

# Innovative Agricultural Adaptation A Case Study on Sandbar Cropping at Sirajgonj, Bangladesh

Regenerative Agriculture and  
Sustainable Livelihoods  
for Vulnerable Ecosystems  
(RESOLVE)

## ABSTRACT

*The Sandbar Cropping* model is a newer approach to strengthen agricultural adaptation in sandy islands of Bangladesh that was developed and introduced by Practical Action in 2005. In 2011, the Regenerative Agriculture and Sustainable Livelihood for Vulnerable Ecosystems (RESOLVE) project introduced the model in two villages, Pargacha and Shanbandha of Kazipur upazila under Sirajgonj district. This was done in partnership with Gana Kalyan Shangstha (GKS) and with the technical assistance of Unnayan Onneshan in a pilot phase. This study investigates the impacts and outcomes of the *Sandbar Cropping* practice on livelihoods in the face of climate change and tries to explore the shortfalls of the current practice. The result of the current report is into five segments: economic feasibility, food security, livelihood improvement, women empowerment and successful adaptation. From the field survey, it has been revealed that the income of the right holders (RHs) increased by certain amount. The watermelon cultivators benefited the most. Their average income was USD 108 (Tk. 8856) in a three month period while the millet cultivators benefited with USD 17 within a three month period. Based on the three criteria of food security, the study found that the sandbar cultivators improved their access to food and a better utilization process as well. There was also a positive impact on livelihoods, food, clothing and education were found in a satisfactory state whether housing, health and miscellaneous expenditures were not so. There was also a positive impact on the empowerment of women in all three dimensions: socio-economic, familial and psychological. The report also discusses the enabling and constraining factors of the current practice and finally, puts forward some recommendations focusing on the limitations of the model as well as a way forward to meet the objectives of the model.

## INTRODUCTION

Bangladesh is referred as one of the most climate vulnerable countries in the world due to its disadvantageous geographic location along with flat and low-lying topography (MoEF, 2008; Ali, 1999; Rahman and Alam 2003; UNDP, 2007). As a consequence, people experience one disaster to another, such as tropical cyclones, storm surges, coastal erosion, floods, riverbank erosion and droughts. These results in a heavy toll of life possess negative impacts on livelihood and jeopardize the mainstreaming of development activities. Moreover, the consequence of climate change further aggravates the disaster situation and puts people in imminent danger.

Though riverbank erosion is a consequence of floods; both floods and riverbank shifting have played a major role in shaping the physical, biotic and demographic landscape of Bangladesh for a very long time (Halcrow and Partners 1992). Channel adjustment and long-term channel change, meander development, catchment sediment dynamics, riparian land loss and downstream sedimentation problems are some of the physical consequences of riverbank erosion (Lawler *et al.*, 1997).

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In Sirajgonj, the *chars* of Jamuna have been inundated with flood waters throughout the monsoon season (June-September), eroded the embankments and left sandy infertile islands in the dry season. Due to mighty wave action, agricultural lands and homesteads are being eroded each year alongside the river and exposing inhabitant's lives to environmental instability. This has led to seasonal migration and pronounced asset, income and consumption fluctuations.

The Khasrajbari union of Kazipur upazila is an area where most of the arable land is erosion prone and *char* dominated. Since 2011, in the area (Agro-ecological zone 4, 7 & 11), RESOLVE has engaged in *Sandbar* cropping practice for the right holders with its local partner Gana Kalyan Shangstha (GKS), on a pilot basis. In the project area, most of the right holders are landless poor (31-55 percent households are extremely poor in this area), small and marginal landowners and about 75 percent of them are engaged in agriculture either as wage labourers or sharecroppers (Unnayan Onneshan, 2012). However, the cultivable land of this region is being squeezed day by day due to flooding & river bank erosion. Therefore, considering the potential adverse impacts of climate change on agriculture, creating income generated activities and nutritional supplements have been aiming to the right holders in the lean period. This research report documents the *Sandbar* cropping practice under the RESOLVE programme based according to the following objectives:

- To find out the probable changing pattern of livelihood options (food and nutrition) of right holders by practicing the model
- To find out the economic feasibilities of this practice through cost-benefit analysis
- To find out how this practice will influence female empowerment by introducing scope for new income generation at the household level
- To show the obstacles of this practice and provide probable solutions for better management

## LOCAL CONTEXT OF THE STUDY AREA

The field of study Kazipur upazila in Sirajgonj is one of the most erosion-prone districts in Bangladesh, situated 75 miles North-west of Dhaka (Haque, 1988). Kazipur upazila has an area of 368.63 sq km, where the main occupation is agriculture (54.22 percent) and the local economy is based on intensive, small-scale rice agriculture (Banglapedia, 2012). Total arable land area is 23384.06 ha, where fallow land is 207.2 ha. Among the people, 6.63 percent are landless, 17.6 percent is marginal, 20.5 percent are small holders, 35.27 percent are intermediate and only 20 percent of the people are rich. Rapid erosion occurs along the West bank of this seasonally mile-wide channel.

The targeted villages, Pargacha and Shanbandha of Khasrajbari union are in the mid-island *char* which are severely prone to bank erosion (Uddin and Basak, 2012). The two villages are surrounded by the river Jamuna and it is very likely to erode the villages within a short period as no structural measures are there to protect it from erosion. The erosion in the Khasrajbari union is more prominent than other unions of the Kazipur upazila. The total eroded area in Khasrajbari union is 203.36 ha, that is 5.41 percent of total the land area. The eroded lands are mostly agricultural land which makes the livelihood more vulnerable. (Uddin and Basak, 2012).

Being located in the remote river island, the people of those areas remain detached from the mainland for the whole rainy season. At that time, they have to rely on their own production for survival. On the contrary, during the dry season they cannot grow any crops and vegetables due to the infertility of the land.

Due to climate change, the agro-ecosystems of the study area have been degrading more abruptly than before. This gradually deprives of the poor right holders of this area from key productive resources. That is why, most of the right holders in this area are poor, landless and marginal sharecroppers. They are struggling to fulfill their food and basic demands of the household and the adverse impact of climate changes makes it harder for them. Taking the observed and potential impacts of climate change into account on agriculture and the resultant that is food insecurity; the RESOLVE has introduced *Sandbar* cropping practice in these areas.

Figure 1: Map of the Kazipur upazila (red circles denote the fields of the study)



Source: Banglapedia and Google map, 2012

## RESEARCH APPROACH AND METHODS

RESOLVE project has been working in Kazipur upazila since October 1, 2010. The project is being monitored since 2010. Regular database regarding livelihood information and income status of the right holders was monitored by Unnayan Onneshan through its quarterly livelihood and baseline survey of the implementation areas. A database has been maintained Unnayan Onneshan, who have been monitoring livelihood information and the income status of the rights holders through quarterly livelihood and baseline surveys.

### **Research Process:**

The research process can be elaborated under the following headings:

#### ***Review of literature***

A literature review on “Sandbar Cropping Vegetables” has been carried out from the available literature.

#### ***Questionnaire Survey***

The sample size of the targeted population is 10. All the respondents have been categorized into three groups (RHs 10, 3 Community representative persons (CRP) and 3 members from the implementing organisation). In the questionnaire survey, the respondents have been asked to answer open ended questions regarding climate change, sandbar culture and female engagement with the practice. The specific questions include-prospects and problems of the sandbar cropping, its effects on livelihood during the lean period, female empowerment, seed-water-fertiliser and compost availability, social impacts, marketing opportunities after production and further extension of the *Sandbar Cropping* practice. During the survey, the logbook of the farmer has been checked to validate information.

#### ***Focus Group Discussion (FGD)***

Focus Group Discussions are the primary tools that have been used to collect and probe information. The Focus Group Discussion (FGD) has been carried out to the participants including field level staffs and community representatives. The major topics of the discussion were regarding climate change scenarios, shifting pattern of livelihood options (food and nutrition), utilization of vacant time and promotion of the family income, utilization of barren infertile lands (*Char*) as well as water resources, female empowerment through the practice, prospects and obstacles of this practice. Each FGD consisted of people in the range of 5-10.

#### ***Direct field Observation***

After the Focus Group Discussion (FGD), direct field observations were carried out in the Shanbandha and Pargacha village where *Sandbar Cropping* model is being practiced in the demo plots. For the case study preparation, demo plots have been visited with the right holders taking their opinions into account related to the practices, availability of seed-soil-water-fertiliser-insecticide as well as production and marketing opportunities of the interventions. The farmers articulated their thinking patterns about the model along with the prospects and improvement. They also talked about the problems of the cultivation in such barren and unproductive sand dominated lands. A total five case studies have been undertaken in the above stated two villages of Kazipur.



### SANDBAR CROPPING MODEL

In Bangladesh, floods not only destroy homes, villages and livelihoods but also leave a crippling legacy as well when the water subsides (Practical Action, 2012). Silted sand plains (Sandbars) appear from the mid-November to mid-April (dry season in Bangladesh) mainly due to the decrease of water flow. These sandbars are subjected to a flood situation as well as available water flow throughout the year.

Most of the sandbars remain unutilised since sand is the main component. However, sandbars contain a thin layer of silt which can be used for cultivation. In this type of sandbar, main cultivable crops are potatoes, chili, onion, garlic, millet, tobacco and maize.

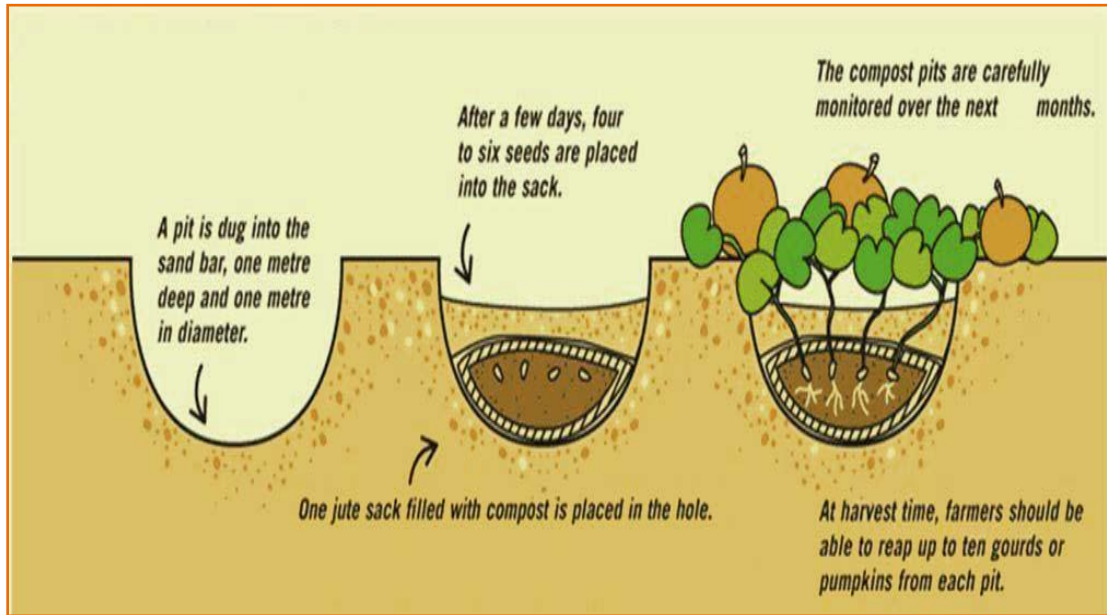
**Table 1: Features of Sandbar Cropping model with different functional components**

Scope	Innovative cultivation practice can be adopted in sandy infertile islands of flood eroded areas		
<b>Key Outputs</b>	Harvested crops; Watermelon, Pumpkin, Pumpkin: 3 metric ton/acre (approx.) Watermelon: 900 pices/acre (approx.)		
<b>Key Inputs</b>	For <i>Pumpkin</i> : Maximum 100 Pits in a Bigha Compost= 5 Kg/Pit Soil =2 Kg/Pit Triple Super Phosphate (TSP) = 250 gm/pit Murat of Potash (MoP) = 250 gm/pit Straw (for mulching) = 120 kg/Bigha		For <i>Watermelon</i> : Maximum 300 Pits in a Bigha Compost= 5 Kg/Pit Soil =2 Kg/Pit Triple Super Phosphate (TSP) = 250 gm/pit Granular Pesticide = 100 gm/pit Murat of Potash (MoP) = 250 gm/pit Straw (for mulching) = 120 kg/Bigha
<b>Required Training</b>	<i>Capacity Building Training</i> : Motivation Compost preparation Cultivation manual	<i>Exposure visit</i>	<i>Follow up</i> Two days per week
<b>Technical Assistance</b>	Seed, insecticide, regular guidance throughout the cultivation		
<b>Key Actors</b>	Farmers-Technical partner-Local Partner (First phase-Training period) → Farmers-Local Partner (Second phase- Cultivation period) → Farmer (Third phase- Harvesting period)		

Sandbars with coarse sand as a main component tend to remain unused previously due to infertility and lack of water retaining capability. In this type of sandbar, pit cultivation technology has been practicing by simply digging holes in these sandy residues and filling them with manure and compost (Figure 2). In this agricultural practice, farmers make several pits of 1 m<sup>3</sup> size in their sandy land after flood waters recede from river basin and making it dry during the time of mid-October to November. Then 10-15 kg compost/cow dung is mixed with the pit soil and left for 15 days. Next 4-6 seeds are planted in each pit and the pit is filled with water. After germination, 2-3 healthy seedlings are kept in each pit and the rest are uprooted. They cover the

pits with straw mulch to conserve the moisture. Farmers soak the pits 2-3 times a week with water carried in pitchers or buckets. When the seedlings are 25-30 days old then quick compost is applied at a rate of 1 kg/pit and at 60-65 days, the farmers apply 2nd time at the same rate (Unnayan Onneshan, 2012). After that, the compost is mixed well with soils and irrigated immediately.

**Figure 2: Illustration of typical sandpit cultivation**



Source: Adapted from Practical Action, 2012  
 (Available at [http://practicalaction.org/food-production/sandbar\\_cropping](http://practicalaction.org/food-production/sandbar_cropping))

**Comparative Assessment**

Sandbar cropping can be referred to as good practice as it is targeted and worked with the most vulnerable groups (including women and socially-marginalised groups). During its pilot phase, the model focused on the poorest, most vulnerable and marginalised communities because of their high dependency on climate-sensitive resources as well as their lack of access to the material; social, political, and economic resources that would enable them to adapt to climate change impacts.

For women, climate change impacts also amplify the existing inequalities, reinforcing the disparity between women and men in terms of vulnerability as well as capability for coping. Sandbar cultivation engages them throughout the entire process. Sandbar cultivation therefore, is concerned about all the five indicators of livelihood upliftment of the right holder’s i.e. economic feasibility, food security, livelihood improvement, female empowerment and good practices in terms of adaptation. The comparative assessments of those aspects have been elaborated under these five segments.

**Economic Feasibility**

In the remote *chars* of Kazipur upazila, poor landless farmers remain idle for job scarcity from November-March. Some of them move towards the towns, mainly to Dhaka for searching jobs as they have no land of their own. The cultivation of watermelon, millet and pumpkin in the sandy infertile islands contributes to household income in this lean period. The duration of cultivation periods of all these three crops is three months. Though the respondents faced a lot of problems during the cultivation process - unfavourable weather, water scarcity, and moisture stress in the sand pits, all of the incomes of the households were found to have increased. From the field survey, it was found that the watermelon cultivators benefitted the most and the average income was USD 108 (Tk.8856) in three months. On the other hand, the millet cultivators were the least profitable and their average benefit in a season was USD 17 (Tk. 1390). RESOLVE’s local partner Gana Kalyan Shangstha (GKS) provided seed, initial fertiliser and necessary insecticides for ensuring quality along with the support of the project. Cost benefit analysis for different crops cultivated in the *Sandbar Cropping* model has been prepared based on the farmer’s notebook and questionnaire survey. The income-expenditures of the RH’s have been averaged since they cultivated the same parcel of land (Table 2).

**Case Story– 1**

**Right Holder:** Mrs. Tarabanu

**Age:** 35 years



Mrs. Tarabanu lives in Pirgacha village under Khasrajbari union of Kazipur Upazila in Sirajgonj. One year earlier, she was selected by local implementing partner, GKS, for the *Sandbar Cropping* model to cultivate watermelon. Her husband cannot work regularly for his sickness where he was only bread earner of this family. Because of an irregular flow of income, the family was leading a miserable life in the lean period (December-March). Because of this extreme poverty, Mrs. Tarabanu was selected for *Sandbar Cropping* training. She started the cultivation of watermelons on one *Bigha* (33 decimals) land. The total cost of cultivation was BDT 16060. Total selling price of 335 watermelons was BDT 28,875 and the gross profit was BDT 8000. Now, Mrs. Tarabanu can contribute to her family income which has been secured as well for the lean period. Their nutrition level have also been improved by consuming watermelons. Mrs. Tarabanu is considering the cultivation of watermelons on a larger area from the next year.

**Table 2: Cost benefit analysis for different crops cultivated in sandbar cropping model**

Type of Crop/Vegetable	Average Income in USD*	Average Expenditure without seed cost in USD*	Net Profit in USD*
Watermelon	303.35	195.85	108
Pumpkin	181.65	75.45	106.2
Millet	61	44	17

Source: RESOLVE Field survey, 2012

\* All the values calculated here on the period of three months.

**Food Security**

Achieving food security is one the prime objectives of RESOLVE project. In the field of study, *Sandbar Cropping* has been found to have a positive effect on increasing productivity and its capacity to withstand climate shocks, which is critical to the food security of the vulnerable farmers. From the field survey, it has been revealed that the sandbar cultivators have improved access to food along with a better utilization process. Based on the three criteria of food security e.g food availability, food access and food utilization, the study assessed the food security of the respondents. Eight of the 10 right holders gave their opinion about food availability in the lean period. Some of them said that, they used to eat the young leaves and twigs of pumpkins as curry throughout the cultivation period. The respondents also were found to be aware of nutritional value of cultivated food products. In terms of accessibility, most of them have no choice about food accessibility as well as allocation, affordability and preference (Table 3). However, all of the right holders put their opinion on how to ensure food security by *Sandbar Cropping* practice which can withstand the changing climate.

**Case Story– 2**

**Right Holder:** Mrs. Manzura Khatun

**Age:** 37 years



Mrs. Manzura Khatun, resident of Pirgacha Village under Kazipur upazila, Sirajgonj. Mrs. Khatun involved with the RESOLVE programme before 8 months ago. She started to cultivate millet (BR-28) after getting suggestion from local implementing partner GKS. As first time, she cultivated one *Bigha* (33 decimal) and got ten mounds Millet. Mrs. Khatun said that, before involving with the programme she has very less income with single paddy cultivation. Her family had no ability to take food three times a day. But in present using homestead fallow land she can contribute food uptake within family members. Her husband although a farmer but most of the time of year he spent outside of home and in this time Mrs. Khatun manage her family including family expenditure, children education etc. *“Millet cultivation made us self-sufficient in food. I can exchange millet for rich and vegetables from my neighborhoods which made me food secure. I also distribute 40 kg of millet to my kith and kin.”*- said Manzura.

**Table 3: Right holders’ opinion about food security in terms of cultivated crops**

Features	Yes	No	No comments
Food availability (production, distribution, exchange)	8	1	1
Food accessibility (allocation, affordability, preference)	2	1	7
Food utilization (nutritional value, social value, food safety)	8	0	2

Source: RESOLVE Field survey, 2012



***Livelihood Improvement***

The Pirgacha and Shanbandha villages of Khasrajbari union are severely prone to riverbank erosion and it is a mid-island char. The right holders of the current cropping model are poor living along the riverbank and own very few assets. During the field survey, it was found that they suffer from different extreme climatic events and multiple deprivations. The villages were formed by land accretions where the villagers are aged over 16 years with a stable condition. However, the sand dominated chars remain uncultivated. After practicing the Sandbar Cropping model, the landless right holders can cultivate different seasonal vegetables (pumpkin, watermelon) and grains.

The livelihood improvement of the right holders is assessed in terms of increased food intake, clothing, improved housing, education, health and miscellaneous expenditures. Most of the respondents articulated the new approach of sandbar as a new window of opportunity to improve livelihoods in the lean period. Among the basic needs of livelihood; food, clothing and education were found in a satisfactory state whether housing, health and miscellaneous expenditures were not satisfactory (Table 4).

**Table 4 Livelihood situations after practicing Sandbar Cropping model**

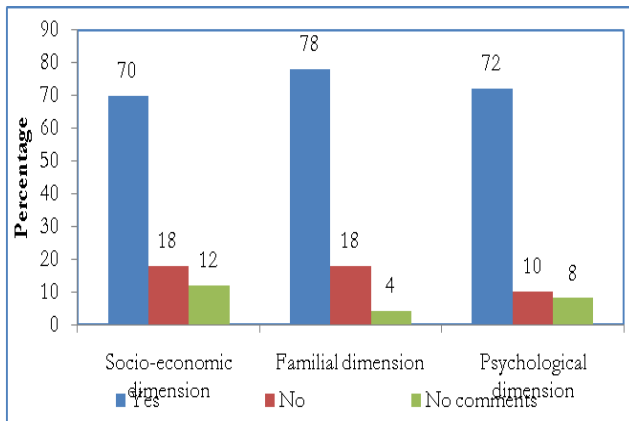
Features	Improved situation	Not satisfactory	No comments	Total
Food	10	0	0	10
Clothing	7	2	1	10
Housing	2	7	1	10
Education	8	0	2	10
Health	5	2	3	10
Miscellaneous	6	2	2	10

Source: RESOLVE Field survey, 2012

***Women’s Empowerment***

Women from the *char* lands are the most deprived in a society facing adverse conditions in terms of social oppression and economic inequality. In this field of study, the situation is worse than other areas because of extreme poverty and fragmented family condition. From the field survey, female right holders were found to be empowered in all the three dimensions: socio-economic, familial and psychological. The result shows that, in socio-economic dimensions; their earning capacity, bargaining power, control over resources, role in household economic decision making, meeting the basic needs and altogether improving self-reliance etc., was found to be increased. Almost 70 percent of the right holders claimed improved socio-economic dimension with all the components, 18 percent did not agree with improved socio-economic conditions and 12 percent didn’t respond (Figure 2). Participation in household decisions in family matters has also been found to have increased. The result from the survey shows that about 78 percent of the respondents put forward their opinion about improved familial decision making, 18 percent did not comply with improved decision making and four percent didn’t answer. The psychological conditions of the extremely poor women have also found to be encouraging as 72 percent of the respondents think their basic rights and coping capacity to different household shocks has been increased.

**Figure 3: Women empowerment by Sandbar Cropping model considering three important dimension**



Source: Field Survey, 2012

### Successful Adaptation

The sandbar cultivation model is considered as a successful means of withstanding the changing climate. This practice has promoted climate-resilient livelihoods strategies such as diversification of land use and incomes through utilizing unfertile barren sandbars. Farmer’s adaptive capacity has also found to have improved. As access to climate information; managing risk and uncertainty has improved, so has the adaptive capacity of farmers. The technical capacity of the right holders was also seen to have improved. They are now thinking of increasing yield by using sustainable techniques. They also want to produce diversified and pricey vegetables, so that they can easily gain market access. Right holders of the Sandbar Cropping model also made use of planning tools to improve farm management. RESOLVE also have the intention for ensuring gender equity and mainstreaming them as a goal during the project implementation. So, it can be stated that Sandbar Cropping Practice is a successful one.

### Case Story– 3

**Right Holder:** Mrs. Amena

**Age:** 45 years



Mrs. Amena is involved with watermelon cultivation for under the RESOLVE project. After receiving necessary training, Amena cultivated pumpkin with her son in a parcel of sandy land. She said that her family income increased from pumpkin cultivation. From the pumpkin profit from pumpkin she bought a cow and necessary household equipments. During the conversation her son also agreed with his mother. *“I purchased new schoolbag for my son and daughter and bought new sharee for my mother and wife after selling pumpkins”*, He added. They both appreciated the cultivation of pumpkin and encouraged others as well for the same cultivation practice.

## **SALIENT FEATURES**

Several salient factors have helped people to cope with and adapt to the impacts of riverbank erosion, moisture stress and hazards or other factors which have enhanced people's capacity to cultivate in infertile sandy *chars*. However, other factors hinder people's capacities and efforts to cope. Some factors can both enable and hinder the coping mechanisms.

### ***Physical and Mental Attributes***

Physical and mental qualities play an important role in coping with any crisis. In the study sites, the respondents have shown the spirit to accept newer cultivation technologies. However, they also have shown the courage to refine their traditional cultivation patterns with the newer technologies. The communities living in the study sites have shown a remarkable resilience to crises in these difficult places for so long.

### ***Strengthened Social Organisation***

In the study villages (Pirgacha and Shanbandha), it was observed that socially, the family system is often fragmented as a result of migration after riverbank erosion. The extremely poor respondents were also excluded from any kind of social or political organisations. Furthermore, they were excluded participating in the local power structure due to their unstable situation. However, in Pirgacha and Shanbandha, RESOLVE helps to organize the targeted right holders. The local partner of RESOLVE (Gana Kalyan Shangstha (GKS) organised meetings and training for sandbar cultivation technique right holders. The respondents were found to be co-operative and organised than before as they claimed. They consulted with each other about their problems; sometimes, they met with the field officials about different problems. Their unity attracted the other farmers which may facilitate in furthering the *Sandbar Cropping* model.

### ***Traditional Knowledge Base***

People of Kazipur upazila have a history of survival during floods and riverbank erosion, which enables them to live and cope with these types of hazards in many ways. They also have traditional knowledge on cultivation in sand bars with silt components. Previously, hardly any type of agriculture was there in the sandbars. However, now with innovative agricultural technologies they want to improve their agricultural patterns.

### ***Changing Nature of Weather, Climate, and Floods***

Though the people of the study sites have lived and coped with floods over the years using their traditional knowledge and skills, their coping practices are no longer effective as before because of the highly erratic nature of flooding. According to the people in Focus Group Discussion (FGD), flooding in Kazipur is more frequent in some years, whereas in some other years flood pattern is quite unfamiliar. Moreover, erratic weather pattern (fog, cold wave, irregular regular rainfall) somehow, creates production lacking in the agricultural intervention of the sandy *chars*.

### ***Lack of Irrigation Practices or Facilities***

Lack of irrigation facilities is found to be a major factor which hinders the cultivation in the sandbars. Most of the respondents said that, they have to collect water from the river for irrigation. They have to water crops twice a day. A lack of irrigation facility therefore greatly constrains their options. If there were suitable irrigation facilities or practices, more groups in the study villages could have grown vegetables or crop grains in the sandbars.

### ***Lack of Proper Market***

A lack of proper marketing system is another obstacle for selling the products at a fair price. Although boats and *trollers* help people to travel to different places to sell their products, most people do not own boats. Moreover, they can only sell their products in the local markets once a week because the whole sellers collect vegetable on the *bat* days. As a result; they are unable to sell their products regularly. The activity of middlemen has been found as a negative impact in maintaining a reliable price as well.

## **CONCLUSION AND WAY FORWARD**

The *Sandbar Cropping* model has opened a new window for cultivation in the unproductive sandy *chars*. The cultivation technique has brought significant changes to the lives and livelihoods of the extremely poor people of Khasrajbari union by income generating opportunities and nutritional uptakes. In the long run, this will positively influence the livelihoods of the extreme poor, as well as help the Government to meet its own ambition of reducing poverty. Though the *Sandbar Cropping* model plays a significant role in enhancing household income in the lean period, some constraints are still there that will hinder the success of the model. Hence, the current research has put some recommendations for improving the *Sandbar Cropping* practice.

- ❖ Improving pit technology for better moisture retention. Hence, water hyacinth (*E. crassipes*) can be used both as compost mixture and mulching.
- ❖ Secondary crops should be cultivated within the same pit to prevent crop loss. Muskmelon can be planted along with the pumpkin and watermelon.
- ❖ Irrigation facilities should be developed; shallow machines could be installed in the project generated area.
- ❖ The aspirations of the right holders should be given priority and analysed to sustain the model
- ❖ Tenure of land should be ensured for the large scale cultivation
- ❖ Sustainable technologies for pest and disease attack need to be developed. Biological means of control such as sex-pheromone or integrated pest management should be applied
- ❖ Finding the ways of reducing the production costs of pumpkins, watermelon and millet. Those will be important to withstand competition in the market when it increases
- ❖ Developing proper market channels and market linkages to ensure the profitability of crops produced in the sandbars
- ❖ More emphasis should be given in monitoring the activities.



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