Sustainable Agricultural Practices in Bangladesh

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Towards Sustainable Agriculture in Bangladesh:

Regeneration via Organic and Holobiont-Based Farming

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Bangladesh Agricultural Research Institute (BARI)

The biggest multidisciplinary public research institute
7 crop centers, 17 divisions , 7 regional stations
dealing more than 140 crops
around 748 researchers

Workshop Objectives

- Understand the legacy and side effects of the Green Revolution
- Explore organic farming and microbiome-based solutions
- Introduce Holobiont Breeding and regenerative models
- Promote NBS, Nature positive actions, PGS, zero emission, and C-farming
- Share scalable models like model villages

Green Revolution – Boon or Bane!?

Assumptions

- never end fosil energy
- water is not a problem
- no negetive impact to nature

GR in BD late 1970

Innovation I: soil amending input N2

- Haber - Bosch reaction of nitrogen fixing and Liebig theories introduced synthetic chemical fertilizers by replacing natural ones

Innovation II: plant breeding (miracle seeds)

- lodging resistant, N2 sensitive dwarf rice cultivar from Thaiwan, Japan (IRRI)
- cross Japanese semi-dwarf varieties of wheat with Mexican one

1971-72 (MT)	2022-23 (MT)
Aus -7.42 Aman -5.69 Boro-1.74	Aus -2.9 Aman -15.4 Boro-20.8

3rd globally in rice production

Veg:
1972-73:0.6 MT
2023-24: 19.5 MT
Fruits:
1972-73:8.5 MT
2023-24: 14 MT
Oilseed:
1972-73:0.112 MT
2023-24: 1.5 MT
Potato:
1980:0.9 MT
2023-24: 10.5 MT

1976-77
Cattle: 2.66
Buffalo: 0.01
Goat: 4.33
Sheep: 0.30

Million

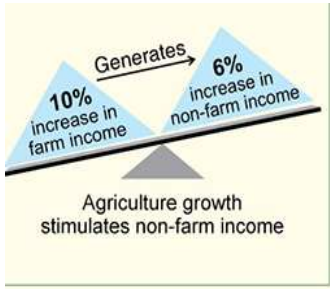
2022-23
Cattle: 29.4
Buffalo: 0.64
Goat: 19.3
Sheep: 0.96

200 M hens, 75 M duck

1976-77
0.44 MT

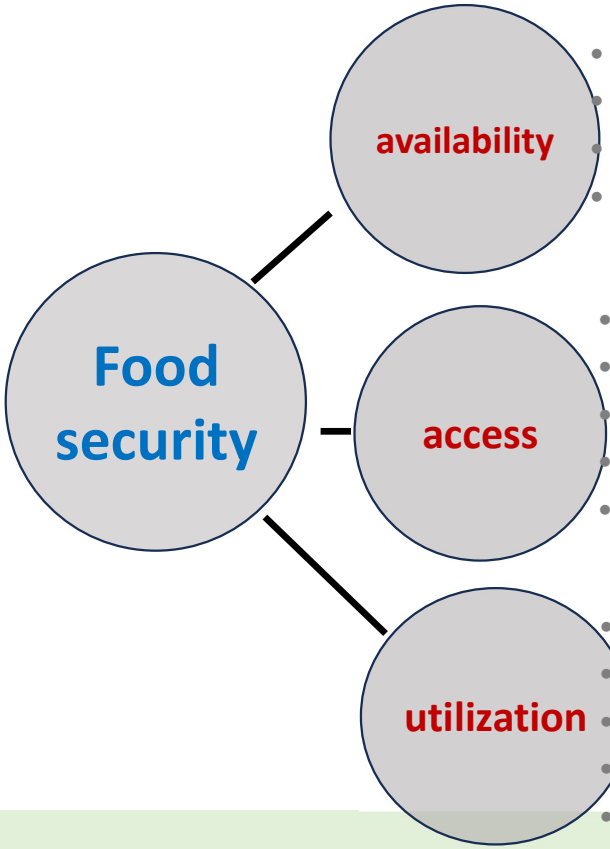
2020-21
3.94 MT

11 % of Global share



10 global producers in 13 sectors

-----the ability of all people to access enough safe and nutritious food at all times to meet their dietary needs and preferences for an active and healthy life



- production
- processing
- water & soil management
- trade & stocking

- transport
- equitable distribution
- marketing
- affordibility
- purchage power

- good health indicators
- nutrious food
- safety and quality
- clean water
- sanitation

Types of tillage	OM loss in 19 days (kg/ha)
Mould board plough + disc harrow (2x)	4300
Mould board plough	2230
Disc harrow	1840
Chisel plough	1720
Direct seeding	860

Impacts of GR based Agril. Tech

	Positive Impacts	Side Effects
Food Production	increased food production	decreased the nutrient density
Famine Risk	reduced famine risk & food politics	increased the malnutrion risk
Irrigation	expanded irrigation using under ground water	depletion of water table @ 1m / year
Soil Quality	None	soil degradation & salinity
Pesticide Use	None	pesticide overuse, - health & - environment
Biodiversity	None	biodiversity loss
Farmer Autonomy	None	farmer dependency on external input & lose seed right

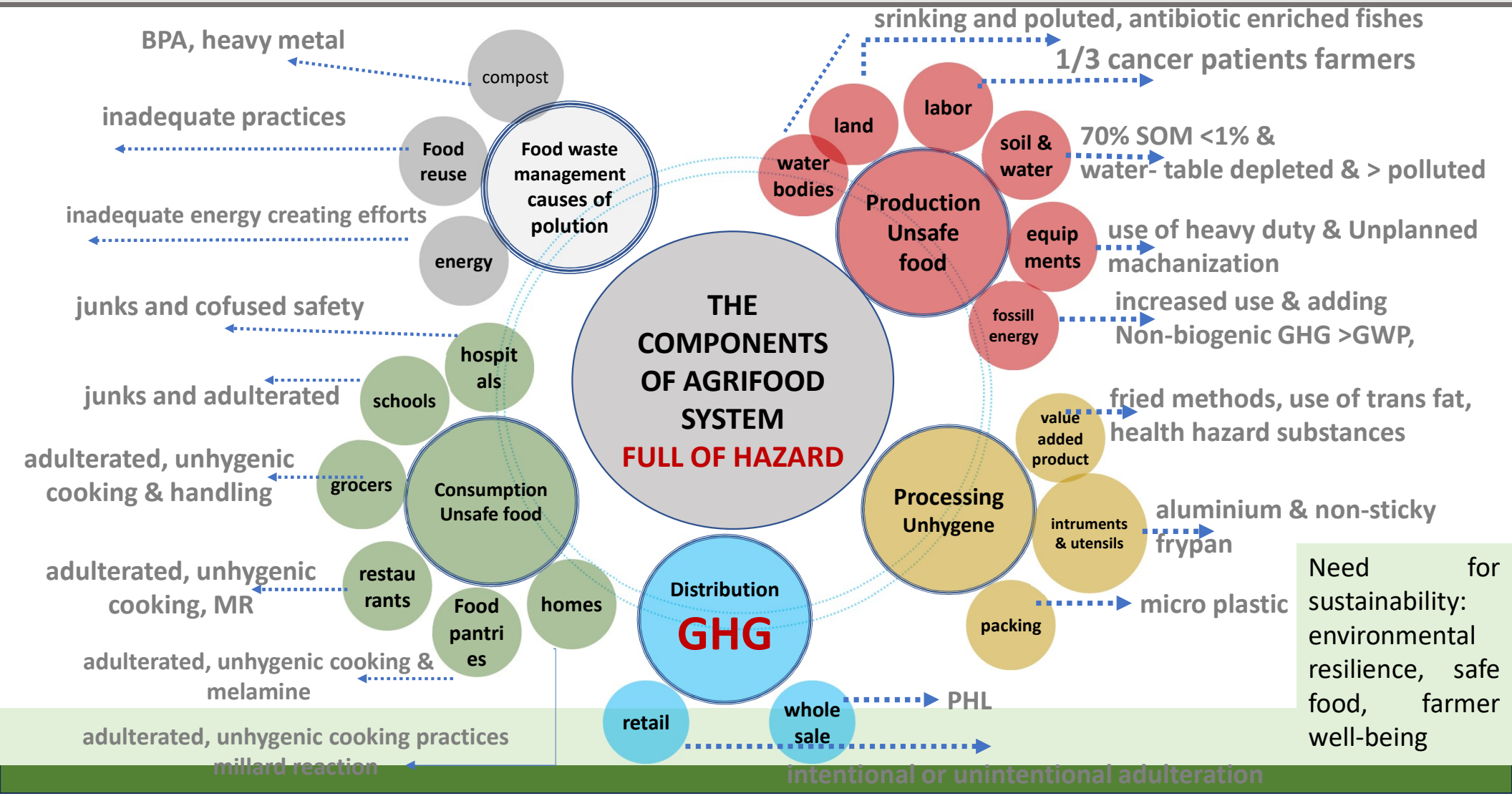
CO2 emission MT CO2equ) from agriculture

1971-72 (MT) 2022-23 (MT)

3.1 → 77 MT

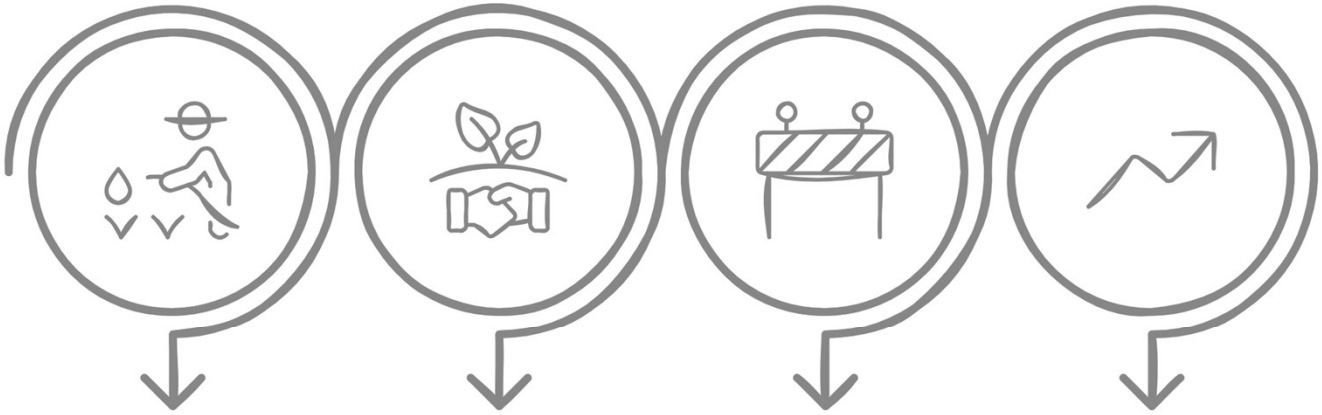
Global share(%) 0.01 0.21

Impact of GR on agri-food system (AFS): Bangladesh



Need for sustainability: environmental resilience, safe food, farmer well-being

Organic Farming Bangladesh : Current status



Current Practice

Practiced by smallholders in limited areas. Current No. of farmers is 10245.

Current Support

Supported by Govt. NGO and local innovation.

Challenges

Strong policy support (absent of input subsidies), certification, market access and training are challenges.

Opportunities

increasingly Increased consumer demand, PGS certification, expansion of practices and global demand are opportunities.

Organic farming: different naming

agro-ecological farming
ecological farming,
conservation agriculture,
permaculture,
regenerative agriculture etc

National organic Policy 2016
- standards and certification
is perquisite to implement the policy

Bangladesh for organic production (including aquaculture) is about 0.19% of total land (FIBL 2017). .

Holobiont Approach to Sustainable Agriculture

GR 1.0
GR 2.0

Plant Definition

Plant defined as a single unit with its microbiome.

Beneficial Microbes

Beneficial microbes enhance yield and disease resistance.

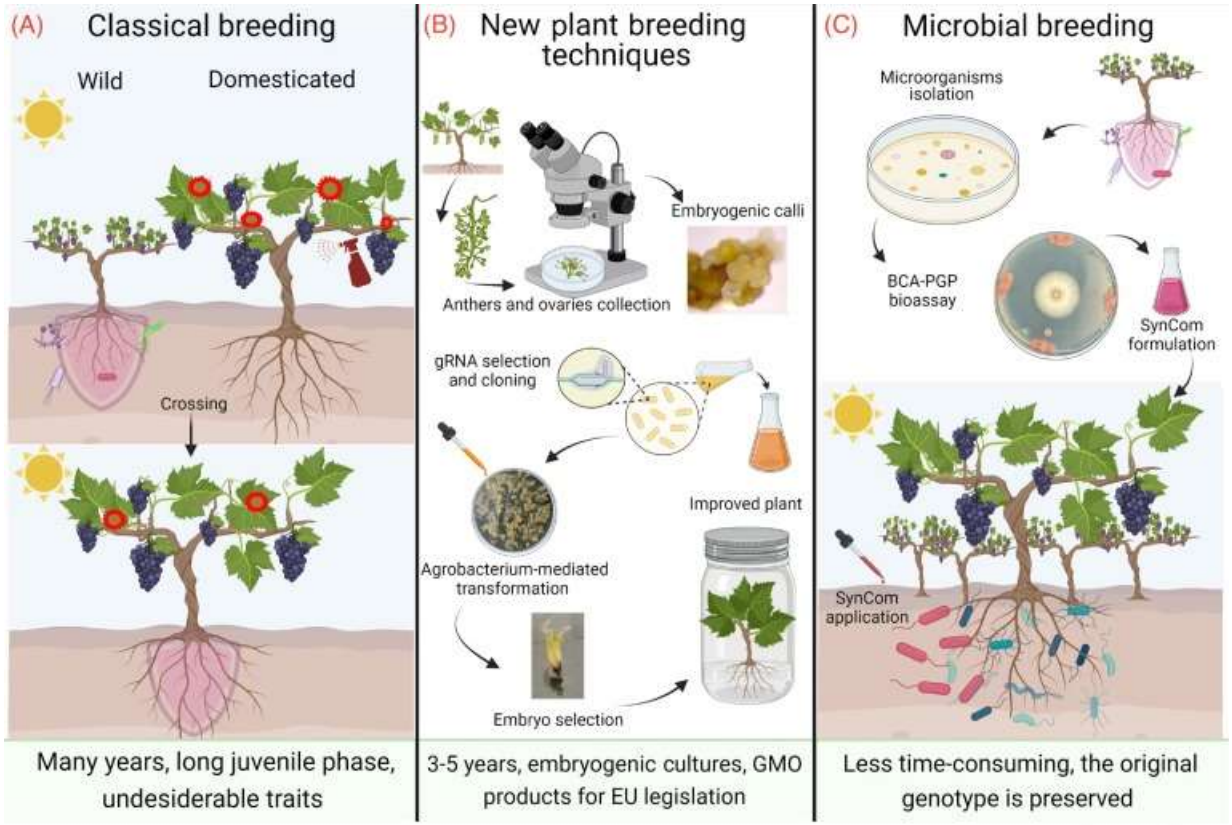
Virus/Wilt Tolerance

Holobiont selection creates virus/wilt-tolerant crops.

Soil-Plant-Human Health

Soil-plant-human health nexus promotes holistic well-being.

Holobiont breeding and Microbiome-Based Solutions



Soil amendment technology

Non-Biogenic emisson '0'

Straw and water hyacinth compost


Water hyacinth


Straw


Wooden frame


Stacking straw and water hyacinth


A layer green debris


A layer half compost cowdung


Completed the stack


Covered by polyethylene

Add adequate water and microbes in every layer, C:N ratio 20-30, keep 60-90 day, every 15-18 days need to de stacking and piled again,

Biologically active compost fertilizer (BAOFER)

Dried fish debris

Oil cake

Bone meal

Rice bran

Poultry refuge

Ash

Mixed all, add water and microbial fertilizers strain, heaped and composting

After heaping remixed everyday during mesophilic, thermophilic and until stable phase, it require 45-48 days

Non-Biogenic emisson

‘0’

Microbial fertilizer(BARI SOMICROBIMOE 1 & 2 Preparation

Oli cake

Rice bran

Heap of ant /weevil

Fresh cowdung

Bamboo / tree leaf litter/

Molasses

Mixed all

An-aerobic

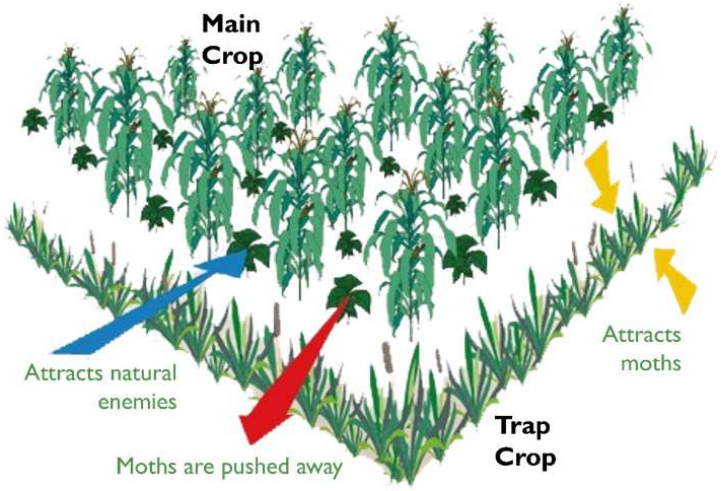
Aerobic

Non-Biogenic emisson '0'

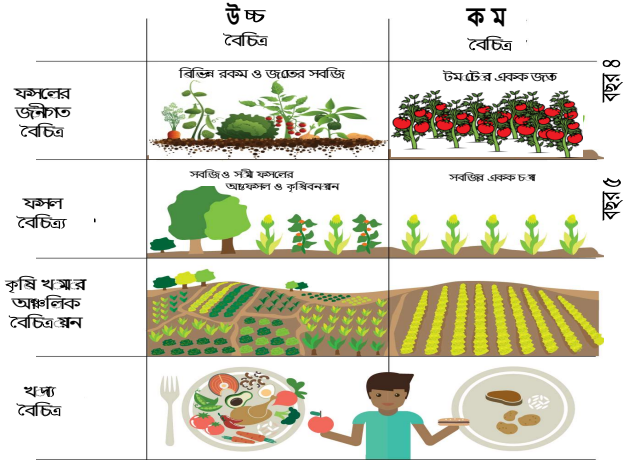
Ensure the soil health fix carbon from nature

intercropping, mixed cropping, trap cropping, biopesticide etc are the main component to maintain biodiversity farm to fork

Clean water washing, ecofrindly sanitizer and packing etc are to applied during post harvest managemtn



Trap crop modell



	রবি	খরিপ ১	খরিপ ২
বছর ১	বেগুন, পাতা ও কপি ফসলঃ বেগুন/ টমাটো/ফুলকপি/ বাধাপপি/ঝাড়শীম +পালংশাক/লালশাক +ফেলন+ মুলা	কুমড়া, ক্রসিফার ও সীম ফসলঃ শশা/করলা/মিষ্টিকুমড়া +পুঁইশাক /বরবটি+ডাটা +ফেলন	সীম ফসলঃ দেশী সীম +পালংশাক + ফেলন/সরিষা
বছর ২	বেগুন, কপি ও কুমড়া ফসলঃ লাউ/মিষ্টিকুমড়া /বেগুন/টমাটো /বাধাকপি/ফুলকপি +মটরশুটি+ফেলন/সরিষা	কুমড়া, ক্রসিফার ও সীম ফসলঃ শশা/করলা/+পুঁইশাক /বরবটি/ঢেড়স +ডাটা +ফেলন	বেগুন ও সীম ফসলঃ দেশী সীম +পালংশাক + ফেলন/সরিষা
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5 years production plan

Comparison of Biodiversity farm to fork

Model Villages for Organic Transition

- Features:
  - Compost hubs
  - Biopesticide units
  - Farmer training centers
  - PGS certification
- Community-led seed banks
- Case studies or pilot sites (BARI, Jhenaidah, Muktagcha, Symnager, Sylhet etc.)

Base line study of agroecological practices in the

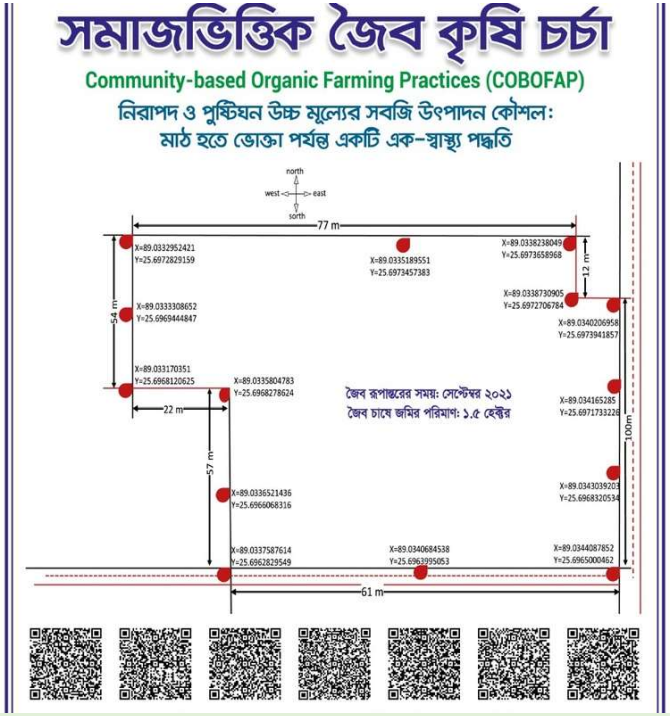
Interviewed at Muktagacha, Mymensingh

FGD at Muktagacha, Mymensingh

Fig: Preparation of BAOFER at Kaligonj, Jhenaidah on July 2023 (10 farmers)

Implementation: Community based approach

1. community selection (FGD,KII)
2. land selection (60 m far from highway & high to medium high
3. land preparation (conservation tillage)
4. Soil amendments (organic fertilizer)
5. PENT and BACT setting
6. Irrigation with clean water
7. Pest management
8. Harvesting Packing



120 farmers, Batoli, Badergonj, Rangpur

230 farmers from 2 locations

110 farmers, Rakudia, Babugonj, Barishal

Hands on Training on input preparation & application mehtods , and inputs prepared for all farmers

Rangpur


Barishal

Rangpur


Rangpur


Barishal


Barishal

During training 4 directors of BARI including field level officers of DAE were attended and delivered lecture

Soil sample also collected from the selected lands

Acttivies of BACT & PENT in two locations of Bangladesh

Land preparation
Rangpur

PENT construction
Barishal

Farmers participations
Barishal

Putting net over frame
Barishal

After PENT fixed white marker for movement

Crops inside the PENT
Rangpur

Acttivies of BACT & PENT in two locations of Bangladesh

BACT
Barishal

BACT
Rangpur

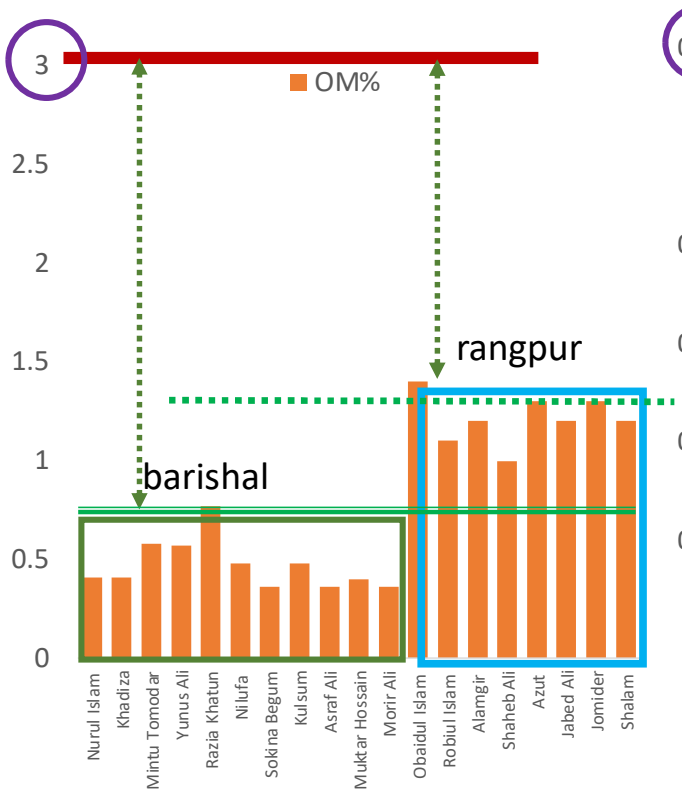
BACT
Barishal

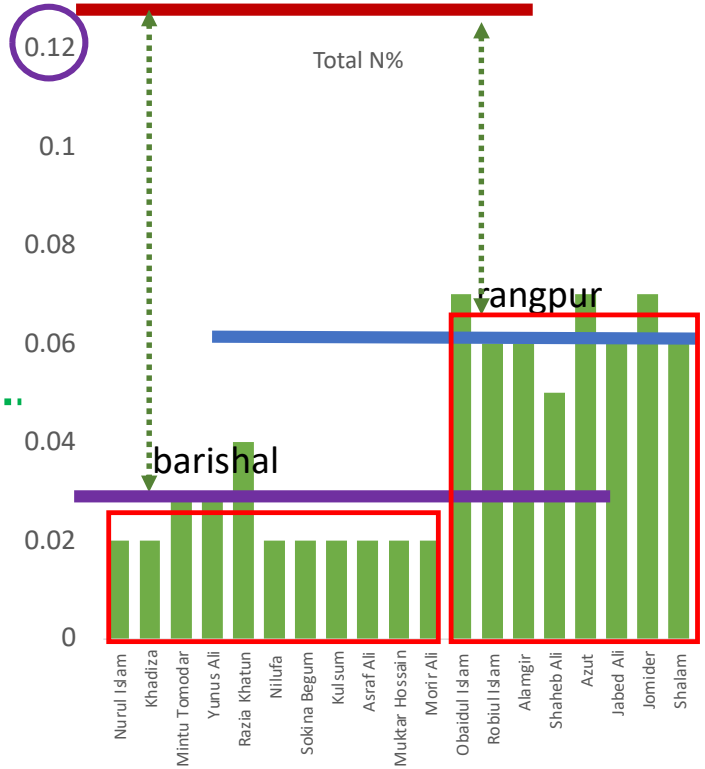
Growth of BACT
Barishal

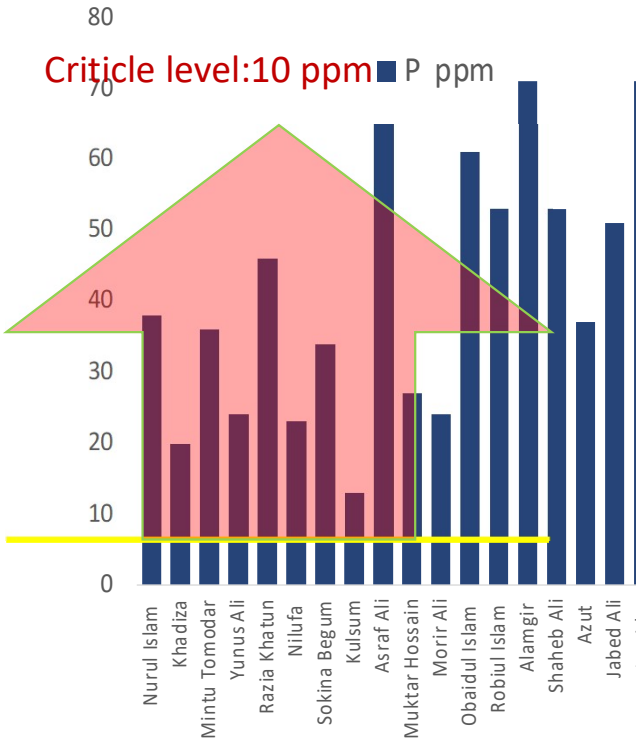
OF application method
Rangpur

OF Method at
Barishal

Status of soil Organic matter (OM), total nitrogen (%) and Phophorus (ppm) at the studied field

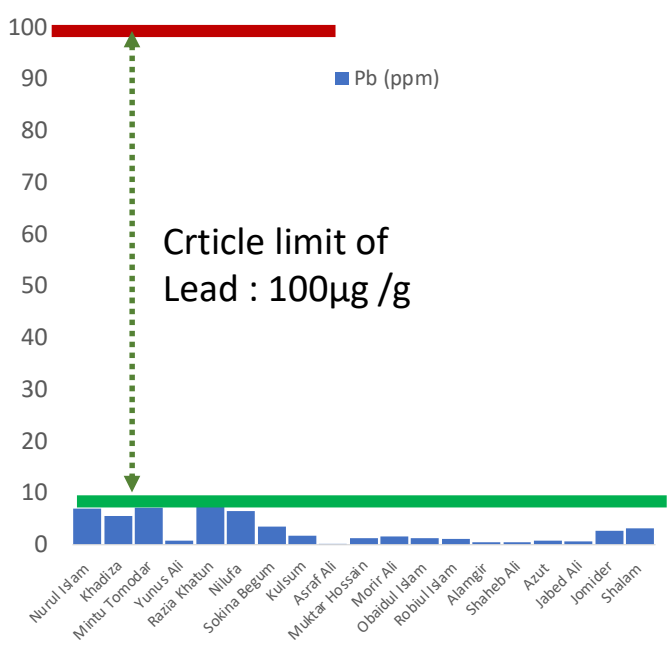


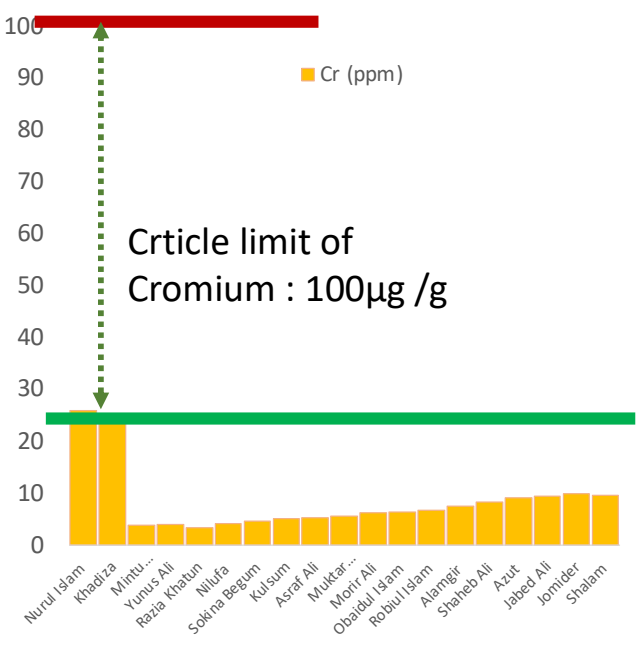


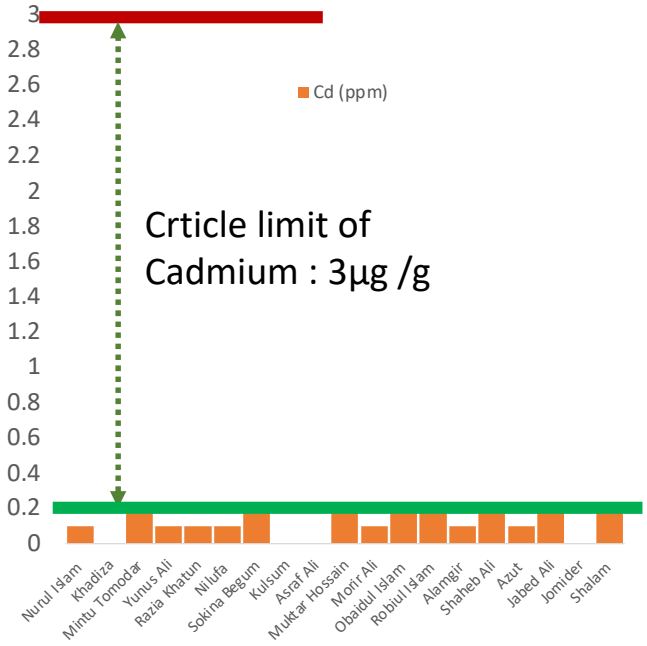


- **In barishal the land was developed by new soil thereby OM & nitrogen were far below than standard soil, although in the Rangpur below than crticle**
- **On the other land the Phophorus found 3-7 times higher than criticle**

Safety status of the soil : Lead, Cadmimum, & Cromium

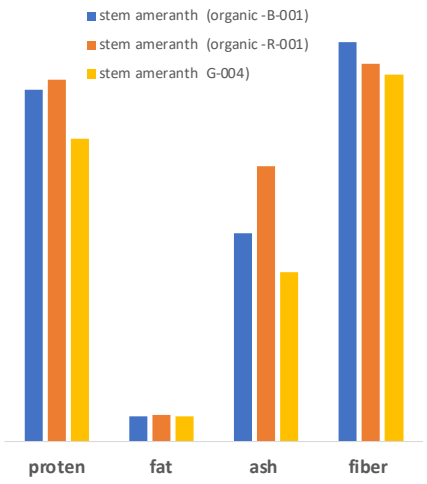


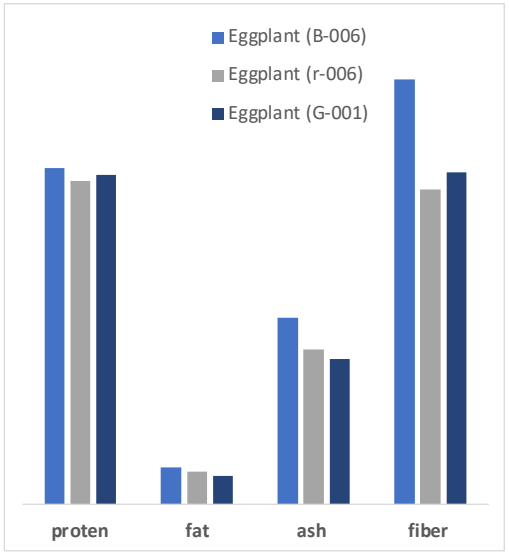


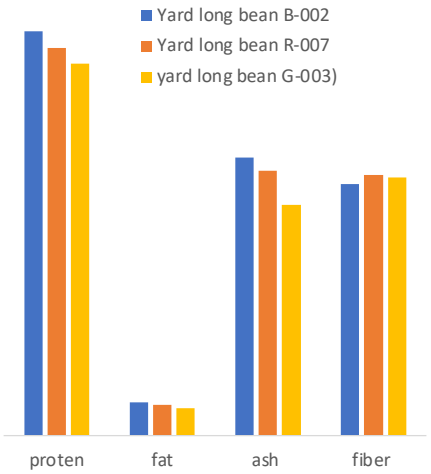


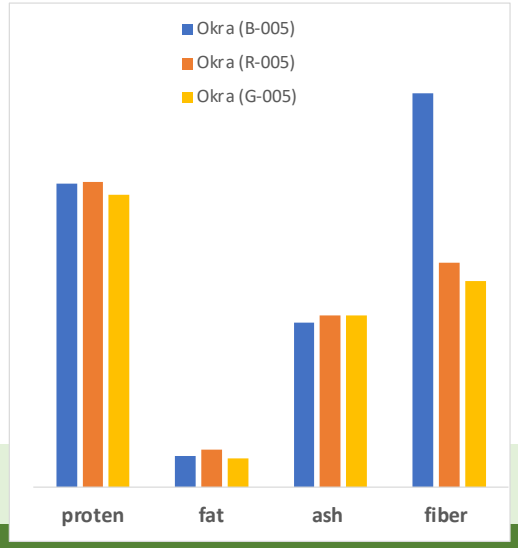
Field view of the growth performances of crops grown at 2 locations using PENT & BACT

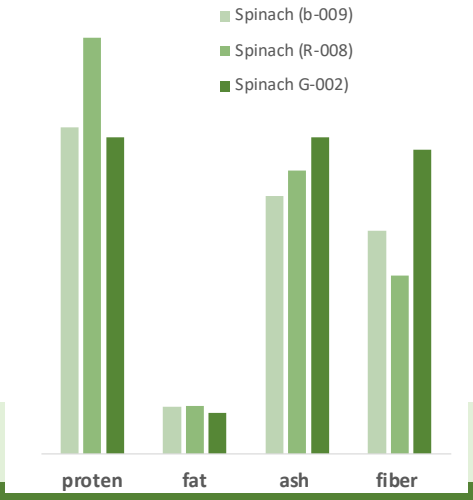
Nutrition status of grown vegetables

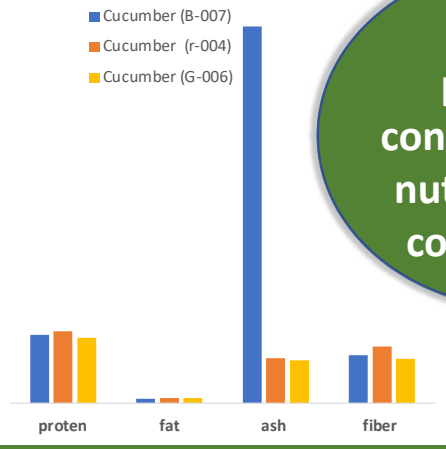






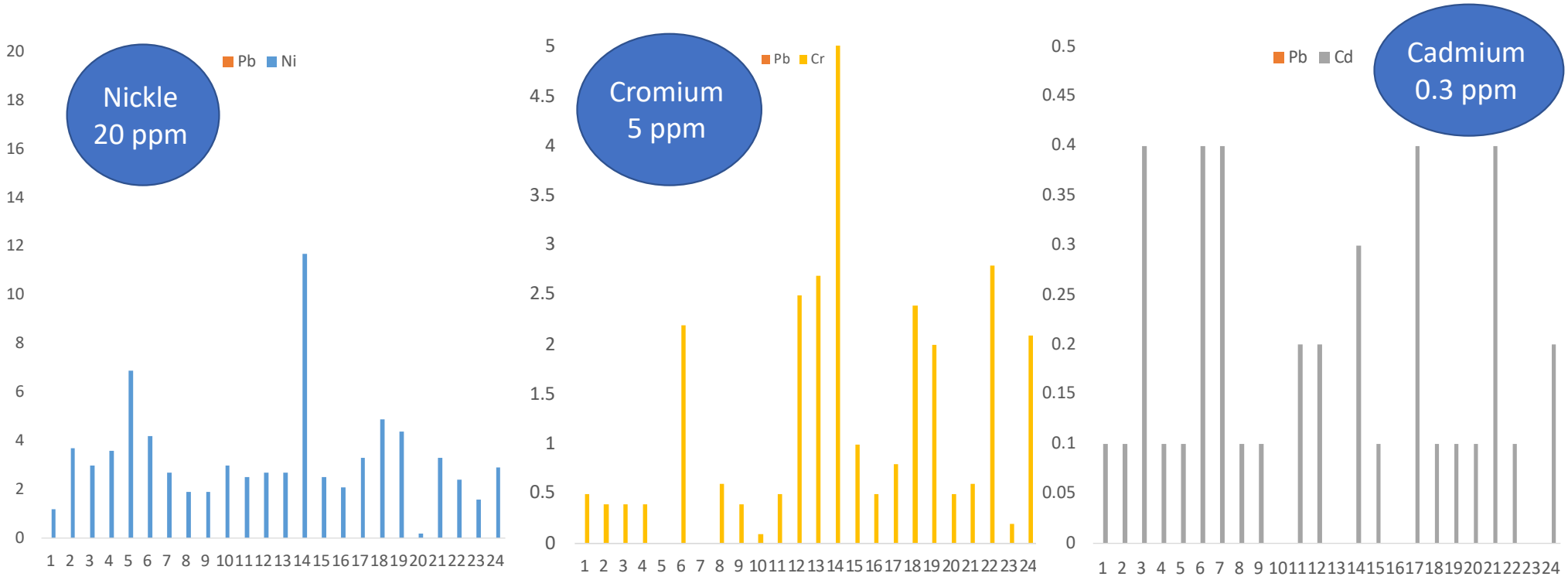




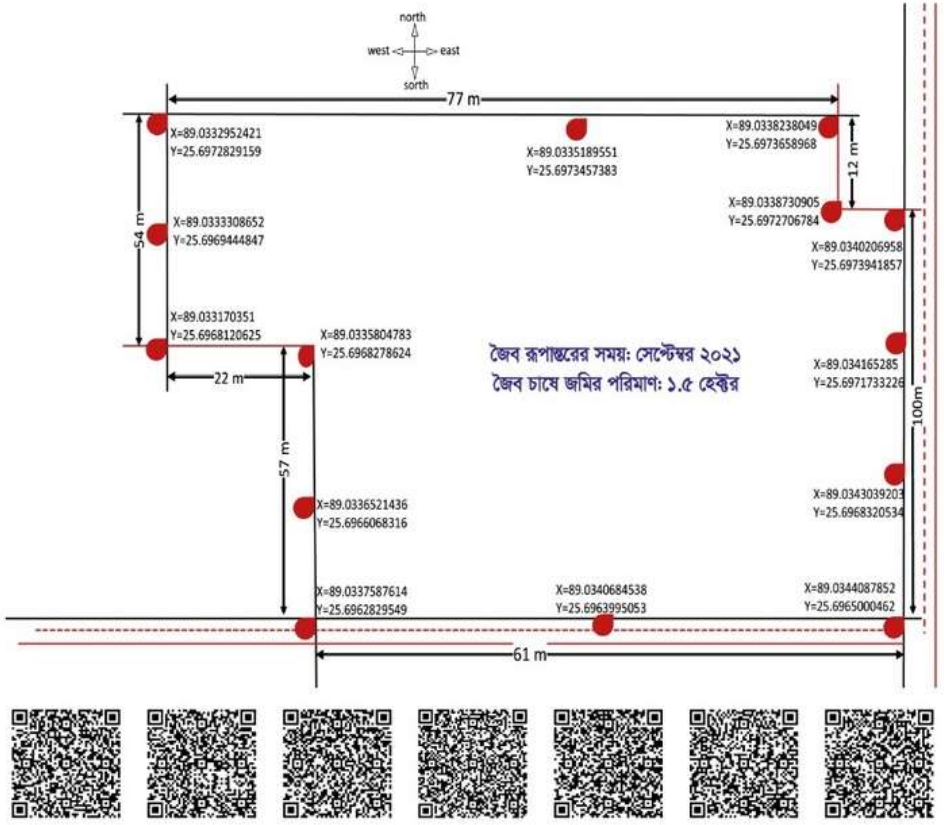


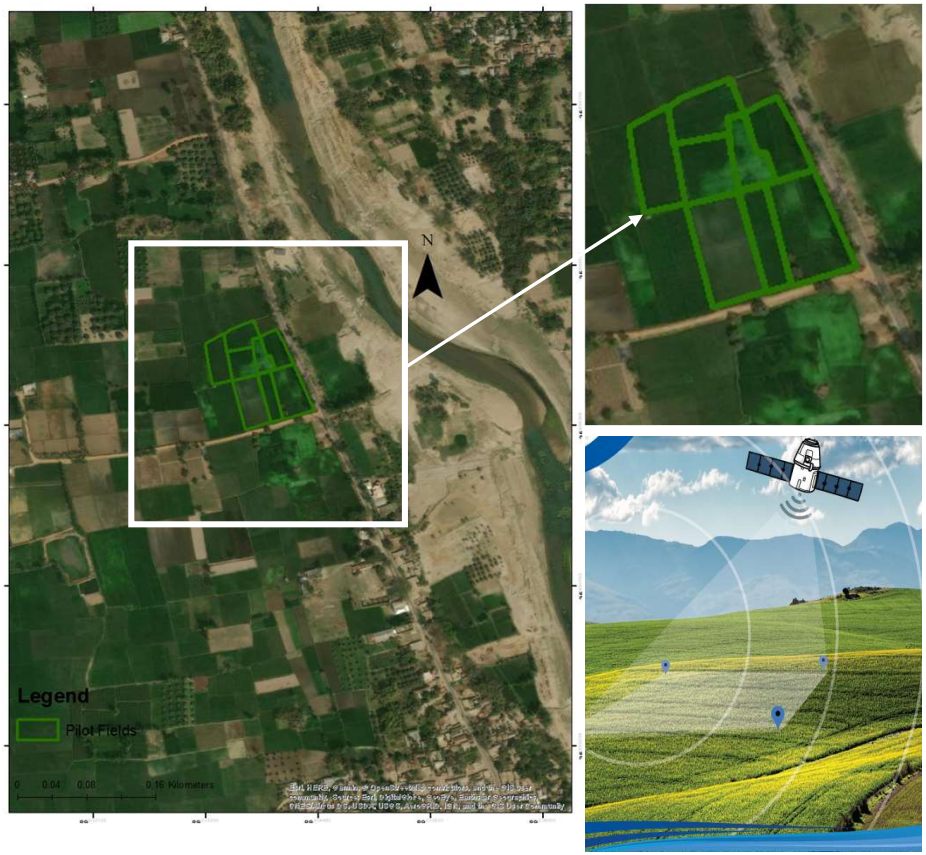
Organic produces contained more nutrients than conventional

safety status of grown vegetables (with globe mrl)



Tracebiltiy of crops grown at different location using satellite





GPS maping of the field for tracebility
Green EO, Germany

Participatory Gurantee system (PGS) certification and logo setting

- Farmer-led organic certification
- Local market linkage
- Reducing cost of certification
- Ensuring trust & traceability in organic produce

BAR code with all information of production process

Packing with natural materials

Bio-genic & non-biogenic emissions

Greenhouse gas emissions (GHG) – fertilizer

CO

N_2O CH_4

production

storage

transportation

synthetic

- energy source
- efficiency
- fertilizer type

organic

- substrate
- operating condition
- fertilizer type
- efficiency

- composition
- operating condition
- storage system

- vehicle types
- fuel types
- efficiency

In-field

- crop & soil type
- previous crop roation
- previous fertlizer use
- current nutrient & om content
- atmosphere conditions
- amount applied and mehtod
- soil microbes
- other amendments soil condition
- irrigaton

all organic fertilizers GHG is Bio-genic and exempted as GWP gas for food security matter

1 kg emit equivlaent -CO2

TSP
in field : 0.56 kg
energy:0.18 mega jule

DAP
In field : **11.27** kg
Energy:6.76 mega jule

Urea
In field : **11.19** kg
energy: 23.45 mega. jule

MoP
In field : 0.46 kg
energy:6.76 mega jule

Water & N-saving preparation





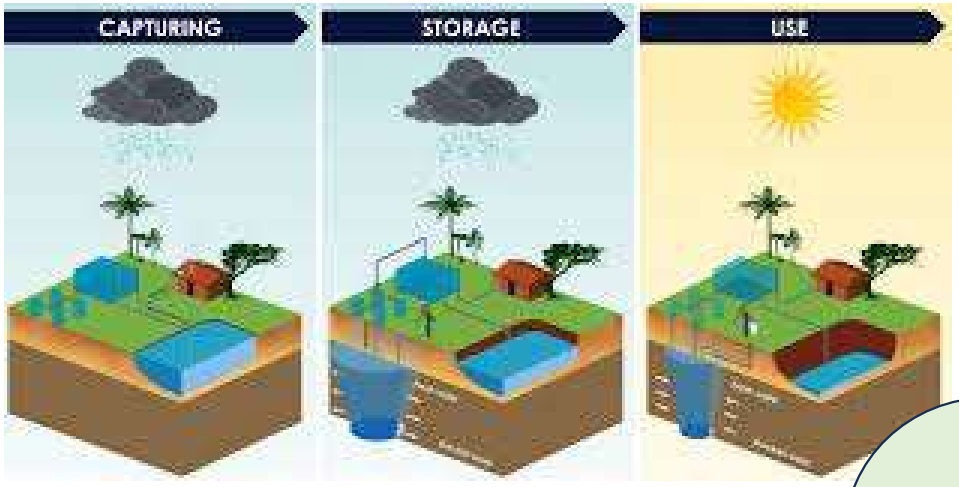

Raised pit planting technology effectively address the late water romoval can grow vine crops and emission can be reduced substantially

Carbon Sequestration & Zero Emission Farming

- Agroforestry integration
- Biochar, cover crops, residue retention
- Organic farming's role in carbon drawdown
- Solar-powered irrigation, reduced fossil fuel dependency

Agroforestry integration

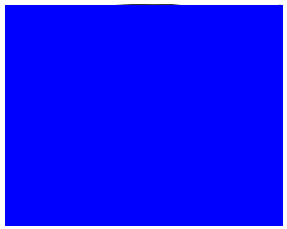
emerging technology many the places of Barinds and saline regions



Adatation aproaches

Traning , motivational tour By national internationall organization **WHH**, Germany

Ethnic Fermented Foods and Beverages in Bangladesh



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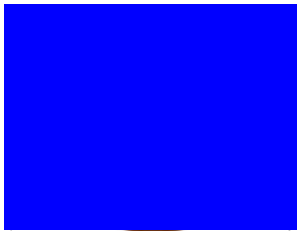
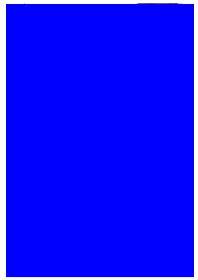


mata



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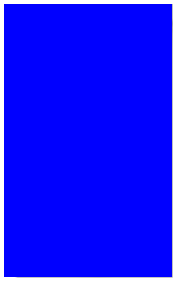
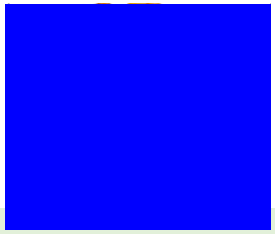


plam wine

coriander chutney

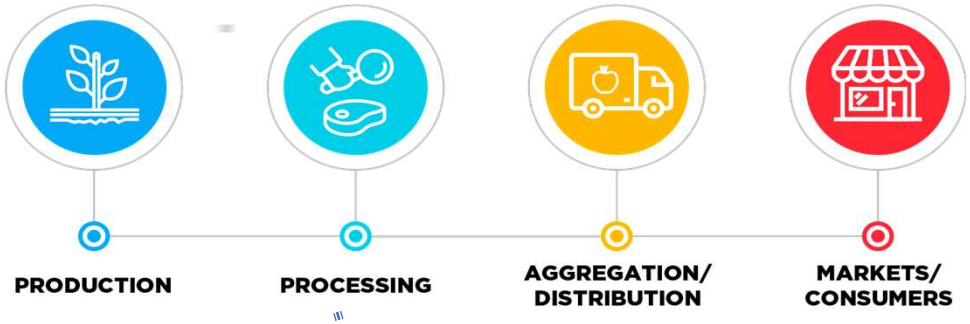


amer acher

beguner acher

upto 1960 food processing & preservation was congeniial to hunman health and gut

Connections among producers & consumers



Producers

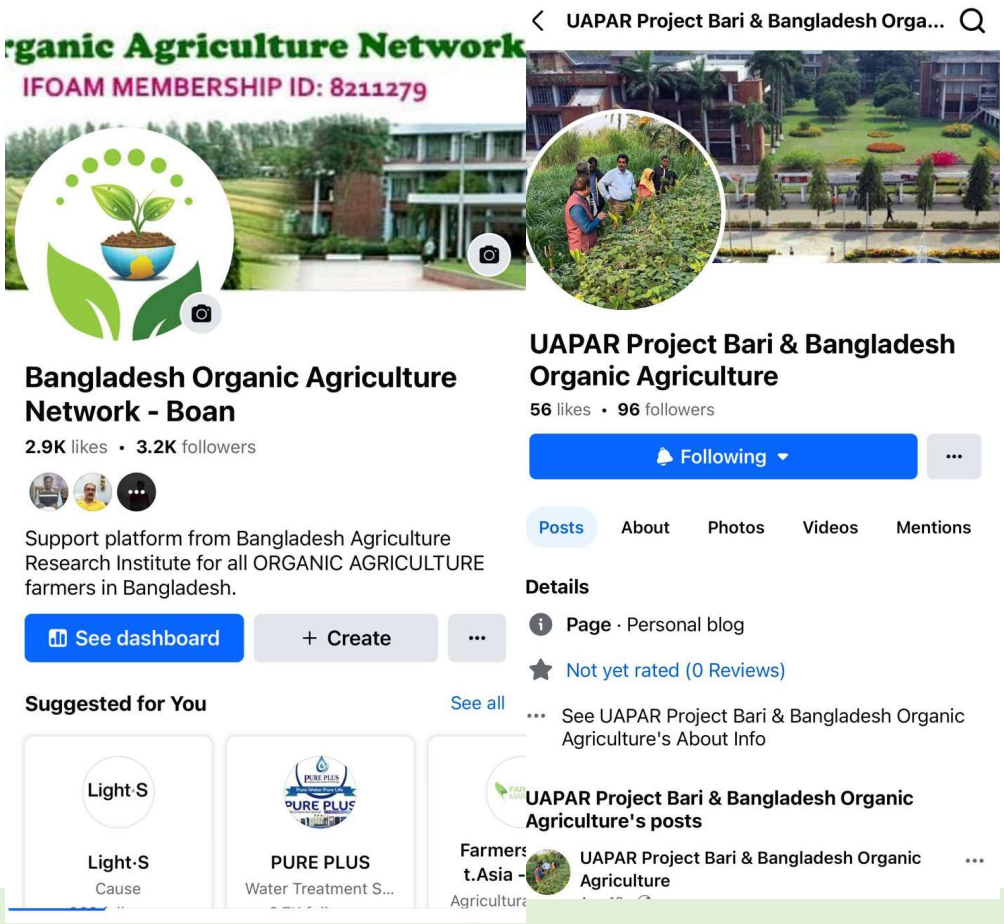
trust

Social certification
PGS of Procesures

consumers

Farmers & other stakeholders reaction and on the activities

- As the technology was new to them initially showed negetative or reluctant attitude
- After getting attractive growth of the crop farmers started to belive to harvest good yidld and income
- Exporters showed keen interest on safe produce & the tracibility system adapted
- Local chain shop agent committed to purchase the produce

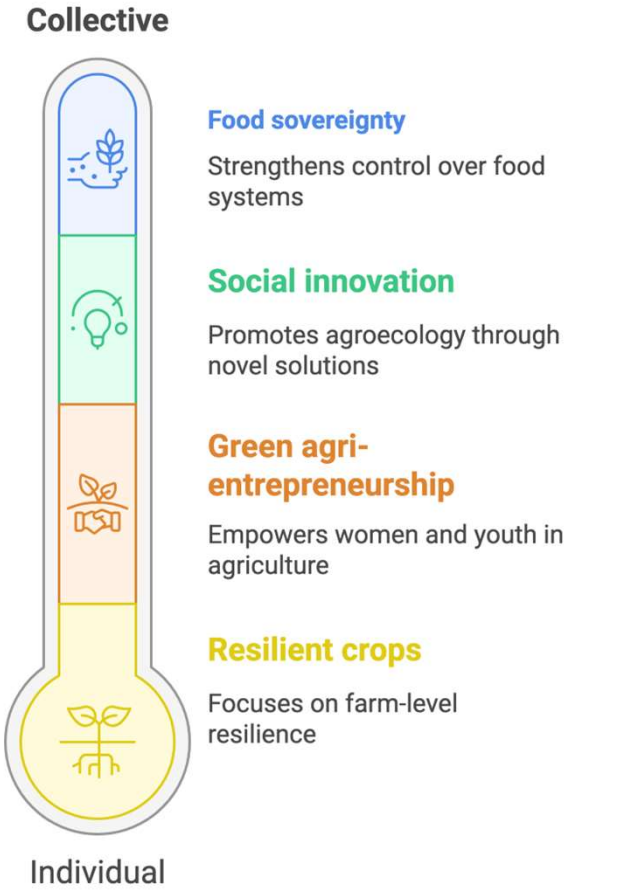


Integrating 3N (Nbs, Np & Net-zero) in Bangladesh's Food Systems

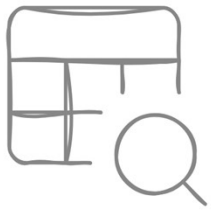
1. **Agroecological Farming:** Agroecology incorporates Indigenous knowledge, NbS, and biodiversity conservation, reducing reliance on synthetic inputs while increasing resilience to climate impacts.

2. **Carbon-Sequestering Practices:** Techniques like crop residue management and agroforestry not only enrich soil health but also act as carbon sinks, supporting Bangladesh's net-zero emission goals.

3. **Community-Led Conservation:** Community engagement in natural resource management has proven effective. Local cooperatives in Bangladesh,



Policy and Practice Recommendations



Research-extension link

Strengthen the connection between research and extension services.

Bio-input incentives

Provide incentives for producers of biological inputs.

Agroecological education

Incorporate agroecological education into curricula.

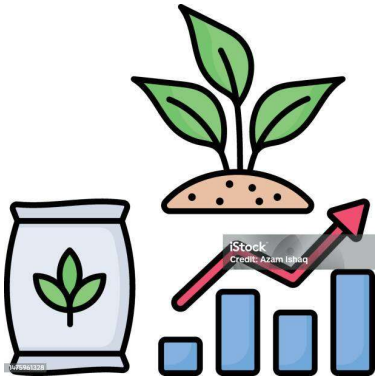
Climate plans integration

Integrate into National Adaptation Plans/Nationally Determined Contributions climate plans.

Demand of Organic Fertilizer in Bangladesh

No official data available, but estimates suggest

60–62 million tons of solid organic fertilizer needed annually.
@ 10 t/ha 75% of agricultural land
(**high, medium-high, and medium-low**)



Subsidy in organic fertlizer

Importance of Data Collection

Highlights the need for official data to better estimate and meet fertilizer demand.

Raw Material Availability:

Total raw material: 130–150 million tons annually.

Sources:
Animal manure (cows, chickens, ducks).
Urban organic waste and household garbage.
Market waste.
Textile industry waste.
Sugar mill residues.

Composting Potential

Proper composting can produce 45–55 million tons of organic fertilizer annually.

Impact of Urbanization

Growing urbanization and industrialization increase the availability of raw materials.

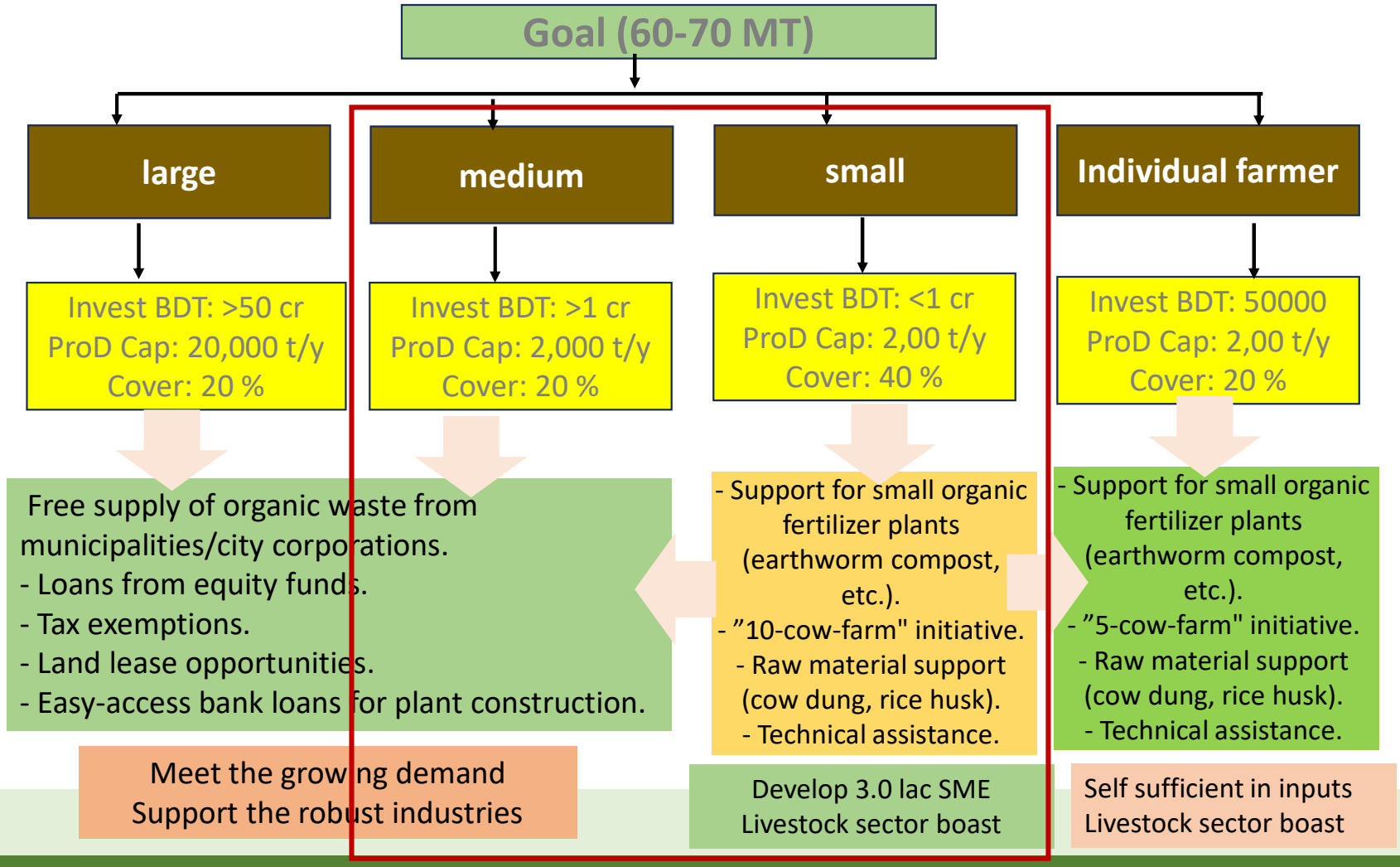
Advanced Fertilizer Production

By blending raw materials with essential additives, advanced fertilizers can be produced:
- Liquid organic fertilizers.
- Microbial fertilizers.

Sustainability Impact

Supports sustainable agriculture by enhancing soil health and reducing dependency on synthetic inputs.

Busniness model and Scope of incentives (proposed)



Status of livestock and potentialities to supply mineral nutrient (NPK) from existing in Bangladesh

Non-Biogenic emisson '0'

Name of Animal	Number (M)	Dung * /year/unit (kg)	Urine * /year/unit (L)	Estimated Available		
				N (Mkg)	P (Mkg)	K (Mkg)
Cattle	20.89	6000	2000	1671.2	752.0	1253.4
Buffalo	1.46	8000	2500	153.3	70.1	116.8
Poultry	255.01	20		89.76	76.5	43.4
Duck	48.86	20		17.20	14.7	8.3

4 cattles 1 ha,

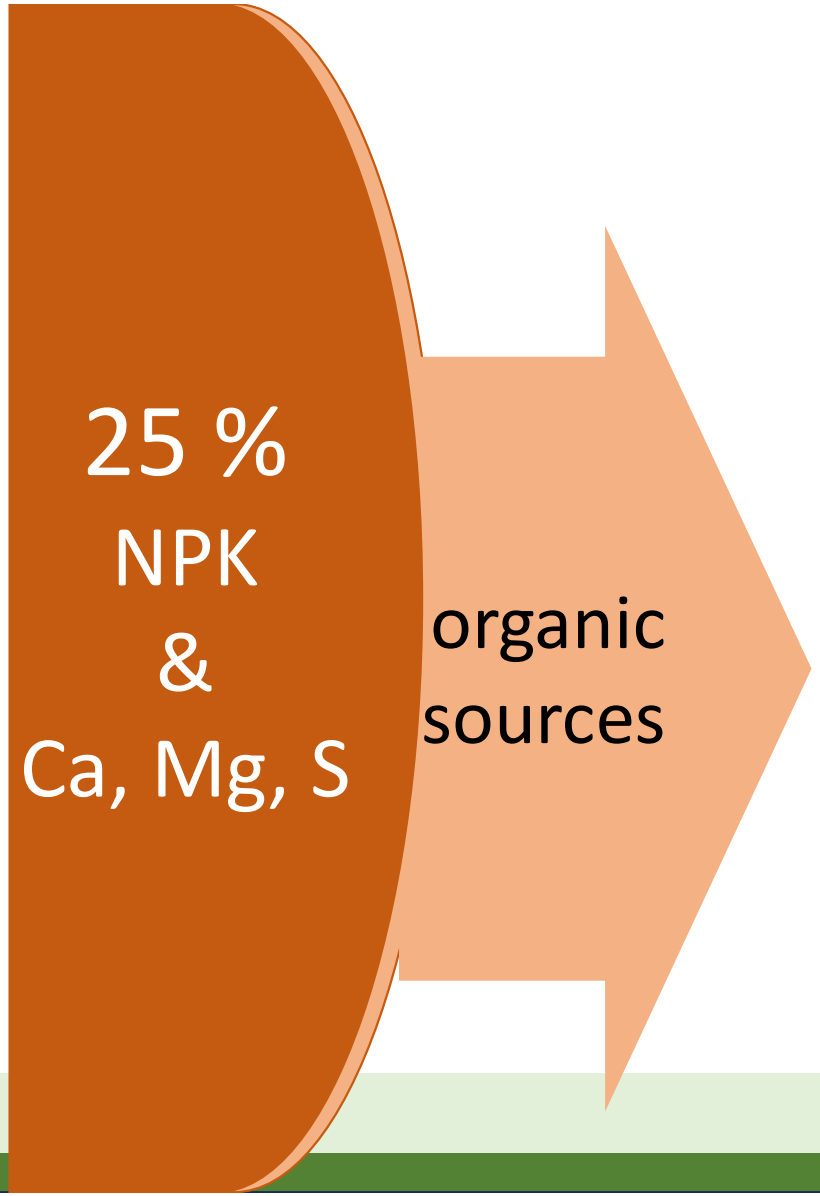
25 youth / block

Total block: 14.5 thousand

5 lac from ferti, 3 lac from cattle

M=million, L=Liter, kg= Kilogram Source: DLS 2024, *Sharma 2005,

Everyday 1kg of organic waste is being produced in each household Contain N:P:K=1.5:2.5:1



Proposed Subsidy for Organic Fertilizers:

- **Market Price of Organic Fertilizer**: 7,000 taka per ton.
- **Cost Consideration**: Includes 17 ingredients and necessary microorganisms for organic fertilizer production.

Proposed Subsidy:

5,000 taka per ton for organic fertilizers

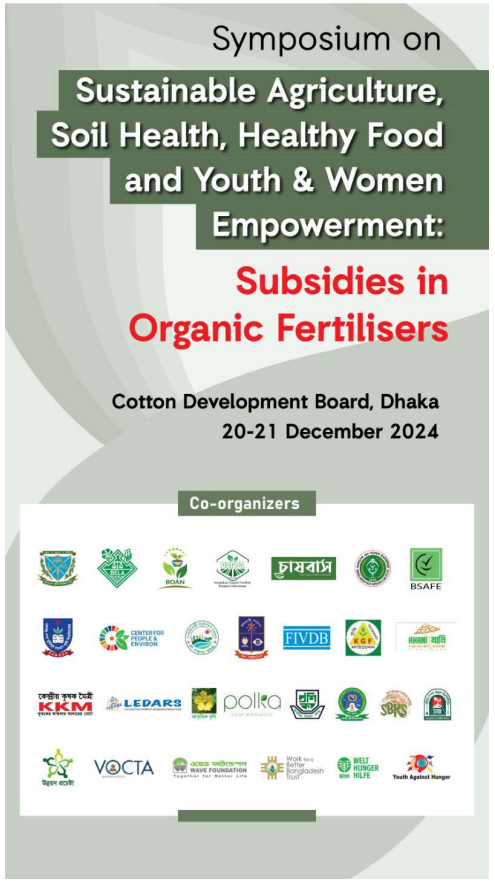
Subsidy Application Strategy:

The subsidy can be applied either to **chemical fertilizers** to make them more affordable or directly to stakeholders involved in the **organic fertilizer production and distribution process**.

Sincere Acknowledgment to …

BOAN

Bangladesh Environment Network



Thanks for patience hearing…!!!!