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

Technical Guideline
on
Establishment of Adaptation Option Demonstrations
for
Kharif-II season/July – October
in
Drought prone and saline areas

Implemented by
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 scientists of DAE, DLS, DoF, BARI, BRRI, BLRI and BFRI. A number of technical books and papers were consulted to make the guideline as appropriate as possible. The entire technical part and tentative budget 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 prerequisite 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 are provided. 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, 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

AEZ	: Agro-ecological zone
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
DAS	: Days after sowing
DAT	: Days after transplanting
DLS	: Department of Livestock Services
DoF	: Department of Fisheries
FAO	: Food and Agriculture Organization of the United Nations
FOM	: Field Officer (Monitoring)
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
MP/MOP	: Muriate of potash, a chemical fertilizer
NTIWG	: National Technical Implementation Working Group
PMU	: Project Management Unit
TD	: Top Dressing of fertilizers.
TSP	: Triple super phosphate, a chemical fertilizer
UAO	: Upazila Agriculture Officers
UDMC	: Union Disaster Management Committee
UTIWG	: Upazila Technical Implementation Working Group

Agricultural/common term

Amropali	: An improved and introduced mango variety
Apple kul	: An improved and introduced jujube variety
BAU kul	: An improved jujube variety from Bangladesh Agricultural University
Barind tract	: North-western drought prone area of Bangladesh
Bigha	: 1 bigha equals 33 decimal
Black Bengal	: A local goat variety
Bombai	: An improved litchi variety from India
China-3	: An improved litchi variety from China
Gher	: Prawn culture field (*Integrated prawn, rice, vegetables cultivation*)
Jambu	: A local high yielding grass variety
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
T. Aman	: Rain fed monsoon rice

List of Options demonstrated in Kharif-II season in the farmers fields

Adapting T. *Aman* rice cultivation to changing conditions

A. Context and Justification:

Transplanted Aman (T. *Aman*) is the second rice crop, grown in the wet Kharif-II season of the year, between July and October, and it may be strongly affected by drought and salinity. 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 which are being used currently in the project upazilas. In the drought prone north-western and south-western coastal upazilas where due to the variability of rainfall in wet season (Kharif-II) and pattern of tide and water recession especially in the coastal areas new and improved rice varieties are sought to be incorporated. Introduction of HYV T. *Aman* rice varieties developed by the BRRI suitable to both regions in a comparison trial with local varieties is considered as an appropriate adaptation option for farming community that serve both the purposes to suit variable crop duration and provide higher yield in comparison to the local varieties.

B. Objective:

To provide the farmers with opportunity for selection of suitable varieties that can grow well in the changing pattern of rainfall and coastal tide in drought prone and coastal areas.

Demonstrations showcase how to –

- select suitable varieties of T. *Aman* rice that grow 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 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 T. *Aman* rice grown in the demonstration.

C. Implementation time:

Kharif-II/July - October.

D. Successfully tested sites/upazilas:

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

E. Technical details:

Land area:
A total of 40 decimal land may be brought in; 10 decimal for each of the variety. The land should be a single piece where all intended varieties can be accommodated.

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: BR 23, BRRI Dhan 39 were commonly recommended for both drought prone and coastal areas which can serve the purpose of suitability to the varying rainfall and duration.

BRRI dhan 40 and 41 were recommended for the coastal area also to learn about the varying duration and also to test the tolerance to the tidal effect. Also BINA 4 and 7 can be used in both the area, which is short duration and high yielder.

Local varieties: *Vozon, Maynamoti, Sadamota, Lalmota, Bathiaghata Balam* for coastal area, as per the selection of the farmers and later validation through the screening process that serves the purpose of comparison with the HYV in respect of the duration and the tidal effect and saline stress.

Seedling raising: T. *Aman* 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 01-10 July.

Transplanted in another Field: In case of heavy rainfall and flood situation and if the main field goes under water, 30 days old seedlings should be transferred to another field. This type of land should be flood free.

***Seed rate*:** Seed rate will be 4-6 kg/ bigha (33 dec).

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*).

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	Register khata	1	30	30.00	
	Total (Two thousand nine hundred and eighteen only)			**2918.00 (US $ 43)**	

G. Replication suitability and recommendation:

The adaptation option was tested in the drought prone and the coastal saline areas in two seasons in 2008 and 2009 in the second phase (LACC-II) of the project. The result and experiences gained demonstrate that farmers still believe in the local varieties for their inherent capacity and resilience to the tidal flow and recession in the coastal area in particular, although a shift towards accepting HYV varieties is promising. Trial conducted in the drought prone (low/flat barind) areas could not make any difference 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.

Cultivation of short duration T. *Aman* as an alternative technology

A. Context and Justification:

In recent years, increasing climate variability has caused serious and frequent drought spells in drought prone north-western Bangladesh, which influence agricultural systems in all stages of growth and consequently the crop yields. Diversification and adjustment of cropping patterns are a way to reduce losses, thus mitigating the impact of droughts on the rural poor. In the rain fed high *barind* tracts farmers usually grow only one rice crop i.e. transplanted Aman during Kharif-II (July-October) season and leave the land as fallow in the other two seasons, Rabi (October-March) and Kharif-I (March-July). BARI introduced T. Aman-Chick pea/pulse cropping pattern in recent years. The pattern includes T. Aman transplantation in the early onset of rain in the month of July and after rice harvesting sowing the seeds of the pulse crop capturing the residual moisture in the field to facilitate easy germination.

B. Objective:

The demonstration was established in order to test the cropping pattern of T. Aman and Chick pea that exploits the current climatic condition of the high *barind* area and provides farmers with options to incorporate crops in the fallow period.

Demonstrations showcase how to –

- select suitable varieties of T. *Aman* rice and chick pea that grow 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 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 and other factors (price) on the sustainability of the production practice and the comparative advantages of the pattern.

C. Implementation time:

Kharif-II/July - October.

D. Successfully tested sites/upazilas:

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

E. Technical details:

Land area:
In order to accommodate more farmers together in a single demonstration block demonstration method was followed in the cultivation of the short duration T. Aman cultivation. A total of 165 dec of land was brought under each demonstration trial.

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:
Swarna a popular local aromatic variety of *Barind* area was selected for drought prone upazilas that has comparatively less crop duration.

Seedling raising: T. *Aman* 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 01-10 July.

Transplanted in another Field: In case of heavy rainfall and flood situation and if the main field goes under water, 30 days old seedlings should be transferred to another field. This type of land should be flood free.

***Seed rate*:** Seed rate will be 4-6 kg/ bigha (33 dec).

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*).

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	32 Kg	60	1920.00	
2	Compost	800 Kg	1	800.00	
3	Urea	96 Kg	12	1152.00	
4	TSP	60 Kg	40	2400.00	
5	MP/MOP	48 Kg	35	1680.00	
6	Gypsum	40 Kg	10	400.00	
7	Zinc Sulphate	4 Kg	150	600.00	
8	Boron	4 Kg	150	600.00	
9	Sign board	1	500	500.00	
10	Register khata	1	30	30.00	
	Total (Ten thousand and eighty two only)			**10082.00 (US $ 147)**	

G. Replication suitability and recommendation:

The option was applied in one season i.e. Kharif-II 2006 and the results justify further demonstration for wider audience in the community. 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 if irrigation is needed that can be supplemented from the pond. As the option requires early seedlings, inclusion of the dry seed bed method for seedlings availability should 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 medium farmers, including sharecroppers, and for the community as a whole, particularly where they can bring more land together (as a block) under the demonstration.

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	147 US $	High	High	Yes	no increase	Highly recommended as adaptation option

Integrated rice-fish cultivation

A. Context and justification:

In the extensive river floodplains and deltaic lowlands of Bangladesh, where floods last several months and land goes under water or inundated from the coast (rendering the land unsuitable for crop production), fish are linked with rice cultivation. The freshwater wetlands of Bangladesh consist of the ecologically coastal low lowlands and floodplain areas are being used for rice-fish culture. Integration of fish culture enables farmers to increase overall production in the flood-prone ecosystem. Rice fish culture increases rice yields (more than 10%) and additional fish to the rice crop can be harvested. As a rule of practice no insecticides are used in rice-fish culture that guarantees an environmentally sound production system and reduce production cost. Small farmers can be benefited while providing their family labour and earning more total production from a unit land by integrating fish in the rice filed.

B. Objective:

To promote integrated rice and fish production and provide opportunities for crop diversification, increased yield and more income.

Demonstrations showcase how to –

- evaluate suitability of the option rice and fish varieties in local conditions, also taking into consideration the future scenario i.e. increased salinity, water stagnation etc.
- assess the amount of fertilizers, organic matters and other inputs required in the cultivation of the rice-fish 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 salinity etc and other factors (price) on the sustainability of the production practice and the comparative advantages of the rice-fish cultivation.

C. Implementation time:
Kharif-II/July - October.

D. Successfully tested sites/upazilas:

Year	North-west	South-west
2008	-	Dacope, Bhandaria and Nazirpur upazilas

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 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.

Bund/aile preparation: The bund or aile should be prepared/raised up to 1 ft (30 cm.) so that 5-6 inch water (or as required for the fish variety) can be retained for fish cultivation. The base of the bund should be 50-55 cm. wide and top should be 30-35 cm. wide.

Drainage canal preparation: Drainage canal should be prepared around the rice field. The depth of the canal should be 50-60 cm. and width should be 60-100 cm.

Millpond (small pond) for fish: A millpond or small pond for fish should be prepared at the corner of the field for the fish to take shelter. The size may be 1 meter depth and wide.

Variety:
Rice: Local varieties –
Lalmota and Sadamota (Bhandaria)
Vojon and Moynamoti (Nazirpur)
Kachra and Nonakochi (Terokhada, Dacope)

Fish and the rate **(BFRI Suggested):**
Rajpunti- 20/decimal, or
GIFT tilapia: 20/ decimal, or
Rajpunti : 15/decimal + Common carp 5/decimal, or
Common carp: 15/ decimal

Fish fingerling – Should be 2.25 cm. to 7.0 cm long and 16 to 30 days (based on the variety).

Seedling raising: T. *Aman* 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 01-10 July.

Transplanted in another Field: In case of heavy rainfall and flood situation and if the main field goes under water, 30 days old seedlings should be transferred to another field. This type of land should be flood free.

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: Fertilizer dose is given in the budget section. The application should follow the standard procedure.

Fish rearing in the rice field:
Maintain the number of fish as per the rate given above or in the budget. Release fish fingerling after 10-15 days of rice transplanting.

If the rice field is fertilized and manured well, field contains enough feed for fish. No need to supplement. However, if needed additional feed like rice burn, oil cake, decomposed cow dung can be applied. The general rule is that the amount of feed should be 5% of the total weight of fish or follow the standard rate.

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	1000 Kg	1	1000.00	
3	Urea	24 Kg	12	288.00	
4	TSP	15 Kg	40	600.00	
5	MP/MOP	18 Kg	35	630.00	
6	Gypsum	20 Kg	10	200.00	
7	Lime	30 Kg	20	600.00	
8	Net	300 ft	10	3000.00	
9	Drainage pipe	1	600	600.00	
10	Transport cost (Lump sum)			1000.00	
11	Sign board	1	500	500.00	
12	Register khata	1	30	30.00	
	Total (Eight thousand nine hundred and twenty eight only)			**8928.00 (US $ 130)**	

G. Replication suitability and recommendation:

The adaptation option was tested in three upazilas of the coastal saline area in the year 2008. There are differences in results and experiences from upazila to upazila. The differences are due to the differences in varieties of rice and fishes among the upazilas and also due to the level of salinity including other local factors. The need for continual support, especially quality seeds and updated technical information, beyond the project period has been gathered from the farmers through informal assessment The option should be continued for the upazilas and with appropriate farmers for at least another one season with a thorough assessment by using the evaluation framework used in LACC-I period so that a well-informed decision and recommendation can be made for further replication.

Integrated rice-fish-vegetable cultivation

A. Context and justification:

In the coastal areas where land use is limited due to frequent tidal inundation, water stagnation and salinity invasion, diversification in a same piece of land can maximize the land utilization. Integration of rice and fish in the same piece of land provides opportunity for diversification and increasing yield. Inclusion of vegetables in the rice-fish system can make the most use of space and resources and add to the total yield of rice and fish and thus increase income of the resource poor vulnerable farmers of the coastal area. Selection of vegetable varieties are based on the season, farmers choice and their yield and market potential for which are farmers are readily motivated. Vegetables are grown on the rice-fish field/pond edge and also over the field on the trellis, fences and sometimes on the fences in a way that the rice and fish production are not compromised.

B. Objective:

To promote integrated rice, fish and vegetables production and provide opportunities for crop diversification, increased yield and year round income from the same piece of land.

Demonstrations showcase how to –

- evaluate suitability of the option rice, fish and vegetable varieties in local conditions, also taking into consideration the future scenario i.e. increased salinity and water stagnation etc.
- assess the amount of fertilizers, organic matters and other inputs required in the cultivation of the rice-fish and vegetables 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 salinity etc and other factors (price) on the sustainability of the production practice and the comparative advantages of the rice-fish & cultivation.

C. Implementation time:

Kharif-II/July - October.

D. Successfully tested sites/upazilas:

Year	North-west	South-west
2009	-	Dacope upazila

E. Technical details:

Land type: Medium high land with loam or clay loam soil, which belongs to *Ganga katal* alluvium soil.

Total area: 50 decimal
Periphery canal inside the embankment for rain water harvest: 10 decimal
Embankment for tidal surge protection and vegetable cultivation: 10 decimal
Plane land for rice cultivation: 30 decimal
Fish cultivation: canal area + plane land = (10+ 30) deci=40 decimal

Embankment preparation: The embankment should be prepared/raised up to 5ft with 7 ft wide at bottom and 4 ft at top so that 5-6 inch water (or as required for the fish variety) can be retained for fish cultivation and tidal flood water can not enter.

Periphery canal preparation: Periphery canal will cover 10 decimal areas, while average depth and width at top level with 22.5^0 sloping will be 5 ft and 8 ft respectively. This canal will be rain water reservoir for irrigation and fish culture.

Pipe setting for drainage: Drainage pipe having net like inlet and out let face should be set at 5-6 inch height from rice field level so that 5-6 inch water can be retained for fish cultivation. Before starting tidal flood, face of drainage pipe will be closed.

Rice Cultivation:

Land preparation for rice cultivation: 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.

Rice variety*:* Local variety – *Nonakochi*.

Seedling raising: T. *Aman* 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 15-31 July.

Transplanted in another Field: In case of heavy rainfall and flood situation and if the main field goes under water, 30 days old seedlings should be transferred to another field. This type of land should be flood free.

Seed rate**:** Seed rate will be 8 kg/bigha.

Spacing: In case of transplanting, spacing should be 36 cm x 25 cm (as per local practice. As Local variety is of higher vegetative growth, higher spacing is more justified).

Fertilizer dose and timing: Fertilizer dose is given in the budget section. The application should follow the standard procedure.

Fish Cultivation:

Fish and the rate **(BFRI suggested)*:*** Monosex tilapia: 200/decimal

Fish fingerling – Should be 2.25 cm. to 7.0 cm long and 16 to 30 days aged

Fish rearing in the rice field: Maintain the number of fish as per the rate given above or in the budget. Release fish fingerling after 10-15 days of rice transplanting.

If the rice field is fertilized and manured well, field contains enough feed for fish. No need to supplement. However, if needed additional feed like rice bran, oil cake, decomposed cow dung can be applied. The general rule is that the amount of feed should be 5% of the total weight of fish or follow the standard rate.

Vegetable Cultivation on Embankment:

Species, variety and area:

Sl #	Species	Variety	Area (Dec.)	Remarks
1	Bottle gourd	BARI lau	1.5	Area of Individual vegetable for cultivation is determined based on farmer's interest and local demand and market price.
2	Country Bean	Ipsa -2	1.5	
3	Brinjal	Local improved	5.5	
4	Kalmi	Gimakalmi	1.0	
5	Red amaranth	Altapeti	0.5	

Production technology of vegetables:

Bottle gourd: Seed rate- 6 g/deci
Spacing – pit to pit for single line on the embankment: 2 meter, pit size- 60 cm x 60 cm x 50 cm

Fertilizer application per pit:

Time	CD compost	Urea	TSP	MP
10-12 days before sowing	20 kg		75 g	
1st TD at 30 DAS		30 g		20 g
2nd TD at 30 DAS		35 g		20 g
3rd TD at 30 DAS		35 g		20 g

Country bean: Seed rate- 50 g/deci
Spacing – pit to pit for single line on the embankment: 1.5 meter, pit size: 60 cm x 60 cm x 60 cm

Fertilizer application per pit:

Time	CD compost	Urea	TSP	MP
10-12 days before sowing	10 kg		100 g	
1stTD at 20 DAE		50 g		50 g
2nd TD at 40 DAE		50 g		50 g

Brinjal: Seed rate – 2 g/ deci ,
Spacing: 60 cm x 45 cm,

Fertilizer application per decimal:

Time	CD compost	Urea	TSP	MP
Basal	60 kg		600 g	800g
1stTD at 15 DAT		350 g		50 g
2nd TD at 40 DAT		350 g		50 g
2nd TD at harvest stage		300 g		

Kang kong: Seed: 40-50 gm/dec.
Spacing- 30 cm x15 cm

Fertilizer application per decimal:

Time	CD compost	Urea	TSP	MP
Basal	40 kg	300g	200 g	100g
1stTD at 30 DAS		100 g		50 g
2nd TD at 60 DAS		100 g		50 g
2nd TD at 90 DAS		100 g		

TD = Top Dressing of fertilizers.

Red amaranth: Seed- 20g/deci,
Spacing- 20-25 cm for line sowing

Fertilizer application per decimal:

Time	CD compost	Urea	TSP	MP
Basal	20 kg	400g	200 g	200g

F. Trial demonstration budget:

SL #	Item	Amount of input/bigha (Kg/No.)	Unit cost (BDT)	Total Cost (BDT)	Remarks
1	Rice seed	7 Kg	60	420.00	
2	Vegetable seed (Lump sum)			1000.00	
3	Fish fry	1200	3	3600.00	
4	Compost	2600 Kg	1	2600.00	
5	Urea	64 Kg	12	768.00	
6	TSP	33 Kg	40	1320.00	
7	MP/MOP	41 Kg	35	1435.00	
8	Gypsum	18 Kg	10	180.00	
9	Lime	35 Kg	20	700.00	
10	Net	300 ft	10	3000.00	
11	Drainage pipe	1	1200	1200.00	
12	Transport cost (Lump sum)			1000.00	
13	Sign board	1	500	500.00	
14	Register khata	1	30	30.00	
	Total (Twenty seven thousand seven hundred and fifty three only)			**17753.00 (US $ 260)**	

G. Replication suitability and recommendation:

The adaptation option has just started testing only in one upazila of the coastal saline area in one season of 2009 and no results and experiences could have been gathered so far. However it is felt that for better lessons and experiences the option may be tested further based on the results gained in the first trial and then a thorough assessment may be needed by using the evaluation framework used in LACC-I period so that a well-informed decision and recommendation can be made.

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:

Kharif-II/July - October.

D. Successfully tested sites/upazilas:

Year	North-west	South-west
2006	Nachole, Gomostapur, Porsha and Sapahar upazilas	N/A
2007	Nachole, Gomostapur, Porsha and Sapahar upazilas	N/A
2008	Lalpur, Bagatipara, Nachole, Gomostapur, Porsha and Sapahar upazilas	Dacope, Terokhada, Bhandaria and Nazirpur upazilas
2009	Lalpur and Bagatipara upazilas	-

E. Technical details:

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

- Area of homestead garden is 1 decimal or 36 m^2.
- No. of beds are 5 (preferably 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.

ii. Other technical aspects:-

- Five recommended vegetables may be grown in five beds so that diversified vegetables are available for family consumption.
- A strong boundary fence is required to establish (with net, bamboo or other low-cost materials) to protect crops from cattle, goats, poultry etc.
- In the boundary canal aroid and on the fence gourd vegetables, country bean, yard long bean and drumstick plant at the corner as support of the fence can be grown as per the choice of the farmers and local suitability.

iii. 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	Kang kong	Kang kong	Same variety
Bed–2	Okra (BARI)	Okra (BARI)	Different varieties
Bed–3	Stem Amaranth (*Katoa*)	Stem Amaranth (BARI)	Different varieties
Bed–4	Indian Spinach	Bitter gourd	Different species
Bed–5	Red Amaranth	Egg plant	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.

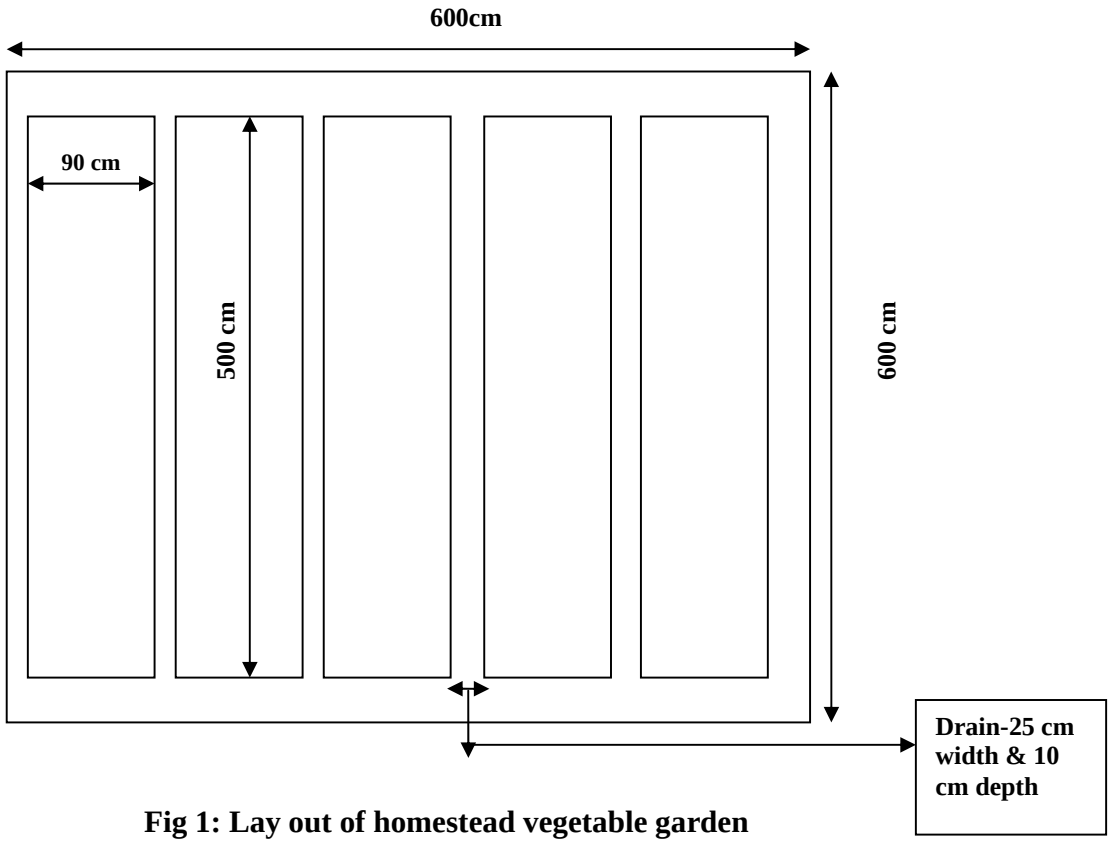

Fig 1: Lay out of homestead vegetable garden

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 phase (LACC-I) 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.

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 owners hip	36 US $	High	High	Yes	No increase	Highly recommended as adaptation option

Vegetable cultivation in the prawn field (*gher*)

A. Context and justification:

Inclusion of vegetables suitable to the particular agro-ecological condition and specific production system is critical for increased yield and development of resilience of farming family in general. Incorporating vegetables in the prawn field (*gher*) can provide additional yield benefits and cash incentive to the farmers by maximizing the utilization of the land in the coastal area. Vegetable varieties cultivated by farmers are not always properly selected and farmers often fail to follow appropriate technical guidance in crop production required to raise the acclimatization in the changing climatic condition. Due change in the frequency and intensity of climate and non-climate hazards in the coastal region in particular, farmers are in need of appropriate technology and up dated information that are able to meet their requirement and facilitate sustain their integrated production enterprise like prawn *gher* farming. New and improved varieties of vegetables and regular technical supports ensure continual production and income from the same of shrinking land of the coastal saline land.

B. Objective:

To promote vegetables cultivation in the prawn field by providing suitable vegetable varieties and by maximizing the utilization of land for year round yield and income.

Demonstrations showcase how to –

- maximize the utilization fallow land on gher through vegetables cultivation.
- select suitable vegetable species/varieties that grow and produce well in 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 salinity etc on the sustainability of the production of vegetables in the gher vegetable garden
- appraise the involvement of the women and men members in the demonstration activities

C. Implementation time:

Kharif-II/July - October.

D. Successfully tested site/upazila:

Year	North-west	South-west
2009	-	Terokhada upazila.

E. Technical details:

i. Lay out (Figure-1) of the plot:-

- Area of gher sides vegetable garden is 15 decimal or 540 m^2.
- Surrounding two beds, one vegetables roofs that makes total 3 (preferably in the north-south directions to ensure equal distribution of sunlight).

- The length of bed is 5400 cm and width of each bed is 40 cm.
- The length of Vegetables roof is 5400 cm and width of each vegetable roof is 250 cm.

ii. Other technical aspects:-

- Three recommended vegetables may be grown in three parts so that diversified vegetables are available for market access & family consumption.
- Under vegetable roof Shrimp cultivation and rice production will be continue.

iii. The recommended vegetables for homestead garden may be:-

- Bed–1: Bringal/ Tomato/ Ladies finger
- Bed –2: Pit prepared for cucumber / karalla / Bittergouard/ Gourd
- Vegetable roof–3: For vegetation of pit vegetables.

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.

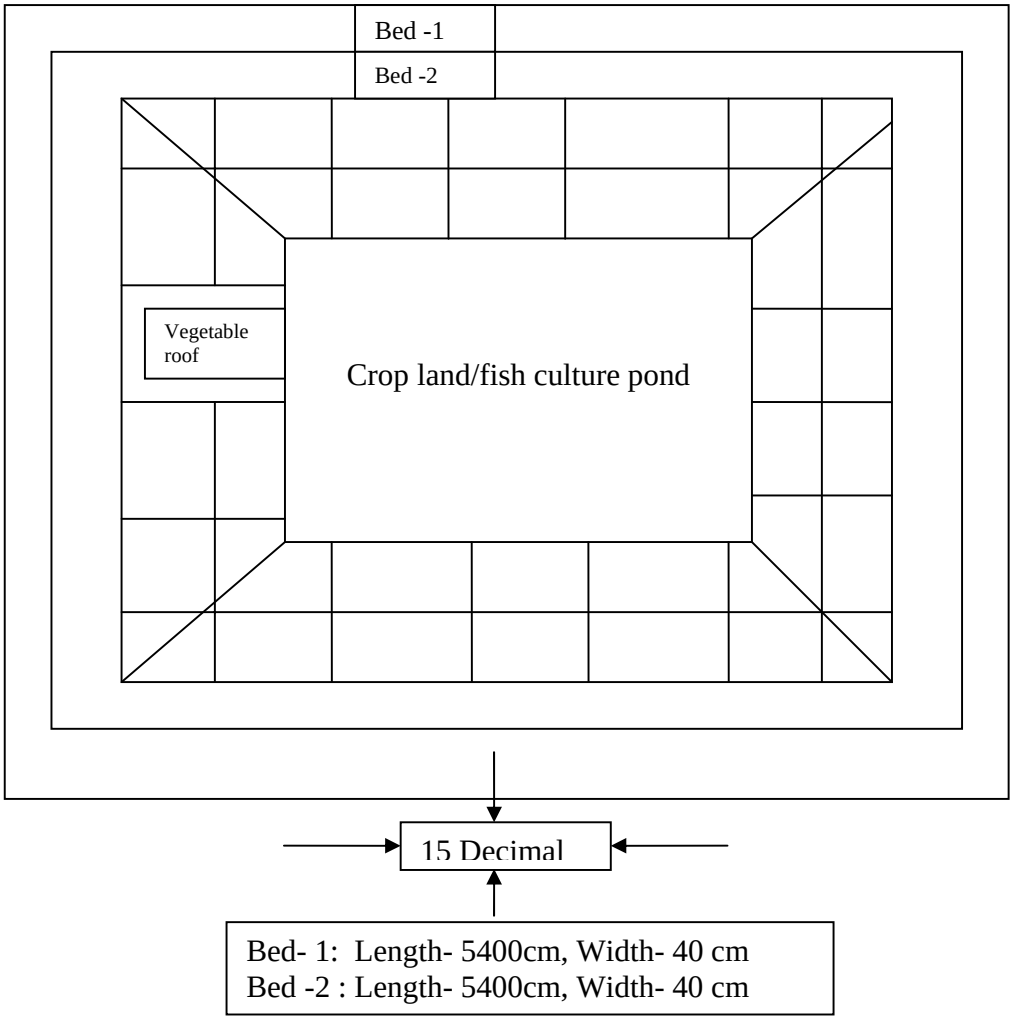

Fig 1: Lay out of gher side vegetable garden

F. Trial demonstration budget:

SL #	Item	Amount of input/bigha (Kg/No.)	Unit cost (BDT)	Total Cost (BDT)	Remarks
1	Seed (Lump sum)		600	600.00	
2	Compost	100 Kg	1	100.00	
3	Urea	20 Kg	12	240.00	
4	TSP	12 Kg	40	480.00	
5	MP/MOP	12 Kg	35	420.00	
6	Watering cane	1	500	500.00	
7	Trellis (Lump sum)		1500	1500.00	
8	Sign board	1	500	500.00	
9	Register khata	1	30	30.00	
	Total (Four thousand three hundred and seventy only)			**4370.00 (US $ 64)**	

G. Replication suitability and recommendation:

The adaptation option has just started testing only in one upazila of the coastal saline area in one season of 2009 and no results and experiences could have been gathered so far. However for better lessons and experiences the option may be tested further based on the results gained in the first trial and then a thorough assessment may be needed by using the evaluation framework used in LACC-I period so that a well-informed decision and recommendation can be made.

Papaya cultivation as a livelihood support activity

A. Context and Justification:

Papaya is cultivated in almost all agro-ecological zones and accepted as a high value, delicious and nutritious fruit in Bangladesh. It is one of the rare crops in Bangladesh which is taken both as vegetable at the green stage and fruit at the ripening stage. It is known that papaya can grow well in a dry climate with a meager rainfall and produce sweet–testing fruits. Farmers of north-western drought prone barind area identified papaya as a promising crop based on the information of its ecological advantage, market value and other good traits and selected for cultivation in their homestead lands. Based on the demand from the farmers, the local agriculture office and project staff recommended the cultivation of papaya in the farmers' homesteads. The major aim of the papaya cultivation demonstration trial was to provide the farming households with the opportunity to produce and ensure food, nutrition and income.

B. Objective:

To promote cultivation of papaya 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 papaya cultivation 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 production practice in comparison with other practices.

C. Implementation time:

Kharif-II/July - October.

D. Successfully tested site/upazila:

Year	North-west	South-west
2007	Nachole, Gomostapur, Sapahar and Porsha.	N/A

E. Technical details:

Variety: The popular varieties are BARI Papaya-1or Shahi or Bhadsha (Ishurdi).

Seedling raising: Seeds are sown on raised seed beds at a depth of 1 cm in rows spaced 15 cm apart and the seeds spaced 2.5 cm apart. The seed beds should be watered with a watering can immediately after sowing and every morning and evening except during the rains. Seeds start germinating within 15 -20 days .This can be faster, if they are soaked in water for 48 hours before sowing. Seedling raised in polythene bags are the best as the roots of the papaya plant are not capable of tolerating transplanting shock. Two to three seeds can be sown in each bag (10x15cm

size) filled with a mixture of sieved soil, farmyard manures and sand in equal proportions. Only one seedling should be kept in each bag after 2-3 days of germination. Seedling aged 20-25 days should be irrigated with 20 gm urea per litre of water at an interval of 15 days, to enhance growth.

Soil: A well drained, sandy loam soil, rich in organic matter is good for papaya. The soil pH for papaya cultivation should be between 6.0-7.0.

Land and pit preparation: The land should be well prepared by plowing and harrowing three to four times. Pits of 60 cm cube are spaced 2x2m apart. The top half of the pit soil should be placed one side of the pit with the bottom half placed on the other. The pit should be filled with top soil, and organic manure, TSP, Gypsum, Zinc oxide and boric acid at the rate of 10 kg, 500 g, 250g and 25g, respectively. The soil of the pit need to be watered. A trench or drain may be made in between two rows, in order to drain out the rain water and raise the beds

Planting: Seedlings of 45 to 60 days old should be planted. Three seedlings should be planted 20cm apart per pit in a triangular fashion. After planting, the soil around the plant needs to be firmly pressed and well irrigated. Transplanting of seedlings should be done at least 10 days after pit preparation, perfectly in the afternoon. The best time to plant the seedlings is March.

Fertilization: Since, papaya grows vigorously and continuously it has a constant demand for nutrients. The basal dose should be applied during pit preparation. The first top dressing (TD) should be done when the seedlings are established about 2 months after transplanting. The rest of the fertilizers may be applied at an interval of 45 days from the first top dressing. Urea and MP are applied at the rate of 50 g per plant up to flowering and thereafter the doses are doubled. After each application of fertilizer, the area should be irrigated and fertilization should be stopped two months before final harvest.

Irrigation: Regular irrigation helps plant and fruit development. It is however, important to prevent water-logged conditions, especially around the plant. Generally plants are irrigated twice in a month but it is good to irrigate weekly in drought conditions. Irrigation should be carried out by making trenches in between the two rows which will prevent the irrigation water from coming into direct contact with the stem, thus preventing collar rot disease.

Table: fertilizer rate and method of application

Manures and fertilizer	Doses/Plant							
	Total	Basal	1st TD	2nd TD	3rd TD	4th TD	5thTD	6thTD
Urea (g)	450	-	50	50	50	100	100	100
TSP(g)	450	Entire	-	-	-	-	-	-
MP(g)	450	-	50	50	50	100	100	100
Gypsum(g)	250	Entire	-	-	-	-	-	-
Zinc Sulphate (g)	15	Entire	-	-	-	-	-	-
Borax	25	Entire	-	-	-	-	-	-
Organic manure (kg)	10	Entire	-	-	-	-	-	-

***Removal of excess plants*:** As soon as the papaya flowers appear and are large enough to determine the male or female plants, most of the male plants should be uprooted, leaving about 10% in the field for pollination. Similarly, only one robust female plant should be left in each pit.

In case of hermaphrodite varieties, which produce only female and hermaphrodite plants, the common practice is to remove all the female plants and keep one hermaphrodite per pit.

Fruit thinning: Some times papaya plant bears several fruits in a cluster, instead of a single fruit at each node and can create a crowded condition. So, a thinning of the fruit cluster should be done immediately after fruit set allowing a single fruit per node to develop properly.

Propping: Papaya is soft wooded heavy bearing plant coupled with a hallow stem, which makes it highly vulnerable to wind damage. So, the plants need support by bamboo, other strong pole.

Harvesting: Papaya fruits are very soft, they ripe rapidly once it attained maturity. So it is advisable to harvest the fruits as soon as they are mature. The fruits should be harvested individually by hand or by net, taking care to avoid all possible injuries.

F. Trial demonstration budget:

SL #	Item	Amount of input/bigha (Kg/No.)	Unit cost (BDT)	Total Cost (BDT)	Remarks
1	Seed	20 gm	10.00	200.00	
2	Compost/cow dung	200	1.00	200.00	
3	Urea	15	12.00	180.00	
4	TSP	15	40.00	600.00	
5	MP/MOP	15	35.00	525.00	
6	Gypsum	8	10.00	80.00	
7	Boron	0.5	150.00	75.00	
8	Zinc Sulphate	0.5	150.00	75.00	
9	Sign board	1	500	500.00	
10	Register khata	1	30	30.00	
	Total (Two thousand four hundred and sixty five only)			**2465.00 (US $ 36)**	

G. Replication suitability and recommendation:

The adaptation option was tested in the drought prone barind area in one season in 2007 in the first phase (LACC-I) of the project only. Yield of the demonstrations was not consistent throughout the season and the areas and farmers were not satisfied with the result of the demonstrations. Recurrent and incessant rainfall during the growing period hampered the growth and damaged the papaya trees in some demonstrations. All demonstrations of Gomostapur upazila were fully damaged due to the nonstop rain and hence no result could be obtained from the upazila. Heavy soil of the *barind* tract was also not very suitable for the papaya cultivation as there drainage capacity is low and water stagnation damaged the papaya trees which are very weak and sensitive to stagnant water.

The result of papaya demonstrations illustrates that every option must be selected through a rigorous process where experts, scientists and others can provide their judgment and clarification on every aspect of the demonstration including technical suitability and socio-economic acceptability. The project discontinued the demonstration of the option after the feedback from the farmers and others concerned. Further trials may be taken up if suitable varieties for drought prone areas are recommended by the research institutes.

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**	**No/ marginal increase of GHG**	
Rice-Wheat/ Fruit tree/ Fallow / Poultry	25, 26	Drought spells; loss of crops	Irri-gated/ rain fed	High and low barind tract	Small/ medium farmers with land ownership	36 US $	Me-dium	Low	No	no increase	Not recommended

Jujube gardening for exploiting drought and salinity condition

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 promote improved variety of the fruit with am aim to provide farmers with an alternative in order for diversification of their livelihood 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 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, salinity etc and other factors (price) on the sustainability of the production practice in comparison with the autonomous mango adaptation, other practices.

C. Implementation time:
Kharif-II/July - October.

D. Successfully tested site/upazila:

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

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 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

Mixed fruit gardening for exploiting drought and salinity condition

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:

Kharif-II/July - October.

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 (BAU 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: Mid May to Mid July and Mid August to Mid October.

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 litchi with the branches as soon as litchis show reddish tinge.

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.

Fruit tree/tree plantation in the homestead and adjacent lands

A. Context and justification:

Due to increased population and demand for land to produce crops in order to feed the huge population, a judicial and multiple use of same land has become critically important for the people of Bangladesh. Fruit tree plantation especially in the homestead has been an age old practice in rural Bangladesh. Farmers often plant trees in their homestead and adjacent lands but in most cases without following appropriate technical consideration and criteria. Access to good quality and improved variety fruit saplings also limit farmers' choices and initiatives. Planting fruit trees in the homestead provides food, nutrition, fodder, fuel and shelter for the farming households and offers a cash income opportunity and adds aesthetic value to the community. Project initiates a need based and ecologically suitable fruit tree plantation practice in the project villages of there north-western drought prone areas where green coverage is highly desirable.

B. Objective:

To promote the practice of community participation and pursue long term benefits for the poor people and the concept of mitigation by planting trees in the community road.

Demonstrations showcase how to –

- assess the suitability of the fruit tree species in local conditions - soil and water
- assess the long-term food, nutrition and economic benefits farmers can get from the fruit trees
- assess the qualitative impact on environment - soil/ water conditions and others.
- appraise farmers perceived opinion about the potential effect/impact of climate change induced hazards like drought etc on the treeless drought prone area and planting tree as a potential adaptation and mitigation option.

C. Implementation time:
Kharif-II/July - October.

D. Successfully tested sites/upazilas:

Year	North-west	South-west
2008	Nachole, Gomostapur, Porsha and Sapahar upazilas	-

E. Technical details:

Land area: Total homestead, in the available space surrounding the homestead.

Fruit tree species/varieties:
Olive, pomegranate, mango, sweet carambola and hog plum are selected by the farmers and then recommended and approved through the screening process. Short duration and small stature species are suitable.

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

Size of the pit: 1 meterX1 meterX1 meter. Pit should be prepared one month prior to planting.

Spacing:
Varies from 10 ft to 25 ft as per the variety and type. However, the fruit sapling should be planted in the available space of the homestead boundary or around where it can get sufficient sunlight, water and other after care.

Fertilizer application:
Should be applied during land preparation.

After care:
Irrigation, fertilization, disease pest management and other care like pruning of braches and twigs etc should done at appropriate time and as per the technical guidance of the DAE/project field officers.

F. Trial demonstration budget:

SL #	Item	Amount of input/bigha (Kg/No.)	Unit cost (BDT)	Total Cost (BDT)	Remarks
1	Sapling (Olive, Pomegranate, Mango, Sweet Carambola, Sweet Plum)	5	50	250.00	
2	Compost	50 Kg	1	50.00	
3	Urea	1 Kg	12	12.00	
4	TSP	1 Kg	40	40.00	
5	MP/MOP	1 Kg	35	35.00	
6	Zinc sulphate	0.30 Kg	150	45.00	
7	Fencing (Lump sum)			1000.00	
9	Sign board	1	500	500.00	
10	Register khata	1	30	30.00	
	Total (One thousand nine hundred and sixty two only)			**1962.00 (US $ 29)**	

G. Replication suitability and recommendation:

The adaptation option has just started testing in two upazilas each of the drought prone area and coastal saline area in 2009. The results are yet to come 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 general perception it may be inferred that at least another one to two times tests are required to inform the decision making process.

Palmyra palm plantation at the community road

A. Context and justification:

In the pursuit of suitable varieties of trees for drought prone areas, farmers selected and later experts recommended the Palmyra palm tree for plantation in drought prone villages of the barind area. Palmyra palm is considered as a desert species and can be planted in drought prone environment where it can thrive well without any regular care except a few days supervision at the early stage of planting of sapling. The plant is regarded by the local community as a species that can possibly withstand in the increasing drought condition of barind region. The unique features of palmyra palm are that it can be planted at anywhere and it can produce fruit, juice, wood for construction materials, fuel and can act as good sink for carbon. Planting palmyra palm in the community lands like rural road is an excellent way of integrating community participation in the project activity at the same time utilizing the unused space for better productivity and income and can serve as a good adaptation and mitigation option.

B. Objective:

To promote the practice of community participation and pursue long term benefits for the poor people and the concept of mitigation by planting trees in the community road.

Demonstrations showcase how to –

- assess the suitability of the tree species in local conditions- soil and water
- assess the long-term food, nutrition and economic benefits farmers can get from the fruit trees
- assess the qualitative impact on environment- soil/ water conditions and others.
- appraise farmers perceived opinion about the potential effect/impact of climate change induced hazards like drought etc on the treeless drought prone area and planting tree as a potential adaptation and mitigation option.

C. Implementation time:
Kharif-II/July - October.

D. Successfully tested sites/upazilas:

Year	North-west	South-west
2009	Nachole upazila.	-

E. Technical details:

Land area: Community rural/feeder road (in agreement with the community people versus the local administration i.e. UP).

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

Size of the pit: 1 meter X 1 meter X 1 meter. Pit should be prepared one month prior to planting.

Spacing:
Varies from 7-8 meter ft, although a little variation may be accepted as per the local condition and space availability.

Fertilizer application:
Should be applied during land preparation.

After care:
A minimum irrigation and other care may be needed once the saplings are planted and should be done at appropriate time and as per the technical guidance of the DAE/project field officers.

F. Trial demonstration budget:

SL #	Item	Amount of input/bigha (Kg/No.)	Unit cost (BDT)	Total Cost (BDT)	Remarks
1	Seed/sapling	1000	2	2000.00	
2	Compost	2000 Kg	1	2000.00	
3	Urea	100 Kg	12	1200.00	
4	TSP	100 Kg	40	4000.00	
5	MP/MOP	100 Kg	35	3500.00	
6	Plantation cost (Lump sum)			2000.00	
7	Sign board	1	500	500.00	
8	Register khata	1	30	30.00	
	Total (Fifteen thousand two hundred and thirty only)			**15230.00 (US $ 222)**	

G. Replication suitability and recommendation:

The adaptation option has just started testing only in one upazila of the drought prone area in the year 2009. The results are yet to come 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. But as far as the information gathered through informal meeting and discussion with the community people a general consensus was being developed on the participation of the community people and then sharing the benefits including the environmental benefits with especial reference to changing pattern of rainfall and temperature.

Excavation of mini pond for supplemental irrigation

A. Context and justification:

To reduce impacts of intermittent dry spells in the drought-prone areas of north-western Bangladesh, surface water stored from the previous rainfall needs to be used before rice maturity stage. Yet often high intensity rainfall is wasted, due to non-availability of proper water storage structures. Therefore adaptation options on rainwater harvesting, recycling and conservation are key to managing seasonal droughts through supplemental irrigation. The excavation and re-excavation of mini ponds is one of the feasible climate change adaptation options in the *barind area*. In farmlands with no irrigation source, rainwater harvesting was done through the excavation of mini-ponds for supplemental irrigation for T. Aman rice during drought spells in the early monsoon season.

B. Objective:

To create opportunity of Small and marginal farmers to provide supplementary irrigation in their rain fed *T. Aman* rice field in case of scarcity of moisture.

Demonstrations showcase how to –

- find out the frequency and amount of irrigation provided to the rice fields.
- determine the area of rice field provided with the irrigation water.
- assess the farmers opinion about the possible impact of using supplemental irrigation to the rice fields and contribution to the development of climate change resilience in drought condition.

C. Implementation time:

Kharif-I/March – July.

D. Successfully tested sites/upazilas:

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

E. Technical details:

Size: Size of the mini pond will be 10 meter x 10 meter x 2 miter.

Location of pond: Pond will be at one corner of the rice field.

Note: At the beginning, as per the barind Multipurpose Development Authority (BMDA) model, mini-ponds of 5m x 5m x 2m (length x breadth x depth) size were preferred on small farms. However, based on the feedback from the farmers, larger ponds (10m x 10m x 2m) were excavated in the following seasons.

F. Trial demonstration budget (10m x 10m x 2m):

SL #	Item	Amount of input/bigha (Kg/No.)	Unit cost (BDT)	Total Cost (BDT)	Remarks
1	Soil digging cost (200 cubic meter)	200 cu.m.	40.00	8000.00	
7	Sign board (90×65cm)	1	500	500.00	
8	Register Khata	1	30	30.00	
	Total (Eight thousand five hundred and thirty only)			**8530.00 (US $ 125)**	

G. Replication suitability and recommendation:

The adaptation option was tested in the drought prone barind area in the kharif-I season of 2006, 2007, 2008 and 2009. Farmers have accepted the mini pond and rated very high as per a performance assessment done by the project with the farmers. From the farmers' perspective, the size of the mini pond was enlarged and more diversification with vegetables on the pond bank and quick growing fish in the pond water was done.

The size of the pond should be dependent on the farmers land size and other socio-economic factors. The 10mX10mX2m or even bigger size pond is suggested for richer farmers while the earlier size, i.e. 5mX5mX2m, may be promoted further for the poorer ones. The option can be promoted through the usual extension system of DAE. More social mobilization programmes for greater dissemination of the technology may be undertaken.

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	125 (more or less) US $	High	High	Yes	no increase (Use of surface water)	Highly recommended as adaptation option

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:
Kharif-II/July - October.

D. Implementation sites/upazilas:

Year	North-west	South-west
2008	Lalpur, Bagatipara, Nachole, Gomostapur, Porsha and Sapahar upazilas	Bhandaria and Nazirpur upazilas
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.

Fish rearing in the mini pond for additional food and income

A. Context and justification:

In farmlands with no irrigation source, rainwater harvesting was done through the excavation of mini-ponds for supplemental irrigation for T. *Aman* rice during drought spells in the early or sometimes late monsoon season. In some years where drought spells may not appear or may not damage monsoon rice (T. *Aman*) and thus leave water of the mini pond unused for which it was excavated. Hence mini pond provides opportunities for alternative uses of the harvested water. In the barind tract due to the dryness and high temperature water can be found seldom in ponds or reservoirs and production of fish is hardly possible. Mini pond is used as a suitable option for storing and rearing quick growing fishes that supplement the family nutrition and income within short period of the year.

B. Objective:

To promote the practice of fish rearing in the pond where water is not used for irrigation and provide farmers with the opportunity for additional food, nutrition and income.

Demonstrations showcase how to –

- assess the suitability of the species selected for mini pond water condition.
- assess the amount inputs required in the fish rearing in comparison with the control/traditional practice
- evaluate the additional economic benefits farmers can get from the fish rearing which can support their livelihood in the drought hit period
- appraise farmers perceived opinion about the sustainability of the fish rearing practice due to the potential effect/impact of climate change induced hazards like drought etc.

C. Implementation time:
Kharif-II/July - October.

D. Implementation sites/upazilas:

Year	North-west	South-west
2008	Nachole, Gomostapur, Porsha and Sapahar upazilas	-
2009	Nachole, Gomostapur, Porsha and Sapahar upazilas	-

E. Technical details:

Stocking density: Any one of the following single species of combination can be followed

- Mono culture of GIFT Tilapia – 150 pieces per dec. of 8-10 gm body weight of each fingerling.

OR

- Culture of Rajpunti with carp: Rajpunti: 60/decimal + Silver carp: 5/decimal+ Common carp: 5/decimal

Pond preparation:
During the preparation of the pond for stocking i.e. before harvesting of rain water the pond may be cleaned properly. Cleaning of unwanted grasses, debris and other inert materials and addition of lime, if needed, may be done earlier to the rain. If lime is needed to add to the pond the rate is 1 Kg lime/dec. of pond.

Decomposed cow dung, at 3-4 Kg/dec. may be added to the pond after adding the lime.

If needed, urea and TSP may be applied at a rate of urea-100 gm and TSP-200gm per dec.

Salt may be added, if needed, to the water at the following rate per dec.

For Raj puti only – 250 gm at 15 days interval.

For Tilapia – 250 gm at 30 days interval.

Feed supply:
Supplying feed for the fish will entirely depend on the objective/s of the farmer whether s/he wants to provide supplemental irrigation to the rice field and then rearing fish afterwards in the remaining water or fish rearing is the sole objective. In that case the feed preparation and supply is as under.

Oil cake (25%) + rice-bran (75%) and start at a rate of 20% of the body weight of the fish. The amount will be increased as the fish grows. Rice-bran may only be applied, in case oil cake is not accessible/available. *Source: Dr. Moniruzzaman, SO, BFRI and BFRI leaf lets.*

F. Trial demonstration budget:

SL #	Item	Amount of input/bigha (Kg/No.)	Unit cost (BDT)	Total Cost (BDT)	Remarks
1	Fish fingerlings	440	5	2200.00	
2	Cow dung	150 Kg	1	150.00	
3	Urea	16 Kg	12	192.00	
4	TSP	10 Kg	40	400.00	
5	Lime	6 Kg	20	120.00	
6	Oil cake	25 Kg	25	625.00	
7	Rice bran	25 Kg	15	375.00	
8	Sign board	1	500	500.00	
9	Register khata	1	30	30.00	
	Total (Four thousand five hundred and ninety two only)			**4592.00 (US $ 67)**	

G. Replication suitability and recommendation:

The option has been accepted well by the farmers as far understood through informal meeting and discussion. The option may be replicated through the ongoing extension mechanism of DAE and few more test for demonstrations may be continued for the new villages and areas in the next phase of the project.

Duck/goose rearing for livelihood resilience

A. Context and justification:

In many rural areas of Bangladesh, duck rearing has been practiced 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 on 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 especially in the drought hit period and saline conditions can take up the duck rearing enterprise as an option which provide some flexibility in their livelihood planning and income.

B. Objective:

To promote duck/goose 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 duck/goose 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/goose 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/goose rearing.

C. Implementation time:
Kharif-II/July - October.

D. Successfully tested sites/upazilas:

Year	North-west	South-west
2008	Nachole, Gomostapur, Porsha and Sapahar upazilas	-
2009	Sapahar upazila	Dacope, 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 extensive system of duck/goose rearing will be followed.

Duck Variety: Local for drought prone area and Khaki Kamble for coastal saline area or BLRI suggested suitable varieties.

Number of Duck: 5 (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.

Disease problems for duck:
The common diseases in our country are Duck Plague and Duck Cholera.

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.

Note: *The concept of community based duck/goose rearing was introduced with a view to involve more number of farmers under a single option and a more opportunity for sharing in all respects of rearing and management among the fellow farmers.. In community based duck/goose rearing the technical requirement is same as usual duck/goose rearing.*

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	Housing	1	1500.00	1500.00	
3	Feed	60 Kg	25.00	1500.00	
4	Vaccination (Lump sum)			500.00	
5	Transport (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 $ 93)**	

G. Replication suitability and recommendation:

As 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 doing well. However there have been differences in performance not only due to the varietal difference but due to the management process 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 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 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:
Kharif-II/July - October.

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.

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:

Kharif-II/July - October.

D. Successfully tested site/upazila:

Year	North-west	South-west
2009	Lalpur, Bagatipara, Nachole, Gomostapur, Porsha and Sapahar upazilas	Bhandaria and Nazirpur 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

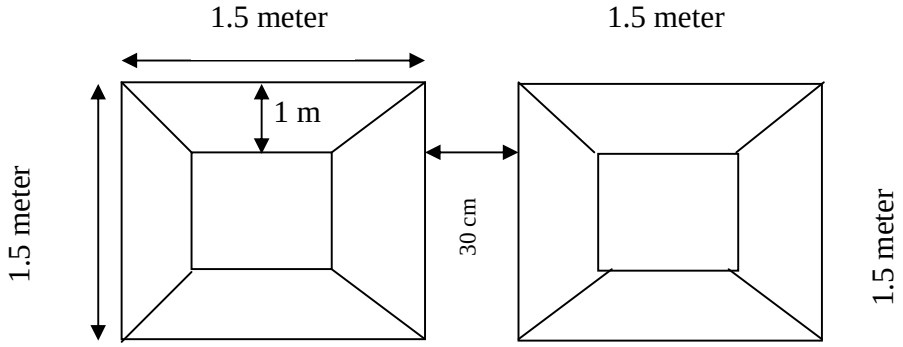

Fig-1: Lay out of two-chamber FYM pit

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. Thereafter, allow two times stirring the compost material at 15-20 days interval for quick decomposition and add N, P, K and Gypsum fertilizer (10:1 by weight) for making a balance in nutrients. 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:
Kharif-II/July - October.

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.

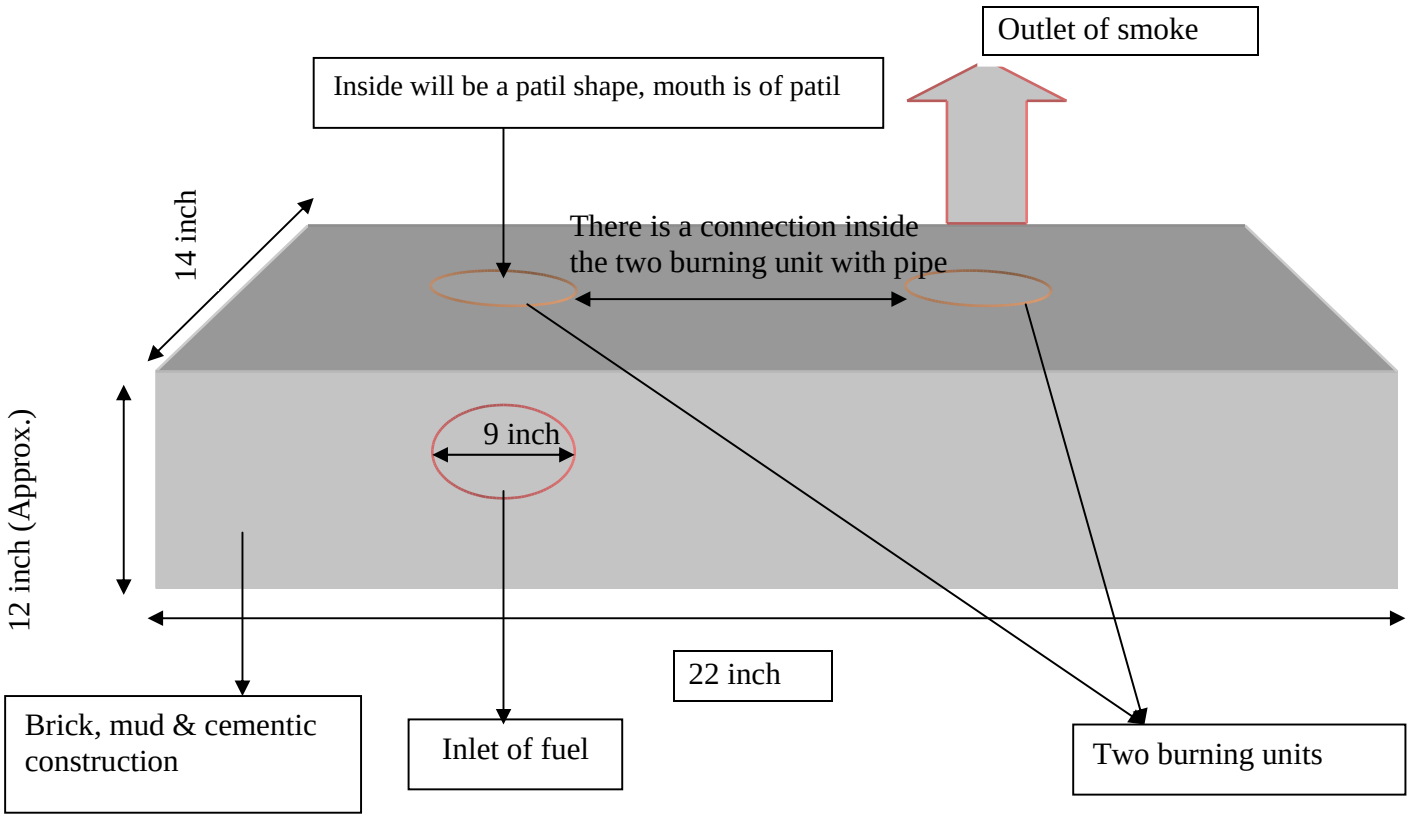

Fig-2. Double mouth Improved Cooking Stove (*BSCIR Model*)

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 as renewable 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:
Kharif-II/July - October.

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 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 number of cattle owned by the farmer.

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	Cropping Pattern		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