Livelihood Adaptation to Climate Change (LACC-II) Project
(BGD/01/004/01/99)

Technical Guideline
on
Establishment of Adaptation Option Demonstrations
for
Rabi season/October - March
in
Drought prone and saline areas

Department of Agricultural Extension
Food and Agriculture Organization of the United Nations

Introduction on the adaptation option identification, demonstration and evaluation process

The identification, validation and approval of the adaptation practices have done by following a sequence of activities. In the first step, adaptation practices that had already been applied locally and/or had been previously introduced by national development, research and extension organizations were collected and documented by the project. The adaptation practices identified from the project area can be categorized as: a) agronomic management, b) water harvesting c) water resources exploitation, d) water use efficiency, e) crop intensification, f) alternative enterprise, g) alternative energy source etc.

From this preliminary list, those adaptation options to be further promoted and/or replicated were selected through a sequence of evaluation processes at different levels starting from upazila-level DMC members, Upazila level Technical Implementation Groups (UTIWG) and National level Technical Implementation Working Groups (NTIWG). First consultative meetings and brief feed back workshops were also organized with the national research institutions (BARI, BRRI, BLRI and BFRI) and developmental organizations. The adaptation options were evaluated with the UTIWG and NTIWG for their technical suitability in drought-prone areas.

The outcome of the stakeholder evaluation was integrated into the multi-criteria analysis that included (a) drought/salinity mitigation potential, (b) suitability for future climate scenarios, (c) environmental friendliness, (d) economic viability, (e) increased productivity, (f) sustainability (f) social acceptability, (g) gender integration, (h) household income, (i) employment opportunity, (j) relevance to vulnerable community, (k) applicability to multiple sectors, (l) seasonal relevance, (m) immediate need, (n) institutional support and (o) expert acceptance. The criteria based evaluation was followed by a selection and prioritization based on (i) effectiveness in reducing key risks, (ii) potential technical as well as costs, social acceptance and manageability, and (iii) current state of implementation and additional requirements.

Selected adaptation practices suitable for different seasons (*kharif I*, *kharif II* and *rabi*) are recommended for field demonstrations in the farmers fields. Local farmer groups together with extension staff finally choose suitable adaptation options for their localities.

Once the options are tested in the farmers' fields a two step evaluation is carried out in order to get an over all assessment of the acceptance of the technologies at the farmers level. An evaluation is done afterwards, preferably after carrying out trials for 2-3 seasons, at the scientific and technical level to find out the relevance and flexibility of the certain options in relation to climate change and development the resilience of the farming community.

The assessment and evaluation have been done so far for the options tested in the first phase of the project and therefore the recommendation has been followed in the implementation of the same in the second phase of the project. Recommendation for promotion and replication to the similar areas and upazilas are suggested based on the over all performance and acceptance ratings of the adaptation technologies. Evaluation and assessment for the new options, identified and tested in the second phase have to be done following the same framework used in the first phase. However, there have been some observations gathered from the implementation and regular monitoring of the option demonstrations in second phase and those may be considered for further implementation and replication.

The adaptation demonstrations are established in the farmers' field of the project villages who were selected through an approved criteria and maintaining certain process. As far as the project objectives are concerned mostly interested poor and female farmers having enough land, required resources and manpower have to be selected and engaged in the demonstration activities. The technical guideline with the monitoring guideline is meant to follow as hands on guidance in the implementation, day to day technical support and monitoring of the adaptation demonstrations.

Information and guidance provided in the technical guideline are mostly standard and specific as per the general and specific needs in drought and coastal areas. For example implementation of any demonstration follows almost same principle and process everywhere and however the there are differences in the selection of species or crop varieties, computation of the fertilizer doses etc which are done as per requirement of the area/upazila.

Project and DAE Officers are placed to pay regular visits to the demonstration sites, observe the status of the trial and provide on the spot technical suggestions and guidance as deemed necessary and as per need of the farmers. A monitoring register is maintained for

Social mobilization initiative like farmers' field day, result demonstrations, cross visits were arranged in order that the surrounding farming communities had opportunity to get exposed to the technologies of the demonstrations.

General information and guidance for implementation and monitoring of the option demonstrations

Background

This guideline is prepared based on the need received from the pilot upazilas of the LACC-II project and have been validated and cleared by the UTIWG, UDMC and NTIWG. The technical information gathered from the respective Upazila Agriculture Officers (UAO) and Field Officers (Monitoring) of the project are also incorporated in the guidelines. Necessary technical inputs were also collected from the experts of DAE, DLS, DoF, BARI, BRRI, BLRI and FRI. A number of technical books and papers were consulted to make the guideline as appropriate as possible. The entire technical part and budget (attached separately) of the guideline was shared with the DAE experts, research scientists, team members at PMU and FAO, HQs and necessary adjustment has been made.

General instruction

1. Implement the demonstration as per the time/duration provided in the guideline. Any adjustment required due to the local condition and environment may be done with prior consultation with the PMU/concerned person.
2. Farmer selection must be according to the need of the demonstration, which is essentially based on the local farmers need and it should be such that the objective of the demonstration can be achieved successfully.
3. Follow the budget break-up, procure the required materials and services, keep necessary documents and vouchers and proof evidence by attaching photograph during the re-imbursement/adjustment of the project advance.
4. A general fertilizer dose is provided in each demonstration. This may be adapted to the local condition as per the dose suggested in the recommendation by BARC/AEZ (Annex-1) and also the soil test results of particular plot.
5. The number of demonstrations i.e. the replication in each demonstration and the required budget for it is specified in the guideline. Therefore any change in this case can be done only after prior consultation with the PMU/concerned person.
6. Every single demonstration has its own monitoring requirement and accordingly a *monitoring guideline and formats have been attached*. Timely and regular monitoring is vital for capturing the effect/impact of project intervention. Therefore it is mandatory to keep timely, authentic and verifiable data and information and prepare the report and send to the PMU/concerned person in time. An establishment/progress report has to be prepared and submitted immediately after the establishment of the demonstration (Format-I).
7. A signboard for each demo has to be prepared and placed at the demonstration site as per the sample attached with this guideline.
8. For any technical matter consultation with the scientists of local BARI, BRRI, BLRI, FRI, BFRI stations and DAE, DLS, DoF, Forest Department is essential and open.
9. Use common sense and rational judgment while taking decision in every situation and such that farmers must not be the looser.
10. PMU/concerned person may be contacted for any thing related to the demonstrations.

Farmer selection criteria

1. LACC project insists to work with poor farmers who really need project support in their endevour to improve their livelihood by increasing resilience to climate change.
2. LACC must work with real farmers who work by own hand not (generally) by the hired labour and who are not (generally) involved in any other business.
3. Find farmers who are really interested in the type of works LACC project intends to do with him/her and participate, contribute, share activities, resources and information.
4. Select farmers who have land/space for undertaking demonstration trial of adaptation options as decided and agreed with the farmers.
5. Identify farmers who have time to spend for the project activities, demonstration of technical options, participation in the meeting, training, contribution to the awareness programmes etc.
6. Better to select farmers who have family labour to employ in the demonstration activities so that the unused or underemployed labour gets used and money saved from hiring a labour.
7. Must make a balance in selection while distributing the adaptation trials in a village so that both male and female farmers are picked up as per the requirement and merit.
8. Should nominate farmers who are respectful to the project/DAE officers/staff (Farmers s*hould not believe that the project/DAE staff are working with them for retaining their job only*).

Monitoring guideline and process

1. For each option, as per the requirement and the decision, a control farmer/plot has to be selected prior to the initiation of the demonstration activities. The control farmers and plots have also to be monitored and data and information collected accordingly.
2. Baseline information of farmer/plot have to be recorded at the beginning of the demonstration activities which could be used later (preferable at the end of each activity) to compare the results and findings.
3. Soil analysis of each plot/site is a mandatory to record the soil condition i.e. the nutrient content and other aspects of the soil as per the situation need and requirement.
4. Soil and water salinity (in coastal area specially) analysis has to conducted likewise from the plots, ponds.
5. Monthly rainfall, temperature, humidity and other data can be collected from the nearest reliable sources like Upazila Agriculture Office, local Weather Station.
6. Monitoring will be done basically to record the quantitative data and appraise qualitative information from the farmers, others.
7. Monitoring indicators or variables of each option are based on the objective/s of the particular option demonstration.
8. A monitoring register/khata must be maintained at the demo farmer household and the farmer should be facilitated to understand and regularly/periodically record the data and information as per the requirement of the demonstration.

Provision for control farmer or control plot

Engagement with or finding out the control farmer or control plot and thus monitoring the production, management, yield and other aspects are conditional with the requirement and merit of the option which must have been decided at the beginning of the season. But, the criteria for selection of the farmer and plot, others must be same as the project/main/treatment farmer or plot.

List of abbreviation

BARC	: Bangladesh Agriculture Research Council
BARI	: Bangladesh Agriculture Research Institute
BCSIR	: Bangladesh Council for Scientific and Industrial Research
BFRI	: Bangladesh Fisheries Research Institute
BINA	: Bangladesh Institute of Nuclear Agriculture
BLRI	: Bangladesh Livestock Research Institute
BRRI	: Bangladesh Rice Research Institute
DAE	: Department of Agricultural Extension
DLS	: Department of Livestock Services
DoF	: Department of Fisheries
FYM	: Farm Yard Manure
GHG	: Green House Gas
ICS	: Improved Cooking Stove
LACC-I	: Livelihood Adaptation to Climate Change, Phase-I Project
LACC-II	: Livelihood Adaptation to Climate Change, Phase-II Project
NTIWG	: National Technical Implementation Working Group
PMU	: Project Management Unit
SRI	: System of Rice Intensification
UAO	: Upazila Agriculture Officers
UDMC	: Union Disaster Management Committee
UTIWG	: Upazila Technical Implementation Working Group

Agricultural/common term

Apple kul	: An improved and introduced jujube variety
BAU kul	: An improved jujube variety from Bangladesh Agricultural University
BARI Chola 5	: A chick pea variety released by BARI
Barind tract	: North-western drought prone area of Bangladesh
Bigha	: 1 bigha equals 33 decimal
Black Bengal	: An local goat variety
Bombai	: An improved litchi variety from India
Boro	: Irrigated winter rice
China-3	: An improved litchi variety from China
Khaki Kamble	: An improved duck variety from UK
Kharif-I	: Early monsoon cropping season
Kharif-II	: Monsoon cropping season
Macha	: Bamboo mat/platform
Monga	: Seasonal famine condition in northern Bangladesh
Narkeli kul	: A local jujube variety found in the coastal region
Rabi	: Winter cropping season
Sarjan	: An age old composite crop production practice of coastal (Barisal) region
Satabdi	: A wheat variety released by BARI
T. Aman	: Rain fed monsoon rice
Til	: Bengali terminology of Sesame

List of Options demonstrated in Rabi season in the farmers fields

Impact of water saturated soil condition on rice cultivation

A. Context and Justification:

Farmers of *barind* tract struggle for irrigation water especially in the months of Rabi season, for cultivating irrigated rice crops. As a general practice, farmers irrigate the rice field by flooding method, i.e. they drain in more than enough water and keep the rice field in almost stagnant water. Sometimes redundant water is lost which is costly and causes negative environmental impacts like soil erosion, leaching loss of soil nutrients etc. The water saturated soil condition on rice production, a similar technology as the System of Rice Intensification (SRI), was suggested by the scientist and thus introduced in the winter season to increase water use efficiency by ensuring use of judicious amount of water in irrigation and save the precious water from being lost though evaporation, seepage and run-off during the production cycle.

B. Objective:

To provide the farmers with opportunity to learn as how irrigation water can best be utilized and increase its efficiency in irrigated rice cultivation.

Demonstrations showcase how to –

- assess the amount of water required in the cultivation of the crop in comparison with the control/traditional practice.
- evaluate the economic comparison with the control/traditional practice.
- appraise farmers perceived opinion about the potential effect/impact of climate change induced hazards like drought on the sustainability of the option and the comparative advantages of the with the traditional practice.

C. Implementation time:

Rabi/October - March.

D. Successfully tested sites/upazilas:

Year	North-west	South-west
2005	Nachole, Gomostapur, Sapahar and Porsha	N/A
2006	Nachole, Gomostapur, Sapahar and Porsha	N/A

E. Technical details:

Land area:
A total of 33 decimal land may be brought in for the cultivation of the variety.

Land preparation: The land should be well prepared by ploughing and harrowing three to four times. Fertilizer should be applied in appropriate dose at the time of land preparation. For sandy loam to silty loam soil, 2-3 ploughing to and cross plowing with subsequent 3-4 laddering are required so that the soil has a good tilth. For a clay type of soil, soil preparation requires more tillage operation at appropriate soil moisture status

Variety:

BRRI dhan28 was recommended for by the scientist and thus accepted by the farmers.

Seedling raising: *Boro* seeds should be sown in medium high land near the main field. Before seed sowing the organic matter and other nutrient should be ensured.

Time of seed sowing: The appropriate time to sowing seed is 30 October to 15 November.

Seed rate**:** Seed rate will be 4-6 kg/ bigha.

Spacing: In case of line sowing, line to line spacing should be 15 cm.x 20 cm.

Fertilizer dose and timing: Apply fertilizer as per quantity shown in table 1 below. The application should follow the standard procedure applicable for the agro-ecological context/area/zone.

Table 1.Fertilizer dose per pit for rice cultivation

Name of Fertilizer	**Quantity per bigha (33 dec.)**
Urea	24-30 Kg
TSP	14-20 Kg
MP/MOP	10-14 Kg
Gypsum	10 Kg
Zinc sulphate	1 Kg
Boron	1 Kg
Compost/cow dung	200 Kg

Source: BARC

Method of Fertilizer Application: Half of the urea and all of other fertilizers may be applied during the last round of tillage/land preparation following broadcast method and mix the fertilizer properly with the soil. The remaining half of the urea should be applied by topdressing in two installments first one after attaining 4-5 tillers per hill and second is before 5-7 days of the dough stage (*Kiachthor*).

Irrigation: The option should be demonstrated in the villages where the farmers have access to irrigation water. Rice field should be irrigated only when it requires water. The field must not be submerged with water all the time rather than the irrigation has to be provided in a way that the soil is moistened and the plants get water. A prefixed schedule may not be necessary as usually followed, rather irrigate the field actually when water is required. Water is applied to the field while the soil is dried and no water remains in the rice field unlike the usual irrigation provision that keeps water in the field.

Weeding: As per the need of the field.

Harvesting: While the 80% of the crop is matured, the harvesting can be initiated.

F. Trial demonstration budget:

SL #	Item	Amount of input/bigha(Kg/No.)	Unit cost (BDT)	Total Cost (BDT)	Remarks
1	Seed	8 Kg	60	480.00	
2	Compost	200 Kg	1	200.00	
3	Urea	24 Kg	12	288.00	
4	TSP	15 Kg	40	600.00	
5	MP/MOP	12 Kg	35	420.00	
6	Gypsum	10 Kg	10	100.00	
7	Zinc Sulphate	1 Kg	150	150.00	
8	Boron	1 Kg	150	150.00	
9	Sign board	1	500	500.00	
10	Irrigation cost (Lump sum)			1500.00	
11	Register khata	1	30	30.00	
	Total (Four thousand four hundred and eighteen only)			**4418.00 (US $ 64)**	

G. Replication suitability and recommendation:

The adaptation option was tested in the drought prone in rabi season of 2005 in the fist phase (LACC-I) of the project. The option was introduced with the aim of increasing the water use efficiency in the rice field. Since the irrigation is provided from a power driven deep tube well, the availability of irrigation water is dependent on the power supply situation which is often disrupted during the cropping season in the area concerned. Due to the less secure access of irrigation water a low acceptance by the local farmers was observed. Another reason for low acceptance was the labour requirement for the demonstration which is a little higher than for the usual practice for boro rice cultivation. However, in respect of the climatic and environmental benefits, the option is suggested to be offered to the project farmers under more secure irrigation conditions and/or water availability or in combination with options that increase water availability (e.g. a mini pond). The practice saves energy required in the machine for uplifting irrigation water from the ground and thus reduces the emission of the green house gas.

Table: Evaluation framework for recommendation and replication

Suitable for replication under the following conditions					**Primary target group**	**Investment costs for replication**	**Environ-mental benefits**	**Justification for replication**			**Recommendation (remarks)**
Farming system	AEZ	Hazard type/ impacts	Water mgt system	Micro-topography/ terrain				**Increase of CC resilience**	**Economic**	**No/ marginal increase of GHG emission**	
Rice-Rice/ Wheat	25, 26	Drought spells; loss of crops	Irri-gated	High and low barind tract	Poor/ medium farmers with land owners hip	64 US $	High	Me-dium	Yes	marginal increase (use of energy for irrigation)	Recommended as adaptation option with secured irrigation (from mini pond)

Adapting *Boro* rice cultivation to changing conditions

A. Context and Justification:

Rice has been the lifeline of the huge population of Bangladesh which is grown throughout the year in all three cropping season. Due to the climate variability and other environmental changes, rice cultivation especially in the drought prone areas and the coastal saline region is facing increasing challenges. Adjustment is needed in varieties and other technologies being used currently. In the drought prone north-western upazilas where due to the reduced duration of the rabi season current varieties need to be replaced with the short duration varieties. Similarly, the increased salinity in the south-western region has posed the farming community to change the local and other varieties which can tolerate increased salinity in the rabi season and at the same time provide more yield per unit area. Introduction of Boro rice varieties like BRRI dhan28 and BRRI dhan47 developed by the BRRI are respectively recommended for the drought prone and coastal saline area are considered as an appropriate adaptation option for farming community that serve both the purposes of short duration for the north and salinity tolerance in the south.

B. Objective:

To provide the farmers with opportunity for learning the suitability of the rice varieties that can grow well in the increased drought in the north-western part and salinity in coastal areas.

Demonstrations showcase how to –

- assess the amount of water and other inputs (e.g. fertilizer, energy) required in the cultivation of the crop in comparison with the control/traditional practice.
- evaluate the economic comparison with the control/traditional practice.
- appraise farmers perceived opinion about the potential effect/impact of climate change induced hazards like drought, salinity etc and other factors (price) on the sustainability of the production practice and the comparative advantages of the local and HYV varieties rice grown in the demo.

C. Implementation time:

Rabi/October - March.

D. Successfully tested sites/upazilas:

Year	North-west	South-west
2008	Lalpur and Bagatipara	Dacope, Terokhada, Bhandaria and Nazirpur
2009	-	Bhandaria and Nazirpur

E. Technical details:

Land area:
A total of 33 decimal land may be brought in for the cultivation of the variety.

Land preparation: The land should be well prepared by ploughing and harrowing three to four times. Fertilizer should be applied in appropriate dose at the time of land preparation. For sandy loam to silty loam soil, 2-3 ploughing to and cross plowing with subsequent 3-4 laddering are required so that the soil has a good tilth. For a clay type of soil, soil preparation requires more tillage operation at appropriate soil moisture status

Variety:

HYV varieties: BRRI dhan28 was recommended for drought prone area i.e. Lalpur and Bagatipara.

BRRI dhan47 was recommended for the coastal area i.e. Terokhada, Dacope, Bhandaria and Nazirpur.

Seedling raising: *Boro* seeds should be sown in medium high land near the main field. Before seed sowing the organic matter and other nutrient should be ensured.

Time of seed sowing: The appropriate time to sowing seed is 30 October to 15 November.

Seed rate**:** Seed rate will be 4-6 kg/ bigha.

Spacing: In case of line sowing, line to line spacing should be 15 cm.x 20 cm.

Fertilizer dose and timing: Apply fertilizer as per quantity shown in table 1 below. The application should follow the standard procedure applicable for the agro-ecological context/area/zone.

Table 1.Fertilizer dose per pit for rice cultivation

Name of Fertilizer	**Quantity per bigha (33 dec.)**
Urea	24-30 Kg
TSP	14-20 Kg
MP/MOP	10-14 Kg
Gypsum	10 Kg
Zinc sulphate	1 Kg
Boron	1 Kg
Compost/cow dung	200 Kg

Source: BARC

Method of Fertilizer Application: Half of the urea and all of other fertilizers may be applied during the last round of tillage/land preparation following broadcast method and mix the fertilizer properly with the soil. The remaining half of the urea should be applied by topdressing in two installments first one after attaining 4-5 tillers per hill and second is before 5-7 days of the dough stage (*Kiachthor*).

Irrigation: The rice field should not be submerged with water all the time. Irrigation should be applied maintain a schedule as described in the BRRI manual. It is important to mention that in between two irrigations a three days dry period should be maintained. It is also to be noticed that before application of top dressing of fertilizer, the crop field must be without irrigation water and can be given after 2-3 days.

Weeding: As per the need of the field.

Harvesting: While the 80% of the crop is matured, the harvesting can be initiated.

F. Trial demonstration budget:

SL #	Item	Amount of input/bigha (Kg/No.)	Unit cost (BDT)	Total Cost (BDT)	Remarks
1	Seed	8 Kg	60	480.00	
2	Compost	200 Kg	1	200.00	
3	Urea	24 Kg	12	288.00	
4	TSP	15 Kg	40	600.00	
5	MP/MOP	12 Kg	35	420.00	
6	Gypsum	10 Kg	10	100.00	
7	Zinc Sulphate	1 Kg	150	150.00	
8	Boron	1 Kg	150	150.00	
9	Sign board	1	500	500.00	
10	Irrigation cost (Lump sum)			3000.00	
11	Register khata	1	30	30.00	
	Total (Five thousand nine hundred and eighteen only)			**5918.00 (US $ 86)**	

G. Replication suitability and recommendation:

The adaptation option was tested in the drought prone and the coastal saline areas in the rabi season of 2008 and 2009 in the second phase (LACC-II) of the project. The result and experiences gained demonstrate that farmers in coastal area still believe in the local varieties for their inherent capacity and resilience to the increased salinity in the coastal area in particular, although a shift towards accepting HYV varieties is promising. Demonstration trials of the same variety for another 2 to 3 seasons in different locations along with awareness raising campaigns are needed for confirmation of the results and acceptance by the farmers as well. The variety tested in the drought prone (low/flat barind) area did not show much difference in the usual varietal traits and therefore further test may not be needed. However a thorough assessment by using the evaluation framework used in LACC-I period is needed for making a confirmed decision and recommendation.

Adapting Wheat cultivation to changing conditions

A. Context and Justification:

Wheat is one of the most important tropical grain crops grown well in the northern regions of Bangladesh. Compared to rice it requires less water and can tolerate more drought condition. Hence, for drought prone areas where scarcity of ground and underground water is a major problem, the production of wheat can be taken as an adaptation option. In addition to the drought problem, temperature pattern and length of the winter in the drought prone area has been changing over the period. The intensity and extent of fog has also been increasing over the years especially in the flat barind area. In this condition farmers are struggling to find a suitable wheat variety that can thrive well and give a good yield. BARI has advocated a variety suitable to that particular area can be promoted as a technology to be tested for the region which is expected to perform well and produce good yield.

B. Objective:

To provide the farmers with opportunity for learning the suitability of the wheat varieties that can grow well in the increased drought in the north-western part and salinity in coastal areas.

Demonstrations showcase how to –

- assess the amount of water and other inputs (e.g. fertilizer, energy) required in the cultivation of the litchi in comparison with the control/traditional practice, other crops
- calculate the economic benefits in comparison with the control/traditional production practice, other crops
- appraise farmers perceived opinion about the potential effect/impact of climate change induced hazards like drought and other factors (price) on the sustainability of the wheat production.

C. Implementation time:
Rabi/October – March.

D. Successfully tested site/upazila:

Year	North-west	South-west
2008	Lalpur and Bagatipara	-
2009	Lalpur and Bagatipara	-

E. Technical details/production guideline of maize:

Variety: BARI variety *Satabdi* is suggested for its possible suitability in the area.

Soil : Flood free and sandy loam or loamy soil.

Land preparation: Land has to be tilled 4-5 times depending on the soil type. To soil should be leveled by laddering to make the soil particles thin.

Time of sowing: October to November.

Seed rate: 18 – 20 kg/bigha.

Method of sowing: Line sowing is better.

Fertilizer dose: Fertilizer doses for wheat production are shown in table below:

Table - Fertilizer dose for one bigha wheat production demonstration

Name of Fertilizer	**Quantity per bigha**
Urea	30-35 kg.
TSP	18- 20 kg.
MP	7-8 kg.
Gypsum	17-20 kg.
Cow dung	800 kg.

Method of Fertilizer application: Cow dung will be mixed well in the soil. One third of urea and all other fertilizers will be mixed with soil during the last tillage. The remaining urea in two equal halves will be applied. In rabi season the 1st half will be applied during 20-25 days after sowing. The other half will be top dressed 40-45 days after sowing.

Irrigation: Depending on soil types and level of moisture in the land 2-3 irrigation may be needed. Efforts must be made to ensure that there is no shortage of soil moisture during seedling, flowering and grain formation stages.

Weeding: 2-3 times weeding is needed.

F. Trial demonstration budget:

SL #	**Item**	**Amount of input/bigha (Kg/No.)**	**Unit cost (BDT)**	**Total Cost (BDT)**	**Remarks**
1	Seed	20 Kg	80.00	1600.00	
2	Compost	300 kg	1.00	300.00	
3	Urea	30 Kg	12.00	360.00	
4	TSP	15 Kg	40.00	600.00	
5	MP/MOP	15 Kg	35.00	525.00	
6	Gypsum	10 Kg	10.00	100.00	
7	Irrigation (Lump sum)			2000.00	
8	Sign board	1	500.00	500.00	
9	Register khata	1	30.00	30.00	
	Total (Six thousand one hundred and five taka only)			**6105.00 (US $ 89)**	

G. Replication suitability and recommendation:

The adaptation option was tested in the drought prone in two seasons in 2008 and 2009 in the second phase (LACC-II) of the project. The result and experiences gained demonstrate that the wheat variety *Satabdi* performed well in the increased trend of drought, temperature, fog and reduced winter duration. Farmers have been found to accept the variety and are enthusiastic to continue with the variety and can easily be promoted in the low/flat barind area. However a thorough assessment by using the evaluation framework used in LACC-I period is needed for making a confirmed decision and recommendation.

Maize cultivation as an alternative crop

A. Context and Justification:

Facing with recurrent drought and struggling with shortage of irrigation water, farmers of the drought prone *barind* area are always in search of alternatives, technologies, crops to enable them to cope with the situation. As common traits, farmers of the areas are looking for more drought-tolerant crops, which maintain higher yield level and require fewer inputs and are thus less time intensive technologies. In the context of unavailability of appropriate alternatives, Maize comes as an option despite several demerits. Yet even maize has other economic and multiple uses like raw material for poultry feed to support the ever increasing poultry industry, cattle feeds, fuel etc. Hence, cultivation of maize was selected by the local farmers and thus recommended by the upazila agriculture office as an adaptation option.

B. Objective:

To cultivate the maize in the drought prone area as an alternative to the existing cropping pattern and also increase the yield and income form the same piece of land.

Demonstrations showcase how to –

- evaluate suitability of the crop in local conditions, also taking into consideration the future scenario i.e. increased drought, temperature etc.
- assess the amount of fertilizers, organic matters and other inputs required in the cultivation of the maize in comparison with the control/traditional practice.
- evaluate the economic comparison with the control/traditional and other practices.
- appraise farmers perceived opinion about the potential effect/impact of climate change induced hazards like drought, temperature etc and other factors (price) on the sustainability of the production practice and the comparative advantages of the crop.

C. Implementation time:

Rabi/October – March

D. Successfully tested sites/upazilas:

Year	North-west	South-west
2006	Nachole and Gomostapur	N/A

E. Technical details:

Land area: 1 Bigha (33 dec.).

Land type: Medium high land with loam or clay loam soil, which is not flooded.

Land preparation: The land should be well prepared by ploughing and harrowing three to four

Variety: Hybrid variety.

Soil: Flood free and sandy loam or loamy soil.

Land preparation: Land has to be tilled 4-5 times depending on the soil type. To soil should be leveled by laddering to make the soil particles thin.

Time of sowing: March to April.

Seed rate: 20 kg/ha.

Method of sowing: Line sowing should be done.

Distance between lines**:** 75cm.

Distance between plants**:** 25cm.

Depth of sowing**:** 25-30cm.

Number of seeds in each hole: 1 seed.

Fertilizer dose: Fertilizer doses for maize production are shown in table 1 below.

Table-1. Fertilizer dose for one bigha Maize production demonstration

Name of Fertilizer	Quantity per bigha (33 dec)
Urea	70kg.
TSP	35kg.
MP	35kg.
Gypsum	25kg.
Zinc sulphate	2.5 kg.
Boron	1kg.
Cow dung	800kg.

Method of Fertilizer application: Cow dung will be mixed well in the soil. One third of urea and all other fertilizers will be mixed with soil during the last tillage. The remaining urea in two equal halves will be applied. 1st half will be applied during 20-25 days after sowing and the other half will be top dressed at 40-45 days after sowing.

Irrigation: Depending on soil types and level of moisture in the land 2-3 irrigation may be needed. Efforts must be made to ensure that there is no shortage of soil moisture during seedling, flowering and grain formation stages.

Weeding: 2-3 times weeding is needed.

F. Trial demonstration budget:

SL #	Item	Amount of input/bigha (Kg/No.)	Unit cost (BDT)	Total Cost (BDT)	Remarks
1	Seed	3 Kg	180.00	540.00	
2	Urea	70 Kg	12.00	840.00	
3	TSP	35 Kg	40.00	1400.00	

4	MP/MOP	35 Kg	35.00	1225.00	
5	Gypsum	25 Kg	10.00	250.00	
6	Boron	1 Kg	150.00	150.00	
7	Irrigation	Lump sum		2500.00	
8	Sign board	1	500.00	500.00	
9	Register khata	1	30.00	30.00	
	Total (Six thousand one hundred and five taka only)			**7435.00 (US $ 109)**	

G. Replication suitability and recommendation:

The adaptation option was tested in the drought prone in the rabi seasons in 2006 in the first phase (LACC-I) of the project. Although maize has a strong adaptive capacity in most of the geographical and hazardous areas, there are negative aspects to the cultivation: Maize is an exhaustive crop that depletes most of the nutrients of the soil and thus leaves the land very unproductive for the following seasons. The project discontinued the activity based on the feedback from the farmers and considering other environmental implications like loss of soil fertility, require increased amount of chemical fertilizers that costs additional money for farmers. Time was also too short, to discuss the suitability of the option with other stakeholders, in particular scientists. The option should not be promoted further.

Table: Evaluation framework for recommendation and replication

Suitable for replication under the following conditions					**Primary target group**	**Investment costs for replication**	**Environ-mental benefits**	**Justification for replication**			**Recommendation (remarks)**
Farming system	AEZ	Hazard type/ impacts	Water mgt system	Micro-topography/ terrain				**Increase of CC resilience**	**Economic and social**	**No/ marginal increase of GHG**	
Rice-Rice/ Wheat	25, 26	Drought spells; loss of crops	Irri-gated/ rain fed	High barind tract	Small/ medium farmers with land ownership	109 US $	No	No	Yes	no increase	Not recommended

Chickpea cultivation as drought evading strategy

A. Context and Justification:

In the rain fed dry areas of the *barind* tract farmers are unable to cultivate rabi (winter season) crops like pulses and oils with their traditional practice that starts late while the crop land gets dry. Due to the high temperature and early withdrawal of rain in some years, field soil is left with no or little amount of moisture which does not allow crops to grow and sustain. As a result the most of the high lands remain fallow for the whole rabi season after the harvest of T. Aman rice. In this context, research institutes as BARI suggest crop diversification and introduced T. Aman-Chick pea/pulse cropping pattern in recent years. After T. Aman transplantation in the early onset of rain in the month of July and rice harvesting, the seeds of the pulse crop are sown tapping the residual moisture in the field to facilitate easy germination. As a part of the T. Aman-Chick pea cropping pattern the chickpea block demonstration can be established to introduce a new cropping pattern that exploits the current climatic condition of the drought prone area and provides farmers an option to incorporate crops in the fallow period. Introduction of chickpea in the existing cropping pattern will as well increase cropping intensity of this drought prone region and may be the one of the important adaptation options for resource poor farmers of the Barind tracts.

B. Objective:

To provide the farmers with opportunity for learning the suitability of the chick pea variety that can grow well in the increased drought in the north-western part and salinity in coastal areas.

Demonstrations showcase how to –

- appraise the suitability of the BARI variety as an alternative in the drought prone area of the project
- assess the amount of water and other inputs (e.g. fertilizer, energy) required in the cultivation of the crop in comparison with the control/traditional practice
- evaluate the economic comparison with the control/traditional practice
- assess the nutrient status and other changes happened in the soil
- appraise farmers perceived opinion about the potential effect/impact of climate change induced hazards like drought and other factors (price) on the sustainability of the production practice and the comparative advantages of the chick pea over other pulse crops grown in the demo

C. Implementation time:

Rabi/October - March.

D. Successfully tested sites/upazilas:

Year	North-west	South-west
2006	Nachole and Gomostapur	N/A
2008	Nachole, Gomostapur, Porsha and Sapahar	-

2009	Nachole, Gomostapur, Porsha and Sapahar	-

E. Technical details:

Soil: Clay loam and loam soils are good for chickpea cultivation.

Variety: BARI *Chola* 5.

Land preparation: 3-4 cross-ploughing followed by laddering.

Time of Sowing seed: For Barind area time is between last week of October to first week of November.

***Seed rate*:** For broadcast 50-60 kg / ha. and for line sowing 45-50 kg.

Spacing: In case of line sowing, line to line spacing should be 40 cm.

Fertilizer dose: The following fertilizer doses per hectare to be applied at the time of last tillage are shown in Table 1.

Table 1. Fertilizer doses for chickpea cultivation

Name of Fertilizer	Fertilizer Dose/ha
Urea	40-50 kg.
TSP	80-90 kg.
MP	530-40kg.
Boron	5-6 kg.

Method of Fertilizer Application: Apply all fertilizers during the last round of tillage.

Irrigation: Usually no need of irrigation but if the soil is not adequately moist, apply slight irrigation after sowing.

Weeding: Weeding within 30-35 days after sowing.

Harvesting: Harvesting time varies between 125-135 days.

H. Trial demonstration budget:

SL #	Item	Amount of input/bigha (Kg/No.)	Unit cost (BDT)	Total Cost (BDT)	Remarks
1	Seed	35Kg	80.00	2800.00	
2	Urea	30 Kg	12.00	360.00	
3	TSP	60 Kg	40.00	2400.00	
4	MP	25 Kg	35.00	875.00	
5	Gypsum	30 Kg	10.00	300.00	
6	Boron	5.0 Kg	150.00	750.00	
7	Sign board	1	500.00	500.00	
8	Register khata	1	30.00	30.00	

	Total (Eight thousand and fifteen only)	**8015.00 (US $ 117)**	

Note: *Some insects like pod borer infected some chick pea fields in previous years and caused some damages. According to the knowledge and information from the scientists, experts and other sources chick pea was intercropped with Barley, Coriander with a view and belief to reduce the attack of Borers. The incorporation of the seeds of the crops and other management have to be done according to the usual procedure.*

G. Replication suitability and recommendation:

As per the lessons from the first and second phases (LACC-I and LACC-II) and evaluation done through the evaluation framework below, the option can be promoted in high barind area where farmers have less or no access to irrigation water. The option can also be combined with the mini pond where some irrigation is needed. As the option requires early seedlings, inclusion of the dry seed bed method for seedlings availability may also be taken up as part of the total pattern. The technology should be promoted further in the community and the adjacent villages in the following seasons for the poor and small farmers, including sharecroppers, and for the community as a whole, particularly where they can bring more land together (as a block) under the demonstration. In addition, more social mobilization programmes are needed for more awareness generation and a higher adoption by the farmers.

Table: Evaluation framework for recommendation and replication

Suitable for replication under the following conditions					**Primary target group**	**Investment costs for replication**	**Environ-mental benefits**	**Justification for replication**			**Recommendation (remarks)**
Farming system	AEZ	Hazard type/ impacts	Water mgt system	Micro-topography/ terrain				**Increase of CC resilience**	**Economic and social**	**No/ marginal increase of GHG**	
Rice-Wheat /Pulse	25, 26	Drought spells; loss of crops	Rain fed	High and low barind tract	Poor/ medium farmers with land ownership	117 US $	High	High	Yes	no increase	Highly recommended as adaptation option combined with mini pond

Mustard cultivation as drought evading strategy

B. Context and Justification:

In the rain fed dry areas of the *barind* tract farmers are unable to cultivate rabi (winter season) crops like pulses and oils with their traditional practice that starts late while the crop land gets dry. Due to the high temperature and early withdrawal of rain in some years, field soil is left with no or little amount of moisture which does not allow crops to grow and sustain. As a result the most of the high lands remain fallow for the whole rabi season after the harvest of T. Aman rice. Mustard regarded as drought tolerant oil crop and recommended by the farmers and UTIWG to grow in the high and medium barind land with/without minimum irrigation. It is believed that introduction of mustard can exploit the current drought prone condition and provides farmers an option to incorporate a crop in the fallow period and will as well increase cropping intensity of this drought prone region. The option was later approved by the NTIWG members i.e. scientist, experts and officers with a view to test the yield and other performances in the increased temperature induced drought condition.

B. Objective:

To provide the farmers with opportunity for learning the adaptive capacity of mustard and its yield and other performances in the increased drought in the north-western area.

Demonstrations showcase how to –

- appraise the suitability of the BARI variety as an alternative in the drought prone area of the project
- assess the amount of water and other inputs (e.g. fertilizer, energy) required in the cultivation of the crop in comparison with the control/traditional practice
- evaluate the economic comparison with the control/traditional practice
- assess the nutrient status and other changes happened in the soil
- appraise farmers perceived opinion about the potential effect/impact of climate change induced hazards like drought and other factors (price) on the sustainability of the crop and the comparative advantages of the mustard over other oil crops grown in the area.

C. Implementation time:

Rabi/October - March.

D. Successfully tested sites/upazilas:

Year	North-west	South-west
2009	Nachole, Gomostapur and Porsha upazilas	-

E. Technical details:

Soil: Clay loam, loam, sandy loam.

Variety: BARI *Sharisha* 9 or BARI *Sharisha*14 and 15.

Land preparation: In rabi season the best time of land preparation is between October to mid – November.

Sowing of seed: 15 October -15 November.

Seed rate**:** 8-10 kg / ha.

Spacing: In case of line sowing, line to line spacing should be 30 cm with continuous sowing. Later on maintained 55-60 plants/m^2 by thinning at 10-12 days after emergence.

Fertilizer dose: Usually farmers do not use fertilizer for mustard cultivation. But for better production the following fertilizer dose as in table 1 may be used for mustard cultivation.

Table 1. Fertilizer doses for mustard cultivation

Sl #	Name of Fertilizer	Fertilizer dose (Kg/ha)
1	Urea	250-300kg.
2	TSP	150-180kg.
3	MP	70-100kg

Method of Fertilizer Application: Half of the urea and all doses of other fertilizers may be applied during the last round of tillage following broadcast method and mix the fertilizer properly with the soil. The remaining half of the urea should be applied by topdressing 25-30 days after flowering stage.

Irrigation: For mustard cultivation during *rabi* season requires one irrigation at 25- 30 days after sowing at the flowering stage. In case of lack of soil moisture second irrigation may be applied after 50-55 days at grain formation stage.

Harvesting: Harvesting time varies between 75-90 days.

F. Trial demonstration budget:

SL #	Item	Amount of input/bigha (Kg/No.)	Unit cost (BDT)	Total Cost (BDT)	Remarks
1	Seed	1.5 Kg	100.00	150.00	
2	Urea	35 Kg	12.00	420.00	
3	TSP	20 Kg	40.00	800.00	
4	MP	12 Kg	35.00	420.00	
5	Gypsum	20 Kg	10.00	200.00	
6	Zinc sulphate	1 Kg	150.00	150.00	
7	Boron	1 Kg	150.00	150.00	
8	Sign board	1	500.00	500.00	
9	Register khata	1	30.00	30.00	
	Total (Two thousand eight hundred and twenty only)			**2820.00 (US $ 41)**	

G. Replication suitability and recommendation:

The adaptation option was tested once in the rabi season of 2009 in two upazilas under the Chapai Nawabganj district and one upazila under Naogaon district in the second phase (LACC-II) of the project. Therefore, no results could have been possible to gather and thus analyze within the reporting period. Hence further test of the option may be recommended for making appropriate judgment and decision. However, farmers showed up their keen interest in the option in informal discussion during the implementation of the demonstration.

Linseed cultivation as drought evading strategy

A. Context and Justification:

Farmers are unable to cultivate rabi (winter season) crops like pulses and oils in the rain fed dry areas of the *barind* tract with their traditional practice that starts late while the crop land gets dry. Due to the high temperature and early withdrawal of rain in some years, field soil is of the barind lands left with no or little amount of moisture which does not allow crops to grow and sustain. As a result the most of the high lands remain fallow for the whole rabi season after the harvest of T. Aman rice. Linseed, once cultivated in the drought prone villages started disappearing due to the loss of interest of the farmers due to the unavailability of suitable variety. Linseed was recommended by the farmers and UTIWG to grow in the high and medium barind land with/without minimum irrigation. Farmers believed that introduction of linseed can exploit the current drought prone condition and provides farmers an option to incorporate a crop in the fallow period and will as well increase cropping intensity of this drought prone region. The option was later approved by the NTIWG members i.e. scientist, experts and officers with a view to test the yield and other performances in the increased temperature induced drought condition.

B. Objective:

To provide the farmers with opportunity for learning the adaptive capacity of linseed and its yield and other performances in the increased drought in the north-western area.

Demonstrations showcase how to –

- appraise the suitability of the selected variety as an alternative in the drought prone area of the project
- assess the amount of water and other inputs (e.g. fertilizer, energy) required in the cultivation of the crop in comparison with the control/traditional practice
- evaluate the economic comparison with the control/traditional practice
- assess the nutrient status and other changes happened in the soil
- appraise farmers perceived opinion about the potential effect/impact of climate change induced hazards like drought and other factors (price) on the sustainability of the crop and the comparative advantages of the linseed over other oil crops grown in the area.

C. Implementation time:

Rabi/October - March.

D. Successfully tested sites/upazilas:

Year	North-west	South-west
2006	Nachole and Gomostapur upazilas	
2009	Nachole and Sapahar upazilas	-

E. Technical details:

Soil: Clay loam, loam, sandy loam.

Variety: BARI linseed 1 and 2 variety.

Land preparation: In rabi season the best time of land preparation is between October to mid – November.

Sowing of seed: 15 October -15 November.

***Seed rate*:** 7-8 kg / ha.

Spacing: In case of line sowing, line to line spacing should be 30 cm. and plant to plant 5 cm.

Fertilizer dose: Usually farmers do not use fertilizer for linseed cultivation. But for better production the following fertilizer doses as in table 1 may be used for linseed cultivation.

Table 1. Fertilizer doses for linseed cultivation

Name of Fertilizer	**Fertilizer dose/ha**
Urea	70-80kg.
TSP	110-130kg.
MP	40-50kg

Method of Fertilizer Application: Half of the urea and all doses of other fertilizers may be applied during the last round of tillage following broadcast method and mix the fertilizer properly with the soil. The remaining half of the urea should be applied by topdressing 25-30 days after flowering stage

Irrigation: For linseed cultivation during *rabi* season requires one irrigation 25- 30 days after sowing at the flowering stage. In case of lack of soil moisture second irrigation may be applied after 55- 60 days at grain formation stage.

Harvesting: Harvesting time varies between 85- 95 days.

F. Trial demonstration budget:

SL #	**Item**	**Amount of input/bigha (Kg/No.)**	**Unit cost (BDT)**	**Total Cost (BDT)**	**Remarks**
1	Seed	2.5 Kg	80.00	200.00	
2	Urea	10 Kg	12.00	120.00	
3	TSP	18 Kg	40.00	720.00	
4	MP/MOP	7 Kg	35.00	245.00	
5	Sign board	1	500.00	500.00	
6	Register	1	30.00	30.00	
	Total (One thousand eight hundred and fifteen only)			**1815.00 (US $ 27)**	

Note: *Insect like pod borer infected some linseed fields in previous years and caused some damages. According to the knowledge and information from the scientists, experts and other sources linseed was intercropped with Barley with a view and belief to reduce the attack of*

Borers. The incorporation of the seeds of the crop and other management have to be done according to the usual procedure.

G. Replication suitability and recommendation:

The adaptation option was tested once in the rabi season of 2009 in one upazila each under Chapai Nawabganj and Naogaon districts in the second phase (LACC-II) of the project. Therefore, no results could have been possible to gather and thus analyze within the reporting period. Hence further test of the option may be recommended for making appropriate judgment and decision. However, farmers showed up their keen interest in the option in informal discussion during the implementation of the demonstration.

Grass pea (*Khesary*) cultivation as salinity and tide evading strategy

A. Context and Justification:

Due to changes in the climatic and other environmental factors, the coastal region is undergoing and experiencing various changes in the cropping pattern. In some coastal districts like Pirojpur, low lying crop lands remains moist after the harvesting of T. Aman and duration for rabi crop/s becomes shortened where cultivation becomes difficult for some crops. On the other hand the situation can be exploited without investing in the land preparation cost and other inputs. Grass pea cultivation is a local adaptation practice in the moist land. The grass is a popular crop in the region and used both as food and fodder. The practice has been selected by the farmers and recommended by the local experts and approved by the scientists as a suitable technology to be promoted and further tested.

B. Objective:

To provide the farmers with opportunity for learning the suitability of the grass pea variety that can grow well in the increased salinity in the coastal areas.

Demonstrations showcase how to –

- calculate the economic benefits in comparison with the control/traditional production practice, other crops
- assess the nutrient status and other changes happened in the soil of the part
- appraise farmers perceived opinion about the potential effect/impact of climate change induced hazards like tide, salinity and other factors (price) on the sustainability of the production practice in comparison with other practices

C. Implementation time:

Rabi/October - March.

D. Successfully tested site/upazila:

Year	North-west	South-west
2008	-	Bhandaria and Nazirpur
2009	-	Bhandaria and Nazirpur

E. Technical details:

Seed rate:
Seed rate is 7-8kg/bigha. For relay, cropping a little more seed may be needed.

Variety: Local.

Land preparation: No land preparation is required and only cleaning of the remains of the earlier crop.

Fertilizer dose: Apply fertilizer as per quantity shown in table 1. below

Table 1.Fertilizer dose *kheshari* cultivation

Name of Fertilizer	**Quantity per bigha (33 dec)**
Urea	30 Kg

Source: BARC

Method of Fertilizer application: Apply all fertilizers at the final land preparation.

Harvesting: Harvesting may be initiated while the stem and leaves start changing to brown and drying.

F. Trial demonstration budget:

SL #	**Item**	**Amount of input/bigha (Kg/No.)**	**Unit cost (BDT)**	**Total Cost (BDT)**	**Remarks**
1	Seed	30 Kg	50.00	1500.00	
2	Urea	15 Kg	12.00	180.00	
3	Sign board	1	500.00	500.00	
4	Register khata	1	30.00	30.00	
	Total (Two thousand two hundred and ten taka only)			**2210.00 (US $ 32)**	

G. Replication suitability and recommendation:

The adaptation option was tested in the coastal saline area in two seasons in 2008 and 2009 in the second phase (LACC-II) of the project. Although cultivation of grass pea has been a sporadic practice in the area but it has got a strong potential as a salinity and tide evading strategy where the problem of increased salinity and inundation due to tide is a regular phenomenon. Therefore the promotion of the technology can be undertaken by DAE through its existing extension system where further trial may be demonstrated in new villages/unions/upazilas by the project. However a thorough assessment by using the evaluation framework used in LACC-I period is needed for making a confirmed decision and recommendation.

Sesame cultivation as salinity management strategy

A. Context and Justification:

Sesame is an oil crop grown especially in sandy loam to clay loam, loamy soil and has been a good source of raw oil for the industrial use. Sesame is being cultivated in some upazilas of Khulna districts like Terokhada where farmers are traditionally cultivating the crop in slightly saline land of the upazila. In some land where cultivation of seasonal crops is limited due to the retention of excessive moisture and salinity in the soil sesame stands as a ready crop for cultivation. It provide the opportunity for additional yield and income from the land that otherwise might have been left fallow. Based on the recommendation from the local farmers and the upazila technical team, sesame cultivation has been taken as potential local adaptation option. The project's intervention would be to incorporate new or BARI variety and endeavour to learn the suitability of the varieties in the changing saline regime of the area.

B. Objective:

To provide the farmers with opportunity for learning the suitability of the sesame that can grow well in the increased drought in the north-western part and salinity in coastal areas.

Demonstrations showcase how to –

- appraise the suitability of the BARI or BINA variety as an alternative in the saline area of the project
- assess the amount of water and other inputs (e.g. fertilizer, energy) required in the cultivation of the crop in comparison with the control/traditional practice
- evaluate the economic comparison with the control/traditional particular land
- assess the nutrient status and other changes happened in the soil of the part
- appraise farmers perceived opinion about the potential effect/impact of climate change induced hazards like salinity etc and other factors (price) on the sustainability of the production practice

C. Implementation time:

Rabi/October – March.

D. Successfully tested sites/upazilas:

Year	North-west	South-west
2008	-	Terokhada

E. Technical details:

Soil: Sesame can be cultivated in any land which is free from water logging. High lands with sandy loam or loam soil is more suitable for sesame cultivation.

Variety: BARI Til 3 and 4 or BINA Til 6 etc.

Land preparation: In *Rabi* season the best time of land preparation is between October to mid November.

Sowing of seed: Line sowing or broadcasting method of seed sowing.

Seed rate**:** 5.5 -6.5 kg / ha.

Spacing: In case of line sowing, line to line spacing should be 30 cm. and plant to plant 5 cm.

Fertilizer dose: The following fertilizer doses as in Table 1 may be used for sesame cultivation.

Table 1. Fertilizer doses for sesame cultivation

Name of Fertilizer	**Fertilizer dose/ha**
Urea	100-125 kg.
TSP	130-150kg.
MP	40-50kg.
Gypsum	100-110kg.
Zinc Sulphate	0-5 kg.
Boron	8-10kg.

Method of Fertilizer Application: Half of the urea and all doses of other fertilizers may be apply during the last round of tillage following broadcast method and mix the fertilizer properly with the soil. The remaining half of the urea should be applied by topdressing 25-30 days after flowering stage.

Irrigation: For sesame cultivation during rabi season requires one irrigation 25- 30 days after sowing at the flowering stage. In case of lack of soil moisture second irrigation can be applied after 55- 60 days at grain formation stage.

Weeding: As per the need of the field.

Harvesting: Harvesting time varies between 85- 95 days.

F. Trial demonstration budget:

SL #	**Item**	**Amount of input/bigha (Kg/No.)**	**Unit cost (BDT)**	**Total Cost (BDT)**	**Remarks**
1	Vine cuttings	10560	Lump sum	1000.00	
2	Compost	1000 Kg	1.00	1000.00	
3	Urea	16 Kg	12.00	192.00	
4	TSP	20 Kg	40.00	800.00	
5	MP/MOP	8 Kg	35.00	280.00	
6	Gypsum	8 Kg	10.00	80.00	
7	Zinc sulphate	1 Kg	150.00	150.00	
8	Boron		150.00	150.00	
9	Sign board	1	500.00	500.00	
10	Register khata	1	30.00	30.00	
	Total (Four thousand one hundred and eighty two taka only)			**4182.00 (US $ 61)**	

G. Replication suitability and recommendation:

The adaptation option was tested in the coastal saline area in one season in 2008 in the second phase (LACC-II) of the project only. The result and experiences gained demonstrate that the option may be tested further for making well informed decision whether to promote and replicate the option in new areas. After the subsequent test, a thorough assessment by using the evaluation framework used in LACC-I period is needed for making a confirmed decision and recommendation.

Potato cultivation by zero tillage

A. Context and Justification:

Due to changes in the climatic and other environmental factors, the coastal region is undergoing and experiencing various changes in the cropping pattern. In some coastal districts like Pirojpur low lying crop lands remains moist due to late recession of monsoon water after the harvesting of T. Aman. As a result the duration for rabi crop/s become shortened where cultivation becomes difficult for some crops. On the other hand the situation can be exploited without investing in the land preparation and other inputs. Zero tillage potato cultivation is an emerging and potential adaptation option in the moist land. The practice has been recommended by the farmers and local experts and approved by the scientists in NTIWG as a suitable technology to be tested for recommendation for wider promotion as a sustainable option for the region.

B. Objective:

To provide the farmers with opportunity for learning the suitability of the potato that can grow well in the increased tidal and salinity problems in coastal area.

Demonstrations showcase how to –

- assess the amount of water and other inputs (e.g. fertilizer, energy) required in the cultivation of the litchi in comparison with the control/traditional practice, other crops
- calculate the economic benefits in comparison with the control/traditional production practice, other crops
- appraise farmers perceived opinion about the potential effect/impact of climate change induced hazards tide, salinity etc and other factors (price) on the sustainability of the production practice in comparison with other practices

C. Implementation time:

Rabi/October - March.

D. Successfully tested site/upazila:

Year	North-west	South-west
2008	-	Bhandaria and Nazirpur
2009	-	Bhandaria

E. Technical details:

Variety: Diamont/Cardinal/Lalpukri or local.

Land preparation: No land preparation is required and only cleaning of the remains of the earlier crop.

Tuber selection: Select healthy and disease free tuber for the cultivation.

Transplanting time: Last week of October to last week of November.

Planting distance: 50 cm x 25 cm.

Planting of tubers: Seed potato may not be covered or may be covered a little in the soil.

Application of mulch: After planting, the rows may be covered by water hyacinth or straw (17-20 cm thick). This will ensure adequate soil moisture.

Fertilizer dose: Apply fertilizer as per quantity shown in table 1. below

Table 1.Fertilizer dose per potato cultivation

Name of Fertilizer	**Quantity per bigha (33 dec)**
Urea	30 Kg
TSP	20 Kg
MP	35 Kg
Gypsum	16 Kg
Zinc sulphate	2 Kg

Source: BARC

Method of Fertilizer application: Apply all fertilizers at the time of final land preparation.

Rat management: Rat may attack the crop. Appropriate IPM methodology can be applied for rat control.

Harvesting: While the stem and leaves start changing to brown and drying, harvesting may be done.

F. Trial demonstration budget:

SL #	**Item**	**Amount of input/bigha (Kg/No.)**	**Unit cost (BDT)**	**Total Cost (BDT)**	**Remarks**
1	Potato seed/tuber	50 Kg	30.00	1500.00	
2	Compost	500 Kg	1.00	500.00	
3	Urea	5 Kg	12.00	60.00	
4	TSP	2 Kg	40.00	80.00	
5	MP/MOP	2 Kg	35.00	70.00	
6	Gypsum	2 Kg	150.00	300.00	
7	Zinc sulphate	1 Kg	150.00	150.00	
8	Sign board	1	500.00	500.00	
9	Register khata	1	30.00	30.00	
	Total (Three thousand one hundred and ninety taka only)			**3190.00 (US $ 47)**	

G. Replication suitability and recommendation:

The adaptation option was tested in the coastal saline area in two seasons in 2008 and 2009 in the second phase (LACC-II) of the project. The result and experiences gained demonstrate that the option has received a positive response from the farmers towards the acceptance and replication and hence the option may be promoted further. However a thorough assessment by using the evaluation framework used in LACC-I period is needed for making a confirmed decision and recommendation.

Adapting Sweet potato in a coastal tidal land

A. Contest and Justification:

Owing to the changes happened due to the climate uncertainties, seasonal variability or other environmental problems low lying flat lands of Pirojpur district are frequently inundated by tidal flow from the sea leaving the crop lands of this area drenched and unsuitable for a longer period of time. As a result cultivation of seasonal crops is limited in some years in most of the flat low lying areas. Farmers have little choice and hardly can make decision for growing any crop in these lands based on the prevailing and impending circumstances where risk of crop loss is a regular phenomenon. Sweet Potato cultivation has been found as farmers' practice in some low lying areas of the district as a response to the stated problem. The practice of sweet potato cultivation is identified and recommended by UTIWG/NTIWG to promote as a potential alternative/option in the project villages of the coastal region.

B. Objectives:

To provide the farmers with opportunity for learning the suitability of the sweet potato that can grow well in the increased tidal problem in coastal area.

Demonstrations showcase how to –

- assess the amount of water and other inputs (e.g. fertilizer, energy) required in the cultivation of the sweet potato in comparison with the control/traditional practice, other crops
- calculate the economic benefits in comparison with the control/traditional production practice, other crops
- appraise farmers perceived opinion about the potential effect/impact of climate change induced hazards like tide, salinity etc and other factors (price) on the sustainability of the production practice in comparison with other practices

C. Implementation (Sowing) time:

Rabi/October – March.

D. Successfully tested Sites:

Year	North-west	South-west
2008	-	Bhandaria and Nazirpur
2009	-	Bhandaria

E. Technical details:

Variety: *Tripti* or *Kamalasundari* or BARI sweet potato 7 and 8

Soil: Loam and sandy loam soil is more suitable for sweet potato cultivation.

Planting of sweet potato: The number of creepers needed 50,000 per hectare. The first and the second part from the top of the creeper are to be sown. The spacing between the lines is 60 cm and plant's 30 cm. It has to be sown in lines in a way that keeps 2-3 joints under soil.

Fertilizer dose: Fertilizer doses for sweet potato cultivation are shown in table below:

Table - Fertilizer dose for sweet potato cultivation demonstration

Name of Fertilizer	Quantity per bigha
Urea	18-20 kg.
TSP	15-16 kg.
MP	22-25 kg.

Apply cow dung and one-fourth of urea, TSP and MP by using it with soil at the time of sowing. The remaining fertilizers are to be placed beside the lines 60 days later.

Irrigation: Apply 2-3 irrigation depending on the level of soil moisture.

Intercultural operation: Tie up twice the lower end of the plants when second round fertilizer is given.

F. Trial demonstration budget:

SL #	Item	Amount of input/bigha (Kg/No.)	Unit cost (BDT)	Total Cost (BDT)	Remarks
1	Vine cuttings (Lump sum)	10560		1000.00	
2	Compost	1000 Kg	1.00	1000.00	
3	Urea	14 Kg	12.00	168.00	
4	TSP	15 Kg	40.00	600.00	
5	MP/MOP	15 Kg	35.00	525.00	
6	Gypsum	8 Kg	10.00	80.00	
7	Zinc sulphate	1 Kg	150.00	150.00	
8	Mulching materials (Lump sum)			1000.00	
9	Sign board	1	500.00	500.00	
10	Register khata	1	30.00	30.00	
	Total (Five thousand and fifty three taka only)			**5053.00 (US $ 74)**	

G. Replication suitability and recommendation:

The adaptation option was tested in the coastal saline areas in two rabi seasons in 2008 and 2009 in the second phase (LACC-II) of the project. The trial demonstration and subsequent yield of sweet potato and other information gathered from the farmers during the cultivation of the crop has yielded a positive signal towards the acceptance of the crop. Therefore, the crop stands almost ready for further promotion in the same/similar lands of the area under Pirojpur district. However a thorough assessment by using the evaluation framework used in LACC-I period is needed for making a confirmed decision and recommendation.

Adapting Sweet gourd in a coastal tidal land

A. Context and Justification:

Owing to the changes happened due to the climate uncertainties, seasonal variability or other environmental problems low lying flat lands of Pirojpur district are regularly inundated by tidal flow from the sea leaving the crop lands of this area moist for a longer period of time. As a result cultivation of seasonal crops is limited in some years in most of the flat low lying areas. Farmers have little choice and hardly can make decision for growing any crop in these lands based on the prevailing and impending ambiguity of climatic factors where risk of crop loss is a regular phenomenon. The cultivation of sweet gourd is recommended by NTIWG and scientists as a suitable adaptation option in the rabi season for some new areas of the coastal upazilas where the risk of salinity and tide is high. The practice may be considered as a livelihood support activity as well that offers farmers more resilience especially in the hazards like high tide and water surge periods.

B. Objective:

To provide the farmers with opportunity for learning the suitability of the sweet gourd that can grow well in the increased tidal problem in coastal area.

Demonstrations showcase how to –

- assess the amount of water and other inputs (e.g. fertilizer, energy) required in the cultivation of the crop in comparison with the control/traditional practice
- evaluate the economic comparison with the control/traditional particular land
- appraise farmers perceived opinion about the potential effect/impact of climate change induced hazards like tide, salinity etc and other factors (price) on the sustainability of the production practice and the comparative advantages of the sweet gourd grown in the demo

C. Implementation time:

Rabi/October - March.

D. Successfully tested sites/upazilas:

Year	North-west	South-west
2008	-	Bhandaria
2009	-	Bhandaria

E. Technical details:

Variety: BARI Mistikumra 1 and 2 variety or suitable and locally acceptable variety.

Soil: Sweet gourd can be grown in almost all types of soil. However, loam and clay loam soils are best for the cultivation of sweet gourd

Pit preparation: A pit with a size of 1 mX 1 mX 1 m has to be prepared before 15 days of the sowing of seeds or transplanting of the seedlings.

Time of sowing: Sweet gourd is a non-photo sensitive and creeper plants. As a result it can be grown through out the year and can be cultivated by sowing seeds and planting seedlings. For winter cultivation seed sowing could be done from October. But for early winter crops seeds can be sown even earlier.

Seed rate: 1000-1500 gm/ha

Transplanting seedling/sowing of seed: Seedlings can be grown in small polythene bags or small earthen pots. To allow better germination and survival, 2-3.5 meter distances should be maintained between the pits by sowing 4-5 seeds/seedlings in each pit. This crop can be cultivated in plain land without making any supporting structure. A thick layer of straw should be placed over the ground of the crop field that can protect the plants and fruits from infestation by rot and other diseases.

Fertilizer dose: Following fertilizer dose should be followed for sweet gourd cultivation

Table - Fertilizer dose for sweet gourd cultivation demonstration

Fertilizers	Doses (gm/pit)
Urea	65.0
TSP	13.0
MP	47.0
Gypsum	67.0
Zinc sulphate	3.8
Boron	1.2
Cow dung	2.0 MT

Fertilizer Application**:** All phosphate, potassium, sulphur, zinc, boron and organic manure should be applied in 5-7 days prior to planting. Urea should be applied around the plant by side dressing at 30 and 50 days after planting and be mixed well with the soil.

Intercultural operation: Regular watering, breaking soil crusts, making supporting structures and other intercultural operations are to be done as a routine basis. Artificial pollination may be done in the morning while of pollen grains from male flowers have to be placed on the stigma of the female flowers that increases the change of fertilization and thus yield.

Other cultural practices: If needed poison baits may be used for controlling fruit flies which are considered as serious pest for the sweet gourd.

F. Trial demonstration budget:

SL #	Item	Amount of input/bigha (Kg/No.)	Unit cost (BDT)	Total Cost (BDT)	Remarks
1	Seed	Lump sum		500.00	
2	Compost	Lump sum		1000.00	
3	Urea	15 Kg	12.00	180.00	

4	TSP	10 Kg	40.00	400.00	
5	MP/MOP	10 Kg	35.00	350.00	
6	Gypsum	8 Kg	10.00	80.00	
7	Zinc sulphate	1 Kg	150.00	150.00	
8	Boron	1 Kg	150.00	150.00	
9	Signboard	1	500.00	500.00	
10	Register	1	30.00	30.00	
	Total (Three thousand three hundred and forty taka only)			**3340.00 (US $ 49)**	

G. Replication suitability and recommendation:

The adaptation option was tested in the coastal saline areas in two rabi seasons in 2008 and 2009 in the second phase (LACC-II) of the project. The trial demonstration and subsequent yield of sweet gourd and other information gathered from the farmers during the cultivation of the crop has yielded a positive signal towards the acceptance of the crop. Therefore, the option stands almost ready for further promotion in the same/similar lands of the area under Pirojpur district. However a thorough assessment by using the evaluation framework used in LACC-I period is needed for making a confirmed decision and recommendation.

Adjusting *Sarjan* cultivation in the changing coastal environment

A. Contest and Justification:

Intrusion of tidal water and thus flooding into the crop land and homestead has been a regular phenomenon, in some upazilas of the Pirojpur district. People of this area are managing the situation (tidal water intrusion) by digging trench, erecting land and by this way producing various crops and raising trees in the raised land. The ongoing climate and environmental changes undergoing in the region and future uncertainties are thought to be contributing to this irregular and frequent tidal flow that creates more uncertainty to the crop production than ever. In addition risk from increased salinity in the water and soil from the tidal water has been a major concern for the farmers of the area. *Sarjan*, an age old local practice is seen as an appropriate adaptation strategy for producing crops and raising trees in the changing tidal flow and risk of salinity of the area. An improved version of the *Sarjan*, advocated by BARI is recommended for the project villages of Bhandaria under Pirojpur district that accommodates vegetables, trees, fishes and spices.

B. Objectives:

To provide the farmers with opportunity for learning the suitability of the *Sarjan* cultivation that can grow well in the increased drought in the north-western part and salinity in coastal areas.

Demonstrations showcase how to –

- assess the amount of water and other inputs (e.g. fertilizer, energy) required in the cultivation of the crops, fishes, trees etc.
- calculate the economic benefits in comparison with the control/traditional production practice, other crops.
- find out how the current problems of the duration of the crop and high tide and low tide situation are managed in the production system.
- appraise farmers perceived opinion about the potential effect/impact of climate change induced hazards like tide, water surge, salinity etc and other factors (price) on the sustainability of the production practice in comparison with other practices

C. Implementation time:

Rabi/October – March.

D. Successfully tested Sites:

Year	North-west	South-west
2008	-	Bhandaria

E. Technical details:

Sarjan is a long-term and composite production technology where a number of crops, trees, fishes are grown. Every unit, entity and things are important and thus make the total cropping system. Technology for each unit, entity differs and requires different types of inputs and management.

Total area: Total area of the Sarjan varies from place to place and also according to the land size and farmers' need. As a general practice, 1 bigha of land is suggested to prepare a Sarjan. The lay out of the total Sarjan field remain same if the size varies..

Crops: Various seasonal vegetables including bed crops, vine crops, fruit crops, leaf crops may be cultivated as per the farmers need and local demand.

Trees: Trees are discouraged at the initial phase of the Sarjan cultivation. However, as the days go and based on the need, short duration fruit trees may be plated at the corner of the ridge/bed provided that the crops inside the beds are not affected by the shade.

Fishes: The ditch/trenches in between the bed/ridges are good spaces for fish rearing. Short duration and quick growing fish can be released and grown for a certain period of time.

Intercultural management and other operations: Various intercultural operation and other management activities should be undertaken as per the need of any particular crop or entity.

F. Trial demonstration budget:

SL #	Item	Amount of input/bigha (Kg/No.)	Unit cost (BDT)	Total Cost (BDT)	Remarks
1	Vegetables seeds	Lump sum		600.00	
2	Fish fingerling	600	5.00	3000.00	
3	Compost	1000	1.00	1000.00	
4	Urea	25	12.00	300.00	
5	TSP	20	40.00	800.00	
6	MP/MOP	15	35.00	525.00	
7	Gypsum	15	10.00	150.00	
9	Boron	1.5	150.00	225.00	
10	Net	5 yds	200.00	1000.00	
11	Zinc Sulphate	1	150.00	150.00	
12	Bamboo	20	100.00	2000.00	
13	Steel wire/string	10	120.00	1200.00	
14	Plastic tape/string	1 kg	150.00	150.00	
15	Soil Digging cost	12000 cft	1.50	18000.00	
16	Sign board	1	500.00	500.00	
17	Register Khata	1	30.00	30.00	
	Total (Twenty nine thousand six hundred and thirty only)			**29630.00 (US $ 433)**	

G. Replication suitability and recommendation:

The adaptation option was tested once in the rabi season of 2008 in one upazila under the Pirojpur district in the second phase (LACC-II) of the project. Crops of the demonstration were damaged by sudden tidal surge after few months of the establishment of the trial. Therefore, no results could have been possible to gather and thus analyze. Hence further test of the option may be recommended for making appropriate judgment and decision. However, farmers showed up their keen interest in the option in informal discussion during the implementation of the demonstration.

Homestead vegetable gardening for enhanced resilience

A. Context and justification:

Homestead gardening is an old production practice in the rural areas of Bangladesh, creating opportunity for employment and year-round income even when other sources fail due to drought. The practice was already suggested by the Bangladesh Agricultural Research Institute in the early 1980s. However at that stage it was not successful due to non-availability of drought and saline resistant vegetables. Current efforts helped to identify drought and saline resistant vegetable crops involving farmers themselves. This practice ensures year round income, nutritional security and gender involvement. Producing vegetables in the homestead can also ensure use of fallow and unexploited land and is a way of using homestead wastes, sweepings and debris as organic matter, as well as irrigation water from the homestead source. The practice was considered as a good adaptation option for improving family food and nutrition for both drought and saline coastal regions.

B. Objective:

To promote vegetable production for home consumption throughout the year by providing more drought and saline tolerant varieties as per the regional requirements.

Demonstrations showcase how to –

- select suitable vegetable species/varieties that grow and produce well in drought prone and saline areas.
- assess the amount of water and other inputs (e.g. fertilizer, energy) required in the cultivation of the vegetables in comparison with the control/traditional practice.
- calculate the economic benefits in comparison with the control/traditional practice.
- appraise farmers perceived opinion about the potential effect/impact of climate change induced hazards like drought, salinity etc on the sustainability of the production of vegetables in the homestead garden.
- evaluate the improvement in home surrounding environment (qualitative).
- appraise the involvement of the women members in the demonstration activities.

C. Implementation time:

Rabi/October - March.

D. Successfully tested sites/upazilas:

Year	North-west	South-west
2008	Nachole, Gomostapur, Porsha and Sapahar, Lalpur and Bagatipara	Dacope, Terokhada and Nazirpur
2009	Lalpur and Bagatipara	Dacope

E. Technical details:

f.1. Lay out (Figure-1) of the plot/bed:-

- Area of homestead garden is 1 decimal or 36 m^2.
- No. of bed are 5 (in the north-south directions to ensure equal distribution of sunlight).
- The length of each bed is 550 cm and width of each bed is 90 cm.
- Width and depth of boundary drain are 25 cm and 10 cm. respectively.
- The height of the seedbeds will be 15 cm.

f.2. Other technical aspects:-

- Five recommended cropping pattern of vegetables may be followed for five beds so that diversified vegetables are available throughout for family consumption.
- A strong boundary fence is required to establish (with bamboo or other low-cost materials) to protect crops from cattle, goats, etc.
- In the boundary canal aroid and on the fence bitter gourd, country bean, yard long bean, sponge gourd can be grown.

f.3. The recommended vegetables for homestead garden:- Following species of vegetables are selected following BARI recommendation, local suitability and may be grown as per the distribution per bed of the garden.

Beds no.	Drought prone area	Coastal saline area	Remarks
Bed–1	Radish/Tomato	Tomato	Same variety
Bed–2	Red amaranth	Bringal	Different species
Bed–3	Garlic	Spinach	Different species
Bed–4	Kang kong	Batishak/Carrot	Different species
Bed–5	Bringal	Cabbage	Different species

As far as the assessment from the regions, there are very few species of vegetables which are particularly adaptable either to drought or to the coastal saline condition. Most of the species grown in both areas are same, although there are variations in case of the varieties of a particular species. As for example Kang kong is widely cultivated in each and every place of the country and it is regarded as one of the most ecologically suitable species in almost all soils and conditions. However there is a variety of stem amaranth called *Katoa* which is better suited in drought prone area and bitter gourd grows better in the coastal saline region.

Similar and suitable crops/vegetables can be grown round the year as per the seasonal requirement and with farmers' own inputs and technical guidance from the project/DAE.

Note: The model called Kalikapur and the lay out and crop combination of the said model are recommended from BARI. There are few other models developed by BARI being practiced like the Barind model in high-low barind area (Chapai Nawabganj, Naogaon), Goyeshapur model in the flat barind area (Natore), Laudobe model in the Dacope upazila. The model/s can be adapted as per the suitability in any area and the technical details should be followed accordingly.

The concept of community based vegetable cultivation was introduced in the year 2009 based on lessons of previous years. In community based vegetable cultivation the technical requirement is same as homestead vegetable cultivation. The difference is only in the involvement of more number of farmers under a single option and a more opportunity for sharing in all respects of production and management among the fellow farmers.

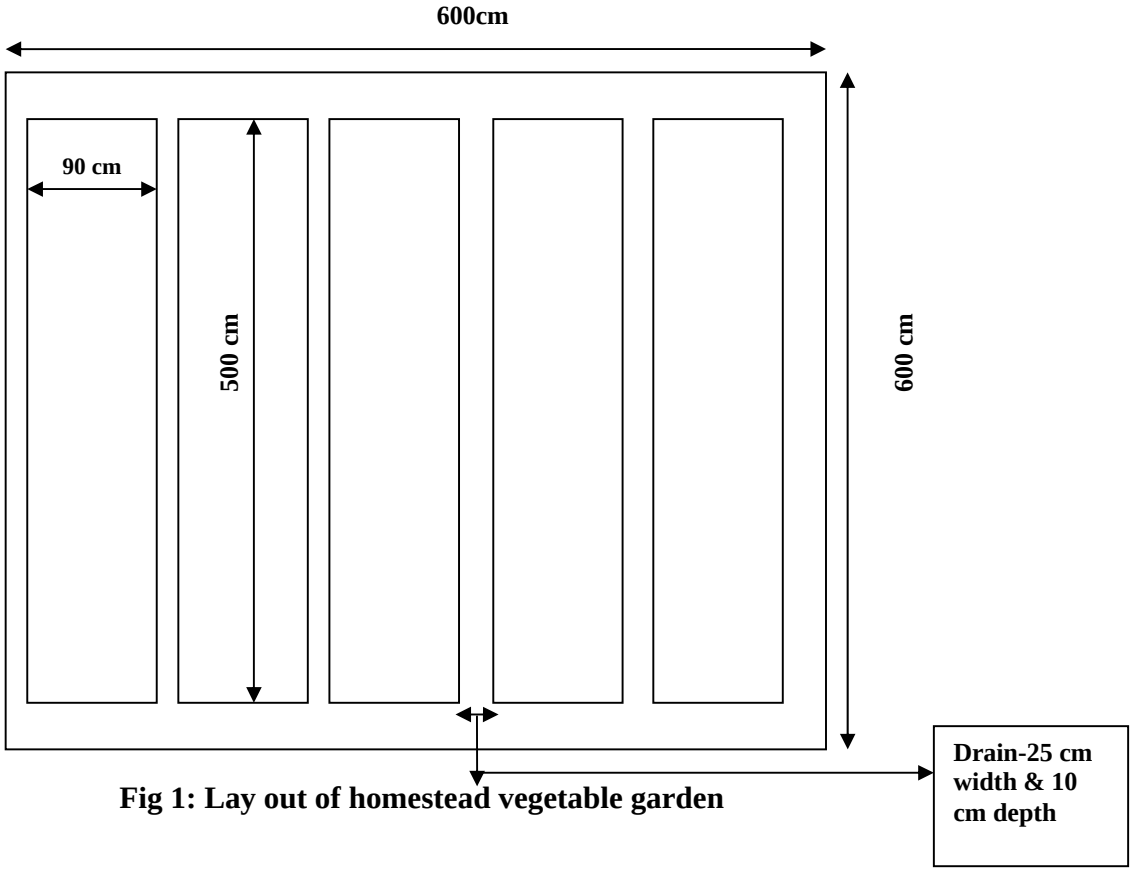

Fig 1: Lay out of homestead vegetable garden

F. Trial demonstration budget:

SL #	Item	Amount of input/bigha (Kg/No.)	Unit cost (BDT)	Total Cost (BDT)	Remarks
1	Seed (Lump sum)		400	400.00	
2	Compost	100 Kg	1	100.00	
3	Urea	5 Kg	12	60.00	
4	TSP	2 Kg	40	80.00	
5	MP/MOP	2 Kg	35	70.00	
6	Watering cane	1	500	500.00	
7	Fencing (Lump sum)		700	700.00	
8	Sign board	1	500	500.00	
9	Register khata	1	30	30.00	
	Total (Two thousand four hundred and forty only)			**2440.00 (US $ 36)**	

G. Replication suitability and recommendation:

As per the lessons from the first and second phases (LACC-I and LACC-II) and evaluation done through the evaluation framework below, promotion of the technology has been recommended to continue as a routine activity with more drought tolerant varieties (and varieties suitable to the coastal saline area as well) in the homesteads of landless and marginal farmers. At the end of the implementation of adaptation demonstrations at farmers' fields for 3-4 seasons, scientists and experts recommended that other homestead gardening models like *Goyeshapur* model for Natore

areas, *Laudobe* model for coastal (Khulna) areas may be adapted based the local demand and ecological suitability.

Table: Evaluation framework for recommendation and replication

Suitable for replication under the following conditions					**Primary target group**	**Investment costs for replication**	**Environ-mental benefits**	**Justification for replication**			**Recommend ation (remarks)**
Farming system	AEZ	Hazard type/ impacts	Water mgt system	Micro-topography/ terrain				**Increase of CC resilience**	**Economic and social feasibility**	**No/ marginal increase of GHG**	
Vege-tables/ fruit, tree/ timber, tree/ livestock/ poultry	25, 26	Drought spells; loss of crops	Irri-gated / rain fed	High and low barind tract	Poor/ medium farmers with land ownership	36 US $	High	High	Yes	No increase	Highly recommended as adaptation option

Jujube Gardening for exploiting drought and salinity conditions

A. Context and Justification:

In the *barind* tract of Bangladesh, fruit trees are cultivated as a viable drought impact reduction strategy. Fruit trees such as jujube thrive well in drought prone environments and were recommended in the uplands of the *barind* tract as a potential adaptation option to the existing spontaneous mango cultivation. Mango plantation is an autonomous adaptation spreading rapidly. However, the project anticipated that under changing climatic conditions, high temperature induced synchronized maturity may lead to price drop. Further, it threatens to replace rice completely causing food insecurity and aggravate *monga* (seasonal famine conditions). Rice is the only crop grown during monsoon season and is crucial for food security of the *barind* tract. Introduction of Jujube offers scope for diversification, risk reduction due to its tolerance of high temperatures and a reduced shade effect on the rice and other crops beneath, as and wherever cultivated. Hence rice may not be completely replaced by jujube cultivation in an area predominantly cultivated by rice. The option is suitable to initiate at the beginning of monsoon where it can take the advantage of natural rainfall just to get established.

Two new/improved varieties of jujube i.e. *Apple kul and BAU kul* are getting fast popularity due to their yield and market potential. These varieties are expanding as a usual manner to every corner of Bangladesh and thus taken up by the farmers of coastal area as well. There is a jujube variety called *Narkeli kul* is found available and indigenous to the coastal saline areas. In the coastal districts jujube gardening has been taken as a new option to learn and evaluate the suitability in the advent of increasing threat of salinity and other natural hazards. In addition a comparison among the improved varieties and the local variety has been one of the major focuses in the coastal area.

B. Objective:

To provide the farmers with opportunity for learning the suitability of the wheat varieties that can grow well in the increased drought in the north-western part and salinity in coastal areas.

Demonstrations showcase how to –

- assess the amount of water and other inputs (e.g. fertilizer, energy) required in the cultivation of the jujube in comparison with the control/traditional practice, other crops
- calculate the economic benefits in comparison with the control/traditional production practice, other crops
- find out other additional benefit like fuel, etc
- appraise farmers perceived opinion about the potential effect/impact of climate change induced hazards like drought, etc and other factors (price) on the sustainability of the production practice in comparison with the autonomous mango adaptation, other practices

C. Implementation time:

Rabi/October - March.

D. Successfully tested site/upazila:

Year	North-west	South-west
2008	Lalpur and Bagatipara	-
2009	Lalpur and Bagatipara	-

E. Technical details:

Land area: 1 Bigha (33 dec.).

Soil: Satisfactory production is possible from any type of land. Jujube plant can tolerate both salinity and drought condition. But heavy and slightly alkaline sandy loam soil is good for jujube production.

Variety: *Apple kul, BAU kul, Narkeli kul* (as suitable to the area concerned). Apple kul is mostly selected by the north-western upazilas and Narkerli kul is indigenous to the coastal saline area for their already adaptive characters to the respective areas. BAU kul is a new variety and have been selected for both drought prone and coastal areas.

Land preparation : Prepare the pit and apply organic matter 10-12 days before transplanting the sapling**.**

Method of transplanting : For jujube garden square planting method is good. Planting distance should be 3.5-4 meters (12ft X 12ft). Spacing may be increased or reduced depending on the variety and place. 1metre x 1meter x 1metre pit should be prepared one month prior to planting. Total number of saplings should be 66 per bigha.

Fertilizer Application and dose: Apply fertilizer 10 to 12 days before plantation as indicated in budget break-up.

Intercultural Operation : For good production irrigation should be done once in a month during flowering and fruiting time in dry season. In case of saplings branches up to 75 cm from the bottom should be allowed to grow to make the plant more strong.

Pruning or Removal of undesired parts: During pruning cut the branch leaving some portion at the joint. In addition cut of weak, disease affected, insect attacked thickly grown branches. Afterwards when new branches will come, then keep the strong branches and remove weak ones.

Pest and disease Management : Powdery mildew of a jujube is a dangerous disease. After flowering spray any fungicide (Thiovit) to control powdery mildew disease at the rate of 2 gm. in 1 litre of water or Tilt 250 EC at the rate of 0.5 ml in litre of water. Afterwards, spray 2 times at an interval of 15 days.

Harvesting : Fruits generally collected in January to March depending on the variety. Start harvesting when the fruits start becoming light green or yellow.

F. Trial demonstration budget:

SL #	Item	Amount of input/bigha (Kg/No.)	Unit cost (BDT)	Total Cost (BDT)	Remarks
1	Sapling	66	60	3960.00	
2	Compost	100 Kg	1	100.00	
3	Urea	17 Kg	12	204.00	
4	TSP	17 Kg	40	680.00	
5	MP/MOP	17 Kg	35	595.00	
6	Zinc sulphate	4 Kg	150	600.00	
7	Fencing (Lump sum)			2000.00	
8	Plantation cost (Lump sum)			1200.00	
9	Sign board	1	500	500.00	
10	Register khata	1	30	30.00	
	Total (Nine thousand eight hundred and sixty nine only)			**9869.00 (US $ 144)**	

G. Replication suitability and recommendation:

As per the lessons from the first phase (LACC-I) and evaluation done through the evaluation framework below, the promotion of the adaptation option was continued for another 2-3 seasons to allow for policy recommendation in other similar areas as a part of planned adaptation strategy. The option may be targeted to small farmers who can afford land for a perennial garden. A market study may also be undertaken to find out the comparative advantage over mango.

Table: Evaluation framework for recommendation and replication

Suitable for replication under the following conditions					**Primary target group**	**Investment costs for replication**	**Environ-mental benefits**	**Justification for replication**			**Recommendation (remarks)**
Farming system	AEZ	Hazard type/ impacts	Water mgt system	Micro-topography/ terrain				**Increase of CC resilience**	**Economic and social**	**No/ marginal increase of GHG**	
Rice, Wheat/ Fruit tree/ Fallow	25, 26	Drought spells; loss of crops	Rain fed	High and low barind tract	Poor/ medium farmers with land ownership	144 US $	High	High	Yes	no increase	Highly recommended as adaptation option

The option was approved based on farmers' demands and local recommendation. However, as far as the adaptation possibility and thus plant growth are concerned, jujube should best be recommended and planted in both Kharif-I and Kharif-II season while tender sapling can get enough moisture and favourable environment.

Litchi Gardening for exploiting drought condition

A. Context and Justification:

In north-western drought prone areas of Bangladesh, fruit trees are cultivated as a viable drought impact reduction strategy. Fruit tree such as litchi thrive well in drought prone environments as for example in the Natore area, is selected and recommended by the farmers, community people and the local level experts as an adaptation option suitable to the increased drought. Litchi plantation especially in the upazilas of Natore is preferred as a potential alternative to the degraded and marginal land once used for the sugar cane cultivation. The litchi garden can be diversified incorporating rice and other crops until a certain age of the trees. Hence rice may not be completely replaced by litchi cultivation. The fruits have a high market value and the market access is much easier over the other crops. Therefore litchi is considered as one of the good options for promotion in the drought prone areas that contribute to the over all adaptation strategies and also enhance the livelihood status of the poorer community.

B. Objective:

To provide the farmers with opportunity for learning the suitability of the wheat varieties that can grow well in the increased drought in the north-western part and salinity in coastal areas.

Demonstrations showcase how to –

- assess the amount of water and other inputs (e.g. fertilizer, energy) required in the cultivation of the litchi in comparison with the control/traditional practice, other crops
- calculate the economic benefits in comparison with the control/traditional production practice, other crops
- find out other additional benefit like fuel, etc
- appraise farmers perceived opinion about the potential effect/impact of climate change induced hazards like drought, etc and other factors (price) on the sustainability of the production practice in comparison with other practices

C. Implementation time:

Rabi/October - March.

D. Successfully tested site/upazila:

Year	North-west	South-west
2008	Lalpur and Bagatipara	-
2009	Lalpur and Bagatipara	-

E. Technical details:

Variety: BARI Litchi 3, Bombai and Chaina-3.

Soil: Deep, well drained, fertile sandy or loamy soil is suitable.

Land preparation: Select high and medium high land. Make the land plain, weed free by plowing and laddering.

Sapling selection: Select one year old healthy and strong grafted saplings.

Transplanting time: October and March.

Planting distance: 10 meters.

Pit size: 1 meter x 1 meter x 1 meter

Fertilizer dose: Apply fertilizer as per quantity shown in table 1 below

Table 1.Fertilizer dose per pit for Litchi gardening

Name of Fertilizer	Quantity per pit (gram)
TSP	600-700
MP	350-450
Gypsum	200-300
Zinc sulphate	40-60
Cow dung	20-25kg.

Source: BARC

Method of Fertilizer application: Apply fertilizers in 3 installments. Ist installment at the time of flowering, 2nd installment at the time when fruits become like pea grain and third installment two weeks before fruits ripe.

Sapling transplantation: After 10-15 days of filling the pit, the sapling with ball is placed at the center of the pit. After plantation irrigate water, fix a pole and fence. After 6 month of plantation apply 300-350 gm. urea.

Irrigation: Irrigate frequently to enhance growth of the saplings. If there is no rainfall, irrigate at the time of flowering and at the time of getting the fruit size like pea.

Weeding: Always keep the pit weed free.

Pruning: Cut off undesirable branches to allow sufficient light and air.

Attack by birds: Trees should be covered by net in ripening period.

Harvesting: Start collecting litchi with the branches as soon as litchis show reddish tinge.

F. Budget break up for litchi gardening:

SL #	Item	Amount of input/bigha (Kg/No.)	Unit cost (BDT)	Total Cost (BDT)	Remarks
1	Sapling	25	150	3750.00	
2	Compost	300 Kg	1	300.00	
3	Urea	9 Kg	12	108.00	
4	TSP	18 Kg	40	720.00	

5	MP/MOP	12 Kg	35	420.00	
6	Zinc sulphate	1.5 Kg	150	225.00	
7	Fencing (Lump sum)			2000.00	
8	Sign board	1	500	500.00	
9	Register khata	1	30	30.00	
	Total (Nine thousand eight hundred and sixty nine only)			**8053.00 (US $ 118)**	

G. Replication suitability and recommendation:

The adaptation option was tested in the drought prone upazilas of low/flat barind area in two seasons in 2008 and 2009 in the second phase (LACC-II) of the project. Yield and other performance of litchi were found good and farmers appeared to accept the option. The result gained from the option looked positive and may be promoted through the DAE's usual extension system. However a thorough assessment by using the evaluation framework used in LACC-I period is needed for making a confirmed decision and recommendation.

The option was approved based on farmers' demands and local recommendation. However, as far as the adaptation possibility and thus plant growth are concerned, litchi should best be recommended and planted in both Kharif-I and Kharif-II season while tender sapling can get enough moisture and favourable environment.

Mixed fruit gardening for exploiting drought and salinity conditions

A. Context and Justification:

Fruit tree gardening in the open land is a way of securing the growth of cash crops that may constitute an alternative source of income in moments of crisis, especially if high value species are chosen. Besides being a source of food, nutrition and cash incentive, wood fuel, a greater presence of trees contributes to decreasing temperatures and to increasing rainfall, thus contrasting the negative environmental impact of deforestation. Mixed fruit gardening either by incorporating jujube, mango or other species in the litchi garden or other way around is a well known practice in the drought prone areas and coastal regions of Bangladesh. The practice is same or similar in both the regions with a particular difference in species or varieties suitable to the regions. There are species like litchi is suitable to the low barind area of Natore and *Narkeli kul* in the coastal saline areas which are cultivated by the farmers in a mixed plantation in order that their yield, income support their livelihood on a year round basis especially in the vulnerable period.

B. Objective:

To promote improved variety of the fruits with am aim to provide farmers with an alternative in order for diversification of their livelihood, income opportunities and development of resilience of the farming community.

Demonstrations showcase how to –

- assess the amount of water and other inputs (e.g. fertilizer, energy) required in the mixed fruit gardening in comparison with the control/traditional practice, other crops.
- calculate the economic benefits in comparison with the control/traditional production practice, other crops.
- find out other additional benefit like fuel, etc.
- appraise farmers perceived opinion about the potential effect/impact of climate change induced hazards like drought, salinity etc and other factors (price) on the sustainability of the production practice in comparison with other practices.

C. Implementation time:

Rabi/October - March.

D. Successfully tested site/upazila:

Year	North-west	South-west
2009	Lalpur and Bagatipara upazilas.	Terokhada and Bhandaria upazilas.

E. Technical details:

Land area: 1 Bigha (33 dec.).

Soil: Deep, well drained, fertile sandy or loamy soil is suitable.

Land preparation: Select high and medium high land. Make the land plain, weed free by plowing and laddering.

Variety: Combination of Litchi (varieties *Bombai* and Chaina-3) and Jujube (Apple *kul*) for the drought prone upazilas where litchi is mostly suitable due to its tolerance to drought.

And a mixture of Jujube (BAU *kul* and *Narkeli kul*) and Mango (*Amropali*) is recommended for the coastal area. *Narkeli kul* is already adapted to the local condition and the other jujube variety and the mango variety are selected for the testing the suitability as new varieties.

Sapling selection: Select one year old healthy and strong grafted saplings.

Transplanting time: October and March.

Planting distance: 10 meters.

Pit size: 1 meter x 1 meter x 1 meter

Fertilizer dose: Apply fertilizer as per quantity shown provide in the budget section.

Method of Fertilizer application: Apply fertilizers in 3 installments. Ist installment at the time of flowering, 2nd installment at the time when fruits become like pea grain and third installment two weeks before fruits ripe.

Sapling transplantation: After 10-15 days of filling the pit, the sapling with ball is placed at the center of the pit. After plantation irrigate water, fix a pole and fence. After 6 month of plantation apply 300-350 gm. urea.

Irrigation: Irrigate frequently to enhance growth of the saplings. If there is no rainfall, irrigate at the time of flowering and at the time of getting the fruit size like pea.

Weeding: Always keep the pit weed free.

Pruning: Cut off undesirable branches to allow sufficient light and air.

Attack by birds: Trees should be covered by net in ripening period.

Harvesting: Start collecting fruits once matured depending on the species planted.

F. Trial demonstration budget:

SL #	Item	Amount of input/bigha (Kg/No.)	Unit cost (BDT)	Total Cost (BDT)	Remarks
1	Sapling (Jujube)	66	60	3960.00	
2	Sapling (Litchi/Mango)	25	150	3750.00	
3	Compost	200 Kg	1	200.00	
4	Urea	24 Kg	12	288.00	
5	TSP	24 Kg	40	960.00	
6	MP/MOP	24 Kg	35	840.00	
7	Zinc sulphate	8 Kg	150	1200.00	
8	Fencing (Lump sum)			2000.00	
9	Plantation cost (Lump sum)			1200.00	

10	Sign board	1	500	500.00	
11	Register khata	1	30	30.00	
	Total (Fourteen thousand nine hundred and twenty eight only)			**14928.00 (US $ 218)**	

G. Replication suitability and recommendation:

The adaptation option was tested in two upazilas each of the drought prone area and coastal saline area in 2009. The results are yet to be tested and based on the result and lessons and also a thorough assessment by using the evaluation framework used in LACC-I period a well-informed decision and recommendation can be made. However, as a common practice, it may be inferred that at least another one to two times tests are required to inform the decision making process.

The option was approved based on farmers' demands and local recommendation. However, as far as the adaptation possibility and thus plant growth are concerned, litchi, jujube and other fruit plants should best be recommended and planted in both Kharif-I and Kharif-II season while tender sapling can get enough moisture and favourable environment.

Fodder cultivation for sustained feed supply

A. Context and justification:

Fodder is a vital ingredient while rearing cattle especially the milking cows. Green fodder is not much available in Bangladesh based on the fact that the grazing lands are being continually shifted to crop field or for other socio-economic uses. The increasing intensity of drought in the north-western barind area and tidal inundation, salinity intrusion in the coastal area also poses additional problems for non-availability of natural green grasses which were available everywhere in Bangladesh. As a result farmers are forced to depend on the dried concentrate feeds and are not getting desired out put from their cattle. The dried feeds are not likely to supplement the green fodder and farmers incurred additional cost without substantial benefits. National livestock research institute is producing and promoting improved fodder varieties. Project is undertaking adaptation trials in northern drought prone areas and southern coastal saline regions with different varieties of fodder with a view to provide farmers with alternatives for cattle feeding.

B. Objective:

To promote improve fodder cultivation in the area where green grass are not available and accessible to the poor farmers for their cattle farming.

Demonstrations showcase how to –

- assess the suitability of the species selected for local soil and water conditions
- assess the amount of fertilize, manure, water and other inputs required in the cultivation of the fodder in comparison with the control/traditional practice
- evaluate the (economic) savings farmers can make out of the production and feeding to the cattle with comparison to the cost they have to bear for purchasing
- appraise farmers perceived opinion about the potential effect/impact of climate change induced hazards like drought, salinity etc on the sustainability of the production of fodder/s in the farmers field.

C. Implementation time:
Rabi/October - March.

D. Successfully tested sites/upazilas:

Year	North-west	South-west
2009	Lalpur and Bagatipara upazilas	-

E. Technical details:

Land area: 10 dec.

Land and soil type: Can be grown in any type of soil from drought to saline area.

Land preparation: The land should be well prepared by ploughing and harrowing three to four times. Fertilizer should be applied in appropriate dose at the time of land preparation. The cutting can be transplanted even at the moist land after flooding.

Variety:
Napier and German and *Jambu* varieties were recommended for the drought prone upazilas.

Para was particularly selected for the coastal upazilas and Napier was also on the list.

Spacing:
Spacing for cutting transplantation – line to line 70 cm and cutting to cutting 35 cm (may little vary based on the variety)

Fertilizer application:
Should be applied during land preparation.

Harvesting:
At summer – 30 – 35 days interval.
At winter – 35 – 45 days interval.

F. Trial demonstration budget:

SL #	Item	Amount of input/bigha (Kg/No.)	Unit cost (BDT)	Total Cost (BDT)	Remarks
1	Cutting	200	1	200.00	
2	Compost	200 Kg	1	200.00	
3	Urea	7 Kg	12	84.00	
4	TSP	3 Kg	40	120.00	
5	MP/MOP	4 Kg	35	140.00	
6	Grass cutter/knife	1	100	100.00	
7	Sign board	1	500	500.00	
8	Register khata	1	30	30.00	
	Total (One thousand three hundred and seventy four only)			**1374.00 (US $ 20)**	

G. Replication suitability and recommendation:

The option has been accepted well by the farmers of both drought prone and coastal saline upazilas as per the informal assessment by the project. The trend so far shows very good potential in areas where there is a lack of natural grass and where farmers own cattle. Till this time the farmers of two upazilas of Natore district have shown more interest and involvement over other upazilas of the drought area and coastal zones. Therefore the option may be replicated through the ongoing extension mechanism of DAE and few more test for demonstrations may be continued for the coastal upazilas.

The option was approved based on farmers' demands and local recommendation. However, as far as the adaptation possibility and thus growth are concerned, fodder may be recommended and cultivated in both Kharif-I and Kharif-II season while it can get enough moisture and favourable environment.

Duck rearing for livelihood resilience

A. Context and justification:

In many rural areas of Bangladesh, duck rearing has been practicing as a household level small scale income generating activity. The duck rearing enterprise requires minimum technical skill and as well as small financial inputs. Duck can depend on the natural feed and thrive well in unfavourable condition which is regarded as one of many advantages of rearing duck. There are varieties of duck that can grow up well and produce good number of eggs in both drought prone area and coastal zone. Farmers having less livelihood opportunities can take up the duck rearing enterprise as an option which provide some flexibility in their livelihood planning and income especially in the period of economic stress.

B. Objective:

To promote duck rearing as an alternative livelihood option while farmer can improve their food and income security and thus their resilience to the changing climate.

Demonstrations showcase how to –

- evaluate the economic benefits farmers can get out of goat rearing and its contribution to the family food and other well-beings (*livelihood support*) in the environmental stress period especially.
- assess the suitability of the duck variety in the salinity condition whether the variety can sustain in saline prone coastal area.
- appraise farmers perceived opinion about the potential effect/impact of climate change induced hazards like increased salinity etc on common livestock and poultry production practices and comparative advantages of duck rearing.

C. Implementation time:
Rabi/October - March.

D. Successfully tested sites/upazilas:

Year	North-west	South-west
2008	-	Dacope and Terokhada upazilas
2009	-	Terokhada upazila

E. Technical details:

Land area: Open, as the rearing will be done in the homestead space and/or the adjacent pond/water body. The extensive system of duck rearing will be followed.

Duck Variety: Khaki Kamble.

Number of Duck: 20 (as per the proposal from Upazila).

Feed for duck:

Feed 2-3 times per day for duckling of 4 weeks.

Feed 2 times per day for adult duck.

Provide food to the duck in the form of pellet or tablet otherwise they can not take it.

Duck feed – Preparation of 1 Kg feed

Feed ingredient	Percentage ingredients for different groups	
	Duckling (gm)	Adult (gm)
Half messed wheat	450	450
Rice bran	270	300
Sesame cake	140	120
Fish meal powder	120	100
Shell (*Jhinuk*) powder	15	25
Salt	5	5
Vitamin-Mineral Premix	1.5 gm/Kg	2 gm/Kg

Duck shed:
Height of the shed – 4-5 ft.
Mat for the duck shed floor – bamboo mat.
Materials for the roof – Straw, long grass, gol/palm leaves.
Enough light should come into shed.

Space required for duck:

Age	Space for each duck (Sq. ft) (Layer)
4 weeks to 8 weeks	1.0
8 weeks to 12 weeks	2.0-2.5
12 weeks and more	3.0

Measurement for Feeding pan and water pot required for duck:

Age	Space for each duck (Inch)	
	Feeding pan	Water pot
4 weeks to 8 weeks	3.0	Big pot
8 weeks to 12 weeks	4.0	Big pot

Age of duck to release in water:
Common practice is that the duckling can be released to water once it attains 1 month of age. It is better to release only after the end of brooding period when duckling is physically strong enough. At the beginning starts in a small water body to have practice. In the summer period the duckling can be released even after 15 days.

Diseases and other problems management:
Ducks are resistant to most of the common problems and diseases. However, two infectious diseases especially the duck plague and duck cholera may create huge loss to the whole lot of ducks. Therefore, care must be taken and necessary measures have to be taken in close cooperation with the concerned officer/s of the upazila livestock department.

Duck plague – This is contaminated *virus* disease and duck of any age can be infected by this disease. General symptom is that the duck gets weak, can not stand on feet and walk properly and does not want to swim. To protect duck form the disease, vaccination must be done, the infected duck should be kept aside from the fresh lot and clean the shed, feeding pan, water pot properly etc.

Duck cholera – This is contaminated *bacterial* disease and duck of any age can be infected by this disease. General symptom is that the duck loss appetite, want to drink more water and release slippery substance from the mouth. To protect duck form the disease, vaccination must be done and apply some sulphur based medication etc.

F. Trial demonstration budget:

SL #	Item	Amount of input/bigha (Kg/No.)	Unit cost (BDT)	Total Cost (BDT)	Remarks
1	Duckling (3 weeks)	20	90.00	1800.00	
2	House	1	1500.00	1500.00	
3	Feed	60 Kg	25.00	1500.00	
4	Vaccine			500.00	
5	Duck carrying cost (Lump sum)			500.00	
6	Sign board	1	500.00	500.00	
7	Register Khata	1	30.00	30.00	
	Total (Six thousand three hundred and thirty only)			**6330.00 (US $ 92)**	

G. Replication suitability and recommendation:

As a new intervention from the poultry sub-sector in the changing climatic condition and as an alternative initiative for farmers' livelihood support the option has so far been accepted well. However there have been differences in performance not only due to the varietal difference but due to the management practices also. A thorough and critical assessment is needed before recommending the option for replication.

Goat rearing for livelihood resilience

A. Context and Justification:

Goat is one of the most productive household animal species in Bangladesh. It is mostly liked by the poor and landless farmers for its prolific growth, regular production and cash incentives. While there is limited scope for rearing cattle due to lack of fund and scarcity of green grass at coastal saline area, goat offers an excellent opportunity especially for the resource poor farmers. A local breed, *Black Bengal goat*, is widely regarded for its best quality meat and hides for leather industries and its strong adaptability to extreme condition. In rural areas, farmers often fail to fetch the maximum benefits from the enterprise due to non-accessibility of technical information and services. Farmers are provided with breeds that are suitable to the saline condition and also with regular technical information and services in order to enhance their capacity and income.

B. Objective:

To promote goat rearing as an alternative livelihood option while farmer can improve their food and income security and thus their resilience to the changing climate.

Demonstrations showcase how to –

- evaluate the economic benefits farmers can get out of goat rearing and its contribution to the family food and other well-beings (*livelihood support*) in the environmental stress period especially.
- assess the suitability of the goat variety in the salinity condition whether the variety can sustain in saline prone coastal area.
- appraise farmers perceived opinion about the potential effect/impact of climate change induced hazards like increased salinity etc on common livestock and poultry production practices and comparative advantages of goat rearing.

C. Implementation time:
Rabi/October - March.

D. Successfully tested sites/upazilas:

Year	North-west	South-west
2009	-	Terokhada and Bhandaria upazilas

E. Technical details:

Land area: Open, as the rearing will be done in the homestead space and the adjacent pond. The open system of goat rearing is followed.

Goat Variety: Black Bengal goat.

Age of goat: 1 year plus.

Number of goat to be given: 2 female goats per family as per the proposal from Upazila (UTIWG).

Fodder/feed for goat:

The goat will be fed with local available grass in open grazing and also confined feeding process. In the period of high salinity and any other natural hazards, the goat will be fed with additional/prepared feed. The feed is available in the local market prepared with rice bran, molasses and some other ingredients. The rate of the feed will 1.5 Kg/goat/day. If it is needed, feed may be prepared and fed to the goat as per following combination.

Feed ingredients	Amount (%)
Wheat husk	45
Rice bran	20
Grind grass pea	18
Sesame cake	16
Salt	0.9
Ambavit	0.1

Goat shed:

Shed for goat should be in a sunny, airy place so that it remains clean, dry and free from bad smell. An adult goat requires a space of 1.0 – 1.5 sq. meter or 10 – 15 sq. ft.

While the demonstration starts with 2 female goats, there is a likely possibility that the goats give birth about 10-13 goats in a year. So, for the whole family a bamboo platform (*Macha*) of 60 (6X10) sq. ft may be constructed. The shed/roof may be prepared by tin, leaves and straw. The height of the shed (*macha*) from the ground should be 3 ft.

There should be interspace of 0.5 inch between two bamboo pieces to allow/facilitate the litter and debris to pass out or clean. If the platform is of soil, it should be covered with sand/sandy soil. In the winter specially, the ground should be covered with straw to make bed (thick 4-5 inch).

Disease problems for goat:

The common diseases for goat in our country are PPR, goat pox, ekthima, pneumonia etc. The goat has to be provided with enough care and cleanliness so that a preventive condition is created. Proper vaccination and after care are must for goat rearing. For any problem, regular consultation with the upazila level livestock and veterinary specialist need to be made.

F. Trial demonstration budget:

SL #	Item	Amount of input/bigha (Kg/No.)	Unit cost (BDT)	Total Cost (BDT)	Remarks
1	Goat	2	2500	5000.00	
2	Housing	1	1000	1000.00	
3	Feed	80 Kg	25	2000.00	
4	Vaccination (Lump sum)			500.00	
5	Transport (Lump sum)			500.00	
6	Sign board	1	500	500.00	
7	Register khata	1	30	30.00	

	Total (Nine thousand five hundred and thirty only)	**9530.00 (US $ 140)**	

G. Replication suitability and recommendation:

The options has just tested for the first time in two coastal upazilas and the results are yet to come and confirm whether to recommend for further trial or replication of the same in other areas.

Sheep rearing for livelihood resilience

A. Context and Justification:

Sheep is one of the productive household animal species in Bangladesh. Rearing sheep is profitable for the poor and landless farmers for its growth, production and cash incentives. It produces quality meat and wool which have a good demand in the local market. Sheep has got a strong adaptability to extreme condition like high temperature induced drought condition, salinity and other environmental stress. Although as a local practice sheep rearing has been found in the rural areas of the drought prone and saline coastal upazilas of the project but the production and return is limited due to non-accessibility of technical information and services. The option recommended from the farmers and UTIWG was approved in the NTIWG by the scientists and experts for the drought and saline prone villages. The option is expected to validate the wider adaptability of sheep in the increased threat of temperature, salinity and other climate problems in the drought prone area.

B. Objective:

To test the wider adaptability of sheep in the increased threat of temperature and salinity and sheep rearing as an alternative livelihood option while farmer can improve their food and income security and thus their resilience to the changing climate.

Demonstrations showcase how to –

- evaluate the economic benefits farmers can get out of sheep rearing and its contribution to the family food and other well-beings (*livelihood support*) in the environmental stress period especially.
- assess the suitability of the sheep variety in the drought and salinity condition whether it can sustain in drought prone area.
- appraise farmers perceived opinion about the potential effect/impact of climate change induced hazards like increased drought, salinity etc on common livestock and poultry production practices and comparative advantages of sheep rearing.

C. Implementation time:

Rabi/October - March.

D. Successfully tested sites/upazilas:

Year	North-west	South-west
2009	Sapahar upazila	Dacope upazila

E. Technical details:

Land area: Open, as the rearing will be done in the homestead space and the adjacent pond. The open system of sheep rearing is followed.

Goat Variety: Local.

Age of goat: 1 year plus.

Number of goat to be given: 2 female sheeps per family as per the proposal from Upazila (UTIWG).

Fodder/feed for sheep:

The sheep will be fed with local available grass in open grazing and also confined feeding process. In the period of high temperature, salinity and any other natural hazards, the sheep will be fed with additional/prepared feed. The feed is available in the local market prepared with rice bran, molasses and some other ingredients. The rate of the feed will 1.5 Kg/sheep/day. If it is needed, feed may be prepared and fed to the goat as per following combination.

Feed ingredients	Amount (%)
Wheat husk	45
Rice bran	20
Grind grass pea	18
Sesame cake	16
Salt	0.9
Ambavit	0.1

Sheep shed:

Shed for sheep should be in a sunny, airy place so that it remains clean, dry and free from bad smell. An adult sheep requires a space of 1.0 – 1.5 sq. meter or 10 – 15 sq. ft.

While the demonstration starts with 2 female sheeps, there is a likely possibility that the sheeps give birth about 10-13 sheeps in a year. So, for the whole family a bamboo platform (*Macha*) of 60 (6X10) sq. ft may be constructed. The shed/roof may be prepared by tin, leaves and straw. The height of the shed (*macha*) from the ground should be 3 ft.

There should be interspace of 0.5 inch between two bamboo pieces to allow/facilitate the litter and debris to pass out or clean. If the platform is of soil, it should be covered with sand/sandy soil. In the winter specially, the ground should be covered with straw to make bed (thick 4-5 inch).

Disease problems for sheep:

Sheep is resistant to almost all types of problems. However enough care and cleanliness should be provided so that a preventive condition is created. Proper vaccination and after care are must for sheep rearing. For any problem, regular consultation with the upazila level livestock and veterinary specialist need to be made.

F. Trial demonstration budget:

SL #	Item	Amount of input/bigha (Kg/No.)	Unit cost (BDT)	Total Cost (BDT)	Remarks
1	Sheep	2	1200	2400.00	
2	Housing	1	1500	1500.00	
3	Feed	40 Kg	25	1000.00	
4	Vaccination (Lump sum)			500.00	
5	Transport (Lump sum)			500.00	

6	Sign board	1	500	500.00	
7	Register khata	1	30	30.00	
	Total (Six thousand four hundred and thirty only)			**6430.00 (US $ 140)**	

G. Replication suitability and recommendation:

The options has just tested for the first time in one drought prone and one coastal upazilas and the results are yet to come and confirm whether to recommend for further trial or replication of the same in other areas.

Farm yard manure (FYM) preparation for soil health improvement

A. Context and Justification:

The vulnerability of the agriculture sector is high and increasing due to growing water requirements, cropping intensity and population pressure. Climate change phenomena are posing an additional burden, in particular in the *barind* area and south-west *coastal* region where agriculture is exposed to a number of climate change hazards. The organic matter content of the *barind* tract and coastal area is exceptionally low which is not enough to support agricultural production. External addition of organic matter like cow dung and household sweeps is not possible because these are used as fuel due lack of fuel woods in the areas. Enhancing the organic matter level in soils improves soil structure, moisture retention, erosion stability and water infiltration and hence strengthens the resilience of farming systems to drought, climate variability, increasing temperatures and salinity problems. This can be achieved by the preservation and increased application of Farm Yard Manure (FYM), which is organic matter prepared from various kinds of animal excreta mixed with other organic materials.

B. Objective of FYM Preparation:

To promote the practice for conservation and use of organic matter in the crop land for soil improvement and over all yield increase and also to serve the mitigation purpose by reducing the use of chemical fertilizers.

Demonstrations showcase how to –

- find out the amount of organic matter produced which is readily available to be used in the crop field, in comparison to the traditional way of preparing the same.
- determine the amount of chemical fertilizers and amount of money saved from being used in the crop.
- determine the status of nutrient content and make comparison with the earlier nutrient status of the soil.
- assess the farmers opinion about the possible impact of using organic matter to the fertility and productivity crop field and contribution to the management of climate change induced drought and salinity.

C. Implementation time:

Rabi/October - March.

D. Successfully tested site/upazila:

Year	North-west	South-west
2008	Lalpur, Bagatipara, Nachole, Gomostapur, Porsha and Sapahar upazilas	Dacope and Terokhada upazilas
2009	Lalpur and Bagatipara upazilas	-

E. Technical details:

f.1. Lay out (Figure-1) of the FYM pit:-

Number of chamber = 2 chambers

Length of the chamber = 1.5 m
Width of the chamber = 1.5 m
Depth of the chamber = 1 m
Gap between 2 chambers = 50 cm

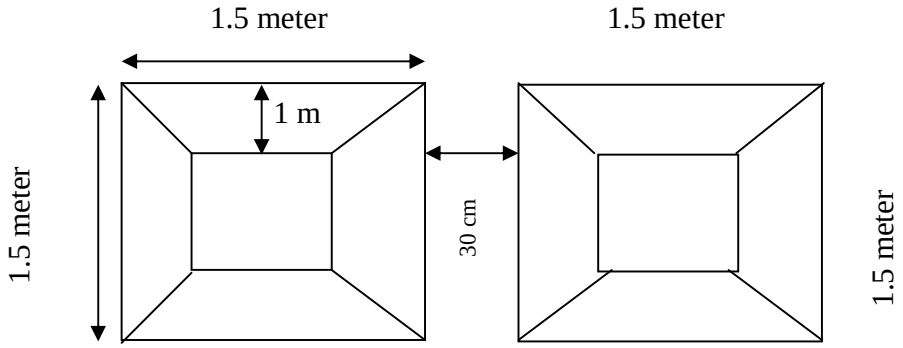

Fig-1: Lay out of two-chamber FYM pit

f.2. FYM pit shed/roof and boundary wall:-

To protect FYM from sun and rain a shed/roof made of local material such as bamboo and rice straw/polythene has to be constructed over the pit where FYM is heaped. The structure should be sufficiently strong to withstand winds. To protect the pit from entering rain and flood water, a barrier or boundary wall with mud around the pit can be made.

f.3. Piling dung, debris, wastes and FYM use:-

Collection of raw cow dung, urine soaked litter, kitchen wastes, vegetables waste, house sweeping, etc. should be done every day and pour it into one component until full. After full filling one chamber cover the chamber by plastering with mud mixed with dung and allow the materials to decompose. Afterwards fill the next chamber in the same way.

Sprinkle the FYM pit with water when the FYM becomes too dry. Decomposition may take 6-8 weeks depending on the ratio of dung to other organic materials used. Apply the decomposed FYM at the time of land preparation to any crop for improved and sustainable production.

f.4. Use of FYM in crop field
Arrange an informal trial in a definite crop where FYM will be used and there will a control plot with the same area and same crop where FYM will not be used. Application of other things like chemical fertilizer, water, intercultural operations will remain same for both FYM plot and control plot. Use FYM as per the common guideline used in the DAE.

F. Trial demonstration budget:

SL #	Item	Amount of input/bigha (Kg/No.)	Unit cost (BDT)	Total Cost (BDT)	Remarks
1	Shade making materials (Bamboo, wood, nails rope)			1,200.00	
2	Pit digging cost	1	400.00	400.00	
3	Signboard	1	500.00	500.00	
4	Register Khata	1	30.00	30.00	
	Total (Two thousand one hundred and thirty only)			**2130.00**	

		(US $ 31)	

G. Replication suitability and recommendation:

Based on the lessons and recommendation from the first phase, the option has been released to the farmers for continuation in all agro-ecological settings from the drought upazilas to the coastal areas. As per the suggestion made in the first phase retesting the option in combination with the improved stove has been testing in some upazilas and the results may confirm for further replication or promotion. Regular social mobilization programme is needed for awareness raising on the benefits and technical aspects that would encourage a higher adoption of the option among the farming families.

Table: Evaluation framework for recommendation and replication

Suitable for replication under the following conditions					**Primary target group**	**Investment costs for replication**	**Environ-mental benefits**	**Justification for replication**			**Recommendation (remarks)**
Farming system	AEZ	Hazard type/ impacts	Water mgt system	Micro-topography/ terrain				**Increase of CC resilience**	**Economic and social feasibility**	**No/ marginal increase of GHG emission**	
Rice-Wheat/ Pulse - Mango	25, 26	Drought spells; loss of crops	Rain fed	High and low barind tract	Poor/ medium farmers	31 US $	High	High	Yes	no increase	Ideal as single option or combined with improved stove

Improved cooking stove for win-win adaptation and mitigation

A. Context and Justification:

In Bangladesh every year more than 39 million tons of traditional fuels are used for cooking and other purposes, and the figures are rising due to population growth. About 50% of the fuel comes from agricultural residues, depriving the soil from organic matter and essential micro nutrients. Increased need for fuel wood encourages deforestation, increasing environmental degradation. The situation is even worse in the drought prone north-western districts where almost 100% of rice straw and cow dung are burnt to meet household level fuel need, resulting in declining soil fertility. The use of appropriate appliances such as improved stoves, being promoted by the project, may diminish the need for fuel and improves energy efficiency, thus saving wood, organic matter and money and cooking time as well. By releasing less green house gas i.e. carbon dioxide, it contributes to also to climate change mitigation. Improved stoves are efficient in reducing biomass use for cooking and other heating purposes, and lead to a reduction of Green House Gas (GHG) emissions. Improved stoves can serve many purposes, from domestic cooking to industrial use. Therefore, improved stoves act as a win-win situation in adaptation and mitigation.

B. Objective:

To promote the practice to reduce the use of wood, organic matter and crop residue as fuel and thus facilitating the use of organic matter in the crop field and also to serve the mitigation purpose by releasing less green house gas to the atmosphere.

Demonstrations showcase how to –

- compare the amount of fuel and time consumed for cooking required in improved and traditional stoves
- evaluate the (economic) savings a farmer can make from the fuel in comparison to the traditional practice
- assess the amount of organic matter (cow dung) savings made and its contribution to the soil fertility maintenance
- appraise farmers perceived opinion about the health condition, over all home environment, mitigation that improved stove can contribute to in the wake of the potential effect/impact of climate change induced hazards

C. Implementation time:

Rabi/October - March.

D. Successfully tested sites/upazilas:

Year	North-west	South-west
2008	Nachole, Gomostapur, Porsha and Sapahar upazilas.	-
2009	-	Dacope, Terokhada, Bhandaria and Nazirpur upazilas

E. Technical details:

Follow the technical guideline from Bangladesh Council for Scientific and Industrial Research (BCSIR) for making improved stove and the figure (Fig.2).

Both cement and mud can be use for making the stove. However, experience says that cement stove may crack and it is costlier. Therefore, mud can be used instead which is also liked by the farming family.

These stoves are of two types: (i) efficient stoves without chimney and (ii) efficient stoves with chimney. The models developed by BCSIR are (i) single-mouth domestic improved cook stove, half-underground, with iron rod or cast iron grate, (ii) single-mouth commercial efficient stove with iron rod or cast iron grate, (iii) double mouth domestic improved cook stove, half underground, coupled with chimney, (iv) double-mouth domestic improved cook stove, on-ground, coupled with chimney and (v) commercial improved cook stove coupled with chimney. .

The improved double-mouth domestic cook stove is constructed on the ground with a chimney. This consists of one outer frame, above ground, and is made of mud. Two holes at the bottom of the frame on both sides act as air entry and ash outlets. One fuel feed hole is provided above the grate. One grate made of cast iron is placed in the first pothole at a certain distance from the top of the stove. A chimney made of RCC pipe is provided, along with a chimney cap to protect it from rainwater. This improved model is suitable for burning fuel wood, briquettes, branches and twigs.

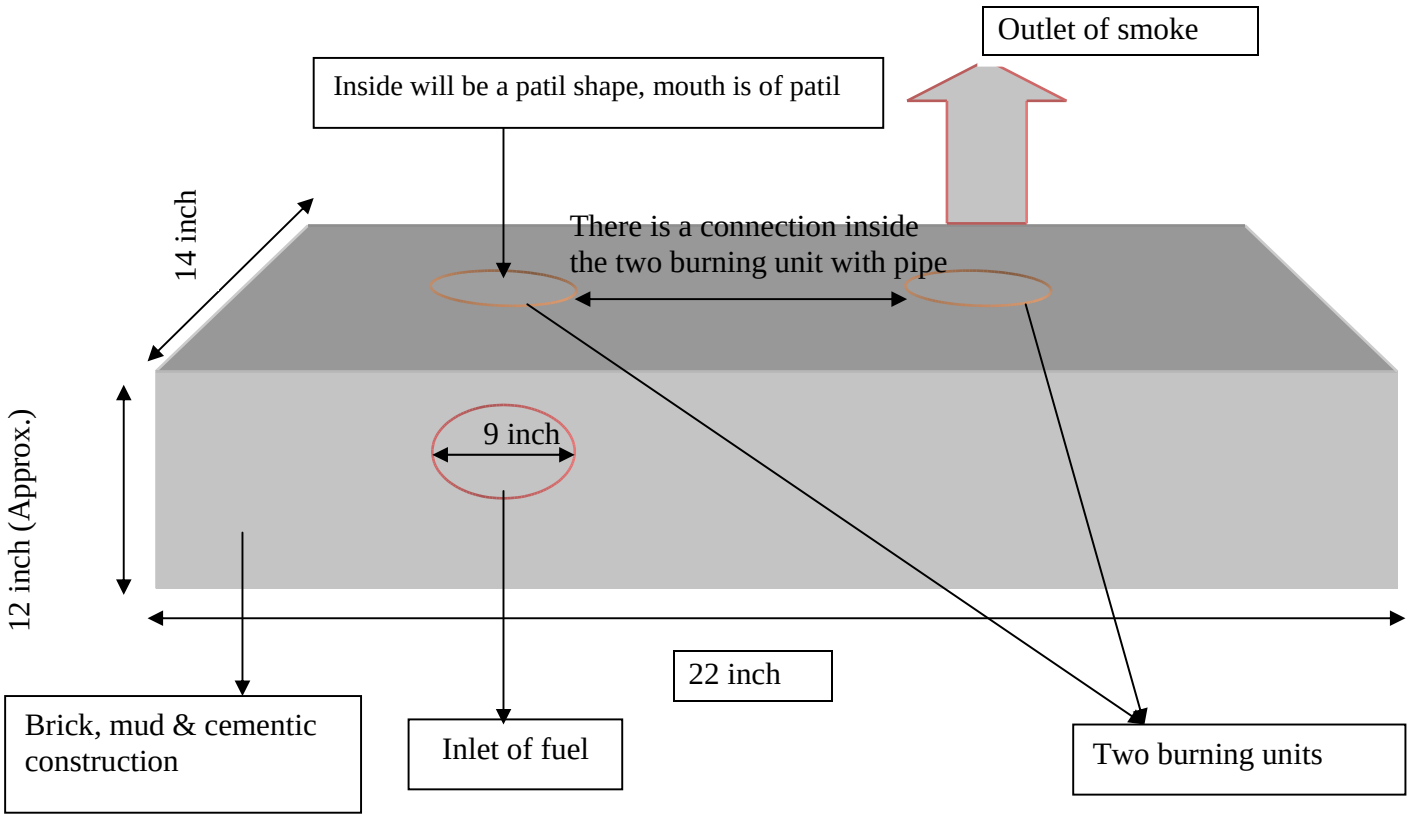

Fig-2. Double mouth Improved Cooking Stove (*BSCIR Model*)

F. Trial demonstration budget:

SL #	Item	Amount of input/bigha (Kg/No.)	Unit cost (BDT)	Total Cost (BDT)	Remarks
1	Cost of Outlet pipe	2	200	400.00	
2	Iron Rod	1 kg	80	80.00	
3	Cover lid	1	120	120.00	
4	Earthen pot/Patil	1	25	25.00	
5	Labour Cost	2		300.00	
6	Transport cost (Lump sum)			150.00	
7	Sign board (90×65cm)	1	500	500.00	
8	Register Khata	1	30	30.00	
	Total (One thousand six hundred and five only)			**1605.00 (US $ 24)**	

G. Replication suitability and recommendation:

Based on the results and lessons from the trials done in the first phase, some changes have been made especially in the materials for making stove and introduction some low cost materials may enhance the acceptance in the community. The promotion of the option should has been continued to new upazilas and villages under the second phase. The stove is suitable for farmer and community people of all socio-economic classes. However, using local and low cost materials for making the stove has encouraged more households, especially the poorer, to implement the option. Awareness raising programme especially on the win-win adaptation and emission reduction benefits is felt highly important.

Table: Evaluation framework for recommendation and replication

Suitable for replication under the following conditions					**Primary target group**	**Investment costs for replication**	**Environ-mental benefits**	**Justification for replication**			**Recommendation (remarks)**
Farming system	AEZ	Hazard type/ impacts	Water mgt system	Micro-topography/ terrain				**Increase of CC resilience**	**Economic and social**	**No/ marginal increase of GHG emission**	
-	-	-	-	-	all farmers	24 US $	High	High	Yes	no increase (reduction)	Ideal for promotion in any area of the country (ideally combined with FYM)

Biogas plant establishment for alternative energy source

A. Context and Justification:

Bangladesh reserves for the natural gas are being used for almost every purpose, from household cooking to electricity generation and manufacturing industries thus making the natural gas extremely valuable and getting exhausted at the same time. The current trend of utilization of natural gas tells that the reserve will be exhausted within next 15-20 years if new sources are not identified. In Bangladesh every year almost 40 million ton traditional fuels like wood, straw, leaves, twigs, cow dung etc are used up only for household cooking purpose. And this figure is getting increased every day due to increased population pressure and as a result the natural woods and other organic sources are diminished which has secondary and ultimate impact on our ecosystem and livelihood of the general people. Establishing domestic biogas technology and using the biogas for household cooking purpose can be a potential alternative to save the costly natural sources and also can serve as adaptation and mitigation option for any area and a family.

B. Objective:

To introduce an alternative energy source and thus reduce dependency on the use of wood, organic matter and crop residue as fuel and also to serve the mitigation purpose by releasing less green house gas to the atmosphere.

Demonstrations showcase how to –

- evaluate the (economic) savings a farmer can make from the fuel in comparison to the traditional practice
- assess the amount of organic matter (cow dung) savings made and its contribution to the soil fertility maintenance
- appraise farmers perceived opinion about the health condition, over all home environment, mitigation that improved stove can contribute to in the wake of the potential effect/impact of climate change induced hazards

C. Implementation time:

Rabi/October - March.

D. Successfully tested sites/upazilas:

Year	North-west	South-west
2009	Lalpur upazila	Dacope and Nazirpur upazilas

E. Technical details:

Follow the technical guideline from Bangladesh Council for Scientific and Industrial Research (BCSIR) and take technical assistance of the *Grameen Shakti* for establishing the plant. As per the demand and decision of NTIWG validation meeting smaller size (3.2 cft) plant has been selected.

F. Trial demonstration budget:

SL #	Item	Amount of input/bigha (Kg/No.)	Unit cost (BDT)	Total Cost (BDT)	Remarks
1	Cost of plant establishment	1	30000	30000.00	
	Total (Thirty thousand only)			**30000.00 (US $ 440)**	

G. Replication suitability and recommendation:

The option has just been testing for the first time in one drought prone upazila and two coastal upazilas and the results are yet to come and confirm whether to recommend for further trial or replication of the same in other areas. It is observed that the option may not be suitable to the small and poor farmers based on the cost involvement in the establishment of the plant and also based on the required number of cattle to be owned by the farmer as a source of cow dung.

Annex-1

AEZ – BARC FERTILIZER RECOMMENDATION

AEZ 10: Lalpur, Bagatipara

Soil Characteristics	Cropping Pattern		Yield Goal t/ha	Fertilizer Recommendation (kg/ha)							
	Seasons	Crops		Urea	TSP	MOP	Gypsum	Mg	Zinc Sulphate	Boric Acid	Mo
Land Type: High land, Medium High land, medium high land O M; Low-medium, pH- 6.5 - 7.9, Texture: loamy - clay, K - Bearing minerals: Medium- high	Rabi	Boro rice	6.0+_ 0.6	260.4	71.12	72	44.48	0	2.78	0	0
		Wheat		97.65	50.8	36	44.48	0	1.39	2.94	0
		Chickpea	1.5+_ 0.5	32.55	91.44	30	44.48	0	2.78	2.94	0.5
		Seasame	1.0+_ 0.1	117.18	45.72	22	44.48	0	0	0	0
	Kharif I	Mugbean	.7+_0.1	15.19	25.4	0	0	0	0	0	0
	Kharif II	T. Aman	4.0+_.4	86.8	30.48	36	38.92	0	2.78	0	0

AEZ 11: Lalpur, Bagatipara, Gomostapur, Terokhada

Soil Characteristics	Cropping Pattern		Yield Goal t/ha	Fertilizer Recommendation (kg/ha)							
	Seasons	Crops		Urea	TSP	MOP	Gypsum	Mg	Zinc Sulphate	Boric Acid	Mo
Land Type: High land- low land, O M: Low- medium, pH- 6.1 - 7.9, Texture: Sandy loam- clay, K - Bearing minerals: Medium- high	Rabi	Boro rice	6.0+_ 0.6	260.4	71.12	72	44.48	0	2.78	0	0
		Wheat	2.5+_ 0.25	97.65	50.8	0	16.68	0	1.39	2.94	0
		Mug bean	.7+_0.1	15.19	25.4	22	0	0	0	0	0
		Seasame	1.0+_ 0.1	117.18	45.72	72	27.8	0	0	0	0
	Kharif II	T Aman	4.0+_.4	868	30.48	36	38.92	0	2.78	0	0

AEZ 12: Dacope, Nazirpur, Bhandaria

Soil Characteristics	Cropping Pattern		Yield Goal t/ha	Fertilizer Recommendation (kg/ha)							
	Seasons	Crops		Urea	TSP	MOP	Gypsum	Mg	Zinc Sulphate	Boric Acid	Mo
Land Type: High land- low, O M; Medium, pH- 6.2 - 7.7, Texture: Silt loam, K - Bearing minerals: Medium- high	Rabi	Boro rice	6.0+_ 0.6	260.4	71.12	72	44.48	0	2.78	0	0
	Kharif I	Aus Rice	3.5+_0.3	117.18	30.48	10	5.56	0	0	0	0
	Kharif II	T Aman	4.0+_.4	86.8	30.48	36	38.92	0	2.78	0	0

AEZ 13: Terokhada, Dacope, Nazirpur, Bhandaria

Soil Characteristics	Cropping Pattern		Yield Goal t/ha	Fertilizer Recommendation (kg/ha)							
	Seasons	Crops		Urea	TSP	MOP	Gypsum	Mg	Zinc Sulphate	Boric Acid	Mo
Land Type: High land- low, O M: medium, pH- 6.5 - 7.0, Texture: loamy, K - Bearing minerals: Medium	Rabi	Boro rice	6.0+_ 0.6	260.4	71.12	72	44.48	0	2.78	0	0
	Kharif I	Jujube									
		Aus Rice	3.5+_0.3	117.18	30.48	10	5.56	0	0	0	0
	Kharif II	T Aman	4.0+_.4	86.8	30.48	36	38.92	0	2.78	0	0

AEZ 14: Terokhada, Dacope, Nazirpur, Bhandaria

Soil Characteristics	Cropping Pattern		Yield Goal t/ha	Fertilizer Recommendation (kg/ha)							
	Seasons	Crops		Urea	TSP	MOP	Gypsum	Mg	Zinc Sulphate	Boric Acid	Mo
Land Type: High land- very low land, O M:Medium, pH- 5.0 - 7.7, Texture: Clay, K - Bearing minerals: High	Rabi	Boro rice	6.0+_ 0.6	260.4	71.12	72	44.48	0	2.78	0	0
		Seasame	1.0+_ 0.1	117.18	45.72	22	27.8	0	0	0	0
		Potato	25+_2.5	208.32	81.28	64	44.48	1.5	1.39	0	0
		Grass pea	1.2+_0.1	8.68	40.64	8	2.78	0	0	0	0
	Kharif I	Aus Rice	3.5+_0.3	117.18	30.48	10	5.56	0	0	0	0

AEZ 25: Nachole, Gomostapur, Porsha, Sapahar

Soil Characteristics	Cropping Pattern		Yield Goal t/ha	Fertilizer Recommendation (kg/ha)							
	Seasons	Crops		Urea	TSP	MOP	Gypsum	Mg	Zinc Sulphate	Boric Acid	Mo
Land Type: High land- low land, O M:low, pH- 5.0 - 5.7, Texture: Loamy, K - Bearing minerals:low	Rabi	Boro rice	6.0+_ 0.6	260.4	71.12	72	44.48	0	2.78	0	0
		Wheat	2.5+_ 0.25	97.65	50.8	36	16.68	0	4.17	2.94	0
		Chickpea	1.5+_ 0.5	32.55	91.44	30	27.8	0	2.78	2.94	0.5
		Seasame	1.0+_ 0.1	117.18	45.72	22	27.8	0	2.78	0	0
		Mugbean	.7+_0.1	15.19	25.4	0	0	0	0	0	0
		White gourd		21.7	91.44	12	0	0	2.78	0	0
		Seasbania (GM)	-	0	0	0	0	0	0	0	0
	Kharif II	T Aman	4.0+_.4	86.8	30.48	36	38.92	0	2.78	0	0
		Chini Atop	3.0+_0.3	97.65	25.4	30	33.36	0	2.78	0	0

AEZ 26: Nachole, Gomostapur, Porsha, Sapahar

Soil Characteristics	Cropping Pattern		Yield Goal t/ha	Fertilizer Recommendation (kg/ha)							
	Seasons	Crops		Urea	TSP	MOP	Gypsum	Mg	Zinc Sulphate	Boric Acid	Mo
Land Type: High land- medium high land, O M:low, pH- 4.8 - 5.9, Texture: Loamy, K - Bearing minerals:low	Rabi	Boro rice	6.0+_ 0.6	260.4	71.12	72	44.48	0	2.78	0	0
		Chickpea	1.5+_ 0.5	32.55	91.44	30	27.8	0	2.78	2.94	0.5
		Seasame	1.0+_ 0.1	117.18	45.72	22	27.8	0	0	0	0
	Kharif I	Mugbean	.7+_0.1	15.19	25.4	0	0	0	0	0	0
		Aus Rice	3.5+_0.3	117.18	30.48	10	5.56	0	0	0	0
		White gourd		21.7	91.44	12	0	0	2.78	0	0
		Seasbania (GM)	-	0	0	0	0	0	0	0	0
	Kharif II	T Aman	4.0+_.4	86.8	30.48	36	38.92	0	2.78	0	0
		Chini Atop	3.0+_0.3	97.65	25.4	30	33.36	0	2.78	0	0