Evaluation Report

WATER FOR FOOD IN THE COASTAL AREA OF SUNDARBANS-INDIA AND BANGLADESH

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Executive Summary

Geo-morphologically coastal communities of Bangladesh are highly exposed to the threats of climate change and the livelihoods of majority of the coastal people depend on agriculture. The project area is situated in the southern coastal areas of Bangladesh adjacent to the world's largest mangrove forest, the Sundarbans. People living in these two areas have been suffering from lack of food security. To address the impacts of the climate change and to ensure security of the quality of lives and livelihoods of the poor living in the disaster affected coastal communities, **Dalit** has implemented a project entitled 'Water for Food in the Coastal Area of Sundarbans-India and Bangladesh'. Present program activities are concentrated one union of Assasuni Upazilla namely Borodal and one union of Tala Upazilla namely Islamkati. Inhabitants of these two unions were the worst victims of climatic disasters. 'Water for Food in the Coastal Area of Sundarbans-India and Bangladesh' is a one year program implemented by the **Dalit** in Tala Upazilla covering 6 villages (Islamkati, Dhamsakla, Sujanshaha, Nangla, Poranpur and Ghona) in Islamkati union and Assasuni upazilla covering 4 villages (Buria, Borodal, Bamondanga and Fakirabad) in Borodal union. The targeted people are of two categories: very poor and poor. Dalit provided trainings to the beneficiaries on a number of subject matter like saline tolerant technology, floating gardening, hanging vegetable gardening, animal rearing, fish culture and crab fattening, and water management etc. The production of farm families has increased significantly after receiving the trainings. The livelihood patterns of the inhabitants have also changed and they are capable of selecting alternate livelihoods. There was improvement in food security among the key stakeholders. **Dalit** also established linkages with several GOs like the Department of Agricultural Extension (DAE), Bangladesh Agricultural Research Institute (BARI), Bangladesh Rice Research Institute (BRRI), Directorate of Fisheries (DoF), Directorate of Livestock (DoL) and Soil Resource Development Institute (SRDI). Through this project a number of water control structures have been developed and/or repaired. A good number canal were re-excavated and cleaned. Moreover, farm ponds were also dug to harvest rain water. The overall progress of the project is note worthy. Objective wise scores range from 4-4.5 i.e. very good. However, more number of trainings and workshops are necessary for continuous improvement. Finally recommendations are suggested both for water logging and saline conditions for future implementations. There are 15 recommendations for water logging condition but 17 recommendations for saline areas. In a nutshell, it can be told that the project is a good one and will be sustained if the recommendations are followed accordingly.

Background

The Context

Bangladesh is a deltaic country situated between the Himalyan Mountains in the north and the Bay of Bengal in the South. Because of its geographical position Bangladesh is widely considered to be one of the most climate vulnerable countries in the world (Harmeling and Eckstein, 2014). The country frequently experiences natural and human induced disasters including sea level rise, cyclones, storm surge, flooding, land erosion, water logging, and salinity intrusion in soil and water because of extreme variability of climate change which cause loss of life, damage the infrastructure and economic assets, and adversely affect the livelihoods of people especially the poor, vulnerable and destitute living in environmentally fragile areas. The combination of a high level of poverty, and a depleted ecological system increase the country's vulnerability to the impacts of climate change.

More than 30% of the cultivable land in Bangladesh is in the coastal area, about 1.0 million ha of which is severely affected by varying degrees of salinity during the dry season and flooding/submergence during the wet season each year (Karim et al., 1990; SRDI, 2012). Farmers mostly grow low yielding traditional rice varieties only during the monsoon (Aman) season spanning July to December. Most of these lands remain fallow in the dry (Rabi/Boro) and pre monsoon (Aus) seasons because of perceived high soil and water salinity and lack of good quality irrigation water (Karim et al., 1990; Mondal et al., 2004). Crop yields, cropping intensity, production levels and people's quality of livelihood are much lower in this region than in other part of the country (BBS, 2009). Improvement of Aman rice yields, crop intensification by adding either an Aus or a suitable non-rice crop before or a Boro rice or a non-rice crop after Aman rice can improve productivity, farmers' income, and enhance their livelihoods (Mondal et al., 2004). Farmers rely on traditional rice varieties that are tall, do not respond to inputs and have low yields of 2-2.5 t/ha (Mondal et al., 2004). Farmers are reluctant to use HYV because they are short stature, easily submerged and damaged by tidal fluctuations. To address the impacts of the climate change and to ensure security of the quality of lives and livelihoods of the poor living in the disaster affected coastal communities, **Dalit** has implemented a project entitled 'Water for Food in the Coastal Area of Sundarbans-India and Bangladesh'. The program covered Assasuni and Tala Upazillas under Stakhira district with the direct beneficiaries of 225 households; 110 from Assasuni but 115 from Tala. Considering the frequency of extreme weather events the program intended to develop natural resource

base for sustainable ecosystem. In addition, the program has tried to ensure sustainable waterlogged and saline tolerant agriculture practices.

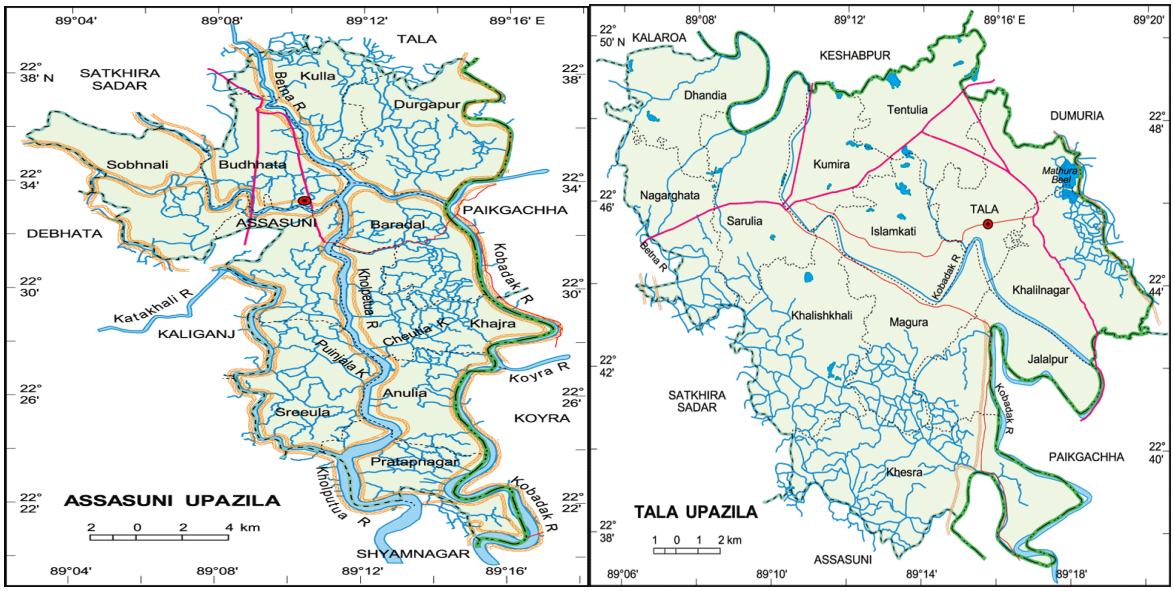

Fig. 1. Maps of the project area

Overview of the Project

Geo-morphologically coastal communities of Bangladesh are highly exposed to the threats of climatic disasters and the livelihoods of majority of the coastal communities depend on employment linked with agriculture and natural resources (Gemenne, 2011). The Project area is situated in the southern coastal areas of Bangladesh, and is adjacent to the world's largest mangrove forest, the Sundarbans. People living in these two areas have been suffering from lack of food security. Some of the notable reasons behind that such as lower crop productivity and less cropping intensity due to increased salinity, increased incidences of pests and diseases, erratic rainfall, higher temperature, drought, tidal surges, cyclone, submergence/water logging, large fallow lands/water bodies, land degradation, poor road network, poor marketing facilities and unemployment with long-term cumulative effects of soil-related constraints, climate risks and socio-economic problems (Rahman, 2012).

Present program interventions covered one union of Assasuni Upazilla namely Borodal and one union of Tala Upazilla namely Islamkati. Inhabitants of these two unions were the worst victims of climatic disasters. Potential climatic disasters can be divided into two categories: rapid onset disasters and slow onset disasters. Gradual soil salinity intrusion is the notable slow onset disasters for Assasuni and Tala Upazillas. Salinity intrusion causes the loss of crop cultivation and sterility of the arable land.

Consequently, the farmers of this area failed to produce crops and most of the cultivable lands remain fallow especially in dry season. On the other hand, due to limited technical know-how, local farmers could not choose alternative livelihoods. For rapid onset disasters like cyclones, tidal surges, water logging and river erosion, the situation is more exacerbating.

The strategy of the project was to find an efficient and effective way to solve the problems that inhibit local development in the targeted areas in India and Bangladesh, in the geographical area known as the Sundarbans. Amongst the problems there is the difficulty of producing food, both to meet the household food needs and to sale the products in the local markets. Ensure water for food production was at the center of the program strategy. Complementary to this effort there is the provision of alternative livelihoods in the areas where the agriculture cannot be implemented. Finally, cross cutting to both the production and the access to food, the environmental issue of climate change and the protection of the areas. Finally, another key element in the strategy of the program is the involvement of research institutions and universities. The project's main methodology was the horizontal transfer of knowledge-farmer to farmer methodology. The added value of the project is the participation of women to the project activities not only from the apparent point of view but also from an organizational and decision-making one. 'Water for Food in the Coastal Area of Sundarbans-India and Bangladesh' is a one year program implemented by the **Dalit** in Tala Upazilla covering 6 villages (Islamkati, Dhamsakla, Sujanshaha, Nangla, Poranpur and Ghona) in Islamkati union and Assasuni upazilla covering 4 villages (Buria, Borodal, Bamondanga and Fakirabad) in Borodal union. The core concepts of this program were:

- Consultation and participation
- Water management
- Production of food
- Access to food
- Environment

Majority of the farmers were male (68%) while females were 32%. Livelihoods of majority of the inhabitants depend on agriculture (72%). Two-thirds of them possessed only 8.25 decimals of land and the female participants have no ownership of land. Average land holding of them is 0.77 acres (Dalit, 2016). The targeted people are of two categories: very poor and poor. The very poor group has no lands, unemployed and has risk of migration, day labor, resides near river bank, and their food security is only

for 3 months in a year. On the other hand, the poor group has 1 acre of land, small farmers and fishermen, lease lands from others, but food security of 6 months (**Dalit**, 2017b). They use their income mainly for food and investment in education is only 5%. As a result, the human capital of the program beneficiaries is also very limited. Furthermore, they invested their efforts in searching employment rather than enhancing their skill thus, the poor people could not manage to obtain skill of alternative livelihoods (**Dalit**, 2016).

Project General Objective: To contribute to reduce poverty and social exclusion in India and Bangladesh, in the area known as the Sundarbans.

Specific Objective: To promote local development by responding to the basic needs of the target group in the districts of North and South 24 Pargana in India and in the Satkhira district in Bangladesh.

Results

1. Increased the capability of water management in the project areas.
2. Increased Agricultural production
3. Alternative livelihoods Different from those related to agriculture introduced

Project Activities

The program activities are described below:

- Culvert construction
- Culvert repair (Ghona village)
- Construction of water flow control structures
- Pond digging
- Canal re-excavation (62500 cft)
- Canal cleaning

Methodology

The key purpose of the evaluation is to check whether the project attains its intended objectives, discovering out gaps if any, narrate lessons and propose recommendation for better implementation in the future. The first purpose of this evaluation is to assess the appropriateness, relevance and impact of the 'Water for Food' program in Assasuni and Tala Upazillas. The evaluation also provides key recommendations towards better program impacts on the vulnerable population of the targeted area.

Evaluation Criteria

A number of analyses have been adopted to put up the data collected. The analytical tools for this evaluation report are divided into several folds (Sowgat, 2015): 1. Assessment of the program outcomes-What differences the program made till to date? 2. Assessment of the program efficiency and effectiveness-How has it made the difference? And what more needs to be done to ensure holistic achievements?

Evaluation Tools

Review of Documents

- Project Proposal
- Monitoring and program reports
- Baseline survey report
- Quarterly progress reports
- Activity plan
- Relevant documents supplied by **Dalit**
- Journal articles
- Stakeholders workshop material

Initial Briefing

Prior to the field work, the evaluator participated in a discussion with **Dalit** Personnel about their perceptions about the project and evaluation focus.

Questionnaire Survey

A semi-structured questionnaire survey of beneficiaries has been conducted at household level. An interview schedule was used as the data-gathering instrument. The interview schedule was carefully prepared considering the objectives of the study. The interview schedule contained both open and closed form questions. Considering the selected characteristics of the respondents, easy and direct questions were included in the schedule to obtain necessary information. Necessary corrections, alterations and modifications were made before finalizing the interview schedule. The interview schedule was then printed in its final form and was multiplied for collecting data from the respondents.

Outcomes and Discussion

Project Objective: To contribute to reduce poverty and social exclusion in India and Bangladesh, in the area known as the Sundarbans

Activities to achieve the objective include linkage with local service provider/Department of Agricultural Extension (DAE) to receive support crop production in stress environment (salinity and water logging), skill development on alternative livelihood options and identification of locally appropriate possible livelihood considering climate change.

Beneficiaries received training on different livelihood options including vegetables gardening (floating vegetables garden and hanging vegetables gardening), livestock rearing, fish culture and saline tolerant crop cultivation (especially rice cultivation in dry season). It is worth noting that **Dalit** provided training to all the beneficiaries (100%) of Assasuni and Tala Upazillas on vegetable cultivation, livestock rearing and rice cultivation as revealed by the study (Table 1).

Table 1. Trainings received by beneficiaries of Tala and Assasuni Upazillas

Training provider	Name of training	Upazilla	Number of participants	Percentage
DALIT	Rice cultivation, vegetables production and animal rearing	Assasuni	110	100
		Tala	115	100
		Total	**225**	**100**

The study tried to recognize whether the activities taken by DALIT helped improving the households' assets in a sustainable way. There were significant changes in primary occupations of people in the targeted area as shown in Table 2. It is clear from Table 2 that there is remarkable reduction in number of wage labor and rickshaw pullers. On the contrary, participants at present condition prefer livestock rearing, tailoring and fish culture that need more skills. This in turn denotes the knowledge gaining in other professions.

Three major livelihood options identified are agriculture, livestock rearing and fishing. Rice and vegetables cultivation are the main agricultural options practiced by the beneficiaries. However, there is no significant change in the number of participants growing vegetables and rice. It is well to note that all the 115 beneficiaries of Tala Upazilla are now growing rice in their fields. The beneficiaries reported that rice and vegetables production have increased due to the intervention of **Dalit.**

Table 2. Changes in primary occupations before the program and at present

Primary occupations	Before	Current	Change
Cultivation	172	176	+4
Wage labor	15	6	-9
Rickshaw puller	11	1	-10
Fish culture	9	16	+7
Small business	7	3	-4
Livestock rearing	0	16	+16
Tailoring	0	5	+5
Others	11	2	-9
Total	**225**	**225**	**0**

The most important thing is to mention here that there is a large improvement in food security in the study area. At the baseline survey period, 31% of the respondents replied that they do not have enough food to eat. But at the end line, none of them told about total insecurity rather food scarcity for a certain period in the year (Table 3).

Table 3. Food security situation of the inhabitants

Food security condition	Baseline (%)	Present (%)
Not enough food to eat	31	0
Food shortage during certain period (August-November)	28	23

As salinity and water logging are two major problems in the targeted area, farmers adopted diverse methods of crop cultivation namely floating bed agriculture and sack (bag) gardening. **Dalit** provided technological support to the growers. Seven percent of the inhabitants practice floating bed agriculture while 22% of them grow vegetables in sack (bag) gardens. It is worth noting that farmers under this project also started to grow crops in *kharif-1* season when salinity restricts crop cultivation in coastal areas of Bangladesh.

Trainings provided by Dalit through the project

- Community training on water management

- Training of beneficiaries on saline tolerant cultivation and technology
- Training on domestic animal rearing
- Seminar/meeting/workshop
- Study visit for the beneficiaries for gathering experience
- Workshop with stakeholders
- Awareness building camp
- Workshop on water management
- Distribution of income generating agricultural inputs
- Distribution of inputs for vegetables cultivation
- Distribution of inputs for fish cultivation
- Distribution of inputs related to domestic animal rearing for economic development
- Floating vegetables garden preparation

Associated organizations

- Department of Agricultural Extension (DAE)
- Bangladesh Agricultural Research Institute (BARI)
- Bangladesh Rice Research Institute (BRRI)
- Directorate of Fisheries (DoF)
- Directorate of Livestock (DoL)
- Soil Resource Development Institute (SRDI)
- Local government (union parishad)

Outcome wise Progress

The criteria considered here is the progress in relation to the outcomes of this project. The percentage data presented here are not brought from numeric inferences but they are based on the assumed progression level identified by the program staffs at **Dalit**. The study finds that action wise the highly significant progresses are made. However, the program staffs feel that more activities are necessary for the identification of alternative livelihoods.

Table 4. Outcome wise Progress

Logical Intervention/Result	Objectively Verifiable indicators (OVI)	Progress made	Progress in percentage
R-1:Increased the capability of water management in the project areas	90% of beneficiary farmers is able to implement in an efficient way the water management technologies promoted by the project	According to our first year target we have achieved all the targeted activities and 80% beneficiaries are capable to implement an efficient way of water management technologies by using their knowledge and skills.	90%
	The period of Water logging in the beneficiaries' plot is reduced at a maximum of 45-60 days per year starting from the third year of the project	Though we are in the previous stage of this output. But according to our informal assessment it seems that it is difficult for reducing water logging situation by the limited support under this project till we are trying to do.	50%
	Beneficiaries' cultivated land within the plots increases of 30% in three years	About 10% of fallow land of beneficiaries came under cultivation from where they are getting benefit.	50%
	70% of the population increase its access to safe and fresh water for agricultural use	We have already excavated canals and some ponds inside agricultural lands, after the upcoming rainy season the targeted	80%

		beneficiaries will get the benefit.	
R-2:Increased agricultural production	550 beneficiary farmers receive inputs for the agriculture production (rice and vegetables) and for fish farming	120 beneficiaries received inputs for the agricultural production and fish farming in first year.	50%
	8000 quintals of rice produced in 190 acres of land by the beneficiary farmers in the first two years of the project	380 quintal of vegetables produced in 5.84 acres of lands in first year.	40%
	4800 quintals of vegetables produced in 72 acres of land by the beneficiary farmers in the first two years of the project	120 quintal of fish produced in 7.26 acre in the first year.	40%
	1200 quintals of fish produced in the 29-acre ponds by the beneficiary farmers in the first two years of the project	-	-
R-3: Alternative livelihoods different from those related to agriculture introduced.	430 beneficiary households strengthen and increase their livelihoods	Among the targeted number of our part, 55 beneficiary's households strengthen and increased their livelihoods.	50%
	100 beneficiary households strengthen and increase their livelihoods	Till now we are in implementation phase, Result not yet measurable and those need some	-

		months to grow fully. So, quantity is not measurable at this moments but it will be achieved.	
	70% of beneficiary women are able to keep a positive fate of reproduction of the animals during the three years of the project	All the targeted beneficiary women were aware on reproduction of the animals during the first year. They are confident about product ion.	80%

Table 5. Objective wise progress

Logical Intervention/Result	Objectively Verifiable indicators (OVI)	Score (Out of 5)
OJ: To promote local development by responding to the basic needs of the target group in the districts of North and South 24 Pargana in India and in the Satkhira district in Bangladesh	500 beneficiary farmers increase their harvests as consequence of the implementation of technologies and practices for agricultural production in saline soils	4
	At the end of the project 80% of the beneficiaries recognize an improvement of their condition	4.5
	Within the end of the project 20 SHGs have access to financial services of rural credit and cooperative banks	3.5

Lessons Learned

Women empowerment

All over the world, women represent a substantial and under-utilized force. ‘Water for Food’ project has prioritized women because of their acknowledged importance for family advancement. As women are vulnerable in the public domain, the program provided a supportive environment for the participation of women. Twenty percent of the participants of the program were women. The women participants showed more boldness and have reported that they are increasingly concerned in decision-making processes at the household level.

Alternate livelihood options

The ‘Water for Food’ project promoted appropriate livelihood activities considering climate change. The following are the lessons learned from the project regarding climate resilient agriculture:

 Drip irrigation (drum method) is a water saving technology that enables farmers to irrigate their crops with adequate amount of water.

 Hanging gardens in waterlogged areas and in dykes provide an effective coping mechanism for small farmers in coastal saline soils of Bangladesh.

 Employment opportunities for women have increased in the area with increased food security.

 Floating bed agriculture could be an promising alternative livelihood option for the people of the project area in providing family nutrition with increased food security.

 Pitcher irrigation has been supplying required amount of water for crops during periods of water shortages.

 Farm pond model helped the farmers to grow vegetables as well as fishes thus ensuring food security.

 Five square model can be promising technology year round vegetables cultivation.

 ‘Sorjan Cropping’ has been a method practiced in different countries of the world to grow crops in saline conditions.

 ‘System of Crop Intensification (SRI) method has been widely practiced in rice cultivation in home and abroad.

Partnership development

Successful adaptation requires meaningful engagement and coordination from all sectors and stakeholders. There was a strong commitment from the government, especially the DAE, in design, planning, and provision of technical support. For the successful adaptation, collaboration was vital

among the community, NGOs and government. Through this program **Dalit** developed linkages with Department of Agricultural Extension (DAE), Bangladesh Agricultural Research Institute (BARI), Bangladesh Rice Research Institute (BRRI), Directorate of Fisheries (DoF), Directorate of Livestock (DoL), Soil Resource Development Institute (SRDI) and local government (union parishad).

Mixing local knowledge with scientific knowledge

In saline prone and waterlogged areas of Islamkati and Borodal, traditional practices are given some technical and scientific modifications, which increased the productivity. The key learning is that knowledge is a critical input to the population adaptation and alternate livelihood.

Case study

"Rezwan Seikh, a Poor Farmer of Tala upazila under Satkhira District Ducceed in Increasing Paddy Production by Adopting the Appropriate Technology"

Rezwan Seikh aged 57 years, son of Abu Bakkar Seikh lives in village Sujan Saha, union Islamkathi, upazila Tala of Satkhira district. He has a family of three members (wife and one divorced daughter). He is a poor farmer having only 33 decimal of cultivable land and totally depended on the paddy production (two times in a year) from it. In the last 3 years the average paddy (*Aman*) production on his land was 13-15 manuds. It was really difficult for him to maintain his family with this small production. He was disappointed with the production as he used good quality rice seedlings, used proper dose of fertilizers, and watered the field properly.

In the above circumstances, he became attached to the project "**Water for Food in the Coastal Area of Sundarbans – India and Bangladesh"**. He has participated in the various activities of the project and has received a two-day-long training on "**Paddy Cultivation Technology in Saline Land and Agricultural Production**" on July, 2017. On receiving the training he gathered knowledge and skills on the appropriate procedure of rice cultivation for its better production. He became affirmative and planted *Aman* rice seedlings in his land (33 decimals) in middle of August, 2017. He maintained appropriate procedure from tilling to harvest what he has learned from the training. He also received different variety of fertilizers (urea- 30 kg, TSP-15 kg, MoP- 10 kg, Zinc- 1 kg, Gypsum- 5 kg) and used in his land properly. For the first time he harvested a better crop than it was in the last several years and hoping to get 20-22 maunds. He has a glaze on his face when he saw his paddy field and planning to have some savings and take sublease another 33 decimal in the coming years. He is grateful to the project activities for making him hopeful for better agricultural production in that coastal remote area where communities live in an isolated and hopeless condition with frequent natural calamities.

Conclusion, Recommendations and Challenges

Identification of alternate livelihood options is difficult in the targeted area as because the sites are exposed to high salinity and water logging. At the beginning of the program, while working with the community the duty bearers found this difficult to identify appropriate alternative livelihood options as the community were unable to find livelihood options that matched different natural constraints (salinity, water logging). There are opportunities that further researches are conducted to identify more livelihood options for the marginal people. Beneficiaries suggest that alternative livelihood options should focus more on saline tolerant agriculture activities and water logging.

A huge number of women in the study area have less access to land, education, decision-making, safety and control over their bodies. The strategy would be to ensure that they can decide their own destiny, and participate effectively in the decisions that affect their lives and livelihoods which needs support to fight for their rights in order to tackle poverty and injustice.

A good number of trainings were provided to the beneficiaries by DALIT. The trainings have acted as starting step for strengthening peoples' capacity to adapt climate change. However, to strengthen their livelihoods new and alternative employment opportunities need to be sustainable.

Recommendations

Climate change is damaging the livelihoods of millions and increasing poverty by amplifying environmental and socio-economic pressure on land and access to and availability of natural resources e.g. fresh water. The livelihoods of women, marginalized people and poor communities must be protected from the impacts of climate change. More than 30 good practices have been documented in Bangladesh in the past three years (Islam *et al*., 2015); only 05 practices are suitable for coastal areas. The present study focuses on promoting alternate and economically profitable livelihood options for the most vulnerable groups and communities of Borodal and Islamkati. The livelihood options for women and poor communities were identified based on localized climate change impacts, knowledge levels of local people and available resources (Jahan and Ali, 2017). It is our belief that poor and vulnerable communities' ability to adapt (in terms of awareness, new knowledge, technologies and skills) will be increased so that communities can take anticipatory adaptive measures and gain greater livelihood options.

The proposed climate resilient alternate livelihood options are categorized into two groups namely, for Water Logging Condition and for Saline Conditions. However, the proposed livelihood options are changeable based on prevailing conditions in future. A brief outline of proposed livelihood options is given below:

Alternate Livelihood Options for Water Logging Condition

1. Floating vegetables gardening
2. Hanging vegetables gardening
3. T. aman rice cultivation (local as well as HYV's tolerant to water stagnation)
4. Vermicomposting
5. Duck rearing/goose rearing
6. Goat/sheep rearing
7. Fish culture in mini ponds
8. Fish culture small cages
9. Homestead gardening (vegetables production in beds)
10. Vegetable production in sacks
11. Crab fattening
12. Dhaicha for fuel wood
13. Vegetables production in dykes (*Ghers*)
14. Water chest nut (panifal, locally known as singra) cultivation
15. Handicrafts for women

Alternate Livelihood Options for Saline Condition (description of each option is given in (Table 6)

1. T. Aman- boro rice (hybrid variety SL-8): transplanting must be done in early December; where sweet water can be stored in natural canals)
2. Jute (variety BJRI-8 sowing in wet soil must be done in early Choitra, light irrigation at knee-height stage)-T. Aman.
3. T. Aman- pulses (relay cropping of kheshari and lentil).
4. Hanging vegetables cultivation in gher boundaries and rice-fish culture fields
5. T. Aman-Cucurbits (sweet gourd, bitter gourd, etc.)
6. Fish+vegetables cultivation (mini ponds).
7. Dhaicha (Sesbania)-T. Aman- Cucurbits (sweet gourd, bitter gourd, etc.)

8. Crab fattening
9. Sorjan cropping
10. Water harvesting in mini ponds for irrigation
11. Duck and poultry rearing
12. Vegetable cultivation through pitcher irrigation
13. Handicrafts for women
14. Zero tillage potato cultivation
15. Raising winter vegetables seedlings in nursery beds
16. Dragon fruit cultivation
17. Sugarbeet cultivation

Challenges (**Dalit,** 2017a; Jahan and Ali, 2017)

1. Free movement of domestic animals may hamper cultivation of crops in *kharif-I* season. Therefore, community involvement is extremely important.
2. Demonstration of each option is necessary.
3. Greater exposure visit of project people.
4. Value chain addition (to sell commodities of farmers).
5. Providing guide book to farmers for the technologies suggested.
6. Local Administration's cooperation for implementing the project activities was not encouraging
7. NGO bureau approval was lengthy process requiring more time
8. No incentive for accountant but account maintenance was laborious

Table 6. Management techniques of each option proposed for field condition

Options	**Management techniques for crops other than T. Aman**								
	Variety	*Soil type*	*Seed rate (kg/ha)*	*Sowing/ transplanting time*	*Irrigation*	*Fertilizer dose (kg/ha)*	*Other operations*	*Harvesting time*	*Remarks*
1. T. Aman- boro rice (T. Aman can be grown as usual)	SL-8 (hybrid variety)	Any type of soil near mini pond	40	Early December	Irrigation from farm ponds	Urea: 300 TSP: 150 MoP: 150 Gypsum: 45 Zinc sulphate: 15	Normal intercultural operations	End of March	i) Water harvesting in mini ponds ii) Maintain transplanting time
2. Jute-T. Aman (T. Aman can be grown as usual)	BJRI-8, Advance line with red color on petiole	Any type but free from water logging	7-9	Sowing in wet soil in early Choitra	Light irrigation at knee-height stage	Urea: 200 TSP: 50 MoP: 60 Gypsum: 90 Zinc sulphate: 10	Mite control		i) Mite control ii) Maintain sowing time iii) Apply urea & MoP in two splits
3. T. Aman- pulses (relay cropping of kheshari and lentil) (T. Aman can be grown as usual)	Any improved variety	T. Aman field	40-50	15-30 days before harvesting of T. Aman rice	Rainfed crop	-	Proper weed control	March-April	5-6 hours Soaking of seeds before sowing

4. Hanging vegetables cultivation in gher boundaries and rice-fish culture fields	Sweet gourd, Bitter gourd, Cucumber, Musk melon, Kakur, Papaya, Brinjal, etc.	Dyke soil	Vary with crops planted in pits (Dibbling)	Kharif & Rabi	Irrigate if possible	Vary with crops	Proper pest control (Pheromone traps)	Different periods based on necessity	
5. T. Aman-Cucurbits (sweet gourd, bitter gourd, etc.)	Sweet gourd, Bitter gourd, Melon	T. Aman field	Vary with crops planted in pits (Dibbling)	Summer (Kharif-1)	Cover pits with mulch	Vary with crops	Proper weed & pest control (Pheromone traps)	Different periods based on necessity	Pits must be covered with mulches
6. Fish+hanging vegetables cultivation (mini ponds).	Summer season: Summer tomato *var. Bijli*, Brinjal in beds Winter season: Different	Pond boundary and beds	Vary with crops planted in pits (Dibbling)	Year round	Irrigation from ponds	Vary with crops	Proper pest control (Pheromone traps)	Different periods based on necessity	

	vegetables in beds; Brinjal, Yard long bean & beans hanging on nets								
7. Dhaicha-T. Aman (T. Aman can be grown as usual)	Local	T. Aman field	40-50	June-July	Rainfed crop	TSP: 80	-	Burying in soil during flowering	-

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