Appropriate Technology Park for Climate Change Adaptation and Environment Friendly Coping Strategy

Developing People's Ability to Reduce the Vulnerability through Transfer of Technology

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Prepared by

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Final Evaluation Report

Project title:	Appropriate Technology Park for Climate Change Adaptation and Environment Friendly Coping Strategy
Country	Bangladesh / Jessore and Dinajpur
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Partner organisations:	None
NetRes	IGES represented by Dr S.V.R.K. Prabhakar, Policy Researcher
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LIST OF ACRONYM, ABBREVIATIONS AND TERMINOLOGIES

Appropriate Task	:	Appropriate tasks are those defined by necessity, history, or situation in specific contexts
Best Practice	:	A superior method or innovative practice that contributes to the improved performance of an organization, usually recognized as best by other peer organizations
Capacity	:	The ability to perform appropriate tasks effectively, efficiently, and sustainably
Capacity Building	:	Improvements in the ability of institutions and organizations to either singly or in cooperation with other organizations, to perform appropriate tasks
Driving forces	:	Forces that tend to change a situation in desirable way
Environment	:	The sum of factors found outside the immediate confines of the institution/organization that have a significant bearing on it. It includes policy considerations, cultural values, and donor assistance, among other factors
Force Field Analysis	:	A technique for analyzing what aids or hinders an organization in reaching an objective
Goal	:	The desired end toward which activities are directed
Guidelines	:	Descriptive tools that are standardized specifications developed by a formal process that incorporates the best scientific evidence with expert opinion
Information	:	Data which has been processed and analyzed in a formal, intelligent way so that the results are directly useful to those involved in the management of a system or process.
Input	:	The combination of directives, prerequisites, and resources needed to execute a process.
Institution	:	An entity (or group or related entities) having a legal framework, an organizational structure, operating systems, staff, and resources and constituted to fulfill a set of related functions valued by a client or constituent group. To fulfill these functions, an institution incorporates, fosters, and protects normative relationships, rules, and action patterns. To the extent that an organization succeeds in demonstrating the value of its functions and has them accepted by others as important and significant, the organization acquires the status of an institution. The key factor is a recognized, continuing, and valued role at some level of the society
Objective	:	A statement that will assist in the determination if there is movement away or toward the goal. This is a desired, usually quantified, end result that a company, team, or individual wants to achieve within a specified period of time.
Outcome	:	Product or end-result of one or more processes and short- and longer-term results of service provision; the degree to which outputs meet the needs, expectations, and/or requirements of the customer/other stakeholder; the valued results.
Resources	:	Funds, human resource, time, equipment, technology etc., used to produce outputs and outcomes
Stakeholder	:	A stakeholder is defined as persons, groups, organizations, systems, etc., that have a 'stake' in a change effort (e.g. a development project) and that are either likely to be affected by the change, whose support is needed or who may oppose the change
System Approach	:	An analytical model that describes a collection of interdependent parts each of which is essential for the whole
Subsector	:	A vertically integrated group of enterprises (both large and small) that deal with the same product group. A subsector includes enterprises that produce or procure raw materials, enterprises that process them, and enterprises that sell the finished products (both on a wholesale and retail basis).
Trade Group	:	Enterprises that share the same economic activity. Within the fruit juice subsector, for example, one can find distinct trade groups in fruit juice production, processing, wholesaling, and retailing.
Subsector Analysis	:	A process that: 1) examines the relationships between enterprises that produce, procure, process, and distribute goods within a single product group; 2) identifies the constraints and opportunities facing these enterprises along with potential interventions to address them, and; 3) identifies sources of leverage where interventions can have the greatest impact.
GDP	:	Gross Domestic Product. A basic measure of a country's economic performance, is the market value of all final goods and services made within the borders of a nation in a year
GNP	:	Gross National Product. The value of all goods and services produced in a country in one year, plus income earned by its citizens abroad, minus income earned by foreigners in the country.
UP	:	Union Parishad. Union Council is the first step (lowest tier) of Local Government System in Bangladesh. There are 4,466 union councils in Bangladesh. The council comprises with 1 Chairman, 9 Members and 3 Women Members who are elected by the voters of the union. Union divided into 9 wards. 9 members are the representatives of the 9 wards.
DC	:	District Commissioner. There are 64 districts in Bangladesh
Upazilla	:	An administrative unit of District. Upazilas are the tertiary level of administrative government in Bangladesh. In 1983, the Local Government Ordinance of 1982 was amended to re-designate and upgrade the existing thanas as upazilas.

		Bangladesh, at present, has 482 upazilas and 599 administrative thanas
CBO	:	Community Based Organizations
NGO	:	Non-Government Organizations
MDG	:	Millennium Development Goal. Eight international development goals that 192 United Nations member states and at least 23 international organizations have agreed to achieve by the year 2015. They include reducing extreme poverty, reducing child mortality rates, fighting disease epidemics such as AIDS, and developing a global partnership for development.
PRSP	:	Poverty Reduction Strategy Paper. Describes a country's macroeconomic, structural and social policies and programs to promote growth and reduce poverty, as well as associated external financing needs. PRSPs are prepared by governments through a participatory process involving civil society and development partners, including the World Bank and the International Monetary Fund (IMF)
Ward	:	An administrative unit of Union Parishad
Vulnerability	:	
Demography	:	The composition of the household (e.g., age-sex distribution, size, life cycle stage) influences consumption requirements, availability of labor, and the intra-household distribution of food.

PREFACE

The Asia-Pacific Forum for Environment and Development (APFED) Showcase Facility is a joint activity of the UNEP, acting as the Showcase Facility Secretariat and the Institute for Global Environment Strategies (IGES) acting as the APFED Secretariat. The Showcase facility aims to demonstrate, through the implementation of showcase projects, innovative practices for sustainable development in the Asia and Pacific region. The Showcase program enabled the proponent organizations to overcome implementation barriers, to promote good practices and to explore potential for wider replication within the country.

Following a call for proposals by APFED secretariat in 2008, ChangeMaker - Society for Social and Economic Development, Bangladesh submitted a project proposal entitled, "Appropriate Technology Park for Climate Change Adaptation and Environment Friendly Coping Strategy" and the project was selected by the APFED Showcase Panel for implementation. IGES, Japan was the partner organization in the implementation of this showcase project in Bangladesh.

The project planned to assimilate, implement and display various proven technologies in an integrated way to obtain maximum benefit. Introduce, demonstrate and help adopt the technologies that provides multimode benefits to the community and poor farmers in mitigating and interacting with the environmental challenges in a more proactive manner

To help the rural community to adapt to the changing environmental conditions and to minimize human suffering and maintain a decent livelihood in climatologically difficult conditions, the Park not only displayed appropriate technologies but also provided knowledge and information about the supply-chain, application and usage of the technologies for improved diffusion and adoption of these livelihood-improving technologies.

Each component of the project and each selected technology were planned to be independent and standalone units; which may be integrated to provide maximum benefit. The few technologies (biogas, bio-sand filter, treadle pump, composting, solar de-salinezation) that were adopted by the local community provided direct tangible benefit to the beneficiaries. Each component is environment friendly and has certain contribution in mitigating climate change, reducing pollution, reduce energy consumption, reduce the use of natural resources and chemicals. In addition, almost all of the technologies can be built or created using locally available resources.

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EXECUTIVE SUMMARY

The one-year (February 2009 through January 2010) pilot project "Appropriate Technology Park for Climate Change Adaptation and Environment Friendly Coping Strategy" was sponsored by APFED Showcase Panel for implementation together with IGES, Japan, one of the registered institutes of the APFED Network of Research Institutes for Sustainable Development (NetRes), as partner organization for the implementation of the project in Bangladesh.

The project planned to collect and display various proven climate sensitive technologies in an integrated way to reduce vulnerabilities of the climate change impacts on rural poor. The project introduced, demonstrated and helped adopt the technologies that provide multimode benefits to the community and poor farmers in mitigating and interacting with the environmental challenges in a more proactive manner.

The goal of the project was to demonstrate technologies through establishing a technology park, create enabling environment for easy access and develop knowledge and awareness regarding climate change and the coping strategies using appropriate technologies. The project was implemented in two different locations of Bangladesh - South West (Jessore) and North West (Dinajpur) regions of Bangladesh.

The project integrated a number of key stakeholders for the achievement of the project mandates in a sustainable way. The Community people (women, men and youths), Local and Central Government Institutions, NGOs, different Networks and Forums, Private Sector Business Enterprises, University/College/Schools and Research Institutions were engaged to achieve the program goals and objectives. Each played specific roles in realizing the project mandates.

The technologies were selected based on the local needs, demands and local climate vulnerabilities. Although the two regions have significant changes, the demonstrated technologies were not so significant since majority of the technologies are related to drought, safe drinking water and energy. Only differences were the technologies that addressed salinity and prolonged water logging, which the two regions also has significant divergences.

Two different approaches for demonstration were tested – a cluster approach (Technology Park) and the other dispersed approach (technologies were set-up at household levels). Although the initial proposal was to set-up Parks (cluster approach), however, it was argued that if technologies were actually place within the households, the credibility and motivation would be more to the visitors by looking into the real-life applications. The users can work as advocates of the technologies and the sustainability will be achieved through continued usage even after the project phase. The two approaches were taken with the initial discussion with IGES. The results, however, show that the park approach has significant impact in diffusion and adoption of technologies over the dispersed approach. The community approach has significant limitation in privacy, comfort, articulation of the answers to the different queries of the visitors.

The awareness materials were developed in local language and campaigns were organized to create awareness on climate change and adaptation strategies. A large number of people visited the park and had almost the same opinion that the initiative has created significant knowledge and understanding about improving livelihood and quality of life during climate disasters.

The technologies, although quite indigenous, due to knowledge and awareness as well as accessibility, availability and affordability were not adopted by the local people. As a result appropriate supply-chain development activities were undertaken. At the same time, appropriate policy advocacy was undertaken to encourage the technology diffusion in the rural areas to different fiscal and monitory incentives for the private sector market actors and the users. A large number of youths were engaged in developing the installation, repair and maintenance (I,R&M) service provision for the technologies in the rural area.

The integration and engagement of the local community, administration and private sector has helped demonstrated early signs of sustainability of the pilot project. However, it was felt that project of this nature (particularly that has seasonal affects of flood, drought, cold spell, extreme heat, etc., and its impact on livelihood – agriculture, fisheries, etc.,) requires at least two to three years of piloting to complete the cycle and demonstrate the impacts and benefits of the project. Therefore, instead of one-year support, APFED should consider for two to three years support for such projects.

A number of factors have attributed to the success of the project its impact and the technologies solutions to the climate challenges to the community and achieved desired results. These factors include:

1. **Demand Driven Technologies**
   One of the key factors was the relevance of the project to the need of the people in the project area. There is lack of adequate knowledge and information about climate change and its potential impact and vulnerability as well as lack of appropriate technologies to minimize the social and economic risks and vulnerability in rural Bangladesh. The people especially the farm community could feel the gradual changes in their yield and profitability as well as food security but could not explain the same neither they could access adequate knowledge, information and technologies to address them. Lack and surplus of water in the wrong time, salinity, draught, gradual decrease of ground water, loss if soil fertility, etc., are profoundly affecting the local people. The village women readily saw the tangible benefits of fuel-efficient stove as well as biogas that not only provide easy cooking, but also lighting and bio-fertilizer. The local administration and local institutions could see how indigenous knowledge and local materials can improve livelihood and quality of life of the local people at an extremely affordable price. They could see the necessity of learning science and its application of improvement of social and economic conditions of people. These were evident from their engagement and integration with the project. The immediately observable adoption of technologies that were demonstrated in the Technology Park by the local community as well as extremely high rate of interest not only among the communities in the working area, but also communities from distant districts.

2. **Indigenous technologies**
   Being indigenous and demand-driven, the demonstrated technologies are more responsive to the need and expectations of the local people. Moreover, the simplicity of the technologies made it easier to learning. The technologies did not conflict with the earlier learning, process logic or rationale of the local community nor were they socking to the culture of the local community

3. **Low cost technologies**
   The cost of the technology was found to the determining factor in adoption, particularly for the marginalized people. The challenge was to find and develop technologies that can be afforded by the local community. Since most of the technologies demonstrated were reasonably affordable. A number of technologies were demonstrated in different variations in different cost structure. Some of the technologies are so simple that it can be made by the local people with locally available materials.

4. **Easy to understand and develop locally**
   We have found that the simpler the technology is, they are more likely to be adopted by the local community. If the rural people can understand the logic of the operation such as the reasons for cost effectiveness or improved productivity, the interest and adoption rate is also found to be higher. Moreover, the local community usually wants a technology they can be either developed or repair and maintained locally. Customization is also an important factor; people want to build the technology to meet their specific needs.

5. **Engagement of local opinion leaders**

Engagement of local opinion leaders is also an important factor. The community peoples having less exposure to technological information and knowledge tend to look forward to the opinions of the local leaders. A second opinion from a socially accepted people such as schoolteacher, religious leader, government official, social worker, doctor, lead farmer etc., are generally the people the local community have high level of confidence.

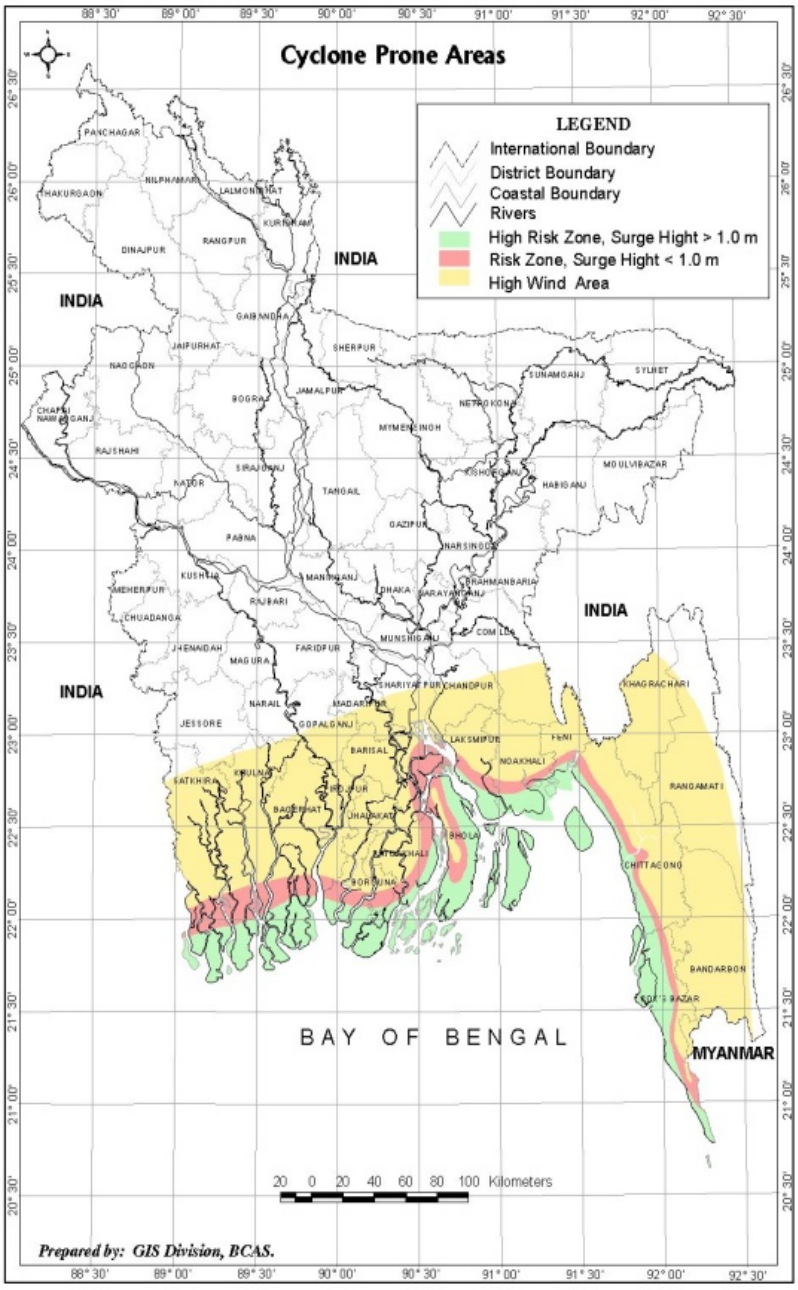
6. **Acceptance And Credibility of ChangeMaker in the Community**
   The acceptance and credibility of ChangeMaker in the community because of their earlier successful interventions in the area was also a great booster in getting peoples support for the project and in meeting project objectives.

7. **High level of Commitment by ChangeMaker team members**
   High level of Commitment by ChangeMaker team members in planning and managing the project as well as field workers in effectively delivering the project helped in reaching to the people. At the same time, the supported and guidance from IEGS/NetRes Institute in planning implementing activities helped greatly in achieving the project objectives.

OUTLINE OF THE PROJECT

PROJECT BACKGROUND

The geographic location and geo-morphological conditions of Bangladesh have made the country one of the most vulnerable ones to climate change, particularly due to erratic weather conditions and Sea Level Rise. Bangladesh is situated at the interface of two different environments, with the Bay of Bengal to the south and the Himalayas to the north. This peculiar geography of Bangladesh causes not only life giving monsoons but also catastrophic ravages of natural disasters. The country has a very low and flat topography, except the northeast and southeast regions about 10 percent of the country is hardly 1 meter above the mean sea level (MSL), and two-thirds of the country is less than 5 meters above sea level and is susceptible to river and rainwater flooding, tidal flooding during storms. Bangladesh drains huge water of the Ganga, Brahmaputra and Meghna catchments to the Bay of Bengal. These rivers have a combined peak discharge in the flood season of 180,000 m/second (the second highest, after the Amazon) and carry about two billion tones of sediment each year.



Bangladesh ranked 146th in the human development index report 2009. The majority of population is dependent for income and livelihood on agriculture. Access to drinking water is also insecure in some parts all the year round due to saline intrusion in the coastal area, while a large part of the country groundwater is contaminated with arsenic. With 40 percent of the active workforce unemployed, livelihood options disappearing, and options to diversify earnings is limited. The people, over time has build up resilience to respond to natural hazards like floods, tornado, landslide, cyclone, storm surges, cold spell, etc. However, they are ill prepared to meet the frequent and

uncertain weather conditions and extremes challenges that are manifesting with the changing weather pattern related to climate change.

1. LOCATED BETWEEN 20O34 TO 26O38 NORTH LATITUDE AND 88O01 TO 92O42 EAST LONGITUDE, PART OF BENGAL BASIN
2. AREA IS 147.57 THOUSAND SQ. KM
   - 80 PERCENT FLOODPLAIN
   - 12 PERCENT HILLY AREA
   - 8 PERCENT PLEISTOCENE TERRACE;
3. TOTAL POPULATION IS 140MILLION WITH VERY LOW GDP, 360 US$ PER CAPITA;
4. CLIMATE IS CHARACTERIZED BY HIGH TEMPERATURE, HEAVY RAINFALL, OFTEN-EXCESSIVE HUMIDITY, SEASONAL VARIATIONS

SOCIO-ECONOMIC SITUATION

- HUMAN DEVELOPMENT INDEX HAS IMPROVED FROM 0.35 IN 1980 TO 0.509 IN 2002, STILL VERY LOW;
- INCOME POVERTY HAS DECLINE FROM ABOUT 59 PERCENT TO 49 PERCENT OVER THE LAST DECADE;
- INCOME POVERTY IN THE RURAL AREA IS HIGHER COMPARE TO NATIONAL LEVEL INCOME POVERTY – 53 PERCENT
- HUMAN POVERTY TREND SHOWS CONSIDERABLE IMPROVEMENT OVER THE LAST TWO DECADES – 61 TO 35 PERCENT.

1. BANGLADESH IS AT THE LOWER END OF THE HIMALAYAN DRAINAGE ECOSYSTEM
2. COMPRISES ONLY 8 PERCENT OF THE GBM SYSTEM AND CARRY ABOUT 92 PERCENT OF WATER FLOW
3. AVERAGE MONSOON FLOW VARIES FROM 80,000 T0 140,000 CUBIC METER/SEC (SECOND TO AMAZON SYSTEM)
4. 1.7 TO 2.4 BILLION TONS OF SEDIMENTS CARRIED BY THE RIVER SYSTEM THROUGH BANGLADESH
5. THERE ARE 230 RIVERS IN THE COUNTRY AND 53 ARE TRANS-BOUNDARY IN NATURE
6. THE TRANS-BOUNDARY RIVERS HAVE BEEN GREATLY INTERFERED – DIVERSION OF WATER IN DRY SEASON
7. VIRTUALLY – BANGLADESH IS A CONGLOMERATE OF ISLANDS
8. VERY LITTLE STRUCTURALLY SOLID ROCKS, MOSTLY FLEXIBLE MUD
9. EIGHT PERCENT OF AREA IS WATER
10. COAST AREA OF BANGLADESH IS VERY PRONE TO CYCLONE AND STORM SURGES
11. COASTAL ISLAND AND SEA FACING AREA ARE MORE PRONE COMPARE TO OTHER COASTAL AREA
12. INTENSITY OF CYCLONE VARIES AND DAMAGE AS WELL
13. SALINE AFFECTED AREA IS SHOWING INCREASING TREND
14. SURFACE WATER SALINITY, SALINITY IN THE GROUNDWATER IS MAJOR CONCERN

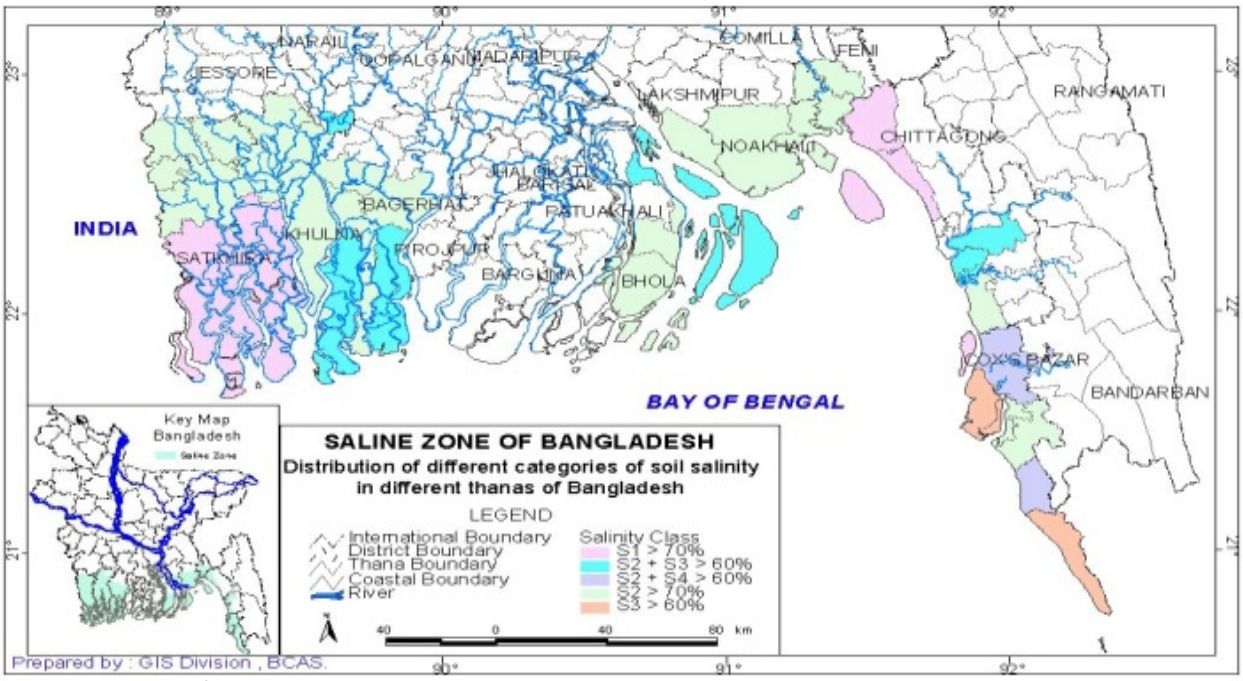


Figure 1: Saline Zone of Bangladesh. BCAS

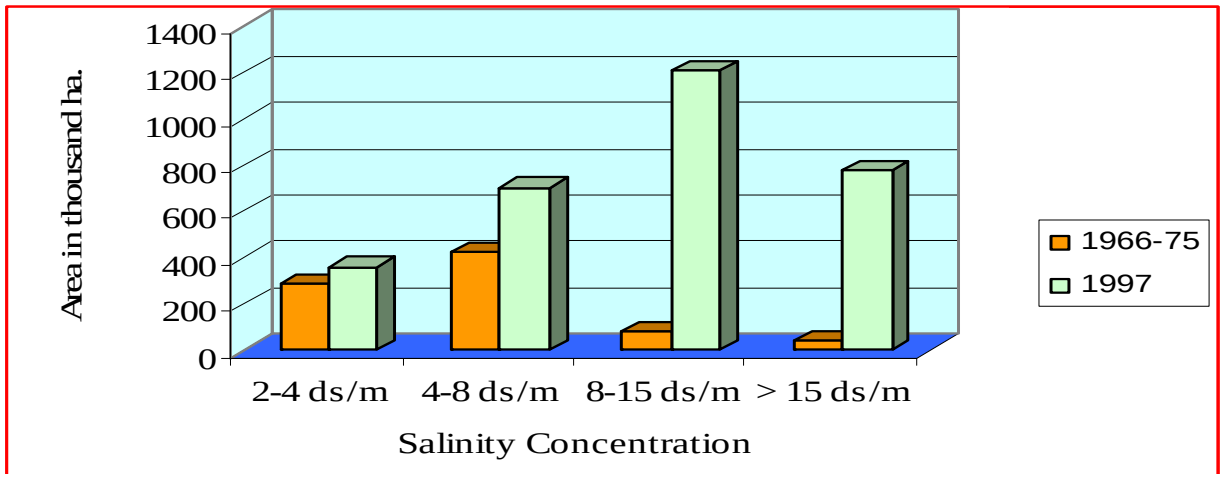


Figure 2: Salinity Concentration, BCAS

CLIMATE AND NATURAL HAZARDS

Bangladesh has a humid, warm, tropical climate. Its climate is influenced primarily by monsoon and partly by pre-monsoon and post-monsoon circulations.

Figure 3: Hazard Risk Intensity in different months, Climate Change Cell, Ministry of Environment, GOB

IMPACT OF CLIMATE CHANGE ON RURAL POOR

Most analyses of global climate change agree that the poorest and most vulnerable people would be affected first and to the most significant degree. The sectors particularly vulnerable to climate change are those on which rural people largely depend for their livelihoods: agriculture, forestry (non-timber forest products) and fisheries; and access to portable water. Climate change will exacerbate the existing vulnerabilities. It is clear that climate change and poverty are interlinked in complex and mutually reinforcing ways.

While climate change impacts will vary from place to place, requiring locally specific adaptation strategies, there are some general indications of the ways in which climate change will affect smallholder farmers:

The United Nations Framework Convention on Climate Change (UNFCCC) predicts countries with “arid and semi-arid areas or areas liable to floods, drought and desertification” are “particularly vulnerable to the adverse effects of climate change”. Poor farmers on rain fed farms in low latitudes are immediately vulnerable to warming, and

reductions in crop productivity are expected to have serious economic impacts. Climate change is evidently a challenge that will make it more difficult to achieve the MDGs, particularly the first goal of halving the proportion of people living in extreme poverty by 2015.

Achieving the first MDG would still leave some 800 million people living in absolute poverty and deprivation – many of whom will be chronically poor (Chronic Poverty Research Centre 2008).

TECHNOLOGY AND LIVELIHOOD

Technology, a word with Greek origins, is defined as, "the practical application of knowledge especially in a particular area[1]". Technology collectively describes or portrays the advancements, abilities, creations, undertakings, views, and knowledge of a singular group of persons: we as humankind.

Indigenous people, all around the world, have used the unique strategies to respond and adapt to critical environmental distresses. For example:

- diversified their resource base (to minimize the risk due to harvest failure, they grow many different crops and varieties, and they also hunt, fish, and gather wild food plants);
- changed their crop varieties and species;
- changed their timing of livelihood activities (crop harvests, wild plant gathering, hunting and fishing);
- changed their livelihood techniques;
- change their habituations or livelihood location;
- changed their resources and/or life style (resorting to wild foods in the case of emergency situations such as droughts and floods);
- changed their trading practices (obtaining food and other necessities from external sources through exchange, reciprocity, barter, or markets in times of crises); and
- changed their resource management (enhancing scarce and environment-sensitive resources management)

Like the others around the World, local people in Bangladesh have also developed their own prediction schemes based on the observation of the behavior of the surrounding world. It appeared that the local communities are knowledgeable not only of whether there might be floods or drought in the coming season, but also on whether the season is going to be long or short and evenly or poorly distributed rains with an early or late onset. The people in the Bangladesh commonly used the traditional methods as indicators of local environmental change or distress:

- the appearance of plants
- flowering density of certain trees
- immature dropping of fruits by certain tree species
- dripping of water from the leaves of some trees before the onset of the rains
- higher than normal flowering density of certain trees
- higher than normal ambient temperatures
- wind direction
- appearance of insects
- appearance of certain animals
- mists
- cloud formation
- solar or lunar eclipse
- behavior of animals or insects

[1] Merriam-Webster's dictionary

Adaptive responses to environmental changes are multidimensional. They include adjustments in livelihood practices and life-styles as well as alterations in emotional, cultural, and spiritual life. Adaptation can involve changing personal relationships between people and the weather and new forms of language and communication developed in response to novel environmental phenomena. Changes in knowledge and uses of knowledge and technology also constitute forms of adaptation. This report would primarily focus on the knowledge and technology, which was the mandate of our project.

SIMPLE TECHNOLOGIES HAVE TRANSFORMED LIVES

Technologies need not be high-end and costly in order to transform lives. Experience elsewhere shows that simple technologies can transform the lives and livelihoods. Because these technologies are designed with special consideration to the environmental, ethical, cultural, social, political, and economical aspects of the community it is intended for, they are much easily been adopted without cultural transformation or rigorous learning process. Since these technologies require fewer resources, are easier to maintain, and have less of an impact on the environment, they become part of the rural culture seamlessly.

According to Melvyn Kay, FAO/IPTRID Consultant[2] treadle pump, a simple human-powered pump designed to lift water from a depth of seven meters or less has transformed the agriculture economy of Africa. A treadle is a lever device pressed by the foot to drive a machine, in this case a pump. The treadle pump can do most of the work of a motorized pump, but costs considerably less (75%) to purchase. Because it needs no fossil fuel (it is driven by the operator's body weight and leg muscles), it can also cost less (50%) to operate than a motorized pump[3]. It can lift five to seven cubic meters of water per hour from wells and boreholes up to seven meters deep and can also be used to draw water from lakes and rivers.

The reported impacts on farming practices in Africa have been substantial and include:

- increased land area under irrigation;
- reduced work time compared with bucket irrigation;
- full irrigation of fields, resulting in improved crop quality;
- reduced frequency of irrigation to two or three times per week;
- less strenuous irrigation work compared with bucket irrigation;
- additional and new crops grown each season;
- increased number of growing cycles, as crops are able to grow faster with full irrigation.

The economic benefits of introducing treadle pumps are also significant. In Zambia, incomes have risen more than six fold from US$125 achieved with bucket irrigation on 0.25 ha of land to US$850-1 700 using treadle pumps[4]. This was attributed to increased crop yields and to being able to increase the area of land irrigated. Cropping intensity also rose in some cases up to 300 percent (three crops a year), with noticeable increases in the variety of crops grown. With more water available, farmers were more willing to take risks with new crops. Similar benefits have been reported in other countries where treadle pumps have been introduced. In addition to the direct benefits for farming families, there is the positive effect on the whole supply chain of manufacturers, retailers and selling agents. Employment has increased in rural areas where artisans are manufacturing pumps, carpenters are producing treadles and an increased workforce is needed on the farm to cope with the additional produce.

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[2] Melvyn Kay, FAO/IPTRID Consultant and Tom Brabben "Treadle Pumps for Irrigation in Africa" IPTRID Secretariat, Food and Agriculture Organization of the United Nations, Rome, 2000

3 ibid

4 ibid

Social and cultural issues vary from country to country but they can play an important role in the adoption of any new technology. In Zambia, irrigating crops, weeding, fertilizing and harvesting of vegetables are generally considered to be women's activities. Women operate treadle pumps without any traditional or religious constraints and see this as an opportunity for empowerment. Women are targeted by organizations promoting treadle pumps and used in publicity material. It has been reported that women find the pumps harder to operate than men do. They do, however, find suction pumps easier to use than pressure pumps. Of all the pumps sold in 1999 in Zambia, only four were purchased by women, though women are the main users of treadle pumps. Pumps are mostly operated by women and children, as they tend to do all work in the garden. In Kenya, although men buy most of the pumps, women mainly manage them and then control and benefit from the additional income. In Zimbabwe, the improvement of family nutrition as a result of the increase in garden produce has been noted in many areas.

In Bangladesh too, Treadle Pump, manual thrasher, seed drill, hand pump has also revolutionized the livelihood and quality of life of rural Bangladesh society and economy.

CHARACTERISTICS OF TECHNOLOGIES FOR THE CONDITIONS OF BANGLADESH

Technology is a process by which certain resources such as land, material, labor, skill etc. are utilized to obtain some desired products like food grains, clothing, household goods etc. Technology, therefore, is the method or technique for converting inputs to outputs in accomplishing a specific task. Appropriate technology is, therefore, that set of technology that is appropriate to meet the needs and the development goals of a country. For a developing country like Bangladesh, appropriate technology is a mix of modern, intermediate and simple technologies3. Appropriate technology, in this context, aims at a better balance of the three levels of technology that is modern, intermediate and simple or traditional in order that:

(a) effective and sustainable development can take place
(b) accelerated growth can be achieved, and
(c) people using them can improve their livelihood and quality of life.

It has been seen that the appropriate technology helps to accelerate the process:

- Building indigenous skill, innovativeness and entrepreneurial attitude that tend to release greater creative potential of the people; and
- Utilizing a great deal more human and material resources available within the country

It is worth emphasizing that appropriate technology does not imply rejection of modern and sophisticated technology. Thus, appropriate technology should be understood as a dynamic technological concept and not just a policy of manufacturing low cost traditional items. It should have the following characteristics4:

- stimulate or contribute to economic progress by making use of the local resources, labor and material.
- represent technical progress by raising technological levels of existing methods and practices
- have an evolutionary capacity, so that progressive transformation of technology can occur.
- represent social progress by enhancing the process of productive employment generation

The unique characteristics of low cost affordable technologies are they:

- require only small amounts of capital;
- emphasize the use of locally available materials, in order to lower costs and reduce supply problems;
- are relatively labor-intensive but more productive than many traditional technologies;
- are small enough in scale to be affordable to individual families or small groups of families;

- can be understood, controlled and maintained by villagers whenever possible, without a high level of specific training;
- can be produced in rural villages or small workshops;
- suppose that people can and will work together to bring improvements to communities;
- offer opportunities for local people to become involved in the modification and innovation process;
- are flexible, can be adapted to different places and changing circumstances;
- can be used in productive ways without doing harm to the environment.

Some of the reasoning that underlies the concept of appropriate technology may be summarized as follows:

- it permits local needs to be met more effectively because local people are involved in identifying and working to address these needs; for the same reasons, it is likely to be in harmony with local traditions and values;
- it means the development of tools that extend human labor and skills, rather than machines that replace human labor and eliminate human skills;
- it represents a comprehensible and controllable scale of activities, organization and mistakes, at which people without management training can work together and understand what they are doing;
- it allows more economical operation by minimizing the transport of goods in an era of expensive energy, allowing greater interaction of local industry and permitting greater use of local resources—both human and material;
- it makes unnecessary many expensive or unavailable finance, transportation, education, advertising, management, and energy services; avoids the loss of local control that use of such outside services implies;
- it helps to establish a self-sustaining and expanding reservoir of skills in the community which begins from already existing skills;
- it provides a region with a cushion against the effects of outside economic changes (e.g., the sudden unavailability of fertilizer);
- it helps to reduce economic, social, and political dependency between individuals, between regions, and between nations, by recognizing that people can and will do things for themselves if they can find a way.

LIMITING FACTORS IDENTIFYING/PROMOTING APPROPRIATE TECHNOLOGIES

The primary challenge to promotion and adoption of appropriate technologies in Bangladesh mostly related to supply (the appropriate technology providers primarily the private sector market) and demand (the users) side constraints as well as poor policy environment to encourage both.

- Supply Chains challenges:
  - Demand Driven (poor knowledge and awareness results in poor demand of appropriate technology)
  - Supply Driven (poor demand or “market” results in poor incentives to cater this market)
- Poor availability of technology products in the local markets resulting from supply chain challenges
- Poor accessibility to the customers (in right locations - rural markets, that give easy access)
- Affordability of the rural customers (pricing, no subsidy, no mechanism for credit)
- Poor demonstration and promotion of products/services with appropriate, creative tools and mediums
- Poor R&D investment to cater the needs and demands of the local people
- Pursuance of Government and development sector (NGOs) to provide appropriate technology under alternative (non-market) supply-driven approach, resulting in
  - Inefficient and expensive product/service delivery

- Subsidization
- Uncompetitive
- Distorted market
- No or narrow range of options
- Dependency
- Non-transparent transactions
- Non-sustainable delivery and service

THE MARKETING CHALLENGES

- While urban customers are often over-communicated by the corporate world, rural customers (poor) in particular, are left out of communication
- Rural customers require same level of exposure as affluent customers of corporate brands
- Caring for customers, offering warranties, assuring after sales services are unknown business practices in rural marketing in Bangladesh
- Marketing strategies requires designing keeping in mind the economic as well as cultural aspects of rural poverty
- Incentives of the supply chain is critical for making market development interventions
- Identifying developing and testing new appropriate technologies
- Policy incentives for R&D, import and local manufacturing of appropriate technologies

PROJECT OVERVIEW

With the above background in view, Change Maker initiated efforts to disseminate appropriate technologies to the rural poor so as to change their socio-economic conditions.

GOAL

The rural poor of selected districts of Bangladesh have knowledge and access to appropriate affordable technologies to cope with the climate change vulnerabilities in a sustainable way

PURPOSE

The purpose of the project is to demonstrate technologies, create enabling environment for easy access and develop knowledge and awareness regarding climate change and the coping strategies through the use of appropriate technologies.

Figure 4: Purpose of the Project

PROJECT OBJECTIVE

The objective of the project is to demonstrate and to convince the community to adapt the effective coping strategies to changing environmental conditions and to minimize the human suffering. To this effect, ChangeMaker undertook demonstrations of appropriate technologies and develop enabling environment (knowledge and information, access, and availability) for using technologies to reduce climate vulnerability.

Creating awareness, creating access and availability through developing and strengthening supply-chain and integrating research organizations, government departments, private sector enterprises and other actors and stakeholders is the primary mandate of the project. “Seeing is believing” is the critical philosophy of the rural people. By demonstrating the technologies in the park, the groups of rural people are able to see, feel and understand how it can improve their day-to-day livelihood.

The project attempted to assimilate, implement and display various proven technologies in an integrated way to obtain maximum benefit. Introduce, demonstrate and help adopt the technologies that provide multimode benefits to the community and poor farmers in mitigating and interacting with the environmental challenges in a more proactive manner.

To help the rural community to adapt to the changing environmental conditions and to minimize human suffering and maintain a decent livelihood in climatologically difficult conditions, the Park not only displays and demonstrates appropriate technologies but also provides knowledge and information about the supply-chain, application and usage of the technologies for improved diffusion and adoption of these life-saving technologies.

Each component of the project and each selected technology were planned to be independent and standalone units; which may be integrated to provide maximum benefit. The adoption and use of any or all advocated technologies will provide direct tangible benefit to the beneficiary. Each component is environment friendly and has direct contribution in reducing pollution, power consumption or reduces the use of chemicals. In addition, almost all of these can be built or created using locally available resource, affordably.

SCOPE OF WORK

The scope of the project included three primary activities:

- Demonstration of Appropriate Technologies
- Creating Access to Technologies through developing or strengthening supply chain
- Creating awareness of the people on climate change and possible coping strategies through adoption of technologies

Figure 5: Scope of Work of the Project

It is believed that the climate change and it is related and consequences are expected to affect everyone - directly, physically, economically and socially. It would directly affect the livelihood and quality of life of people specially the poor, the women and the children. The most effected will be the marginalized population and small farmers and producers. Experiencing inundation, draught and extreme weather changes; the beneficiaries of Technological Park is not limited to this population. The pilot project has the potential to contribute and assist everyone at personal, institutional and enterprise level by providing low cost technological solution to adopt and mitigate the adverse effects or at least reduce the impact of the changes.

RELEVANCE

The project has significantly high relevance to the local needs and expectations since there is a complete void in the following issues:

- Poor awareness regarding climate change and related vulnerabilities due to the change conditions resulting in increased sufferings
- Poor accessibility, availability as well as affordability of appropriate technology resulting in poor adoption and opportunity to improve livelihood and quality of life
- Poor supply chain resulting in poor availability of right technologies in the rural area
- Poor policy encouragement resulting in poor private sector incentives for promotion of the products in the rural area

The project has therefore addressed the above issues and worked for the improvement of the conditions of the rural communities.

EXPECTED OUTPUTS

1. Technologies that can address climate change vulnerabilities (shortage and abundance of water) and climate change mitigation (renewable energy and emission reduction) are identified.
2. Linkage with selected technology providers developed for demonstration of technology at the park.
3. Technology Park established for promoting and demonstrating technologies.
4. Partnership with private sector companies developed and are encouraged and motivated based on CSR principles for diffusion of technologies to the poor.
5. A favorable Government policy for adoption of appropriate technologies particularly that can potentially address climate change vulnerabilities
6. Both formal and non-formal financial institutes are motivated to finance purchase of appropriate technologies for the rural poor.
7. Supply-chain developed and strengthened for easy access to technologies in the rural areas.
8. Media, campaign and events organized targeting the stakeholders to create knowledge and awareness on climate change and Appropriate Technologies to reduce vulnerability.
9. Demand creation activities undertaken for adoption of technologies.

METHODOLOGY FOR PROJECT IMPLEMENTATION

THE CONCEPT

Two separate strategies were used to identify the best approach and acceptability of the rural people.

- Consolidated approach: displayed the available technology ensemble in one place in a park formation.
- Dispersed approach or community based approach: technologies were installed in household setting within a community.

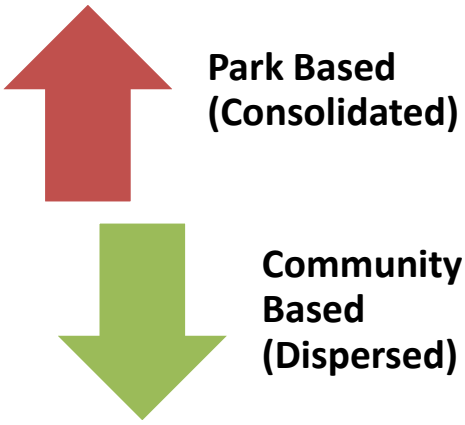


Figure 6: Two different approach of the project

The two approaches had their own merits and challenges. They provided a broader scope to understand the adopter's mindset in acceptance of the demonstrated technology by providing opportunities to evaluate and take appropriate implementation measures to increase the effectiveness of the project.

Community based approach provided a quick penetration in the community with the technology and provided more opportunity for the community to evaluate the system closely and to observe the benefits it offers in context to their local variables. However, as the demonstrated technologies were dispersed among the households in different clusters, it was difficult and laborious for people to observe all the technologies being offered. Visitors need to spend more time and need to be guided by knowledgeable people (promoters). Sometimes demonstration of the technology becomes difficult as it is located in congested space People who missed the general orientation could not evaluate the actual benefits properly.

Table 1: Comparative Analysis of Park vs Community Approach of Technology Display

Park Approach		Community Approach	
1	All technology are in located in one place	1	Technologies are dispersed in the community
2	Maintenance of the technology is easy	2	Maintenance is difficult and time-consuming
3	Demonstration is easy as each technology has its own space and observer have 360° view.	3	Demonstration is difficult as technology is in use by household and does not offer 360° view.
4	Technology can be observed any time. Unguided viewers can get comprehensive understanding.	4	Needs scheduled time depending on user's convenience. Unguided viewers have little access and sometimes get wrong understanding.
5	Viewers have no psychological pressure	5	Viewers feel psychological pressure as user many not be compatible socio-economic, religious and ethnographic context.
6	Demonstration sets can be maintained and adjusted to provide optimum results.	6	Demonstration sets depends on the users ability and practice of usage. Difficult to ensure optimum results.
7	Demonstration is conducted by trained personnel and detail cost benefits can be highlighted.	7	Most Users cannot articulate all the benefits and real implication of using the technology but can highlight the benefits from his point of view.

Baseline survey: a combination of field survey and literature survey were conducted for collecting the baseline information. The primary information (field surveys) served as the critical framework for analysis while the secondary information (literature review) provided important input for understanding the context and rationality behind the status. This combination provided rich context-bound information that led to explaining the situation.

It was believed that a simple data-collecting instrument (structured questionnaire) would neither reveal the true picture and the dynamics nor would it demonstrate the true needs and benefits of such project, moreover, the observation would also be difficult particularly with the limited time-period and seasonality influence, as a result, both qualitative and quantitative investigation using projective technique was used. This provided meaningful insights of how the local community – institutions, market beneficiaries believe and project themselves towards the pilot project. This technique is chosen since in addition to the quantitative information, it enabled the respondent to "project" beliefs and feelings onto a third party, to an inanimate object, or into a vulnerable

situation. Structured format therefore was not used. Answers largely tried to understand and interpret the respondent's mental profile relating livelihood and quality of life.

The approach, therefore, involved both qualitative as well as quantitative methods. The piloting was cross sectional in nature since operations for a complete cycle is too expensive and time consuming. Thus, the following approach was followed in phases.

- **PHASE ONE:** A detailed secondary and primary study (baseline study and technology need assessment) were undertaken to understand and appreciate the present status of all the climate vulnerability, potential technology needs, livelihood and quality of life in the working area to identify the target groups, technologies and service provisions that are most appropriate for the pilot project objectives and mandates. The study involved visits to major government and development agencies, market actors, beneficiaries, their needs, expectations, level of awareness and knowledge, capacities, leveraging points such as with other government and non-government interventions, etc). During this phase a list of potential target locations, beneficiaries and technologies were identified, a matrix was developed based on selection criteria, ranged as per significance weight, short list and prioritize the appropriate technologies, target groups, needs, etc.
- **PHASE TWO:** Once the appropriate target groups and technology needs were identified, looked at, based on the objectives of the pilot, the reliability of the data through qualitative study at the primary level and additional information for building hypothesis. This part of the study involved Key Informant Interview (KII), Focus Group Discussions (FGD) with various members of the value chain, market actors, business and market associations, members of the government and non-government organizations working for the promotion of knowledge, information, technology, climate change related activities, etc. The FGD with the these members helped check findings of the secondary data directed towards individual value chain while that of the interview with the key informants of government and non-government organizations looked at the issues pertaining to access to technical and financial supports, etc (Chowdhury, 2010).
- **PHASE THREE:** This involved survey of the beneficiaries and market actors in the supply chain of each of the target groups. The interviews were semi-structured gathering information on issues related to climate change, technology needs, factors influencing livelihood and productivity gaps, demographics, psychographics[5], etc. The study involved a snowball approach[6] starting from the needs and moving forward up to the technology suppliers and service level. This part of the study helped in developing the detailed mapping of the groups and identified opportunities and constraints across the chain.
- **PHASE FOUR:** Technology demonstration site/households were prepared and related site and demonstration operation and management issues were set in place. Based on the seasonal factors, availability of proven technology, space and time the technologies were demonstrated.
- **PHASE FIVE:** Awareness Development programs were undertaken. A number of Information, Education and Communication (IEC) materials were developed in local language and distributed to strategic places and institutions. Programs were undertaken for courtyard meetings; Park visits, open-air movie and Park based events were organized.

5 Psychographic variables are any attributes relating to personality, values, attitudes, interests, or lifestyles. They are also called IAO variables (for Interests, Activities, and Opinions). They can be contrasted with demographic variables (such as age and gender), behavioral variables (such as usage rate or loyalty)

6 In sociology and statistics research, snowball sampling is a technique for developing a research sample where existing study subjects recruit future subjects from among their acquaintances. Thus, the sample group appears to grow like a rolling snowball. Snowball Sampling is a method used to obtain research and knowledge, from extended associations, through previous acquaintances, "Snowball sampling uses recommendations to find people with the specific range of skills that has been determined as being useful." An individual or a group receives information from different places through a mutual intermediary. This is referred to metaphorically as snowball sampling because as more relationships are built through mutual association, more connections can be made through those new relationships and a plethora of information can be shared and collected, much like a snowball that rolls and increases in size as it collects more snow. Snowball sampling is a useful tool for building networks and increasing the number of participants. However, the success of this technique depends greatly on the initial contacts and connections made.

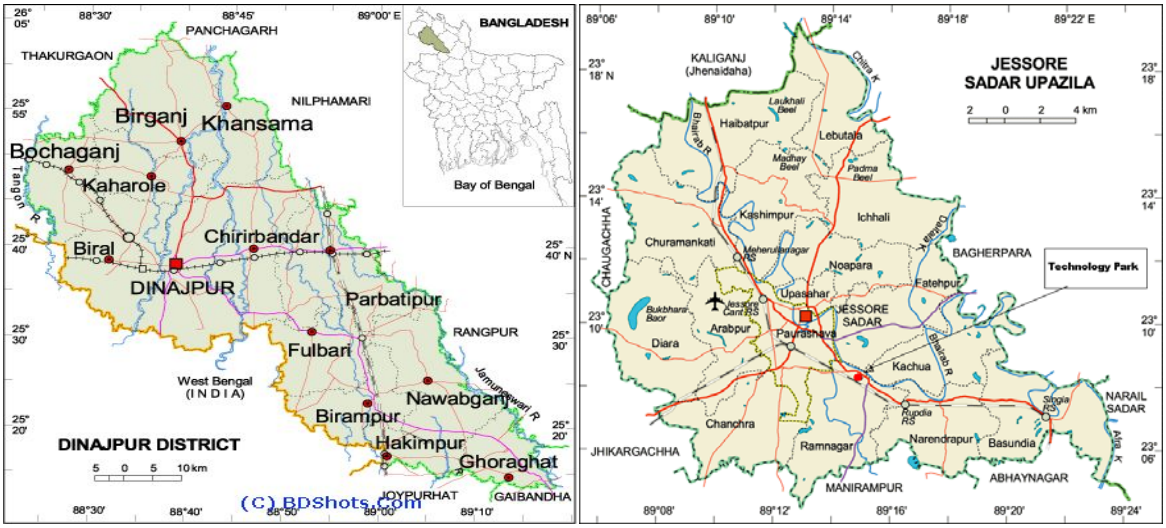
- **PHASE SIX:** Supply chain for easy access to technologies were either developed or strengthened in the working areas. For this major business and research organizations were contacted, products, literature, and other materials were collected and their local distributers and suppliers were organized. A database was developed on the potential suppliers of related technology in the work areas. For effective service provision a groups of youths were developed and trained to provider installation, repair and maintenance services to the local community. At the same time advocacy and lobbying was conducted both at local and national level to encourage the involvement of private sector enterprises to engage in the promotion of effective technologies at an affordable price to the rural community.

A logical framework of series of secondary objectives and actions was prepared, reviewed and implemented which included:

- Assessments of the critical needs of the target area through baseline study. KII interview and interview with local authorities
- Mapping of available technology and technology suppliers in the area
- Awareness building activities
- Integration of the local community with the project
- Involving the local business and creating and strengthen the supply-chain
- Capacity building of the local expertise development
- Partnership building with NGO, government, local authorities

LOCATION

The "Appropriate Technology Park for Climate Change Adaptation and Environment Friendly Coping Strategy" was implemented in two locations of Bangladesh –



The demonstration of technologies was initially planned in South Western (Jessore) and North Western (Rangpur) regions. The land dispute had to relocate the Jessore site in nearby Union but in the same Jessore Sadar Thana.

For North Western region showed a greater demand for such initiatives. Two separate meetings were conducted with Rangpur and Dianjpur District Commissioners and later the park was relocated to Dinajpur.

A separate community based approach was used in Dinajpur. As per the approach, the technologies were demonstrated at the household level. A large number of indigenous people (*Santal*) were included and integrated with the Dinajpur project.
The tow locations of the pilot project have significant differences in terms of social, economic and environmental issues.

JESSORE:

Jessore is a district in southwestern Bangladesh with a population of around 2,440,693. It is located in the Khulna administrative division. It is bordered by India in the West. Jessore has eight sub-districts (*upazillas*), namely, Abhaynagar, Bagherpara, Chowgacha, Jessore-Sadar, Jhikargacha, Keshobpur, Monirampur, & Sharsha. Jessore has a population of about 2,440,693 (male 51.22%, female 48.78%). Average literacy 33.4% (male 41% and female 25.1%). The primary occupations are agriculture 39.84%, agricultural laborer 24.13%, wage laborer 2.68%, commerce 11.99%, service 8.66%, industry 1.41%, transport 3.11% and others 8.18%.

Jessore is the primary commercial district of Khulna division. The economy of Jessore is based upon agriculture (vegetable, spices, flower, forestry, fishery, dairy, poultry, etc.) and agriculture supportive (agro-tools, fertilizer, seed processing, etc.) and agriculture based (sweetmeat, tobacco, molasses (*gur*), jute, etc.) industries, as well as some major industries such as cement, etc.

Jessore belongs to the Southwestern Region of Bangladesh. The districts also fall within the Ganges Dependent Area (GDA), within the catchment of the Gorai River – the major distributaries of the Ganges River flowing to the south to discharge water in the Bay of Bengal. The northern reaches of the districts is generally sweet water zone. The southern part is aligned north to south, having the Sundarban mangrove forest located in the southern most reaches, the latter defining the boundary with the ocean. All three Districts constitute part of the Ganges Delta – the largest deltaic region on Earth, having extremely flat topography and located within 1~5 meters from the mean sea level[7].

In recent decades, the region has undergone severe forms of environmental degradation, which devastated livelihoods of primarily the farming communities, and lately of those involved in other livelihoods. The general occupation of the inhabitants of the region had been farming, mostly based of rain-fed paddy cultivation. The rather sudden change in environmental conditions has forced farmers to forfeit the dry season cropping opportunities due to increase in salinity, especially along the southern boundaries of the districts. Moreover, along the northern parts of the area, a gradual process of riverbed aggradations leading to water logging has been observed, which made it impossible to continue land-based agriculture, consequently, farmers find it difficult to maintain their livelihoods and out migrated to urban areas.

The Southwestern Region of Bangladesh has been subjected to a plethora of hydro-geomorphological hazards which include poor drainage through its river systems, high rates of sedimentation on river beds, acute low-flow conditions during the dry season, salinity ingress along the rivers, cyclonic storm surge, moisture stress in the dry season, rise in sea level, and to a lesser extent, flood (Halcrow-WARPO, 2001). The region is located near the coastal zone[8], and is influenced by tidal effects. According to available statistics on Coastal Zone, majority of the land is within one meter from mean sea level, a significant proportion of which again falls below high-tide level.

7 Ahsan Uddin Ahmed, Desakota Phenomenon Observed in Satkhira-Khulna-Jessore-Dhaka Corridor in the Southwestern Bangladesh, Case Study.

8 According to the coastal zone policy (CZPo, 2005) of the Government of Bangladesh, 19 districts out of 64 are in the coastal zone covering a total of 147 upazillas1 (Figure-1) of the country. Out of these 19 districts, only 12 districts meet the sea or lower estuary directly. The zone is divided into exposed and interior coast according to the position of land. The upazillas that face the coast or river estuary are treated as

Demographic Characteristics

The Southwestern Region support livelihoods of a large population. The population density in this region is about 743 per square kilometer, as against the average national density of 839/km2[9]. However, the population density of Jessore district appears to be quite high i.e., 962/km2. The household population in the region is about 5.1, which is higher than the average for the country. A large fraction of the population belongs to two categories: children and old. About 41 per cent of population belongs to age group of below 15 years[10]. Therefore, the number of dependent population on every employable (income worthy) person is high (i.e., 0.9), compared to the national average (i.e., 0.83).

Climatological changes

Over the past few decades, the climate of the region has shown slight changes. A general warming has been observed in the surface average temperature, which is in the order of 0.5 ~ 0.6°C[11]. Although there hasn't been a great deal of analysis on the climatological aspects of the region, the scanty available research reveals that the night time minimum temperature has been showing a rapid increase over the past five decades. Due to rise in temperature, the winter has gradually been becoming milder and the autumn hotter. The region receives an average rainfall of about 1980 mm per annum, while about 78.3 per cent of is falls within the four months of monsoon. No significant change has been observed in terms of rainfall over the region, though on a national scale a bimodal shift in rainfall with a bias towards later parts of monsoon has been reported.

Effects of Salinity on People

Increasing salinity has decreased the overall performance of lands on crop production and contributed to food insecurity in the region[12]. Majority of the farmers are forced to forfeit at least one cropping season, thereby accept huge economic losses. A significant proportion of farmers, however, do grow alternative crops with much lesser economic return. Such a coping mechanism does help maintain livelihoods; however, it cannot provide a safety net against impoverishment. The low level of intake of important commercial product such as iodized salt testifies that poor households in saline prone areas cannot afford essential commodities.

The absence of saline-free safe drinking water appears to be a mirage for people in the region. Not only the tube well density there is rather poor (about 50 per cent with respect to the country average)[13], most of the tube wells draw saline water, since ground water aquifers (even confined aquifers) have been found to be saline affected! Moreover, many tube wells are sunk 300 feet below ground and a significant proportion of such tube wells draw water in highly reducing conditions. While tube wells across Bangladesh are known to have high concentrations of labile arsenic, in a few tube wells high concentrations of Nitrite have been reported[14], which may be attributed to rather unusual high incidence of 'blue baby' syndrome in the region. Women in pregnancy suffer from high blood pressure due to salinity in water. Cases of miscarriages and abortion are also common in the severely saline affected areas. Since in some areas water sources in the neighborhood are all affected by high salinity, the women need to travel long distance on foot everyday in search of drinking water. This is done by women irrespective of their physical condition. Women in their advance pregnancy and lactating mothers find it extremely difficult to

exposed coastal zone. Total number of upazillas that fall on exposed coastal zone is 48 in 12 districts. A total of 99 upazillas that are located behind the exposed coast are treated as interior coast.

9 BBS, 200

10 BBS, 200

11 Chowdhury, M.R., 2007. Rainfall Variability: Impacts of Climate Change? An article published in the Daily Star, also available at the URL http://www.southasianfloods.icimod.org/

12 Soil Resources Development Institute (SRDI, 1998a)

13 Ahmed, A.U., Neelormi, S., Adri, N., Alam, M.S. and Nuruzzaman, K., 2007a. Climate Change, Gender and Special Vulnerable Groups in Bangladesh, Draft Final Report, August 2007, BASTOB and Center for Global Change (CGC), Dhaka, p. 84.

14 Ahsan Uddin Ahmed, Desakota Phenomenon Observed in Satkhira-Khulna-Jessore-Dhaka Corridor in the Southwestern Bangladesh, Case Study.

carry on such duties. Most of the people, especially the poor faces acute salinity problem in drinking water (Reducing Vulnerability to Climate Change (RVCC) In Southwest Bangladesh, Care Bangladesh 2003).

Women and adolescent girls are usually required to collect drinking water from distant sources. This may take three to four hours a day. As a result, they do not have enough time or energy to carry out other household duties like cooking, bathing, washing clothes, taking care of elders, etc. In saline prone region, therefore, women have to curtail extra hours from their household works to combat with salinity problem. The consequent effects are difficulty in time management in their other household duties. For example, women become tired after the daily ordeal and cannot concentrate to the fullest towards their mental and physical health. In cases, respective husbands use to complain for not serving food on time and women are also physically assaulted for this reason (Ahmed et al., 2007a). Women, especially young girls, are also subject to different harassment when traveling long distances for water.

DINAJPUR:

The region as a whole is considered as North West of Bangladesh, which includes Bogra, Dinajpur, Pabna, Rajshahi and Rangpur. The piloting concentrated in the part of northwest region of the country comprising mainly Dinajpur districts traditionally found itself as the hinterland of the country. The remoteness of the region from the political and economic centers was due to poor infrastructural facilities, weak industrial development, prevalence of remnants of feudalism in agriculture, and landholding systems. This contributed to the positioning of the region as one of the poorest in the country. However, significant changes have taken place in the last couple of years in the economic and social landscape of the region. Tremendous infrastructural development has contributed to increasingly mainstreaming itself with the countries socio-economic pace of development. The construction of Jamuna Bridge has been a significant milestone in infusing new dynamism and vitality in the region's development. The region is also characterized by a strong presence of many NGOs that has been instrumental in initiating diverse, multi-prong developmental activities in the region.

The region has a high population density, about 870 persons per square kilometer (1996) and very slow rate of urbanization, about 10% (after correction for classification of urban areas). With a population growth rate about 2.1% per year, the density of population continue to increase to above 1,000 persons per square kilometer. As a result, the future of the region is dominated by this high and growing population density. Accompanying this dense population is a heavy burden of dependent young persons. Some 50% of the population is below 15 or above 55. Thus, each member of the labor force supports about 3.3 persons. With cultivated land more or less constant, the pressure on rural areas is acute and growing.

The literacy rate in the North-West is 27%, which is below the national average. The low level of educational achievement is a serious impediment to economic growth of North-West. Poverty is pervasive with different measures indicating around 50-60% of the population are resource poor. There are 57% of rural households considered landless. Physical risk from natural disaster is generally lower in the North West then elsewhere in Bangladesh.

The key characteristics of the North-West economy are the low wages, high interest rates, extreme level of poverty, which shapes the economic behavior of the region.

Dinajpur has its unique local variables, which manifests with the change of seasons in a year. Based on the seasonal impact and aggravation by climate change impacts on the people and their livelihood, appropriate technologies effective and applicable for the people has been chosen and demonstrated in the respective areas.

The area now constituting Dinajpur became a subdivision in 1860. It was upgraded to zilla (district) in 1984. The zilla is bounded on the north by the Panchagor and Thakurgaon, on the south by Gaibandha and Joypurhat and India, and the west by Thakurgaon and India. The total area of the zilla is about 3437.98 sq. km of which 19.45 sq.

km is riverine and 78.87 sq. km is under forest. The zilla lies between 25010' and 26004' north latitudes and between 88023' and 89018' east latitudes. The total population of the zilla is about 2,260,131 with an annual growth of population of 2.28. Total number of household is 430,357, of which 71.40% is farm household and 28.60% non-farm household. 36.74% of the farm households are marginal farmers having 0.05-2.49 acres of land, 27.72% medium farmers having 2.50-7.5 acres of land and 6.93% are large farmers having 7.5-above acres of land. Population growth, limited migration and land inheritance laws results in steady fragmentation of land holdings. This socioeconomic condition is a salient characteristic of this region.

Agriculture plays a critical role in the North-West economy. About 85% of total population of this area is directly dependent on agriculture. The most important activity in agriculture is grain production. Rice is cultivated in 82% of total land of Dinajpur. Of all variety aman is cultivated by most of the farmer. The agro-ecological conditions dictate the farmers for this variety. According to the district gazetteer of Dinajpur, Katari-Bhog, Dadkhani, Dighol Shoru and Darika Shail of aman is cultivated for long years; all of these varieties are fine and aromatic rice.

PROJECT PERIOD

The project period of the project "Appropriate Technology Park for Climate Change Adaptation and Environment Friendly Coping Strategy" was February 2009 to January 2010 (12 months) with three distinct periods (Figure 7).

Figure 7: Project Duration

KEY STAKEHOLDERS INVOLVED IN THE PROJECT AND THEIR ROLES

A large number of stakeholders were involved in the project with specific roles and responsibility to augment the success of the project. A brief list is provided below:

Table 2: Key stakeholders involved in the project and their roles

Categories	Stakeholders	Involvements and Roles
Community people	• Lead farmers • Community Leaders • Youths • Women	Motivation and information dissemination on adoption as well as provide services on installation, repair and maintenance
Local and Central Government Institutions	• National government ministries (Environment and Forestry, Food and Disaster, Agriculture, Science and Technology) • Government departments (CC Cell, CDMP)	Information promotion support (posters, leaflets, booklets, toolkits, documentaries, movies, etc)
	• Local Government and Administration • District Commissioner (Jessore, Rangpur, and Dinajpur) • UP Chairman (Jessore and Dinjpur) • Ward commissioners (Jessore and Dinajpur	Support for operation and operating environment, such as land leasing, electric connection, safety and security, etc.) as well as motivation and information dissemination
	• Government agencies: • Local Government and Engineering Department (LDEG) • Bangladesh Agriculture Development Corporation (BADC) • Department of Agriculture Extension (DAE) • Rural Electrification Board (REB)	Technical assistance in setting-up technologies as well as collection of existing technologies that they promote
NGOs, Networks and Forums	• GTZ, Dhaka	Efficient stove, PV cells
	• Biogas Foundation	Biogas promotion and technical assistance

Categories	Stakeholders	Involvements and Roles
	• Infrastructure Development Company Limited (IDCOL), Dhaka	Biogas promotion and technical assistance
	• Padakhep, Jessore	Access to Micro Finance, dissemination of information to group members
	• Grameen Shakti, Dhaka	PV cells
	• PAUP, Dinajpur	Local advocacy
Private Sector	• RahimAfrooz (Bangladesh) Limited	PV cells
	• Singer (Bangladesh) Limited	Energy efficient bulb (CFL)
	• Advance Engineering Limited	Biogas spare parts
	• Nooria	Biogas spare parts
University/College/ Schools	• United International University (UIU), Dhaka	Technical assistance and advice, volunteers and interns
	• Ifas, Germany	
	• University of Dhaka (DU)	
	• Bangladesh University of Engineering and Technology (BUET), Dhaka	
	• Institute of Business Administration (IBA), Dhaka University	
	• Bangladesh Agriculture University (BAU)	
	• Haji Danesh University, Dinajpur	
	• Jessore Science and Technology, Jessore	
	• Khulna University of Engineering and Technology (KUET), Khulna	
Research Institutions	• International Rice Research Institute (IRRI)	Technical assistance in setting-up technologies as well as collection of existing technologies that they promote
	• Bangladesh Rice Research Institute (BRRI)	
	• Bangladesh Agriculture Research Institute (BARI)	
	• Bangladesh Council of Scientific and Industrial Research (BCSIR)	
Others	•	

QUESTIONS FOR EVALUATION

The key evaluation questions were:

- Can the pilot approach and strategy create favorable awareness of the target people about climate change and how to adapt to the change conditions
- Can the pilot approach and strategy create a favorable awareness about adaptation to climate change?
- Can the pilot approach and strategy help minimize the climate vulnerabilities on livelihood and quality of life of the rural poor?
- Can the pilot approach and strategy create a favorable integration of the private sector in the process of technology diffusion?

SCHEDULE OF THE PROJECT

Table 3: Schedule of the Project

	Key Activities	Duration											
		February 2009 through January 2010											
		1st quarter			2nd quarter			3rd quarter			4th quarter		
		Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
1	Government Clearance and Fund Receipt												
2	Identification and selection of location												
3	Base Line survey												
4	Sourcing appropriate technologies												

5	Setup Technology Demo Park													
6	Develop appropriate linkage with Stakeholders													
7	Develop and distribute appropriate awareness materials													
8	Organize awareness building events													
9	Capacity building training programs													
10	Develop awareness on climate change issues and coping strategies													
11	Develop appropriate service providers/Supply Chain													
12	Performance Evaluation													
13	Project Documentation													
14	Project progress sharing with stakeholders													

PLANNED AND ACTUAL ACTIVITIES

The activities lists were re-evaluated and the technologies to be demonstrated and promoted in the park were reviewed in the light of the baseline survey findings. All the activities as planned were completed, however the timeframe for the implementation varied due to a number of reasons: 1) delay in government approval, 2) Seasonal reasons (rain and flooding), 3) Religious holidays (Ramadan and Eid), 4) Longer time in integrating private sector and micro finance institutions.

Some of the technologies that were planned in the proposal were dropped from the implementation plan and a few were re-enforced. Some of the challenges and work around are modifications are presented here.

Table 4: Planned vs Actual Project Activities

Demonstration of Technology **1.1 Assessment of local climate change situation and needs** **1.2 Available appropriate technologies mapping** **1.3 Meetings with technology suppliers** **1.4 Technology park infrastructure development** **1.4 Sourcing of technology for demonstration**	1.1.1 Local assessment completed by March 1.2.1 Mapping of available technologies and its supply/value chain completed by March 1.3.1 Partnership meeting with technology suppliers from February 1.4.1 Technologies set-up for demonstration by March	**1.1.1 Local assessment completed by April** **1.2.1 Mapping of available technologies and its supply/value chain completed by April** **1.3.1 Partnership meeting with technology suppliers from May** **1.4.1 Technologies set-up for demonstration by August**
Access to Technology **2.1 FI & MFI mapping in the area** **2.2 Meetings with FI** **2.3 Media Advocacy** **2.4 Meeting with policy makers**	2.1.1 Mapping completed by February 2.2.1 Meeting from March through June 2.3.1 Meeting with government agencies 2.3.2 Media coverage in national and satellite channels 2.4.1 Meeting with MPs in April/May	**2.1.1 Mapping completed by April** **2.2.1 Meeting from May through October** **2.3.1 Meeting with government agencies** **2.3.2 Media coverage in local and national print media** **2.4.1 Meeting with MPs in September**
Creating Awareness **3.1 Awareness campaign** **3.2 IEC materials development and dissemination** **3.3 Events for women and youths** **3.5 Events for SMEs and local service providers**	3.1.1 Campaign in rural bazaar, households, schools and NGO group members – FGDs, Group meetings, discussion, round tables, seminars, open air video documentary show, etc 3.2.1 IEC materials, documentation, video documentation, media reporting, etc 3.3.1 Special events for women and youth to develop knowledge and disseminate information 3.5.1 Events organized for SMEs (farmers, dairy, job shops, food processors, etc.) and service providers	**3.1.1 Campaign in rural bazaar, households, schools and NGO group members – FGDs, Group meetings, discussion, round tables, seminars, open air video documentary show, etc** **3.2.1 IEC materials, documentation, video documentation, media reporting, etc** **3.3.1 Special events for women and youth to develop knowledge and disseminate information** **3.5.1 Meetings organized for SMEs (farmers, dairy, masons, etc.) and service providers**
Program Management **Placement, orientation and training of:** **1. Project Coordinator** **2. Project Supervisor** **3. Group Facilitator** **4. Support Staff**	1. Training/orientation 2. Process documentation 3. Evaluation 4. Reporting 5. Financial management	**1. Training/orientation** **2. Process documentation** **3. Evaluation** **4. Reporting** **5. Financial management**

TECHNOLOGY NEEDS ASSESSMENT

TECHNOLOGY PREFERENCE BY THE COMMUNITY

It was observed that technology adoption and preference by the community is influenced by many factors. Some of the major driving forces are:

- Direct and tangible benefit from the technology (capable of generating incremental income or save cost)
- Affordability of the technology
- Availability of support and service
- Ease of use
- Access to finance
- Return on Investment
- Social benefits (sometime social status)

The chart below shows how the community preference for different technologies in two different areas. It may be mentioned here that although there are no significant difference in the preferences, however, the slight changes are due to geographic locations, vulnerabilities faced, as well as the ability of the technology to address the pressing local needs. For example, the salinity is never a problem in the north nor is a problem of water logging in Dinajpur, although they face flash flood every year. The multiple responses may not add to 100%

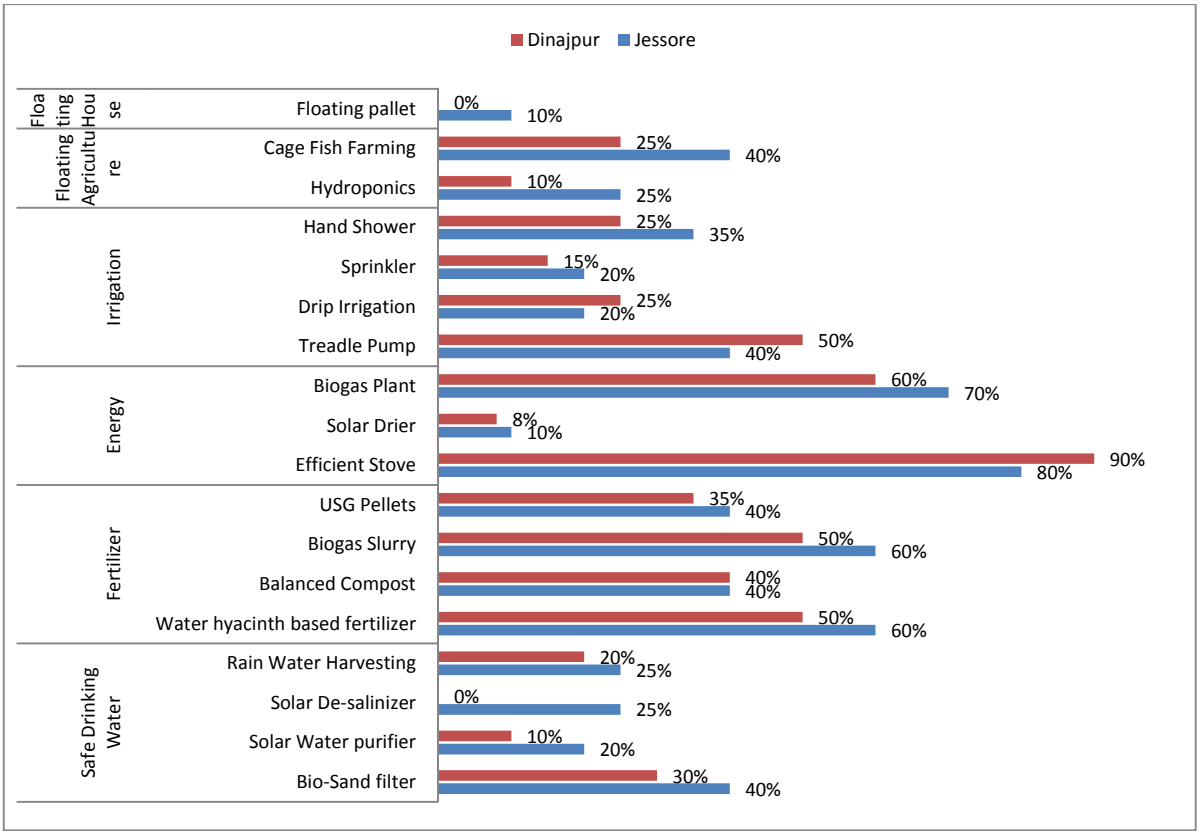


Figure 8: Technology Preference by the Community

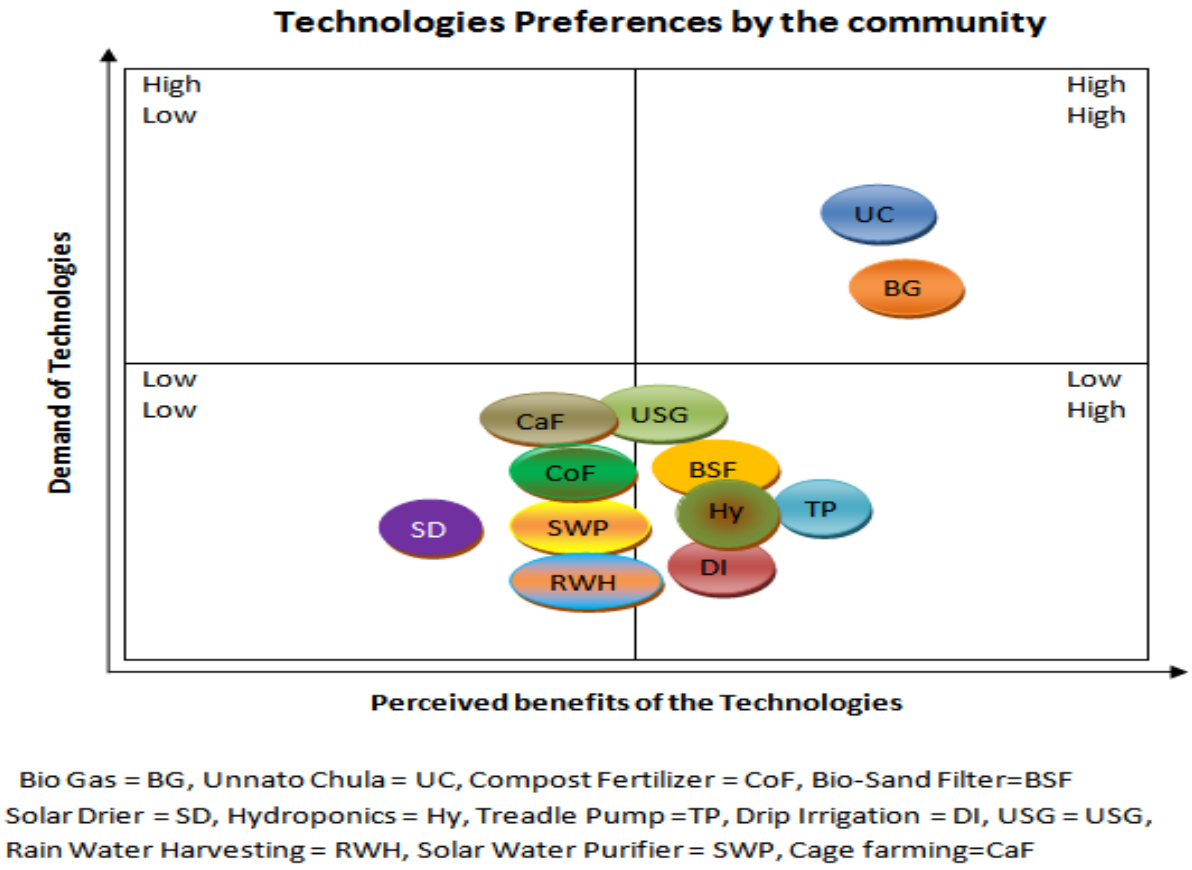


Figure 9: Perceived benefits of Technology vs Demand of Technology (data from field survey)

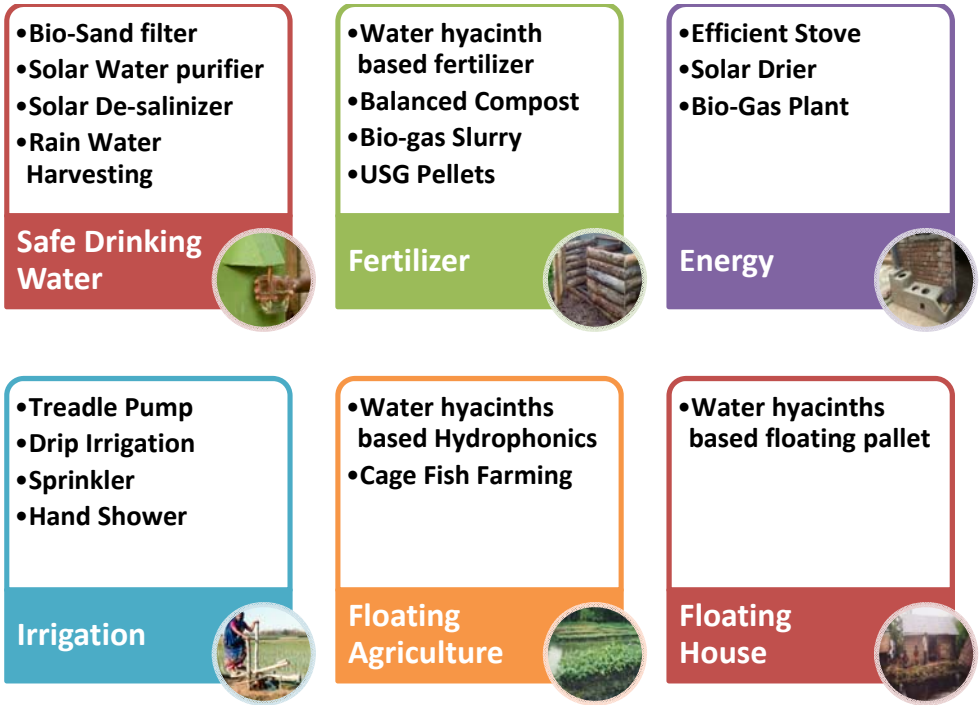
Chart 9 shows the relative preference of technologies based on demand and perceived benefits of the technology (primary survey)

TECHNOLOGY DEMONSTRATION

One of the key components of the project is to demonstrate the most appropriate and affordable technologies for the rural community so that they have a first-hand experience and understanding of the technologies that can reduce the climate vulnerabilities and help improve livelihood and quality of life.

TECHNOLOGIES SHOWCASED

A list of technologies that has been installed in the technology park in Jessore and in community initiatives in Dinajpur are provided below:



Details of each technology is provided in annex 1.

VISITOR'S OF THE PARK

A wide cross section people visited the demonstrated technologies. The youths, farmers, NGO people and housewives are the most significant visitors followed by private sector technology providers, local government people, community leaders and journalists.

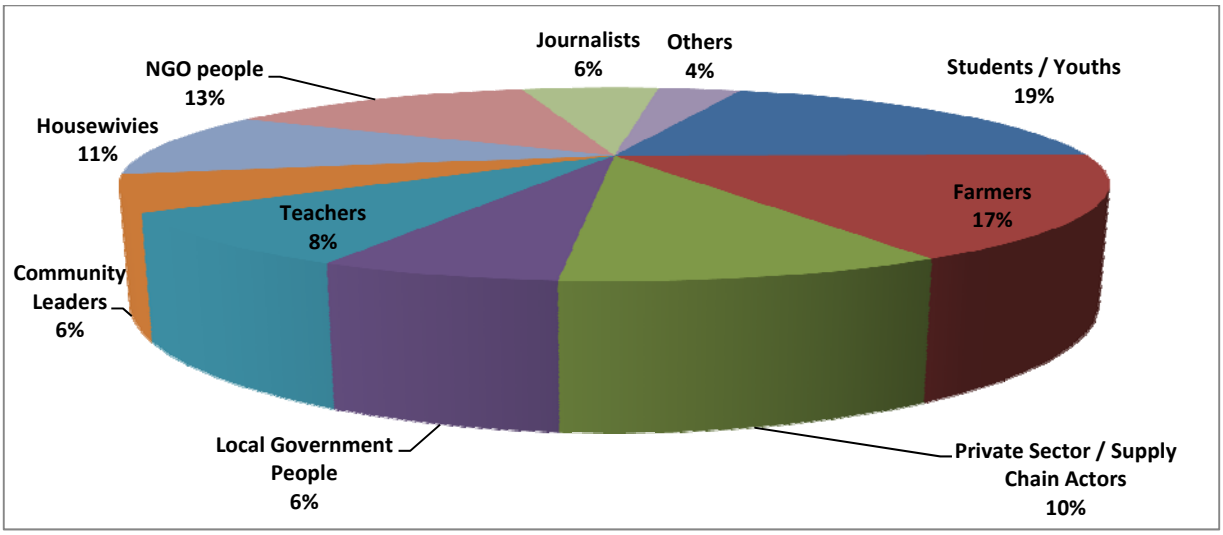


Figure 10: Types of visitors in the Park

OBSERVED TECHNOLOGY ADOPTION CHARACTERISTICS

PEOPLE'S OPINION

People had extremely positive opinions about the pilot project. A large number of stakeholders missing sentence?:

- Local community people (women, men and youths)
- Local opinion leaders
- Local administration and local government bodies
- Business enterprise, associations and market committee
- Educational institution
- NGOs and CBO
- Micro finance institutions
- Ministries and its agencies

The primary opinions of these people are they had the first hand opportunity to know and understand climate change and also the mechanism to prepare themselves from the vulnerabilities. It was a straightforward approach where people had the opportunity to understand interactively. The initiative requires more publicity and needs to be replicated in all the villages of the country.

Table 5: Opinions of the people regarding the project (Collected from the Visitors Log Book at the Park and the Evaluation Survey)

Comments	Local Community People			Local opinion leaders	Local administration and local government bodies	Business enterprise, associations and market committee	Educational institution	NGOs and CBO	Micro finance institutions	Ministries and its agencies
	Women	Men	Youths							
N =	16	25	30	8	4	6	10	8	4	4
We had no idea that solutions could be so simple	8	12	10	2	2	1	3	3	2	1
I would like to set-up this technology right away	6	10	3	2	2	0	1	1	2	0
Now I know what is climate change	5	4	5	3	4	3	4	3	1	0
All the villages of Bangladesh requires similar Park	4	7	8	4	5	4	5	2	4	4
I expected more technologies in the Park	0	1	2	1	1	0	2	0	0	1
The technologies are outdated, we want more sophisticated one	0	2	5	2	0	1	1	0	0	0
Can these technologies be purchased locally	3	5	6	4	2	2	1	1	3	0
NGOs should provide the technologies free of cost	4	5	2	2	1	0	0	0	0	0
I am convenience but need more proof that it would work. It sound too simple to believe	0	4	0	0	0	0	0	0	0	0
I have started using this and I am extremely happy (biogas)	2	7	2	1	1	1	1	0	0	0
There are technologies that our older generations used to use which can also be displayed	0	3	0	2	0	0	0	0	0	0
The secrets of compost is now open to all, I can start making this	0	6	2	2	0	0	1	1	0	0
ChangeMaker should expand this park	3	10	12	3	1	2	4	1	2	1
More video films will help people to understand better	6	12	14	2	2	1	5	3	1	1
More promotion is required many people still don't know about this park	8	14	8	3	1	2	6	3	1	1
More promotion is required many people still don't know about these technologies	3	12	10	3	2	2	4	2	1	1
More promotion is required many people still don't know about climate change	5	15	15	4	4	3	3	4	1	1
Are other people also using these technologies (in Bangladesh and Abroad)	0	6	3	1	1	1	1	1	1	0
We need more of these technologies	3	9	11	2	1	2	5	1	1	1
I will help spread the message to the others	6	11	22	6	4	4	10	8	4	1
We are willing to help promote this initiative	3	13	22	8	4	3	10	3	2	1
Nobody told us about Climate Change and how to develop preparedness in such wonderful way	8	9	11	5	2	1	4	1	1	0
It is a great initiative to bring all the technologies in one place	12	16	25	8	4	2	10	3	1	1

PURCHASE DECISION

How the purchase decisions are made in a rural setting depends on the educational, social and financial status of the purchaser as well as the immediate and tangible benefit presented by the product. However, it has been observed that the decisions are generally made by the head of the family along with their wives. The children often influences the decision making process. Apart from this, in a joint family, the elders (father, brother, in-laws) often influence decision-making process. Although the study suggests this influence is not very significant. Specific decisions, particularly relating to long-term investment are often consulted with knowledgeable persons in the community such as teacher, social worker, UP chairman, religious leaders, etc.

The following chart shows the typical decision making process of key investment area by the different family members. The numbers (in percentage) show that women have significant role in decision making for technology purchase. The project rightly focused both the women and the men as well as the children of the family in developing awareness about different technologies that can improve their livelihood and quality of life. This provides the strategy for developing and targeting for awareness and promotional campaigns

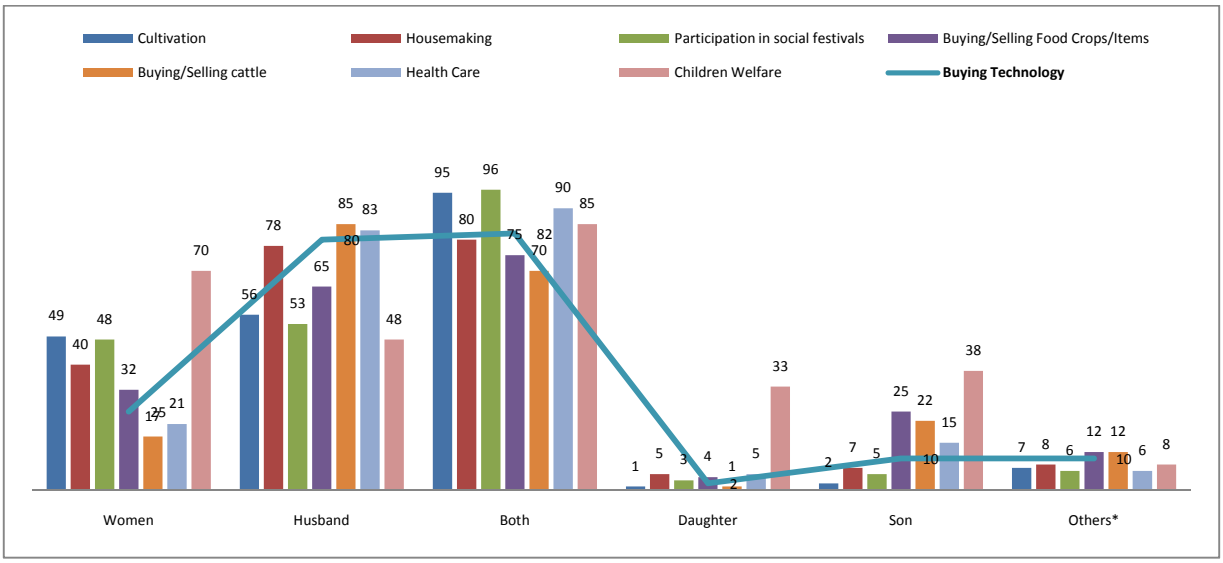


Figure 11: The typical decision making process of key investment area by the different family members

ABILITY AND WILLING TO PAY FOR TECHNOLOGY

Theoretically, willingness to pay (WTP) for a program is known as the amount of payment by a consumer such that the utility after provision of the good or service remains the same as in the base case (without the program). Willingness to pay is an amount that compensates utility loss due to reduction in income by an improvement in the goods or service in question and leaves the household on the same indifference curve.

Willing to pay for technology products by the rural people depends on income, socio-economic demographic characteristics like age, family size, education and amount of livelihood earned. Other factors like quantity of farmland and firming characteristics and inputs needed like seed, fertilizer, irrigation etc. also directly influences the decision.

By using a contingent evaluation method, people's willingness to pay for the different technologies was assessed. It is very important to note that in a market driven approach the community people can actually select the technology of their choice, based on this market principles they would be willing to pay for what it costs to provide that benefit from the technology.

Products and services such as appropriate technologies are generally not traded in markets and information on market demand or competitive market prices are often unavailable to value benefits[15]. The study used a survey-based mechanism called the Contingent Valuation Method (CVM) which has been widely used in last few decades to elicit people's preferences when market for a good is absent, imperfect or incomplete[16]&[17]. CVM creates a hypothetical market for such products and reveals the stated preference of the respondent. CVM is the standard and often the only approach that can include both use and non-use value[18]. It is well reported that, with stated preference techniques, survey design can elicit references for goods with attributes that are not currently available in the market[19].

In the case of appropriate technologies, the willingness to pay did not cover the costs for the higher service levels such as cost of labor, certain endogenous materials that are locally found, repair and maintenance, etc. Thus, the survey shows that if the Climate Change Technology Demonstration develops the supply chain for increased access to technologies in line with preferred choice of technologies, the demonstration could be financially sustainable because people would be willing to pay the full cost of the facilities in most cases. Sustainability is also linked to putting in place an efficient networking with the private sector enterprises that are willing to expand their market and create demand for their own products. This shows a permanent solution of sustainable demonstration initiative of technologies of essential livelihood improvement in the working area. The assessment shows that only higher potential for income or savings in terms of cost, labor, pre-occupation, would require subsidy since people are not willing to meet the actual cost of these services. It is suggested that it would be unreasonable that the people requiring the highest service level (frequently the higher income groups) should be the ones to be subsidized and Government should thus promote full cost recovery from the highest income groups.

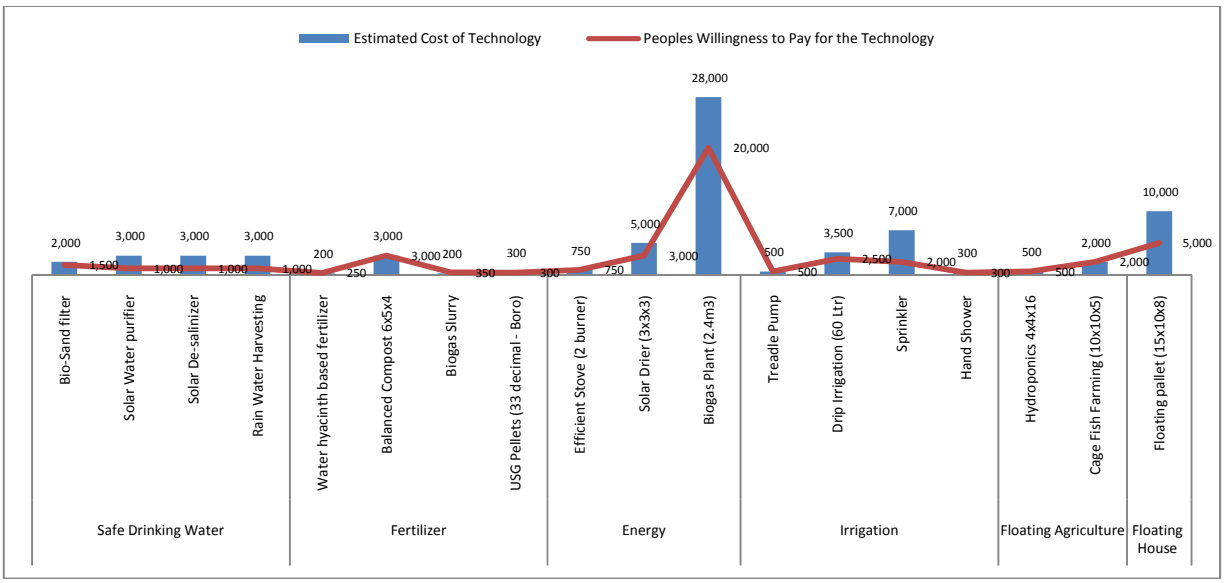


Figure 12: Ability and Willing to Pay for Technology

[15] FAO (2000). Application of the contingent valuation method in developing countries, 2008)

[16] Ahmad J, Goldar BN, Misra S, Jakariya M (2003). Fighting arsenic: listening to rural communities. Willingness to pay for arsenic-free, safe drinking water in Bangladesh. Dhaka: The World Bank and BRAC. 120p

[17] Fujita Y, Fujii A, Furukawa S, Ogawa T (2005) Estimation of willingness-to-pay (WTP) for water, sanitation services through contingent valuation (CVM) method, a case study in Iquitos City, the Republic of Peru. Japan Bank for International Cooperation.

[18] Carson RT (2000). Contingent valuation: a user's guide. Environ Sci Technology 34(8):1413-8.

[19] Devicienti F, Klytchnikova I, Paternostro S (2005). Willingness to pay for water and energy: an introductory guide to contingent valuation and coping cost techniques. Washington DC: The World Bank. (Energy Working Notes No. 3)

ACCESS TO FINANCE

Microfinance provides access to basic financial services to the poor. Through small loans with compulsory, frequent repayments to groups or individuals, microfinance helps the poor build up their assets, establish or develop a business, and protect against risks. Microfinance institutions (MFIs) are now spread all over the world (including in developed countries), and count over 100 million of the world's poor among their clients. According to the Credit and Development Forum (CDF), in 2002, there were as many as 1,200 MFIs; a more recent CDF estimate suggests that about 1,500 MFIs currently operate in Bangladesh, with another 500 entities soon to join the industry. Almost 90% of the clients of MFIs are women. The scope of microfinance services, meanwhile, not only includes the provision of credit for income generation, but also savings, insurance, money transfer, and educational and health loans. Many MFI's also provide "credit plus" complementary services such as skills education and training, health and nutrition workshops, and advice on agricultural practices.

The majority of credit programs related to water, agriculture, health, and disasters (which are all vulnerable to climate change) constitute slightly less than 40% of the existing portfolio of the MFIs[20]. However, even if programmatic priorities are closely intertwined with sectors and activities that might be vulnerable to climate change, not all microfinance activities within these areas might be relevant for adaptation.

Analysis of the credit programs and projects reveals that a number of existing microfinance lending programs and projects already offer adaptation "win-wins". In fact, 43% of the portfolio could be termed as win-wins[21], i.e. synergistic with adaptation. These include, for example, lending programs that support disaster relief and preparedness, crop diversification, improving access to irrigation, and provision of better sanitation facilities that reduce the risks of water borne diseases. They also include at least a few programs that go beyond coping or adapting to current climate risks. For example, lending programs to support construction of weather resistant housing or the adoption of drought and salt tolerant seeds can theoretically facilitate adaptation to longer-term climate change.

Beyond harnessing existing "win-wins", there are nevertheless other areas where microcredit activities might need to be undertaken differently in order to facilitate adaptation to climate change. This includes at least three kinds of activities:

(i) changes in the technical design of existing loan financing;
(ii) modification of financing modalities; and
(iii) inclusion of activities that are not currently part of existing microcredit portfolios – all with a view to facilitating adaptation to the impacts of long-term climate change.

With regard to existing MFI practices, it is important to bear in mind that micro financed projects are typically very small scale and short-term. Unlike many large-scale projects financed by other channels (Commercial Bank's SME loan), most microfinance funded projects do not have a long-term footprint. Therefore, they cannot explicitly incorporate considerations of longer-term climate-change technology financing. Some exceptions however include the construction of biogas, disaster resistant housing through microfinance where exposure to future climatic risks is present in a lesser extent. Likewise, projects relating to pond excavations for aquaculture may need to consider any anticipated changes in the location and vulnerability of the land to flooding and saline intrusion.

[20] Agrawala Shardul and Maëlis Carraro (2010), "Assessing the role of microfinance in fostering adaptation to climate change", OECD Environmental Working Paper No. 15, 2010, OECD publishing, OECD

[21] These percentages exclude a variety of other microcredit programs that reduce baseline vulnerabilities through promotion of income generation activities, but are not directly tied to weather and climate risks

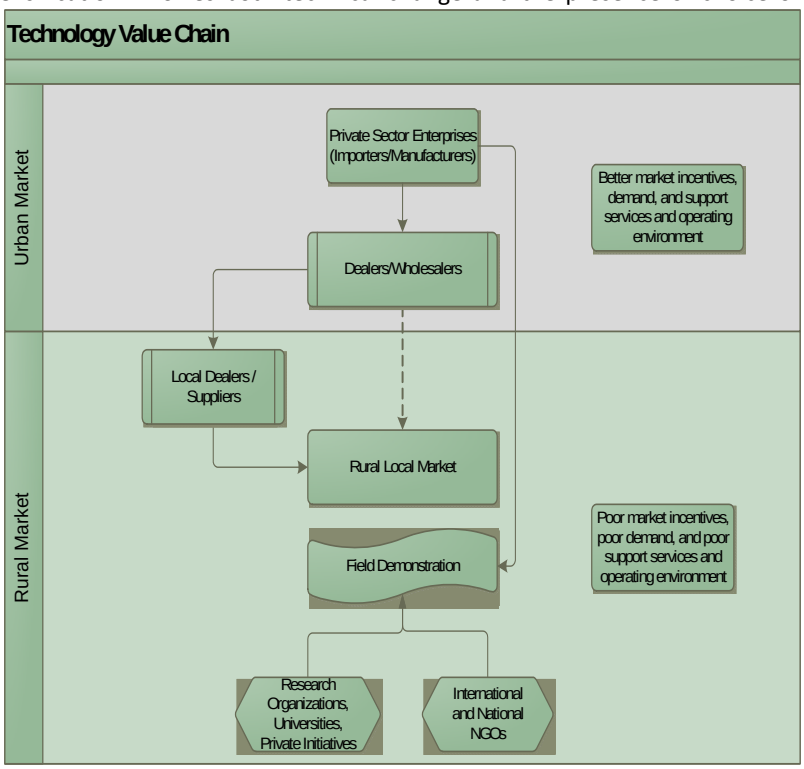
There are also cases where there might be a conflict between short-term development and income generation needs which microfinance might fund, and responses that might be needed to enhance resilience to the impacts of climate change. In such cases, microfinance institutions need to ensure that their projects do not end up enhancing vulnerability to climate change over the longer term.

Climate change may also require changes in microfinance lending practices, such as flexibility in repayment schedules. At the same time, it is critical not to compromise fiscal discipline that is required for the long-term sustainability of such programs. Finally, there is potential to undertake new projects or to scale up existing activities that can help promote adaptation to climate change. For example, education loans and training programs could be offered to target groups on community level adaptation strategies. Loans for promotion and use of flood, drought, and salt resistant crops may also be scaled-up.

PRIVATE SECTOR SUPPLY-CHAIN

Supply and demand is the main guiding rules for any product or business. Developed market mostly (urban) provides clear and credible information in this area and business germinates and expands with considerable certainty. Less developed market and especially rural market tend to remain small due to the fact that demand and supply situation does not manifest so clearly. The absence of demand can be traced back to the lack of availability or awareness of such product.

Technology diffusion and adoption intensification involves both technical change and the presence of choice of technology, access to finance as well as marketing and distribution systems to increase livelihood opportunities and quality of life and deliver it to rural population at an affordable price. Intensification therefore involves the development of supply-chains around rural poor population.



Supply-chains include a company's entire manufacturing and distribution process. They involve every step of the production from planning to manufacturing to handling defective goods. The overall goal of these chains is to keep the process running smoothly at all times and to keep all of the components (i.e. vendors, warehouses, etc.) connected. One of the biggest benefits technology has given to the supply-chain concept is the ability for companies to collaborate. These collaborations are designed for the mutual benefit of all parties. For example, a supplier of consumer goods may be linked up via the Internet to one of its distributors so that when the supply gets too low an order for more of those goods can be placed automatically. In this way, the distributor never has to worry about running out of a product and disappointing customers and the supplier does not have to worry about maintaining a large inventory in expectation of demand. Similar systems have also been constructed to send out multiple

requests to vendors when an order is placed. Collaborating this way makes better use of existing resources and paves the way for a larger profit margin on all sides of the equation.

The Technology Park attempted to generate the awareness and create demand so that the local business can cater to the demand. It also prepares the infrastructure and environment for new startup business, and expansion of existing business. The supply chain is still either does not exists or require significant strengthening.

A technology mapping was conducted during the baseline survey to understand the status of present and future technology needs as well as to get an insight into how the existing infrastructures and technology service providers (business enterprises) can be integrated with the local rural community. Each component of the supply-chain were studied, strengthened/enforced and sometimes created. Local technology people were trained to provide services and repairs quickly and in a cost effective way.

- Enforcing existing supply-chain
- Creation of new supply-chain
- Technology Infrastructure and support mechanism
- Biogas parts, mason, supervisor
- Bio-sand supply line
- Other technology
- Compost
- Irrigation

ADVOCACY

Power Division of Ministry of Power, Energy and Mineral Resources, Government of the People's Republic of Bangladesh on 6 November 2008 developed a Renewable Energy Policy of Bangladesh, which primarily focused on the renewable energy aspects only. The policy provides a number of incentives and encouragements to the private sector participation including joint venture initiatives in renewable energy development, such as:

- Renewable energy project investors both in public and in private sectors shall be exempted from corporate income tax for a period of 15 years.
- Renewable energy project investors both in public and private sectors shall be allowed to get the fiscal incentives provided in (i) SRO.73-Law/97/1700/Custom, Date: 19/03/1997; and (ii) SRO.100-Law/2000/1832/Custom, Date: 18/04/2000.
- Accelerated depreciation up to 80% may be allowed in the first year.
- An incentive tariff may be considered for electricity generated from renewable energy sources, which may be 1.25 times the highest purchase price of electricity, by the utility from private generators.

The project wanted to advocate for develop or change policies to encourage development, production and import of low-cost, affordable and appropriate technologies, tools and equipments that mitigate or develop capacities to adapt to the changing conditions of climate, such as water efficient irrigation, energy efficiency, renewable energy generation and storage, etc. In this regard, ChangeMaker undertook a number of policy advocacies with a number of stakeholders:

Table 6: Policy Advocacy with Different Institutions

Government	In 2009 drafted a letter to the Ministry of Finance for considering the urgent needs of the country during provide adequate monetary and fiscal incentives in the 2009-10 budget preparation. The 2009 budget reflected a number of encouragements for renewable energy sector. In addition to this regular communication was maintained with the Ministry of Environment and Forestry, Climate Change Cell, Comprehensive Disaster Management Program (CDMP), Ministry of Food and Disaster, Ministry of Youth and Culture, Ministry of Women and Children Affairs, Ministry of Energy, etc.

District Administration	At least 5 meetings were held with the District Commissions in Jessore, Rangpur and Dinajpur regarding the provisions of necessary local administrative support for the promotion of the climate change and adaptation strategies. The support includes lease of land, implementation of the project, safety and security, support services of different government agencies, etc.
Local administration	At least 10 different meetings were held with the Union Parishad and Municipalities in Jessore and Dinajpur regarding the provisions of necessary local administrative support for the promotion of the climate change and adaptation strategies. The support includes lease of land, implementation of the project, safety and security, support services of different government agencies, etc.
Market committee	The primary objective of meetings with Market Committees was to integrate the private sector business enterprises in the project and develop the required supply chain.
Educational institutes	At least 25 educational institutions were engaged in the process both at national and local level. The objectives of engaging these educational institutes were multifarious, ranging from, lobbying with the government, provide advisory services, conduct research on the technologies, help get interns and volunteers, develop credibility of the message through the endorsement of the education institutions
Research Institutes	At least 10 different government and private research institutions were engaged in the project for collection, improvisation of technologies, acquirement of new technologies as well as to advocate for the need for such research to address climate change vulnerabilities
NGOs and CBOs	At least 15 NGOs were engaged in the project both at national and local level to spread the messages to their group members, develop access to finance for the procurement of technologies, change micro credit policy for procurement of appropriate technologies

SERVICE PROVIDERS (INSTALLATION, REPAIR & MAINTENANCE – I, R&M)

To create the provisions for IR&M services, the local youths were organized to form service providers. The youths not only provided services but also acted as advocates for the technologies. The youths also worked in demonstrating and popularizing the project objectives to the community people. 25 youths in Jessore and 20 youths in Dinajpur were selected following the basic criteria:

Picture 1: Youth Training as Service Provider (Installation, Repair & Maintenance - I,R&M

The youth group members went through special awareness, orientation and training courses.

- The awareness training on climate change: one or two day workshop covering general awareness of climate change, its impact, possible strategies to cope with such situation, etc.
- General orientation on technologies and its benefits: a brief introduction of the technologies that were demonstrated in the local area, i.e., the use, benefits, expenses, supply sources, etc.
- Special hands-on technical sessions on each of the technology in details for installation, repair and maintenance was provided.

Table 7: Criteria of Youth Volunteer Section

Sex and Age	Age between 14 and upwards, male or female
Education	Grade 5 and above, so that they can read manuals, write and record information
Locality	Located in the local community or are well conversant with local dialects
Acceptability	Technically oriented and interested in community works
Social Leadership	Able to follow instruction and work independently or in a group, with leadership quality

RELEVANCE OF PROJECT SCOPE, EXPECTED OUTCOME AND APPROACH

It is believed that changes in climate may show adverse affect through:

- Excessive rain and flood
- Draught and state of waterlessness for a longer duration
- Poor productivity of farm production and agriculture
- Loss of bio-diversity

Table 8 and 9 showing some of the potential direct and indirect affect of climate change on local people

Table 8: Potential Direct and Indirect Affect of Climate Change on Local People

Major Changes and Effects	Issues	Perceived Effects
Extreme Weather Changes	Sea Level Rise Snow Melting Water Logging Seasonal changes	Flooding
		Drought
	Temperature Extreme variation	Crop Failure Increase and spread of Disease
Energy	Depletion Pollution GHG	Unavailability High cost of Fuel Tree Cutting
		Search for Alternate /Renewable Energy
Use of Toxic Chemicals to mitigate direct effects causing Ecological Problem	Fertilizer Insecticides Herbicides Pesticide	Chemical Spill Poisoning
		Contamination Adverse Reaction on Bio diversity
Social Effect on Food Security and livelihood	Food Security	Production
		Preservation
	Livelihood	Health& Hygiene
		Reduced Income Generation

The technology park is designed to provide the opportunity to display the different technologies that can address the perceived effects of climate change, improve livelihood and wellbeing of people, and help restore the environment.

Table 9: Climate Change Perceived Effects and Adaptation

Perceived Effects	Agriculture Mitigation / Adaptation	Homestead Mitigation / Adaptation
Flooding	Floating Agriculture Cage farming Duck farming	Floating Dwelling Rainwater harvesting Safe water system (bio-sand filter)
Drought	Rainwater harvesting Drip Irrigation Use of sprinkler	Rainwater harvesting Safe water System (bio-sand filter) Simple water transportation
Crop Failure Increase and spread of Disease	Temperature Tolerant Variety Salinity Tolerant crop	Health & Hygiene practices Inoculation and prevention
Unavailability High cost of Fuel Tree Cutting	Convert Farm Machine to run on CNG, BIO Fuel, Bio Gas	Use Less carbon fuel Efficient Cooker Efficient use of available resource

Search for Alternate /Renewable Energy	Solar pump Wind pump Solar Drier	**Solar Lighting, Solar Cooker** **Bio-gas for cooking and lighting**
Chemical Spill **Poisoning**	Reduce Use of Chemical Fertilizer Use Urea Super Granules (USG)	**Reduce Chemical Use**
Contamination **Adverse Reaction on Bio diversity**	Compost Making Use slurry from Bio gas plant. Use Biological agents Use IPM	**Use home waste for compost** **Natural Pesticides (IPM)** **Bio Mosquito Repellent**
Production	Protect Plant Indigenous variety Bio-diversity Compost fertilizer	**Home Gardening** **Value added products** **Derivatives**
Preservation	Solar Drier Use of natural preservatives	**Sun Dried Foods** **Pickles, Other Process foods**
Health& Hygiene	Promote Organic Farming Reduce use of Toxic Chemicals	**Health and Hygiene Awareness** **Safe water system (bio-sand filter)**
Reduced Income Generation		**Alternate Income generation** **Reduce Expenses using renewable and available resource.**

The technology park is designed to work in a sustainable model so that ChangeMaker can initiate and facilitate the linkage between the community and the technology providers and work to develop an enabling environment to adopt through creating awareness and developing capacity to procure the appropriate technologies. Since ChangeMaker is working in the areas for quite some time and developed the project in consultation with the needs and expectations of the local people, its scope, outcome and approach are extremely relevant which are demonstrated from the significantly high integration of local community and local administration.

AWARENESS CREATION

The axiom "knowledge is power" is central to climate risk and vulnerability reduction. Reducing climate vulnerability requires increasing knowledge about the presence, imminence, and consequences of climate change hazards, and empowering individuals, communities, as well as public and private agencies with that knowledge to lower risk and respond effectively.

For the project, the awareness has to distinct dimension:

1. Awareness regarding climate change, its impact and nature of vulnerabilities as well as means to adopt and develop coping mechanism
2. Awareness regarding technologies that can help reduce vulnerabilities, its application, sources, operation, etc.

AWARENESS DEVELOPMENT TARGET

- Creating availability by enforcing Supply-chain of CC mitigation technology suppliers
- Capacity building and dissemination of selected technology
- Integrating private sector institution
- Integrating government efforts and policy advocacy for CC adaptation strategy
- One stop site for demonstration and information source for general public and SME on the best and cost effective CCA Technology

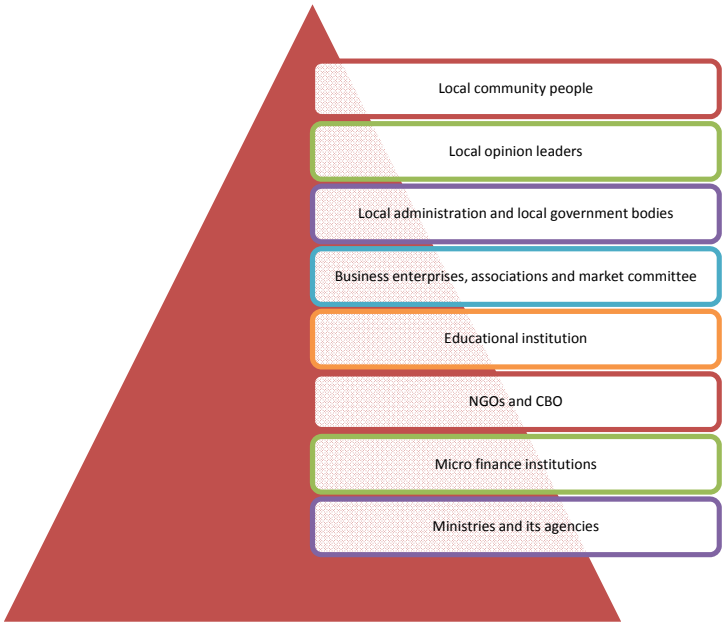


Figure 13: Awareness Development Target Groups

AWARENESS DEVELOPMENT ACTIVITIES

The activities included various approach to present the effects climate change effects that are envisioned to have an impact to the rural people to the various stakeholders. This included:

- Courtyard Meeting
- Group Discussion with Youths, School and College Children, School and College Teachers
- Workshops and Seminar on Climate Friendly Technology and Climate Change
- Seminar on Climate Change Challenges and Preparedness
- Special Event at Park Site
- Open-Air Video show on Technology, Climate Change Documentary
- Display of technology at household level
- Meeting with Technology Users groups

Major theme of the activities was to present the threats and vulnerabilities of the people, its consequence and how the people can safeguard and take effective actions against such ensuring disaster. Even though the issue is global, each of us can play an important role in practicing and promoting environmental friendly living and adopt strategies', which will help overcome or reduce the impacts and sufferings.

During the evaluation of the project, the effectiveness of the awareness was measured through viewing, message retention and understandability. Figure (14) shows the awareness campaigns that were actually were more effective to the rural people. The effectiveness was measured through participation, message retention, satisfaction, etc.

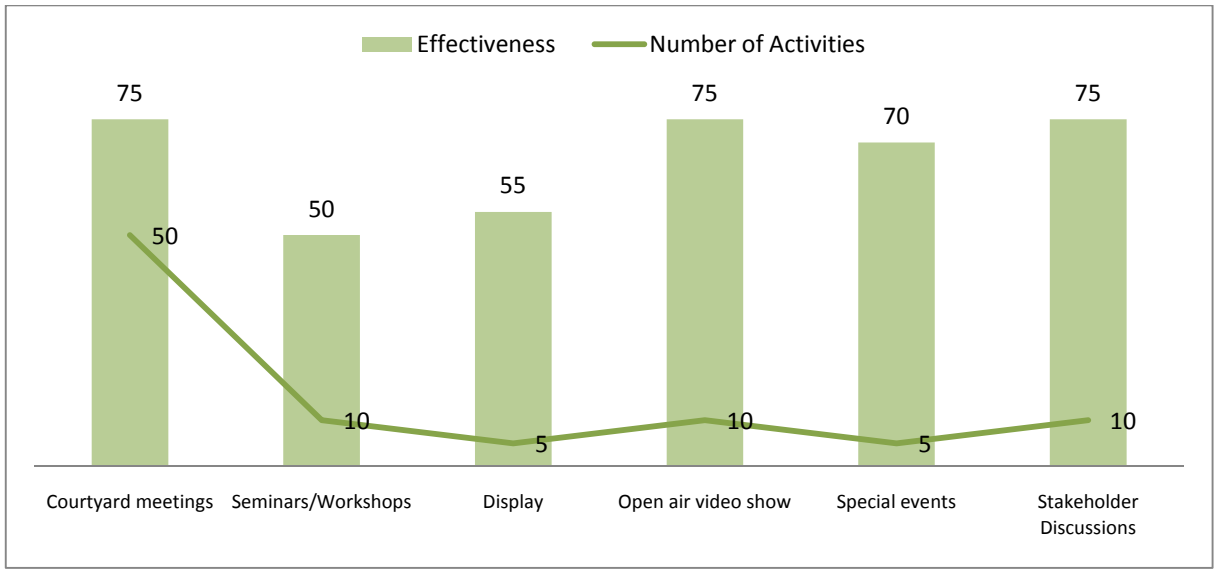


Figure 14: Awareness Development Activities and their Effectiveness

AWARENESS ISSUES AND COMPONENTS COVERED DURING THE ORIENTATION

- General Climate Change Issues
- Vulnerabilities' and threats
- Effects and impacts on life and livelihood
- Technologies available to reduce the impact
- Technical Aspect of each technology
- How supply change can improve adoption of technology
- Employment and Alternate Income from technology dispersion

Youth group were formed with the objectives to have a gender balance but was not always possible due to non-availability of female members. In Dinajpur the number of female members are more than the males, whereas Jessore has fewer female members.

[Picture of youth groups in meeting]

AWARENESS MATERIALS FOR THE COMMUNITY

Awareness materials on climate change and environmental issues were collected from the Ministry of Environment, Climate Cell. Other materials were sourced from various websites of national and international origins. These were compiled, categorized based on the issues and objectives of the park.

Twelve leaflets were produced in local language on twelve important technologies. Considering the low educational background of the target area, the leaflets on each technology contained extensive visuals and the language and text explaining the technology where lucid and readable by elementary or new learners. In addition to the leaflets, a brochure was also developed stating the general context of climate change, the potential vulnerabilities, and the different ways to mitigate and cope with the adverse changing climate as well as the objective and usefulness of the project.

Movie and documentary films were collected on various issues from the Government Climate Change Cell, 'Eco 4 the World, BBC and other documentaries some were in local language others were in English. The English contents were translated and a volunteer would read it while displaying it. Power point presentations were prepared in both Bangla and English to cover the various levels of stakeholders from government officials, students and business people.

The different awareness materials are provided in annex 2

MESSAGE RETENTION

As mentioned earlier, the awareness activities including training, seminars, workshops, courtyard meetings, special events, video shows, etc., were arranged and were evaluated through formal and informal interview, discussions to find out the effectiveness of the awareness activities. The quality as well as effectiveness of different methods and the retention of the message was evaluated periodically.

Courtyard meetings, open-air video shows, stakeholder meetings, and special events proved to be the most effective and useful method for creating awareness.

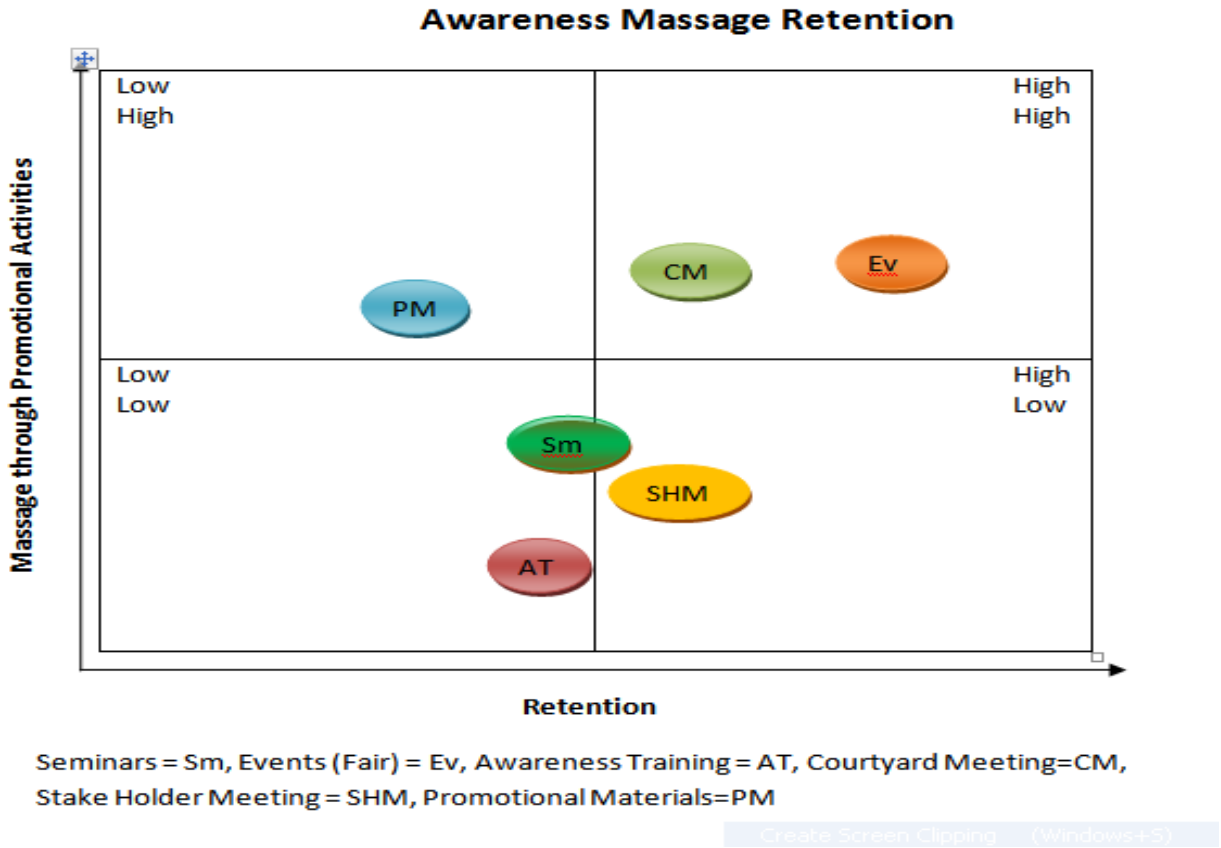


Figure 15: Message Retention vs Awareness program activities (data from field survey)

IMPACT OF THE PROJECT

TECHNOLOGY ADOPTION

The technologies, which provide direct and quantify able dividends in terms of short-term financial dividend were high in the accepted and adopted technologies. These included Biogas technology, Efficient Stoves, treadles pumps, compost fertilizer etc. The following chart shows actual adoption (completed and work-in-process) in both Jessore and Dinajpur.

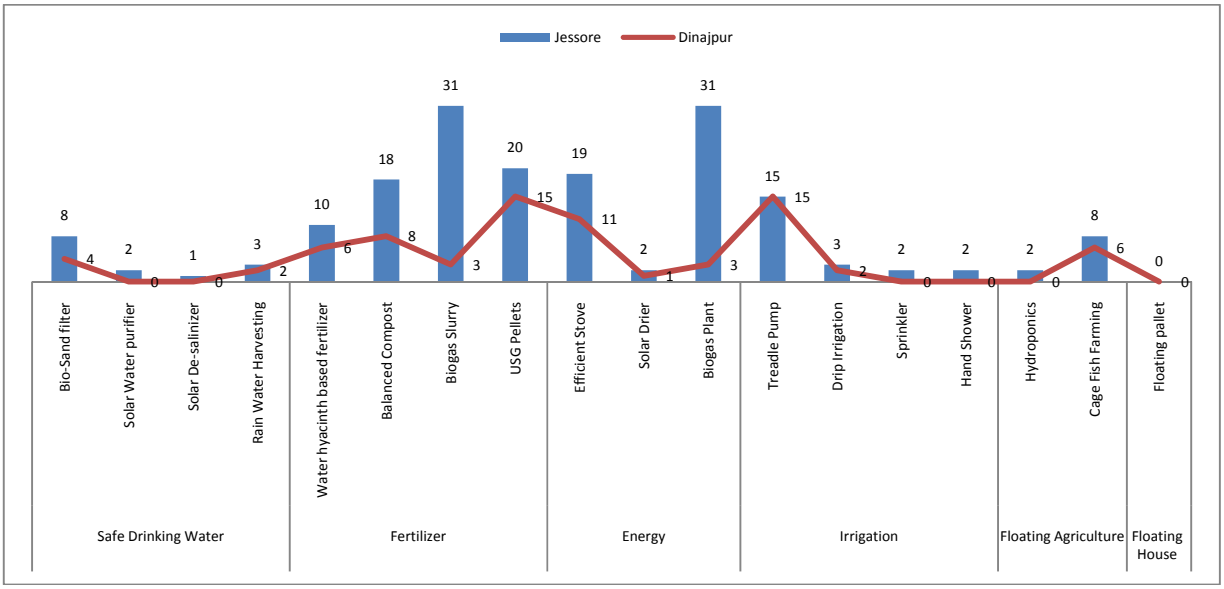


Figure 16: Technology Adoption

The high rate of adoption of biogas, despite expensiveness, is high awareness because of its multidimensional benefits (cooking, lighting, compost). Moreover, ChangeMaker has been working on biogas and bio-sand filter six months before the pilot project.

Considering the limited timeframe and demand creation, the adoption rate is extremely satisfactory.

OTHER ACHIEVEMENTS OF THE PROJECT

The primary achievements of the project are as follows:

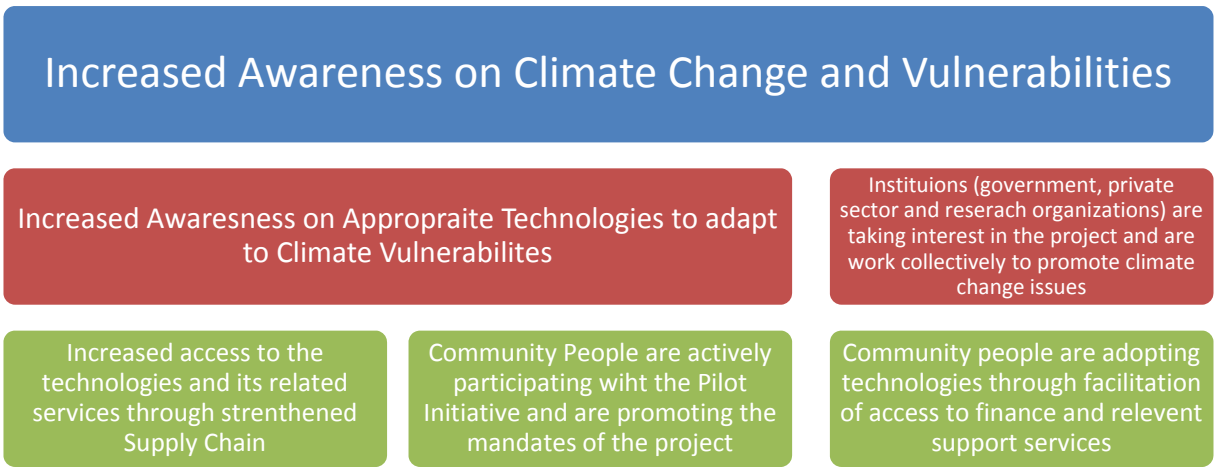


Figure 17: Achievements Framework of the Project

More specifically the project could achieve the following:

- Created awareness about climate change to more than 100,000 people
- Created awareness about climate coping technologies to more than 100,000 people
- Helped adopt 253 different technologies to about 250 households
- Helped develop a strong supply chain for at least 10 technologies in the rural area
- Helped developed capacities of 50 youths for I,R&M service provision
- At least 25 educational institutions were engaged in the process both at national and local level.
- At least 10 different government and private research institutions were engaged in the project for collection, improvisation of technologies, acquirement of new technologies as well as to advocate for the need for such research to address climate change vulnerabilities.
- At least 15 NGOs were engaged in the project both at national and local level to spread the messages to their group members, develop access to finance for the procurement of technologies, change micro credit policy for procurement of appropriate technologies.
- Developed strong relationship with relevant government ministries and different departments and agencies of the government

Apart from the above, the following achievements were also realized from the pilot project:

- Advocacy with Ministry of Finance during budget preparation session to encourage import, manufacture and sales of appropriate climate friendly technologies at an affordable price
- The local governmental officials and the local Union Parishads at district level are assisting in developing a permanent facility for the park
- Developed a pool of volunteers to work on climate change issues
- Developed local capacity to address the climate change issue through their local effort
- A list of technology experts and suppliers were identified

ATTRIBUTION OF THE IMPACTS OF THE PROJECT

- MOU with NGO for implementation of Energy Efficient Stoves
- MOU with MFI to provide finance on technology products
- Development of local supply-chain for technology products
- Formation of Local youth groups, supply-chain, technology providers etc.

- Meeting with the Local Union Parishad, Local Market Committee, and Local influential people

SUSTAINABILITY OF THE PROJECT

One of the key priorities of the project mandate is to develop the strategic ability of the project to endure and be growing over the long term. Therefore, a "sustainable project" for the project, is one that is healthy, vital, resilient, and able to creatively adapt to changing conditions over time.

As a result, from the very onset a strategy of growth and development was developed so that the project continues to function even after the direct facilitation of the project. As a result, key focus was given on maintaining the outcomes, goals and services of the project as well as institutionalizing the entire process.

As a result, the following strategies were undertaken from the onset of the project:

- Develop broad-based relationships/partnerships that foster collaboration.
- Involve all stakeholders: community people, women, children, youths, the affected people, the users of the technology, parents, students, business, politicians, community leaders, local administrations, funders, etc.
- Nurture community involvement
- Develop a core of supporters
- Make the project visible
- Develop an effective outreach plan
- Be flexible, modifying the project based on evaluation, feedback and community needs and expectations
- Communicate and make the stakeholders aware
- Share resources, share expertise, share successes and celebrate success together with the community

PARTICIPATION

At the core of program development and implementation of 'technology showcase' program was the need for people to believe that the technology park represents their need and are addressing their concerns and best interests in improving the welfare and "quality of life" for the local community. This was felt increasingly important at the local government level where the effectiveness and efficiency of such service delivery is absent and where the lack of accessibility to appropriate knowledge and information as well as technologies are causing distress to the people and decreases the likelihood for social and economic improvements.

Community participation is a process, where community people organize themselves and their goals at the grassroots level and work together through facilitators (ChangeMaker) to influence the decision-making process. Citizens get most involved in this process when the issue at stake relates directly to them. Furthermore, citizen participation occurs when all the stakeholders cooperate to implement changes.

Table 10: Participation of Different Stakeholders in the Project

Categories	Stakeholders	Involvements and Roles
Community people	Lead farmer	Motivation and information dissemination on adoption as well as provide services on installation, repair and maintenance
	Community Leaders	
	Youths	
	Women	
Local and Central Government Institutions	Ministry and Departments (CC Cell)	Information promotion support (Posters, leaflets, booklets, toolkits, documentaries, movies, et.c)
	Local Government and Administration	Support for operation and operating

	District Commissioner (Jessore, Rangpur, and Dinajpur) UP Chairman (Jessore and Dinjpur) Ward commissioners (Jessore and Dinajpur	environment, such as land leasing, electric connection, safety and security, etc.) as well as motivation and information dissemination
	Government agencies: Local Government and Engineering Department (LDEG) Bangladesh Agriculture Development Corporation (BADC) Department of Agriculture Extension (DAE) Rural Electrification Board (REB)	Technical assistance in setting-up technologies as well as collection of existing technologies that they promote
NGOs, Networks and Forums	GTZ, Dhaka	Efficient stove, PV cells
	Biogas Foundation	Biogas promotion and technical assistance
	Infrastructure Development Company Limited (IDCOL), Dhaka	Biogas promotion and technical assistance
	Padakhep, Jessore	Access to Micro Finance, dissemination of information to group members
	Grameen Shakti, Dhaka	PV cells
	PAUP, Dinajpur	Local advocacy
Private Sector	RahimAfrooz (Bangladesh) Limited	PV cells
	Singer (Bangladesh) Limited	Energy efficient bulb (CFL)
	Advance Engineering Limited	Biogas spare parts
	Nooria	Biogas spare parts
University/College /Schools	United International University (UIU), Dhaka	Technical assistance and advice, volunteers and interns
	Ifas, Germany	
	University of Dhaka (DU)	
	Bangladesh University of Engineering and Technology (BUET), Dhaka	
	Institute of Business Administration (IBA), Dhaka University	
	Bangladesh Agriculture University (BAU)	
	Haji Danesh University, Dinajpur	
	Jessore Science and Technology, Jessore	
	Khulna University of Engineering and Technology (KUET), Khulna	
Research Institutions	International Rice Research Institute (IRRI)	Technical assistance in setting-up technologies as well as collection of existing technologies that they promote
	Bangladesh Rice Research Institute (BRRI)	
	Bangladesh Agriculture Research Institute (BARI)	
	Bangladesh Council of Scientific and Industrial Research (BCSIR)	
Others		

ANALYSIS OF FACTORS ATTRIBUTABLE TO PROJECT IMPACTS

A number of factors could have attributed to the success of this project and achieve desired results. One of the key factors was the relevance of the project to the need of the people in the project area. There is lack of adequate knowledge and information about climate change and its potential impact and vulnerability as well as lack of appropriate technologies to minimize the social and economic risks and vulnerability in rural Bangladesh. The people especially the farm community could feel the gradual changes in their yield and profitability as well as food security but could not explain the same neither they could access adequate knowledge, information and technologies to address them. Lack and surplus of water in the wrong time, salinity, draught, gradual decrease of ground water, loss if soil fertility, etc., are profoundly affecting the local people. The village women readily saw the tangible benefits of fuel-efficient stove as well as biogas that not only provide easy cooking, but also lighting and bio-fertilizer. The local administration and local institutions could see how indigenous knowledge and local materials can improve livelihood and quality of life of the local people at an extremely affordable price. They could see the necessity of learning science and its application of improvement of social and economic conditions of people. These were evident from their engagement and integration with the project.

The immediately observable adoption of technologies that were demonstrated in the Technology Park by the local community as well as extremely high rate of interest not only among the communities in the working area, but also communities from distant districts.

The acceptance and credibility of ChangeMaker in the community because of their earlier successful interventions in the area was also a great booster in getting peoples support for the project and in meeting project objectives.

There was a high level of commitment by ChangeMaker team members in planning and managing the project as well as field workers in effectively delivering the project mandates closer to the people. At the same time, the supported and guidance from IEGS/NetRes Institute in planning implementing activities helped greatly in achieving the project objectives.

Other factors include simple, indigenous technology, low cost and easily understandable and development of local capacity and engagement of local opinion leaders.

CONCLUSIONS

The pilot project planned to address the most vulnerable issue of climate change and developing coping strategy of the local people. During the short duration (12 months), the project met all the objectives and deliverables.

The pilot project helped developed significant interest and awareness among the local people regarding climate change, its potential impact and strategies for adapting to the change situation.

Eighteen different technologies (bio-sand-filter, solar-water-purifier, solar de-salinizer, rain-water-harvesting, water-hyacinth based fertilizer, balanced compost, biogas slurry, USG-pellets, efficient-stove, solar-drier, biogas plant, treadle-pump, drip-irrigation, sprinkler, hand-shower, hydroponics, cage fish-farming, floating-pallet) were demonstrated in six broad categories (safe drinking water, fertilizer, energy, irrigation, floating agriculture and floating-house) that can directly the local reduce climate vulnerabilities.

The project influenced local development and adoption of technologies and at the same time developed strong partnership with a wide cross section of stakeholders to promote the project concept. The significance of the project activities has attracted the attention of government, local NGOs, private sector, the media and the community people and has developed a strong footing for sustainability of the project.

LESSONS LEARNED

- Project that has direct relationship with seasonal variation requires longer term project duration to make it effective
- Integration of local people and administration is significantly important in achieving desired results of the project
- A project that meets the local needs and expectation is the critical success factor of the project
- Access to finance is the primary barrier in adoption of technologies
- Micro finance institutions should have policy to finance technology procurement
- Adequate awareness materials and appropriately designed promotion campaign adds value to the success of the project
- Constant feedback and satisfaction of the users of technology is essential for technology adoption
- Extremely high coordination and monitoring is essential for technology oriented project
- Technology innovation, availability and accessibility is required

- Local educational institutions and SMEs should be oriented and capacitated to develop new appropriate technologies
- Product and service subsidization of other government and non-government program activities affects fee-based program approach

RECOMMENDATIONS FROM THE NETRES INSTITUTE (IGES, JAPAN)

One of the important problems plaguing the social development in Bangladesh has been the poor penetration of private sector and life-transforming low-cost and climate-friendly technologies. The reasons for poor penetration of low-cost technologies are listed below:

1. Poor purchasing power of rural communities which has acted as disincentive for the private sector to see rural areas as market areas for their produce which in turn hindered in producing suitable products.
2. Poor education and skill levels of rural communities which couldn't be directly utilized by the private sector to establish rural industries those could produce low-cost climate friendly technologies.
3. Poor incentives from the government: Though there has been several developmental programs implemented by the national and local governments, these are often based on technologies that are already available, suffer from poor reach through hierarchical government systems and often have been far from successful in addressing local needs. In addition to government's own initiatives, the support to private sector in innovating and spreading low-cost climate-friendly technologies has been far from sufficient.
4. Lack of mechanism that identifies and promotes local innovations.

This project aims to address some of the above issues through the approach of identifying and deploying low-cost climate friendly technologies in rural Bangladesh. The approach has been based on the fact 'seeing is believing.' The project provides several lessons for developmental workers, private sector and government to learn and improve the existing practices in low-cost technology development and diffusion. From the experience of this project and review of other experiences in Bangladesh and elsewhere, we derive the following recommendations for consideration of different stakeholders in low-cost technology development and diffusion.

RECOMMENDATIONS FOR PRIVATE SECTOR INDUSTRY

- **Recognize the potential of low-cost technologies:** There is a huge potential for low-cost technologies in terms of spread and revenue generation in Bangladesh. With more than 70% of people living in rural areas who are eager to get out of poverty, any low-cost climate-friendly technologies that addresses the local needs would be quickly be adopted.
- **Promote appropriate technologies:** The project has shown that the technologies with income generation potential will have more potential than those technologies and tools that aid in day-to-day life. Some of such technologies include bio-energy (e.g. bio-gas plants where households can sell excess biogas to their neighbors), food production (e.g. floating cage fisheries), and food processing and preservation (e.g. solar driers).
- **Scaling up in adoption:** Scalability of a technology is an important aspect to be considered. A technology that is low cost, in the socio-economic context of rural Bangladesh, easy to use, and efficient can be easily be scaled up in adoption. A simple scalable characteristic of a technology alone may not be sufficient since there needs to be some enabling environment and achieving economies of scale are crucial to maximize this potential.

- **Collaboration for Reaching Economies of Scale:** Economies of scale refers to the phenomenon of reduced unit cost of a product with increasing production. A simple example of Grameen phone in Bangladesh tells us the story of the potential of converting high cost technologies into low-cost through the economies of scale. Several of technologies promoted today suffer due to the reason that the proponents of these technologies have failed in reaching the economies of scale. Economies of scale can be reached by expanding the production in tandem with a vigorous marketing strategy that can impress potential adopters of the benefits of technology so that the breakeven point can be quickly reached. The production process should consider usage of local materials and the using the abundant rural labor. We see that many technologies showcased by the Change Maker have high potential to be scaled up soon reaching economies of scale. For such a thing to happen, it is imperative that various stakeholders work together which can set an appropriate enabling environment for enhanced adoption of the technology.

GOVERNMENTS AND FINANCIAL INSTITUTIONS

As Enabler: Government should play a role of enabler, by providing enabling environment for promoting the actions of the private sector in reaching out to the rural market places. Enabling environment could be created by:

- **Establish incentive mechanisms:**
  - **Tax benefits** for climate friendly and low-cost technology producing firms and entities including rural groups.
  - **Subsidies** for climate friendly technologies for consumers (especially those focusing on farmers groups and for those technologies that have income generating potential)
- **Promoting public-private partnerships** where government supports research and development of low-cost technologies while private sector focuses on scaling up and reaching out to the rural markets.
- Establishing a **technology fund** that can be used for providing grants and low interest loans to institutions and individual innovators for showcasing the low-cost and climate friendly technologies.
- **Revisiting the rural development programs for local innovation**: The current rural development programs are designed in such a way that there is only a one-way flow of information and it often see the rural communities as 'receivers'. The capacity development aspect of rural development is mainly focused on simple 'use' of 'a' technology with no emphasis on how to promote local innovation. The potential for paradigm shift here is to introduce educational and training programs that can help generate local innovations.
- **De-regulation:** Governments often fail to see the full potential of markets by putting in place several regulations. The experience from elsewhere has proved that the de-regulation and open market conditions help in spreading the technologies through private sector.
- **Create Rural Tech Institutions:** Currently, there are no public owned research and educational institutions that engage in developing and diffusion of climate friendly low-cost technologies in the country and there is a very high need for establishing such an institute at the national level that identifies and improves the local innovations and links public with the private sector entities.
- **Rules and Regulations:** Certain rules and regulations within banking industry have become hindrance in adoption of technology. One such rule that hindered the uptake of technology was the condition of income generation for issuing loans to biogas plants. The banks could issue loans both for biogas plants and cattle, where cattle alone can be considered as income generating component. Excess cattle could have helped the loanee to generate excess biogas and sell to the neighbors. The **combining of bank loans with other government developmental programs** could be another way of improving the rural energy security through

biogas plants where bank provide loans for biogas plant while the developmental programs of the government help in obtaining improved cattle breed.

- **Coupling with innovative financing programs including Microfinance:** Diffusion of climate-friendly technologies be effectively coupled with the microfinance programs offered by banks and other microfinance institutions. Income generating technologies such as solar driers and biogas plants could be effectively promoted. In addition, obtaining loans require one to mortgage certain assets. Since most of the rural poor are devoid of 'mortgagable assets', obtaining loans for initiating an income generating activity becomes a difficult proposition. There is a need that banks recognize the importance of promoting adoption of climate friendly technologies and provide special provisions for these sections of people. One of the ways is to provide **group loans** and to design loan projects that fully engage low-cost and climate friendly technologies.

NON-GOVERNMENTAL DEVELOPMENTAL ORGANIZATIONS

- **Be a catalyst:** NGOs play a catalytic role and can fill the gaps that government and private sector cannot effectively fill. Most effectively, developmental agencies should help governments and private sector with understanding the local needs, help uptake of local wisdom and innovations into government run research and developmental programs and educate communities about various ongoing initiatives for development.
- **Have better understanding of local needs:** Since NGOs work closely with the local communities, the main role expected from these developmental agencies is to have better understanding of local needs in terms of technologies and identify strategies to organize communities to take benefit from the private sector and government initiatives.
- **Technology targeting through promoting participation:** NGOs should help communities identify appropriate technologies by educating them and help choosing the one that is suitable to their socio-economic conditions. Here, NGOs play an important role in converting the unfelt needs into felt needs which is necessary in initial technology acceptance.
- **Combining technology demonstration with facility to uptake:** The often missing component in the ongoing technology demonstration activities is the missing facility for the potential adopters to uptake the technology. It is advised that NGOs should bring together the technology provider and financer together and design a package that helps in easy diffusion of technology. The design factor here could consist of organizing communities to accept group loans in order to buy a technology that helps in group income generation.

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