Feasibility Study of Eco-Village Development concept in the coastal region of Bangladesh

ecovillage

Grameen Shakti

The "Feasibility Study of Eco-Village Development Concept in the Coastal Area of Bangladesh" was made in the framework of an NGO cooperation Project titled "Strengthening the Eco-Village Development concept: Affordable local climate actions for sustainable development in South Asia" in September 2019 to July 2020.

The feasibility study is based on the following two publications:
The Eco-Village Development Concept described in the publication "Eco-Village Development as Climate Solution, Proposals from South Asia". 60 pp. 2017. INFORSE ISBN 978-87-970130-1-4.
"Socio-Technical Manual for Training of Trainers (ToT) Manual on Participatory Planning, Technology and Knowledge Transfer of Eco-Village Development (EVD) in India, Nepal, Sri Lanka and Bangladesh." 132 pp. 2018, INFORSE ISBN: 978-87-970130-3-8.
Both publications are available in English, Bangla, Hindi, Nepalese, and Sinhala.

Download from: http://www.inforse.org/asia/Publications_EcoVillageDevelopment_SouthAsia.htm

The Project Partners:
International Network for Sustainable Energy (INFORSE), INFORSE-South Asia regional and national coordinators: Grameen Shakti (Bangladesh), INSEDA (India), CRT-N (Nepal), IDEA (Sri Lanka), and CANSA. Project Coordinated by INFORSE and DIB in Denmark.

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Report prepared by Abdul Arif, Manager, Project Development (Grameen Shakti)

Editorial Advisory Team: Sohel Ahmed from Grameen Shakti, Gunnar Boye Olsen and Judit Szoleczky from INFROSE, and EVD Project Partners (see above).

Contributor: Sanjida Islam, Asst. Manager, Project Development (Grameen Shakti)

EVD Project's web sites:

www.ecovillagedevelopment.net

www.inforse.org/asia/EVD.htm

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Address:Grameen Telecom Bhaban (Level-3), 53/1, Box Nagar, Zoo Road, Mirpur-1, Dhaka-1216
Phone: +88-02-44802061-3
Mail: g_shakti@grameen.com
Website: www.gshakti.org

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1. Introduction

1.1. Background

Eco-Village Development

In South Asia, more than half the population lives in villages and the development of the subcontinent is linked to the development of the villages. The Eco-Village Development (EVD) Concept in South Asia is based on promoting local and affordable climate friendly technologies and practices, as a means to create sustainable local development and climate mitigation and adaptation actions in existing rural villages and communities. The EVD Concept involves the implementation of inexpensive, renewable energy solutions, food and water security interventions, and livelihood enhancing solutions, mainly via capacity building and with aims of climate change adaptation and mitigation. EVD is an integrated approach of creating development-focused, low-carbon communities of practice in pre-existing villages. The Concept has been promoted by a multi-country, Danish funded project, comprising NGO partners from four South Asian countries - Bangladesh, India, Nepal & SriLanka. Grameen Shakti has been implementing this project in Bangladesh since 2015.

Brief on feasibility study

During the previous phases of the Eco-village Development (EVD) Project, the concept has been tested in smaller areas selected by the project partners, and the evidence has been collected from those areas for policy advocacy. While this has demonstrated the viability of the concept, there is a need for further work to scale-up the implementation on the ground and to convince local decision-makers that control local development funds that can be used for replicability of EVD. This is in particular the case for dissemination outside the existing project areas.

Two previous projects had a strong focus on advocacy at national and international level. This had its advantages but it also limited our possibilities to organize scaling up of the concept on local level. For further replication of EVD concepts at the local level, advocacy, testing the feasibility of EVD were crucial.

1.2. Executive Summary

Eco-village development (EVD) focuses on local affordable climate friendly solutions and the feasibility study of EVD concept in the coastal region of Bangladesh provides an insight and potential viability of the EVD solution in the aforementioned areas. This study tries to find out the opportunities of using the tools from EVD basket in order to tackle the major challenges and create sustainable local solutions for coastal zones.

Primary data was collected from key informant interviews (KII) or Focus Group Discussion (FGD). To conduct the survey, the *Mathbaria* sub-district under *Pirojpur* district in southern Bangladesh was selected. Secondary data was collected from desk research and experts opinion in the stakeholder consultation webinar.

The key findings are:

Firewood is the primary means of cooking fuel and the use of LPG is very small, though it is rising fast. A vast number of respondents are not aware of the availability of improved cook stoves (ICS) in their locality. Hence, ICS have a significant amount of potential scope to scale-up.

The study recommends that efforts should be made by local NGOs, governmental organizations & infrastructure development entities to build awareness, grassroot level advocacy and capacity building initiatives for manufacturing and distribution of ICS for future scale up.

As the coastal areas are more disaster prone and seasonal migration happens frequently, people prefer not to keep more domestic animals. Building resilience in the coastal area can encourage communities to keep cattle and to install biogas plants.

Access to electricity in the area has been significantly increased and communities use Solar Home Systems as a back-up solution in case of emergency. To sustain the

existing Solar PV system, DC appliances and peer-to-peer solar electricity technology can be introduced.

The availability of clean drinking water is scarce. The saline rich water is one of the major reasons of water borne diseases in the area as well as salinity intrusion in the agricultural land is endangering fertility and resulting threat for local food security. Indigenous technology, as well as advanced new technologies, can be further tested and disseminated with proper financial support.

Based on the findings and Grameen Shakti's experience in the coastal region and village development, surveyed EVD solutions were leveled as feasible, moderate feasible or not feasible. Also a strategy for the way forward, was investigated in this study.

2. Objective

- Test the viability of the EVD solutions in the coastal zones of Bangladesh
- Utilize the findings of the feasibility study for future development

3. Scope of Work

To conduct the feasibility study, data has been collected through questionnaire survey of focused group discussion and key informant interview. Also desk research has been done to collect different data and information.

4. Methodology

4.1. Parameters of area selection

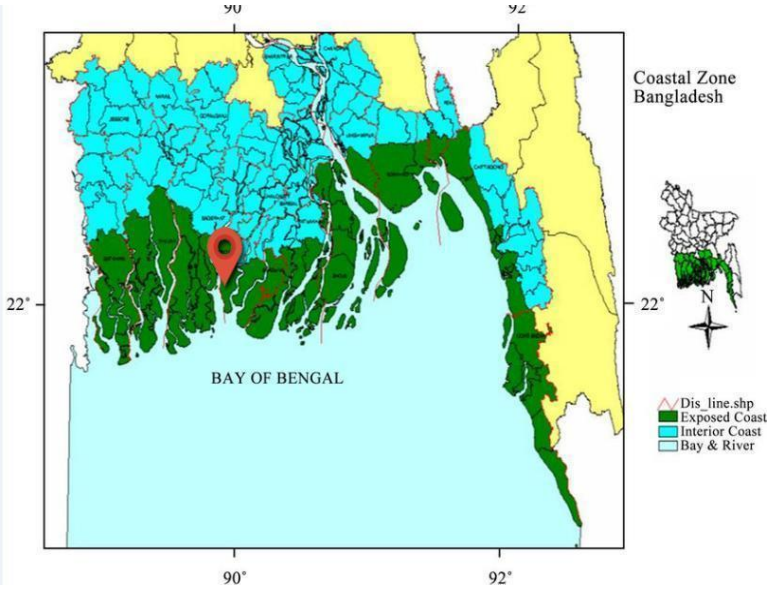
Major threat and challenge in Bangladesh, due to climate change, is the increased vulnerability due to frequent natural disasters like cyclones and floods in the coastal zone. As this project targeted testing the feasibility of Eco-Village Development (EVD) solutions in different geographic locations, in Bangladesh the coastal region was selected for the study.

Bangladesh

District	: 64
Sub-District	: 492
Village	: 68,000

Project Area

District	: Pirojpur
Sub-District	: 7
Village	: 94



Map of Bangladesh

Out of 7 sub-districts of the Pirojpur district, *Mathbaria* district was selected, as this area is the most exposed to the coast and consists of the highest population (263,527). Out of 94 villages in this Pirojpur sub-District, we conducted surveys in 22 villages, under *Mathbaria.*

Map of Mathabaria

4.2. Questionnaire

Two types of questionnaires were prepared for the feasibility study

(1) Community leader, Community Based Organization (CBO) & Household
(2) Local NGO or local government official

4.3. key informant interview (KII) or Focus Group Discussion (FGD)

In order to find the viability of the EVD solutions in the coastal areas of Bangladesh, some of the key target groups for collecting information were selected based on some key criteria. As there were two different sets of questionnaires targeting two different groups with the purpose of getting a complete scenario of the selected area, the criteria varied slightly for each group.

Criterias for the interviewed person for Community leader, Community Based Organization (CBO) & Household:

1. Must be a local person living in this area since their past generations.
2. Must hold enough knowledge regarding the lifestyle of his/her locality.
3. Actively involved in community issues.
4. Holds decision making authoring to a certain extent.

Criterias for the interviewed person for Local NGO or local government official:

1. The official should be designated by the NGO or government for the specific locality.
2. Alignment of NGO's activity with the concept of EVD project.

4.4. Data collection and analysis

Primary Data

For primary data collection, we divided the area in a way so that we can cover most of the villages that are mainly near to the river.

- Data was collected through face to face interviews.
- Data was collected and analyzed with the help of the KoBo toolbox.

Secondary Data

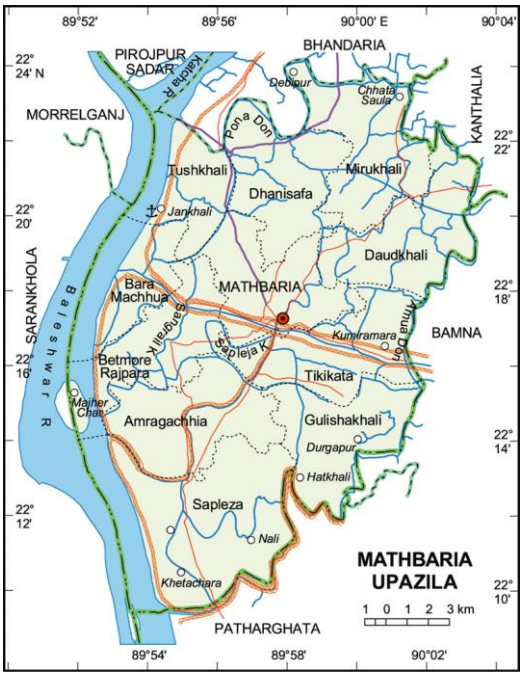
For selecting the secondary data, we have studied different official websites, national policies and guidelines, newspaper, article, research publication and review of publicly available documents etc.

4.5. Validation

During the survey we asked different relevant questions, other than the questionnaire, to cross-check their answers. Also we conducted desk research, reviewed different relevant articles and talked with experts to validate the survey data.

General Information of the Area

- **Brief of the Area:**



Pirojpur is a riverine district situated at the southern-western part of Barisal division of Bangladesh. Boleshhwar river flows beside Pirojpur at 22 30’ 00" N 89 52’ 00" E & 22 52’-00" N 90 13’00" E and bounded by Gopalgonj, Barisal District on the north, Barguna District on the south, Jhalokati District on the east and Bagerhat on the west.

Among the seven upazila of Pirojpur, Mathbaria has the largest number or population. This upazila is divided into Mathbaria Municipality and 11 union parishads: Amragasia, Betmor Rajpara, Boromasua, Dhanishafa, Daudkhali, Gulishakhali, Mathbaria, Mirukhali, Shapleza, Tikikata, and Tuskhali. The union parishads are subdivided into 67 mauzas and 93 villages.

- **Climate**

Mathbaria has a climate of tropical nature as it is situated in the tropical zone. The district is remarkable for its uniform temperature, high humidity and heavy rainfall from June to August. The climate is thus moist, warm and equable. The sea breeze helps in keeping the climate equable and the summer temperature rises upto a maximum of 35 oC. The level of humidity is around 88% from August through February and around 77% from December through February. The annual rainfall as recorded in 2008 was 1918 millimetres. In monsoon, the weather becomes turbulent when cyclones and tornadoes occasionally hit the coastal areas of the district causing loss of life and damage to houses and property.

Mathbaria Pourashava, a cyclone center

Natural disasters:

Mathbaria has experienced multiple natural disasters in the past 10 years. The major three were Sidr in 2015, Bulbul in 2019, Amphan in 2020. The cyclones caused immense sufferings to people of the coastal area of Mathbaria. The cyclones interrupted the electricity as the poles were uprooted, caused scarcity of water as the areas were flooded and the crops were destroyed. Many people lost their homes and means of livelihood in these disasters. A total of 557 shelters have been set up in Pirojpur to deal with cyclone Amphan and out of this 61 in Mathbaria in 2020.

Electric poles devastated due to cyclone

- **Energy Scenari**

Mathbaria Upazilla has almost 96% of national grid coverage for their electricity supply but they also use solar home systems for their household and business. Most of the

villages of this area have street light powered by the grids, though these are not adequate.

For cooking purposes, most people in the upazila use traditional stoves that use firewood, dung etc as fuel. These fuels are collected mostly from their kitchen garden and nearby bazaars. Some of the village dwellers use LPG gas for cooking. Though as the primary source, the number is still low to 4%, it's getting popular among the villagers. As a part of development of clean cooking in the area, an improved cook stove/ green cook stove was introduced. But because of the lack of availability and awareness, only 4% of the households use improved cook stove.

Solar Home System in Mathbaria

- **Agriculture**

The soil of the district is of two types viz., (a) old lower *Meghna* tidal flood plain with non-saline tidal silty clay and (b) poorly drained saline phase of Barisal tidal clay of the old lower Meghna tidal flood plain. The northern part of the district occupies old lower Meghna tidal flood plain with non-saline tidal silty clay and the southern part of the district is covered by poorly drained saline phase of the Barisal tidal clay of the old lower Meghna tidal flood plain.

The 353 square kilometre upazila has always been dependent on the production of rice. Mathbaria's aman acreage was 20,100 hectares this year, which is about one-third the paddy produced in the belt.

This district is largely a rice growing area. Rice covers 86 percent of the gross cropped area. Other crops include wheat, jute, khesari, mung, musur, chillies, turmeric, ginger, betel leaf and tobacco. Betel nut is the main cash crop.

Irrigation

This is an area of total land brought under irrigation coverage for growing crops with irrigations done through mechanical or manual means. Irrigated area classifications fall into two categories: (1) surface water irrigation with main water sources being

rivers, canals, beels, ponds, and other water bodies; and (2) underground water irrigation with water lifted by shallow tube-wells, deep tube wells, and country traditional devices. The irrigation equipment is run by electricity, diesel or petrol, or manual labor.

Rice cultivation in coastal region

- **Economy**

  The economy of Pirojpur is predominantly agricultural. Out of total holdings of the district, 72.86% holdings are farms that produce varieties of crops namely local and High-yielding variety (HYV). rice, vegetables, spices, cash crops, pulses, oilseeds, betel leaves and others. Fish of different varieties abound in the district. Moreover, varieties of fish are caught from rivers, tributary channels even from paddy fields during the rainy season. Some prawn and hilsa fish are available in the district. Various types of timber and forest trees are grown in the district. Nesarabad upazila is famous for business of sundari wood and gol pata. Sundari is mainly used as timber while gol pata is used for making roof of the thatched house.

  Remittance is one of the biggest sources of economy in Mathbatia. Around 50,000 inhabitants of the upazila out of 3,00,000 people live in Saudi Arabia. Migrant workers remit Tk 325 crore (USD 382 Million) to Mathbaria every year.

5. Co

5.1.

Topography : Coastal Flatland

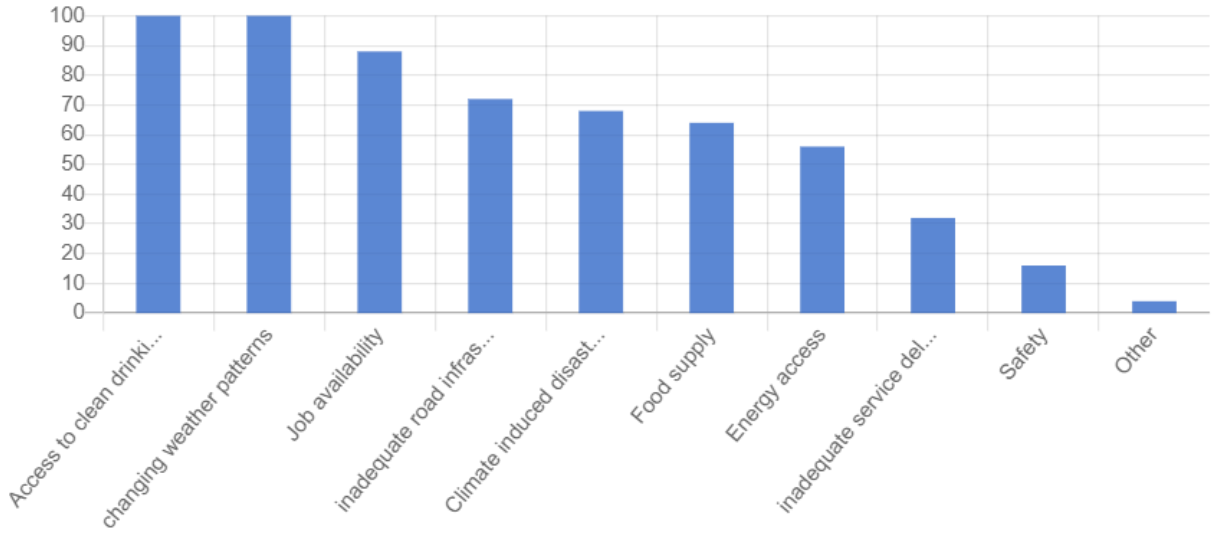
Natural Resource : River, Clay

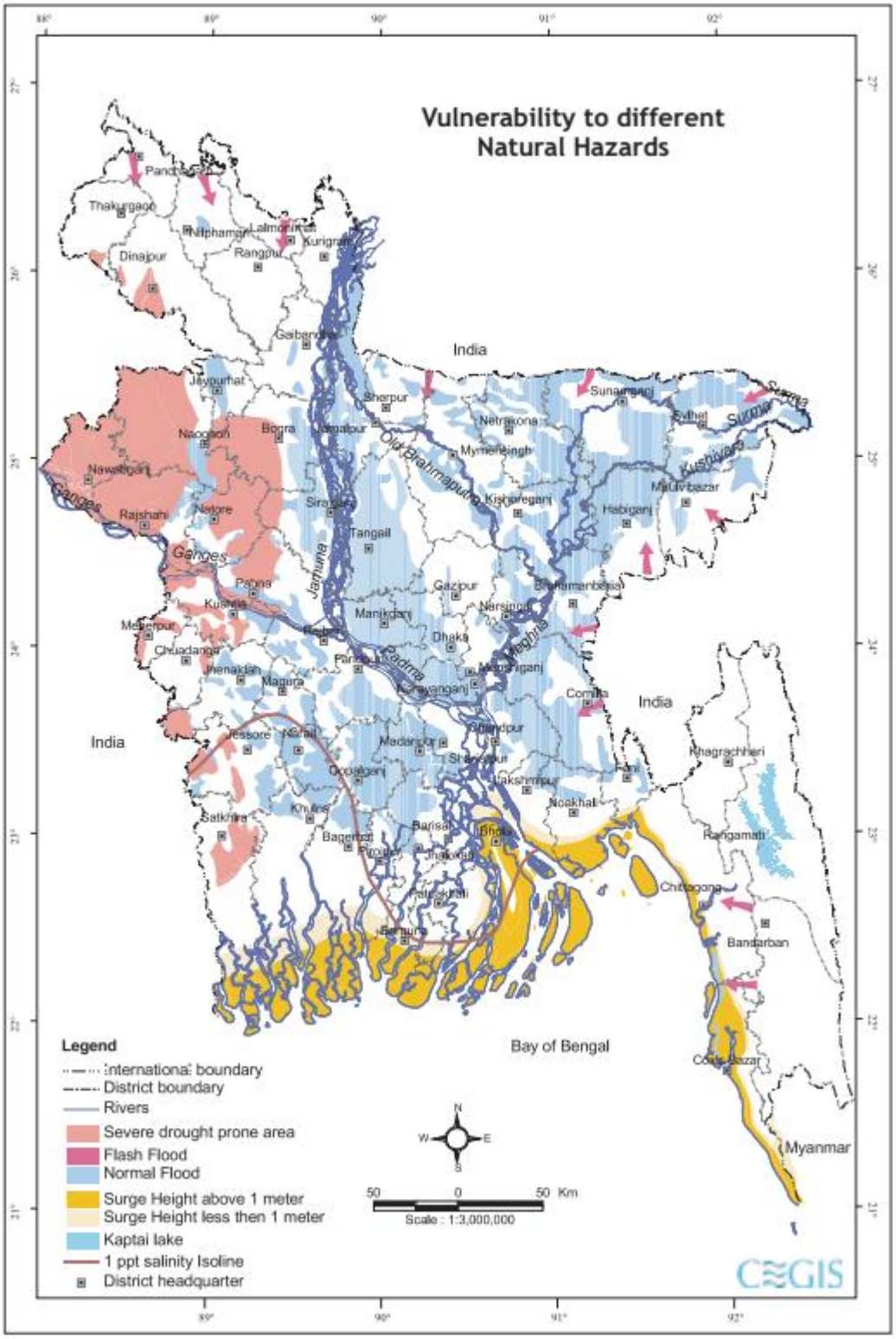
5.2. Demography

Household in each village	: 895
Village Population (Avg.)	: 3,750
Income Level	: $ 150 – 200 per month
Expense for Energy	: 20% of the income
Major Occupations	: Fishing, Farming & Day Laborer

5.3. Major Challenges:

As located in the coastal area Mathbaria Upazilla is a high-risk zone for any occurrence of natural disasters such as: cyclone, river erosion etc. Access to clean drinking water is also one of the major challenges for this area because of salinity intrusion.

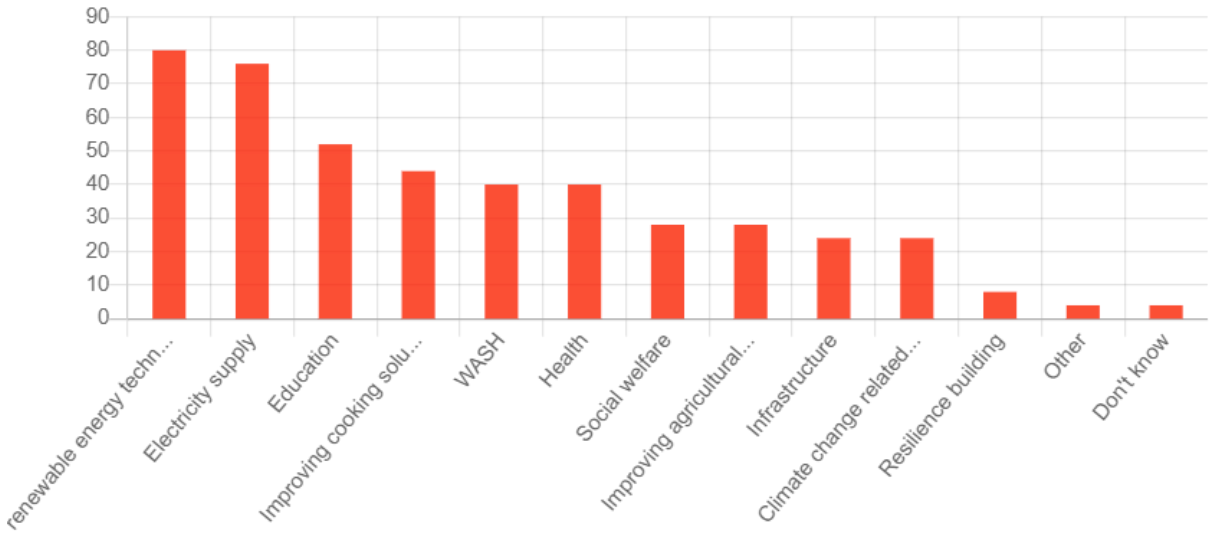




Source: CEGIS, Dhaka.

5.4. Existing projects, development activities:

Being a remote sub-district of the Pirojpur district, development activities of Mathbaria upazila focuses on renewable energy and electricity supply.



6. Feasibility Study

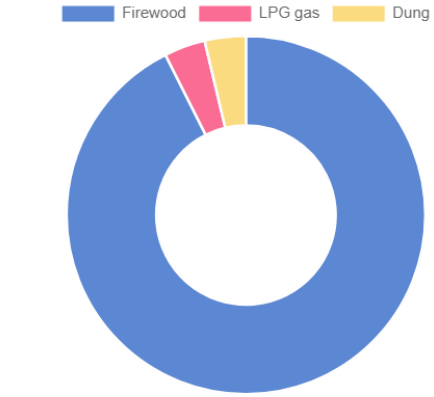
6.1. Current Scenario

A) Access to Energy

Cooking Solutions

❖ Improved cook Stove

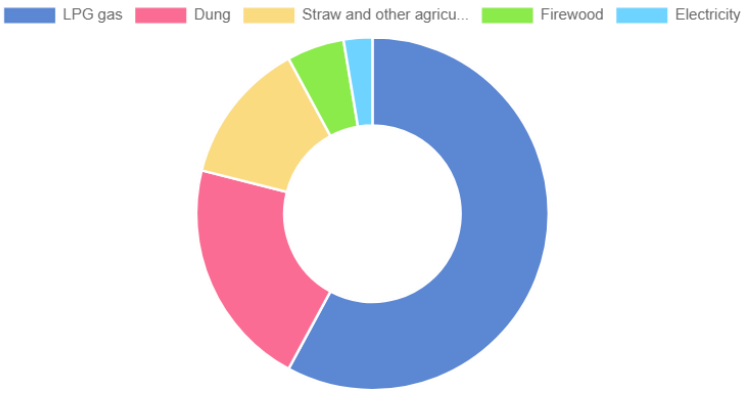
Primary source of fuel



Firewood	100%
LPG	4%
Dung	4%

Note: Respondents use more than one type of energy source for fuel.

Secondary source of fuel



LPG	**88%**
Dung	32%
Straw	20%
Firewood	8
Electricity	4

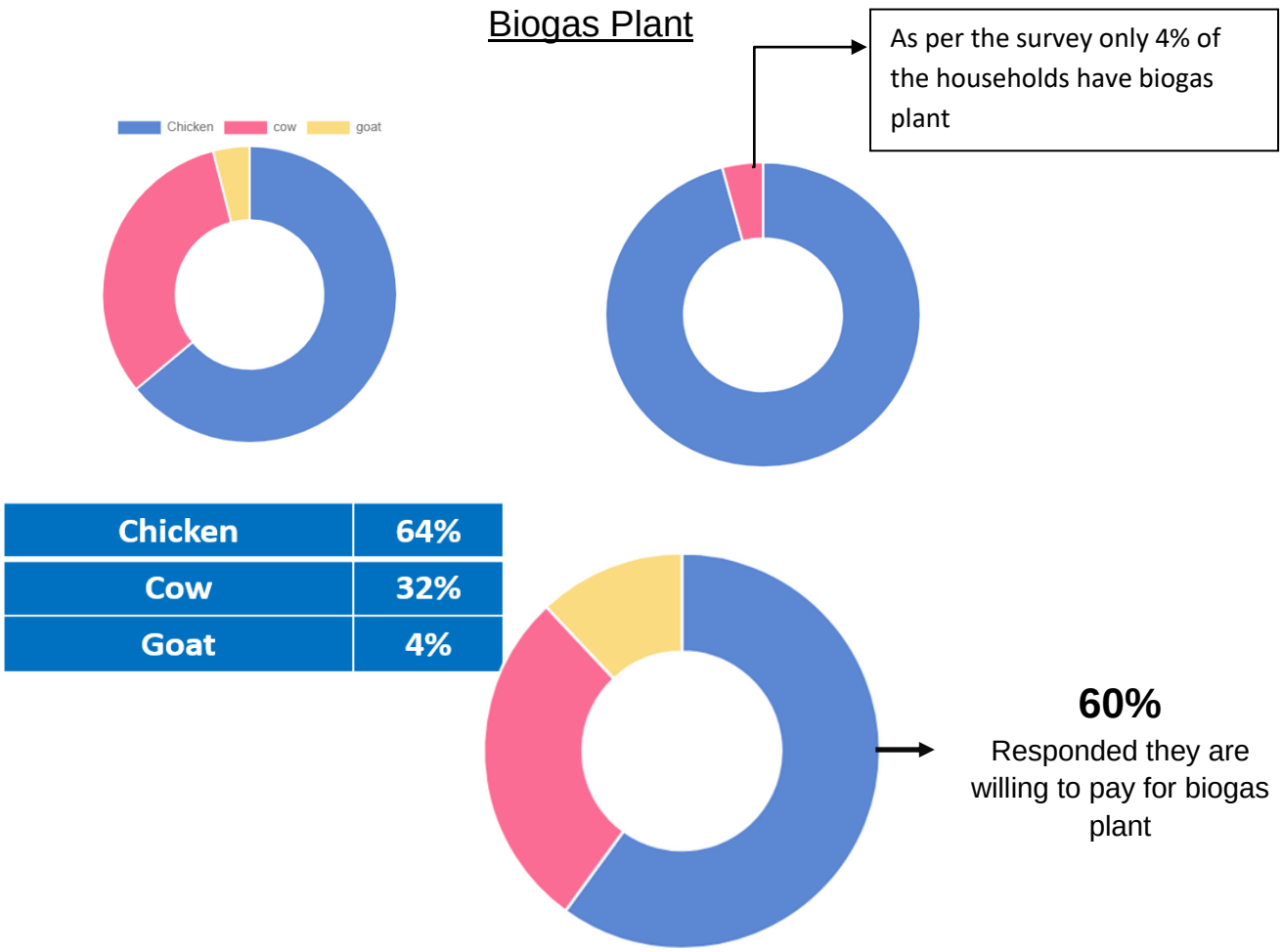
Key Findings

- 100% of the respondents opined that firewood is the primary source of cooking fuel.
- Majority uses dung and straw as secondary fuel sources.
- Currently LPG is gearing up fast and 68% of the respondent thinks LPG is a more suitable form of fuel.

- Only 4% of the households use an improved cook stove.
- During the survey 44% of the respondents said that they do not know anything about improved cook stove or where to get them.

Way forward

- Since 100% of the households use biomass as the primary source of fuel, ICS has tremendous potential for scale-up.
- Local communities are not properly aware of the effects of indoor air pollution (IAP) (only 40% reported illness due to IAP & 44% of them do not exactly know where to get ICS).
- Awareness building, grassroot level advocacy and capacity building efforts by local NGOs, Govt. organizations & infrastructure development for manufacturing and distribution of ICS are required for future scale up

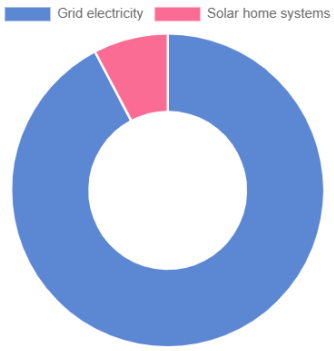


Findings & Way forward

- Villagers use tractors to ploughing crop field, Cattle is no more used
- Coastal region is frequently affected by natural disasters. Households don't keep cattle as they have to migrate very often due to natural disaster
- Local Government can play pivotal role encourage communities to keep more cattle (cow, buffalo etc)
- Resilience building of the coastal communities is mandatory to prevent climate induced migration. Reduced migration will motivate cattle to be kept.

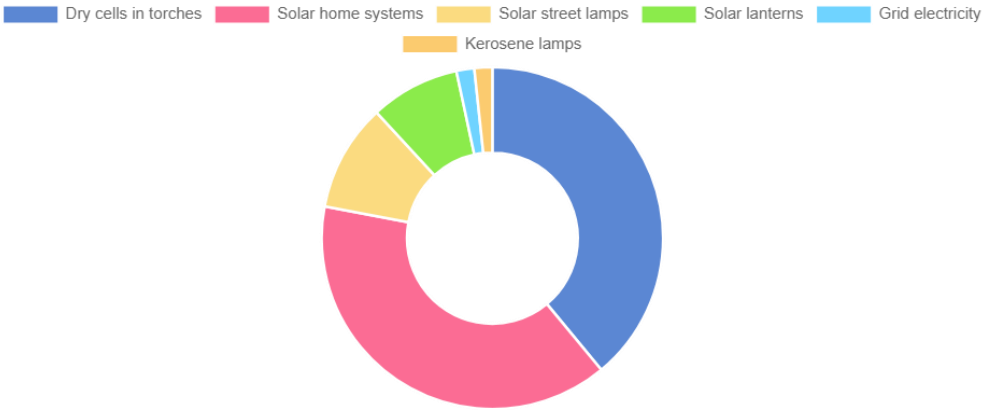
Electricity

Primary source of electricity



96 % of the respondents said that they have access to grid electricity.

Secondary source of electricity



Dry cells in torches	**92%**
Solar home systems	92%
Solar street lamps	20%
Solar lanterns	20%
Grid electricity	4%
Kerosene lamps	4%

Key findings:

- **96%** of the respondents use Utility Grid as their primary source of electricity. Despite having access to utility grid,
- **92%** of the respondents still use the Solar Home System as their secondary source of electricity.
- Households use the solar home system, mostly as a back-up solution.

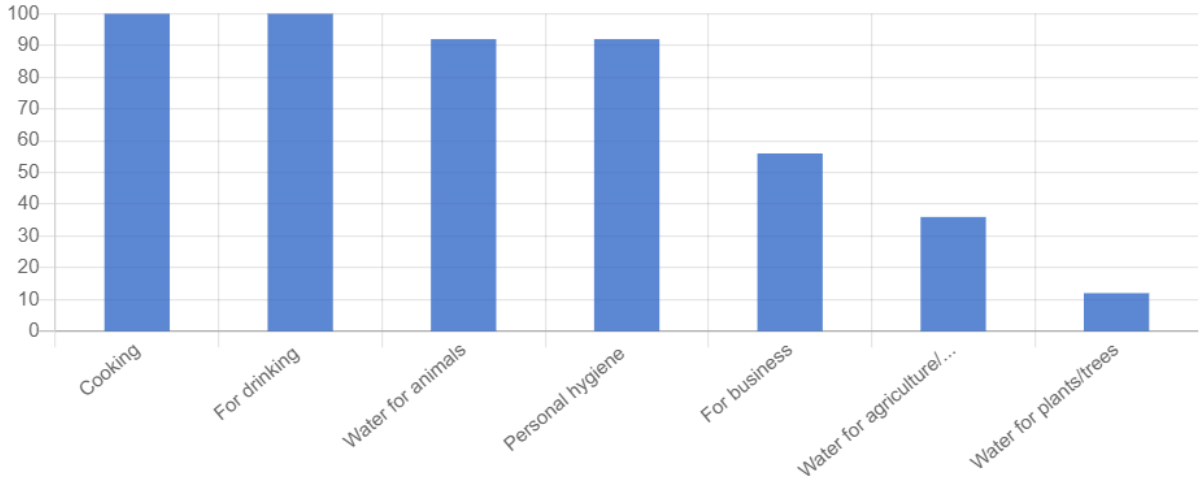
Way forward:

- In Bangladesh, access to electricity has reached **92%**
- Overlapping of national utility grid and Solar Home System (SHS) is taking place
- Households have spent **USD 150-250** for and now they **USD 3-6** per month for grid electricity
- To sustain the existing SHS, DC appliances need to be pushed and also peer-to-peer solar electricity can be a solution.

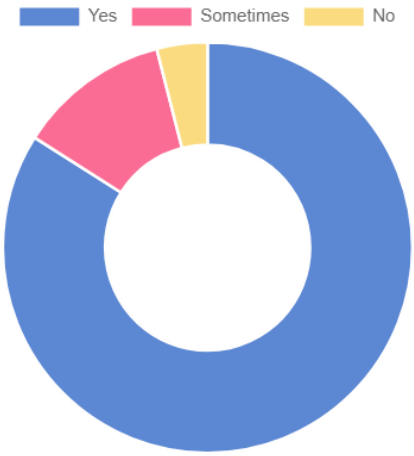
Access to Water

Water usage pattern

Most of the dwellers of the area mainly use water for cooking and drinking.



Lack of drinking water



90% respondent opined scarcity of clean drinking water due to salinity.

Key Findings:

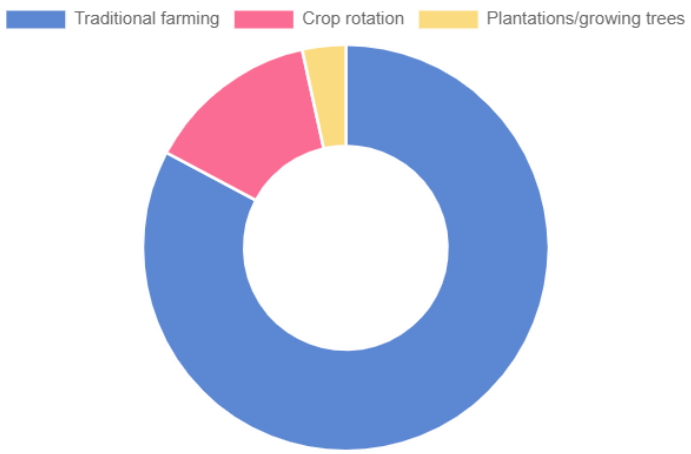
- 88% of the population have to treat (mostly by using chemical, boiling & filtration) water before use.
- 96% have faced illness due to water borne diseases.
- 32% of the population pay for clean water.
- 4% of the households in the area have rainwater harvesting systems.
- 68% of the respondents are willing to pay for rain water harvesting.
- 12% of the respondents think additional income/savings is possible if water harvesting unit is installed

Way forward:

- Access to clean water is the major problem, faced by the coastal communities.
- Limited usage of the rain water harvesting system has been found. However indigenous technology can partially fulfill the requirement of water.
- New technologies need to be incorporated to facilitate clean water in the coastal communities.
- Proven new technologies can be scaled up through engaging local government.

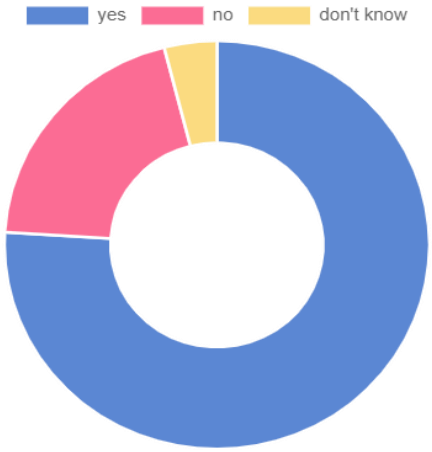
Agriculture

Farming practices:



In Mathbaria sub-district, most farmers still do traditional farming and some of them also use crop rotation techniques to better utilize their land.

Change in the soil quality:



More than **90%** of the respondents said that the quality of the soil of Mathbaria Upazilla lost its previous fertile characteristic due to salinity intrusion.

Key Findings:

- 80% of the population of Mathbaria sub-district are farmers.
- Main crops of the area are: rice, pulse and betel.
- Farmers in the area have bad experience with soybean cultivation, due to limited market linkage.
- 96% of the respondents said they use chemical pesticides in their field.
- 96% respondents said there are no markets for organic products.
- 50% of the households in the area have kitchen gardens.
- 92% respondents said they use chemical fertilizers.
- Only 4% of the farmers use organic fertilizers.

Way forward:

- Salinity intrusion is threatening local crop cultivation, endangering food security and economic growth.
- Practice of or chemical fertilizer/pesticides is significantly high.
- Awareness building and infrastructure development to encourage organic farming can be done.

- Advance farming technologies, which are suitable for coastal areas (For instance: vertical gardening, Aquaponics, stress tolerant crop, floating garden etc) can be tested and incorporated in EVD baskets.
    a. Kitchen gardening
    b. Organic farming

6.2. Feasibility Study Summary

EVD Solution	Technical	Economical	Cultural
Solar Home System (SHS)	Solar Energy is an abundant source of energy and SHS is technically very feasible	The cost of the solar energy system has reduced drastically. However solar is still costly compared to utility grid. However through more efficient use of SHS, it can be made feasible	Households are comfortable to use SHS. Opposed to kerosene lamps, they are happier with this better alternative. (No smoke, brighter light, use of mobile charge, TV, radio etc)
Improved Cook Stove (ICS) with chimney	Being an agrarian country, Bangladesh has sources of biomass. There are different established designs of ICS that ensure proper IAP reduction, less smoke, less fuel consumption etc.	ICS is a low cost solution and also there is national program to support capital buy down	ICS causes behavioral changes to some extent compared to traditional mud stoves or /3 stones. Women use less time to collect firewood, and to cook.
Biogas plant	Technically, biogas plants are a proven technology and Bangladesh has installed more than 80,000 units of biogas plants. Lifetime of the plants are high	Biogas plants are comparatively expensive. However use of biogas plants significantly reduces households expense for energy. Also there is national program to	In the coastal region, seasonal migration occurs due to natural disasters like cyclones, floods etc. For due to this households usually do not tend to keep cattle and for this reason

		support capital buy down	they are not much willing to implement biogas
Rain Water Harvesting System (RWHS)	Household shed are suitable for installing RWHS	Major cost of installing RWHS is the water tank and the piping.	In spite of the shortage of clean water in the coastal belt, households are more inclined to fetch water from unhygienic water ponds. RWHS are rarely used.
Organic farming	Due to limited practice of cattle keeping, organic fertilizer like cow dung are not much abundant in the coastal belt.	Organic farming is costlier than conventional farming. To generate revenue from organic farming, value chain infrastructure needs to be developed	Farmers are more used to inorganic farming.

EVD Solution/Technology		**Remarks**
Solar Home System	Moderately Feasible	Solar Home System is technically feasible Bangladesh receives abundant sunshine (solar irradiation 4.5 hours), there is already a developed infrastructure and also the cost of SHS installation has drastically decreased in recent times. However, like most of the areas in the coastal regions also there is national electricity grid coverage of the national utility grid and its expanding gradually in the off-grids areas. Households use SHS as a back-up solution during emergencies.
Solar Street Light	Feasible	As our study area was coastal belt, it is more prone to natural disasters like- cyclone, flood

		etc. These disasters interrupted the power supply of the main utility grid. Solar Street Light has technical feasibility as this can be helpful for emergency power supply. It will be a good backup option in important areas of a village (eg. village market) as a decentralized power supply source to lighten the village streets.
Biogas	Not Feasible	Due to natural disasters, seasonal migration rate is high in the coastal areas. In such times people take shelters to save their life. For this reason, they tend to not own many domestic animals as it will be difficult to maintain. Lack of domestic animals makes biogas technically unsuitable for the area as its main feed comes from the animals.. As a low-income area, people are reluctant to invest in biogas, making it economically not viable.
Improved Cook Stoves (ICS)	Moderately Feasible	The improved cook stove has moderate demand in the area. It is a very low cost solution with greater impact. However, there is no developed infrastructure and even if people are willing to purchase ICS, there is no manufacturer or distributor in the coastal area. Through local and national level advocacy with decision makers, capacity building of the local industry, ICS can be introduced in these areas.
Rain Water Harvesting (RWH)	Moderately Feasible	Rain water harvesting is technically feasible as the coastal area experiences enough rain to harvest. But Financially it is not feasible because installing the water tank and the piping for RWH is expensive. With funding support it can be popularized
Organic Farming/Fertilizer	Moderately Feasible	Organic farming is not financially feasible as it is more expensive than conventional farming. As organic farming/fertilizer uses animal dung as raw materials, the absence of enough domestic animals in the area makes it a bit challenging. Despite these, to avoid the salinity issue, growing vegetables in home gardens can be a low-cost solution for organic farming. Training, capacity building and market linkage is required for further development.

7. National Policy review and National Priority

National policies of Bangladesh that support the development of Renewable energy are as follows:

a) Renewable Energy Policy of Bangladesh, 2008

Renewable Energy Policy of Bangladesh, (2008) is a set of policies and programs set by the Bangladesh Government to reach national renewables goals. It was released by the Ministry of Power, Energy, and Mineral Resources with eleven objectives.

This policy has been formed to harness the potential of renewable energy resources and dissemination of renewable energy technologies in rural, peri-urban and urban areas as well as to enable, encourage and facilitate both public and private sector investment in renewable energy projects. The policy also concentrates on scaling up contributions of renewable energy to electricity production and to heat energy. To promote appropriate, efficient and environment friendly use of renewable energy the Renewable Energy Policy of Bangladesh, 2008, also focuses on training facilitate the use of renewable energy at every level of energy usage, enabling environment and legal support to encourage the use of renewable energy, promoting development of local technology in the field of renewable energy, CDM; and achieving the targets for developing renewable energy resources to meet five percent of the total power demand by 2015 and ten percent by 2020.

b) Guidelines for Remote Area Power Supply System (RAPSS), 2008

The Remote Area Power Supply Systems (RAPSS) guideline allows for private sector participation in development, operation, and maintenance of electricity generation systems and distribution networks in remote rural areas, including isolated islands, to supplement the Government of Bangladesh's effort to achieve universal access by 2020. This policy offers connection fee subsidy for increased customer penetration (with connected load less than 300 Watt) for a maximum period of seven years and additional subsidized loan to achieve competitive tariff to the investors in the distributed renewable mini-grids.

c) Energy Efficiency and Conservation Master Plan (EECMP) up to 2030

The EECMP is a supreme plan of Bangladesh's initiative on energy efficiency and conservation. Under the EECMP, all the policies, programs, legal documents (Act, Rules, Regulations, Circulars or Standards etc.) and frameworks isto be established. EE&C implementation is a multi-sectoral issue and will be done by the participation of all the parties including the people, private/public establishments and other organizations in the country. The EE&C activities are related to each other. Some organizations have roles and responsibilities

of support and enforcement of rules, and/or EE&C awareness and dissemination. This master plan is mainly focusing on promoting energy efficiency (EE) in the industrial sector, EE Labeling Program in residential sector and EE Building Program in buildings.

The National Plan of Bangladesh that support the Improved Cook Stoves (ICS) is as follows:

a) Country Action Plan for Clean Cookstoves

Bangladesh Country Action Plan for Clean Cookstoves (CAP) defines what is needed to kick-start and develop the Bangladesh clean cookstove market. The CAP makes the case for taking immediate action towards achieving the goal of 100% clean cooking solutions by 2030. The target of this CAP is to disseminate cookstoves to over 30 million households in Bangladesh by 2030: current market penetration represents just 3% of the target potential, indicating the scale of the challenge and the critical need for a more coordinated, innovative and integrated approach. An approved national action plan is a key step to strengthen overall planning (avoid duplication), coordination (share best practices) and collaboration (increase synergies and capitalize on economies of scale) amongst relevant sector actors with the ultimate goal to create a sustainable market and to scale up current interventions.

The National Plan of Bangladesh that support the resilience building is as follows:

a) National Plan for Disaster Management (NPDM), (2016-2020)

NPDM in 2016-2020 is the Government of Bangladesh's 'white paper' document for the management of disasters and associated events. The plan abides by the institutional and policy regimes of disaster management in the country. Recognizing the country's vulnerability to different hazards, NPDM 2016-2020 embodies both rapid and slow onset disasters that strike various parts of Bangladesh. It also includes recurrent, anticipated and climate induced disasters.

In the National Plan for Disaster Management (NPDM) 3rd priority is to Invest in disaster risk reduction for resilience. To allocate the necessary resources, including finance and logistics, as appropriate, at all levels of administration for the development and the implementation of disaster risk reduction strategies, policies, plans, laws and regulations in all relevant sectors is covered under this priority.

The National Plan & Act of Bangladesh that supports the Environment & Climate Protection are as follows.

a) Bangladesh Environment Conservation Act, 1995.

This Act was passed in 1995 for the conservation, improvement of environmental standards and control through mitigation of the pollution in the environment in Bangladesh. Later on, this Act has been amended several times. This Act is closely related to the Department of Environment on areas of pollution, environment, environmental pollutants,

environment conservation, ecosystems, hazardous material, and wastage. The Act contains other important rules such as the rule of assessment of the environmental impact, issuance of necessary clearance certificates, provision of rigorous penalty for those violating the Act and the making the process of implementation easier in the application of the Act. The environmental law plays a crucial role in promoting environmental protection through the sustainable use of natural resources, prevention of pollution and integration of environment and development. It provides an important framework for regulating social behavior and transforming sustainable development policies into enforceable norms. The environmental law assists governments in adhering to international regimes and building national capabilities to address major global, regional and national environmental issues and problems in the context of sustainable development in Bangladesh.

b) <u>Bangladesh Climate Change Strategy and Action Plan (BCCSAP)</u>

The Bangladesh Climate Change Strategy and Action Plan (BCCSAP) is a knowledge strategy built upon the National Adaptation Programme of Action (2005). It sets out 44 programmes to be taken by Bangladesh over the short, medium and long term within six strategic areas – food security, social protection and health; comprehensive disaster management; infrastructure; research and knowledge management; mitigation and low carbon development; and capacity building and institutional strengthening.

National Policy of Bangladesh that support village development is as follows:

a) <u>National Rural Development Policy (NRDP)</u>

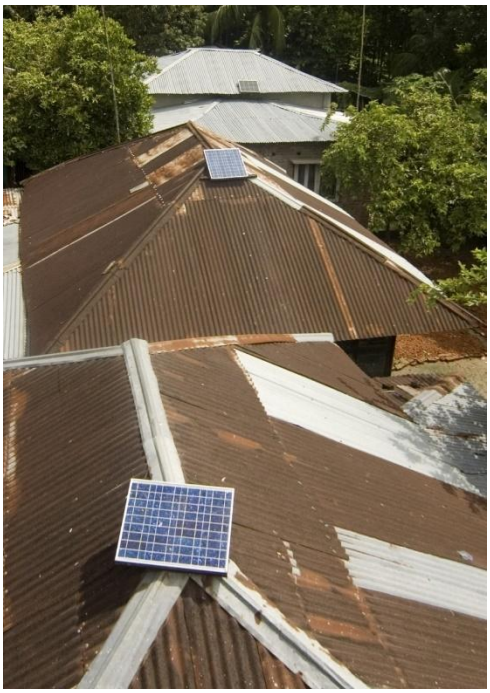
The National Rural Development Policy (NRDP) is formulated to meet the constitutional obligations to develop human resources and bring about positive changes in the standard of living of the people who live in the rural areas of Bangladesh and are dependent on the natural resources therein. The NRDP is intended to provide a set of governing principles for guiding all rural development activities. Rural Development aims at improving the quality of life of rural people, achieving economic prosperity including generation of employment, attaining comprehensive development of the villages and progressively removing the disparity in the standards of living of rural and urban areas through fulfilling the commitments made in the constitution for all citizens irrespective of men and women as well as enabling people to become the driving force of their own development. The primary focus of NRDP is to promote human development. Human development involves increasing human capacity as well as improving human conditions. Human capacity and productivity can be increased by instilling positive outlook and teaching new skills through.

training and at the same time by empowerment of the people. Improving human conditions involves not only adequate income, but also an improvement in the quality of life through access to education, health care, safe drinking water, good sanitation, family planning services, safe and healthy environment etc. Human development is reflected in the enhanced status of individuals both in the family and in the society.

8. National programs

a) Solar Home System (SHS)

The SHS program was launched in 2004 to ensure access to clean electricity for the energy starved off-grid rural areas of Bangladesh. The program supplements the Government's vision of ensuring 'Access to Electricity for All' by 2021. More than 4.5 million SHSs have already been installed under the Infrastructure Development Company Limited (IDCOL) program in the off-grid rural areas of Bangladesh and about 13 million beneficiaries are getting solar electricity. The program has been acclaimed as one of the largest and the fastest growing off-grid renewable energy programs in the world.



b) Improve Cook Stove (ICS) Program

The ICS program was developed by Bangladesh's Infrastructure Development Company Limited (IDCOL) in partnership with the World Bank to mobilize a network of local entrepreneurs, partners and financing that led to the success of the program. The program brings together financing from International Development Association (IDA) and Green Climate Fund (GCF) in Phase II of the program to scale it up. The Improved Cook Stoves (ICS) program in Bangladesh has helped install more than 1.6 million cleaner and more efficient cookstoves in homes around the country, leading to significant health benefits for women and children by helping reduce indoor air pollution drastically. The cookstoves have

also helped families spend less on fuel (like firewood and dung), and have led to women spending less time in the kitchen.

c) Biogas

Infrastructure Development Company Limited (IDCOL) started a biogas program in Bangladesh in 2006 with support from the World Bank, KfW Development Bank and SNV Netherlands Development Organization. Biogas plants not only provide gas for cooking purposes but also produce organic fertilizer for the crops and fish pond. The program helps reduce the use of biomass fuel for cooking. Till December 2019, IDCOL has financed construction of over 53,200 biogas plants all over the country through its 38 partner organizations.

d) Solar Irrigation

Being a country located in the tropical delta, irrigation plays a vital role in Bangladesh's agriculture and accounts for about 43 percent of the cost for cultivation. The solar irrigation system holds huge potential in Bangladesh and can provide sustainable solutions without requiring any fuel, reduce carbon emission and save millions in foreign currency.

Infrastructure Development Company Limited (IDCOL) initiated a pilot project in 2013 with a target to install 1,500 solar irrigation pumps by 2018. Later, identifying the prospects of solar irrigation pumps and its acceptance among farmers, the goal was revised to 50,000 by 2025 which will replace around a quarter million diesel-run pumps. The program intends to provide irrigation facilities to rural off-grid areas. Given the immense potential, the program aims to install solar PV-based irrigation systems in areas where there are possibilities to produce three types of crops throughout the year, all the while staying safe from flooding, arsenic contamination and saline water.

Up to October 2019, IDCOL has approved 1,630 solar irrigation pumps of which 1,323 are already in operation with a cumulative capacity of about 32 MWp. The remaining pumps are expected to come into operation shortly. The World Bank, KfW, GPOBA, JICA, USAID, ADB and BCCRF are supporting this initiative.

Solar Mini-Grid

The Bangladesh Government has initiated different programs and has given enormous efforts to bring mobility in the rural economy. One of the initiatives is solar mini-grid in the off-grid areas. Providing access to electricity in remote areas is a challenge, since the grid cannot be expanded to reach them. The government in 2007 published a Guideline for Remote Area Power Supply System (RAPSS) to facilitate electricity access to un-served areas. So far, IDCOL financed installation of 26 solar mini-grids with cumulative generation capacity of 5 MW. The mini-grid projects have successfully created access to low-emission electricity for approximately 16,000 beneficiaries in rural Bangladesh. They are also contributing an estimated CO2 reduction of 29,300 tons during the project lifetime.

The World Bank, KfW, GPOBA, JICA, USAID, ADB and DFID are financially supporting IDCOL's Solar Mini Grid Project.

9. Finance

IDCOL'S Renewable Energy Financing Scheme and Programs:

To diversify the renewable energy (RE) installations in areas like biogas- and biomass- based power and energy generation, solar micro and mini-grid, solar irrigation and other types of commercial scale RE projects, IDCOL introduced several re-financing schemes and concerted programs. The lending terms of all these different schemes are as follows:

a) Solar Home System (SHS) Program:

Under IDCOL SHS Program, IDCOL does not provide any loan directly to the end users. All loans are being channeled through the Participating Organizations (POs) as per the following terms:

Particulars	Term Details	
Loan Amount	Up to BDT 250 M	80% of POs loans to households

	> BDT 250 M	70% of the POs loans to households
Tenure including Grace	Up to BDT 250 M	Up to 7 years
	> BDT 250 M &<= BDT 500 M	Up to 6 years
	> BDT 500 M &<= BDT 100 M	Up to 6 years
	> BDT 1000 M	Up to 5 years
Interest Rate	Up to BDT 250 M	6% p.a.
	> BDT 250 M and<= BDT 500 M	7% p.a.
	> BDT 500 M and<= BDT 100 M <= BDT 100 M	8% p.a.
	> BDT 1000 M	9% p.a.

Source: SREDA

b) Domestic Biogas Program:

Same as SHS, under the Domestic Biogas Program, IDCOL channel out all loans through the Participating Organizations (POs) to the end users as per the following terms:

The lending terms for Domestic Biogas Program are as follows:

Particulars	**Term Details**
Loan amount	80% of the POs loans to the households
Tenure and Grace	7 years including 1-year grace period

Interest Rate	6% p.a.

Source: SREDA

c) Solar Irrigation Projects:

The lending terms for the solar irrigation projects are as follows:

Particulars	**Term Details**
Loan amount	Up to 50% of the Project Cost
Tenure and Grace	8 years including up to 1 Year grace period
Interest Rate	6.00% p.a.

Source: SREDA

d) Solar Mini / Micro Grid Projects:

The lending terms for the solar mini and micro grid projects will be as follows:

Particulars	**Term Details**
Loan amount	Up to 40% of the Project Cost
Tenure and Grace	10 years including up to 2 years grace period
Interest Rate	6% p.a.

Source: SREDA

e) Biogas-based Power Projects

The lending terms for the biogas-based power projects are as follows:

Particulars	**Term Details**
Loan amount	Up to 80% of the Project Cost
Tenure and Grace	Up to 8 years including up to 1-year grace period
Interest Rate	6% ~ 9% p.a.

Source: SREDA

f) Biomass-based Power Projects

The lending terms for the biomass-based power projects will be as follows:

Particulars	Term Details
Loan amount	60% of the Project Cost
Tenure and Grace	8 years including 1-year grace period
Interest Rate	6% p.a.

Source: SREDA

g) Other Renewable Energy Projects

The lending terms for other solar/wind/hydro/other renewable energy projects i.e. solar diesel hybrid solution for telecom BTSs, solar-powered transportation, rooftop solar system, solar cold storage and dryers, battery charging stations, community biogas projects etc. will be as follows

Particulars	Term Details
Loan amount	Up to 80% of the Project Cost
Tenure and Grace	Up to 10 years including up to 2 years grace period
Interest Rate	6%~10%p.a.

Source: SREDA

However, large grid-tied renewable energy IPP projects will be financed on commercial terms and may also be eligible for a USD loan.

Bangladesh Bank Refinancing Scheme

The central bank launched the BDT 2 billion green banking refinance scheme in August 2009 to set up solar panels, bio-gas plants and industrial ETP (effluent treatment plant) under the scheme in order to help reduce industrial pollution and increase power supply. Under the scheme -

- Bangladesh Bank is providing loans to commercial banks at interest rates from 5% to 12% for direct refinancing
- Bangladesh Bank is also providing wholesale credit to the entrepreneurs, who will then have access to commercial bank loans in those sectors at a maximum interest rate of a further 5%.
- Overall interest rates will not exceed 12%, according to the fund's conditions.
- A maximum of 100% refinance facilities will be provided to the banks against their finance in setting up those plants in rural and urban areas and effluent treatment plants for industries.
- The banks will be allowed to provide loans in rural areas worth up to BDT 175,000 to install home solar panels and BDT 150,000 for setting up solar mini grids.
- For biogas power plants, loans from BDT 50,000 up to BDT 2.5m can be allocated for coordinated cattle farming under the scheme.

The scheme was undertaken in line with the government's plan to meet 5% of the total demand for electricity from green energy by 2015 and 10% by 2020. So far,

- Bangladesh Bank (Central Bank) has included 26 new products under its revolving refinance scheme for solar energy, biogas and effluent treatment plants to give loans at low interest.
- The central bank has brought 47 green products under its refinance scheme where 23 are green energy products.

They have set annual targets for banks and financial institutions for direct financing which is mandatory from January 2015.

Area of the Scheme:

Location: The urban and rural areas of Bangladesh.

Focus & Specification: Main focus is on “Households and Business Enterprise” to set Solar Energy Panel, Solar Photovoltaic Plant, Bio-gas Plant and Effluent Treatment Plant etc.

Sectors: The scheme is allowed for three different sectors

a) Solar Energy

b) Bio-gas

c) Effluent Treatment Plant.

a) Solar Energy

If an individual sets a solar panel in his/her individual/joint apartments, business enterprise, cooperative societies or for familial purpose to generate electricity by taking the finance from banks in urban/rural areas, he/she will be able to get re-finance from this scheme.

The following sub-sectors are granted under this scheme:

- Solar Home System
- Solar Mini Grid
- Solar Irrigation Pumping System
- Solar Photovoltaic Assembly Plant

The Capacity of a Solar System: It ranges from 10Wp to 50KWp.

Loan Ranges: Loan ranges from 10,000-6, 00, 00,000 taka.

The Eligible entities:

- Single/Joint Family,
- Business Enterprise,
- Cooperative Societies

Interest Rate for Loan Holder:

- If Banks/Financial institutions provide loans directly to the consumers, the interest rate ranges from 8%-9%.
- If Banks/Financial institutions provide MFI linkage, interest rate will range from 11-12%.

Loan Payment Period & Interest Calculation:

- Loan payment time ranges from 4 years to 10 years highest. Interest must be calculated in reducing the balance method.

Re-financial Loan Payment Period:

- Re-financial loan payment period ranges from 6 months lowest to 10 years highest.

Debt-Equity Ratio:

- It will be based on the banker-customer relationship.

b) Bio-Gas:

If loan is taken from banks to produce and use biogas in rural and urban areas, then the re-financial scheme will be applicable in this regard.

The following sub-sectors will be granted under this scheme:

- To Set Bio-gas Plant in Existing Cattle/Poultry Firm
- Combined Cattle Rearing & To Set Bio-gas Plant
- To Produce Organic Fertilizer from Slurry
- To Set Medium Bio-gas Plant

Loan Range:

Loan ranges from 25,000-25, 00,000 taka.

The eligible entities:

Single/Joint Family/ Enterprise are eligible to get loans.

Debt-Equity Ratio:

It will be based on the banker-customer relationship.

Interest Rate for Loan Holder:

- If Banks/Financial institutions provide loans directly to the consumer, the interest rate is to be 9%.
- If Banks/Financial institutions provide MFI linkage, the interest rate is to be 11%.

Loan Payment Period & Interest Calculation:

Loan payment time ranges from 3 months lowest to 5 years highest. Interest must be calculated in reducing the balance method.

Re-financial Loan Payment Period:

Re-financial loan payment period ranges from 6 months lowest to 5 years highest.

10. Vulnerability in the Coastal region

Bangladesh, due to its geographic location, is highly exposed to different climatic hazards and natural disasters. Environmental vulnerability coupled with poor infrastructural and socio-economic factors in the coastal belt of the country, further reduces the capacity of local communities to tackle the impacts of climatic shocks and stresses. The south-west coastal region has already been diagnosed with increasing effects of different slow onset stressors such as rising temperatures, salinity intrusion and sudden climatic shocks such as cyclones, floods, storm surge etc.

If the present environmental and socio-political situations persist, livelihood and water security of local communities are likely to substantially deteriorate, further worsening their state of wellbeing. To help build resilience of these communities, there is a need to look deeper into the current absorptive and adaptive capacity of vulnerable communities in the study area - by exploring in detail, different indicators such as knowledge base, asset base, infrastructure availability, natural resource base, access to healthcare, social capital, governance structures etc.

Eventually to make the coastal resilience, two fold approach can be taken:

(1) introduction of such technologies that would substantially reduce the risk of climate vulnerability. For example, through the introduction of floating garden or cage fishing,

communities can produce food even during disaster, introduction of raised tube-well can ensure clean drinking water during flood.

(2) Economic vulnerabilities caused by climatic factors and non-climatic factors which directly affect livelihood need to be addressed. Climate smart agriculture or farming can be possible suitable options. Also alternative income generation though clean technology can be assessed.

11. Recommendation

In the coastal region of Bangladesh, due to the low adaptive capacity, dense population, flat topography and exposure to various natural disasters such as cyclones, storm surges, sea level rise, tidal floods, bank erosion etc life has always been challenging. In addition to these existing vulnerabilities, climate change brings a detrimental impact on socio-economic performance, health, and livelihood of the coastal population. The main challenge in the coastal region is clean water scarcity. Poor water quality contributed significantly to direct and indirect health impacts related to water born, vector-borne diseases and water related diseases, which reduces the health security and livelihood. Through the EVD concept, we can introduce such low-cost and efficient and effective technologies or solutions that will address the water crisis. Previously, many technologies like Pond Sand Filter (PSF) were in many coastal

areas. Unfortunately, they did not sustain. Lessons learned from those technologies can be taken into consideration.

Though the electricity grid has reached most of the villages in Mathbaria, communities still use Solar Home Systems as a back-up solution as during natural disasters power connection goes off, and households need to rely on SHS. However, to make SHS competitive with the nation grid, more productive application of SHS needs to be introduced. Also, prospects of peer-to-peer electricity trading and creating nano-grids with existing SHSs can be introduced.

Biogas and improved cookstoves (ICS) can be promising solutions as they have multifarious impacts ranging from GHG emission reduction, improvement in health, cost saving, less environmental pollution, environmental conservation. However, to popularize biogas and ICS, support from local governmental institutes would be required.

Capacity building of local organizations can be impactful for further development of different clean solutions in the coastal belt.
Aligning the concept of EVD with the government's agenda can create synergy and reach greater improving impacts.

12. Conclusion

Bangladesh has been highly disaster-prone throughout its existence, which has been shaped by the impacts of natural hazards. The disaster risk context, however, is increasing.. Bangladesh is one of the countries in the world, which is the most at risk from the negative impacts of global climate change including increases in incidences and intensity of extreme weather events and hazards.

These emerging risks present major challenges to the continued human development, poverty reduction and economic growth of the country, and to the lives, livelihoods and health of its people. The poorest, most marginalized and vulnerable communities are hardest hit by disasters in Bangladesh as they are repeatedly exposed to natural hazards without the means to recover well.

Despite these challenges, Bangladesh has made major gains in improving socioeconomic conditions in recent years with positive economic trends, accelerating growth, making growth pro-poor and improving the indicators of social progress.

The feasibility study assesses the prospects of different eco-village development (EVD) solutions in the Mathbaria, Pirojpur, which are in the coastal belt of Bangladesh. Through this detailed study, we have found some of the technologies that are promising solutions for this region considering technical, economical and cultural aspects. Some of the technologies need a proper environment and infrastructure to grow. Based on the context of the coastal area, new EVD technology can be introduced. EVD concept has been a proven tool for climate change adaptation and mitigation. Now the horizon of EVD needs to be further expanded to address the challenges in the climate vulnerable coastal region.

13. Annex

(survey Questionnaire)