture, Fishing-cum agriculture, employment and others (Human hair business, shopkeepers, and migrant workers). Where it is seen that the amount of others is the highest which is about 48%. Besides, about 26% engaged in Fishing-cum agriculture, 16% engaged in only Agriculture and 10% engaged in Govt. employees (Figure-12).

Occupational Shift

71% of the farmers have changed their occupations (such as human hair business 42%, shopkeepers 16%, migrant labourers 13%) because of the prevalence of Vannamei cultivation, agricultural farmers lease their land to the businessmen and 29% of the farmers are associated with that previous occupation, such as Agriculture and fishing. `

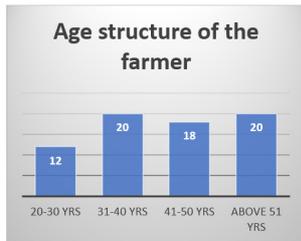


Fig-9: Age structure of the farmers

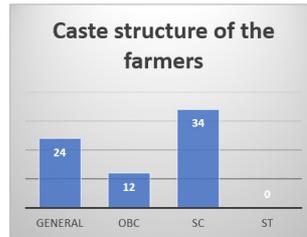


Fig-10: Caste structure of the farmers

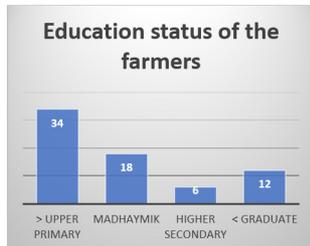


Fig-11: Education status of the farmers

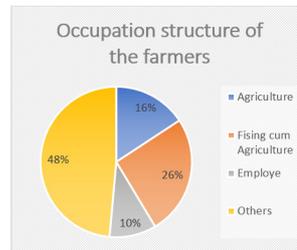


Fig-12: Occupation structure of the farmers

Reason for conversion of Agricultural lands to bheri farm

Owners associated with Vannamei cultivation are mainly two types. i) Absentee (businessmen, feed suppliers etc.) those who do not look after the fishery themselves but there were some labour to look after. ii) Owner farmers, who took care of everything themselves. Reasons for the conversion of agricultural lands to bheries in the study area were explored through interviews with farmers. Mainly four reasons have emerged viz.- 1) As the land is not suitable for paddy cultivation, the land has turned into bheri. The land is situated in such a place where it is always

covered with shade of trees and there is a lack of water available for cultivation. 2) Farmers face various risks in paddy cultivation, including floods, droughts and cyclones. To mitigate these risks, they lease their land to bheri owners. Farmers find leasing their agricultural land for bheri farming more profitable than using it for paddy cultivation. As a result, many are converting their agricultural land for this purpose. 3) As the land is in the middle of the bheri, the cultivation is not so much, so it is forced to lease. When fishermen lease land and cultivate bheri, many farmers' land falls between bheri and farmers are forced to lease for fear of reduced crop production. 4) Farmers are forced to lease their land due to pressure from political leaders or pressure from big traders. Among the above reasons, 60 % of the interviewed farmers gave importance to more profit without risk, 20 % of the farmers' lands are located in the middle of the land because the farming is not good, so they left the farming and converted the lands to bheri. 10 % of the farmers leased out land for bheri, as it was uncultivable. The remaining 10 % of farmers were forced to lease under pressure from political leaders or bheri owners (Figure-13).

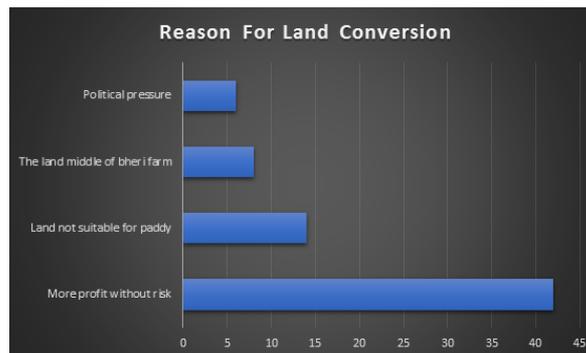


Fig-13: Reason for conversion of agricultural land to bheri culture

Case study of Farmer-1

| | | |
|--------------------|--------------------------|------------|
| Name – B.Shit | Age – 42 yrs. | Sex- Male |
| Village – Garbhera | Marital status – Married | Caste – SC |
| Education- VIII | Occupation – Cultivation | |

Regarding the dynamics of bheri farming and paddy cultivation, B.Shit mentioned that the cultivable land amounts to about two bighas, where he has been cultivating paddy for a long time. Recently, the prevalence of bheri cultivation has been increasing in the village. Big businessmen have been leasing land from farmers to establish and operate bheri farms. Many farmers are leasing their land to these traders for fishery purposes, as it offers better profit margins compared to paddy cultivation. However, B.Shit was reluctant to lease his land, as he was concerned that the soil quality would deteriorate, leading to decreased agricultural

yield over time. Additionally, his land is situated in a location where, if it were not leased, it could hinder the establishment of bheri cultivation. Various pressures were applied to force him to lease the land, including restricting paddy cultivation and introducing saltwater into agricultural fields. Out of fear and to avoid conflict, he ultimately decided to lease his land for bheri farming.

Case study of farmer-2

| | | |
|--------------------------|-------------------------|---------------|
| Farmer Name: B. Bhowmick | Age- 38 | Sex-Male |
| Village Name: Garbhera | Marital status-Married | Caste-General |
| Education- | Occupation- Cultivation | |

About the reduction of agricultural land and prevalence of vannamei farming, B. Bhowmik said that the amount of agricultural land is about 2.5 bigha. His main source of livelihood was agriculture. Those lands have been leased for vannamei cultivation. He was not willing to lease at first because the salt water of the river was injected into the agricultural lands. As he did not lease the land, various threats continued to come. Without going to any trouble, he finally leased the land. But due to fear, he could not complain anywhere.

Case study of farmer-3

| | | |
|------------------------|-------------------------|-----------|
| Farmer name – S. kuila | Age- 44 | Sex- Male |
| Village name- Garbhera | Marital status- M | Caste- SC |
| Education- viii | Occupation- Cultivation | |

Regarding the increase in Vannamei cultivation and reduction in agricultural land, S. Kuili said that his cultivable land was 1.5 bigha. But a few years ago, the land was taken on lease for Vannamei cultivation. He did not want to lease the land. But later he was forced to give it in lease, as his land was located in the middle of the Vannamei fisheries. He realised that paddy cultivation on his land would not be good because saline water would enter his agricultural land through seepage.

Case study of the farmer – 4

| | | |
|-------------------------|---|-----------------|
| Farmer name -S. Patra | Age – 40 | Sex - Male |
| Village name – Garbhera | Marital status- M | Caste – General |
| Education - vi | Occupation- Cultivation and human hair business | |

Regarding the increase of bheri farming and decline of the agricultural land S. Patra stated that his cultivable land spans about 2 bighas. He has been cultivating paddy on this land for the past ten years. However, due to the rising prices of seeds and fertilizers, paddy cultivation has become unprofitable. Currently, he only cultivates winter paddy on this land, earning about Rs. 50000 annually. With the growing popularity of bheri farming, farmers are increasingly leasing

their land to bheri operators. S. Patra has also leased his land, earning Rs. 80000 per annum in rent. The main reason for converting agricultural lands into bheri farms is the higher profitability without the risks and efforts involved in traditional farming. Additionally, he is utilizing the time previously spent on farming to take up temporary occupations, which provide his family with an additional income of more than Rs. 10000 per month. As a result, their economic condition is steadily improving.

Changes in the way of life and economic status of farmers

Agriculture was the mainstay of the peasant economy. Due to flooding and poor drainage systems caused by heavy rainfall during the rainy season, farmers have shifted from cultivating monsoon paddy to growing only winter paddy. But 10-15 years ago, Bheri farming started in the agricultural lands of Garbhera village. First, the farmers started to cultivate bheri on their land. Then, in local and neighboring areas such as Narghat, Nandakumar, Chaknan etc. big farmers increased the amount of bheri farming. As the profits in bheri farming is high, the bheri owners pay the farmers more than in paddy farming, so the farmers have leased out their farmland and joined other temporary occupations such as human hair business, and migrant labourers. Although people of various castes live in this village, the number of Scheduled caste people is about 47 percent of the total population (Census of India, 2011). People of Mahishya, Tiyaar, Namasudra, Dhoba etc. live here. As people of different castes live in the village, they live in a small 'Para' (hamlet). The settlement type in the village is rural in nature. The rural settlement pattern in this village is linear, developed on both sides of roads. Earlier, the village had a joint family system, now it has been broken and divided into small families. The following are the cost of cultivation, and the lease rent paid-

Expenditure of Paddy Farming

| Subject | Approximate Expenditure (Bigha) |
|-------------------------|--|
| Paddy Seeds | 500 |
| Fertilizer and Medicine | 2000 |
| Water | 1500 |
| Total Labour | 4000 |
| Total | 8000 |

(1 bigha = 52 decimal)

According to the information obtained from the interviews of the farmers, the cost of cultivating paddy is about 8000 rupees per bigha, and the profit is about 12000 rupees. The yield of paddy per bigha is 15 quintal. In that case, farmers get about 40,000 rupees if they lease this land to bheri owners. As a result, farmers are keen to leave farming and lease for bheri farming.

From the interviews with the farmers, most are leasing the land and moving to other states for temporary occupations such as human hair trade, thereby earning an extra Rs 8,000-10,000 more per month for the family apart from the lease. As a result, the living and economic conditions of the farmers have changed.

Bheri owners are compelled by contracts with farmers for 10 years, 7 years and 5 years. The reason for binding these different years of contracts is that there are no specific rules regarding land leases. Fishermen themselves usually hold leases for several years. During these lease times, bheri owners cultivate bheries on farmers land. In bheri Ruhi, Catla, Mrigal, and various species of shrimps such as Vannamei etc. are cultivated. According to the interviews with the farmers, fishermen of local and neighbouring areas like Chowkhali, Narghat, Nandakumar, Chaknan etc. have come to bheri farming. Those who are financially sound or big businessmen are cultivating bheri on lease from the farmers. Almost all types of farmers of Garbhera village like marginal farmers, middle-class farmers and financially sound farmers are leasing land for bheri. But only a few middle-class farmers, who know about bheri farming, are farming bheri themselves without leasing their land. Bheri owners are mixing fluoride, arsenic, lead etc. in large quantities of fish food to harvest them more and less time and by mixing harmful chemicals, the pH level is abnormal where the soil acid-base level is less than 6 i.e., the soil is getting poisoned. While aquaculture has many benefits, it also has negative impacts on the environment and health. 1) Uneaten food and bodily waste of fishes are released into the environment, which creates algal blooms, thereby reducing the oxygen content of the water, which affects aquatic life (White, 2013). 2) After harvesting fish from the bheries, groundwater is pumped into the trucks to transport the fish to the market. Once the fish are sold, the water is discarded from the trucks, leading to water wastage and a critical decline in groundwater level. 3) Due to the rise of shrimp farming, rice fields in the rice-growing regions of South India are being converted into fallow lands (Shiva and Karir, 1997). 4) Water contaminated with chemicals and waste from the bheri seeps into neighbouring agricultural lands through leaching. As a result, increased salinity reduces crop yields, negatively impacting food security (Hein, 2000). 4) As a result of the use of chemicals and antibiotics in the fish farm, various types of diseases such as skin diseases, allergies etc. are seen among the workers engaged in bheri farming. 5) Eating highly chemically treated fish may increase the prevalence of diseases such as heart disease (State of Michigan Department of Health and Human Services, 2020).

Although bheri farming may bring short-term financial gains, it will start to have detrimental effects later on. This farming should be planned in a proper scientific way without harming the environment so that there is no impact on the environment and agricultural lands. Both need to be reconciled through proper counselling and planning.

1. Farmers and bheri owners need to develop awareness about the positive

and negative effects of Bheri farming.

2. Permission must be obtained from the government, without permission, fishing cannot be carried out. Vannamei shrimp farming requires registration with the Coastal Aquaculture Authority following specific guidelines and renewal at specified intervals
3. Use of chemicals and antibiotics should be reduced in bheri farms.
4. Freshwater fisheries should be given more importance.
5. Bheri farming is reducing the amount of agricultural land and crop production. As a result, food shortages may occur at the local level. So, the farmers should be encouraged to cultivate paddy, vegetables, betel vines etc.

Conclusion

Bheri farming plays an important role in social and economic development in developing countries like India. This farming started in West Bengal 10-15 years ago. From that time to the present time, the number of bheri has increased. As a result of the cultivation of this bheri, there are positive effects such as employment generation, supply of protein food, earning national and foreign currency by exporting fish (Giri, 2018) as well as some negative effects such as reduction in the amount of agricultural land, reduction in agricultural production due to soil salinity, loss of soil quality etc. So, the amount of paddy cultivation for this bheri farming is decreasing i.e., it is on the way to disappear. If the amount of paddy farming is reduced, there may be food shortages in the future. Therefore, more importance should be given to paddy farming along with bheri farming.

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