

## Post-Amphan management and rejuvenation of the ravaged betel (*Piper betle*) baroj in South Bengal

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### ABSTRACT

Betel cultivation is very popular in West Bengal. The spread of COVID-19 affected betel cultivation but super cyclone 'amphan' devastated the majority of betel orchards of Bengal. The betel cultivation also fetches significant foreign exchange through export. The present investigation was conducted on 51 representative betel farmers of Fingha Dhaowri village under Raskhali panchayat of Bishnupur Block I of South 24 Parganas. The farmers were interviewed in mediated approach using semi-structured open-ended questionnaire, advocating participatory rural appraisal (PRA) mode. The study revealed some important enjoiner for furtherance of cultivation. In Bishnupur block of South 24 Parganas, 359 out of 360 barejas were reconstructed. The construction of a baroj measuring 10 decimal costs between Rs. 0.8 to 1.5 lakh including first year maintenance. The farmers prefer traditional baroj over shade-net structure. The farmers got assistance from Krishak Bandhu Krishi Sahayak scheme of state and Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) in addition to state government disaster relief fund. In new construction, farmers followed good agricultural practises along with COVID advisory with female farmers participation upto 60%. Harvesting is resumed and the farmers of focal group are selling 100 leaves pack @ Rs. 50/- with a 68% loss. The study revealed lack of knowledge of the farmers about post-harvest management but techniques could be adopted by them if the profitability aspects are discussed properly. The low input organic farming is advantageous to start export though the selected farmers sell leaves in domestic market only. The post-amphan betel cultivation could be directed to a positive path and rejuvenation of the baroj may be possible if the farmers' adopt organic farming, apply low cost scientific management practices and industrial skill development in a community based approach. The holistic implementation of this smart package in betel farming may uplift the rural economy of Bengal.

**Key words :** Agricultural losses, Amphan, baroj, betel, COVID-19, essential oil, post-harvest management, rejuvenation

### INTRODUCTION

The outbreak of COVID-19 pandemic was responsible for severe loss of agricultural production in the whole country including West Bengal. *Piper betle* (betel) leaf is a major produce grown mainly in South Bengal in a protected greenhouse like structure called baroj or barejas (Das *et. al.*, 2018). The West Bengal government did exempt the agricultural trade from the purview of the lockdown from April 7, 2020 but that meant little to betel farmers due to lockdown related secondary constraints. Though there was no restriction from the state government regarding the agricultural farming throughout the state but the

indirect effect of lockdown on transportation, labourer availability, shortage and high price of planting material and packing accessories, less market demand, closure of domestic market and total seize in agricultural export played a negative role in the production, sell and intercultural operations for fresh betel produce.

This crop is extremely valuable from the point of export and regarded as a horticultural cash crop. Europe, Afghanistan, Saudi Arab imports huge amount of betel as those countries include a significantly high Asian population and migrant employees. Betel leaf is a highly perishable and sensitive horticultural crop and was severely affected under COVID-19 attack

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(COVID 19, 2020). The devastating tropical cyclone Amphan made landfall in West Bengal on 20th May 2020 (Amphan, 2020a; Amphan, 2020b). Coastal areas in West Bengal comprising East Midnapore, South 24 Parganas, Kolkata, North 24 Parganas, Hooghly and Howrah as well as Odisha were affected by the cyclone. It also caused significant destruction in Bangladesh.

In South Bengal the post-amphan scenario was detrimental and pathetic ruining huge betel germplasm resource. The amphan storm damaged majority of the betel orchards (baroj or barejas) of South Bengal. The betel farmers lost their sole livelihood and the tremendous loss incurred by the farmers made a deep scar in cash crop sector. In this paper an attempt is being taken to highlight the post-amphan scenario of betel farming and different measures that were taken to improve and rejuvenation of *Piper betle* cultivation. The data was collected in a case study approach to comprehend the situation at which the farmers are standing right now and could be applied to strategize the future direction of betel farming.

## MATERIALS AND METHODS

The data collected by direct interaction with the farmers of Raskhali gram panchayat of Bishnupur Block I with 51 farmers having 70 baroj (Table 1). In mediated approach an informal group discussion with a heterogeneous focus group of 50 betel farmers was conducted advocating participatory rural appraisal (PRA) mode (Table 2). The interview encouraged, between farmer interview-cum-interaction with a semi-structured, open ended qualitative questionnaire and data recording. All the farmers were owner or related to farming as family member of vine owners. All the participants including female villagers were directly or indirectly related to betel farming in this village. The male farmers of the focal group were expert in betel farming but provide a significant time to boro paddy cultivation and other jobs. Additionally, primary data were also collected from state agriculture department of South 24 Parganas and Purba Midnapore regarding compensation, subsidy and other support.

All the information shared by participants were precisely recorded and thematic analysis of the qualitative data was done (Sheikh *et al.*, 2017; Clarke *et al.*, 2019). Secondary data was collected from West Bengal State Government website and National

Horticulture Mission, APEDA and were incorporated in this paper. The findings from all the above sources are documented in this paper in form of a report to find an initial strategy for replenishment of the dwindling betel baroj in South Bengal.

## RESULTS AND DISCUSSION

### Post-Amphan Damage and Compensation

This study involves the farmers of Raskhali gram-panchayat. Interaction revealed that the farmers have started reconstruction of their baroj with assistance from government. All barejas were reconstructed except one. A total of 359 out of 360 baroj were reconstructed in Bishnupur Block I with government subsidy (Subsidy, 2019). The baroj which was not re-constructed was an old one with more than 20 years age. The timely and fast disbursement of compensation helped the farmers to restart betel farming. The farmers got an initial compensation of Rs. 5000/- per baroj from the state government irrespective of its size. The farmers also got benefit from Krishak Bandhu Krishi Sahayak Scheme of state department of Agriculture for kharif crops.

Apart from the one-time release of Rs.5000/- per baroj, the farmers got an additional support of manpower subsidy from MGNREGS scheme for baroj making. Each owner of betel baroj got 50-99 man days financial support @ Rs. 292 for Zone-B unskilled labourers from MGNREGS scheme. Betel farming has been the source of livelihood for many farmers across West Bengal. The lockdown played a positive factor by involvement of family members in baroj making and maintenance by reducing labour cost. Female farmers and workers also participated in diverse function in baroj construction.

The participatory interaction with the farmers also revealed that they preferred construction of traditional baroj as they are not so convinced about shade net cultivation. The farmers of the focal panchayat were not eager to shift towards shade net farming in spite of knowledge about high incentive provided by the horticulture department. According to them the shade-net baroj becomes hot and causes huge problem in intercultural operations during summer and monsoon.

The state government data showed that South 24 Parganas and Purba Midnapore were the worst affected districts with havoc loss of betel farming. This farming is also affected in varying extent, in the North

**Table 1.** Inventory of 51 farmers of Rashkhali gram panchayat of Bishnupur block I of West Bengal, India

S. No	Name	Father/Husband	Address	Area (decimal)
1.	Mr. Pranay Kumar Samanta	Sankar	Finghadhowri	15
2.	Mr Tarak Samanta	Panchanan	Finghadhowri	22
3.	Mr. Surajit Samanta	Tarak	Finghadhowri	5
4.	Batakrishna Shaw	Nagendranath	Finghadhowri	18
5.	Mr Debabrata Shaw	Shaktipada	Finghadhowri	5
6.	Mr Subrata Show	Shaktipada	Finghadhowri	6
7.	Mira Bala Shaw	Lakshmikanta	Finghadhowri	25
8.	Mr Tapas Kumar Samanta	Bijay	Finghadhowri	8
9.	Mr. Nityananda Kuley	Gandhiram	Finghadhowri	28
10.	Mr Nakul Bhowmick	Satish	Finghadhowri	11
11.	Mr Tarapada Majhi	Brajendranath	Finghadhowri	8
12.	Haripada Majhi	Rajendranath	Finghadhowri	17
13.	Rita Majhi	Nirapada	Finghadhowri	28
14.	Smt Lakshmi Samanta	Jaydeb	Finghadhowri	5
15.	Purna Baba Majhi	Brajendranath	Finghadhowri	17
16.	Rintu Shaw	Debabrata	Finghadhowri	19
17.	Gopal Chandra Show	Kalipada	Finghadhowri	26
18.	Mr Shankar Samanta	Panchanan	Finghadhowri	15
19.	Mr Shibu Manna	Batakrishna	Finghadhowri	10
20.	Kalipada Kule	Dundiram	Finghadhowri	5
21.	Mr Sadananda Koley	Gandhiram	Finghadhowri	28
22.	Mrs. Sandhya Shaw	Prabirta	Finghadhowri	5
23.	Mrs Tumpa Shaw	Parimal	Finghadhowri	5
24.	Mr Khogen Samanta	Gangadhar	Finghadhowri	18
25.	Latika Bhowmick	Lakshman	Finghadhowri	8
26.	Mr. Umesh Bhowmick	Ram	Finghadhowri	18
27.	Mr. Bhim Ch Bhowmick	Satish	Finghadhowri	15
28.	Mr Arjun Bhowmick	Satish	Finghadhowri	12
29.	Nanda Dulal Bhowmick	Satish	Finghadhowri	26
30.	Mr. Swapan Bhowmick	Ratikanta	Finghadhowri	12
31.	Mrs Purnima Jana	Phanibhasun	Finghadhowri	36
32.	Mr Pratap Manna	Lakshmi	Finghadhowri	10
33.	Mr Ashok Mall	Chandrakanta	Finghadhowri	15
34.	Janardan Shaw	Lakshmikanta	Finghadhowri	7
35.	Mr Tanmay Shaw	Lakshmikanta	Finghadhowri	15
36.	Chandana Samanta	Sankar	Finghadhowri	6
37.	Nirmal Baur	Bhabendranath	Finghadhowri	5
38.	Palash Baur	Arjun	Finghadhowri	23
39.	Gobinda Samanta	Rangalal	Finghadhowri	27
40.	Sasthi Samanta	Kanailal	Finghadhowri	8
41.	Kartick Samanta	Babulal	Bhandaria	7
42.	Shamal Samanta	Babulal	Bhandaria	7
43.	Samir Samanta	Babulal	Bhandaria	7
44.	Sukumar Bag	Paresh	Bhandaria	17
45.	Madhai Bag	Panchkari	Bhandaria	25
46.	Pradip Das	Shyamsundar	Bhandaria	17
47.	Nemai Mondal	Harkumar	Bhandaria	51
48.	Subodh Das	Debendra	Bhandaria	14
49.	Bharat Chandra Khanra	Gour	Bhandaria	16
50.	Jannenjoy Das	Bimal	Bhandaria	10
51.	Sulata Khanra	Bidut	Bhandaria	10
	Total 51			773

**Table 2.** Information generated by farmers interaction in participatory rural appraisal (PRA) mode with interaction with farmers of Fingha Dhaowri village after post-Amphan situation

<b>Baroj</b>	
Number of baroj reconstructed (Bishnupur Block I)	359/360
Baroj Area (decimal)	28-36
Age of Baroj (year)	1-18
Age of Farmers (year)	20-73
Experience in betel farming (years)	1-36
Type of Baroj (Traditional/Shade-net)	Traditional
Construction Material	Bamboo, rope, jute stick, Cloths (sari)
Time taken for reconstruction (days)	30-45
Average monthly income (Rs.)	15,000-20,000
Crops grown other than betel leaf	Boro paddy, seasonal vegetables
Other Occupation	Zari work in clothing, overseas labour
Cost for new baroj construction (lakh)	0.8-1.5
Baroj soil	Solarized local
Row to row distance (ft)	1.5
Plant to plant (inch)	6
<b>Genotype</b>	
Planting Material used for new baroj construction (cultivar)	Bagerhati local
<b>Irrigation</b>	
Watering	Adjacent pond
Equipment	Small pump (1 to 1.5 hp)
<b>Compensation</b>	
One time compensation from state disaster relief fund (Rs.)	5,000
MGNREGS scheme for labour support for reconstruction (man-days)	50-99
MGNREGS labour payment rate per man days (Rs.) for zone B area	292
Krishak Bandhu (assured income) Krishi Sahayak Scheme of state per year (Rs.)	2000-5000
<b>Disinfectant</b>	
Sodium dichloroisocyanurate (NaDCC), bleaching powder (mg/l)	4
Lime (kg/ha)	50
<b>Fertilizer/ Manure</b>	
Farm yard manure (t/ha)	25
Organic cake	Mustard/groundnut
Vermi-compost	
<b>Harvesting</b>	
Leaf plucking in partially reconstructed baroj	initiated
Number of leaves plucked (leaves per day per plant)	2
Price of leaf (Rs./100 leaves)	50
Average monthly loss* (%)	68
<b>Marketing of leaves</b>	
Export/Domestic sell	Domestic
Place of Sell	Local Kishan mandi
<b>Division of labour</b>	
Female	Intercultural operations
Male	Construction, repairing, sell
<b>Post-harvest Management</b>	
Essential oil extraction/ Bleaching/De-petioloation/De-midribing	Yet not adopted
<b>Disease Occurrence &amp; control</b>	
Fungal leaf spot	Colletotrichum infection
Medicine used (w/w)	Thiophanate methyl 70 % WP

\*7200 plants in average baroj with 2 leaves harvested per plant and sell @ Rs. 0.5 compared to 4 leaves per plant and selling price @ Rs. 0.80.

24 Parganas, Paschim Midnapore, Hooghly, Nadia, Bankura, Jalpaiguri, Cooch Behar, Murshidabad and Uttar Dinajpur districts of the state.

In West Bengal at least 2 lakh betel leaf farmers lost their baroj after the cyclone and 1.5 lakh partial damage of baroj were also recorded by the government. The projected loss that betel leaf farmers in West Bengal have suffered stands at Rs. 2,775 crores on 2,477 hectares of land in South 24 Parganas. In East Midnapore, the damage stands at Rs. 1,000 crores with partial damage of their baroj. The state and central government schemes helped the farmers to effectively repair the baroj or vine within 15-30 days. Initial inspection of the re-constructed baroj showed the positive approach of the farmers, their integrity towards betel farming and confidence to overcome the crisis created by calamity.

### Baroj/Bareja Reconstruction

*Piper betle* is a perennial cash crop and is grown in a closed hut like structure with a front door for entry. The farmers have initiated re-construction of the damaged baroj immediately as the structures were regarded as rural house holds bank, stabilizing and securing the rural economy of the country. The fast data collection of the damaged baroj by state agriculture department and direct benefit transfer (DBT) of compensation to farmers account helped them in quick recovery.

The farmers opined that the construction of baroj may expedite an amount between Rs. 80,000/- to 1,50,000/- for a moderate standard baroj. The details of cost required for new baroj construction, its maintenance and aftercare given in Tables 3 and 4 for 10 decimal area. Farmers added that majority of the barejas were reconstructed within one month and by middle of August harvesting could be done. Few farmers are harvesting leaves from partially damaged barejas after re-construction. In those cases within one month, two mature leaves were produced by each creeper, though the farmers reported about appearance of black spot in some leaves. The festive season of Bengal starts from October with demand for betel leaf increases markedly both in domestic and international market from October onward. The construction cost of barejas fluctuate as the price of bamboo, paddy straw and jute stick are not static after post-Amphan condition. The farmers of coastal region are following the APEDA advisory on betel farming but the difference between farming practises followed in

coastal and interior of the state is that soil reclamation is required for coastal barejas before re-construction (APEDA, 2015).

**Table 3.** Cost of setting up of a conventional betel baroj (Bareja) in Bishnupur block of South 24 Parganas, West Bengal

Items (for 10 decimal )	Cost (Rs.)
1. Bamboo pole for the outside structure	12500.00
2. Wire (130 kgx75/-)	9750.00
3. Paddy straw (2X1200)	2400.00
4. Jute stick on which the plant climb (7x500)	3500.00
5. Organic fertilizers	5200.00
6. Chemical Fertilizers	1800.00
7. Pesticides, hormones, fungicides	9000.00
8. Lime	600.00
9. Stem cutting of betel for plant propagation (7200 plant @2/-per plant)	7200.00
10. Pump-set	5000.00
11. Labour (50 x 350) Rs. 350/- as labour charge	17500.00
Total initial investment	74,450.00

**Table 4.** Cost of maintenance of a conventional betel baroj (Bareja) in Bishnupur block of South 24 Parganas, West Bengal

Running and maintenance cost after construction	Rs.
1. Climbing sticks replace	1000.00
2. Labour cost after completing the structure	7000.00
3. Electric cost for pump	2000.00
Total cost of maintenance	10000.00
Total Expenditure Table 3 (Rs. 74450)+ Table 4 (Rs. 1000)	= 84450.00

### New Technologies Adopted During Baroj Construction

A positive result of COVID-19 was noticed during baroj construction. The betel farmers of South 24 Parganas are applying new sanitization techniques during intercultural operations. Betel cultivation is also a miniature version of delicate tissue culture. The farmers used sterilized or properly solarized soil and disinfected farm equipment's during varied operation. Sodium dichloroisocyanurate (NaDCC) was applied at a rate of 4 mg/l for purification of turbid water. The farmers took the advantage of COVID knowledge and during all operations maintained social distance. Disease-free authentic planting materials were used for making of new baroj. In partially damaged baroj previous creepers were used. From the beginning cleanliness is maintained inside baroj with very restricted and hygienic entry of labourer to control disease infestation.

All the tools and equipment's used in baroj were sterilized with potassium permanganate. Streptocyclin was used for cleaning of straw, rope, jute stick, wire and other construction material. Sanitization of the surrounding area of baroj was done with lime and bleaching powder. Regular cleaning of indoor, removal of rotten leaves from outside, restricted entry inside baroj were practised from the beginning. The rinsing and cleaning of baskets, banana leaves and plucked betel leaves with sodium-dichloro-isocyanurate (NaDCC) were effective in preventing pathogen infection and was implemented. The plucked leaves were washed with clean water. The farmers are following the good cultural practices prescribed by state department of Agriculture and export advisory (Saha, 2007).

### **Division of labour Between Male and Female Participation**

Betel farming is a highly labour intensive cultivation requiring labour throughout the year. The labour cost covers (30-80) % of the total expenditure in betel cultivation. With time and age of baroj the labour cost gradually increases. In South Bengal the betel farming is carried as a family business. The female farmers in our focal group mentioned that different cultural practices such as soil sterilization, mustard and ground nut cake preparation, planting of stem-cutting, folding of creeper before touching the top of baroj, elevation of baroj soil, manual watering of plants, plucking of leaves, application of manure, weeding, washing of leaves, removal of rotten top cover of baroj, grading, packing, washing of leaves were done mostly by the female family members. The female community of rural Bengal actively participate in these operations (Mondal *et. al.*, 2020).

The farmers gave details about male participation. Baroj construction, repairing, soil digging, transportation and marketing activities were carried by male members of the family. The active participation of family labour increases the net income by decreasing the labour cost. The survey showed 60% of the labour cost was saved by the family betel farming with pertinent contribution of female members.

### **Average Income**

The farmers interaction also stated average monthly income of (Rs. 15,000 -20,000) was obtained

from a 10 decimal established vine. According to the farmers the price of betel leaves remains comparatively low in monsoon. The farmers are selling betel leaves at a rate of Rs. 50 per 100 leaves from the previous rate of Rs. 80 per 100 leaves. According to the farmers they usually pluck four leaves from each creeper but from partially damaged barejas getting only two leaves. The observation indicates about 68% loss in income for coming few months. The low price and reduced leaf production had reduced the net income of the betel farmers. This year the farmers will face partial loss though they have started selling their produce in the domestic market. The only positive information of this study is the hope of the farmers to overcome the loss within few months and the farmers are not solely dependent on betel cultivation. Additionally, they grow boro paddy and winter vegetables.

In Bishnupur, Budge-budge, Magrahat region of South Bengal integrated boro paddy cultivation and betel farming were major agricultural activity taken up by majority of farmers. Most of the farmers cultivate boro paddy in winter and owns a small baroj that gives uninterrupted money flow during time of crisis. The COVID-19, post-Amphan situation devastated their main earning from paddy harvesting and betel farming as well. Betel cultivation always provided a steady income to the farmers and the farmers hope that within six month the income will be replenished.

### **Export**

In our study the information on export of fresh leaves is not being incorporated due to lack of accurate data. The farmers of our study group were associated with domestic betel trade and they sell their produce in local market (*mandi*). Europe and Middle East countries have resumed import of agricultural products from different countries including India but no significant data is available for fresh betel leaves. In the meantime, the import of betel oil has increased globally and India could play an important role if the extraction of oil from excess betel leaves could be increased.

According to the data obtained from APEDA, India earned Rs. 46.75 crore in 2018-19 financial year by exporting 13,195.43 tonnes of betel leaf to European countries and Middle East. The farmers of Tamluk used to export 500 tonnes of betel leaves to different countries including Bangladesh, Saudi Arabia, Afghanistan and Europe. According to the information given by progressive betel farmers union

of Purba Midnapore, 'Mitha', 'Kali Bangla' and 'Holud Patta' varieties find highest demand in overseas market. Midnapore and South 24 Parganas were gifted with their climatic characteristics, happen to be important hub for the famous and pricey 'Mitha (sweet) Patta' variety. According to APEDA the export has just began for other vegetables and the trade lead is limited for betel leaves. In blocks of Sagar, Namkhana, Kakdwip, Basanti betel farming is a major business of the farmers. Along with farmers the other workforce related to betel business were also affected by reduction in export.

Though betel leaf essential oil (BLEO) export is in progress and some Indian companies were showing promise in global competition. Expansive survey of global leaf oil market showed raw material sourcing strategies, technology adoption, BLEO volume, production cost, product specification, value chain, major vendor, corporate alliance and global presence regulates the global race among rivals. Direct regional alliance between betel farmers and export houses may help farmers to earn a steady income by coping with climatic irregularities and surplus leaf utilization.

### Post-Harvest Preservation of Excess Leaves

The farmers of South 24 Parganas were not accustomed with diverse post-harvest preservation techniques. The post-Amphan loss of betel leaves led the government, farmers, exporters as well as other stakeholders to invent new avenues to sustain natural calamities. Though some conventional methods are available for short and long term storage of betel leaf by delaying senescence, a modern approach to extract the valuable betel essential oil will be a lucrative business opportunity (Basak and Guha, 2015). If community based approaches could be taken for installation of betel leaf oil extractor in identified betel villages, with expert training on extraction, collection, purification and storage of oil, the loss of leaf could be reduced (Madan *et al.*, 2014; Guha and Nandi, 2019). The constituents present in the oil may vary with the variety, soil and agro-climatic conditions followed to raise the crop like any other essential oil yielding crop. Chemo-tagging of different cultivars for signature compounds may increase marketability and export. In implementation of these new strategies female agricultural workers could be included. These new approaches may strengthen the rural economy of West Bengal by ameliorating the loss and

environmental pollution. Additionally, de-petioloation and de-mid-ribbing of detached betel leaves, preservation in zero energy cool chamber by packing with banana leaves in bamboo baskets or drying could reduce senescence (Pandey *et al.*, 2016; Pandey *et al.*, 2018).

### Export friendly Organic Cultivation

This study also revealed an important and favourable finding about the mode of cultivation. According to the farmers of Bishnupur, Budge budge and Magrahat, they hardly apply any chemical fertilizer in their baroj. The positive side of this practice is that it will help them to indirectly shifting towards organic horticulture in this post-amphan period. Farmers apply FYM (25 t/ha) and groundnut cake (0.50 t/ha) during baroj soil preparation. They usually avoid application of chemical fertilizer and depends on farm yard manure (FYM @ 25 t/ha) and vermi-wash in some barejas. There is a practice of applying freshly crushed mustard and raw cow-dung directly to baroj soil, that practice should be replaced with application of well prepared mustard cake and well-decomposed manure. The periodic use of mustard cake, neem cake is also practised by most farmers. Organic farming practises could increase farmer's income up to three times higher than the present earning. FYM, compost, mustard or ground nut cake along with vermi-wash improves leaf quality and replenishes soil fertility (Hegde *et al.*, 2012).

### Irrigation

In this study the water from adjacent pond was used by the farmers of Fingha Dhaowri village. Some farmers use water from the tube well to check disease infestation. In South 24 Parganas the pond water was amended using lime or NaDCC. They use small pump-set for direct watering from pond. Application of dirty water invites *Salmonella* infection in betel, this organism also forms internal colony inside leaf tissues. The disease is difficult to deal with and as betel is consumed raw, application of any antibiotic or chemical could create health problem. Farmers explained that *Salmonella* infection is a major reason behind compliance problem in betel export to different countries especially United Kingdom. Three consecutive non-compliance could ban the export of betel from India.

### Healthy Planting Material

The farmer interaction revealed the use of same cultivar during baroj re-construction. They were conservative regarding choice of planting material. Majority of the farmers use 'bagerhati' cultivar. They have no clear idea about the importance of germplasm. Locally available germplasms were used for a long time with vegetative mode of propagation. This practice may be a cause of the degeneration of the betel vine. The orchards of South Bengal were using local cultivars with different vernacular name creating redundancy problem (Fokou *et. al.*, 2020). The dwindling betel germplasm may be replaced by authentic, high yielding, disease free cultivars. The state government, SAU, CIMAP, APEDA, FIEO could assist the farmers in selection of high performing, export-friendly betel cultivars.

### Government Schemes

Our study revealed three schemes that were availed by the farmers. The amphan relief fund, Krishak bandhu, MGNREGS. The farmers may avail some other schemes operated by National Horticulture Board of India for commercial horticulture under protected cover on project mode including components viz planting material, plantation, irrigation, fertigation, farm mechanization for projects having area over 2500 sq meter. The betel farmers could get subsidy (up to 50%) for construction of shade net house, polyhouse with drip and fogger system. Variety of construction material for green houses and shade nets houses are considered by the board to uplift the economy of cottage industry of each state. Preference were given to locally available construction material to minimize cost of construction of different protected structures with engagement of local manpower and job creation and marketability of local produce. Credit linked back-ended subsidy @ 50% of the total project with cost were given to the farmers.

Winston Churchill once wrote in one of his proverbs that "To improve is to change, to be perfect is to change often". The COVID-19 situation had a negative influence on world agriculture. Amphan had even more negative impact on the total agriculture sector of West Bengal, creating a precarious future for the farmers of Bengal. This drastic outbreak of corona virus and amphan super cyclone has taught us a lesson to deal with the simultaneous occurrence of biotic and abiotic factors on human life. COVID-19

situation has forced us to lead a life with sanitization, cleaning, personal protection and care. The delicacy of betel farming also requires high precision including cleaning, washing, protection, regular waste removal, safe packing of produce and so on. Our present lifestyle will help the farmers in proper management of betel baroj more efficiently (barejas).

In a case study involving Khasi and Garo people showed precipitation and related hazards played a significant role in production of betel leaves. Betel leaves become red in heavy fog and cold with a loss of 30-40 %. To avoid colouring, the leaves are being harvested early. The farmers sell the pre-mature harvest at lower price causing income loss. In hilly region scarcity of water reduces production and traditional mulching was used to conserve moisture. Farmers use cow-dung manure to improve soil fertility. Integrated homestead forestry systems were suitably used for diversification of crop production (Akhter *et. al.*, 2013). In our study also the leaves obtained from partially damaged baroj showing appearance of black spots and reducing market price.

In a study of climate resilient, agriculture it was noticed that south 24 Parganas and Midnapore were the districts mostly suffered from cyclone. The coastal districts were found most vulnerable in post-monsoon season due to low depressions in Bay of Bengal. South 24 Parganas showed highest climatic vulnerability index. The vulnerability of the farming community towards climate change depends on socio-economic condition of the farmers. A high vulnerability index assists in preparedness and development of coping strategies for a district (Ghosh *et. al.*, 2017). This study reveals that integration of new technologies in betel trade may lift the local economy. Essential oil extraction or de-bleaching could be adopted during export.

In our study the appearance of leaf spot is reducing the price of betel leaves. Climatic severity affects disease incidence in betel creating a heavy loss of yield every year. Environmental factors play a significant role in growth, dissemination and infection of pathogen. The intensity of major diseases of betelvine viz anthracnose leaf spot caused by *Colletotrichum capsici* (Syd.) and bacterial leaf spot caused by *Xanthomonas axonopodis* pv. *betlicola* were increased during rainy season. Percent disease index (PDI) of anthracnose leaf spot maximizes in monsoon. PDI of bacterial leaf spot (30.6%) reaches peak during the months of August–September. Anthracnose did not appear during the months from



November to April. Relationship between disease severity of anthracnose leaf spot and the meteorological parameters (maximum and minimum temperature, evening relative humidity and rainfall) was strong and positive (Chakraborty, 2018).

The export market always demands fresh non-toxic produce. The organic betel export could fetch three times more earning. The adoption of shade net cultivation could be a lucrative proposition along with spontaneous pest and disease control. The shade net system with rigid structures requires minimum maintenance for first 5 years and saves the capital investment with more income generation. The farmer interaction revealed their apparent ignorance towards shade-net cultivation but could be convinced if more incentive is provided for betel farming.

In Bihar the government gave huge subsidy to the farmers who are engaged in Betel (Paan) cultivation. To encourage the farmers to cultivate Magahi Paan, the state government promised to provide 75 percent subsidy to farmers for cultivation in shed nets. The cost of cultivation of magahi paan in 500 square meters shed net is Rs. 4.25 lakhs where the farmers will get a grant by the government up to Rs. 3.15 lakhs which can help the farmers to a great extent. According to Tamilnadu Horticulture Development Agency (Tanhoda) under National Horticulture Mission Scheme the Central government will provide 50% subsidy and the state will provide 15% subsidy to farmers adopting shade net protected cultivation in betel farming.

## CONCLUSION

Betel cultivation is a tradition of Bengal and the wit and indigenous knowledge of the Bengal betel farmers about this unique and novel baroj-based betel cultivation should thrive. In this case study it is confirmed that majority of the betel baroj were reconstructed and the farmers are accelerating cultivation with adoption of good practices in the selected gram panchayat area. The application of COVID sanitization helped the farmers in effective maintenance of the baroj and their low input organic farming could increase their entry into export market. If the farmers get training in post-harvest management of betel leaves they could recover and utilize excess leaves for diverse industrial uses. The smart betel farming practised by the farmers of Rashkhali gram panchayat could be utilized for technology transfer in post-amphan betel baroj rejuvenation in all over West Bengal.

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