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LIVELIHOOD SECURITY IN CHANGING CLIMATE : INSIGHT FROM FARMER'S FIELD LABORATORY

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Abstract

Climate induced natural hazards are emerging as a cause of major concern, particularly in the coastal and haor areas of Bangladesh. There is growing evidence that these hazards are appearing more frequently and are expected to be detrimental for agriculture. Given the threat to livelihood the Farmer Field Laboratory (FFL) approach implemented by Islamic Relief Bangladesh. is an extensional approach, which provides opportunities to farmers of improving various skills through practicing various techniques by themselves. This paper describes the impact of the FFL to improve the livelihood security of the underprivileged farmers. The data was collected through the survey method on various aspects of the intervention, 157 randomly selected farmers were selected as the respondents of the survey. Focus Group Discussions with an Unstructured Interview was also undertaken to understand the production technology, profitability, diversification and crop cycle. SPSS 14 and ATLAS.ti were used to analyze data. Study findings showed that about 34 climate adaptive plant and vegetable varieties, trialed under the157 FFL plots,78% trialed crops were found to be very successful. Results also suggested considerable positive impact in terms of income, agricultural investment, nutrition and savings..

Keywords: Livelihood, Climate Change, Food Security, Farmers Field Laboratory

I. Background

The geographical location and geological setting of Bangladesh renders it as one of the most disaster prone countries of the world [1]. Over the last thirty years, Bangladesh has experienced nearly 200 climate-related disasters accounted for around $16 billion economic losses including damage of asset, property, livelihoods [2]. According to National Adaptation Programme of Action (NAPA) for Bangladesh, crop agriculture ranks highest in terms of physical vulnerability. Table 01 shows the aggregated results of vulnerability to 8 major climate change impact categories, namely Extreme Temperature, Sea Level Rise (including Coastal Inundation and Salinity Intrusion), Drought, River Flood, Flash Flood, Cyclone and Storm Surges, Erosion and Accretion for the different sectors.

Table 01: Relative vulnerability of different sectors in Bangladesh [3].

Vulnerability Context	General		Coastal		Haor		Drought	
	Scores	[%]	Scores	[%]	Scores	[%]	Scores	[%]
Crop Agriculture	17	71	8	89	3	50	6	100
Livestock	11	46	8	89	1	17	2	33
Fisheries	10	42	10	33	3	50	4	67

Source: Based on data from NAPA Team Bangladesh, 2005

The coastal area of Bangladesh contains more than 30% of the country's cultivable land, of which 98% of the coastal area is covered through the tidal floodplains [4]. The average crop yields are very low in these coastal belts, due to salinity problems, land erosion, low soil fertility and drought in the dry season. Another region also known as the haor basin is a low lying bowl-shaped basin covering about 6,000 sq. km. Flash flooding is the major threat to thousands of rice farmers in the haor region. Over the years due to climate variability and change, increased precipitation early in the seasons has made flashfloods more unpredictable and damaging, affecting livelihoods and food security severely.

Tackling this challenge Islamic Relief, Bangladesh has been implementing a technical approach, Farmers Field Laboratory (FFL) in both coastal and haor areas of Bangladesh. The Farmers Field Laboratory (FFL) is a modern local farmers to thwart the impacts of climate variability. Generally FFL is an extensional approach through which farmers can test a new crop technology with diversifying their knowledge and skills. The main aim of the FFL program was to improve coping strategies in piloting innovative agricultural practice in hard to reach haor and the coastal areas of Bangladesh. 157 Farmers were chosen to test and contextualize FFL at two different geographical locations. These farmers were chosen from a select set of criteria i.e. ability for contribution of land, time and labor. Islamic Relief Bangladesh provided seed, fertilizer, and cost of land preparation, labor cost, production technology and pesticides. Alongside farmers becomes conversant on basic agricultural and management skills through the ways of re-thinking and problem solving under FFL approach, resulting expertise in their own farms and produce.

II. Objective of the Study

The overall objective of the study is to find out the impact of the Farmers' Field Laboratory (FFL) on social well-being of farming communities. A secondary objective is to analyze the impact of the Farmer Field Laboratory (FFL) on agricultural productivity and profitability.

III. Methodology of the Study

The study was conducted in four upazilas namely Koyra, Shyamnagar, Golachipa and Sulla of Bangladesh. Total farmers of the selected upazilas engaged in FFL technologies were considered as the population of the study. From 157 demonstration farmers, 47 of them (30% of total population) were selected as a sample following the proportionate random sampling technique.

Both Qualitative and Quantitative methods were used in this study. All questions had been pre-tested before collecting the data from the field. The sample survey was designed on both close-ended & open-ended questionnaires for data collection. In addition to this the Control Group Observation had been conducted to get a comparison between the beneficiary groups and non beneficiary groups considering improvements as well as economic sufficiency. 4 Focus Group Discussions (FGD) were also conducted with 10-12 respondents (representation of both male and female). After the completion of the field survey, data from all the interview schedules were coded, compiled, tabulated and analyzed in accordance with the objectives of the study.

IV. Results and Discussions

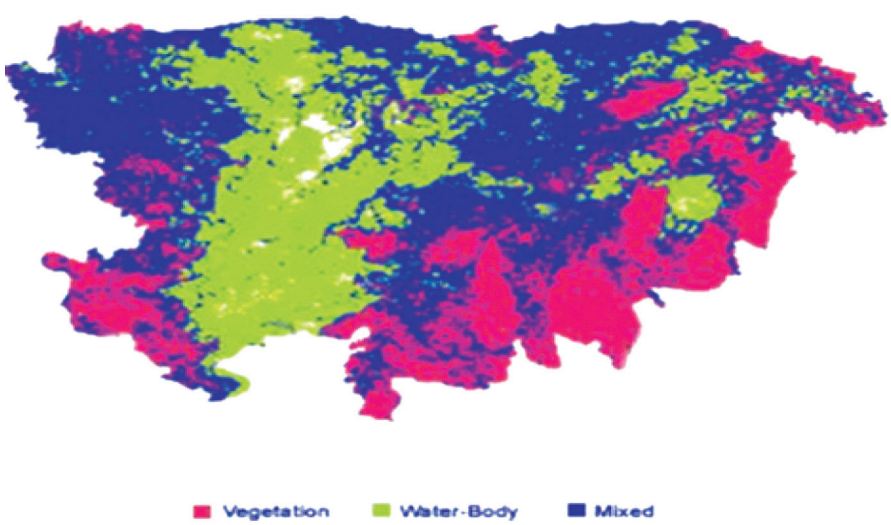
Figure 01: Land Distribution Pattern in Coastal Area

Source: Field Survey, 2014

From the above figure the total displaced land formation can be revealed. The left sided map represents the land distribution pattern before cyclone AILA, whereas the right sided map represents land distribution pattern after cyclone AILA. The comparative illustration shows that net cultivable lands are declining due to salinity intrusion. Because of soil salinity, a sizeable amount of cultivable land (about 30-50 %) remains fallow in Rabi and Kharif-I seasons. Respondents in the focused group discussion said that temperatures has increased over the years and duration of winter has been shortened affecting the potential growing period of winter crops drastically. Cultivation of wheat is being affected at the grain filling stage due to high temperatures and increased incidences of pests and diseases.

This figure - 02 shows various types of land cover in the study area. Analysis revealed that in the dry season, the vegetation cover area is the maximum whereas water bodies are the minimum. In the wet season, the vegetation cover has decreasing trends where as the water body has increasing trends. In the wet season, the number of pixels fluctuated with a downward trend. Similarly, mixed land cover and water body has a rampant difference in change pattern during the dry and wet season respectively.

Figure 02: Land Distribution Pattern in Haor Area



Source: Field Survey, 2015

Table 02: Yearly Land Loss in terms of Taka (thousand)

		< 10	10-30	31-50	51-70	71-90	91-110	111-130	131-150	>150
Landless	Current Land	*	*	*	*	*	*	*	*	*
	2 Years Ago	13	19	6	5	2	*	*	*	*
	5 Years ago	*	*	11	15	3	11	2	13	*
1-10 katha	Current Land	6	3	2	1	*	*	*	*	*
	2 Years Ago	7	12	11	9	*	*	*	*	*
	5 Years ago	*	*	*	7	11	3	13	15	*
11-19 katha	Current Land	2	2	1	4	*	*	*	*	*
	2 Years Ago	*	*	17	19	11	*	*	*	*
	5 Years ago	*	*	10	13	21	*	*	*	*
1-10 bigha	Current Land	*	5	9	11	9	4	*	*	*
	2 Years Ago	*	*	2	*	*	1	6	1	*
	5 Years ago	*	*	*	*	12	12	14	9	5

Field Survey, 2015

Table - 02 shows how people of the study area became landless due to the adverse affects inflicted by natural disaster, itclearly illustrates the vulnerability of agriculture to severe climate conditions. People currently having 1 to 10 katha of land 5 years ago approximately 7 percent had land property of BDT between 51000 to 70000 although in the same year 11 percent, 3 percent, 13 percent and 15 percent had land property fairly (between 71000 to 90000), (between 91000 to 110000), (between 110001-130000) and (between 130011-150000) taka respectively.

Similarly, the landowners currently having 11-19 katha land owning 2 percent value less than BDT 10000 whereas 12 percent household have land value ranged (between 10000-300000) BDT. Five years before approximately 10 percent, 13 percent, and 21 percent had landed property (between BDT 31000 - BDT 50000), (between BDT 51000 - BDT 70000), and (between BDT 71000 - BDT 90000). Hence from the information in the table 2 we can see that there seems to be a relationship between land displacement and continuous disaster.

Adaptive Crop Farming Practices

Table 03: Agricultural Yields and Productivity among FFL Crops

Name of Crop	FFL Yield	Expected highest Yield	National Average Yield	Percentage Increased
Pumpkin	30.0	35	20	50%
Mustard	1.0	1.5	0.89	12.36%
Barely	2.5	2.2	1.80	38.9%
Wheat	2.0	3.5	1.87	6.95%
Sunflower	1.5	1.7	1.4	7.14%

Field Survey, 2015

Through Focus Group Discussions (FGD) it was found that barley, pumpkin, wheat, sunflower & mustard are the most suited adaptable crops for the coastal & haor areas, which have been founded as suitable to face soil salinity, high temperature and water scarcity. All of these crops can be grown in vast fallow land easily also. Table - 03 shows a comparison of yields from Farmers' Field Laboratory (FFL) in relation with the expected highest yield and national average yield. It was observed that pumpkin production was 30 t/ha (Ton per hectare) with an increasing rate of 50% where, the expected highest yield was 35 t/ha and national average yield was 20 t/ha. Potato responded with boosted production of 20 ton/ha which is significantly greater than national average (10 t/ha).

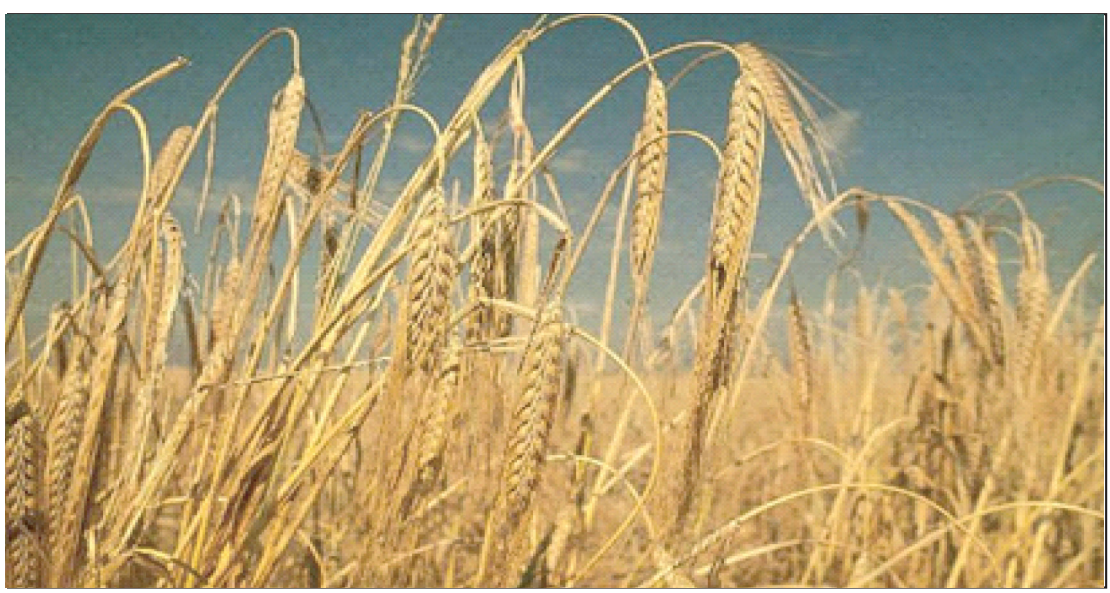
Crop production practices in the haor areas are quite different compared to other parts of the country, in terms of their ecosystem. According to the National Food Policy Capacity Strengthening Program (NFPCSP), 18.1% of households are listed under the hardcore poverty line and about 19% experience severe food insecurity for six to seven months of the year. The net cultivable land for agriculture is gradually diminishing due to the seasonal flooding. People are forced to give up cultivation, which is their traditional and oldest profession and they are struggling to find new employment. Agricultural lands are gradually losing their top soil fertility in fighting adversity of climate variability. Pumpkin production through technical strategies, which have been demonstrated by FFL, have shown a way of sustaining food security in the changing climate.

It takes a short time to cultivate pumpkin, nearly four months after plantation. The ultra poor people of the haor area are getting financial support through cultivating sweet pumpkin. Pumpkin also meets their nutritional demands, since it is relatively high in energy and carbohydrates as well as a good source of vitamins and minerals. Sowing seeds of pumpkin starts in the first week of November & yield begins in the middle of February to early March which is safe from the flash floods. Gradually the crop is gaining popularity in this region. During FGD the participants stated that they started harvesting pumpkins not so long ago.

Successful cultivation of pumpkins in the wetland has changed their fortune, enabling them to lead a better life. Since the past couple of years, many farmers tried to cultivate pumpkin but lack of knowledge and technology made it impossible for them to succeed. To cultivate Pumpkin in a bigha land or 27 decimal lands only BDT 1,200-1,500 is needed. Almost 500-600 pieces of pumpkin can be harvested from a bigha land. Each large size Pumpkin is sold for BDT 130-150 at local markets, whereas the value will increase 2-3 folds in the lean season. The above table reveals the production of pumpkin in per hectare from the Farmers Field Laboratory.

From the table it is evident that pumpkin production through Farmers Field Laboratory strategy is lower than the highest expected production. We saw that pumpkin production was 30 t/ha (Ton per hectare) where the national average yield was 20 t/ha which increased by 50% compared to the national average. It was explicated after discussion that the storage time of pumpkin is long. Through FGD it was found that since the demand is high, farmers can profit greatly by selling products in the lean period with premium sale price. From 2,200 pieces around 50,000 BDT can be attained in profit, which Is a phenomenal sum in the rural areas of Bangladesh.

B. Mustard: During FGD local farmers said that the comparatively low lands of Koyra and Shyamnagar area were typically kept fallow over the last ten years. These areas are suitable for mustard cultivation. Farmers added that this was a great opportunity to use the fallow land near their homestead to cultivate mustard. It took only 75-80 days, from mid-November to end of February. About six maunds of mustard can be obtained from a bigha land, for which approximately 2,800 BDT is needed as an investment cost. Per maund of mustard is sold at 1,700 BDT the total profit is about 7,400 from six maunds. The farmers can invest this profit to increase their crop production. During the Focus Group Discussion local farmers stated that if mustard production continues abundantly and they can get the expected output and



Production of mustard in per hectare from Farmers Field Laboratory (FFL) is demonstrated in table 03. As from the table it is evident that the production of mustard through Farmers Field Laboratory is approximately same with the national average production. The above table shows that mustard yield was seen around 1 t/ha (Ton per hectare), whereas the national average yield was 0.89 t/ha which increased by 12.36% compared to the national average. Nearly all of the FGD participants said that only two irrigations are enough for a plentiful mustard yield. During Rabi season no single crops can be grown in dry land, but currently FFL farmers in Koyra are practicing for mustard cultivation using the sweet rain water from the reservoir.

C. Barley: Barley is a stress tolerant and saline adaptive crop suitable for coastal area. Local farmers said that the harvesting time of Barley is early November in winter season, free from salinity intrusion. This Rabi crop is best adaptable in the coastal parts of Bangladesh. In Bangladesh barley yield is possible only in certain localities, but it's production can be increased at least by 50% along with pulse and oil seed crops [10], Interview with the local farmers suggested that, after a single rubbing, ground became fit for barley production. It requires timely fertilizer application and proper water for irrigation. The production of barley in per hectare from FFL is seen from table 03. As from the table, it is evident that barley production in coastal areas through the Farmers Field Laboratory strategy remains far more effective than that of its highest expectetions. It was seen that barley production in the coastal area was 2.5 t/ha (Ton per hectare), where the national average yield was 1.8 t/ha which increased by 38.9% compared to the national average.

D. Wheat: The Haor is a single crop area.Traditional agricultural practices which resulted in crop loss and food shortage every year due to the changing climate. To cope with the changing climate farmers need to adapt with new technology, variety and methods. Under the economic pricing wheat currently dominates as the second most important cereal crop, mostly in non-irrigated areas. Wheat (BARI Gom-26) is best adaptable to grow in South-Western parts yielding and boron deficient soils are suitable for its yielding. Mid-December is the perfect timing

Even the sowing time of wheat could be postponed for 15 days, but it takes only 104-110 days for harvesting. A light irrigation is needed after sowing seeds for proper germination and retaining appropriate moisture levels.

From FGD results it was found that it needs 24 BDT to produce per kg wheat, whereas the selling price is 32-34 BDT at the local market of the coastal areas. All the farmers are busy in harvesting this crop, because of its high yield potential quality. All of them are hopeful to make a good profit.

The production of Wheat in per hectare from Farmers Field Laboratory is shown in above table - 03. Due to temperature variation & late winter, short cold period the farmers couldn't cultivate Wheat profitably, Farmers Field laboratory has made it possible. It is evident that wheat production through Farmers Field Laboratory strategy remains far more effective than that of its highest expectations. It was seen that wheat production was 2 t/ha (Ton per hectare) where the national average yield was 1.87 t/ha which increased by 6.95% compared to national average. From the result of FGD it was emanated that with Wheat production land utility is being increased, even fallow land has come under cultivation with crop diversification. This practice has already become popular & proved to be viable, moreover daily protein or nutritional requirement of poor households is being attained. Through discussion with the local FFL farmers successful cropping patterns following Farmers Field Laboratory in Koyra Sadar has come out as Dhaincha - Wheat - Dhaincha - Transplanted Aman. They added due to cultivating Dhaincha ground becomes productive and more suitable for wheat yielding.

E. Sunflower: People in the coastal parts of Bangladesh can't harvest all types of crops throughout the year due to limited irrigation water and soil salinity constraints.. Local farmers of coastal areas intend to move on cultivating crops, which are climate adaptive as well as attaining huge market value like sunflower. It's a thermo neutral crop growing mostly in Rabi season. By expanding the area of Sunflower production it's possible to fill up the gap between production and consumption of edible oil.

Discussing with the local farmers it was found that soil salinity levels have increased sharply over the last 20 years. All local farmers in Coastal area strongly believe that salinity intrusion in soil and water is the main challenge in farming. After cyclone AILA salinity has intensified, which hampered the agricultural production thus most of the arable land remained fallow due to intrusion of salinity. IR, B has taken the scheme on assuring cropping intensity of climate adaptive crops along with using futile land for production purpose. Lands, which remain of no use after collecting Aman paddy, are being used for Sunflower cultivation by local FFL farmers.

Sunflower is a short duration yielding crop, the most favorable time of sowing seed is on November. About 2-3 irrigations are required to produce a yield of about 3 t ha. Within 120-130 days Sunflower is being matured to harvest. During harvesting time plants turn yellowish and seeds become black andcurvy. Amusingly, it was disclosed during conversation with the FFL farmers, a good number of female farmers are getting involved in sunflower cultivation on their fallow land since cultivation is easier, cheaper and more profitable.. A kg of sunflower seeds brings 500 to 600 grams of oil, an amount more than that from any other oil seeds. A very little irrigation and small amounts of fertilizers and insecticides are required.

Table 03 illustrates the production of sunflower per hectare through Farmers Field Laboratory. As from the table, sunflower production in coastal area through FFL in close proximity to the highest expected yield. It was seen that sunflower production in coastal area was 1.5 t/ha (Ton per hectare) where the national average yield was 1.4 t/ha which increased by 7.14% compared to national average. The FGD participants remarked that, compared to other existing crops in coastal areas, production process of sunflower is easy and harvest can be expected within a very short time. Even scope of women involvement with the procedure is relatively high, contributing in their family earnings and empowerment.

Socio-Economic Impacts

Table 04: Changes in Occupation After Project Intervention

Principal Occupation	Before Joining with Project			At Survey Period		
	Male	Female	All	Male	Female	All
Cultivation of Family Farm	17.2	38.4	55.6	16.6	53.4	70
Agricultural Wage Labour	20.0	1.9	21.9	2.1	0.2	2.3
Other Agriculture	0.4	0.9	1.3	6.5	7.2	13.7
Processing and Manufacturing	7.3	0.4	7.7	6.3	0.4	6.7
Trade and Shopkeeping	32.2	5.4	37.6	46.3	15.9	62.2
Transport	5.9	0.2	6.1	9.5	0.4	9.9
Construction and Other Services	10.4	2.4	12.8	12.7	1.7	14.4
No Productive Occupation	6.6	50.4	57	Nill	20.8	20.8

Field Survey, 2015

Table 04 clearly shows the changing trends of occupaition among the FFS farmers in the project area. About 70 percent beneficiaries have taken family farming as their major occupation with almost 53.4 percent representation of women. Thus 13.7 percent beneficiaries representing both male and female depends on other agricultural activity to support themselves as well as their family demands

Table 05: Increase in Employment in Activity by Occupation

Occupation	Before	At Survey Period	Increase in Employment
Cultivation	11.5	20.6	9.1
Livestock	13.4	16.7	3.3
Processing and Manufacturing	16.8	18.0	1.2
Trade	19.7	16.4	3.3
Shopkeeping	13.2	7.6	5.6
Transport	19.7	20.3	0.6
Others	2.2	3.9	1.7

Field Survey, 2015

Table 05 demonstrates the significant change in principal occupation of the FFL farmers. It is evident that participation in FFL led to increased production, productivity, and income in both Haor and coastal area. The findings are reported in table - 04 which shows that currently FFL farmers work off additional 20.6 days for cultivation, which was very sluggish before FFL intervention about 11.5 percent. Cultivation is found to be relatively more full time occupation than livestock and shopkeeping. The additional employment generated is found to be the highest for transport (Motorcycle, Van) services but it does not vary much across other occupations.

Table 06: Cumulative Status of Income

Income Interval	Current Income(FFL)	Baseline Income
No Income	0	21.8
<1000	0	3.3
1001-2000	0	5.8
2001-5000	42.54	29.3
5001-10000	46.25	33.8
10001-15000	8.63	4.5
15001-20000	1.88	0.8
20001-25000	0.58	0.3
25001-30000	0.13	0.3
greater than 30000	0	0.5

Source: Baseline Data and Cumulative Tracking Sheet Data, Apr-Oct, 2015

The above table - 06 shows the comparative income of the farmers participated in FFL. A significant number of beneficiaries (46.25 percent) earn BDT 5,001-10,000 currently, earning by 33.8 percent in previous period as the highest range in Baseline Income. The income increase within FFL households is most significant for the household with the lowest income level.

Table 07: Accumulation of Capital

After Project Intervention	Agricultural Investment		Non Agricultural Investment		Social Investment	
	% Reported	Amount	% Reported	Amount	% Reported	Amount
One Year	37.2	1000-2000	43.3	1000-2000	19.9	1000-2000
Two Years	41.3	2001-3000	34.2	2001-3000	24.5	2001-3000
Three Years	47.7	3001-4000	32.4	3001-4000	19.5	3001-4000

Field Survey, 2015

The most direct impact of FFL would be on accumulation of capital, both working and fixed. The change in the status of the FFL farmers with respect to the employment of working capital. The respondents reported that after first year about 37.2 percent benefiary amassed fairly 1,000-2,000 BDT for agricultural investment, which has increased to BDT 3,001 - 4,000 at third year,In addition 43.3 Perent farmers invested BDT 1000-2000 for Non Agricultural Investment includes expenditure on purchase of van, motorcycle, boat whereas a third about 32.4 percent of beneficiaries invested on non-agricultural sectors which increased to BDT 3001-4000 respectively.

Table 08: Perception of the Respondents about the Changes in Economic Condition after Project Intervention

Changes in Household Economy	After Poject Intervention
Improved	92.7
Remained the Same	5.2
Deteriorated	1.4
No Response	0.7
Total	**100**

Field Survey, 2015

The table - 08 shows the perception of of the farmers themselves about the impcat of FFL on their economic conditions. An overwhelming 92.7 percent fermears reported that FFL made a positive contribution to their life and livelihood . Presently they can easily manage their family expenditure with children education. Even their savings in the local bank have assuaged the persecution for future requirement. Only 5.2 percent responded and said that their conditions have remained the same .

Table 09: Reasons Behind the Improvement in Economic Condition after Project Intervention

Reasons	Before Joining with Project (%)			At the time of Survey (%)		
	Male	Female	Total	Male	Female	Total
Free from the clutches of Mahajon	6.5	3.2	9.7	7.4	4	11.4
Accumulation of Capital	6	4.6	10.6	7.2	5.1	12.3
Additional Employment in Productive Work	11.5	8	19.5	11.6	8.6	20.2
Increse in Wage Rate	13.3	6.9	20.2	6.4	2.2	8.6
More involvement in Livestock and Poultry	Nil	0.2	0.2	1	3.3	4.3
More involvement in Vegetable and Fruits Growing	0.3	0.1	0.4	1.2	0.8	2
More Investment in Agriculture	20	12.2	32.2	25.6	13.6	39.2
Others	4	3.2	7.2	1	1	2
Total	**61.6**	**38.4**	**100**	**61.4**	**38.6**	**100**

*** The respondent was asked to report three factors behind the improvement of their conditions in order of imprortence. This column shows the distribution of all respondents. The figure and the row 'total' shows that the respondents on average 2.6 reasons.

Field Survey, 2015

The importance of various factors behind the improvement in economic conditions as stated by the FFL farmers is obvious from table 09. Significant change was seen among FFL farmers economic condition following the involvement with agriculture, livestock and poultry. Before engaging with FFL only 0.2 percent of females were involved with Livestock and Poultry, which is now around 3.3 percent and 4.3 percent in total.

Table 10: Nutritional Behavior Change in Composition of Nutritional Intake

Parameter		Project Period
Three Meal	Before Project Intervention	6.0
	At the time of Survey	97.5
Increase (%)		91.5

Field Survey, 2015

The table reveals that there was a higher diversity of food eaten by the FFL members Based on the 24 hour food frequency, most families were consuming cereals and vegetables that were promoted in FFL. Table also showed that about 97.5 percent has succeeded to have their daily meal triple after engaging with FFL intervention, whereas before FFL intervention it was around 6.0 percent, which has been increased to 91.5 percent.

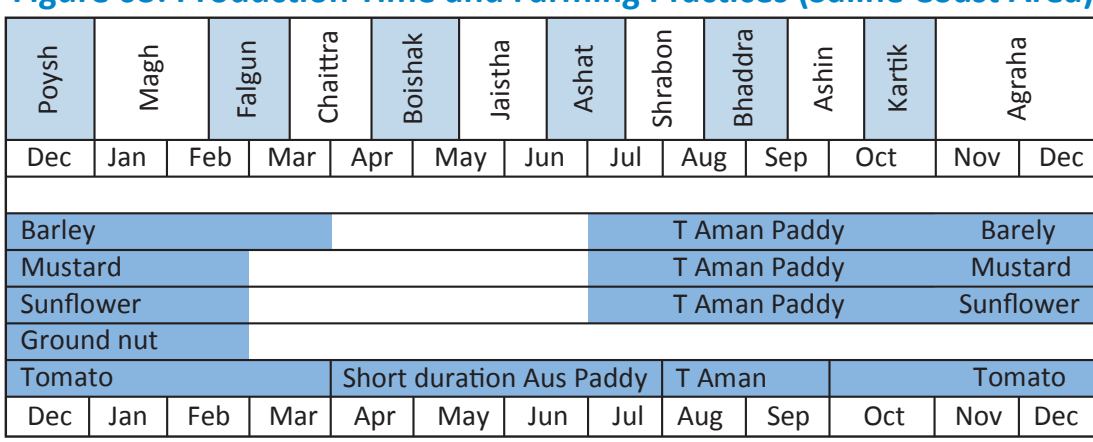
Table 11: Food Intakes of Beneficiary and Non-Beneficiary

Food Groups	Beneficiary Intake	Non Beneficiary Intake (GMS)	National Nutrition Survey (GMS)
Cereal (Rice, Wheat)	501	476	456
Animal (Meat, Egg, Fish and Milk)	49	39	30
Other Plants and Vegetables	307	274	220
Total	857	789	706

Field Survey, 2015

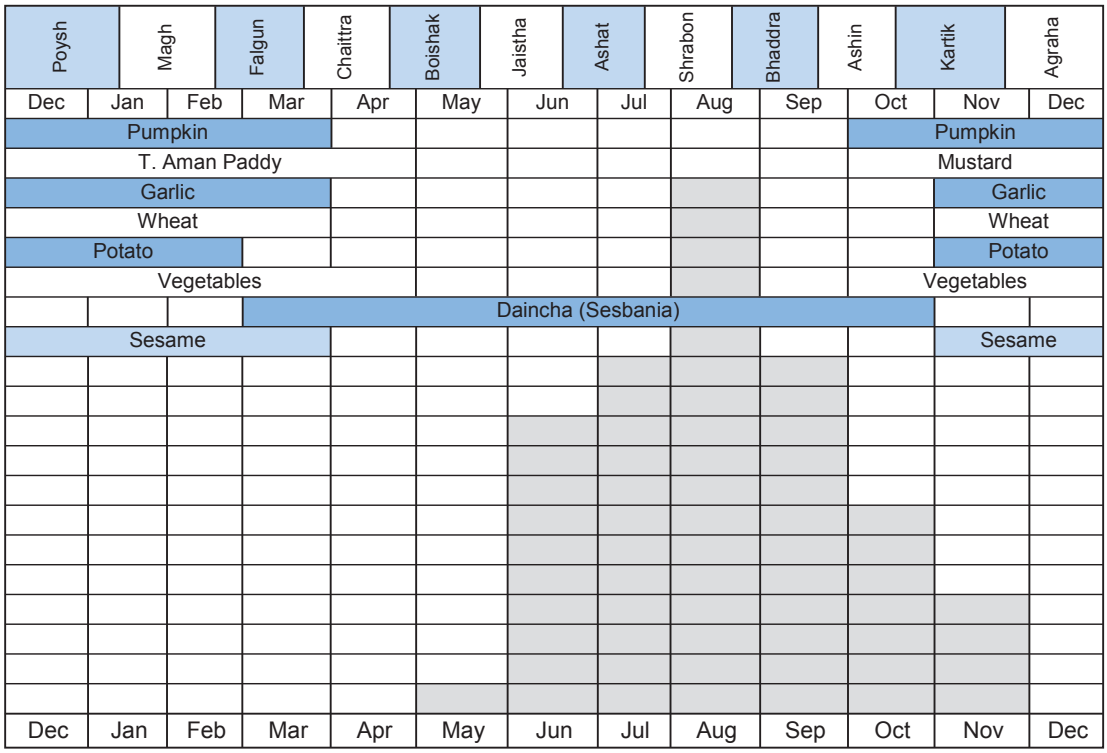
Table 11 presents per capita intake of nutrients of FFL beneficiaries vis-a-vis non beneficiaries.It was found that nearly 49 grams Protein as (Meat, Fish etc) are obtained by beneficiaries both from Haor and coastal belt, whereas only 39 grams can be managed by non-beneficiaries in their daily meal which is higher than the national average (30 grams). For Cereal (grain) dietary food intake almost 501 grams consumed fairly by the benificiary farmers whereas the non-benefiary can't attain vegetables volume more than 274 grams.

Figure 03: Production Time and Farming Practices (Saline Coast Area)



Farmers Field Laboratory a New Cropping Strategy with Advance Profitability for Farmers in Coastal Areas (Findings from FGD): It was identified from the discussion with the farmers July-August is concentrated as the lowest of saline months. In response to questions about salinity most of the participants said that, sometimes Rabi crops like barley, mustard, sunflower, chili, ground nut and tomato dried up due to salinity intrusion. Community people mentioned that most of the land of coastal areas is used for single cultivation. At present a significant amount of land is being used for double cropping after FFL support. Community people also feel that the seasonal cycle could not be anticipated now any longer. Previously practiced cropping pattern and seasons have been changed responding towards climatic change. Many respondents pointed out that due to intensity of disaster as cyclone and hazards as tidal surges, soil salinity farmers are often forced to change their crop production plan. Crops as barley, mustard, sunflower, chili can be grown from November to February, are selected by local farmers as their major crop. Evidently this cropping period is free from seasonal risk of tidal surge, flood and cyclones. From Focus Group Discussion it was elucidated that good timing for barley, mustard and sunflower production is mid-November to February. All participants agreed that changing cropping pattern considering seasonal calendar assures their local food security.

Figure 04: Production Time and Farming Practices (Haor Area)



Farmers Field Laboratory a New Cropping Strategy with Advance Profitability for Farmers in Haor Areas (Finding From FGD): Figure - 04 illustrates the crop in considering flooding period over the year. Oral interviews and FGDs revealed that July to October is the peak time for flash flood in haor area and evidently flood water goes down after November (Karthik), all agricultural lands remain under water till Kartik. The FGD participants identified that flood water inundation is on the highest range from Shrabon to Vadra. From seasonal point of view, Kharif season starts from April and extends up to November, when the moisture of the soil is enough to support rain-fed. On the other hand, Rabi season is characterized by dry sunny weather at the beginning and which ends in December-February. From FGD result it was illustrated that the local farmers have adopted the crop calendar to secure their year round livelihood option. Farmers were acknowledged that Ashin-Kartik is

the perfect timing for Pumpkin production, so pumpkin seed sowing from October to December when flood water tends to go down. It takes a very short time (3-4 months) for harvesting. January-March (Bangla Poysh-Falgun) farmers begin to collect pumpkin, the time mostsafe from flash flooding. The participants said that mustard cultivation leads double profit for haor people. The same field is potentially used for yielding Transplanted Aman (T-Aman) after mustard nurturing from October to mid December. Haor is a suitable cropped area for winter farming. Moreover best time for wheat cultivation is early November, when water levels are reduced.

Recommendation:

- Based on the findings of this study it was concluded that Farmers Field Laboratory as an extension approach is viable for enhancing agricultural production. Also, improvement was noticed for strengthening community capacity to increase agricultural production and improve livelihoods in a way that is adapted to local contexts.
- Mustard, Wheat and Pumpkin are found suitable for crop diversification and intensification in Haor context. In the coastal area barely, wheat, sunflower, mustard is found suitable to face soil salinity, high temperature and water scarcity.
- There is a need for a constant follow-up of both extension and farmers.
- FFL successfully strengthened local knowledge through linkages with scientific institutions, thereby contributing to bridging the gap between the needs of the farmers and research. In order to further strengthen the capacities of farmers the lessons learned through the piloting process should be returned to the farmers.
- In considering sustainability, institutionalizing FFL approach, stronger collaboration and harmonization with extension service interventions need to be explored.

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