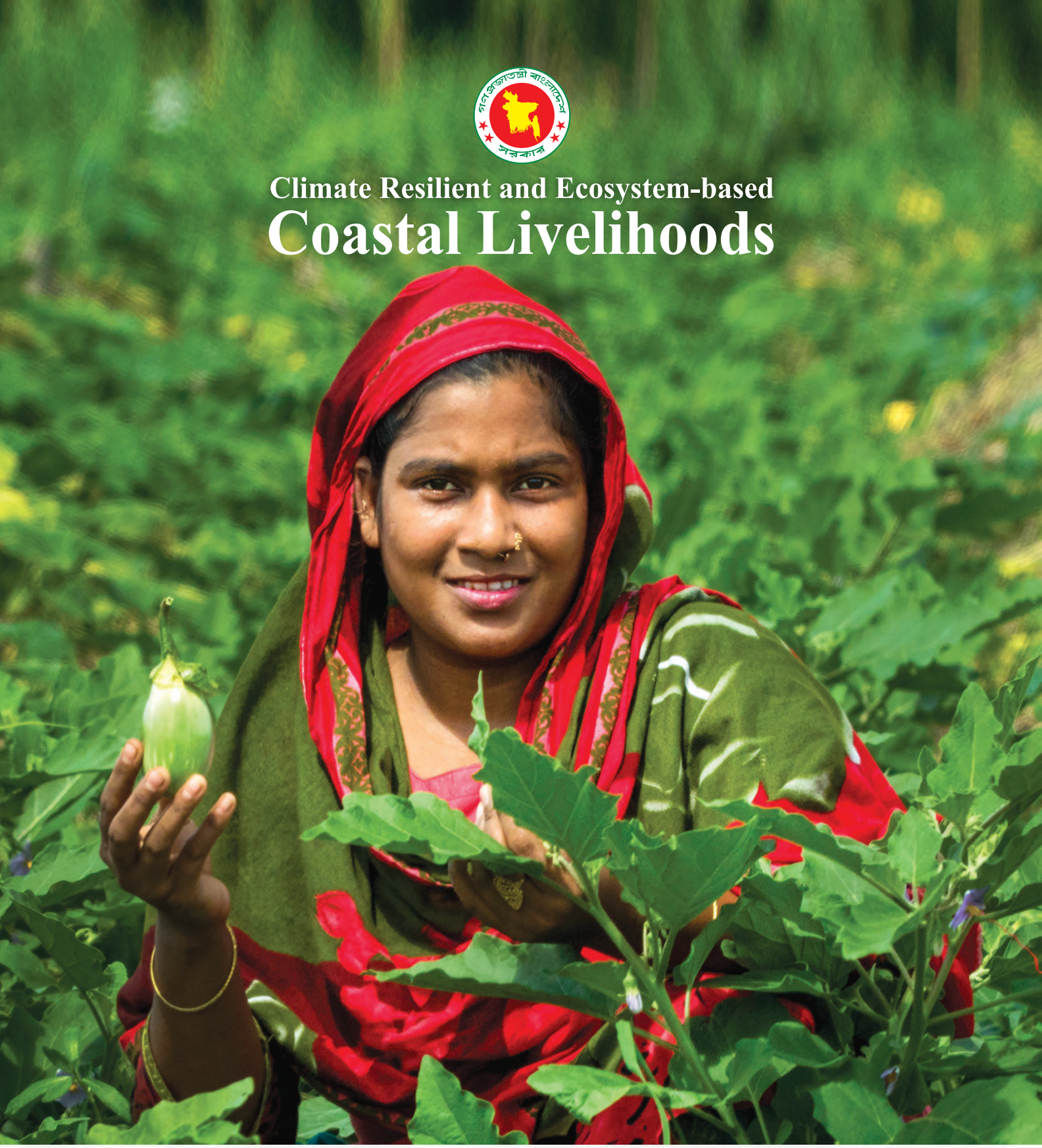

Climate Resilient and Ecosystem-based
Coastal Livelihoods

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UNDP

Integrating Community-based Adaptation into Afforestation and Reforestation (ICBAAR) Programme

Bangladesh Forest Department

Ministry of Environment, Forest and Climate Change

‘FOREST- FRUIT- FISH AND VEGETABLE (3FV)’ MODEL DISPLAY AT GCA SUMMIT

Honorable Prime Minister of the People’s Republic of Bangladesh **Sheikh Hasina,** former Secretary General of the United Nations **Ban Ki Moon,** Marshal Islands President **Dr Hilda Heine,** and former Chief Executive Officer (CEO) of World Bank **Dr Kristalina Georgieva** observing the **‘Forest-Fruit-Fish and Vegetable (3FV)’** Model presented at the Global Commission on Adaptation (GCA) Summit held in Dhaka on 10 July 2019. The model was introduced by Forest Department through the ICBAAR programme implemented by the Ministry of Environment, Forest and Climate Change with financial and technical support from United Nations Development Programme and the Global Environment Facility (GEF).

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Message

Bangladesh is a role model for development in the world under the dynamic leadership of our Honorable Prime Minister Sheikh Hasina. With the current pace of development, Bangladesh is set to be recognised as a developed nation by 2041. However, climate change remains a major concern for Bangladesh. References to impact of climate change say, Bangladesh's economy is more at risk to climate change than any other country.

The Ministry of Environment, Forest and Climate Change is working tirelessly with other ministries, local and international organisations to combat the impacts of climate change. The assistance of United Nations Development Programme (UNDP) is especially significant in this regard. UNDP has been working with Ministry of Environment, Forest and Climate Change since 2009 to establish a sustainable greenbelt in the coastal regions and introduce climate resilient livelihoods. The Climate Trust Fund was created in 2009-10 fiscal year with financing from Bangladesh Government which has been contributing to a diverse range of development programmes to fight the impacts of climate change.

I am pleased to witness the implementation of 'Integrating Community-based Adaptation into Afforestation and Reforestation Programmes in Bangladesh (ICBAAR)' under the supervision of the Ministry of Environment, Forest and Climate Change and with the support of UNDP and Global Environment Facility (GEF). The programme has been highly successful in creating suitable, climate resilient, innovative, nature and ecosystem-based livelihood activities by tapping into experts' and locals' knowledge, experimentation, and evaluation in eight upazilas of the five most vulnerable coastal districts (Noakhali, Bhola, Patuakhali, Barguna and Pirojpur) of Bangladesh. The programme has earned a great reputation in home and abroad. It has brought positive changes in the lives of the coastal communities. If these activities are expanded, numerous communities will be benefitted.

I congratulate efforts to compile and document the livelihood activities of the programme. I believe, this 'Climate Resilient and Ecosystem-based Coastal Livelihoods' publication will be useful for future work in combatting the impacts of climate change.

Joy Bangla, Joy Bangabandhu
May Bangladesh live forever

(Md. Shahab Uddin, MP)
Minister
Ministry of Environment, Forest and Climate Change
Government of the People's Republic of Bangladesh

Message

Climate and environment are two of the most widely discussed topics in today's world. Urgent steps are required to prevent the adverse impacts of climate change, otherwise it will affect the lives and livelihood of millions across the globe. Bangladesh is one of the countries in the world most affected by the impacts of climate change. The lives and livelihood of 3.5 crore people across 19 coastal districts at stake. Thousands have lost their traditional livelihood and became climate refugees. Experts fear that by 2050, about 10 percent of the coastal region will be lost under water and it will displace nearly 250,000 people.

The Ministry of Environment, Forest and Climate Change is working with ministries, departments and directorates of the government to establish a coastal greenbelt and ensure alternative livelihood for the vulnerable coastal community, and mitigate the risks of climate change. The 'Integrating Community-based Adaptation into Afforestation and Reforestation Programmes in Bangladesh (ICBAAR)' is one such effort of the Ministry. The project is led by the Ministry of Environment, Forest and Climate Change, and implemented by Forest Department. The implementing partners of the project are Department of Agriculture Extension, Department of fisheries, Department of Livestock Services, Bangladesh Water Development Board, Cyclone Preparedness Program of the Department of Disaster Management, Ministry of Land, Bangladesh Forest Research Institute and an NGO.

In addition to establishing sustainable coastal greenbelt, the project is side by side assisting the coastal communities to adapt to climate change and poverty alleviation through climate resilient, ecosystem based, environment friendly, diverse, and innovative livelihood activities. I believe the expansion of these activities in the entire coastal region will provide a source of livelihood to those at risk of being displaced.

I extend my congratulations to all those who worked behind this publication and the project.

Joy Bangla, Joy Bangabandhu
May Bangladesh live forever

Habibun Nahar, MP
Deputy Minister
Ministry of Environment, Forest and Climate Change
Government of the People's Republic of Bangladesh

Message

Climate change is a global problem. Although Bangladesh is among the countries least responsible for climate change, it is one of the countries that are most at risk.Three and half crore people across 19 coastal districts of the country remain vulnerable to the adversities of climate change. Continuing usual livelihood activities of the agriculture, fisheries, and livestock divisions is becoming impossible due to salinity, waterlogging and a multitude of other problems caused by cyclones, flooding and tidal surges in addition to inundation, rainfall, drought, flooding and river erosion. As a result, thousands are becoming climate refugees and migrating to the overburdened cities.

The 'Integrating Community-based Adaptation into Afforestation and Reforestation Programmes in Bangladesh (ICBAAR)' is an adaptation project led by the Ministry of Environment, Forest and Climate Change. United Nations Development Programme (UNDP) and Global Environment Facility (GEF) provided technical and financial assistance to the project implemented by the Department of Forest with the support of seven divisions, departments or ministries of the Government of Bangladesh including Department of Agriculture Extension, depatment of fisheries, Department of livestock, Bagladesh Water Development Board, Cyclone Preparedness Programme of Department of Disaster Management, and Ministry of Land. The project provided climate resilient and innovative livelihood for 8600 coastal families between 2016-2020, involving 600 forest-dependent people with the livelihood programme and as guardians of the forest to establish a coastal greenbelt and develop the capacity and communication equipment of 6,000 volunteers as part of Cyclone Preparedness Program (CPP).

The climate resilient and innovative livelihood activities adopted and implemented under this programme through experimentation, expert consultation, local demand and experience has been appreciated by the coastal communities. Implementation through the local government divisions has contributed to capacity building of the government officers and staff. The project has been appreciated both at home and abroad. These successful and noteworthy activities deserve to be replicated elsewhere.

I believe, the 'Climate Resilient and Ecosystem-based Coastal Livelihoods' book published by the programme will contribute to effective management and implementation of climate resilient livelihood programmes in the coastal regions in the future.

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Ziaul Hassan, ndc
Secretary
Ministry of Environment, Forest and Climate Change
Government of the People's Republic of Bangladesh

Message

The 'Integrating Community-based Adaptation into Afforestation and Reforestation Programmes in Bangladesh (ICBAAR)' is a unique project of the Ministry of Environment, Forest and Climate Change, implemented through the Forest Department with technical and financial support from United Nations Development Programme (UNDP) and Global Environment Facility (GEF). This programme contributed to positive development of the communities in eight upazilas of five coastal districts of the country. It developed the adaptation capacity of the most vulnerable forest dependent communities and involved them in guarding the forest. The coastal communities have contributed to the establishment of a sustainable green belt. Though the programme aimed to provide diversified livelihood for 10,500 families, it actually benefitted at least 500,000 families in the coastal regions either directly or indirectly. The success of these innovative, climate resilient, ecosystem-based livelihood activities of the programme has been appreciated internationally.

Lands which remained fallow for years due to inundation are now being utilised to farm fish and vegetables. People displaced due to river erosion are now capable to farm fishes in rivers, canals or open water bodies with technological support from the programme. They are growing fodder for dairy in homesteads and growing vegetables in sacks. Some are utilising a small portion of ponds and growing vegetables and fruits, farming fishes in cages. The women are rearing ducks and selling eggs. As a result, climate refugees who had moved to the cities are returning. The ICBAAR programme has almost given them a new life.

I believe, the elaborate discussion of these successful livelihood activities in this publication will assist in replicating similar activities in other parts of the country. New horizons will be unveiled. I thank everyone involved with this publication.

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Mahmud Hassan
Additional Secretary
Ministry of Environment, Forest and Climate Change
&
National Project Director, ICBAAR programme

Message

Bangladesh Forest Department has been protecting the lives and livelihoods of people in the coastal regions from the impacts of climate change for the last six decades. The department has established over 200,000 hectares of coastal greenbelt which acts as a protective shield for coastal communities.

United Nations Development Programme (UNDP) has been working closely with the Bangladesh Forest Department under the Ministry of Environment, Forest and Climate Change to establish a sustainable coastal greenbelt since 2009. This has supported the plantation of over 9,000 hectares of mangroves and provided livelihood support to over 30,000 forest-dependent families. The ICBAAR programme has contributed to establishment of a climate resilient coastal greenbelt with diverse mangrove species and introduced climate resilient livelihoods to 8,600 forest-dependent families. Over half of the beneficiaries are women. The main objective of these livelihood activities is to ensure that forest-dependent families do not harm the forests, and instead become guardians of the forest. I want to thank the UNDP, donor agency Global Environment Facility (GEF), and all the implementing partners of the government for undertaking this project.

I want to especially mention the 'Forest-Fruit-Fish-Vegetable (3FV)' model implemented by Bangladesh Forest Department. The model has achieved international appreciation and garnered the attention of people in home and abroad. Bangladesh Forest Department presented the '3FV' model in the Global Commission on Adaptation (GCA) Summit held in Dhaka in 2019, which caught the attention of Honorable Prime Minister Sheikh Hasina, former UN Secretary General Ban Ki Moon and other world leaders. This is a matter of pride for Bangladesh Forest Department.

The project selected 600 members of the forest-dependent families to create a team of stewards. They are working with Bangladesh Forest Department to protect and guard the forest. I believe it is not possible to establish a sustainable greenbelt without the support and participation of local communities. I want to thank all those involved with the programme.

The livelihood activities of this programme were selected as a means of adaptation for the coastal region. There is no alternative to books like this for expansion of these experimental, climate resilient, and ecosystem-based livelihood activities. I want to thank all those involved in the publication of 'Climate Resilient and Ecosystem-based Coastal Livelihoods'.

(Md. Amir Hosain Chowdhury)
Chief Conservator of Forests
Bangladesh Forest Department
Government of the People's Republic of Bangladesh

Message

Bangladesh is a country that is under severe risk due to climate change, and it is a nation that takes this threat seriously. The country is focused on tackling climate change through numerous initiatives. In recent years, loss of lives and destruction of property has decreased as the country emphasised on disaster risk reduction and disaster management. The people have shown resilience in the face of natural disasters and continue to adapt to the climate challenges they face.

United Nations Development Programme is proud to be a close partner of the Government of Bangladesh in its many efforts to tackle the dangers of climate change. Some notable, impactful initiatives include strengthening the coastal greenbelt, effective communication of disaster warnings, establishment of cyclone shelters, and creating a well-functioning cyclone preparedness committee.

The adversities posed by climate change is experienced day-in, day-out by the coastal people of Bangladesh. Their lives and livelihoods have been altered with every extreme weather event. Traditional livelihood activities in the coastal regions have been rendered ineffective due to salinity, water logging, flooding, drought, and torrential rainfall. More and more people are at risk of being displaced.

The Integrating Community-based Adaptation into Afforestation and Reforestation (ICBAAR) project's primary focus remains on climate adaptation. The programme set out with an aim to increase the adaptability and resilience of coastal communities, providing them with alternative, climate-adaptive livelihoods. Around 30,000 coastal households have been benefited through such livelihood options.

Additionally, ICBAAR renovated the sluice gates of Monpura and Charfassion in Bhola district – which were built in 1970 as a measure against flooding and water logging. Over 500,000 families in the two Upazilas were relieved from the risk of losing their livelihoods after the gates were repaired.

This publication contains details on the experimentation, research and expert opinions on the different means of climate resilient livelihoods implemented by the project. This is a trove of knowledge for all those who are involved in this sector, tireless working to ensure that no one gets left behind due to climate change. Some of the initiatives presented in this book will be scaled up in the future to give more people a fighting chance against the changing climate.

I firmly believe these initiatives will make a remarkable impact in poverty alleviation as well as disaster risk reduction and climate adaptation in coastal regions. My sincerest thanks to all those worked on this publication.

Sudipto Mukerjee
Resident Representative
UNDP Bangladesh

CONTENTS

BACKGROUND

Bangladesh has minimum contribution in the emission of greenhouse gas in the world. However, it is one of the countries most affected by the impacts of climate change. The climate is being adversely affected due to rising global temperature caused by emission of greenhouse gas. Changes have taken place in the natural weather cycle and seasonal diversity. As a result, cyclones, flooding, irregular rainfall, excessive rainfall, lack of rainfall, unusual heat or cold, longer summers and shorter winters are being experienced all over the world. Melting glaciers and mountain snow are causing the sea level to rise rapidly.

Intergovernmental Panel on Climate Change (IPCC) is concerned that by the end of 21st century, the global temperature may rise by 1.8 degrees to 4.0 degrees Celsius and the average temperature in Bangladesh may increase by 1.8 degrees to 2.7 degrees Celsius. Bangladesh will experience an increased number of warmer days (from 17 percent to 39 percent), prolonged monsoon period, excess rainfall in short durations, and an increase in sea level by 0.14 metres to 0.88 metres. These factors will influence premature flooding, drought, cyclone, tidal surge, excessive rainfall, and unusual rainfall. A 1 metre rise in the sea level can inundate upto 18 percent of the Bangladesh's land area. Consequently, this will increase the salinity in the coastal region.

Every year during April-May and October-November, cyclones damage the lives and livelihoods of people living in the 19 coastal districts of Bangladesh. According to a statistic from the World Bank, 60 percent of the total deaths caused by cyclone during 1968–2000 incurred in Bangladesh alone. 500,000 people were killed during the cyclone of 1970, and 138,000 were killed in the cyclone of 1991.

The number of cyclone casualties have decreased nowadays because of the existing system of preparedness and early warning communication; but it continues to affect livelihood activities severely. For example, the cyclone Sidr killed 3,000 people in 2007, but left a trail of damage worth a year's national budget of Bangladesh. Cyclone Aila in 2009, Mohasen in 2018, and Fani in 2019 inflicted more damage to the livelihood activities and resources rather than causing casualties.

Tidal surge caused by cyclones assists penetration of salt water into the coastal regions and raises salinity levels of water and soil. This has adversely affected the primary sources of livelihood in the coastal regions – agriculture and fisheries. Shrinking scope and scale of traditional livelihood activities have forced the coastal communities to migrate. Experts fear, 10-15 percent of Bangladesh's coastal landscape will be lost to the riverbed by 2050 and more than 2.5 crore (25 million) people will become climate refugees.

There is no alternative to a coastal greenbelt for protecting the coastal lives and livelihood activities from the raging cyclones. That is why establishing a protective greenbelt through reforestation in the coastal regions by local communities has been prioritised in the National Adaptation Plan of Action (NAPA) and Bangladesh Climate Change Strategy and Action Plan (BCCSAP) as means of building resilience to climate change. Coastal greenbelt protects the lives and livelihood activities in the coastal regions. To compare the effectiveness of a greenbelt, it can be stated that the cyclone Sidr of 2007 had the same windspeed of the 1991 cyclone; but casualties were significantly lower because of the presence of the Sundarbans. The contribution of Sundarbans and the coastal greenbelt in protecting lives and livelihood can also be seen in the recent cyclones like Fani in 2019 and the very recent catastrophic cyclone Amphan.

The Ministry of Environment, Forest and Climate Change implemented the 'Integrating Community-based Adaptation into Afforestation and Reforestation Programmes in Bangladesh (ICBAAR)' with technical and financial support from United Nations Development Programme (UNDP) and the Global Environment Facility (GEF) to establish a sustainable coastal greenbelt and ensure climate resilient livelihood for the vulnerable coastal communities. Seven divisions, ministries, departments of the government including Bangladesh Forest Department, Department of Agriculture Extension, Department of Fisheries, Department of Livestock, Bangladesh Water Development Board, Cyclone Preparedness Programme (CPP) of the Department of Disaster Management, Bangladesh Forest Research Institute, Ministry of Land, and an NGO were involved in the project. For the last five years, the programme supported the establishment of a climate resilient, nature and ecosystem-based, innovative and diversified livelihood for 8600 climate vulnerable forest-dependent coastal families (more than half are women) of eight upazilas in five districts.

These diversified, nature and ecosystem-based, innovative and climate resilient livelihood activities were adopted through consultation with locals and experts, experimentation, local demand, analysis of results, research, previous lessons, and experience. As a result, these technologies are adaptable to coastal flooding, inundation and salinity with a higher productivity rate. These activities are affordable and the raw materials required are available locally, resulting in the activities gaining widespread popularity in the coastal regions. Local and foreign press have been following the success of these programmes. Expansion of such successful livelihood programmes will have a long-lasting effect on building the resilience of the coastal communities against the impacts of climate change.

This publication elaborates the successful techniques of the programmes, discusses their advantages and briefly explains the implementation process. This publication will provide assistance to combat the effects of climate change in the coastal region.

Former Senior Secretary Abdullah Al Mohsin Chowdhury discussing on climate resilient and innovative livelihood activities during his speech as the chief guest in a consultation workshop with stakeholders. Among those seen on stage are Statistics and Informatics Division Secretary (former National Project Director of ICBAAR) Mohammad Yamin Chowdhury (right) and former Chief Conservator of Forest Mohammed Shafiul Alam Chowdhury

ICBAAR PROGRAMME AT A GLANCE

United Nations Development Programme (UNDP) has been working in partnership with Bangladesh Forest Department to protect the coastal lives and livelihoods from cyclone, flooding and tidal surges for the last 10 years. The 'Integrating Community-based Adaptation into Afforestation and Reforestation Programmes in Bangladesh (ICBAAR)' is a continuation of such efforts. The Ministry of Environment, Forest and Climate Change is being sponsored this programme which is implemented from 2016 with technical and financial support from UNDP and Global Environment Facility (GEF). Implementing partners of this programme are Department of Agriculture Extension, Department of Fisheries, Department of Livestock, Cyclone Preparedness Program of Disaster Management, Bangladesh Forest Research Institute, Bangladesh Water Development Board, and an NGO. The aim of the programme is to establish a sustainable coastal greenbelt, create climate resilient diversified livelihood, and protect the lives and livelihoods of the most climate vulnerable people residing in 8 upazilas of the most 5 disaster-prone coastal districts in Bangladesh (Noakhali, Bhola, Patuakhali, Barguna and Pirojpur).

COMPONENTS OF THE PROJECT

- Increase resilience of local communities through diversification of climate resilient livelihood and diversification of species in coastal greenbelts.
- Involve local communities in forest management and build an effective co-management framework.
- Protect communal livelihood assets of local people from extreme weather events through effective early warning, disaster preparedness planning and risk reduction programmes.

KEY ACHIEVEMENTS

- Provided climate resilient, innovative, ecosystem-based livelihood support to 8,600 households
- Reforested 650 hectares mangroves with 12 diverse species to establish protective coastal greenbelt.
- Established 20 Forest Resource Protection Groups (FRPGs) mobilising 600 forest dependent household to act forest stewards.
- Established eight Upazila Co-Management Committees (CMCs) under the leadership of Upazila Nirbahi Officers to monitor and implement the project activities and prevent forest degradation.
- Provided training and equipment to 6,000 CPP volunteers (of whom 30 percent are women) working in the project areas to provide disaster time support and rescue.
- Established 6 earthen Killas in 5 acres of land each to provide disaster time shelter to livestock.
- Constructed 10 Community Resource Centres and one satellite Adaptation Learning Centre as channels of communication with Regional Adaptation Centre and to disseminate adaptive information.
- Repaired 20 sluice gates and reexcavated 2.9 km canal to improve drainage facilities along the embankment.

Forest-Fruit-Fish & Vegetable (3FV) model

FOREST, FRUIT, FISH AND VEGETABLE (3FV) MODEL

'Forest, Fruit, Fish and Vegetable (3FV)' Model is an ecosystem-based and innovative livelihood model. This is commonly used as 3FV model. This model was introduced to reduce the climate risk and alleviate poverty of the poor and vulnerable coastal communities. It has been applauded in home and abroad to adapt to climate risk introduced by Bangladesh Forest Department through the ICBAAR Prorgamme. This model was awarded 'Earth Care Award' by Times of India in 2012 and 'People's Choice Award' by USA in 2013 for its ecosystem-based and innovative climate adaptability.

The '3FV' model is implemented in barren, saline and low productive land near the forests of the coastal regions. It increases the adaptability of the population affected by climate change and contributes to ensure productivity in infertile land, prevents destruction of forests and resists illegal encroachment.

The 'Integrating Community-based Adaptation into Afforestation and Reforestation Programmes in Bangladesh (ICBAAR)', supported creating five ditches and six dykes in every hectares of land and awarded to five landless beneficiaries along with dyke and a ditch by the Department of Forest for 10 years in the primary stage, and for 10 more years depending on successful piloting. This model yields diversified crops, vegetables and fish in short, medium and long terms, and provides the beneficiaries with the necessary nutrient and a means to earn over Tk 100,000 a year. This type of repetitive livelihood model can be easily protected from any expected climate disaster. It helps to increase the drinkable water supply for the biodiversity, establishes an ecosystem and promotes a safe ecology in the coastal regions.

The '3FV' model has been implemented with the involvement of the forest dependent poor community. The interest of the beneficiaries and their voluntary effort contributed significantly to the implementation of the model. A total of 140 '3FV' models were implemented across 28 hectares of abandoned forest land (100 models in Hatiya upazila of Noakhali and 40 models in the Tazumuddin upazila of Bhola) and awarded to 140 landless poor families during the 2018-19 fiscal year. Now, considering the interest of poor coastal communities and scarcity of abandoned forest land, this model is being replicated through renovation of abandoned ponds around homesteads.

STEPS OF IMPLEMENTATION

01

Selecting land

- Coastal abandoned forest land near the shore are most suitable.
- Fallow land beside rivers or sea which is not inundated during tides.
- It is advisable to select land with lower soil salinity.

This model can be implemented in any pond in coastal areas which is unused or fallow and is unsuitable for agriculture.

02

Design of the model

- Construct 6 high and wide dykes (length: 252 feet, width: 59 feet, height: 8 feet) and 5 ditches (length 182 feet, width: 49.2 feet and depth: 8 feet) for implementation in 1 hectare.
- Dimensions can be changed according to availability of land.

03

Digging ditches

- Beneficiaries can excavate the ditches themselves, hire labour or use excavators following the ideal design.
- Create the model with a 1.5 metre burm on each side.

04

Preparing dyke

- Flatten the top layer and the slopes of the dyke to make the soil firm.
- Advise planting grass along the slopes for protection during amonsoon and tides.
- Existing salt is removed from the soil and the dykes are stable.

STEPS OF IMPLEMENTATION

05

Preparing soil

- The salt dissolves with rainwater and is washed from the soil. As a result, the dykes become stable. Then dig craters for planting trees in the dykes.
- Dig crater (s) in the middle of the dykes or at either ends.
- Fill craters with organic fertiliser.
- Plant one forest and fruiting tree every 9 feet. Keep 6 feet distance between each row.
- Fast growing trees should be planted further apart.

06

Forest, fruit and vegetable production

- High yielding vegetable, fruiting and forest saplings are provided.
- Training provided on climate resilient yield production, plantation and cultivation management.
- Grow lots of vegetables on the top soilof the dyke.
- Grow vining vegetables on scaffoldings like gourd, pumpkin, water pumpkin, beans, bitter gourd etc.
- Scaffoldings can be extended into the ditches and its water used for cultivation.

07

Fish farming in ditch

- Department of Fisheries provides training on farming climate resilient and high yielding fish breeds, and preparing the ditches.
- Minnows, fish feed, limestone, fertiliser etc. materials are provided.
- Apply limestone and fertiliser during water level rise in monsoon, and release the minnows of a measured quantity of diversified fish breed.

08

Harvest and sale

- Short-term crops and vining vegetables provide opportunity for surplus income.
- Fish farming acts as a short-run to medium-run source of income.
- Fast growing and climate resilient fruiting trees start to yield during 1-2 years of planting. Some trees supply wood in the medium-run and some in the long-run.

Mohammad Shafiul Alam Chowdhury, former Chief Conservator of Forest, visiting the 3FV model of ICBAAR in Hatiya

Beneficiary and her daughter displaying fish produced in the pond of 3FV model

COMPONENTS

Forest: 20 climate resilient trees (Tal, Akashmoni, Arjun, Jhaw, Neem, Mehogoni, Ipil-Ipil and Lumbu) are planted on the dykes of the '3FV' model. Tree plantation supplies wood in the long-run, and branches, fuel wood, and fruits in the medium-run. This model also provides habitat to biodiversity. The created arboriculture will provide protection against the harmful impacts of climate change (cyclone, tidal surge and heavy wind).

Fish: Each ditch can be utilised to breed high yielding climate resilient fish breed or fresh water shrimp on a bi-annual basis. Fish breeds can include monosex tilapia, rui carp, catla, grass carp and mirror carp. One family can earn between BDT 70,000-100,000 annually by farming fish in this model.

3FV model in abandoned forest land

Vegetable farming: Each family can cultivate a variety of short-term seasonal vegetables throughout the year on a 6-feet wide dyke. The salinity of the dyke will reduce gradually and the soil will become fertile. It will provide poor coastal families means to ensure their food security and earn profit at the same time. Case studies show that vegetable cultivation on the dykes can fetch an income of BDT 18,000-20,000 for one family every year which can assist in ensuring financial affluency.

Mr Mahmud Hassan, National Project Director of ICBAAR and Additional Secretary of the Ministry of Environment, Forest and Climate Change (2nd from left) is talking with a 3FV model beneficiary

Fruit Species: 20 climate resilient species (Amrupali, Safeda, Bau Kul, Thai Guava, Malta, Vietnami Coconut and Dragon Fruits) are planted on the inner slope of the dyke. An additional plantation of 40 papaya trees can produce nutritious fruits worth BDT15,000-20,000 per year from each model in the short and medium-run. These fruits can be consumed as well as sold.

Homestead-based 3FV Model

3FV model scenario taken from the above

FEATURES AND ADVANTAGES

This model assists in creating a strong coastal greenbelt through plantation of diverse species of forest trees at the fore of the coasts. This greenbelt can reduce the wind speed of cyclone and act as a buffer zone. Additionally, it protects the coastal households, ensures supply of drinking water for the biodiversity, creates an ecosystem, and establishes a safe environment for the coastal region.

The '3FV' model creates an opportunity of surplus income for the coastal communities, allowing them to accept this model as an alternative livelihood system. Also, this model is rich with carbon source due to the eco-diversity, which assists restoring fertility to the coastal lands. It reduces the dependency on the mangroves and contributes to sustainable development.

Proper utilisation of this model can promote social empowerment of the beneficiaries and assist local communities gain accessibility to natural resources for a livelihood. The longevity of the programme is ensured by social management in the local community. This model can create multifaceted opportunities through an ecosystem-based adaptation which can contribute to sustainable livelihood for the vulnerable coastal communities. It helps to protect natural or manmade ecology.

Bangladesh Forest Department is executing the model with support of ICBAAR programme. The implementing partners of this model are: Department of Agriculture Extension, Department of Fisheries and Department of Livestock. All these four departments of the government provide necessary technical training and equipment and supervises the activities at the field level implementation of the '3FV' model.

Source:

- A New Land Use Model: Forest Fruit Fish : https://www.bd.undp.org/content/bangladesh/en/home/library/environment_energy/a-new-land-use-model--forest-fruit-fish.html
- Forest, Fish and Fruit Model or Triple F model : http://www.asiapacificadapt.net/adaptation-technologies/database/forest-fish-and-fruit-model-or-triple-f-model
- Fish-Fruit-Forest: An innovative Model to Adapt Coastal Communities: https://www.bd.undp.org/content/bangladesh/en/home/presscenter/pressreleases/2018/03/05/fish-fruit-forest-an-innovative-model-to-adapt-coastal-communit.htm

Fish and vegetable farming in Sorjone Culture

FISH AND VEGETABLE FARMING IN SORJONE CULTURE

The coastal region of Bangladesh is severely affected by salinity and inundation. Farmers are losing their crops due to salinity or are unable to utilise inundated lands. Sorjone is a system of excavating trench and dyke in unproductive agricultural land to farm fish and grow vegetables. The saline-prone soil and water of coastal areas are particularly useful for 'Sorjone Culture'. Itis an ecosystem-based adaptation solution for combating the effects of climate change.

WHAT IS SORJONE

The word Sorjone originates from Malaysia or Indonesia. It is a system of excavating trench or trenches and dyke in unproductive agricultural land to farm fish and grow vegetables. This method can be used to grow vegetables and fish to meet the nutrient need of a family. This culture can be used in either small or large extents. Poor farming families owning a small piece of land can utilise this method and reap profit. The 'Sorjone Culture' is a scientific and suitable technology for hostile environments and salinity affected lands or coastal regions. It is considered an effective technique to meet the food requirement for a remote and poor family and producing high yielding crops.

PRODUCTION

November-January-February is the ideal season for creating the Sorjone Culture and January-February-March-April is the ideal time for planting saplings or vegetables. Farming is possible round the year in the 'Sorjone Culture'.

METHOD

Excavate a trench 4-5 feet wide and 5-6 feet deep in any piece of land. The Sorjone can be easily created on the dykes. Level the slopes of the dykes and sow vegetable seeds. It is advisable to grow vegetables that are saline resilient by nature. Vegetables like gourd, water pumpkin, pumpkin, ladies finger, sponge gourd, water spinach, pui spinach, bitter gourd, chili, tomato, turnip, amaranth, beet, coriander, eggplant etc. can be cultivated. Vining vegetables can be grown on scaffoldings to increase productivity. The scaffoldings benefit the fishes during dry seasons. Minnows are released when the trenches fill with rainwater during monsoon. Species like koi, puti, tilapia and carps are suitable for farming in this method.

SORJONE CULTURE IN GROUPS

Vegetable and fish farming in 'Sorjone Culture' can be carried out in groups or by self. The ICBAAR programme has been successful in piloting the project with a group of 25 beneficiaries in Charfasson. Their organic produce is being exported to the international markets. This is an achievement considering that these lands used to remain fallow for upto nine months of the year due to inundation. Now, vegetable cultivation and fish farming in the 'Sorjone Culture' are utilising these lands round the year. This culture is now the livelihood of the 25 families. Some of the beneficiaries have even constructed their homes in the Sorjone fields. The resulting green landscape has also become an issue of attention. A separate display centre has been created beside the project for exhibiting the products. Now, the beneficiaries are socially empowered as well.

Farmer harvesting Sorjone crop

Senior Fisheries Officer of Charfassion Maruf Hossain Minar briefing UNDP's Assistant Resident Representative Khurshid Alam (middle) and Programme Specialist Arif M Faisal (right) on the Sorjone Culture

INCOME-EXPENDITURE

Sorjone agriculture is more profitable in groups. Experience from the project demonstrates that 25 farmers in Bhola's Charfasson earned an annual net of BDT 71,01,000 from cultivating vegetables and harvesting fish in 10 acres of leased land. The income and expenditure based on information from project beneficiaries are given below.

Expenditure List	BDT
1. Land lease	
■ 10 acres of land (lease for 1 year)	1,20,000.00
2. Cultivating vegetables	
■ 25 packets of seeds for 10 acres of land	32,500.00
■ Fertilisers (Urea, TSP, MOP, BRDC)	80,500.00
3. Fish farming	
■ 10 maunds of fish fries (BDT 800/maund)	80,000.00
■ Fish feed (5 sacks/acre for 10 acres)	55,000.00
■ 200kg limestone	3,000.00
Net cost	**3,71,000.00**

Fish cultivation in Sorjone

Interaction of Fisheries Officer with Sorjone beneficiaries

INCOME

Vegetable production: Each acre of land yields 5,760kg of vegetables which can be sold in the market for BDT 30/kg. Yield from 10 acres amount to = BDT 30 x 5,760 x 10 = BDT 17,28,000.00
Fish production: Yield is 130kg per acre which can be sold at BDT 170/kg. Total in 10 acres = 130.00 x 170 x 10 = BDT 2,21,000.00

The first phase of production can yield an income of (BDT 17,28,000 + BDT 2,21,000) = BDT 19,49,000.00

Profit in the first 4 months: (BDT 19,49,000 – BDT 3,71,000) = BDT 15,78,000.00
Second quarter will yield a profit of 1.5x the first quarter = BDT 15,78,000 x 1.5 = BDT 23,67,000.00

Third quarter will yield a profit of double the first quarter: BDT 15,78,000 x 2 = BDT 31,56,000.00

Income for 25 persons in a year (BDT 15,78,000 + BDT 23,67,000 + BDT 31,56,000) = BDT 71,01,000.00

Profit per person: BDT 71,01,000/25 = BDT 2,84,040.00

COMBATING THE IMPACTS OF CLIMATE CHANGE

Salinity and inundation are caused by impacts of climate change and have ruined thousands of hectares of land in the coastal regions. Inundated lands that can bear agriculture for 3-4 months in a year are not producing expected harvest due to technological incapacity among the coastal communities. Vegetable cultivation and fish farming in Sorjone Culture can play an important role under these circumstances and can yield harvest throughout the year. This method is suitable for providing an alternative livelihood for any poor farming family.

Salinity and inundation are both created due to impacts of climate change. Fish farming in the 'Sorjone Culture' can be an effective in combating these impacts. It can be easily adapted by any farmer to create an alternative livelihood system.

CONCLUSION

The 'Sorjone Culture' has proven effectivity in vegetable and fish farming in the coastal regions of Bangladesh. It is effective in protecting the biodiversity in the disaster-prone areas. This method of farming is now widely adopted in Bhola's Charfasson upazila. The 'Sorjone Culture' can be popularised further by providing project assistance to poor and vulnerable families.

Preparation for selling

Three layered vegetable farming

THREE LAYERED VEGETABLE FARMING

This innovative method allows the production of three types of vegetables simultaneously on the same piece of land. This approach is especially useful for landless poor in the coastal regions who have been displaced due to climate change and face a scarcity of land. 'Three Layered Vegetable Farming' can be utilised round the year to produce thrice the yields on a single piece of land. The most significant factor of this method is that it can be managed by women.

In Bangladesh, about 5% of the arable land is homestead land. Farmers usually grow vegetables around their homestead in an unplanned way. The farming process does not use quality or standard seed breeds. These homestead lands can be utilised in a planned cultivation process that can meet the nutrient need of a family and prove to be financially profitable at the same time.

The ICBAAR programme has introduced an innovative ecosystem-based technology to expand vegetable farming in the homesteads known as the 'Three Layered Vegetable Farming'.

SUITABILITY IN THE COASTAL REGIONS

- Most of the lands in the coastal regions are low-lying which are inundated during tides or rainfall, making it unsuitable for growing vegetables. This method of farming ensures multi-productivity of a land that is low productive due to salinity and inundation.
- It is a scientific method of farming that can be utilised to grow vegetables round the year.
- Highest utilisation of homestead resources is possible and one piece of land can meet the nutrient need round the year.
- Maintenance is easy as the vegetable orchard is located in close proximity to the homesteads.
- Ensures maximum utilisation of homestead resources and uses the same amount of land to provide yield throughout the year.

ADVANTAGES

- Variety of vegetables can be produced through utilisation of a small piece of land.
- Vegetables are produced as per the need of a family.
- Fresh and organic vegetables can provide higher nutrition need for a family.
- Can encourage organic farming through utilisation of household sewage.
- Contributes to employment and empowerment of women.
- Surplus produce can be sold and be a source for additional income.
- Ensure maximum utilisation of homestead resources and uses the same amount of land to yield harvest for throughout the year.

FACTORS TO CONSIDER

- Open land exposed to sunlight are most suitable for vegetable cultivation.
- Open spaces are shrinking in the homesteads, therefore, vegetable cultivation in alternative ecosystem is an important consideration.
- Some ecosystems are suitable for specific vegetables. Vegetables have to be selected in suitability to the homestead ecosystem. For example: Three-layered vegetable cultivation system can hold Pui Spinach in the top layer and ginger or other shade-resilient crop in the lower layers.
- Ensures maximum utilisation of homestead resources and uses the same amount of land to yield harvest for throughout the year.

Advice given to beneficiaries by Sub-Asst. Agriculture officer

EQUIPMENT

Suitable land (high or medium high that does not inundate), necessary bamboo or wooden poles, nets, rope, vegetable seeds, organic fertiliser/vermicompost.

INCOME-EXPENDITURE

The method costs an estimated BDT 5,000 for implementation on 3 decimal land. It can be used for one family to grow vegetables worth at least BDT 25,000-30,000 in a year. Programme experience demonstrates that some beneficiaries can earn up to BDT 90,000 from this model in a year.

LAYER-WISE SUITABLE VEGETABLES

Layer	Suitable vegetables
Layer 1	Water spinach, Pui spinach, Red spinach, coriander, radish, etc.
Layer 2	Vining vegetables like cucumber, bitter gourd, ridge gourd, long beans snake gourd, sponge gourd, etc.
Layer 3	Gourd, pumpkin, water pumpkin.

EXPECTED OUTCOME

Increased resilience of vulnerable coastal communities through a livelihood involving technological skill development. Many people are unable to cultivate vegetables due to lack in knowledge, technical capacity and skill. Three-Layered Vegetable Farming can be a food source during disaster and an alternative livelihood for the poor communities.

2FVD Model

INTEGRATED FISH, FRUIT, VEGETABLES AND DUCK FARMING (2FVD)

'Integrated Fish, Fruit, Vegetables and Duck Farming' is an ecosystem-based, innovative and climate-resilient livelihood for coastal communities. Fish, fruit, vegetables and ducks are cultivated in the cage structures in pond, wetland, canal or rivers in this method. It can meet the nutrient need for the vulnerable coastal families as well as provide a source of sustainable income. One way source of livelihood cannot reduce the vulnerability of the communities at climate risk. That is why this model is being implemented in consideration of the demand and suitability, with technical support from the departments of fisheries, agriculture and livestock services.

This method utilises cage structures for rotational cultivation of orange fruit, gourd, bitter gourd, chili, eggplant, long beans etc. throughout the year. The fish produced in the cage aquaculture yields thrice a year. Fish farming in pond cannot ensure proper feeding for the fish. There is added risk of fishes being washed away in cyclones or flooding, or predators and other sources of harm in the coastal areas. This model of fish farming will yield zero loss of fish. They cannot escape during flooding, cyclone or tidal surges because the floating cages will rise with the water level. The structure itself is mobile, and therefore the produce can be protected from damage caused by prolonged direct sunlight by moving the frame to a shadier area of the pond. The frames are low-cost structures as all the raw materials are available locally.

The 'Integrated Floating Cage Aquaculture System (IFCAS)' is based on the cage aquaculture to meet the nutrient need of a family. Researchers of the Bangladesh Agriculture University (BAU) have recently achieved success in simultaneous cultivation of fish and vegetables in this method. Dr Mohammad Mahfujul Haque, Professor of Bangladesh Agricultural University (BAU), is the inventor of this successful method.

Experience from the ICBAAR programme demonstrates that this floating method of fish, vegetable and duck farming can be carried out in pond, canal or river. Maintenance is easier in pond.

DESCRIPTION

Equipment: Materials required for rectangular cage are: bamboo (8-10 poles), rope, net, large size plastic drum (9-10 pieces), plastic fruit baskets (16 pieces), soil, organic fertiliser, seed, fish minnows, 1 duck house, 10 ducks.

Dimension of the cage: Cage is 22 feet long, 20 feet wide and 6 feet high.

Cultivation: Vegetable cultivation is possible in summer, winter and throughout the year in partially or completely waterlogged areas.

Construction: Notches are made at the corners of the bamboo cage to attach the empty plastic drums for floatation. These drums of 200L capacity can be obtained locally. Bamboo scaffoldings are placed on one side of the cage to create a bed for vegetable farming. A mixture of dried mud from the pond, dung and other organic fertilisers are placed on the bed. The bottom of this scaffolding is in contact with the water and hence separate irrigation process is not required for cultivation. Another bamboo scaffolding is placed on the top for growing vining vegetables.

This arrangement can be used to grow vining vegetables that can intake water from the pond. Suggested vegetables are cucumber, snake gourd, pui spinach, bitter gourd, flat beans, etc. Inside the cage, monosex tilapia is farmed at 100 per cubic metre density. Other breeds like rui, catla or mixed carp can also be farmed in these cages. This model is especially suitable for women because they can catch the fish using hand nets or easily harvest vegetables from the scaffoldings.

In the cages, tilapia can grow 80kg-100kg in ponds under partial shade or deep shade. A possible reason for low yield of ducks, eggs, and tilapia in these floating cages can be the presence of ammonia and nitrate in the water caused due to decomposition of leaves and other organic debris in the water.

Several government and private organisations have expressed interest in expanding this innovative integrated aquaculture-agriculture technology for poor farmers. This technique can be used in groups in pond, swamp, canal, river, land inundated by climate change, etc. to ensure nutrient security of the poor farmers and provide them with an alternative source of income from the fish, duck, eggs and vegetables.

The 'Integrated Floating Cage Aquaculture System (IFCAS)' can be utilised for farming duck, fish and vegetables throughout the year. There is no scope of this structure being flooded away.

PROFIT ANALYSIS

Expenditure: Expenditure is between BDT 30,000.00 and BDT 35,000.00 including cost for bamboo, nets, rope and other equipment for frame construction. The expense can be reduced through utilisation of locally available resources. Equipment required for the 2FVD model are available in the localities.

Fish farming: This method yields fish in a short amount of time (90 days in the initial phase and 30 days in the later phases). Fish farming in the floating method requires a one-time initial investment of BDT 10,000.00 This investment can produce 120kg of tilapia in a pond that is located in partial shade or deep shade and fetch BDT 12,000.00 Fish can be farmed at least three times a year in this method by which BT 35,000.00 to 36,000.00 can be earned. The structure can be used for five years for farming fish. The initial investment can be reduced to upto half if the farmer utilises materials available in the homestead.

Vegetable farming: Vegetables can be cultivated in a short time (40-50 days for the first yield and later 30 days). Floating cultivation requires a primary one-time investment of BDT 4,000.00 (for bamboo, rope, net. Plastic cage, compost fertilizer, seeds etc). This investment can provide nutrition for the farming family from the third month. Surplus produce can be sold in the market for an income of upto BDT 1,500.00-2,000.00 The investment cost can be significantly reduced if the farmer uses homestead materials for construction. Cultivation is possible round the year. As a result, this can be an alternative income source for the farmer with upto BDT 20,000.00 profit a year.

Fruit farming: Fruits can be cultivated in 6 month cycles. Growing fruits in this model on canals or open water bodies requires an investment of BDT 1,000.00-1,500.00 The investment will cultivate fruit worth at least BDT 2,000.00-3,000.00 Fruits can be cultivated in phases for five years. The single investment of a cage can provide an alternative income source throughout the year. From the second year, the average income from fruit farming is expected to be at least BDT 5,000.00-6,000.00

Duck farming: Farming 10 ducks in the floating cage method requires an initial investment of BDT 10,000.00 The cost can be reduced significantly if homestead materials are available for construction and home-made feed is provided. Each duck can lay upto 270-280 eggs every year, which can fetch an income of BDT 2,700.00-2,800.00 per duck. Eggs from the ducks can meet the food need of a farming family and provide an additional income source worth BDT 25,000.00-30,000.00 every year.

ADVANTAGES

- Model can be used in local water bodies (canal, pond, marsh or lake) to cultivate fruits, fish, vegetable and ducks round the year.
- Environment friendly method of organic farming.
- Cost of farming is comparatively lower.
- Cultivation does not require irrigation process.
- Cultivation is possible with minimal use of fertiliser and insecticide.
- Can ensure food security and meet nutrient need of poor and vulnerable community.
- Increases income of poor farmers.
- Farming is unaffected by heavy rainfall or seasonal flooding.
- Utilises family labour to bear fruit.
- Same piece of land can be used in a planned way to produce fruits, vegetables and fish.

It is advisable to avoid placement of cages in places where the waves are rough or the water is deep. The produce has to be protected from mice and leech. The arrangement has to be maintained properly to avoid build of bad odour.

Source

IFCAS (Integrated Floating Cage Aquageoponics System) in Bangladesh and Nepalhttps://www.youtube.com/watch?v=LzA05QfZYCs YouTube Video, Access

Project Manager visits 2FVD Model


AFC
AFC
AFC

Beneficiary and her daughter working in 2FVD Model

FLOATING VEGETABLE FARMING

Farming vegetables has become challenging with the impacts of climate change. Salinity in the soil caused by climate disasters like cyclones, inundation and shrinking cropland are the main challenges of vegetable cultivation. These factors are compelling farmers to seek out alternative ways of vegetable farming. The 'Floating Vegetable Farming' is one such innovative and alternative method of vegetable cultivation. This method has drawn appreciation from beneficiaries of the ICBAAR programme and the general people after it was introduced in the coastal regions of southern Bangladesh.

'Floating Vegetable Farming' originated in Eastern China's Jiangsu province. This technique yielded good results in cultivation of vegetables, watermelon and 30 types of grain crops. This method of farming is gradually expanding in China.

A significant portion of the arable lands in Bangladesh's southern region remains fallow for 3-6 months due to inundation or water logging caused by a number of reasons. Floods also affect rivers, canals, marshes and ponds of these regions. Farmers of these regions are using open water bodies for floating cultivation.

The floating cultivation method is suitable for implementation in Barishal, Bagerhat, Jhalakathi, Pirojpur, Gopalganj, Faridpur, Gaibandha, Habiganj, Sunamganj, Kishoreganj, etc. Similar method can be utilised in the flood-prone low-lying lands of Munshiganj, Chandpur, Narsingdi, Tangail, and Manikganj.

'Floating Vegetable Farming' method uses a floating bed to grow vegetables in fruit baskets. This technique can meet the nutrient need of a family and can provide a source of alternative income. During flooding there is no livelihood in the southern region, and people stay unemployed. This region does not give importance to vegetable farming and hence suffers from nutrient deficiency. The coastal communities invented the 'Floating Vegetable Farming' out of necessity. They are farming vegetables in fruit baskets on a triangular floating, thereby meeting their family's nutrient need and creating a source of alternative livelihood. This arrangement remains unaffected during climate disasters.

Floating cultivation is possible on pond, canal or river.

Nursing crops by the beneficiary

ADVANTAGES

- Suitable for coastal regions or flooded and inundated areas.
- Cultivation is possible in pond throughout the year. Does not wash away during flooding.
- Women friendly technology
- Cultivation is environment friendly and organic.
- Cost of cultivation is significantly lower.
- Does not require irrigation process.
- Cultivation is possible with minimum use of fertiliser and insecticide.
- Can ensure food security of remote poor families and meet their nutrient need.
- Increases income of poor farmers.
- Crop is unaffected during excessive rainfall or seasonal flooding.
- Utilises water weed and hyacinth in inundated areas.
- Utilises labour of the whole family.
- Technique can be used in canals and rivers.

PROFIT-LOSS ANALYSIS

One farmer can produce vegetables in a short time (40-50 days in the first run and 30 days in the later stages).

The method requires a one-time initial investment of maximum BDT 15,000 for the construction of cages. The cost can be reduced to BDT 6,000 if available homestead materials are utilised. An additional cost of BDT 1,500-2,000 is required for seeds and fertilisers. This arrangement can meet the daily vegetable need of a farmer family and provide an additional income of at least BDT 15,000-20,000 a year.

Vegetable farming in the coastal regions are being affected severely due to increasing salinity caused by climate change. Women and children are most affected and deprived of nutrition. This method can be utilised to cultivate vegetables and provide for the nutrient need caused by impacts of climate change.

ESTIMATED COST ANALYSIS

Description	Details	Qty	Unit	Cost/Unit (BDT)	Total cost (BDT)
Summer vegetable: Pui spinach/ gourd/ bitter gourd/ snake gourd/ ridge gourd/sponge gourd pumpkin/ sweet bitter gourd/water pumpkin red spinach/ water spinach	Provide 5/6 seed variety to one farmer	Bunch	Bunch	Bunch	300.00
Winter vegetable: Gourd/ bitter gourd/ tomato flat beans/ long beans/ red spinach/ spinach water spinach/ chili	Provide 5/6 seed variety to one farmer	Bunch	Bunch	Bunch	300.00
Urea		6	kg	16	96.00
TSP		4	kg	22	88.00
MOP		4	kg	15	60.00
Gypsum		0.5	kg	35	17.5.00
Zinc sulphate		0.5	kg	255	127.5.00
Boron		0.5	kg	255	127.5.00
Dung (provided by the beneficiary)		30	kg	0	0
Organic fertiliser		20		25	500.00
Organic insecticide	Nimbicidin-250ml bottle	1	bottle		250.00
Fungicide	Propiconazol-100 ml	1	bottle		250.00
Plastic drum	60L capacity	8	pieces	600	4800.00
Plastic fruit basket		8	pieces	200	1600.00
Bamboo	Borak bamboo (50 feet)	6	pieces	500	3000.00
Net (for scaffolding)	New sign net (Hilsa net)	1	kg	450	450.00
Poles (provided by the beneficiary)		-	-	0	0.00
Labour		2	daily	500	1000.00
Signboard	2feet x 3 feet	1	piece	500	500.00
Rope	Nylon	1	kg	400	400.00
Nail		0.5	kg	130	65.00
Transportation cost for beneficiary		-	-	300	300.00
Miscellaneous cost		-	kg	768.5	768.50
			Total cost		**15,000.00**

Source

- Expanding and popularizing vegetable and spices cultivation on floating beds, DAE, Ministry of Agriculture
- Speaking for the farmer, Md Motiar Rahman, publication, 2015
- WorldFish. “Floating gardens can feed Bangladesh” article

Vegetable farming in sacks

VEGETABLE FARMING IN SACKS

Innovative ways and methods are being developed continuously to combat the impacts of climate change. 'Vegetable Farming in Sacks' is one such climate resilient, ecosystem-based and innovative method of farming. It is suitable for landless communities living in the remote coastal regions where salinity affects traditional farming. It is especially useful in consideration of the nutrition and food security of the vulnerable communities in southern Bangladesh.

SUITABILITY IN COASTAL REGIONS

Salinity in the coastal regions has increased significantly due to frequent incidents of extreme climate events like cyclone and flooding. Traditional farming ways are almost impossible for the cultivation of vegetables. Scarcity of irrigation water, tides of the sea, heavy rainfall, flooding, seasonal drought and inundation have discouraged local communities to continue traditional farming in these regions.

In such a situation, 'Vegetable Farming in Sacks' has been a boon for the farmers. Local communities in the coastal regions of Noakhali, Bhola, Barishal, Patuakhali, Khulna and Cox's Bazar have been highly successful in utilising this innovative farming method.

This farming method reduces the risk of soil-borne diseases. The sacks can be moved to safety during incidents of extreme climate events. They can be kept along the boundary walls, in the backyard, on the roof or any other spacious places around the house on a temporary basis.

FEATURES

- **No need of land for cultivation.**
- **No risk of crop loss due to heavy rainfall or flooding.**
- **After the first yield, a second crop can be sowed in the sacks without further cost.**
- **Farming is possible under partial shade.**
- **Ginger and turmeric farming is possible under the bamboo garden.**
- **Cost of farming is very low.**

FORMAT OF FARMING

Summer vegetables: Pilot farming of pui spinach, red spinach, stalk spinach, water spinach, ladies finger, chilies, pumpkin, etc. yielded promising and satisfactory results. Onion, garlic, green chilies, cauliflower, radish and other vegetables can be produced round the year.

Vining vegetables: Gourd, pumpkin, ridge gourd, cucumber, bitter gourd etc. can be sprouted separately and later weaved with threads and hung on bamboo scaffolding.

Spices vegetables: Chilies, ginger and turmeric.

EQUIPMENT REQUIRED

Synthetic sacks, jute sacks, seed, soil, manure, cinder ash, thread, etc

METHOD OF FARMING

Large cement sacks or potato sacks can be used for this method. Crush a clump of silt loam soil into fine dust. Take three pots of soil dust, one pot of sand, one pot dung fertiliser and 25gm Furadan. Other fertilisers like TSP-200gm, MP-200gm, zinc and boron and components like vermicompost, bone dust and cinder ash have to be used quantitatively. Mix all the components and fill the sacks with the mixture. Shake the bags to ensure a tight packing. Place the sack on three or four kilogrames of dry leaves or hay. Sand in the soil will help drain water and Furadan will protect the crop from termites. Brick chips of 20-40mm size can be used in the soil mixture along the middle (from top to bottom) to avoid soil clumping. The sack is now ready to be sowed with seed and grow vegetables. But it is best to plant sprouted saplings in the sacks.

IRRIGATION

The sacks need to be monitored and watered round the clock. In case of rainfall, it can survive up to three days without water. However, ensure that the sacks do not store excess water or are dry.

VEGETABLE YIELD

The vegetables yield within two to three months of planting. 'Vegetable Farming in Sacks' can meet the daily vegetable need for a small family andis suitable for remote and vulnerable farming communities. The surplus harvest in this method can be sold at markets. Case studies show that 10-15 sacks of vegetables can produce enough surplus for a family to sell and have a good income.

INCOME AND EXPENDITURE

Expenditure	Cost (BDT)	Income
Bamboo scaffolding and cost of sack (10 – 15 sacks).	2000.00	After each season, 10 - 15 sacks of vegetables can fetch an income of BDT 10,000.00– BDT 12,000.00 after meeting the family demands.
Dung fertiliser	100.00	
Vermicompost fertiliser	200.00	
TSP – 200gm, MP-200gm	100.00	
Total cost	**2,400.00**	

Cultivation of vegetables in sacks on waterlogged saline soils

VEGETABLE FARMING IN HANGING AND STAIRCASE METHOD

Infiltration of saline water is increasing the soil salinity in the coastal regions in an unprecedented rate and affecting the local agriculture. As a result, arable lands are gradually losing fertility. Coastal inundation particularly during monsoon (June – October), salt water from the tides, and infiltration of saline water during dry seasons are leaving salt in the soil and damaging the fertility of the lands. Bangladesh has 2.5 million hectares of coastal region. Currently, saline water has infiltrated 1.4 million hectares of land in the coastal regions and islands. It has affected agricultural lands, open water sources and underground water system. Vast agricultural lands have now turned unproductive.'Vegetable Farming in Hanging and Staircase Method' can utilize these infertile, water-logged and salinity-affected lands and yield fresh vegetables to meet the nutrition need of a family.

SUITABILITY IN COASTAL REGIONS

As our environment continues to transform due to climate change, people are finding newer ways to adapt and survive. 'Vegetable Farming in Hanging and Staircase Method'is a special technique of climate resilient farming. Since more than half the lands in coastal regions are affected by salinity, or are inundated or fallow, innovative farming is necessary to utilise these lands for a livelihood. Vegetable farming in hanging and stair method is efficient in reducing salinity in the soil and producing better harvests. Thereby, this method has high suitabilityin the coastal regions.

CHARACTERISTICS OF ACTIVITIES

- A high frame is created with bamboo in consideration of the highest levels of flooding. Farming can be done in baskets hung from the frames. The baskets can be accessed with staircase.
- Remains unaffected during inundation.
- Crops can be monitored and nurtured easily.
- Crop is safe from grazing by cows or goats.
- This method can be used to produce vegetables like tomato, eggplant, chili, cabbage, cauliflower, turnip, spinach, pepper, onion, garlic, radish, carrot, etc.
- Meets necessary nutrition need of a family.
- Planting saplings are easy and farming is possible round the year.
- The texture and composition of the prepared soil is strong and helps grow the roots of the plants.
- The soil is capable of retaining its natural moisture and has an increased capacity of holding water.
- Production of vegetables is easy, is less time consuming and is environment friendly.

REQUIREMENTS

Bamboo, rope, plastic tub/vegetable basket, seed/sapling, organic fertiliser/dung, labour, fertile soil.

SELECTION OF PLACE

Low-lying or fallow lands near the house which is open to sunlight and have fresh air can be chosen for placement. It is advisable to have the placement near the household. This can ensure that the crop is well maintained.

STRUCTURE CONSTRUCTION PROCESS

- Collect bamboo and cut them into canes of 12 feet and 10 feet size. Also cut some bamboo to create the staircase. For the hanging structure, the bamboo has to be cut in sizes required for the frame of a two-storied house.
- Slice the pieces of bamboo along its length and make two equal pieces. For hanging structure, six bamboo poles are needed for one decimal land. Then the other slices are prepared from the canes for roof and the structure.
- The poles are planted and the frame and roof attached with ropes. The joints should be secured tightly to ensure a firm structure. For the hanging method, create a framework for two-storied house.
- After the structure is completed, place the tubs/flower baskets filled with soil on the steps of the staircase. For hanging method, hang the tubs/flower baskets from the structure.

PREPARING SOIL AND OTHERS

- Collect soil that does not contains as limited amount of salinity as possible.
- Mix the soil with advised levels of organic fertiliser/dung and leave it covered for 7 days.
- After 7 days, fill the baskets with the prepared soil.
- Place the baskets on the steps of the staircase. For hanging method, the baskets are hung from the bamboo rods with a rope. Vegetable seed or sapling is planted in these containers and are maintained regularly.

BUDGET FOR STAIRCASE STRUCTURE

SL	Description	Quantity	Cost of 1 unit (BDT)	Total cost (BDT)
01	Local bamboo	15	500.00	7,500.00
02	Nylon rope	3 Kgs	300.00	9,00.00
03	Plastic cage	36	120.00	4,320.00
04	Seeds/Sapling	altogether	500.00	500.00
05	Organic fertiliser	50 Kgs	40.00	2,000.00
06	Labour	3 persons	500.00	1,500.00
	Total			**16,720.00**

BUDGET FOR HANGING STRUCTURE

SL	Description	Quantity	Cost of 1 unit (BDT)	Total cost (BDT)
01	Bamboo	12	500.00	6,000.00
02	Nylon rope	4 k Kg	300.00	1,200.00
03	Net for scaffolding	1 Kg	300.00	300.00
04	Plastic cage	10	200.00	2,000.00
05	Seeds/Sapling	altogether	500.00	500.00
06	Organic fertiliser	50 Kg	40.00	2,000.00
07	Labour	2 persons	500.00	1,000.00
Total				**13,000.00**

PROFIT

The one-time cost of stair or hanging method will be around 13,000-16,000 taka. Through this, a family can meet the demand of vegetables throughout the year and earn 10,000 taka.

ADVANTAGES

- Fallow lands can be recovered.
- Only 1 decimal of land needed for vegetable farming.
- Land that remains fallow throughout the year can be recovered and utilised.
- One complete structure can ensure 4-5years of vegetable farming.
- Vegetables that meet local requirement and demand can be produced based on the monsoon.
- Break-even can be achieved within the first year.

Farmers owning low-lying lands in the coastal regions, which remains fallow throughout the year due to salinity, can recover their land with the 'Staircase/Hanging Method' and expand sustainable farming practices to meet the nutrient need for their families and local communities.

The ICBAAR programme is continuing to expand this women-friendly technology in areas highly affected by climate change. The programme is engaging this types of ecosystem-based livelihood activities to fight climate change.

Cultivation of hybrid T-Aman paddy

CLIMATE RESILIENT T-AMAN PADDY

Agriculture is a major sector in Bangladesh. It is the most severe victim of climate change. Flooding, inundation, salinity, heavy rainfall, drought and other extreme climate events have significantly affected the production of traditional Aush and Aman paddy in the coastal regions. Inclusion of T-Aman paddy in the agriculture of disaster-prone coastal regions is a timely step under the existing risks of climate change. Developed jointly with Department of Agricultural Extension and ICBAAR, the climate resilient T-Aman paddy is especially suitable to survive climate change risks in the coastal regions.

CLIMATE RESILIENCE AND OTHER BENEFITS

T-Aman paddy is climate resilient, for example; Bri Paddy-47 and 74 are saline resistant, Bri Paddy-52 is flood resistant and Bri Paddy-58 is drought resistant. The cultivation cycle of T-Aman is shorter by 10-15 days compared to other local breeds. As a result, the crop can be harvested before any major climate event. The grain production rate of T-Aman is 30-35% per kilogramme compared to other local varieties, which yields 20-22 percent per kilogramme.

T-Aman is saline resilient, high yielding and is unaffected if stays inundated for a few days. It can withstand heavy winds and becomes ready for harvest in a shorter time period. Cultivating this breed can ensure crop protection from flooding and utilisation of the land in farming other crops. The success of project beneficiaries with the T-Aman breed has encouraged local communities towards paddy cultivation.

SUITABILITY IN COASTAL REGIONS

Impacts of climate change has made it nearly impossible to cultivate local varieties of crops in most of the lands in the coastal regions of Bangladesh. Scarcity of irrigation water, inundation in saline water during tides, heavy rainfall or seasonal droughts have discouraged farmers from cultivating Aushor Boro paddy. The T-Aman paddy is gaining popularity in the coastal regions because of its high yield, resistance to inundation, rainfall, seasonal droughts and salinity, and shorter cultivation cycle. The new breeds of Aman paddy with a shorter cultivation cycle are Biri Paddy 52, Biri Paddy 62, Biri Paddy 66 and Biri Paddy 75.

Interaction of Agriculture Officer with project beneficiaries

PREPARING SEEDBED

Land open to sunlight exposure and with access to irrigation is suitable for seedbed. Plough the land 4-5 times and use ladders to make a wet muddy top layer. Prepare the seedbed in columns of 1.25 metres (49.21 inches)width. Separate two seedbeds with 50cm (19.69 inches) gaps. The seedbeds have to be raised with mud from these gaps. The ridges formed in the gaps will ease the irrigation management.

Flatten the seedbed before sowing. For every square metre, 80-100 grams of seed has to be sowed. For every 33 decimals of land, 34 kilogrammes of seed is required. The seed has to be sown between 21 July to 20 August. The saplings that grow have to be transferred into the soil when they are 21-25 days mature. From every 1 decimal of seedbed, 20 times more land can be sown.

MAINTENANCE

Pass irrigation water after 5-7 days of sowing when the roots have a firm grip in the soil. Make sure the seedbed is never dry. The saplings grow best if the seedbed is kept under 23cm of water. Later, the water level can be raised up to 35cm in accordance with the growth of the saplings. Any more water may cause the saplings to grow taller and weaker. If the growth of the saplings is slowed or they turn yellowish, apply 7gm of urea fertilizer for every square metres of the seedbed. For bug attacks and pests, permitted use of pesticides can be prescribed.

SOWING

The difference in T-Aman paddy's yield is attributed to the spacing of sowing. The saplings can be sown either in an orderly and non-orderly way. In an orderly sow, the saplings have a measured distance between them. An orderly sowing will require lower number of seeds and will reduce the maintenance cost in the future, especially during weeding. Two to three saplings have to be sown in every bunch. With even spacing, the saplings can evenly extract nutrients from the soil and increase yield. It is best to keep rows 20-25cm apart and sown bunch 15-20cm apart.

IRRIGATION

Seedbed water: For seedbed, the irrigation water need is 100-150ml (4-6 inches) depending upon the condition of the soil. On average, the irrigation can be distributed into 30-40ml (1-1.5 inches) water in 4-5 phases. It is best to pass the irrigation water along the ridges between seedbeds.

Soil water: The soil has to be moistened properly and ploughed thoroughly with a ladder to create a wet mud. This land will require 200-250ml water (8-10 inches) of water.

Crop water: Depending on the condition of the soil, the cultivation requires around 1,000-1,200ml (40-48 inches) water which has to be delivered in 16-20 irrigations.

Cultivation of T-Aman paddy

Cultivation of T-Aman Rice

NUTRITION NEED OF RICE PRODUCTION

Even application of fertilisers: 16 fundamental nutrient contents are required for the cultivation cycle of paddy. 3 of them are obtained from water and air. The remaining 13 are extracted from the soil. Crop cultivation cannot be complete without any one of these contents. Nutrient contents are existent in varied levels and compositions within the soil. Uneven use of fertilisers or intensive farming can reduce the nutrient content within the soil to dangerously low levels. Therefore, it is fundamental that fertiliser is always used evenly.

NUTRIENT CONTENT NEED

High yielding T-Aman variety usually requires higher nutrient content in the soil compared to local breeds. One tonne of T-Aman paddy consumes 18kg Nitrogen, 3kg Phosphorous, 24kg Potassium, 2kg Sulphur and other nutrients on average.

DISEASE CONTROL

Disease control can be carried out in two ways:

1. Prevention

- Use of disease resilient breeds of rice like Bri paddy-19, Bri paddy 45, Brip addy-50, Brip addy -27, Aman-BR-4, Bri paddy 32, Bri paddy-33, Bri paddy-40, Bri paddy-41, Brip-42, Bri paddy-44 and Bri paddy-49.
- Balanced use of fertilizer and use of urea fertilizer in 3 phases.

2. **Cure for land:** It is inadvisable to use urea fertilizer after a thunder storm. Overhead application of urea fertiliser has to be stopped after identification of disease. After identification, use 5kg potash fertiliser for every bigha of land. Land affected by creasing has to be dried and watered every 5-10 days. Ensure that the roots are not affected when saplings are transferred. The straws of the affected land have to be burned to the ground.

INSECT CONTROL

The measures to control bugs and insects are varied on different types of infestation. Below are suggestions according to the types of bugs and insect infestation.

Rice Gall Midge: Adult insects can be terminated using light traps. Insecticide can be used if necessary. However, the use of insecticide is advised when Rice Gall Midges are 5%.

Rice Stem Borer: The eggs have to be collected and destroyed. Tree branches can be placed in the fields to allow perching of insect-eating birds. This is an effective way to reduce insect population. It can also be terminated using light traps. Use of insecticide is advised if the mentioned methods are ineffective in reducing the insect population.

Rice Hispa: Infected leaves have to be identified and cut off 3cm from its base. However, cutting off leaves during the onset of booting can damage the crop. Insecticide can be used if necessary. Use of insecticide is advised if 35% of the leaves are affected.

Rice Case Worm: Drain out the water of the affected land. Terminate the adult moths using light traps. Use of insecticide can be considered if 25% of the leaves are affected.

Grasshopper: The insects can be netted and terminated. Tree branches can be planted in the fields to allow perching of insect-eating birds. Such methods are effective in reducing insect population. Use of insecticides is advised if 25% of the leaves are affected.

Brown Plant Hopper: Use light traps, drain the water from the affected field, and avoid overhead use of urea fertiliser. Use of insecticide is advised if most of the plants in the field contain 2-4 egg bearing adult female insects or 8-10 caterpillars. The insecticides must be sprayed at the base of the plants.

Rice Bug: Insects can be terminated using light traps. Insecticide can be used if necessary, but the application must be carried out before dusk.

Leaf Roller: Destroy the insects using light traps. Tree branches can be planted in the fields to allow perching of insect-eating birds. Such methods are effective in reducing insect population. Use of insecticide is advised if 25% of the leaves are affected.

RAT CONTROL

- Keep the demarcation lines around the crops and make itclean.
- Keep the demarcation lines narrow (15-20cm).
- Dig out holes and eliminate rat population.
- Smoke out the rats with fire or water and eliminate them.
- Place statues beside the rat holes.
- Use of several types of traps to control rats.

Farmers field day observation

COMPARISON WITH LOCAL BREEDS

Cultivation of T-Aman paddy in the agriculture of the disaster-prone coastal regions is an effective and timely decision considering the risks of climate change. Poor and remote farmers who became climate refugees due to impact of extreme climate events were discouraged to cultivate paddy and were displaced to the cities. But now, after cultivating the climate resilient and high-quality T-Aman paddy under Department of Agricultural Extension through ICBAAR, the coastal farmers are developing capacity to build a climate resilient livelihood with the higher crop yield. They are building self-sufficiency with the economic affluency and are contributing to their eradication of poverty.

HARVEST

Towards the end of Agrahayan, or after the second week of December, the harvesting should be started. If 80% of the grainsare ripe, the crop should be harvested without delay.

RETENTION OF SEEDS AT THE FARMER LEVEL

The seeds have to be dried properly so that its humidity level is around 12-13%. The container –plastic drum, tin or of any other material or coloured earthen pots should be cleaned properly and dried under the sun. Before storing, cool the grain should and pack with Neem or tobacco leaves as a measure of protection against bugs or insects. The container should be fully packed with grain. If the grain does not fill the container to the brim, the remaining space should be packed with cinder ash. Seal the neck of the container properly so that the seeds are not exposed to light or air. The seeds need not be dried further before sowing for another crop.

Source

Various books, websites and NGO manuals of the Ministry of Agriculture.

VERMICOMPOST

Vermicompost is an environment friendly high-quality organic fertiliser. It is obtained after processing the waste and parts of a plant or animal by a special species of earthworm. The fertiliser is the excretion of the earthworms after feeding on the organic materials.

Intensive farming and organic farming are gradually reducing the organic content of the soil. Earthworm manure can be identified as a tool of sustainable land management which can increase the organic content of soil. There is no alternative of earthworm manure to keep soil healthy. It is an economically profitable venture and can save a land from turning infertile.

The saliva of earthworms is vitamins for the soil. It contains numerous microorganisms that add nutrient content in the soil and keeps the soil loose. It also reduces existing poisons within the soil. The Department of Agricultural Extension has a successful record of setting up a vermicompost exhibition for producing organic fertilisers and popularizing its use.

Currently farms in our country have an abundance of earthworm supply. Per kilogramme of earthworm is available at between BDT 2,000-2,500. Not all species of earthworms can produce vermicompost. The species widely used for this purpose are Red worm/Red wigglers *(Eisenia fetida).*

SUITABILITY IN THE COASTAL REGIONS

Arable lands in the coastal regions are becoming unsuitable for agriculture due to extreme climate events like flooding, cyclone, inundation and penetration of saline water – influenced by climate change. The lands are losing fertility due to frequent use of chemical fertilisers. Oblivious farmers and unplanned use of fertilisers are also contributing factors to fertility loss in the soil. Use of earthworm manure can eliminate the salinity in the soil and can contribute to higher yield of crops. Therefore, the use of earthworm manure has high suitability for the coastal regions.

SIGNIFICANT ACTIVITIES OF EARTHWORM

Earthworms move through the layers of the soil and feed on its organic content; excreting its remains within the soil as fasces. These activities depend of the pH level of the soil, organic composition, water and temperature of the soil. The species of earthworm required for this purpose are Red worm/Red wigglers *(Eisenia fetida)*, which is widely available. Earthworms can dig into upto 3 metres into the soil, thereby increasing the number of pockets within the soil. This helps to carry the water deep into the layers of soil. It increases the water level, provides a stable temperature and increases the airflow within the soil. Through its nutritional system, an earthworm can break the soil particles and make the food content of a plant easily accessible. Broken down smaller soil particles increase the volume of the soil and increases its capacity of water retention. The presence of earthworms can increase the airflow within the soil up to 67%.

NUTRIENT CONTENTS OF VERMICOMPOST

Earthworm manure protects the soil health, develops its fertility and contains more nutrient content compared to other composts (Nitrogen 1%, Phosphate 1%, Potassium 1%, organic carbon 18% and water content 15-25%).

ADVANTAGES

- Environment friendly and protects the soil health.
- Helps keep the natural humidity of the soil and increases the water retention capacity.
- Helps in reducing the poison level of the soil.
- Increases microorganisms in the soil and strengthens the soil composition and structure, thereby helping in growth of roots.
- Can be used on any crop.
- Turns infertile land fertile.
- Easy production process and takes little time.
- Farmers can produce the vermicompost without help.

RAW MATERIALS

- Special worms.
- Sanitary rings or pucca house.
- Polythene.
- Tin or hay for scaffolding.
- Dung.
- Fasces of cow, goats and poultry.
- Vegetables, legume, mustard, wheat husk.
- Organic debris.
- Agricultural debris/crop remnants (hay, husk, bran).

DEBRIS NOT TO BE USED

- Onion shells, dried leaves, chilies, spices, acid substances like tomato, tamarind, lemon, raw or cooked fish, meat remnants etc.
- Inorganic elements like stone, brick chips, sand or polythene.

SELECTION OF SPACE

- A raised platform under a shade, which is not exposed to direct sunlight but is open to airflow.
- A roofing is placed on the top.

USE OF VERMICOMPOST ACCORDING TO CROP

Crop	Amount to be used	Method of application
Paddy, Wheat, Jute	4-5 kilogrammes/decimal	During preparation of land
Potato, Taro, Onion, Chili, Turmeric Spinach and vegetables, Maize	5-6 Kilogrammes/decimal	During preparation of land
Fruit & forest trees	1 kilogramme per tree	At the base of the tree in a circular pattern
Banana, Papaya	1-2 kilogramme per tree	Dig out earth at the base of the plant and mix with it
Gourd, Pumpkin, Striped Gourd Cucumber, Snake Gourd, Bitter Gourd Lima Beans, Pointed Gourd, Spiny Gourd	1 kilogramme per land	During preparation of soil
Betel leaf	5-6 kilogrammes per decimal	To be mixed with the soil and applied

PREPARING VERMICOMPOST

- Vermicompost can be produced in clay pots, wooden boxes, cement pots, pucca tubs or open space. It is best to prepare a 5-6 feet or 3-2 feet tub. The height of the container has to be between 1-1.5 feet. The bottom should be porous to allow drainage of water.
- Fill the floor of the tub with 3 inch or 7.5cm brick chips and stone grinds. It has to be covered with a layer of sand to ensure that water can drain away.
- The sand is covered with a bed of hay or easily degradable organic material. Then place a layer of partially rotten organic food, cooled under a shade, on it.
- If the water content is low, spray water to ensure 50-60% of water volume.
- Then release 10 earthworms per kilogramme over the mixture. The earthworms will start feeding a minute after release.
- Cover the prepared organic composition with wet jute sack or coconut leaves. Spray a little water from time to time, but make sure that excess water is not used.

Vermicompost or earthworm manure can be prepared in two months time following this method. A dark brown top layer or formation of tea-like grains on the organic composition will mean that the earthworm manure is ready to be used.

STEPS TO PREPARE VERMICOMPOST

- Ensure use of the correct ratio of organic material, dung, soil and fertilisers for compost production (63:0.5:0.5). Mix according to the ratio and keep the pile for partial rot for 15-20 days. Afterwards, the mixture is used as food for the earthworms. In general, a container that is 1 metre long, 1 metre wide and 3cm deep requires 40kg of food. Such a container or crater can be used for feeding 1,000 earthworms.
- In initial stages, it may take longer to prepare the compost (60-70 days). But in time, the compost is prepared within 40 days because the number of microorganisms in the soil increases with time.

SAFETY PRECAUTIONS

Earthworms are vulnerable to ants, termites, cockroaches, poultry, rats and water. The compost site has to be protected from all these threats. Excessive use of poultry fasces can also prove harmful for the earthworms.

PRESERVATION OF EARTHWORM MANURE

Grainy compositions within the compost can be separated using a sieve. This grainy extract is the earthworm manure that can be preserved in poly bags for 1 year under 18-20% humidity level.

LIST OF COSTS

Description	Quantity	Per unit cost (BDT)	Total cost (BDT)
Cement ring	3	300.00	900.00
earthworm	0.75 kilogramme	2,000.00	1,500.00
Cement platform	3	150.00	450.00
Signboard (3 feetx2 feet)	1	500.00	500.00
Polythene, bamboo scaffold and sicks for shade	Altogether	900.00	900.00
Miscellaneous (transport, register and others)	Altogether	250.00	250.00
		Total	**4,500.00**

PROFIT/LOSS ANALYSIS

Vermicompost or earthworm manure is a suitable method of generating employment and income. It is being considered as a profitable business which requires little investment. This successful business is currently the livelihood and earning source of many poverty-stricken families.

Production and sale of vermicompost is generating employment of poor farmers and women. They are making vermicompost easily accessible in the markets.

One farmer can easily produce compost within a short period of time (60-70 days in the initial phases and 40 days in the later phases). Production of vermicompost requires a potential investment of BDT 4,500. This investment can produce at least 600kg of vermicompost or earthworm manure.

The compost can be sold in the local markets at BDT 25/kg. Production of 600kg of the compost can fetch BDT 15,000. A farmer can obtain BDT (15,000-4,500)=10,500 as profit from vermicompost/earthworm manure production.

Arbitrary use of chemical fertilisers a are turning arable lands infertile. The issue of public health is also under threat. Earthworms are natural ploughers of land. Earthworm manure is essential in protecting the health of the soil. It is also economically profitable. Soil scientists are in the opinion that soil must contain at least 5% organic content. But, the organic content in our soil anywhere in the country has come down to 1% on average. If this continues, our lands will no longer remain arable. It is high time to save the lands, agriculture and people, and ensure safe food while protecting the biodiversity of the environment.

The infrastructure can be used for 4-5 years and will not require any further maintenance. No additional cost will be required for earthworms. On the other hand, more compost will be produced. Therefore, this compost can provide a regular income between BDT 5,000 – 6,000 for the beneficiaries. With proper packaging, the vermicompost can fetch BDT 40 for each kilogramme in the local markets. This will increase the production cost.

SOURCE

1) Guidelines for Implementation of Exhibitions on Financing in the Fiscal Year 2017-18 – Department of Agricultural Extension
2) National Agriculture Technology Programme (DoAE)
3) Chapal Krishna Nath, Upazila Agriculture Officer, Monpura, Bhola
4) Krishi Katha, Agrahayan 1420

Cage aquaculture

CAGE AQUACULTURE

‘Cage Aquaculture’ has recently gained popularity in Bangladesh. But it has been in practice all over the world. It is believed that cage aquaculture began in China’s Yang Zhee river about 750 years ago. Due to technological excellence, modern cage aquaculture has become widely popular. It involves use of sustainable cages in open or enclosed water bodies for commercial production of fish in a densely populated space.

‘Cage Aquaculture’ is a modern and ecosystem-based friendly way of fish farming. In Bangladesh, cage aquaculture was introduced by Bangladesh Army in Chandpur district’s Dakatia River in 2002. So, this method is also known as Dakatia Model in this country. This method can utilise cages as ponds and be used in different water bodies as an effective technique of intensive fish farming.

SUITABILITY IN COASTAL REGIONS

‘Cage Aquaculture’is a highly suitable and effective means of climate resilient alternative livelihood for the landless poor communities in the coastal regions. This method can be used in rivers, and canals to improve the livelihood of the landless or climate refugees.

ADVANTAGES

- Floating cages do not require pond-like water bodies.
- Can increase the fish yield by utilising the flowing waters of rivers and canals.
- Fish wastes flow away with the water; therefore, the water does not become polluted.
- Wasted fish food used provides food for the natural fish population in the rivers or canals.
- Because of flowing water, the water inside the cages is constantly replaced. This can be utilised to farm fish in higher density, compared to ponds, for three times in one year.
- Fishes are not washed away in flood.
- This method can be used for saline resilient fish farming.
- The structure of the cage can be used for a long time.

METHOD

In order to cultivate fish in this manner, one has to make a cage first. The frame of the cage – 20 feet in length, 10 feet in width, and 6 feet in height – is constructed with iron pipes or rods. The floating cages can be used to farm fish in two ways. In the first method, the iron structure is fitted with nets and floated. To keep the nets taught under water, it can be tied to boulders or other heavy objects at the corners. To ensure that the structure stays floated, empty plastic drums can be tied in the corners. It has to be ensured that the cage is submerged in 3-4 metres of water throughout the year. In the second method, a series of bamboo frames are constructed, fitted with nets and placed at a safe distance from the bank. It has to be firmly tied to strong poles at a place where water stays 3-4 metres deep throughout the year. If iron is used for, the cages can be kept afloat using strong plastic drums or bots.

PLACEMENT

- The cage is suitable to be placed where the water has a single direction of flow and calm tides. It is best not to place the cages where the waves are intense. The advisable level of water flow for cage aquaculture is 4-8 inches per second. It is advisable to avoid places where the flow is more than 16 inches per second.
- The water should have at least 10 feet of depth. Though flowing water usually prevents accumulation of debris at the bottom which is harmful for the fish, it is best to keep the bottom of the net 3 feet above the riverbed.
- The place has to be near a locality to ensure security.

- The cages should be easily accessible for transportation of the produce.
- The placement should be in such that it does not affect the navigation of river vessels.
- The cages should be placed far from any source of industrial pollution or agricultural land to avoid unwanted death of the fishes due to pollution from industrial wastes or pesticides.

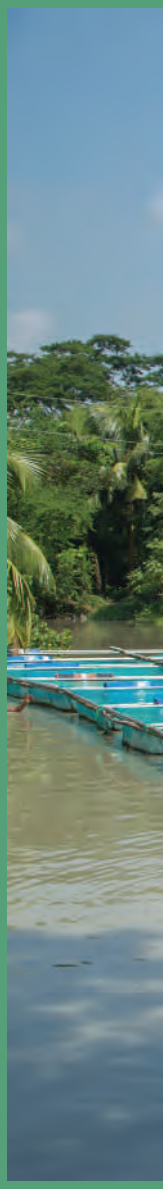
SUITABLE BREEDS OF FISH

'Cage Aquaculture' is a diversified method of fish farming. It can hold minnows in higher density compared to ponds. Fishes of the cages are dependent on the supplementary feed provided. Unlike in the ponds, these fishes will not be able to roam freely and look for natural sources of food. Since the fishes are bred in captivity, it is best to avoid aggressive breeds. Also, weaker fishes will not be able to hide or survive the physical abuse during cage management. Continuous water flow has to be ensured. Without it, the waste produced by the fish will create a challenging environment in the cages. These factors have to be considered along with the regional geography to select the most suitable breed of fish for 'Cage Aquaculture'. Generally, the selection of fish breed takes the following into consideration:

- Good growth in its natural environment and requires average management.
- Capable of living in high density.
- Fries are easily accessible in the markets.
- Has a higher resistance to diseases.
- Good response to supplementary feed.
- Has lower tendency to jump out of the cages.
- Capable of withstanding higher levels of physical abuse.
- High value in local and international markets.

In consideration of the above, the below breeds of fishes have been found suitable for 'Cage Aquaculture'in the southern regions:

- Tilapia,
- Koi,
- Barramundi,
- Grass carp,
- Common Carp,
- Snakehead Murrel,
- Olive Barb, etc.



SIZE OF THE CAGE

It is best advised to use strong material for netting the cages to avoid wear and tear by crabs, turtles, monitor lizards and other harmful animals. Usually, two types of nets are used for the Dakatia Model cages: 20 feet x 10 feet x 6 feet, and 10 feet x 10 feet x 6 feet. The mesh width of the nets is best to be 3/4 inches to 11/4 inches. This ensures that clear water of the river can easily pass between the nets and the water in the cages is easily replaced.

CREATING FRAMES AND SETTING

The frames of the cages are constructed in 20 feet x 10 feet in size with 1-inch GI pipe. Another 10-foot-long pipe is welded along the middle. This frame can be used for cages both 20 feet x 10 feet and two 10 feet x 10 feet in size. After every two frames, 3 plastic drums can be used to ensure floatability of a series of cages. The cages can be held in place with anchors. Each frame is fitted with separate nets.

PRODUCING AND STORING MINNOWS

Fishes produced in 'Cage Aquaculture' can be harvested in 5-6 months. Due to rising popularity, hatcheries in the country are producing mono-sex Tilapia fries. Other species are also being produced in cages. It is possible to farm local varieties of Koi, Snakehead Murrel, Heteropneustes, and Catfish in cages; but in such cases the main challenge proves to be the collection of minnows. If the minnows and high protein feed can be ensured, these local breeds can be easily farmed in 'Cage Aquaculture' with success.

The density of fish storage can be estimated in consideration of the water flow, mesh size of the net, depth of the water, expected size of fish, quality of feed and investment capacity. As example, the cages as advised previously can hold 30 to 40 mono-sex Tilapia fries per metre cube. During storage, the mesh size of the nets has to be small enough to prevent outflow of minnows from the cage. During storage the minnows have to be at least 25-35gm in size.

FEED

Tilapia farming in 'Cage Aquaculture' requires 28-30 percent protein content in the supplementary feed. The feed can be obtained from the market or can be produced by self. However, the feed has to be floating feed. Feeds that will sink may drop out from the bottom of the cages and create debris that might later rot and affect the health of the fish. This is why researchers have advised to use floating feed for 'Cage Aquaculture'. Feed can be provided 2-3 times a day for optimum results.

SELECTION OF FISH

For the first attempt, minnows are generally selected three weeks into storing in the cages (the time may vary according to the species of the fish). Fish selection is best carried out in the morning hours or before dusk. An ideal time to select fishes can be when the flow of water increases in the river. During this time, the water inside the cage is replaced more frequently. Fish selection can be carried out multiple times, if necessary, before marketing.

HARVESTING

‘Cage Aquaculture’ does not require netting fishes as necessary in the ponds or water bodies. Fishes can be harvested easily from the cages using a hand net. Other easy nets can also be used effectively. Harvest of fishes in ‘Cage Aquaculture’ does not require additional investment or costs for a farmer.

COST OF PLACING 50 CAGES

Serial	Item	Quantity	Cost per unit (BDT)	Total cost (BDT)
01	Sewn nets	50	3,500.00	1,75,000.00
02	Barrels/Drums	153	1,450.00	2,21,850.00
03	1-inch GI pipe	3,600 feet	80.00	2,88,000.00
04	Connecting pipe for frames	350	100.00	35,00.00
05	Anchor	12 (20kg each)	2,400.00	28,800.00
06	Chains for anchor	5 coil	5,000.00	25,000.00
07	Bamboo	100	200.00	20,000.00
08	Nylon thread and rope	5,000		5,000.00

PRODUCTION COST FOR 50 CAGES

Serial	Item	Quantity	Cost per unit (BDT)	Total cost (BDT)
01	Collection of minnows	60,000	2.00	1,20,000.00
02	Fish feed	24,500Kg	28.00	6,86,000.00
03	Labour cost	3 (18 months of labour)	3,000.00	54,000.00
Total				**8,60,000.00**

FISH PRODUCTION (MONO-SEX TILAPIA)

Minimum production in each cage	350kg
Minimum production in 50 cages (350x50)	17,500Kg
Retail price of fish (per kg)	BDT 100.00
Total fish sale	BDT 17,50,000.00
Net profit (sale – investment)	**8,90,000.00**

Bangladesh has an abundance of suitable rivers for 'Cage Aquaculture'. Farming fish in this method is easily possible. It can contribute to national fish production. Tilapia fish is high in demand both at home and abroad. Communities living in the coastal regions, especially the poor population, earn a livelihood from fishing in the rivers. It is possible to unite these poor communities and increase fish production. 'Cage Aquaculture' can be an opportunity for the natural species of fishes to breed and populate the rivers. Like other countries in Asia, we can also produce quality Tilapia in 'Cage Aquaculture' and earn foreign currency. With collected efforts from all concerned communities including policymakers, exporters and others, we can take steps to enter the international Tilapia market.

Source

1. Cage aquaculture – agriculture information service (AIS) – Government of the Republic of Bangladesh
2. Cage aquaculture method; advantages of cage aquaculture (http://www.agriculturelearning.com/%E0%A6%AE%E0%A7%8E%E0%A6%B8%E0%A7%8D%E0%A6%AF-%E0%A6%9A%E0%A6%BE%E0%A6%B7-2/)
3. Method of cage aquaculture (https://akkbd.com/%E0%A6%96%E0%A6%BE%E0%A6%81%E0%A6%9A%E0%A6%BE%E0%A 7%9F-%E0%A6%AE%E0%A6%BE%E0%A6%9B-%E0%A6%9A%E0%A6%BE%E0%A6%B7/)

Meeting of the Forest Resource Protection Groups (FRPG)

Fish farming in Biofloc technique

FISH FARMING IN BIOFLOC TECHNOLOGY

The population of the world is increasing day by day. Ensuring food security of this growing population requires expansion of food production sectors like fish farming. The fish farming sector is increasingly becoming competitive due to use of effective technology to boost fish productivity, quality, sustainable technology, biosecurity, and growing market demand. The objectives of sustainable fish farming are to conserve natural resources like water and soil, farm fishes in high density, develop sustainable farming methods, reduce adverse impacts on the environment, reduce costs, and increase the profit margin of farmers. 'Biofloc Technology' is one such sustainable method of fish farming. This technique can be used to produce higher quantity of fish in a small space without the using ponds or water bodies. It can contribute to the achievement of sustainable development goals (SDGs) of Bangladesh Government.

WHAT IS BIOFLOC

Biofloc is a mixture of protein rich organic materials and microorganisms like diatom, bacteria, protozoa, algae, fish excretes, leftover feed, organic remains and other organisms. This effective technique of fish farming ensures highest use of nutrient contents for fish farming that requires very few or change of water. The fundamental concept of 'BioflocTechnology' is that it catalyses the growth of heterotrophic bacteria and ensures a high level of carbon and nitrogen in the water, thereby converting harmful ammonia to protein for the fish. Additionally, it improves the quality of the water by ensuring an equilibrium of carbon and nitrogen in it and reduces the risk of contamination by harmful organisms. This is an alternative and sustainable technology which continuously recycles the existing nutrient content in the water. This type of fish farming has become a sustainable because it does not require water change and assists growth of beneficial microorganisms.

FISH FARMING IN BIOFLOC TECHNOLOGY

‘Biofloc Technology’ is an ecosystem-baed method of fish farming. It is used all over the world to produce a variety of fishes. But, the use of this technique is yet to be popular in our country. This method can be used to farm local fish breeds like Tilapia, Common Carp, Catfish, Prawn, Stinging Catfish and others. However, it is advisable for first timers to start with Tilapia.

SUITABILITY IN THE COASTAL REGIONS

Fish farming in the coastal regions are being greatly impacted by rising sea levels, inundations, flooding, penetration of saline water, increasing salinity in the soil and other effects of climate change. ‘BioflocTechnology’ can be a highly suitable and effective climate resilient means of alternative livelihood for the landless communities of the coastal regions . With reasonable levels of interest and the technical know-how, this technique can be easily used to farm fish in the yard and become a successful fish farmer. Due to a number of limiting factors imposed by climate change, the Biofloc technique is a suitable method of fish farming in the coastal region and can ensure an ecosystem-based alternative livelihood system for the coastal communities.

ADVANTAGES

High Organic Security: This technique uses beneficial bacteria (probiotic bacteria) which improves the quality of the water and reduces the risk of contamination by harmful microorganisms; thereby improving the organic security of the water by controlling harmful organisms.

Removes ammonia: Beneficial bacteria within the Biofloc ecosystem recycles ammonia, the main harmful factor in fish farming, to produce essential nutrients required for physical growth of the fish.

Ensures growth: Biofloc aquaculture ensures growth of fish by improving the quality of water, controlling harmful organisms, and recycling the fish wastes to essential nutrients for the fish.

Source of ideal protein: Useful bacteria (probiotic bacteria) recycles the harmful ammonia and outside carbon sources and turns them into protein for the fish. Also, diatom, protozoa, algae, fish waste, feed wastes and organic remains assist in producing bacteria that provides ideal protein for the fish.

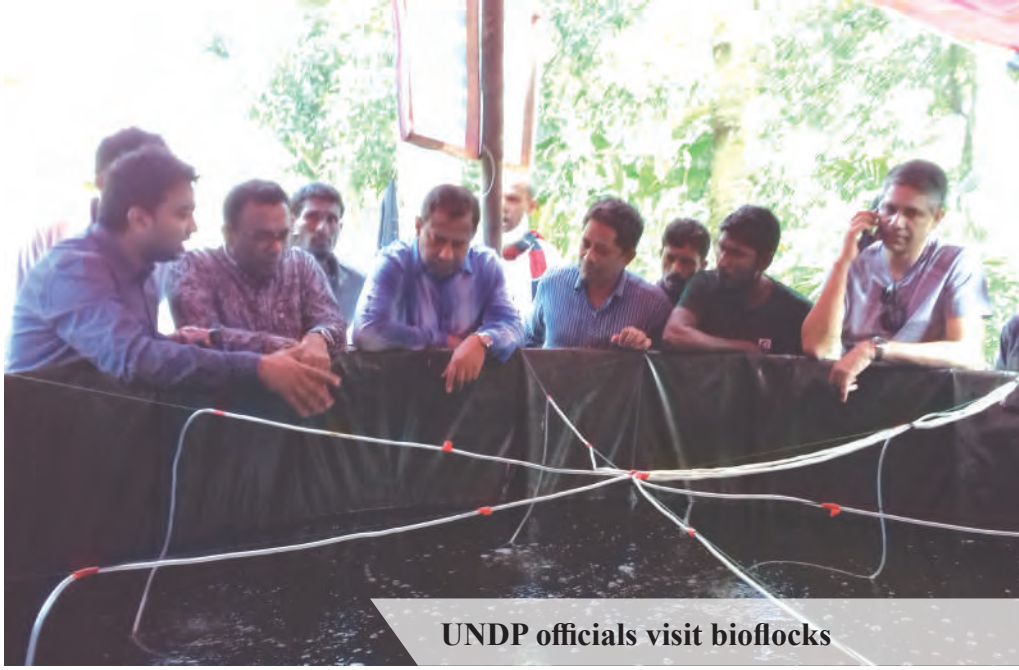
Reduction in Feed Conversion Rate (FCR): The profit in fish farming depends on the feed conversion rate. Biofloc method recycles the feed waste, fish waste and ammonia in the water and converts them to essential nutrients for the fish. Thus, less amount of protein-rich supplementary feed is required. This ensures a low Feed Conversion Rate (FCR) in comparison to other techniques.

Low cost and high profit: About 60% of the investment in fish farming is spent on feed. 'BioflocTechnique' recycles organic content and produces essential nutrients for the fish. Thus, less feed is needed for farming and more profit is earned.

Analysis of results of field activities of project officials

Easy farming method: 'Biofloc Technology' is an easy farming technique. With proper training, fish farming can be easily carried out in 30-40 tanks.

Requires less water change: This technology recycles harmful ammonia, one of the prime deterrents in fish farming, and maintains the quality of the water. Thus, the water in the tank requires low maintenance.



UNDP officials visit bioflocks

Maximum use of land and water: A lot of fish can be farmed in small tanks under this technique. It also uses low amount of water to farm fishes in high density, ensuring highest use of land and water.

Environment friendly aquaculture: This technique uses the natural beneficial bacteria. Thus, this method of farming does not require chemical elements and antibiotics. Therefore, this is an environment friendly method of fish farming.

Reduces risk of disease: Beneficial bacteria in the Biofloc aquaculture controls the harmful organisms within the water and reduces the risk of potential diseases.

FACTORS TO CONSIDER

Supply of electricity: Biofloc technology is used to farm a large quantity of fish in small tanks. This requires uninterrupted supply of oxygen, which has to be ensured by a running supply of electricity. Without uninterrupted supply of electricity, there is risk of fish deaths caused by oxygen deficiency. All the fishes in a tank may die if the oxygen supply is stopped for an hour.

Regular check of water quality: The quality of water has to be monitored regularly to check the levels of ammonia, nitrate, flock density, etc. Necessary steps have to be taken if these elements are present at irregular levels.

Temperature change: In our country, day and night time temperatures change by significant margins, which is not ideal for flock development. Necessary steps have to be taken to control the temperature.

Technical capacity: Biofloc technology requires the maintenance of a trained and technically-skilled workforce. Major loss may be incurred without the necessary knowledge and skills to monitor water quality, feed, flock density, etc.

Flock creation in water: In the first dose, 5ppm probiotic, 50ppm molasses, 5ppm yeast, and 1 litre per tonne water has to be prepared as a culture in a plastic tub and supplied with oxygen for 8-10 hours. On the second day, 1ppm probiotic, 5ppm mollasses, 1ppm yeast and one litre water per tonne has to be prepared in the same way and applied every day.

MONITORING

If the flock level is sufficient the water will turn green or brown and small particles will begin to surface. If tested, the water will show null presence of ammonia. The flock density has to be 0.3gm per litre. They will start reproducing on application of duckweed.

CREATING A TANK

Tank structure: the circular frame of the tank has to be made with grade rods. The base of the tank has to be prepared with concrete cement casting, in the same measurement of the circular frame. A water outlet has to be placed in the middle of the base. The circular frame then has to be placed in the concrete. If the floor is hard enough, a concrete base may not be required and be replaced with a thick sheet of polythene. Then the insides of the prepared enclosure has to be covered in high quality tarpaulin. A thick polythene layer is placed on the tarpaulin before it is loaded with water.

Aerator pump: To ensure uninterrupted oxygen supply in the Biofloc tank, one aerator pump has to be placed. A 6 feet radius and 4 feet high enclosure tank can be used to farm almost 30,000 stinging catfish.

Water source: Good quality water from deep tube well, river, large water body, lake, rain etc. can be used.

Preparing water: The tank has to be disinfected with bleaching powder before loading it with the water.

DESIRED PROPERTIES OF WATER FOR FISH FARMING

- Temperature between 25-30 degrees Celsius.
- Water color to be green, light green or brown
- Dissolved oxygen level is 7-8mg or litres
- pH level is 7.5-8.5
- Alkalinity is 50-120mg or litre
- Water depth is 3-4 feet
- Flock density is 300gm or tonne

- TDS 14,000-18,000mg or litre
- Salinity is 3-5ppt
- Iron 0.1-0.2mg or litre
- Water transparency is 25-35cm
- H2S 0.01 or litre
- Phosphorous 0.1-3 mg or litre
- Nitrate 0-3mg or litre
- Nitrite 0.1-0.2mg or litre
- Ammonia 0.01mg or litre
- Calcium 4-160mg or litre
- Hardness 60-150mg or litre

This environment friendly and sustainable technique can be used to produce large quantities of fish in a small space. If this technology can be propagated in the field level, the fish production of our country can be raised significantly. This will assist Bangladesh Government to achieve the sustainable development goals (SDGs).

CRAB FATTENING

CRAB FATTENING

Crab fattening can provide a climate resilient livelihood for the climate vulnerable coastal communities. It is a profitable venture for areas that remain inundated under saline water for most of the year in the coastal regions of Bangladesh. About 5-6 lakh people in the country are involved with crab fattening. The process is climate resilient and profitable; suitable to be carried out throughout the year. It is possible to be done in groups or by individuals, especially women.

Crab fattening can yield harvest every 4 months when the crabs reach a weight ceiling of 200-250gm. It is a dietary delicacy abroad and therefore can fetch plenty in foreign earnings. The crabs can be sold in the domestic market at BDT 500-700 per kg. This livelihood activity is acceptable among the coastal communities because it is cost effective, takes little time, requires limited investment and can be easily operated.

Bangladesh can produce 16 species of crabs among the 133 species available in the world. Shila crabs are the most popular breed cultivated in our country. Crab produce is exported to China, Taiwan, Thailand, Singapore, Malaysia, Japan, Hong Kong, America and the European Union.

REQUIREMENT

- Cages to prevent crab loss during inundation, limestone, and trash fish, prawns and other fish as feed (use of squids can bring down investment significantly). Crab zoeas weighing 50-60gm can be collected from the mangrove forest areas.

ADVANTAGES

- Can be farmed in fallow ponds abandoned due to salinity or inundation.
- Climate resilient crab fattening can be a source of animal protein and financial profit.
- Suitable for inundated and salinity-affected coastal regions.
- Profitability increases with utilisation of fallow ponds or canals.
- Contributes to climate adaptability of the coastal communities.
- Mangroves are nurseries for crabs, and therefore, zoeas are readily available.

GOALS AND OBJECTIVES

- Immature, soft shelled and inexpensive crabs can be fattened in bamboo cages for 10-20 days to be grown into mature crabs which can fetch more price.
- Can be a source of alternative livelihood for the coastal communities of Bangladesh.

ADVANTAGES

- Cage management issues like maintenance, feeding and crab collecting is convenient. Therefore, crab fattening can be carried out by any member of the family.
- Hard shells can be detected easily and crabs can be readily sold in the market.
- Crabs are not lost during inundation, flooding or tidal waves because they are grown in cages.
- Zoeas mature quicker.

PROCESS

Crab fattening is the process by which immature zoeas (baby crabs weiging approximately 180-200gm) are stored in cages for 10-20 days and fattened by feeding and maintenance.

CAGES

Materials: bamboo, threads, mesh wires.

Dimension: cages are 2 metres in length, 1 metre in width and 0.3 metres in height. Each cell of the cages should be 0.2x0.2x0.3 metre cube (length x width x height). One cage can host 50 cells. The size and dimension of the cage can vary. Bamboo should be spaced in consideration that it will not trap the limbs of the crabs and cause limb loss.

STORAGE

Immature soft-shelled crabs (which do not contain eggs) weighing 180-200gm each have to be stored. It is to be considered that storing bigger crabs can fetch higher earning. One healthy crab should be grown in each cell.

Monitoring of marketing activities by Sub-Asst Fisheries Officer

MAINTENANCE

Cages should be cleaned every few days to ensure that the gaps of the cages stay open to allow flow of water. The gonads of the crabs should be checked after 8-10 days of storage to see if they have achieved maturity. A fully opaque gonad which will not allow any light to pass through its legs will mean that the crabs have achieved maturity. Gonads can also be tested by shining torch light on the crab legs in a dark place.

FEEDING

Trash fish, tilapia, swamp eels, snails, oyster meat, small shrimps and shrimp heads can be used as feed for the crabs. Crabs have to be fed 8-10% of their body weight which have to be equally divided for feeding twice a day – in the morning and evening. It is ideal to have 30-40% protein content in the feed

EXTRACTION

- The cages can be surfaced and the crabs collected with tongs.
- Crabs have to be tied up with threads after collection to prevent any movement.
- Crabs should be extracted and tied carefully to avoid any limb loss. Crabs with lost limbs will fetch less money.

Orientation in determining crab grading

GRADING AND MARKETING

Female crabs are ready for harvest when their gonads are opaque and males are ready when their shells harden. Crabs are graded separately according to gender and weight, and packed separately for markets. The below table provides information about grading of crabs:

Female crab					
Grade	F1	KS-1	F2	F3	F4
Weight (gm)	>180	>180	150 - <180	120 -< 150	<120
Price (BDT)	250 -1000	100 -350	200 -500	150 -500	100 -300

Male crab					
Grade	XXL	XL	L	M	SM
Weight (gm)	> 500	> 400	> 300	> 200	> 100
Price (BDT)	250 -800	200 -650	150 -450	100 -350	50 -200

Source

Mud Crab aquaculture A practical manual: ACADEMIA
Description of mud crab (Scylla spp.) culture methods in Vietnam : ACADEMIA
Technical guidelin e of Crab culture: SDC Shomoshti project, CARE Bangladesh

NURSERY MANAGEMENT OF CARP FISHES

Irregularity in rainfall influenced by impacts of climate change is gradually becoming evident every day. It has negatively affected traditional fish farming methods. Increasing temperature, no or insufficient rainfall is causing drought in the southern region of Bangladesh and affecting the breeding of fishes. Salinity and rising sea levels are creating challenging environment for the fisheries. These factors are contributing to dwindling yield of fish from open water bodies. It is now necessary to invent, develop and expand newer methods of short-term fish farming. Fish breeds that can survive in less water and higher temperatures have to be bred in captivity for the purpose.

It is essential to introduce newer methods and technology in farming carp species. Nursery management plays a key role in increasing the carp production. Farmers can reap good profit by obtaining feeding larvae or fries of the carp breed from hatcheries and growing them to fingerlings (3-4 inches in size) for sale. Profit can be maximised if the carp larvae or fries are grown during the monsoon.

SCIENTIFIC NURSERY MANAGEMENT

Nurseries play an essential role in the production of the carp. Management of carp nurseries is impossible without necessary skills and knowledge. Nursery farming of this species involves storing the larvae or fries in small water bodies or ponds and growing them into fingerlings for farming in bigger water bodies. Small ponds or water bodies where the larvae are grown into fingerlings are called nursery ponds.

Nursery management is the process by which feeding larvae or fries are grown into fingerlings. The nursery involves growing the feeding larvae or fries of 3-5 days of age into fingerlings of 3-5 inches. The process is profitable and requires adoption of latest methods and technologies for profit maximisation.

Features of nursery pond: Any shallow and seasonal pond or water body can be used as a nursery pond. It is advisable to create the nursery in a small pond or water body.

FEATURES OF A NURSERY POND

- Pond is located in open space.
- Easily accessible.
- Length is oriented north-south.
- Pond area is 10-25 decimals.
- 2.5-3 feet deep water
- Loamy, silt loam or clayey loam soil.
- Low amount of silt in the bed.
- Free from waterweed.
- Has tall dykes and is invulnerable to flooding.
- Dykes free from weeds or hedges.
- Availability of water drainage and supply.

Nursery management can be divided into two phases: 1) Nursery pond management, and 2) Rearing pond management.

A) Nursery pond management: Larvae or fish fry aged 3-4 days are reared and fed in the nursery ponds. Larvae growth and fish production depends on proper nursery management.

1) Weeding: Weeds in the nursery pond and on the dykes have to be cleaned during the December-April period. By doing so:

- The pond is exposed to sunlight.
- Natural feed for the larvae grows.
- Production of fingerlings increases.

2) Pond dyke's maintenance and repairing

It is ideal to drain out the water of the nursery pond once in every year. The water drain increases the height of the dykes. It is the ideal time to carry out repair work along the slopes and remove clay soil from the pond bed. It is best advised to plough the soil bed thoroughly. The dyke slope should be maintained in 1:2 ratio.

Release of fingerlings in the pond

ADVANTAGES OF DYKE AND BED REPAIR

- Ploughing exposes the bed soil to sunlight, reducing harmful germs and increasing the fertility of the soil.
- Maintains the quality of the bed and water of the pond.
- Removes harmful gas from the water bed.
- Eases the netting process during extraction of fingerlings.
- Tall and maintained dykes assist in farming and maintenance of fries.
- Prevents infiltration of contaminated water from outside.
- Prevents infiltration of carnivorous species from outside.

3) Removing waterweed: It is essential to remove all floating and submerged waterweed and algae from the water. Waterweed will:

- Hamper the movement of the fish.
- Consume the nutrient content of the water and soil; affecting the growth of natural fish feed.
- Algae may cause death of fingerlings during extraction.

Method of weeding:

- Manual labour.
- Chemical treatment: 8-10gm copper sulphate per decimal land can eliminate algae in 3-4 days.

Advantages of weeding:

- Exposes water to sunlight and assists in growth of natural fish feed.
- Kills germs harmful for the fingerlings.
- Allows larvae or fries to move freely and eases netting during extraction.
- Eases feed distribution for the fries.
- Positively affects the production of fingerlings.

4) Removing carnivorous and undesired fish: Carnivorous breeds can eat and destroy the carp larvae or fries. Other undesired breeds can consume the feed provided for the carp fries. It is therefore essential to remove harmful and undesired breeds like snakehead murrel, spotted snakehead, great snakehead, helicopter catfish, bronze featherback, elongate glassy perch let, puntius, Indian carplet, silver razorbelly, stinging catfish, catfish, and koi from the pond. These fishes can be removed by draining out the water before preparing the nursery pond.

ADVANTAGES OF REMOVING CARNIVOROUS OR UNDESIRED FISH

- Survival rate of carp larvae or fries is higher.
- Increases the growth of the carp larvae or fries.
- Ensures maximum utilisation of natural feed.
- Reduces risk of diseases.
- Production of fries increases.

METHODS OF REMOVING CARNIVOROUS/UNDESIRED FISH

Draining pond: Removing the water with a shallow machine is the most effective method of confiscating carnivorous or undesired fishes from the pond. Once drained, it is advisable to plough the pond bed and expose the soil to about 15 days of bright sunlight. February-April is the ideal time for draining the pond because it requires less time and can be economically profitable.

Intense netting: intense netting with narrow mesh nets can also reduce carnivorous or undesired fishes if it is not possible to dry out the pond water. Rotenone 9.1 can be applied to the water to poison the carnivorous or undesired fishes in water. Rotenone can be applied at 25-30gm per feet of water depth. It is most effective if applied during 10-11am in a sunny morning. One third of the powder has to be molded into balls and mixed with the water. The remainder has to be mixed with water and applied into the pond. Fishes will be poisoned every 20-30 minutes. Dead fishes have to be removed with net. Netting will cause stirring of the water and increase the effectivity of the poison. The poison remains in the water for upto a week. Fishes that die in rotenone poisoning are safe to consume.

ADVISE

- Cover hand with gloves and nose with cloth while mixing rotenone.
- Apply rotenone in the direction of the wind.
- Wash hand and clean utensils thoroughly with soap water after using rotenone.
- Keep rotenone out of reach of children.
- Effectivity of rotenone is decreased if applied during cloudy or rainy weather.

Fishery Beneficiary Group Meeting

5) Limestone treatment: Apply 1kg limestone per decimal land to the ploughed bed and along the dyke after draining pond water. This will remove parasites in the soil and increase alkalinity of the pond. The process also frees nutrient content of the soil for growth of natural feed. The limestone has to be dissolved in three parts water and stored overnight in earthen pot. Mix more water after the solution cools. Then apply the limestone solution evenly in the soil bed and along the dykes. Fill the pond after at least three days of limestone treatment. If rotenone is used, limestone treatment has to be carried out 3-5 days after the poison treatment.

Use of limestone: Use 6kg limestone per decimal of pond land if the pH level of the water is between 3-5, 4kg for pH level between 5-6, and 2kg per decimal for pH level between 6-7.

A healthy pond can be maintained with limestone treatment in every three months. Use a one-fourth or half the initial amount of limestone for quarterly treatment of pond.

Identifying good limestone: Dissolve a pinch of the limestone sample in water inside a transparent glass. Good quality limestone dissolves with bubbles and generates heat. The short test can be carried out in transparent tea cups while purchasing in the market.

6) Filling pond with water: Fill the pond with water 2-3 days after limestone treatment. It is advisable to use water from deep or shallow tube well to fill the pond. Filters must be used if water is transferred from another pond to prevent entry of carnivorous or undesired fish.

7) Fertiliser treatment: The pond has to be treated with organic and inorganic fertilizer for growing natural feed for the fish. Fertilizers increase the nutrient content in the soil and water and assists in growth of microorganisms which are feed for the carp larvae or fries. These microorganisms are known as plankton. Organic fertilizer has to be applied to the ploughed soil bed. Bran can be used at the quantity of 0.5kg per decimal of land. Inorganic fertilizer has to be applied to the water after filling up the pond.

Fertiliser treatment has to be carried out 1-2 days after limestone treatment and at least 4-5 days before storing carp larvae or fries. Fertiliser treatment is advisable during 9-10am in a sunny morning. This ensures proper utilisation of the fertiliser and growth of natural fish feed. For quick growth of natural fish feed, use 300-400gm/decimal bran and 80-100gm/decimal urea. The mixture of bran and urea has to be mixed with three parts water and left for 12-24 hours before application in the pond during 10-11am of a sunny morning.

Fertiliser	Type of fertiliser	Quantity (per decimal)	Application procedure
Organic fertiliser	Dung or compost	6-10kg	**Dried pond:** mix fertiliser with ploughed soil in the pond bed and mix thoroughly. **In water:** Mix with water and apply evenly in the water throughout the pond
Inorganic fertiliser	Urea	75-100gm	Mix TSP with water overnight and apply with urea during the morning hours (9-10am) in the deep parts of the pond.
	TSP	75-100gm	
	MOP	25-50Kg	

8) Testing amount of natural feed in water: The pond water needs to be tested for plankton growth before storing carp larvae or fries. Natural feed is produced in the pond 3-4 days after fertiliser treatment. Production of natural feed will be indicated by a reddish green or brownish green colouration of the water. The water has to be tested 4-5 days after fertiliser treatment to measure the amount of natural feed. This is an essential step because the nutrient content required for growth of carp fries comes from this natural feed.

9) Poison testing: Carp fries can die in poisonous water. The water needs to be tested for poison 1-2 days before storing fries. Take some pond water in a pot for and release 10-15 fries. Observe the fries for 7-8 hours to see if they remain alive. Water free of poison will be able to keep the fries alive. If the fries die, the water is poisonous and it is advisable to wait for some more time before storing carp fries.

10) Remove harmful microorganisms: Microorganisms grow in the water 3-4 days after fertiliser treatment. The growth becomes apparent with a reddish green colouration of the water. The microorganisms include plankton and other harmful elements like insects and tadpoles. These harmful microorganisms can destroy fish larvae and compete for feed. It is essential to remove these harmful microorganisms before they can cause damage.

LARVAE MANAGEMENT

Selection: it is ideal to grow one variety of carp larvae in the nursery pond. A number of factors including availability of carp larvae, demand of the carp larvae, pond type and size, farming method and experience, and financial affluency of the farmer has to be taken into consideration for growing quality carp larvae or fries in the nursery pond for profit.

In consideration of the mentioned factors, rui, catla, mrigal, silver carp, grass carp, mirror carp, bighead carp, common carp, pangasius, Thai koi, Vietnamese koi, stinging catfish, catfish and monosex tilapia are considered as popular choice of larvae in our country.

IDENTIFICATION OF FRIES

Larvae: Babies have sacs in their stomach for 2-3 days after hatching. They do not eat outside food.

Fry: The belly sacs disappear. The fries look like mosquito larvae. Can eat boiled egg yolk, small floating insects, flour, and bran.

Advanced fry: The larvae matures to one-third the length of a finger or about 1 inch in size. These fries can eat small insects, algae and powdered bran. It takes 8-10 days for larvae to mature into advanced fries.

Fingerlings: When the fries grow to finger length (7-15cm) or 3-4 inch in length. It takes about 40-60 days for advanced fries to mature into fingerlings.

Climate tolerant fish training

Fries per gram according to carp breed

Serial	Breed	Average number of fries/gm
01	Catla	400 pieces
02	Rui	475 pieces
03	Mrigel	400 pieces
04	Silver carp	325-400 pieces
05	Grass carp	450 pieces
06	Mirror carp	450 pieces
07	Bighead carp	300 pieces
08	Thai Olive barb	700-800 pieces

Storage density: Carp larvae or fries of 3-5 days age can be stored at a density of 40-50gm per decimal of the nursery pond. Initial growing of the larvae is carried out in small ponds for 10-15 days. Advanced fries are transferred to bigger ponds for farming. It is advisable to grow one single breed of fries in a nursery pond. Maintaining different varieties of fries in the same nursery pond yields poor results.

Adaptability of larvae: Death or loss of carp larvae or fries can be averted if the fries adapt to the nursery pond. Adaptation can be achieved by:

- Float the larvae containing bag or pot in the pond water for 15-20 minutes.
- Gradually open the mouth of the bag or pot and release the larvae into the pond.
- Wait for the temperature of the bag and the pond water to equate and release the larvae. Wade the water gently with the bag to allow the larvae to swim out of the bags and into the pond. This action has to be carried out for 25-30 minutes.

CONCLUSION

Good nursery ponds are essential for the production of healthy carp larvae or fries. The fries are sensitive in nature and does not grow well without proper maintenance of the nursery ponds. Our villages have an abundance of small ponds at the homesteads which can be easily utilised for production of carp fries. This can ensure supply of quality carp fries across the localities and contribute to creation of employment in the rural areas, increase the income for farmers, increase fish production and ensure utilisation of family labour and resources.

KHAKI CAMPBELL DUCK FARMING

Bangladesh has 19 coastal districts with a population of about 3.5 crore. Majority of this population is extremely poor. Most of them do not have their own land to cultivate and are therefore forced to work as fishermen or agriculture labour. These vulnerable families can reduce their poverty by farming Khaki Campbell ducks.

INTRODUCTION OF KHAKI CAMPBELL DUCK

The Khaki Campbell species of duck was first created at a duck farm called Cherry Valley in England during 1901-1905. One Ms Campbell cross bred the Indian Runner and Rouen ducks to create the breed. The breed was named after her as Khaki Campbell and is known as an egg-producing breed. This breed of ducks is capable of being grown under any climatic atmosphere.

A male Khaki Campbell weighs 2.5kg and a female weighs 2-2.5kg. They have a record of producing 364 eggs in England. In other countries, they generally lay 280-300 eggs a year. These ducks are
capable of laying white eggs which can be upto 25 percent of their body weight.

ADVANTAGES

- Grows and starts giving eggs faster compared to local breeds.
- Bigger in size compared to local breeds and can lay upto 280-300 eggs a year.
- Is less vulnerable to diseases.
- Can live without frequent coop maintenance.
- Has higher capacity of searching for food both in the water and on land.
- Cleans environment by consuming harmful insects which can cause disease in humans.
- Duck eggs has a higher protein content compared to chicken eggs.
- Can be maintained like local breeds.

SUITABILITY IN COASTAL REGIONS

The vast waterbodies, rivers, canals, ponds and swamps in the coastal areas of southern Bangladesh are ideal for duck farming. These water bodies are rich in snails, oysters and insects, which are prime sources of food for the ducks. The fowls can search and feed throughout the day and need lower quantities of external feed. Duck farming can lead the way for coastal communities to alleviate poverty. The eggs obtained from the farms can provide necessary nutrient for the family.

DUCK COOP

Ducks are kept in three ways: open system, semi-closed system and closed system.

Fowls are usually kept in coops at night in the rural environments and for some time during the day. This process is known as the semi-closed system of keeping ducks. This process requires 1-2 square foot comfortable space for each duck with ventilation system for light and air passage. It is essential to ensure a comfortable coop to maximise profit from duck farming.

Livestock Project Director visiting field activities of livestock component

Coop measurement: Make the coop in consideration that each duck will require 1-2 square foot space.

Height: Coop height will have to be 2 feet.

Floor: Use bricks or scaffoldings for floor. Earth can be used for flooring material.

Scaffolding: Bamboo, betel nut wood or planks of wood can be used for the floor scaffolding. It is good to use bamboo. Cut even size of bamboo and lay them at half-inch gaps to allow dirt and excretes to fall through the floor.

Fencing: Bamboo can be used as the fencing material.

Roof: It is best to have a two-storied coop. Hay, golpata, thatch or tin can be used as roofing material. Roof can also be made out of bamboo mats and polythene.

FEATURES OF COOP

- Litter management: Regular cleaning is required if scaffolding is used as the flooring material. For brick flooring, spread out 5-6 inches of saw dust or bran on the floor. The litter material has to be moved about every 1-2 days. It is advisable to change the litter sometimes and dry it out in the such. It reduces risk of diseases.
- Ventilation: It is essential to ensure good ventilation in the duck coop.
- Temperature: both heat and cold can affect the laying ability of the ducks. The temperature of the coop has to be maintained between 20-25 degrees Celsius.

FEED

The fowls need to be fed properly to ensure good meat and egg production. Farms need to keep stock of at least 15 days of feed for the ducks.

Duck feed must contains the following nutrient contents: sugar, protein, oil, vitamin, minerals and water.

SOURCE AND FUNCTIONS

Sugar: Grains such as wheat, corn, paddy, bran, and powdered rice contains sugar. These foods provide energy and contribute to the development of egg yolks and meat fat.

Protein: Powdered dried fish, bran, leguminosae, fish entrails and worms are rich in protein necessary for healthy growth, egg production, and meat fat in the ducks.

Fat: Mustard, soyabean, nut oil and any other form of organic oil or seed is rich in fat content. It can be a source of heat and energy for the ducks.

Vitamin: Green grass, yellow grains, meat and dried fish contains vitamins. Sunlight and cod liver oil can be a source of vitamin D. Sugar, protein and fat cannot be digested without vitamins. It also strengthens the immunity and assists in energy production.

Minerals: Oyster powder, limestone and egg shells contain calcium and phosphorous. These minerals strengthen the bones of the fowls and helps in production of eggs.

Statistics and Informatics Division Secretary (formerNational Project Director of the ICBAAR Programme) Mohammad Yamin Chowdhury (right), former Deputy National Project Director and Joint Secretary Shamshur Rahman Khan (left) and Deputy Chief Conservator of Forest Gobinda Chandra Roy (second from left) visiting the programme activities. Project Manager Dr. Mohammed Muzammel Hoque briefing them.

COLLECTING AND HATCHING EGGS

Collecting eggs: Ducks usually lay eggs before dawn. However, in some cases the timing can stretch to 9am in the morning. Laying ducks have to be let out after they finish laying eggs. Laid eggs have to be collected and stored in a cool place.

Selecting eggs for hatching: Fertile eggs have to be chosen for hatching. One goose for every 10 female geese is adequate for producing fertile eggs.

Hatching: Duck eggs can be hatched in two ways. Incubators can be used for artificial methods and ducks or chickens can be used for natural method of hatching eggs.

SELECTING DUCKS/CHICKENS FOR HATCHING

Only Muscovy ducks brood on their eggs. Therefore, it is essential to utilise Muscovy ducks or healthy chickens to brood over the eggs for hatching.

During hatching: A duck egg requires 28 days to hatch. Muscovy ducks may take 32-35 days to hatch eggs.

Rearing ducklings

It is essential to keep the ducklings confined with the mother duck or chicken for 3-4 days after hatching. This ensures proper care for the ducklings.

Separating ducklings: After the initial 3-4 days, the ducklings have to be separated from their mother fowls and fed in a confined environment to ensure fast growth

Confining ducklings: It is advisable to keep the ducklings confined for up to 10-15 days.

Ducs are being vaccinated by livestock department official

POSSIBLE INCOME-EXPENDITURE CHART (10 ducks)

EXPENDITURE

Expense	Description	Quantity	Unit cost (BDT)	Total cost (BDT)
Ducks	10 (8 geese, 2 goose) of four months age	10	300.00	3000.00
Medicine/vitamin	Approximate cost			150.00
Feed		10Kg	45.00	450.00
Coop	Bamboo/wood, hay, polythene, tin			1000.00
Vaccination	Duck plague & cholera			100.00
Natural feed	Snail/oysters/fish/insects			-
Total cost				**4700.00**

INCOME

Expense	Description	Quantity	Unit cost (BDT)	Total cost (BDT)
Eggs	7 every day	10.00	70.00	2100.00
Excrete & litter				200.00
Duck price	10	400.00	4000.00	4000.00

Excluding the cost of buying10 ducks and building coop, the profit from the ducks is BDT 1,500 per month. The ducks require vaccination every 6 months. Profit margin can be increased if the coop is made from materials available in the homestead.

CONCLUSION

Duck farming can ensure nutrition and financial gain throughout the year. Coastal communities can reap profit from duck farming. It can contribute to generating employment.

Source

1. Duck Farmin of USAID PROSHAR project
2. DLS Website
3. Duck Farming module of Chars Livelihood Program
4. Duck Farming module of SMAP project of Bangladesh Bank

HYDROPONIC FODDER

Fodder is an essential feed for dairy. Scarcity of land and unavailability of fresh water is shrinking the fodder production in comparison to existing demand. The southern region of Bangladesh is facing an acute shortage of fodder due to salinity in the land. Production of high nutrition fodder in an alternative method using measured quantity of water without the use of land is known as hydroponic fodder farming. The method is an ecosystem-based adaptable way of growing fodder for dairy in the coastal region. There are multiple methods of hydroponic fodder farming.

Hydroponic fodder is suitable for growing in the coastal regions where salinity is high and land is scarce. This process can use small spaces around the homestead to grow fodder. The hydroponic fodder can contribute to higher production of milk and meat in dairy. Hybrid cows will be capable of producing more milk from the fodder compared to local `breeds.

CLIMATE RESILIENCE

Hydroponic fodder can be protected from flooding, cyclone or climate disasters because it is grown in small spaces around the homesteads. Hydroponic fodder can continue to feed domestic animals during incidents of flooding and other climate disasters. It is a suitable technology that utiliseslimited investment and labour.

MATERIALS

A rack made from wood, plastic or steel, some trays (plastic trays can avoid rusting), thick cloth, plastic buckets, plastic pipe, and seeds of corn, paddy, or wheat are required.

HYDROPONIC SYSTEM

The hydroponic system has to be placed in a shade for easy control of temperature and humidity. The ideal temperature for growing the fodder is 25-32 degrees Celsius and humidity 80-85%. The rack can be arranged in two, three or four layers. Each layer contains porous trays that are placed evenly apart for maintenance and watering/drainage purpose. The racks have to be equivalent to the height of an average human being to allow easy access to watering or drainage. A pipe is attached to the trays for draining out excess water.

PRODUCTION

- Take 5-7L of lukewarm water in a plastic bucket.
- Soak 1-1.5kg of seed in the water. Separate the floating seeds because these seeds will not sprout.
- Good quality fodder must use good quality seed material. Corn, wheat, paddy and lentil seeds are ideal for use (cost is lowest with paddy and corn seeds).
- Mix 50-100gm salt in water to act as fungicide.
- Soak the seeds in water for 12 hours (24 hours in case of corn seed).
- Drain the seeds, rinse them and dry them in a piece of cloth.
- Wrap the seeds in a thick cloth and leave them in a shady place (or place the seeds in a bucket and cover the opening) for 24 hours for sprouting.

Rinse the sprouted seeds and place them in plastic trays. Arrange the seeds so that they are placed side by side and not one on top of another. Cover the trays with a black cloth for 2 days to control temperature and humidity. Spray the trays with measured quantity of water every day. Warmer climates may require spraying water every two hours.

The system has to be cleaned regularly. Sprouted seeds cannot be moved or touched. Fodder can be collected from the trays after 7 days. One kilogramme of corn seeds can yield upto 8kg of fodder. The collected fodder has to be chopped to smaller pieces before being fed to cows. If 3 trays of fodder are required every day, it is advisable to use 21 trays for hydroponic fodder.

USES

- Produced fodder is minced and fed to cows, goats, buffalos, lambs, ducks, chicken etc.
- Fodder cannot be stored for 9 days because it will reduce the nutrient content of the fodder.
- Hydroponic fodder has to be fed as part of extra feed with the regular feed for dairy and poultry.

ADVANTAGES

- Hydroponic fodder has a higher nutrient content of sugar, mineral and vitamins compared to local fodder or dried feed.
- Can be produced in a week. Fodder can be grown upto 8-10 inches in a week. Local fodder takes upto 2 months to produce.
- Hydroponic fodder uses minimum water for production. 1kg hydroponic fodder requires use of 3-4 litres of water.
- Increases the fertility and milk production capacity of dairy.
- Production is possible throughout the year.
- Does not require use of any chemical or insecticide.
- Can be grown with minimum labour and investment.
- Produced fodder is not wasted.
- No need for storing fodder.

PROFIT-LOSS

Installation of a hydroponic production system will require the costing given in the side table (considering that the fodder is being produced for 2 milking cows).

Serial	Equipment necessary	Cost (BDT)
1	Wooden rack (1 piece)	4,500.00
2	Tray (14 pieces)	1,000.00
3	Plastic bucket (1 piece)	200.00
4	Seed (corn, 1Kg)/every day	80.00
	Total	**5,780.00**

Cost per day excluding installation:

1 kg corn seed will cost BDT 80. 1kg rice seed will cost BDT 15.

Two hybrid cows can produce 24 litres (12 + 12 litres) of milk after eating usual feed which will fetch BDT 960 (BDT 40 per litre milk). Hydroponic fodder increases the milk producing capacity of cows by upto 25 percent.

Cows will be able to produce 30 litres of milk which can fetch BDT 1,200. The fodder can fetch an additional income of BDT 240 per day and incur a cost of BDT 80 per day (for 1kg corn). Thus, the net profit per day is BDT 160.

COMPARISON BETWEEN NORMAL FODDER AND HYDROPONIC FODDER AS BELOW

Hydroponic fodder	Normal fodder
■ Fodder can be grown without soil	■ Fodder growth requires soil
■ Can be produced in 7-9 days	■ Requires 2 months for growing
■ Rich in nutrient content	■ Nutrient content is low
■ Energy content is 4,727Kcal/kg	■ Energy content is 2,600Kcal/kg
■ Protein content is 31.99%	■ Protein content is 11.5%
■ Increases the fertility of domestic animals	■ Low capability in increasing fertility
■ 1 kg fodder requires 3-4 litres of water	■ 1 kg fodder requires 70-100 litres of water
■ Does not require insecticide	■ Insecticide uses are needed sometime
■ Fodder can be grown throughout the year	Fodder cannot be grown throughout the year

SILAGE

Feed for dairy is scarce during climate disasters like flooding, cyclones, tidal surges or inundation. Farmers worry about feeding animals during these times of disasters, when grain-based feed is also scarce. Silage can be an alternative source of feed at times of storm, flooding, tidal surges or pandemic (Covid-19).

Monsoon grows a lot of grass and weed at some areas of Bangladesh. These include a lot of greenery that can be used as dairy feed like ipilipil, banana leaves etc. These local grasses,weed and remnants of farmed agro produce like corn, oat, banana tree, etc. can be stored as silage.

Silage is preparing with the direct supervision of Livestock Officer

Silage is a type of fodder made from green foliage crops preserved by acidification, achieved through fermentation. The silage is usually made from grass crops, including maize, sorghum or other cereals, using the entire green plant. It can be directly fed to the dairy. It will increase the nutrient content of hay and maintain the silage quality. Feeding silage from this mixture ensures that there is no need for feeding additional hay to the dairy.

Sileage can be created without hay if it is scarce. Lentil or legumes-type plants like grass pea, black matpe bean, black-eyed pea, ipilipil, etc. can be stored as silage in its green form. Legumes plants have a high protein content and may not provide a good silage if not mixed with other plants. Other non-legumes plants like corn, napier, etc. can be mixed in maximum 1:1 and minimum 1:3 ratio to create silage with molasses. Hay can be used instead of non-legumes plants.

Pit: A 100 CFT pit can store 2.5-3 tonnes of green fodder. The pit has to be invulnerable to flooding and have 3 feet of depth. The bottom should be 3 feet wide, the midsection 8 feet and top 10 feet in diameter. The area of the excavated pit will depend on the amount of fodder. It will be easier to store silage if the bottom of the pit is flat as a pot.

POLYTHENE

The silage can be covered with polythene for proper storage. However, it may increase the storage cost of the silo. Alternatively, the polythene can be used to cover the top and dried hay can be used at the bottom and the sides for storing the silage. 8-9 yards of two-yard-width polythene can be used to cover the top.

CREATING SILAGE

Measure molasses 3-4% of the fodder in a bucket and mix with 1:1 or 4:3 water to create the solution. Sprinkle the solution on fodder with hand. Cover the bottom of the pit and its sides with polythene or a thick layer of hay. Layers of fodder and dried hay have to be stacked to create the silage.

Each layer of the silo can contain 300kg green fodder and 15kg dried hay. Use molasses 9-12kg and 8-10kg water to make the solution for every 300kg of green fodder. Sprinkle the solution on top of each layer evenly. It is not necessary to use the solution on the dry hay. Arrange the silo in tightly packed layers to ensure production of good quality silage. Stack layers upto 4-5 feet higher than the ground level and cover the silo with a thick layer of hay before covering with polythene. Cover the silo with 3-4 inches of earth. The silo layer can be packed in one day, and also can be done in phases over a number of days. It is inadvisable to create the silo in low-lying land because inundation can damage the silage

FACTORS TO CONSIDER

- Cover the top with polythene to make the silo waterproof.
- If the solution is too light, it will drain away from the bottom. It is advisable to use less water with the molasses to make the solution. It has to be sticky to be able to stay on to the fodder.
- Pack the fodder and hay tightly. It is inadvisable to leave any air pockets in the silo.
- It is advisable to have low water content in the fodder.

FEEDING

The silage can be fed 10kg at a time to dairy weighing 100kg. Silage system or storage of green grass is becoming a popular source of feed for dairy at times of natural disasters. Beneficiaries of the ICBAAR programme are practicing silage storage as part of the coastal afforestation and reforestation adaptation programme. The programme is building resilience of the small and remote farmers vulnerable to climate change by providing means of adaptation through climate resilient activities.

TURKEY FARMING

Turkey is mainly a fowl from the north Americas. These birds are big in size. The Spanish took these birds from Mexico to Europe and domesticated them. Later they took the turkeys to their colonies. Turkeys are reared in homesteads all across the world, but America, Canada, Germany, France, Italy, Netherland, UK, Poland and India are leading in turkey farming. These birds have a high capacity of adapting to their environment.

Turkeys are mainly farmed for meat, but in Bangladesh they are occasionally reared out of hobby. Growing turkeys do not require formal setup. Their diet consists of 50-60% grass, and are therefore economical to farm. Turkeys are less vulnerable to diseases and require limited medical attention. They are high yielding birds, weighing 5-6kg at 6 months age. The meat is delicious with low fat content;and can easily be an alternative to beef or lamb meat. Many in Bangladesh do not consume broiler chicken. Turkeys can be an alternative for them. These birds can be an alternative source of protein and a new avenue for commercial success. Turkeys are easier to rear and farm in our climatic conditions. They have a high adaptive capacity to their environment and can adapt to survive in any environment. These harmless birds can be farmed in captivity or in the open. They start laying eggs from 6-7 months of age and can lay upto 10-12 eggs in a year in 2-3 phases. Female turkeys can weigh upto 5-6kg and males can weigh upto 8-10kg. They are used to eating grass, insects and general food. However, they can yield more meat and eggs if fed with higher quality feed. It is best to purchase turkeys 4-5 months old for easy detection of sex and low risk. A pair of turkeys of this age can cost almost BDT 4,500-5,000. It is advisable to start with 8-10 pairs of turkeys in the initial stages of farming.

Disease: Turkeys are not particularly vulnerable to any disease. Chicken pox can be averted with vaccination. The birds may catch cold during monsoon or cold weather. However, it can also be averted with regular vaccination.

Vaccination: Ranikhet vaccine – 1 to 7 days old and again on 21 days old. Fowl pox in the fourth and fifth week, and cholera vaccine in the 8-10 weeks.

ADVANTAGES

- Has high meat yield and grows faster compared to broiler chicken.
- Can be reared easily like domestic fowl. An ideal turkey farm is possible with limited investment.
- Cost is relatively low because turkeys eat grass and other vegetation.
- Turkeys are beautiful birds and increases the decoration of a house.
- Turkey meat is rich in protein and low in fat content; can be an alternative to beef or lamb.
- Meat contains higher amount of zinc, iron, potassium, vitamin B6, vitamin E, and phosphorous – useful minerals for human beings that assists in lowering the cholesterol level in the body.
- Meat is rich in amino acid and tryptophan, and therefore increases immunity.
- Is less vulnerable to disease and relatively safe for farming with a few guidelines.
- Is highly valuable and therefore more profitable considering the investment.

METHOD

Turkeys can be reared in two ways: free grazing and intensive farming.

FREE GRAZING METHOD

Upto 200-250 adult turkeys can be reared per acre of enclosed land in this method. The birds require 3-4 square feet space at night. They have to be protected from predators during grazing. Trees need to be planted to provide a cool and shade in the grazing land for the turkeys. The land has to be used repetitively for grazing to reduce contamination of parasites.

Advantage: feed cost can be lowered by upto 50%. Requires limited investment and can yield high profit compared to investment.

Feed: Turkeys can feed on worms, small insects, snails, kitchen waste and termites – food that are rich in protein content; and reduces feed cost by upto 50%. Can also feed on bean-like food, like desmanthus and stylo. The birds can be fed with calcium in the form of 250gm powdered oysters per week to prevent weakening of leg bones or developing a limp.

Wastes produced from vegetables can contribute to upto 10% of the feed content for the birds and reduce the feed cost.

Health: Turkeys farmed in the open grazing method are prone to infection from worms and fowl mites. It is essential to carry out de-worming and dipping once a month to ensure good health of the birds.

Intensive farming method: Coops protect turkeys from sunlight, rain, wind and predators, and can provide comfort. Warmer regions can build turkey coops with length oriented towards the west. Coops can be within 9 metres in length and 2.6-3.3 metres in height. The roof has to be extended by a metre to prevent rainwater from entering the coop. It is essential to build the floor out of cheap, sustainable, safe and moisture resistant material like concrete. Adult birds and baby birds must be separated by at least 50-100 metres. Two coops must be separated by at least 20 metres. The turkeys can be reared in the same waste management style as chickens in the deep litter method, however, the bigger birds require adequate space, water and feeders.

Advantages: Increased production capacity, management and disease control capacity.

Feed: Turkeys are fed in both mash and pellets in this method. Compared to chickens, turkeys require more energy, protein and minerals in their feed. Feed has to be provided in the feeders. It is ideal to rear male and female turkeys separately because their different energy requirements. The birds require access to clear drinking water. The water supply has to be increased during summer and the feeding time maintained properly.

Green feed: Green feed can be provided in the form of dry mash and can be provided upto 50% as the total feed content in this method of farming. Lucern is the best form of grade green feed for turkeys of all age. Desmanthas and stylo can be chopped up and provided as fodder to reduce feed cost.

Advantages:

- Less prone to disease.
- Alternative to beef, broiler and lamb.
- Creating a meat market requires widespread marketing.

LIMITATIONS

Turkey meat has not gained popularity in Bangladesh, but its rearing has grown in popularity. Turkey is an ideal bird for commercial production of meat, but not eggs.

Turkey is a beautiful bird and can contribute to home décor. The fowls grow fast and reach maturity very quickly like the broiler chickens. It is easy to grow like chickens. Our coastal environment is highly suitable for turkey farming. There is a bright prospect in commercial production of turkey. Proper research, marketing and cooperation of the buyers and sellers can make turkey farming a means of self-sufficient livelihood and can even fetch foreign earnings.

CLIMATE RESILIENT MIXED FRUITS AND CROPS

Fruits are necessary dietary requirement for healthy living. Fruits can be consumed raw and its nutrient content remains unaffected in raw ingestion. It is a low-cost and accessible source of necessary nutrients for our body including vitamins and minerals. It builds immunity in our bodies. Minerals in fruits such as calcium, iron, phosphorous, etc. contributes to growth and assists with metabolism in our bodies.

Bangladesh produces 70 types of fruits, among which 40 are common and 30 uncommon. Fruits account for about 10% of Bangladesh's total crop revenue. We consume insufficient fruitson a daily basis. According to nutritionists, fruit consumption of a person should be at least 115gm per head. But, in Bangladesh the fruit consumption is only 38gm per head. Thus, it is necessary to seriously consider fruit farming. Bangladesh produces over 14 lakh metric tonnes of fruits every year which is insufficient against the demand. Due to impacts of climate change, fruit farming in the southern regions is being affected.

The ICBAAR programme is encouraging coastal households to grow climate resilient fruits and crops to reduce their vulnerability. The programme supports the farmers with training and providing equipment for cultivation of the following fruits and crops. The significance of some fruits and crops are described here.

1. Hybrid coconut-OP variety.
2. Guava.
3. Baukul
4. Sunflower oil.
5. Hybrid chili.
6. Dragon fruit.
7. Malta
8. Sapodilla, etc.


Photo: Internet

HYBRID DWARF COCONUT

Two varieties of hybrid dwarf coconuts are cultivated in Bangladesh. One is the full hybrid dwarf coconut and the other is the open pollinated (OP) breed. The coconut is a Monocotyledonous plant. *Cocos nucifera* and Arecaceae varieties can start bearing fruit from 2.5-3 years. This newly-invented breed of coconut is capable of bearing 150-200 coconuts a year while local breeds are able to yield only 50 fruit. It is possible to harvest these coconuts without climbing trees as the plants start to bear fruits when they are 2-4 feet tall. Compared to the local breed, these hybrids are four times more productive. Bangladesh government is emphasising on production of these hybrid coconuts.

ECONOMIC UTILITY

The hybrids imported from Vietnam are two varieties: Siam Green Coconut and Siam Bulu Coconut. A main characteristic of this breed is that the plants can be grown from the fruits. The Siam Bulu Coconut is a dwarf-size plant that is convenient for maintenance and harvest, and has sweet and scented water. Coconut farmers often suffer from bug attacks and insect control is difficult with big trees. But, insect control for the cultivation of these hybrid coconuts is easy and convenient. According to Indonesia-based Asia Pacific Coconut Community which is involved in expanding and developing coconut farming, it is possible to plant almost 40 crore coconut plants in Bangladesh. Bangladesh Government has subsidised and encouraged the plantation of these imported coconuts in the 19 coastal districts and other parts of the country.

HERBAL BENEFITS

Coconut is antibilious and de-worming. Extract from the fruit is a medicine for ringworm disease.

USE

Apart from use of coconut water as drink, all the parts of a coconut tree can be utilised.

NUTRIENT CONTENT

Coconut water contains calcium, phosphorous and other nutrients. The coconut flesh is rich in fat. Every 100gm of consumable coconut contains 82.8% liquid content, 0.6gm mineral, 5.2gm fibre, 76Kcal energy, 1.8gm protein, 1.1gm fat, 15.2gm sugar, 20mg calcium, 1.4mg iron, 0.21mg vitamin B-1, 0.09mg vitamin B-2, and 210mg vitamin C.

SUITABLE SOIL

Silt loam soil is ideal for growing coconut trees.

SAPLING

Seed coconut is prepared from matured coconuts.

PLANTATION

June to October is the best advisable time for planting coconut saplings. Saplings are best planted 8 metres apart in rows. A one-acre land can be sowed with 63 coconut saplings.

Photo: Internet

FERTILISER MANAGEMENT

Advisable to be used for the hybrid coconut breed

Advised fertiliser use (gm/tree/year)							
Tree age (yr)	Urea	TSP	MOP	Gypsum	Zinc Sulphate	Boric acid	Organic Fertiliser (kg/tree/year)
Before planting	-	50	-	-	-	-	12
1-4	90	20	150	15	12	1.7	5
5-7	180	40	300	30	15	2.6	7
8-10	360	80	500	40	20	3.4	10
11-15	450	100	800	50	25	5.1	12
16-20	540	120	1000	50	25	6.8	15
20+	675	150	1200	50	25	8.5	20

Source: Fertiliser recommendation handbook-2018, Bangladesh Agriculture Research Council

APPLICATION

- Mix recommended levels of organic fertiliser and TSP evenly with the soil 15-20 days before plantation and water.
- Provide fertiliser twice for growing trees – in April and October. Dig 3-5 inches of soil around the base with a 2-feet radius and apply the fertiliser before covering it with soil.

IRRIGATION AND WEEDING

Irrigation is advisable 2-3 times every 15 days in the dry season. During monsoon, the water needs to be drained away.

HARVEST

Fruit is ready for harvesting after 11-12 months of flowering. When ripe, the colour of the coconuts range from green to brown or chocolate.

CONCLUSION

The southern region is suitable for coconut farming. A small family can secure an alternative source of income from two-three hybrid coconut trees. The dwarf coconuts will bear fruit and provide profit if it can be maintained properly. This hybrid coconut can provide means of alternative livelihood for the coastal communities in Bangladesh.

National Project Director planting a dwarf coconut seedling

GUAVA

Guava is the universal apple of Bangladesh. It is a nutritious and profitable fruit. Bangladesh is placed 8th in the global ranking of guava production. Guava trees are fast growing, can bear fruit in a small space and provide high yield. The fruit itself is delicious and can alleviate the poverty of the poor. The tree is highly productive and its fruit has an ideal nutrient content. Cultivation of higher quality guava breed is expanding in the southern region. New orchards of guava are being planted. Poor farmers are finding mixed fruit orchards a reliable source of income. In recent years, the mixed guava orchards are yielding higher harvests compared to other fruits.

DESCRIPTION

The guava is a plant of the Mirtaceae family. Its scientific name is *Psidium guajava*. This fruit can be utilised to make jam, jelly, squash, chutney and jelly. Several companies including Pran achieved success in manufacturing jelly and juice from guavas. The roots, bark, leaves and immature fruit can be used in the treatment of cholera, dysentery and other diseases of the stomach.

SOIL REQUIREMENT

Guava is best cultivated in high/medium high lands containing gravel sandy loam silt which is invulnerable to inundation and has accessible drainage. The tree can withstand harsh environment but is vulnerable to high salinity and inundation. Cultivation of guava is possible in climate ranging from 10-33 degrees Celsius temperature.The suitable rainfall range for cultivation is 700-3,700mm and pH level between 4.5-8.2.

BREED

Bangladesh grows some varieties of the guava. Local breeds include Swarupkathi, Kanchannagar and Mukundapuri. Hybrids include Kazi Guava and Bari Guava-2.

Kazi Guava: The fruit is big with an average weight of 400-500gm per piece. Mature fruit is yellowish-green in colour and the core is white. The fruit can be conserved for upto 10 days in room temperature. It is slightly sour in taste.

Bari Guava-2: The tree is shaped like an umbrella and is shorter than the Kazi Guava. The leaves are pointed. Fruits yield twice a year in monsoon and winter. The fruit is delicious and sweet.

SAPLING

Saplings are prepared using the tree grafting technique.

FERTILISER MANAGEMENT

Recommended for hybrids

Advised fertiliser use (gm/tree/year)						
Tree age (yr)	Urea	TSP	MOP	Gypsum	Zinc Sulphate	Organic Fertiliser (kg/tree/year)
Before planting	-	50	-	-	-	5
1	46	50	50	10	5	5
2	92	50	50	-	-	5
3	138	50	150	10	5	7
4	200	80	200	-	-	10
5	230	100	250	10	5	10
5+	230	100	250	10	5	12

Source: Fertiliser recommendation handbook-2018, Bangladesh Agriculture Research Council

APPLICATION

- Recommended levels of organic fertiliser and TSP has to be mixed evenly with the soil 15-20 days before plantation and the mixture is watered.
- Growing trees will require the recommended levels of fertiliser in three phases: late mid-January to mid-March, mid-April to mid-July and mid-August to mid-October.

MAINTENANCE

Disease-affected and dead branches and leaves have to be trimmed after harvest. This enables growth of new shoots. Guava trees can yield in big quantity. That is why some fruits have to be plucked and thrown away when they are marble size.

Project field official advices beneficiary on mixed fruit species

IRRIGATION AND WEEDING

Irrigation is required 2-3 times during dry season. Weeding has to be carried out regularly. Sometimes the leaves and branches can be affected by a type of fungus.

DISEASE CONTROL

Name: Anthracnose

Symptoms: Sunken, dark colored lesions on mature fruit which may become covered in pink spores; lesions coalesce to form large necrotic patches on surface of fruit. Infected fruit will have a hardened flesh and may rupture.

Spread: Air and rainfall are main mediums of propagation of this disease. Germs may breed on the abandoned branches, leaves or fruit of the trees and spread.

Prevention: Fallen leaves at the base of the trees have to be removed and burned. After flowering, spray water mixed with Topsin-M (2gm per litre) or Tilt 250EC (0.5ml per litre) every 15 days for 3-4 times.

HARVEST

Fruits can be harvested when the guavas take a green to yellowish green in colour.


Photo: Internet

BAU KUL

Cultivation of apple berdates back to more than 4,000 years in history when the fruit was being grown in eastern China. Apple ber is one of the oldest sources of food known to people. The tree of the apple ber is highly resilient to harsh environment conditions. It is highly suitable for farming in the coastal regions of southern Bangladesh. The fruit is gradually adapting to the conditions of the region and gaining popularity among the coastal community. Cultivation of the apple ber has picked up significantly in the coastal homesteads. It is providing small families a source of alternative income. Currently, cultivation of hybrid apple ber has gained widespread popularity and has expanded rapidly due to its profitability. The apple ber is known as a fruit of ‘alleviating poverty’.

ENVIRONMENT& NATURE

High and well drained loamy soil is suitable for cultivation of apple ber. The fruit is adaptable to harsh environment and can be grown all over Bangladesh, starting from the Kalapara of the coasts of Bay of Bengal to Tetulia in the north. It can be cultivated a thousand metres above sea level on mountainous forestsand also at its base and in both dry and cold climates. The temperature range for cultivation of apple ber is 10-37 degrees Celsius and the range of rainfall is 250-2,000mm. The trees grow and fruit best under intense and long exposure to sunlight. Commercial cultivation of apple ber is expanding in Khulna, Rajshahi, Naogaon, Cumilla, Mymensingh and Bogura. Widespread cultivation of the fruit is being carried out in Rangpur, Sylhet, Dhaka, Gazipur, Pabna and Patuakhali districts.

SAPLING

Breeding can be carried out in two ways – from seeds or grafting. It is best to use grafting technique for breeding because it preserves the genetic qualities of the fruit. Rind, patch or t-budding techniques are used for grafting and preparing saplings.

SCIENTIFIC IDENTITY

The scientific name of the apple ber is *Ziziphus mauritiana*. Bangladesh is cultivating the Narikeli ber, Cumilla ber, Rajshahi ber, Dhaka-90 ber, apple ber, Bau ber, Satkhira ber, Bari ber-1, Bari ber-2, Taiwan ber, etc. breeds of ber in the country.

NUTRIENT CONTENT

The consumable portion of the ber fruit contains 73.2gm water content, 1gm minerals, 104Kcal energy, 2.9gm protein, 0.1gm fat, 23.8gm sugar, 11mg calcium, 0.02mg vitamin B, 0.05gm B-2, and 51mg vitamin C.

PLANTING

January to March is the ideal time for planting ber saplings. Before planting the soil has to be dug 1m deep at least a month in advance. Plant saplings 1m apart from each other.

Photo: Internet

FERTILISER MANAGEMENT

Tree age (yr)	Fertiliser recommendation (gm/tree/year)						Organic Fertiliser a(kg/tree/year)
	Urea	TSP	MOP	Gypsum	Zinc Sulphate	Zinc Sulphate	
Before planting (soil)	-	50	-	-	-	-	12
1-2	135	50	125	15	15	1.0	5
3-4	225	80	200	20	20	1.5	7
5-6	338	140	350	25	25	2.0	10
7-8	450	170	425	30	30	2.5	12
8+	563	200	500	40	40	2.5	15

Source: Fertiliser recommendation handbook-2018, Bangladesh Agriculture Research Institute

APPLICATION

Recommended level of fertiliser and TSP has to be mixed evenly with excavated soil and watered properly. Growing trees have to be provided with fertiliser at the base of trees to the extent of its branches in three phases from January-March, April-June, and August-October.

TRIMMING

Trimming is a necessary step to ensure growth and optimum yield of the ber trees. Orchards may be damaged without proper trimming. After plantation of the saplings, support should be provided to assist the vertical growth. Trim the necessary side growths and fresh branches with scissorscarefully so that it does not affect the tree or damage its bark. The trimmed branches and leaves have to be covered with raw dung. New shoots will grow after trimming. This process will give an umbrella-like shape to the tree. At one stage this tree will grow to a hedge. The tree then has to be trimmed in March every year. Big branches have to be cut carefully with saw. Ber trees flower in the newly-grown branches.Trimming will ensure abundant growth of new buds and flowering. This process will ensure high yield of the fruit.

IRRIGATION AND WEEDING

Yield is better if irrigation is carried out once in the dry period during flowering and every 15 days after bearing fruit. It is essential to clear weed at the base of the plant and at the trenches of boric acid. Branches should be trimmed at least upto 75cm off the ground to create a strong foundation for the plant.

DISEASE CONTROL

Disease: the powdery mildew is a fungal disease of the ber trees which affect the productivity of the plant and reduce the yield of the fruit.

Effect: affected trees lose their flowers and fruits.

Suitable environment: Disease thrives in the abandoned parts of the plants and other parasitic insects. Can easily spread through the air.

Spread: The disease spreads in dry and wet climate, especially during cloudy atmosphere.

HARVEST

Fruit is ready for harvest between January to mid-April. Fruit should be plucked when it shows light green to yellowish colouration.

MIANTANANCE

After flowering of the tree, theov fungicide should be sprayed by mixing 2 g 250 EC per liter of water and 0.5 mg per liter of water. Spray twice in the next 15 days.

Photo: Internet

HYBRID CHILI

Chili is an essential spice in Bangladesh and its cultivation is universally profitable. It is one of the important crop of the world. Chili farming dates back to 7,000 years B.C. A component in the chilies known as Capsaicin causes the hot taste. It is useful for making food delicious, colourful and appetizing. The fruit is cultivated in fields or homesteads. It is primarily a winter crop, but some of the breeds are able to bear fruit throughout the year. Cultivation of chilies is growing in the southern region of Bangladesh because it is a profitable crop that takes shorter time for harvest. Introduction of hybrids have contributed to increased annual production of chilies. According to statistics of the Department of Agriculture Extension, the annual production of chilies in 2018-19 was 3,08,394 metric tonnes in 1,34,279 hectares of land.

WHY CLIMATE RESILIENT

Cultivation of chilies is possible in the southern regions after the late harvest of Aman paddy. Fallow lands in the char regions are also suitable for intensive chili farming. The tree is resistant to climate disasters and is marginally salinity resistant. The crop can be harvested near the end of monsoon and before the usual period of cyclones and tidal surges. Farmers are able to secure good price for their produce. Chilies produced in the southern regions are directly supplied to the capital.

NUTRIENT CONTENT

Both green and dried chilies are nutritious for health. Green chilies are rich in vitamin C. Dried chilies on the other had are rich in vitamin A and vitamin B. Every 100gm consumable chili contains 0.1gm minerals, 29Kcal energy, 3gm sugar, 30mg calcium, 80mg phosphorous, 1.2mg iron, 175mg keratin, 0.19gm and 111mg vitamin C.

CULTIVATION

Cultivation environment	Soil type	pH level	Organic content	Salinity resistance
Ganges tidal floodplain-13	High land,has sunlight exposure, fertile and loamy soil with drainage. Chili can be cultivated in char lands. It cannot survive inundation.	Alkaline soil 6-7	Generally low	Partially resistant
New Meghna estuary floodplain-18, Patuakhali Barguna, Barishal Jhalakathi, Pirojpur Noakhali, Bhola	Cultivation is possible in clayey soil if drainage system is available. 20-25 degree Celsius temperature is suitable	Alkaline soil 6-7	Generally low	Partially resistant

BREED

Chili has a diverse botany. Mainly two types of chilies are useful-hot chili and sweet chili. Bari chili-1 is a high yielding hybrid (hot chili) invented by Bangladesh Agriculture Research Institute (BARI). These breeds are suitable for cultivation throughout the year.

- **Hot chili:** Production is possible round the year. Local varieties include small chili, big/long chili, Patnai, Dhani chili, black chili, Shaheb chili, Surjamukhi, Ubadha, Jhalujhuri, etc.
- **Sweet chili:** Cultivation not possible everywhere. Varieties include Ruby King, Wald Better, Chinese Giant, etc.
- **Preparing land:** Plough land 4-6 times and use ladders to reduce soil to fine dust. Deep plough can be beneficial for cultivation because it helps deep penetration of roots into the soil and can enable the plants to survive through droughts.

SEED

Chilies can be cultivated either through direct plantation of seeds or preparing seedbeds.

SEEDBED

Prepare seedbed land 10 feet x 3 feet in size. This seedbed requires application of 10kg dung, 100gm TSP and 50gm MOP into the soil. Before planting, the seeds are soaked for 6-12 hours and mixed with dry sand/cinder ash before planting in the seedbed. Flatten the seedbed gently after planting seeds. It is advisable to apply Insecticides such as kerosene or dipterex around the seedbed to prevent attack of insects such as ants or termites.

PLANTATION TIMING

Chili	Winter	Summer
Hot chili	September-November (preparing sapling)	March-April
	June-September (planting)	March-April
Sweet chili	September-November (preparing sapling)	Low suitability in this season
	June-September (planting)	

SEED RATE

Method	Seed (gm/acre)	Comment
Preparing saplings for planting	160-240	Preparing saplings requires 8-10 seedbeds 10 feetx3 feet in dimension

SAPLING AGE FOR PLANTATION

Saplings are mature in 30-35 days during winter and 25-30 days during summer.

PLANTING

Bigger trees require 60-75cm distance between each sapling in rows. Each row has to be planted 30-45cm apart.

PLANTING TECHNIQUE

Saplings are selected considering their age or when 5-6 leaves sprout from the saplings. Before an hour ago of transferring the saplings, the seedbed has to be irrigated to create a moist soil. Saplings have to be uprooted using a bamboo or iron stick. This will ensure that the roots suffer minimum damage. It is advisable to withdraw saplings in the afternoon and plant them into the soil before dusk. Soil has to be pressed slightly after planting the saplings and irrigated lightly.

FERTILISER MANAGEMENT

Soil quality	Quantity of fertiliser (kg/hectare)						Organic fertilise (tonnes/hectare)
	Nitrogen	Phosphorous	Potassium	Sulpher	Zinc	Boric acid	
Ideal soil	0-32	0-15	0-25	0-5	0-0.5	-	
Medium quality	33-64	16-30	26-50	0-10	0.6-1.0	0.0-0.7	3
Low fertile soil	65-96	31-45	51-75	11-15	1.1-1.5	0.4-1.4	
Extremely low fertile soil	97-128	46-60	76-100	16-20	1.6-2.0	1.5-2.1	

Source: Fertiliser Recommendation Handbook-2018

OVERHEAD APPLICATION OF FERTILISER

Fertiliser has to be spread on the ground and the soil ploughed gently. This will raise the bed of the orchard, store water and assist in draining excess water away. As a result, the plants will grow to become resistant to drought.

MAINTENANCE

Yield is best if the soil is ploughed to fine dust and weeding is carried out on a regular basis. Mulch can be applied to the soil to prevent hardening of the top soil, which will also make the chili plants sturdier. Irrigation should be managed in the winter season and drainage of excess water ensured in the summer.

INSECT CONTROL

Leaf fold: Leaves roll up and become smaller in size and yellowish in colour. Older leaves are hard and brittle. Disease causes stunted growth and crookedness in plants. Stops flowering and fruiting in plants.

Control: White fly is the carrier of this virus. It is essential to control white fly population to control the disease

Chili plague: Tree branches become dehydrated as effect of this fungal disease. Bark and the fruits bear a stain and rot quickly as a result.

Wilting: Causes plants to wilt and become dehydrated.

Control: Both the diseases can be controlled by application of Rimodil/Bavistin/copper-based fungicide 2-3 times every 7-15 days.

HARVEST

Plants begin to flower from 30-45 days after planting saplings. After 20-25 more days the chilies become ready for harvest. Chilies are capable of harvest when they mature. Ripe red chilies are dried under the sun to be turned into dried chilies. Every 40kg ripe red chilies can yield 9-10kg dried chilies.

MARKETING

Mature chilies are harvested before dusk and spread under the shade or the open sky in the night. These are packed in jute sacs or cartons before dawn and transported to the markets. It is advisable to keep the sacs or cartons 20kg in size. Green chilies can be stored for a long time in cold and shady environments. Chilies can easily rot if they are sprinkled or rinsed with water. Dried chilies can be stored for upto 3 months in air-tight packets. If they are occasionally dried under the sun, they can be stored for upto 6 months.

PROFIT

Chilies fetch the highest revenue among spices. It is a profitable crop for farmers.

Reference:

1. Vegetable Science, Mohammad Mominur Rashid
2. Agriculture Information Services

DRAGON FRUIT

Dragon fruit is one of the non-local fruits that has gained popularity among local farmers. The southern region of Bangladesh has begun cultivation of this cactus-like dragon fruit in consideration of its high profitability. It is especially suitable and profitable for remote and poor farmers. Cultivation of this fruit is possible in small spaces around the homesteads or open land invulnerable to inundation. The ICBAAR programme decided to expand the cultivation of this fruit considering rising local demand and high price.

INTRODUCTION

The scientific names of dragon fruit varieties are *Hylocere usundautus* (red skin and white flesh), *Hylocereus polyrhizus* (red skin and coloured flesh), and *Selenicereus megalanthus* (yellow skin and white flesh). The fruit is rich in vitamin C and minerals. Every 100gm of consumable fruit contains 85.3% water, 1.3gm digestible fibre, 67.6Kcal energy, 1.1gm protein, 12.2gm sugar, 0.57gm fat, 10.2mg calcium, 3.37mg iron, 0.01mg keratin, 0.04mg vitamin B-1, 0.05mg vitamin B-2, and 22mg vitamin C.

CLIMATE RESILIENCE

Dragon fruit is slightly resilient to drought and salinity and is therefore capable of cultivation in the coastal regions. The fruit is also grown in the roof tops of the city scapes. The local demand of this fruit is rising and it sells for high price. Expanding the cultivation of the dragon fruit in the southern coastal regions can ensure proper utilisation of remote lands. Cultivation of this fruit is a timely step considering the disaster-prone vulnerable agriculture of the coastal regions.

ECONOMIC UTILITY

The dragon fruit is unparalleled as nutrient and food content. The fruit is suitable for all diet types. The dragon fruit is rich in fibre which is a suppository for stomach-related problems and liver. Diabetic patients can consume glucose from this fruit and maintain sugar levels. The dragon fruit is also rich in antioxidants which grows the resistance capacity to cancer in human bodies. It is ideal to be consumed as a drink and also can be served in salads. The raw fruit can also be utilised as a vegetable.

BREEDS

Bari-1 or Bau dragon fruit-1 (white), Bau dragon fruit-2 (red), and Bau dragon fruit-3 (pink) can be selected as the breeds suitable for commercial production of the fruit.

BAU Dragon fruit-1 (white)

BREEDING

1) Bred from seeds: the fruit can be bred from its seeds. This method is economically profitable, but the process is lengthy and the fruit loses its genetic characteristics. Mature fruits have to be collected and sliced open along the middle to extract the seeds. The collected seeds have to be rinsed and sowed in seedbeds or poly bags to grow saplings. The sprouted saplings will be ready for planting in 4-5 months.

Sliced fruit for collecting seed

Seeds being dried

Saplings sprouting from the dragon fruit seed

Fruit bagging in polythene

2) Cutting: The cutting technique has a success rate of 100% and ensures quick bearing of fruit. Matured and strong branches are cut 0.5-1.5 feet in length and planted in sandy loam soil under partial shade. The cut part is planted head first into the soil and the soil is treated with fungicide.

Process of planting cutting into the soil

The cuttings will grow roots in 20-30 days – mature to be planted in fields. However, cutting grafts can be directly planted in the soil under favourable conditions.

PREPARING SOIL

The soil has to be 2 foot in width and 2 foot in depth. During excavation, 30cm of soil from the top soil has to be kept separately from the rest of the soil.

FERTILISER

Tree age (yr)	Recommended fertiliser level (gm/tree/year)					(gm/tree/yr)	Organic Manure
	Urea	TSP	MOP	Gypsum	Boric acid		
Before planting (in soil)	-	20	10	56	-	30	15
1-2	75	50	100	-	1.0	10	2
3-4	100	60	120	10	1.5	12	3
5-6	125	75	150	15	2.0	15	4
7-8	150	90	200	20	2.5	22	5
8+	175	100	250	25	2.5	25	6

Source: BARI and Fertiliser Recommendation Handbook-2018.

PREPARING SOIL

- 30-40 KGs dung or organic manures to be mixed with the soil 20-30 days before planting, and watered.
- Mature trees will require fertiliser in two equal phases during April-May and August-September. The fertiliserhas to be spread around the trees and mixed with the soil evenly. The soil will have to be irrigated.
- Mix the soil evenly with 50gm Urea, 100gm of TSP and MOP, and 10gm of Gypsum, Zinc Sulphate and Borax.
- Apply powdered coconut husk and rice bran in generous quantities.
- Later, 40-60kg of dung or organic fertiliser mixed with 50gm urea, 100gm TSP and MOP, and 10gm gypsum, zinc sulphate, and borax is applied in every year for each plant.

PLANTATION

The dragon fruit tree is a cactus-species plant which can be planted at any time of the year. However, it is best to plant the cutting grafts during April-September period. The Vietnam process can be followed in plantation which involves planting 4-5 grafts around a pillar and tied to it with plastic threads.

Planting dragon saplings

MAINTENANCE

Weeding: Weeding has to be carried out regularly. It is advisable to remove weeds by gently ploughing out soil with a spade. The soil has to be flattened out after weeding with the spade or by hand. Rice bran and coconut husk can be used as mulch.

Irrigation: Irrigation and water drainage is a crucial process in the farming of the dragon fruit. Irrigation must be carried out in dry seasons and drainage ensured during monsoon. Trenches 40-100cm wide can be dug into the lands to assist this process. Irrigation is essential during the dry season until the plants start flowering. The plant is vulnerable to excess water. On the other hand, the fruits can be stunted and the yield lowered without irrigation during droughts.

Pruning & thinning: The dragon fruit grows rapidly and bears thick shoots. A one-year-old dragon fruit tree can grow 30-40 offshoots and a 4-year-old can grow upto 130 offshoots. The offshoots can be controlled in the pruning and thinning process. An offshoot can be cut off after it grows. One research shows that one dragon fruit plant can bear fruit after 12-18 months in Bangladesh. Each of the 40-50 main shoots can grow 1-2 secondary offshoots. This growth can be curbed in this process. It is advisable to carry out the pruning and thinning process during daytime. Application of fungicide is compulsory after the process, otherwise the plants may be vulnerable to attacks.

DISEASE AND INSECTS

The fruit does not usually bear risk of diseases. However, rots can be seen on the buds or base which may be influenced by fungus or bacterial infestation. This disease causes:

- The stem of the plant becomes yellowish and later turns black.
- The affected area starts to rot and the rot spreads with time.

Prevention: Affected shoot has to be cut off and buried in the soil. Spraying affected plant with 2gm/L fungicide (Bevistin, Ridomil or Theovit) can be advised.

Brown spot: Fungal infection caused by a species of fungus named Cercospora causes gradual dehydration of the shoots. The plant may die without intervention and proper action.

DISEASE CONTROL

- Infected part of the plant has to be cut off and buried in soil.
- Application of any fungicide (Bevistin, Ridomil, Theovit, etc.) is advised to be sprayed (2gm/L) on the plants.

Insects: The fruit is not specifically vulnerable to insect attacks. However, there are rare cases of infestation by aphids and Melaybug.

- Baby and adult aphids suck out the juice from the young shoots. This causes discolouring of the shoots and weakening of the plants.
- The bug excretes on the plants and assists in growth of a black fungus named sooty mold.
- This affects the food processing of the plants and reduces the yield.

Control: The infestation can be easily controlled by spraying insecticide at 25ml per 10L water density.

Ants/birds: Mature fruits are food for ants and birds. Powdered insecticide can be applied at the base of the plants to prevent ant attacks. The fruits can be bagged in polythene to avert birds.

Dragon fruit damaged after ant infestation

HARVEST

Fruits mature 30-33 days after flowering and can weigh from 200gm to 1Kg. The dragon fruits can be harvested when it will form a deep red colouration and the fruits can be pressed slightly. It is advisable to extract the fruits with sharp knives.

- Harvested fruit has to be kept in a cold atmosphere for some time.
- Sorting has to be carried out to remove bad, infected, rotten or damaged fruits.
- Fruits have to be categorised according to size for grading according to the market demand.

STORAGE

The dragon fruit can be easily stored for 5-7 days in dry and cold atmosphere. A special characteristic of the fruit is that mature fruits can stay on trees for 5-7 days and on table 8-10 days after harvest. The fruit can be stored and preserved in refrigerators for upto 15-20 days.

Dragon Fruit Collection

PROFIT

Cultivation of the dragon fruit is profitable compared to other fruits. One time cultivation can yield crop for upto 20 years. Cost of producing this fruit is low. Yield of the fruit is about 20-25 tonnes per hectare land, which has a total market value of BDT 40-50 lakh. Trees that are 12-18 months of age can bear 5-20 fruit; but mature trees can yield between 25-100 fruits a year.

Coastal farmers are cultivating the dragon fruit under the ICBAAR programme implemented by the Department of Agriculture Extension and are building resilience against the impacts of climate change and an alternative source of income to become financially independent.

Source

1. Dragon Fruit Cultivation Technique-Dr Abdur Rahim, Bangladesh Agriculture University
2.http://www.agriculturelearning.com

Sunflower

SUNFLOWER

Sunflower oil is cholesterol free and is particularly helpful for patients of the heart disease. It can also assist in reducing the cholesterol level in the body. Sunflower seeds are rich in fibre and contains serenium that builds resistance capacity to cancer. Sunflower is grown in the United States, France, Russia, Egypt, Turkey, Germany, Italy, Pakistan, India and Bangladesh. It is essential to consider cultivation of sunflowers to promote healthy living.

CLIMATE RESILIENCE

Sunflower is naturally resilient to climatic disaster. Inundation in the southern region of Bangladesh delays removal of water from arable lands. Sunflower cultivation has increased in the southern region recently. Sunflower seeds are planted in this time. The late crop is harvested in 100-120 days during March-April, before the start of rainfall and increase in salinity. The sunflower has a measured level of saline resilience and can be cultivated in lands which have low to high texture. Its cultivation increases the crop intensity. An additional increase in land capacity has contributed to growth in annual production of this crop.

Sunflower is placed second in the world in oil-like crop production. Bangladesh has a significant deficit of edible oil. Edible oil has to be imported. The cultivation of sunflower is growing in the southern region, especially in Borguna and Patuakhali districts. According to statistics, the winter season of 2018-19 produced 3,052.15 metric tonnes of sunflower in 1,920 hectares of land.

ECONOMIC UTILITY

Sunflower increases the glow of the skin. Fibre present in the seeds helps alleviate constipation. It is used in woolen clothes, wax and soap production. High quality paper can be produced from the stem and flower of the sunflower tree. Sunflower bran is an ideal food source for cows and buffalos. The flowers can be used as fodder or fish feed after extraction of the seeds. The tree can be utilised as a fuel source. Edible seeds contain upto 40-50% oil and 40-45% linolic acid which is very useful for the human body. Sunflower oil does not contain harmful iodic acid. Sunflower bran is highly nutritious as feed for domestic animal, fowls and fish.

Sunflower cultivation with the help of the project

Farmers cultivating sunflower in the field through ICBAAR support

ENVIRONMENT AND SOIL TYPE

Farming environment	Soil type	pH level	Oraniccontent	Salinity Resilience
Ganges tidal floodplain-13, new Meghna estuary floodplain-18, Patuakhali, Barguna, Barishal, Jhalakathi, Pirojpur, Noakhali, Bhola	Sandy loam and clayey loam soil, moderately high and well drained land is suitable for cultivation	Alkaline soil 6-7	Generally low	Partially-moderately saline resilient

ADVANTAGES

- Energy consumed from food usually is provided from three main sources: sugar, protein and fat, or oil. Edible oil provides us with energy and makes food delicious. It assists us to extract existing vitamin A, vitamin D, vitamin E, vitamin K, etc from food soruce.
- This effectively means that our body cannot extract all the nutrients from our regular food like fish, meat, eggs, vegetables, etc. without cooking these food items with edible oil.
- Edible oil is essential to produce baby food. Sunflower oil contains 40-45% oil.
- Sunflower oil contains useful linolenic acid (68%) and does not contain harmful iodic/acid, which is present in mustard oil.
- Sunflower oil is helpful for patients with heart disease. This oil assists in reducing the level of cholesterol in blood and high blood pressure.

BEEDS

Bangladesh Agriculture Institute has invented some successful hybrids of the sunflower. Two of those, Bari sunflower-1 and Bari sunflower-2 are especially suitable for cultivation in the southern regions.

Hybrid	Planting time	Seed quantity (kg/hectare)	Expected yield (kg/tonne)	Life cycle (days)	Characteristic
Bari Sunflower-1	November-December winter-1, April-May	8-10	1.6-1.8	90-110	Resistant to Alternaria bright disease
Bari Sunflower-2	November-December and April-May	8-10	2.0-2.3	90-95	Contains 42-44% oil

IRRIATION AND WEEDING

Irrigation process has to be carried out three times for a high yield of sunflower. First irrigation has to be provided after 30 days of sowing seed (before flowering), followed by second irrigation 50 days after sowing seed (during flowering), and finally third irrigation after 70 days of sowing (before seeds mature).

INSECT AND DISEASE CONTROL

Insect name: Scorpions. Small scorpions stay in groups. They are yellow in colour and have stings on their bodies. These insects generally attack the leaves. These insects eat the green portions of the leaves and leave a white stain on them.

Control: Insects have to be destroyed on sight. Insects can also be terminated by applying kerosene with irrigation water. The plants have to be sprayed with water mixed with Diagenin-60 EC (2ml/L).

Disease name: Leaf scorch.

Identification: A fungus known as Alternaria Helianthi assists in spread of this disease. Infection causes greying of leaves or surfacing of uneven dark brown spots. These spots come together to create a bigger infection and gradually scorch the entire leaf.

FERTILISER

Season	Fertiliser	Quantity (kg/hectare)	Quantity (gm/decimal)	Application Method
	Urea	180-200	800	Apply half the urea during last plough and split the remainder to two equal halves 20-25 days after sprouting and 40-45 days (before flowering) after sprouting
Winter	TSP/DAP	180-200	719	During soil preparation
	MOP	120-150	81	During soil preparation
	Gypsum	120-170	-	
	Zinc Sulphate	8-10	27	During soil preparation
	Boric acid	10-12	-	During soil preparation
	Dung/compost	As per need		During soil preparation

Spread: Spreads through seed and air.

Control: Spray water mixed with 2gm/L Roveral-50WP every 10 days for 3 times. Burn leaves and plant after harvest.

HARVEST

Sunflower yields and is ready for harvest between 90-100 days.

EXTRACTION, CONSERVATION AND USE

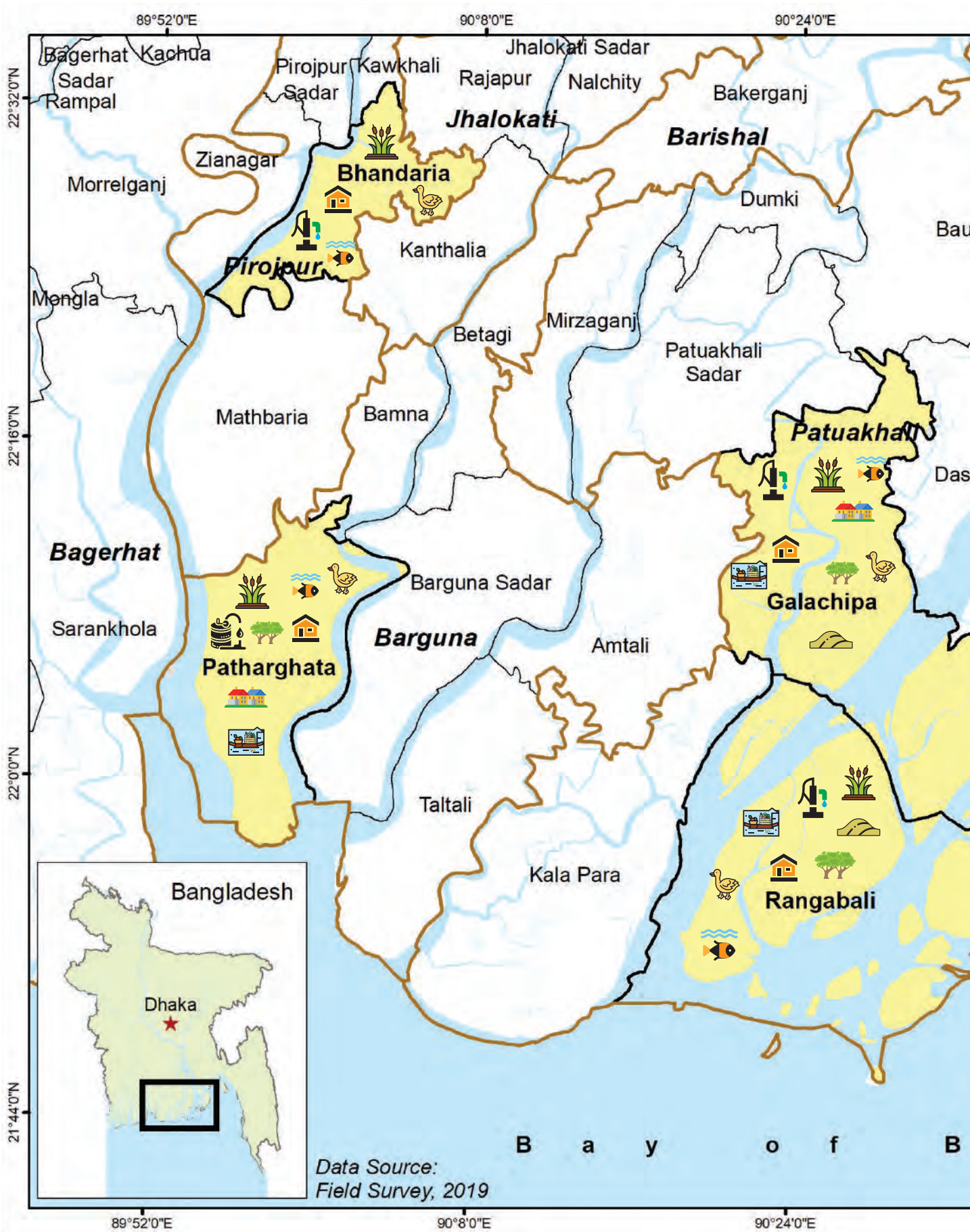
Sunflower seeds can be grinded in the same machine used to grind mustard seeds. These machines are capable to extract 32-38% oil. Avoid shaking the extracted oil and add 1-2 pinch of salt per litre and leave it for 3-4 days. This will allow the formation of a sediment at the bottom. The good quality oil has to be skimmed off the surface and left under sunlight for 2-3 days. Otherwise, the oil has to be heated gently in a container. It is highly inadvisable to boil the oil. The oil has to be cooled and stored in clean containers in a cold and dark place. Glass bottles are suitable for the purpose.

Sunflower oil can be preserved in this way for upto a year if it is occasionally exposed to the sun. It will also avoid build up of bad odour. However, it is inadvisable to store oil beyond two months.

INCOME AND EXPENDITURE

Sunflower is a high value crop. It is possible to extract oil from the sunflower seeds with local equipment and machinery. Sunflower seed has a market value of BDT 1,200-1,600 per maund. The crop yields a profit of BDT 8,000 per Bigha land. It is possible to increase profit margin with early sowing, proper application of fertiliser and irrigation. Every 12kg seed (3 tonners per hectare) can yield 4 litres of oil and 8kg bran extracted by self. The extracted oil can be sold at BDT 130 per litre and bran BDT 60 per kg. The production cost is BDT 230 per decimal land and the cost of extracting oil is BDT 60. Factoring all these into consideration, the net profit can increase beyond BDT 15,000. Red spinach, Spinach, coriander and other intermediate crops can provide additional income to sunflower crop.

Source : Krishi Katha, Department of Agriculture Extension, 2019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90°8'0"E
90°24'0"E
22°32'0"N
22°16'0"N
22°0'0"N
21°44'0"N
Bagerhat Sadar
Kachua
Rampal
Pirojpur Sadar
Kawkhali
Jhalokati Sadar
Rajapur
Nalchity
Bakerganj
Jhalokati
Barishal
Zianagar
Bhandaria
Morrelganj
Dumki
Kanthalia
Pirojpur
Mongla
Mirzaganj
Betagi
Patuakhali Sadar
Mathbaria
Bamna
Patuakhali
Bagerhat
Barguna Sadar
Galachipa
Sarankhola
Barguna
Amtali
Patharghata
Taltali
Kala Para
Rangabali
Bangladesh
Dhaka
Data Source:
Field Survey, 2019
B a y o f B

Area


90°40'0"E
90°56'0"E
91°12'0"E
22°32'0"N
22°16'0"N
22°0'0"N
21°44'0"N
Bhola Sadar
Daulat Khan
Lakshmipur
Ramgati
Sandwip
Subarnachar
Noakhali Sadar (sudharam)
Noakhali
Burhanuddin
Tazumuddin
Hatiya
Lalmohan
Bhola
Manpura
Char Fasson
N
W
E
S
0
10
20
km
Legend
Enrichment Plantation
3FV Model
2FVD Model
Forest Resource Protection Group
Climate Resilient Model Village
Earthen Killa
Sluice Gate
Adaptation Learning Center
Community Resource Center
Climate Resilient Agriculture
Climate Resilient Fisheries
Climate Resilient Livestock
Canal Excavation
Tube Well
Pond Sand Filter (PSF)
Waterbody
Uapzila Boundary
District Boundary
Project Area

Production of saline tolarent vegetables using dyke cropping technology

Livelihood activities in the coastal regions have been most affected by impacts of climate change. Cyclones, floods, tidal surges, river erosion, irregular rainfall, heavy rainfall, drought, inundation, salinity and other effects of climate change are preventing continuation of traditional agriculture, fisheries, and livestock activities. Thus, coastal communities are being displaced and moving to the overburdened cities.

The 'Integrating Community-based Adaptation into Afforestation and Reforestation Programmes in Bangladesh (ICBAAR)' has been successful in creating suitable, climate resilient, innovative, nature and ecosystem-based livelihood activities through experimentation, expert and local knowledge, and analysis of results in eight upazilas of the five most vulnerable coastal districts (Noakhali, Bhola, Patuakhali, Barguna and Pirojpur) of Bangladesh. The programme activities have been appreciated both at home and abroad. It has returned life to the coastal regions.

These climate resilient engagements are capable of adapting to climate challenges like salinity, inundation, flooding, and cyclones. These activities have a high productivity, are economical in execution, and the materials required are readily available in the localities. Implementation of the programme activities through the local government divisions has contributed to capacity building of the government officers and staff. A major element of the programme is that most of its activities are gender-responsive.

We believe, the publication 'Climate Resilient and Ecosystem-based Coastal Livelihoods' will play an important role in combatting the present and future impacts of climate change.