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Asian Clusters in Agriculture and Climate Change

Deliverable: D2.2 - Best practices in climate adaptation

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Table of Contents

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I. Introduction

Within the “Innovative curricula” pillar of the ALIGNING project in Cambodia and Bangladesh, this report is part of Work Package 2: “Fostering institutional engagement and change”. The work aims to validate the needs analysis and pave the way for a strategy to develop ALIGNING Innovative clusters and to prepare the ground for institutional change. The report presents the outcome of the first two objectives of the work package: (i) the needs validation analysis for upskilling of Asian farmers and agribusinesses departing from HEI programs and (ii) mapping the climate adaptation best practices for agriculture systems in the Asian context. The report is on Task T2.2 Assessing climate emergency and mapping adaptation measures in agriculture with D2.2 “Best practices in climate adaptation”. It builds on the previous T2.1. “Validation and alignment of skills’ demand in agribusiness” with deliverable D2.1. These two tasks set the basis for developing/proposing a strategy and network valid in the national contexts for the establishment of agricultural innovative clusters in the HEIs in Bangladesh and Cambodia.

The main aim of this report is to present the findings of the mapping exercise regarding “climate proofing practices” (as defined in the proposal) in the Asian agricultural context, with sub-focus on digital solutions. Agriculture in Cambodia and Bangladesh remains the core sector in the national economy development. Most farming is still traditional, and the use of modern technology is limited. The use of digital technology is even more limited, especially in agricultural context (making decision on field/farm and agrifood chain management). The cultivation by the farmers is often rainfed without irrigation, thus susceptible to weather variability with prolonged dry and hot spells. The economy of both Bangladesh and Cambodia, in term of their GDP, economic growth and development is threatened by climate change. Agrifood value chains suffer from inadequate primary production, storage, unstable prices, expensive and limited resources (fertilizers, pesticides), in addition to unknown or declining soil health and fertility state, as this report also finds based on literature and stakeholders’ views. The population at all scales needs to realize these risks through, among others, education to different stakeholders in addition to policies, action plans and surely innovation clusters activities in order to increase resilience and buffer/adaptive capacity. This is very important because the effectiveness of national strategies at all scales, but especially at operational scale depends not only on technical solutions but also on the engagement and collaboration of various stakeholders across the agricultural value chain. Also, farmers everywhere in the world are reluctant to adopt unfamiliar practices and digital tools without a clear understanding of their benefits. Therefore, timely, correct and plausible identification of needs are required in addition to proper education. This report synthesizes research findings from literature review on such needs and also presents the outcome of focus discission groups with participants from all HEI on the topic of climate calamities in Cambodian and Bangladeshi agriculture seen from HEI perspective and how these can be tackled.

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The report presents the results of a combined systematic literature review and *Focus Discussion Groups* (FDGs) with approach developed by Aarhus University with revision and inputs from all ALIGNING partners and distributed to key members of the agribusiness ecosystem in the Asian participating countries, including the HEIs in Bangladesh and Cambodia.

II. Methodology

In May 2024 we conducted a scientific literature review on climate change and digital tools in agricultural innovation, focused on Cambodia and Bangladesh. This topic has been extensively reviewed for South-East Asia already (e.g., Habib-ur-Rahman et al., 2022; Aryal et al., 2020). We obtained studies for this scientific review from the Web of Science™ Core Collection Science Citation Index Expanded and Google Scholar databases. We limited the search to a specific time period of the past 5 years, 2019-2024, in order to build on the knowledge on agricultural innovation in Cambodia and Bangladesh identified earlier by other studies (Yun et al., 2015; OECD, 2013) and avoid repetition. This is because the topics of agriculture and innovation in South-East Asia overlap with megatrends such as climate change, population growth or urbanization and have been reported (Tran et al., 2023). We filtered the articles using the abstracts through keywords (for instance, “Cambodia”/”Bangladesh”, “agriculture”, “agrifood”, “digital”, “innovation”, “climate change”) and reviewed in detail 15 articles, 10 for Cambodia and 5 for Bangladesh. The difference reflected the considerably fewer studies published in Bangladesh on the topic of digital tools in agriculture amid climate change.

Next, we conducted FDGs based on the ‘Stakeholder influence mapping’ (SIM) - a visual technique enabling to better understand and explicitly discuss influences for achieving a context. In this case:

- The general context is “*Innovation*”
- The narrow context is “*Innovation in agricultural practices as climate adaptation*”
- Sub-context is “*Use of digital solutions*”

Climate change is complex and multi-factorial and assessing its emergency and mapping adaptation measures in agriculture requires inputs from all relevant stakeholders. The SIM tool is especially useful as an aid for discussion among different stakeholders. Participants arrange different “players” in the agrifood value chain within a triangle or ‘pyramid’ to determine the level of influence to the narrow context – “*Innovation in agricultural practices as climate adaptation*” through discussing the tools and avenues for the influences. The closer the stakeholders at the top of the pyramid, the more influence to the context.

The main aim is to “map” a road of stakeholders through “influences” to the narrow context “*Innovation in agricultural practices as climate adaptation”*. An influence map can be presented visually as a model to show the stakeholders influencing decision and processes and make decisions

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about these. However, more important is to understand how stakeholders relate to one another. Approximately 2 hours were allocated for focus group with 12-20 participants discuss five items:

1. The most significant issues of agrifood value chains - crop production, harvest and storage, retail and sales, including climate effects- drought, heat, hail, flood, pests & diseases, with particular note on the problems and the barriers in agricultural practices along the entire value chain, especially the stakeholders involved.

2. Which practices are used to improve crop production? Discussion and identification of currently used approaches to maintain or increase crop production and highlight opportunities from environmental, economic and societal points of view, including institutions and usage of digital tools. The focus is on crop production- farm economy and sales.

3. Which practices are used to improve soil fertility? Discussion and identification on currently used approaches to maintain or increase soil fertility (carbon content) and health (pathogens) and highlight opportunities from environmental, economic and societal points of view, including institutions and usage of digital tools. Focus is on soil.

4. Which digital tools are used (or are desired to be used)? Collection and identification of “innovative ways” for using digital tools (electronic devices and/or connectivity in general), including success stories linking stakeholders, knowledge exchange and dissemination.

5. Obstacles and advantages to full adoption of practices? Identification of stakeholders needs for technical knowledge and advance for the successful implementation of the suggested practices, also education and research needs and any new directions for further education/research.

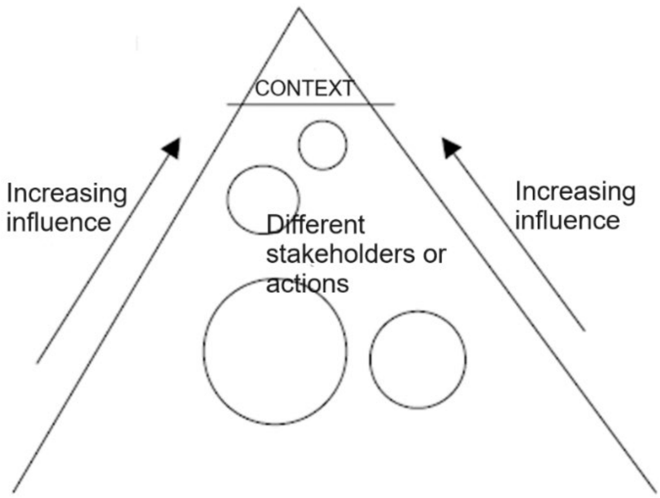

Figure 1. Depiction of the Stakeholder influence mapping method, where sub-context can be integrated (upper sketch) or combined aside (lower sketch).

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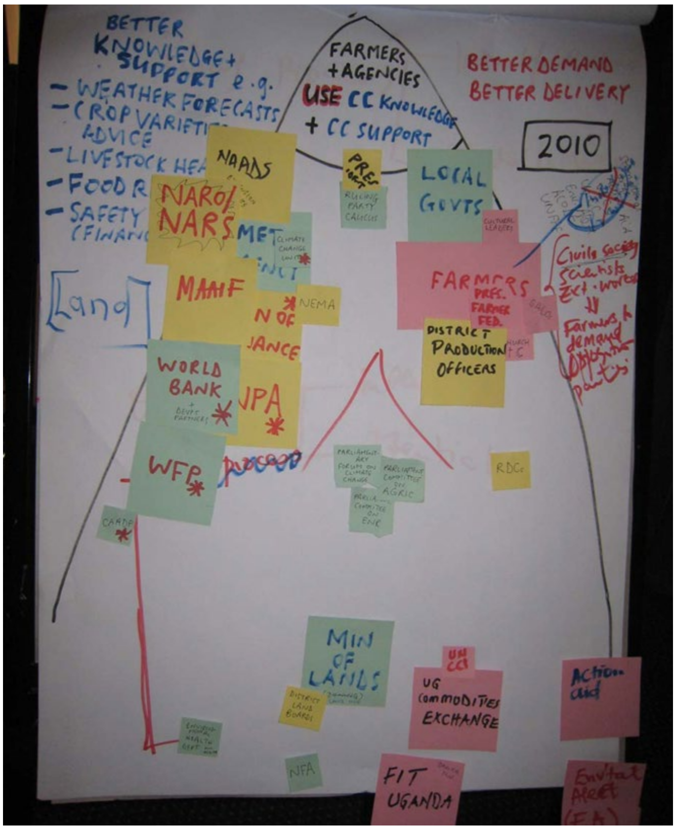

Figure 2. Example of a simple Stakeholder influence mapping method applied to identify "power brokers" in climate change adaptation policy and decision making in Uganda. https://cgspace.cgiar.org/server/api/core/bitstreams/cc56ae89-e768-47da-92a9-57c450f79692/content

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III. Results

a. Literature review

Impacts of climate change on agriculture in South-East Asia and adaptation options have been reviewed from scientific perspective earlier (e.g., Habib-ur-Rahman et al., 2022; Aryal et al., 2020). A recent literature review found significant effects of various climate change indicators on agriculture in Bangladesh over the period 1980–2014. Based on ARDL bounds tests and the Granger causality tests, both approaches very useful to assess long-run associations, this study clearly identified unidirectional causality (positive) from carbon emission to agricultural output, agricultural output to average rainfall, and agricultural output to energy consumption. For Bangladesh, we found considerably fewer published papers in the last 5 years compared to Cambodia, which might relate to a plateau in research interest. The recent ones show the trend in increased interest for open innovation, potential of digital tools design and usage in agriculture and combating climate change. Kabir et al. (2022) investigates the reasons for low adoption of floating agriculture in Bangladesh Wetlands through Roger's five-stage innovation-decision theory. The study found that educated farmers are less likely to adopt floating agriculture as being aware of its disadvantages, and both climatic factors and non-climatic factors can make floating agriculture difficult to practice. Sultan et al. (2023) found that microbial-assisted phytoremediation, a new eco-friendly technology, may be effective in reducing soil salinity, which is a big problem n Bangladesh due to climate change, while maintaining plant growth and productivity. The article states that a successful implementation of bioremediation technology will create a milestone to protect our irreplaceable soil while ensuring food security. Rahman et al. (2024) examines the effect of Foreign Direct Investment’s (FDI) inflow in agriculture on the agriculture sector’s contribution to Bangladesh’s economic development. The study uses the Autoregressive Distributed Lag (ARDL) co-integration approach to measure short- and long-term relationships between FDI inflow in agriculture (AFDI) and agricultural share to GDP (AGDP) in Bangladesh. Results show FDI significantly affects agricultural GDP in the short run but not in the long run. The study concludes that Bangladesh will have to improve its policy for creating the environment to attract FDI in the agricultural and thereby boost the agricultural productivity. Polas et al. (2023) investigate the effects of dimensions on the adoption of green innovation to design a clean energy strategy and eco-friendly SMEs among rural entrepreneurs in Bangladesh. The findings of the study illustrate that environmental concern and perceived ease of use are positively and significantly associated with adoption of green innovation. Additionally, the study illustrates that the intention to use green energy technology, such as solar energy, mediates the relationships between environmental concern and attitude with the adoption of green innovation. Also, despite the fewer studies, there seem to be more apparent case studies with digital tools in Bangladesh. Sayem et al. (2023) for instance presents an IoT-based smart agro-farm security system to ensure agro-farm security and promote agricultural industry sustainability. The system detects unauthorized access and triggers alarms, sending real-time notifications to the farmer's house and mobile device. The study reports an overall system efficiency of 90%.

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Cambodia is more inland and generally with less aquaculture compared to Bangladesh, hence most studies focus on terrestrial agroecosystems. Heng et al. (2024) discussed key challenges to realizing Cambodia's aspirations for a knowledge-based society based on the Cambodian education system. The article found that key challenges were related to low higher education enrollment, a shortage of educational staff with doctoral degrees, a weak innovation capacity, and other critical challenges such as low academic salaries, a lack of clear academic career pathways, limited research funding, and limited knowledge about research. The article provides a set of recommendations to involved stakeholders to improve the quality of the Cambodian education system, mainly involving 1) investment in HEIs, ii) increasing HE enrollment, iii) provision of capacity building for academic staff and academic mobility for both staff and students, and iv) promotion of research and innovation.

Although more than two decades ago, Moreover, Mak S. (2001) examined an interesting example of farmer-led innovation using novel inputs in Cambodia's rice-based farming systems. It was found that the adoption of IR66, a rice variety from the International Rice Research Institute breeding program in the mid-20th century for high yields (but not necessarily high resistances to diseases, e.g., Horgan et al., 2021) in the early wet season was driven by various factors and involved both professional research and local farmer adaptation. Key to this process was farmer experimentation with new inputs, making innovation a collaborative effort of learning and social change. This study is a good example of the triple helix model for innovation where the HEIs interact with industrial stakeholders and being supported by local government. Flor et al. (2016) investigates and evaluates a case of an implemented *learning alliance* (LA). Data is based on interviews and network maps of actors involved, as well as farmers and town-level actors in Battambang and Pursat, Cambodia. The study found that an LA approach can promote actor–network processes that target social, technical, and institutional reordering. However, according to Yun et al. (2015), 3 main simultaneous components of knowledge and technology - production, distribution, and consumption - are most important for "perfect" open innovation policies as shown for the national innovation system of Cambodia. This research group built a causal loop diagram and a system dynamics model to simulate the effects of open innovation policies on the national innovation systems and apply the results to propose/develop Cambodia's national science and technology master plan. Interestingly, moderate open innovation policies had a slight but not lasting effect in improving national competitiveness, whereas high-level open innovation policies clearly had significant and persisting effects. These authors emphasized the caution needed when transferring open innovation models because every country has its own peculiarities, e.g., in Cambodia high knowledge distribution potential with low knowledge production.

We further showcase case studies to exemplify the potential of digital tools in open innovation in agricultural practices as climate adaptation, or barriers for their adoption. Hu et al. (2016) covers a project aimed at enhancing agricultural information flow in Cambodia by adopting China's use of Mobile Internet Technologies. It reviews China's achievements and Cambodia's current *Information and Communication Technologies* (ICT) status in agriculture. The article provides an insight into the farmers' needs and their willingness to adopt mobile-based information services, leading to the development of AgriApp, tailored to Cambodia's conditions. Initial testing and feedback collection promise improved deployment in Cambodia. Sary et al. (2019) analyzed household food expenditure

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and food price in rural Cambodia based on 2017 conducted survey in Takeo, Kandal and Kompong Speu province of Cambodia using Linear Approximate Almost Ideal Demand System (LA/AIDS) statistical model proposed by Deaton and Muellbauer (1980) to estimate price and expenditure elasticities. Among the many interesting results of this study for policy makers, the study clearly revealed a strong relationship between income and household food demand. Hence, proposed digital solutions should meet this condition (farm income). Drain et al. (2018) presents the *participatory design* (PD) process used to design a low-cost rice drum seeder with a community in rural Cambodia. They detail the ideology of the process, enablers, barriers, trade-offs, and the resulting technology. The study concludes that PD is an important process for humanitarian technology development and community empowerment and offers three key recommendations for future PD projects, aiming to benefit practitioners and researchers. Eissler et al. (2021) evaluates the management of *neglected and underutilized species* (NUS) around rural homesteads in Cambodia as a sustainable intensification (SI) strategy. The SI assessment framework from the Feed the Future Innovation Lab covers productivity, economic, environmental, human condition, and social domains. Findings show wild gardening is vital for rural livelihoods but underused due to limited knowledge of its benefits. Wild gardening addresses multiple SI domains and is an important component of rural livelihoods. However, a general lack of knowledge of strategic benefits inhibits its use for maximum benefits.

b. Focus discussion groups on stakeholder influence mapping

The FDGs were conducted by the five universities as follows:

1) University of Heng Samrin Thbongkhmum, UHST, 09 May 2024, 20 participants.

2) National University of Management (NUM), 08 May 2024, 12 participants

3) National University of Battambang (NUBB) and Tasey Samaki Agricultural Cooperative (TSAC), 08 May 2024, 15 participants

4) Bangladesh Agricultural University, BAU, 13 May 2024, 11 participants

5) Sylhet Agricultural University, SAU, 13 May 2024, 19 participants.

In summary, several concerns were repeatedly identified by all universities, directly but especially indirectly related to “climate proofing” practices in the Asian agricultural context, including concerns on digital solutions, and these can be grouped in four main categories:

1) Economic: Challenging to identify market for products due to poor quality and cool-storage issues; not agreed prices, resulting in low/irregular market prices; high cost of the raw materials; limited market access; lack of support from small enterprises; Investment costs

2) Agronomic: Input either in lack or unsuitable for the field condition such as purified seeds for planting (but also quality feeds for livestock and fisheries in Bangladesh), lack of crop rotation, in addition to lack of water storage for irrigation; no clear crop calendar

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3) **Social:** Limited information between farmers and dealers, no collaboration among farmers themselves to exchange knowledge on all aspects. Lack of awareness, training, or education about new technologies and practices can hinder adoption.

4) **Climate/weather:** Flooding and water logging, which was represented by the FDG by SAU, and combined heat-drought, which seem to affect especially vegetables.

Concerning the focus on digital tools, we did not expect at the first place a large-scale or wide-spread use of digital tools in agricultural value chains, and this was indeed identified. This is because uptake and use of digital tools in agricultural production and agrifood value chains require first removal of constraints other than those constraining the use of the digital tools such as digital literacy, IT equipment, price of digital tools. These involve secured crop production, crop pricing/market and farm economy as the first to be ensured. Some farms do use digital tools mostly related to soil moisture, which not necessarily relates to decision for irrigation but likely is required knowledge on final product quality, especially in vegetation and fruit productions; however, the use of digital tools on farms remain exception.

The universities are well equipped with knowledge of the local context and therefore, with the other stakeholders involved in of the FDGs, successfully identified many plausible solutions. The common ones involve 1) increased support of farm economy (subsidies for various external resources, primarily seeds and irrigation), 2) education for proper use of fertilizer in terms of time, amount and method of application, use of integrated pest management (IPM) and farmers must familiarize themselves with compost production techniques and integration of green manure crops to effectively improve soil fertility, and 3) utilizing agriculture tools and machines correctly, also through education/training to well-trained operators. Several other solutions are also proposed and are more dependent on the local context. The reports from the universities regarding the FDGs they conducted are shown next.

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1
FOCUS GROUPS DISCUSSION
ON
STAKEHOLDER INFLUENCE MAPPING
UNIVERSITY OF HENG SAMRIN THBONGKHMUM, UHST
09 MAY 2024

SUMMARY AND DISCUSSION OF RESULTS

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1. University of Heng Samrin Thbongkhmum	02 Persons
2. Provincial Department of Agriculture	02 Persons
3. Provincial Department of Rural Development	02 Persons
4. Extension Worker and Agriculture Staffs	02 Persons
5. Community, Commune and Village Leander	02 Persons
6. Key Farmers, Agriculture Practice	02 Persons
7. Green Agriculture Associations	02 Persons
8. Company, Ruike Cambodia Agrochemical	01 Person

INTRODUCTION

We had a very effective discussion with the relevant stakeholders, who are willingly eager to provide us with insightful input for our discussion. They are authorities, commune/village chiefs, commune agricultural extension officers, university lecturers and staff, community and company staff, and farmers. To get them to respond confidently, we set the color sticker card for them; for example, the Provincial Department of Agriculture, the Provincial Department of Rural Development, and lecturers (blue), authorities and farmers (pink), the Community Agricultural Extension Officers (yellow), and communities and private sectors (green). Below are their meaningful responses:

1. THE BIGGEST ISSUES OF AGRIFOOD VALUE CHAINS- CROP PRODUCTION, HARVEST AND STORAGE, RETAIL AND SALES, INCLUDING CLIMATE EFFECTS- DROUGHT, HEAT, HAIL, FLOOD, PESTS & DISEASES.

The most significant challenges in value chains for them are that it is challenging to identify a market for their products due to their poor quality and storage issues, including storage techniques, which prevent them from being stored for a longer period of time. The soil losts its nutrients and contains pests lead to infecting some other diseases to their crop. The lack of crop rotation as well as the lack of support from small enterprises are also big challenges. They also mentioned the high cost of the raw materials, limited information between farmers and dealers, and market access, which are also affecting their benefits. Lack of water leads to long droughts, resulting in low yields. This makes their product unstable and non-profitable to meet market demand.

The pests have destroyed their crop, lowering the selling price, and they spend a lot on fertilizer because it is expensive. Floods and heat are two of the major problems that cause their crop to have a low yield. It is difficult for them to source purified seeds for planting, which turn out to be the *Sro Ngae* seed crop (not 100% original seeds). The farmers do not know the fixed price of their product for the market, resulting in an unstable price.

There is no collaboration among farmers themselves, and they still apply traditional techniques in their farming, such as the fact that the fact that they do not know how to use fertilizer correctly and effectively, the use of appropriate seed is still limited, and there is no harvesting plan or cropping calendar, which causes them to get an overwhelming yield (the dealer lowers the price). Natural disasters are a big challenge too. Proper storage techniques for their product lead to damaging it and lowering its quality. The electricity is still high for farming practices.

2. WHICH PRACTICES ARE USED TO IMPROVE CROP PRODUCTION?

To improve crop production, the farmers should utilize pure seed, use fertilizer correctly, and use IPM. Farmers should work together collaboratively (sell and buy together). An increase in using natural or organic fertilizer, using irrigation system to save water, and checking the weather forecast regularly are other good practices to improve crop production. Also, it should be used the top soil with organic fertilizer. Setting a clear plan for growing and harvesting is a good way to improve the soil quality.

It is highlighted that the use of fertilizer, selecting the right crop that can grow in any season, and utilizing agriculture tools and machines correctly (well-trained on how to use the machine) are the best practices to improve crop production. Moreover, watering crops by using drip irrigation systems, using machinery to flatten the soil, doing business reports, changing crop calendars, advertising on action, and meeting market demand for farmers are effective ways to improve crop production too.

The preparation of a water well or pond, an irrigation system, electricity or solar power usage, and controlling pests, diseases, and clearing weeds and land are also the best practices for them to improve crop production. It is also indicated to use natural fertilizer, decrease the use of pesticides, weed, keep growing crops on empty soil, making them healthy, prepare good land before planting, water crops sufficiently, and utilize fertilizer properly, such as compost fertilizer.

3. WHICH PRACTICES ARE USED TO IMPROVE SOIL FERTILITY?

During the group discussion on practices to enhance soil fertility, several valuable practices were identified. Firstly, it was emphasized that selecting land management techniques appropriate for each season is crucial. This includes the planting of cover crops, the utilization of compost, and the reduction of chemical fertilizers. Additionally, promoting animal husbandry and utilizing manure as fertilizer was encouraged, as it can contribute to the economic well-being of families and communities. Another way is that crop rotation and adaptation also help. Farmers were also taught to familiarize themselves with compost production techniques to effectively improve soil fertility. Furthermore, it was suggested that the use of chemical fertilizers should adhere to technical standards or be minimized by substituting them with natural fertilizers and properly preparing the soil while ensuring adequate moisture retention. By implementing these practices, farmers can optimize soil health and productivity, leading to sustainable agricultural systems.

Implementing good land use practices is crucial prior to embarking on any planting endeavors. One of the key aspects of such practices involves the utilization of compost. By incorporating compost into the soil, we can enhance its fertility and overall health. Additionally, to ensure optimal moisture levels and proper drainage, it is advisable to plow the land multiple times. This method aids in maintaining the soil's moisture content while preventing waterlogging. Moreover, it is essential to minimize the application of chemical fertilizers and herbicides and instead prioritize the substitution with compost because it can contribute to the long-term health of our land.

To enhance soil fertility, implementing certain practices is essential. One effective approach is to cultivate alternative crops or cover crops. Additionally, the application of compost can significantly improve soil fertility by enriching it with essential nutrients and organic material. Another practice is that lime can be added to the soil to improve soil fertility.

Enhancing soil fertility involves employing a combination of natural fertilizers, such as compost, alongside appropriate chemical inputs. Another effective practice is the planting of cover crops and utilizing green manure. Implementing agricultural conservation practices, such as terracing and contour plowing, Additionally, crop rotation and adaptation promote biodiversity and prevent the depletion of specific nutrients. The application of agricultural lime and suitable fertilizers and regular analysis and monitoring of soil health are crucial to identifying any deficiencies or imbalances promptly, allowing for timely corrective measures.

4. WHICH DIGITAL TOOLS ARE USED (OR WANT TO BE USED)?

Digital tools are revolutionizing agriculture, enhancing efficiency and productivity. Automatic irrigation equipment and drones are used for precise and efficient watering of crops. The Crop Health Analyzer and Soil Controller provide real-time data on crop health and soil conditions. Transplanters and sewing machines streamline planting processes. Greenhouses and hydroponic systems enable year-round cultivation, while sensor-equipped sprinklers optimize water usage. These tools drive productivity, efficiency, and sustainability in agriculture.

Digital equipment like pH meters, agricultural machinery, drones, and NPK test equipment has revolutionized agriculture. They provide precise monitoring, automation, data collection, and nutrient analysis, empowering farmers with efficient and informed decision-making.

Digital tools like agricultural drones, laser tillage equipment, smart irrigation systems, pH tests, disease detection by drones, pesticide spraying by drones, small weather stations, and farm book applications are revolutionizing agriculture, enhancing efficiency and productivity while providing valuable data for informed decision-making.

5. OBSTACLES AND ADVANTAGES TO FULL ADOPTION OF PRACTICES?

Obstacles	Advantages
- Extensive outreach training - Acceptance of new techniques to farmers is still limited (farmers' knowledge is still limited) - Managing over the production chain process is still lacking - Lack of capital and lack of promotion - Supply is limited and expensive. - Knowledge of new technologies is still limited	- Increase productivity and high income - encourage stakeholders to continue to disseminate new techniques - Labor profit - Provide food security - Provide Economic and environmental sustainability
- Farmer knowledge is limited - Lack of capital	- Time-saving - High yield
- Lack of participation - Farmers can’t afford to buy agricultural vehicle	- Provide convenience - Provide profit - Prepare for the season in advance

- Farmers do not know much about modern digital techniques - Weather is getting hot which affects people, animals, especially vegetables - Long dry season causing lack of irrigation water	- Reduce natural disaster risk
- Digital illiteracy - Digital tools are expensive. - Lack of equipment maintenance - Expensive agricultural inputs - Advertising is not yet widespread	- Labor force reduction - Cost reduction - Problem-solving on time - Increasing economy of community farmers - Receiving production standard.

PICTURES


UHST
UNIVERSITY OF HENG SAMRIN THBONGKHMUM


Focus Group Discussion
FGD
Stakeholder Influence Mapping
SIM

2
FOCUS GROUPS DISCUSSION
ON
STAKEHOLDER INFLUENCE MAPPING
UNIVERSITY OF HENG SAMRIN THBONGKHMUM, UHST
08 MAY 2024

NATIONAL UNIVERSITY OF MANAGEMENT

COORDINATOR

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FACILITATOR

Assoc. Prof. Dr. NOP Kanharith, Director of International Graduate Program, NUM

REPORTER

Mr. CHOEUN Nareth, Lecturer and Researcher, Center of Excellence for Research and Innovation, NUM

Mrs. TIE Porly, Research staff, Center of Excellence for Research and Innovation, NUM

PARTICIPANTS

There are 12 persons as well as 2 persons from lecturers, 5 persons from farmers, and 5 students from agro-tourism

SUMMARY AND DISCUSSION OF RESULTS

1. THE BIGGEST ISSUES OF AGRIFOOD VALUE CHAINS - CROP PRODUCTION, HARVEST AND STORAGE, RETAIL AND SALES, INCLUDING CLIMATE EFFECTS- DROUGHT, HEAT, HAIL, FLOOD, PESTS & DISEASES.

Agriculture in Cambodia remains the core sector in the national economy development. Most Cambodian farming is still relatively traditional, and the use of modern technology is still limited. The cultivation of Cambodian farmers depends on nature as much as rain, if the weather is very dry, it is very likely to face a sharp decline in yields.

Another problem for farmers is they don’t have enough drying fields for the community or there are not enough dryers for the farmers to keep their rice good (drying by the sun is not enough to dry rice that can grind and get less raw rice), high spending on fertilizers and pesticides during planting period, and when harvesting period and the cost of oil for pumping water to irrigate the crop, which makes the cost of farming less profitable for the farmers. Market factors are also difficult for farmers, seemingly unstable, which makes it difficult for farmers to continue farming. Cambodia's irrigation system is not yet modern and adequate and has not yet responded to farmers and has not yet responded quickly to droughts and floods. The care and storage of the harvested agricultural products is not yet modern, so more or less there is an impact on the quality, which makes it difficult to compete in the markets of other countries export.

2. WHICH PRACTICES ARE USED TO IMPROVE CROP PRODUCTION?

Improving crop production involves a combination of various practices aimed at enhancing soil fertility, optimizing water usage, managing pests and diseases, and maximizing crop yield. For Cambodian farmers use higher chemical fertilizers the make unsustainable soil and will face big problem in future. Farmers tend to use machines like tractor in their farming process, harvesting machine that mostly they rent it from others, so it can make their cost higher.

There is no real mechanism to control on using chemical pesticides that maximizing environmental impact and not preserving natural enemies of pests. Now most farmers also spend more on renting farming and harvesting machine.

In responding climate change (such as drought) and also save cost on production, some farmers start to make a water well and dig a pond for watering.

Receiving loan or capital from bank or development partners and technical support or advices also improve the crop production.

3. WHICH PRACTICES ARE USED TO IMPROVE SOIL FERTILITY?

Soil fertility (like cow dung, tree leaves) also be used to imporve soil and if technical experts from Ministry of Agriculture, Fishery and Forestry or stakeholders come to teach and advise the farmers with knowledge and information of how to keep and make the soil more fertilized then it is better.

Now some farmers implementing practices like terracing, contour plowing, and buffer strips helps prevent soil erosion, which can protect soil fertility by preserving topsoil and reducing nutrient runoff and leaving crop residues on the field after harvest helps build soil organic matter, retain moisture, and prevent erosion. Meanwhole, most farmers have been using more natural fertilizers to increase yields then at the end it makes soil with fertility.

4. WHICH DIGITAL TOOLS ARE USED (OR WANT TO BE USED)?

Global Positioning System (GPS) is also used to identify the size of farming land, size of soil fertility control and size of land needed to use pesticides or herbicides.

The farmers want to use their own tractors or other machcines or drone in process of producing the producs to lower their cost of production and increase their yield of land used but those points government should reduce tax spending on agricultural tools and products.

Farmers want to use ground sensor (soil water- or pH meter) to measure soil moisture, temperature and other factors that affect crop growth. The data collected by the sensors is transmitted wirelessly to the farmer, who can adjust his farming practices as needed. GPS technology is motivated widely to used for precise farming. It helps to find the boundaries of the fields and apply fertilizers, pesticides and herbicides properly. For Climate control, farmers now have access to real-time weather data that can help them decide when to sow, how to irrigate and what crops to grow.

Information can be obtained through the weather app or website or through the weather station. Automation Machinery is used in agriculture, such as sowing, transplanting, and harvesting. It reduces reliance on manual labor and increases efficiency.

5. OBSTACLES AND ADVANTAGES TO FULL ADOPTION OF PRACTICES?

Investment costs of agriculture for adopting certain technologies or practices, such as purchasing equipment or investing in infrastructure, can be difficult for some farmers, particularly those in low-income or resource-constrained areas. Lack of awareness, training, or education about new technologies and practices can hinder adoption. Farmers are reluctant to adopt unfamiliar practices without a clear understanding of their benefits. Traditional farming practices, and social norms of Cambodian farmers can influence to adopt new technologies and practices. Resistance to change about the effectiveness of new approaches may really exist within communities. Capital need also plays an important role for farmers to continue farming and they require subsidies from government or development partners to facilitae loan with low interest rate to farmers. Limited access to resources such as water, fertilizers, seeds, and extension services can impede the adoption of certain practices, particularly in remote communities.

Adoption of technologies in soil fertility improvement practices can lead to higher crop yields, improved crop quality, and enhanced farm profitability. Many modern agricultural technologies and practices are designed to optimize resource use, such as water, fertilizers, and pesticides. Improved resource efficiency can reduce production costs, minimize environmental impact, and enhance sustainability. Some soil fertility improvement practices, such as conservation agriculture and agroforestry, contribute to climate resilience by enhancing soil carbon sequestration, water retention, and adaptation to extreme weather events and meanwhile adoption of sustainable soil management practices can mitigate soil erosion, nutrient runoff, and soil degradation, thereby preserving ecosystem health, biodiversity, and natural resources. Implementing advanced technologies and practices can improve farmers' access to markets, enhance product quality and consistency, and strengthen their competitiveness in the marketplace by reducing their cost of production. And the other hand, adoption of new technologies often involves knowledge transfer, capacity building, and collaboration between stakeholders, including farmers, researchers, extension agents, and policymakers and can foster innovation, empower local communities, and promote inclusive development.

PICTURES

3

FOCUS GROUPS DISCUSSION
ON
STAKEHOLDER INFLUENCE MAPPING
UNIVERSITY OF HENG SAMRIN THBONGKHMUM, UHST
07 MAY 2024

NATIONAL UNIVERSITY OF BATTAMBANG
AND
TASEY SAMAKI AGRICULTURAL COOPERATIVE

COORDINATOR

Prof. UNG Veasna, Freelance Consultant, TSAC, Battamang

FACILITATOR

Mr. Nob Nun is founder of Tasey Sammiki Agriculture Cooperative and Mr. San Sattya is staff of Tasey Sammiki Agriculture Cooperative

REPORTER

Mr. Rien Ratha, Deputy Head, Department of Agriculture

PARTICIPANTS

1 officer from government

7 persons from agricultural community

5 students from field of agriculture

2 persons from NGO

SUMMARY AND DISCUSSION OF RESULTS

1. THE BIGGEST ISSUES OF AGRIFOOD VALUE CHAINS - CROP PRODUCTION, HARVEST AND STORAGE, RETAIL AND SALES, INCLUDING CLIMATE EFFECTS- DROUGHT, HEAT, HAIL, FLOOD, PESTS & DISEASES.

According to the discussion with the key stakeholders, the biggest issue of Agrifood value chains is climate change, increasing temperatures or long droughts. There are a few more issues such as lack of water resources, irregular prices in the market, and input unsuitable for the field condition such as seed, etc. These issues will cause more problems including insects and disease, harvest, and storage.

According to the seller, the best sales are in April and May compared to July-October, which are very difficult to sell crop production (vegetable, and rice).

2. WHICH PRACTICES ARE USED TO IMPROVE CROP PRODUCTION?

The farmers around the cooperative are using good agriculture practices to improve their crop production such as:

- Using the black net to reduce the heat
- Apply water before the temperature increase
- Plant crops in the greenhouse
- Seed selection
- Apply the input according to the recommendation
- Crop rotation
- Crop Integrating
- Using drip irrigation

High improvements in crop production also cause market problems: the wrong type of needed production makes the price of the products go down and it would be good to process the products which remain from the market. This is also a part of the farmers problem-solving. Besides that the the cooperative and especially the farmers shall prepare the growing plan to fix the market needs.

3. WHICH PRACTICES ARE USED TO IMPROVE SOIL FERTILITY?

Compost and animal manuals are used to improve soil fertility before and during planting crops. Fertiliser is also used to improve crop production but it is good to the soil health and crop growing to apply compost which is made from other sources including animal manuals and crop residues. According to GAP, soil quality is very important to improve production so the farmers shall apply organic fertilisers to keep the micro-organisms in the soil that good effect on soil fertility and crop growth.

4. WHICH DIGITAL TOOLS ARE USED (OR WANT TO BE USED)?

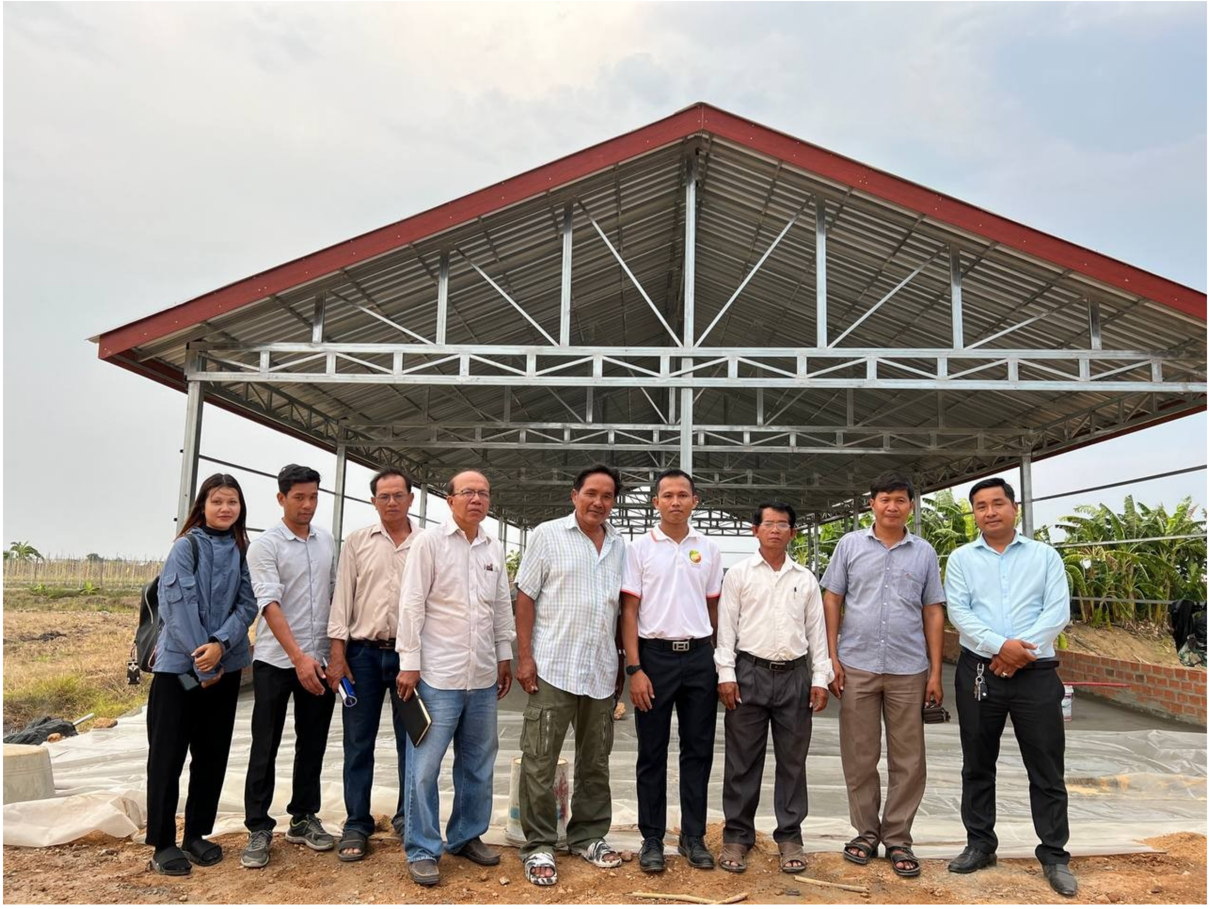
Digital tools are good to set up in greenhouse for vegetable production. The farmers in the cooperative have used soil sensors to measure the moisture content. We used to setup the sprinkler on top of the greenhouse to apply water. For the nursery plant, we used small size sprinkler to apply water. Hydroponics is a good choice for vegetable growers, but it costs a lot of money. We want to try the mid-hydroponic technique on our farm by using different media such as coconut skin instead of soil. It is a good option that we can manage the nutrition in the media by using the sensors.

5. OBSTACLES AND ADVANTAGES TO FULL ADOPTION OF PRACTICES?

Lack of training or education about new technologies and practices cannot make the farmer adapt to the problem. Traditional farming practices of Cambodian farmers can influence to adoption of new technologies and practices. Too much rain in the rainy season can affect crop growth such as low light and high humid that cause insect and disease pests.

Adoption of technologies in soil fertility improvement practices can lead to higher crop yields, improved crop quality, and enhanced farm profitability. Many modern agricultural technologies and practices are designed to optimize resource use, such as water, fertilizers, and pesticides. Some soil fertility improvements practices, such as conservation agriculture and agroforestry, contribute to climate resilience by enhancing soil organic carbon sequestration, and water retention.

PICTURES



A Report on

Focus Group Discussion on Stakeholder Influencing Mapping

Bangladesh for project Asian Cluster in Agriculture and Climate Change

Coordinator: Prof Dr. Mohammad Jahangir Alam

Moderator: Prof Dr M Nasir Uddin

Facilitators: Md Asif Iqbal & Md Abdullah Al Mamun

Participants Attended:

#	Name	Designation	Address
1	Dr Ahmed Khairul Hasan	Professor	Department of Agronomy, Bangladesh Agricultural University Bangladesh
2	Mr M Sahedul Islam	Upazila (Sub-district), Agriculture Officer (UAO)	Madarganj Upazila (Sub-district), Jamalpur District, Bangladesh
3	Dr Rezbi Ahmed	Upazila (Sub-district), Livestock Officer (ULO)	Madarganj Upazila (Sub-district), Jamalpur District, Bangladesh
4	Ms Tahmina Khatun	Senior Upazila (Sub-district), Fisheries Officer (SUFO)	Madarganj Upazila (Sub-district), Jamalpur District, Bangladesh
5	Md. Zahidul Islam	NGO Officer (ASPS)	Madarganj Upazila (Sub-district), Jamalpur District, Bangladesh
6	Md. Masudur Rahman Shovon	NGO Officer (SAUA)	Madarganj Upazila (Sub-district), Jamalpur District, Bangladesh
7	Md. Iqbal Hossain	Inputs Dealer	Madarganj Upazila (Sub-district), Jamalpur District, Bangladesh
8	Md. Rafiqul Islam	Inputs Dealer	Madarganj Upazila (Sub-district), Jamalpur District, Bangladesh
9	Mr Rasel Khan	Farmer	Madarganj Upazila (Sub-district), Jamalpur District, Bangladesh
10	Mr Jahangir Alam	Farmer	Madarganj Upazila (Sub-district), Jamalpur District, Bangladesh
11	Mr Jaynul Abedin	Farmer	Madarganj Upazila (Sub-district), Jamalpur District, Bangladesh

Introduction

As we are all aware, Bangladesh, with its dense population and predominantly agrarian economy, is exceptionally vulnerable to the impacts of climate change. Changing weather patterns, increased frequency of extreme events, and rising sea levels pose significant challenges to our agricultural systems, threatening food security, livelihoods, and economic stability. In response to these challenges, there have been concerted efforts at local, national, and international levels to promote climate change adaptation strategies in agricultural production. However, the effectiveness of these strategies depends not only on technical solutions but also on the engagement and collaboration of various stakeholders across the agricultural value chain. Today, we aim to delve deeper into understanding the dynamics of stakeholder influence mapping in climate change adaptation within the context of the agricultural value chain. By mapping out the roles, relationships, and power dynamics among different stakeholders, we seek to uncover opportunities for enhanced collaboration, policy coherence, and collective action.

Fieldwork (FGD) was planned and carried out on 13 May 2024 to collect data from stakeholders whose lives are disrupted by climate change-induced extreme weather events resulting in floods and droughts. The research team consisted of four members (Annex 1). The field site consisted of one Upazila, Madarganj (sub-district) of Jamalpur district. The data was collected using a focus group discussion (FGD).

At the beginning of the fieldwork, the research team welcomed the respective participants to conduct the Focus Group Discussion (FGD) on a topic entitled "Stakeholder Influence Mapping on Climate Change Adaptation in Whole Value Chain for Agricultural Production System (producers to Consumers) in Bangladesh." The representatives from various sectors and organizations who play pivotal roles in the agriculture value chain considering climate change issues in our country were presented at the place of FGD. The research team was well explained in the local language and the local climate-induced issues in the location. This enabled them to collect the data within the planned time efficiency.

This report synthesizes the discussions held during a Focus Group Discussion (FGD) focusing on stakeholder influencing mapping in agricultural value chains in char land areas of Bangladesh. The FGD aimed to identify challenges encountered throughout the agricultural value chain, practices utilized to improve crop production and soil fertility, digital tools currently in use or desired, and obstacles and advantages to the full adoption of these practices.

Before starting a discussion, we explained the objectives of the work and distributed color strikers while each color striker indicated the response to the questions they made. Afterward, they pasted their responses on the board (See the below Photo1).

Based on their responses to the questions we asked them, the following are the major observations:

1. What are the challenges and or barriers you have been facing during the whole value chain process of agricultural products in chaining climatic conduction?

Climate change affects the production phase and the entire value chain of agricultural products, from production to distribution and consumption. Here are some challenges and barriers faced throughout the agricultural value chain in changing climatic conditions, as the stakeholders explained:

Climate variability, like excessive temperature and rainfall fluctuation, decreased production. Water retention capacity is one of the big challenges for crop production in the study area. Moreover, people in the area are threatened by flash floods and droughts, the major natural hazards affecting agricultural activities and resulting in lower yield and or crop damage. On the other hand, pests and diseases also affect crop health due to climate variability. Besides, they explored the availability of quality seeds, fertilizers, and pesticides at the farmers' level, which are the major challenges that may affect safe crop production. Besides, quality feeds for livestock as well as fisheries sectors are also big challenges for production. Labor shortage at peak seasons is one of the big problems while harvesting agricultural products from the farm. Inadequate infrastructure for post-harvest handling and processing and lack of proper storage facilities lead to post-harvest losses, which are alarming for keeping the quality of the products. They explored that the quality of agricultural products like rice, potatoes, and fruits deteriorated from pests, rodents, and fungal infestations, while limited access to modern storage technologies such as cold storage leads to poor market prices. Market volatility and price fluctuations are also severe barriers to production.

At the end, under the question, they explored that addressing these challenges requires a coordinated effort across stakeholders involved in the agricultural value chain, including governments, businesses, farmers, consumers, and civil society organizations. Strategies may include investing in climate-resilient infrastructure, promoting sustainable agricultural practices, strengthening market linkages and supply chain management, and enhancing policy coherence and coordination at the national and international levels.

2. Which practices are used to improve crop production?

Improving crop production involves a combination of traditional and modern agricultural practices to maximize yield, quality, and sustainability. Some of the key practices are mentioned below:

Cultivation of drought, insects, and disease tolerance/resistance varieties may be good practices that may accelerate sustainable crop production, as they said to us. However, choosing suitable crop varieties adapted to local conditions and utilizing breeding techniques such as hybridization and genetic modification to enhance traits like yield, disease resistance, and tolerance to environmental stresses. Ensuring proper soil fertility through techniques like crop rotation, cover cropping, composting, and organic matter addition. Moreover, efficient use of irrigation techniques like drip irrigation, sprinkler systems, and rainwater harvesting to optimize water usage and reduce wastage. Employing a holistic approach to pest control that combines biological, cultural, physical, and chemical methods to minimize pest damage while reducing reliance on synthetic pesticides. Application of judicial doses of fertilizers to meet crop nutrient requirements, prevent deficiencies, and minimize environmental pollution from excess nutrients. Using machinery and technology for tasks such as planting, harvesting, and weed control to increase efficiency and reduce labor costs. Implementing practices like minimum tillage, mulching, and crop residue management to improve soil structure, reduce erosion, conserve moisture, and enhance nutrient cycling. Increase advisory services for farmers with access to knowledge, training, and resources through agricultural extension programs to adopt best practices and stay informed about new technologies and developments in crop production.

3. WHICH PRACTICES ARE USED TO IMPROVE SOIL FERTILITY?

Improving soil fertility is crucial for sustainable agriculture. Several practices can enhance soil fertility as explained and thus mentioned below:

Crop rotation, like crop cultivation in sequential seasons, can prevent nutrient depletion and soil erosion while enhancing organic matter content. Planting cover crops like legumes (e.g., clover, peas) adds organic matter to the soil, fixes atmospheric nitrogen, prevents erosion, and suppresses weeds. Composting or vermicomposting accelerates organic materials like crop residues, animal manure, and kitchen waste into compost, enriches the soil with nutrients, improves soil structure, and enhances microbial activity. Cultivating green manure crops (e.g., dhancha) and incorporating them into the soil before they mature adds organic matter, nitrogen, and other nutrients, improving soil fertility. Covering the soil surface with organic mulches (e.g., straw, leaves) helps retain moisture, suppress weeds, moderate soil temperature, and add organic matter as they decompose. Minimizing soil disturbance through reduced tillage or no-till practices reduces erosion, preserves soil organic matter, and maintains soil structure, thus improving soil fertility. Applying fertilizers based on soil nutrient tests to meet crop requirements ensures optimal nutrient balance and minimizes nutrient runoff, leaching, and environmental pollution. Introducing beneficial microorganisms like mycorrhizal fungi and rhizobia enhances nutrient uptake by plants, improves soil structure, and promotes plant growth. Finally, they said that both organic and inorganic fertilizers should be applied judiciously after testing the soil health that leads to sustainable soil fertility.

4. WHICH DIGITAL TOOLS ARE USED (OR WANT TO BE USED)?

Digital tools play an increasingly significant role in modern agriculture, offering solutions for various aspects of farm management, crop production, fish and livestock, and sustainability. Some widely used and desired digital tools include:

They explored that they have been using different apps like “Krishoker Janala”, Khamare Apps, “Plantag”, “SMS Gateway”, “doctor fish”, “Krishi Seba”:16126 Mothsho call center” for getting services from the experts. Moreover, they have also been using different social media like “Facebook”, “Fb messenger” “WhatsApp” “Imo” YouTube, etc. for getting as well sharing agricultural information that might be helpful for production as well as market information. However, they commonly used the mobile phone with an internet connection to get information on agricultural activities. Moreover, tools like GPS-guided tractors, drones, and satellite imagery enable precise mapping and management of fields, optimizing inputs like water, fertilizers, and pesticides to enhance productivity while minimizing environmental impact. Different TV channels broadcast weather information and provided real-time weather forecasts and historical data, assisting farmers in making informed decisions regarding planting, irrigation, and crop protection. Moreover, success stories of farms and farmers are also broadcast on TV, and thus, the information may also be disseminated. The information on the market of agricultural products is also telecasted through different TV channels, and thus, they are informed. The important one is that stakeholders, especially farmers, have the opportunity to take part in the discussion related to agriculture through the agricultural program broadcasted on TV channels.

However, they assumed that these digital tools, along with ongoing technological advancements, have the potential to revolutionize agriculture by increasing efficiency, sustainability, and profitability while addressing challenges such as climate change, value chain, resource scarcity, and food security.

5. OBSTACLES AND ADVANTAGES TO FULL ADOPTION OF PRACTICES?

The full adoption of agricultural practices faces both obstacles and advantages:

Obstacles:

Limited access to inputs like quality seeds and breeds, quality feeds, fertilizers, pesticides, and water can impede the adoption of certain agricultural practices, particularly in remote or resource-constrained regions. Many modern agricultural practices require significant investment in technology, equipment, and training, which can be prohibitively expensive for smallholder farmers or those operating on tight budgets. Moreover, farmers may not be aware of or fully understand the benefits of modern agricultural practices, hindering their adoption. Traditional farming practices are deeply ingrained in many agricultural communities, and farmers may be reluctant to adopt new methods due to fear of failure, cultural factors, or skepticism about the benefits. Inadequate infrastructure, such as poor road networks, inadequate irrigation channels, or unreliable electricity and internet connectivity, can limit access to digital tools and technologies that could otherwise support agricultural innovation. Lack of agricultural insurance and even poor loan distribution are also obstacles to the adoption of agricultural practices. They also said that inappropriate selection of farmers for training may lead to low adoption of agricultural practices. They explained that indiscriminate application of pesticides may lead to unsafe agricultural products and pollute the environment. Unavailability of agricultural mechanization at farm levels are also a barrier to saving resources, particularly time and labor, as explored.

Advantages:

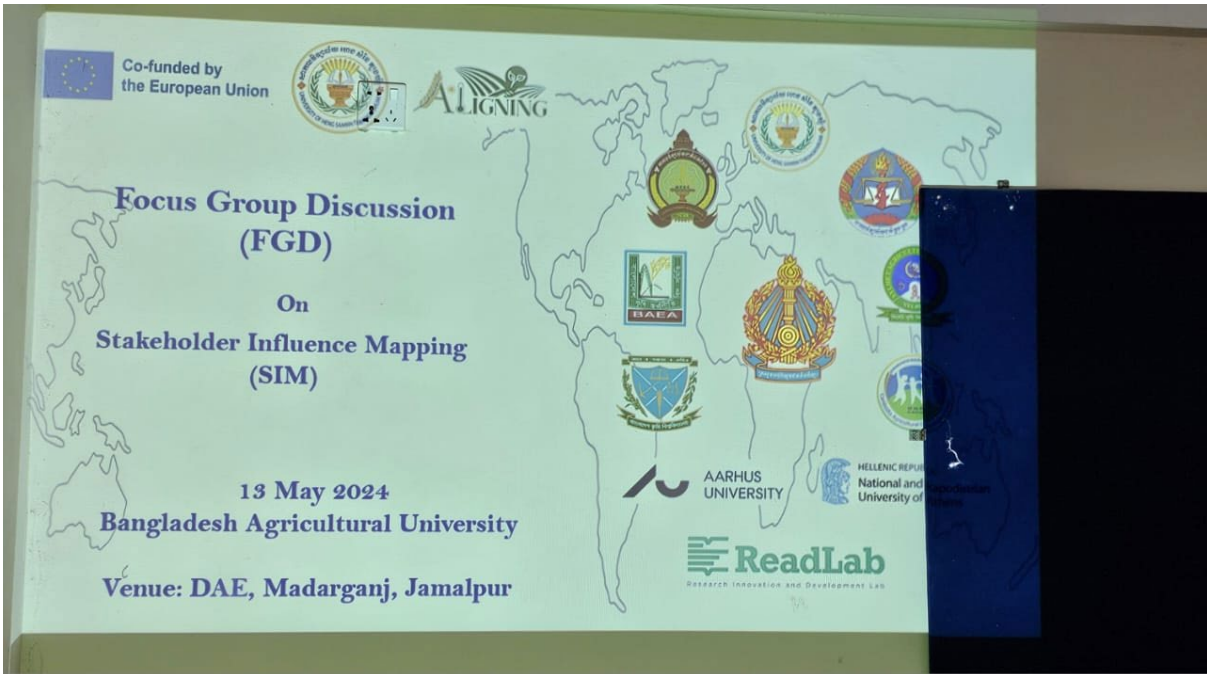
Modern agricultural practices, such as precision farming, mechanizations and improved crop varieties, can boost productivity and yield potential, leading to higher incomes for farmers and greater food security for communities. Sustainable agricultural practices, such as conservation tillage, water-saving irrigation techniques, and integrated pest management, promote efficient use of resources like water, soil, and nutrients, reducing waste and environmental degradation. Climate-smart agricultural practices, such as agroforestry, crop diversification, and soil conservation, help farmers adapt to changing climatic conditions by enhancing resilience, mitigating risks, and maintaining stable yields. Adoption of sustainable farming practices can reduce greenhouse gas emissions, minimize chemical inputs, preserve biodiversity, and protect ecosystem services, contributing to environmental conservation and ecosystem health. Consumers increasingly demand sustainably production of agricultural products, creating market opportunities for farmers who adopt environmentally friendly and socially responsible practices, such as organic farming or fair-trade certification.

While obstacles to full adoption persist, the potential advantages of embracing modern agricultural practices are substantial. They offer pathways to increased productivity, sustainability, and resilience in the face of global challenges. Efforts to overcome barriers and promote the widespread adoption of these practices are essential for the future of agriculture.

Annex 1: Team conducted the FGD at Jamalpur District, Bangladesh

Sl No.	Name	Address with contact no.
1.	Dr Mohammad Jahangir Alam	Professor, Department of Agribusiness and Marketing, Bangladesh Agricultural University (BAU), Bangladesh Mobile: 01799763274 Email: **alambau2003@yahoo.com**
2.	Dr M Nasir Uddin	Professor, Department of Agricultural Extension Education, BAU, Mymensingh
3.	Mr M Asif Iqbal	Research Fellow, Department of Agribusiness and Marketing, BAU, Bangladesh
4.	Mr M Abdullah Al Mamun	Research Fellow, Department of Agribusiness and Marketing, BAU, Bangladesh

Photos


Co-funded by
the European Union
ALIGNING
Focus Group Discussion
(FGD)
On
Stakeholder Influence Mapping
(SIM)
13 May 2024
Bangladesh Agricultural University
Venue: DAE, Madarganj, Jamalpur
BAEA
AARHUS
UNIVERSITY
ReadLab
Research Innovation and Development Lab


Focus Group Discussion
(FGD)
On
Stakeholder Influence Mapping
(SIM)
Bangladesh Agricultural University
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Asian Cluster in Agriculture and Climate Change ERASMUS-EDU-2023-CBHE-STAND-2, ALIGNING
Project ID: 101129154

FGD conducted by the SAU

Topic: Focus Group Discussion on Stakeholders Influence Mapping (SIM)

<table>
<tr><td>Date</td><td>13/05/2024</td></tr>
<tr><td rowspan="6">Facilitators</td><td>Professor Dr. Jasim Uddin Ahmed
Sylhet Agricultural University, Sylhet-3100, Bangladesh</td></tr>
<tr><td>Professor Dr. Md. Shah Alamagir
Sylhet Agricultural University, Sylhet-3100, Bangladesh</td></tr>
<tr><td>Dr. Md. Omar Sharif
Sylhet Agricultural University, Sylhet-3100, Bangladesh</td></tr>
<tr><td>Mr. Md. Shaikh Farid
Sylhet Agricultural University, Sylhet-3100, Bangladesh</td></tr>
<tr><td>Mr. Dabasis Sharma
Sylhet Agricultural University, Sylhet-3100, Bangladesh</td></tr>
<tr><td>Mrs. Muslima Akter
Sylhet Agricultural University, Sylhet-3100, Bangladesh</td></tr>
<tr><td colspan="2">The project manager welcomed the participants after briefly introducing the team members above. The FGD session was conducted using a predefined checklist involving various questions. These questions were asked during the participants' discussion of certain limits. The technical staff was responsible for solving technical issues regarding the session. The session coordinator observed the whole session and provided necessary suggestions when and where necessary.</td></tr>
<tr><td colspan="2">Focus Group Profile

Thirteen participants attended this focus group. All of these participants were male farmers, except one female. Their age ranged between 30 and 60. The list of participants is given below.</td></tr>
<tr><td rowspan="6">Stakeholders</td><td>Professor Dr. Md. Abul Kashem, Sylhet Agricultural University, Sylhet, Bangladesh</td></tr>
<tr><td>Professor Dr. Mohammad Ashraful Islam
Sylhet Agricultural University, Sylhet-3100, Bangladesh</td></tr>
<tr><td>Professor Dr. Md. Shahidul Islam
Sylhet Agricultural University, Sylhet-3100, Bangladesh</td></tr>
<tr><td>DR. Md. Jobayer Hossen
Upazila Livestock Officer
Shantiganj, Sunamganj</td></tr>
<tr><td>Mr. Md. Moniruzzaman
Upazila Fisheries Officer, Shantiganj, Sunamganj</td></tr>
<tr><td>Mr. Abul Kalam Azad
Sub-Assistant Agriculture Officer, Shantiganj, Sunamganj</td></tr>
</table>

	Mr. Muhammad Salah Uddin Regional Manager, Friends In Village Development Bangladesh, Shantiganj Branch, Sunamganj
	Mr. Bishajit Das Area Manager, Padakhep Manabik Unnayan Kendra (PMUK), Shantiganj Branch, Sunamganj
	Mr. Md. Majibur Rahman, Fertilizer Dealer, Shantiganj, Sunamganj
	Mr. Rakhal Mojumder, Pesticides Dealer, Noagaon Village, Shantiganj, Sunamganj
	Mr. Md. Alamgir Hossain, Farmer, Noagaon Village, Shantiganj, Sunamganj
	Mr. Md. Romjan Ali, Farmer, Noagaon Village, Shantiganj, Sunamganj
	Mrs. Milon Akter, Farmer, Noagaon Village, Shantiganj, Sunamganj

Background

The consequences of climate change are already being felt by a number of countries worldwide. Climate changes are the root causes of property damage, increased frequency, intensity, and severity of weather- and climate-related phenomena also have an impact on agriculture, forestry, human health, sea level rise, heavy rains, high humidity, and floods (Rakib *et al.,* 2017; Cho, 2019). Bangladesh, a developing country, is not an exception to the harsh weather patterns those other nations face, including drought, floods, erosion of riverbanks, waterlogging, and surges from cyclonic storms in various sensitive locations such as coastal areas, char, and *haor* (GoB, 2010). Extreme natural disasters like flash floods, hailstorms, droughts, and changes in upstream river discharge are a few of the ways that climate change often affects rural areas. The lives of the residents are seriously endangered by these disasters. The *haor* region's population is primarily employed in fishing and monocrop farming, and because there aren't many other reliable sources of income, they regularly lose their jobs means that individuals in the *haor* region frequently experience losing their employment. This could be due to various factors such as fluctuations in market demand for their products, environmental challenges affecting their fishing or farming activities, or lack of diversified economic opportunities in the region (Kazal, Rahman, & Hossain, 2017). Furthermore, the dearth of employment opportunities, inadequate communication networks, and inadequate support from the government and other service providers exacerbate the situation and can make it seem like a famine for these individuals. Frequent occurrences of flash floods, siltation, and soil erosion drastically lower or completely eliminate agricultural yields. To mitigate the climatic hazards a project was undertaken known as “ALIGNING” to identify the key challenges and strategies in Asian, African, and European contexts due to climate change. Also, the project focuses on improving productivity in the agricultural sector, improving the life standards of farmers, and implementing sustainable environmental practices to mitigate climate-related issues. Lastly, upon project completion, we will develop a national priority framework to assist policymakers in devising effective long-term strategies to counteract the negative externalities of climate change.

Study area

The *Haor* region, basically a waterlogged area, is situated in the northeastern part of Bangladesh. It's a wetland ecosystem with huge bowl-shaped floodplain depressions (*Haor*s) that are seasonally flooded every year, known collectively as the *Haor* basin (Miah, 2013). It also resembles a swampland that is submerged for nearly six months of the year, beginning with the monsoon (Sharma, 2010), with upland areas of one to ten hectares known as *Aati*. The *Haor* areas occupy approximately 2.0 million hectares and shelter approximately 19.4 million inhabitants (MoWR, 2012). In Bangladesh, there are 373 small and large *Haor*s spread across 8000 square kilometers in the districts of Sunamganj, Sylhet, Moulvibazar, Hobigonj, Netrokona, and Kishoreganj, accounting for roughly 43% of the entire area of the *Haor* zone (MoWR, 2012). The topography of *Haor* regions is uneven. Furthermore, in terms of geographical elevation, they are lower than the typical plain lands. The *Haor* receives between 3000 and 4000 mm of rainfall during the monsoon season, which is combined with the monsoon river flow from the Meghalaya and Barak basins. Almost all of this land is below 4- 8 meters and is submerged for seven to eight months during the monsoon season (NERP, 1995). The Sunamganj district has the largest number of *Haor*s (133) (Alam *et al.,* 2010), therefore the whole community is covered by many *Haor*s. Saneer, Hail, Dekar, Chayer, Tangua, Kawadighi, and other *Haor* names are the most prominent *Haor*s in the Sunamganj district. Shantiganj is one of the important and most climatic areas under the Sunamganj district, surrounded by the large *Dekher Haor.*

Information gathering

A focus group discussion was conducted in the haor regions of Shantiganj Upazila in the Sunamganj district of Bangladesh. To achieve our objectives, we employed the SIM technique to gather necessary information from the participants, who included university professors, representatives from various government organizations, national and regional NGOs, and farmers. Checklists were used to collect information from the participants. A moderator facilitated the session, while other members were responsible for organizing the information provided by the participants.

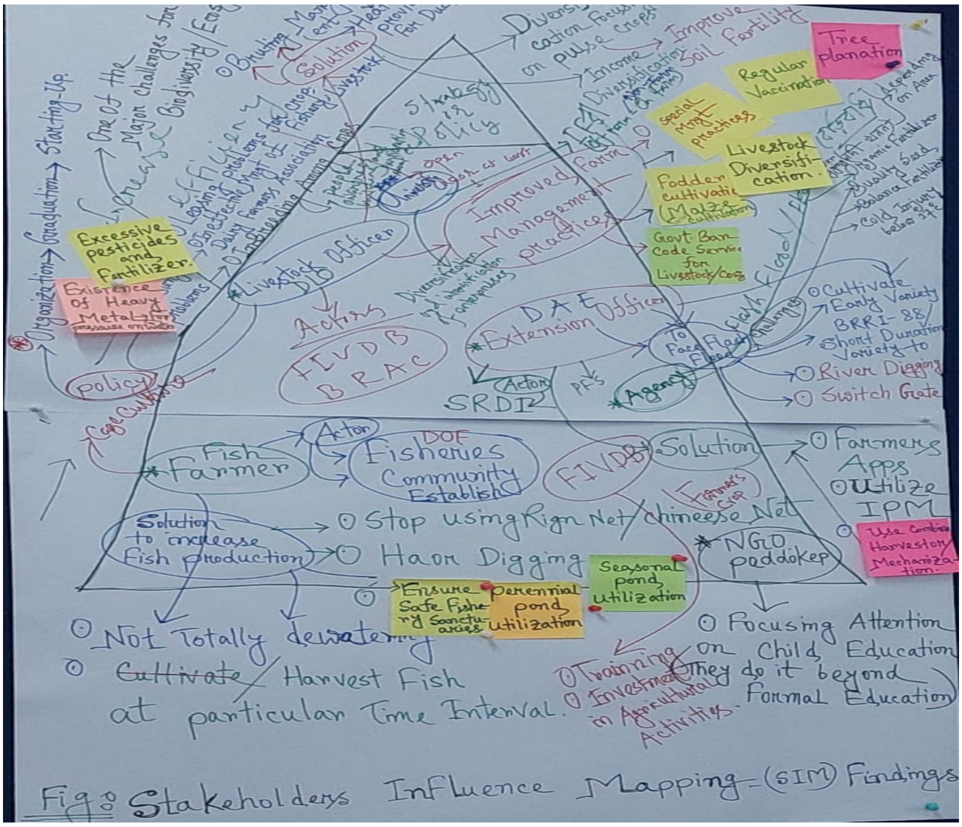

Fig: Stakeholders Influence Mapping (SIM)

Findings of FGD

University representatives: Sylhet Agricultural University has been working to improve the agricultural systems in *haor* regions from 2006 to date. The university professors conducted different experiments to recommend varieties that can fight against climate change. Also, they provide consultation on different diseases, pests, and insect infestations, conserving the ecosystems, etc. Mono-cropping is the major challenge in the *haor* region. Farmers are not interested in producing crops/fisheries/livestock throughout the year. Twenty-three technologies were developed, refined, modified, and fine-tuned into location-specific, system-based appropriate technologies through farmers' participatory research. The adoption of these technologies increased household productivity in field crops, vegetables, livestock, fisheries, and agroforestry systems. Diversification and intensification of farming and non-farming activities led to increased employment and income. Efficient mobilization and management of natural resources were achieved through capacity building of the participants, including training, motivation, consultation, and ensuring the availability of inputs for sustainable production systems. Integrated farming systems might be a possible solution to address climate change issues.

Department of Agricultural Extension: DAE works to provide services and guidelines in order to increase the productivity of the crop sector in Bangladesh. The challenges are Flash floods, Diseases of rice (Blast), Market price of rice, Water management, Lack of crop diversification, Lack of people awareness and delay in policy implementation, deficiency of micronutrients like Zn, B, Ca, Mg, etc. and use of excess fertilizer. The strategies are building the embankment and Sluice gate and the development of rice variety with a 140-day life cycle (Already using BRRI 89, 92). Rice should be harvested when 80% of the grain ripened; selling rice in the apps (Krishoker Apps). More diversification/intensification of crops should be introduced. River degrading to ensure water flow in the river, Proper management of water irrigation, perching method, encouraging towards IPM and tree plantation, balance fertilization of organic and inorganic, soil health management, and ensuring food security.

Department of Livestock: Livestock department focuses on increasing the productivity of the livestock in Bangladesh. The challenges are facing Production costs, Lack of proper management, the spreading of diseases, the effect on biodiversity in the wetland, the impact on the ecosystem, lack of proper food in nature due to biodiversity depletion (for duck and poultry), and people's awareness. The following practices might mitigate the aforementioned challenges: Leguminous (dhaincha, ipil-ipil, maize) fodder cultivation, training for proper duck management, obtaining treatment from the specialist during disease outbreaks, maintaining the natural ecosystem, and conservation of Biodiversity.

Department of Fisheries: The Department of Fisheries is mainly responsible for providing suggestions on how to improve the productivity of fish in *haor* areas. Lack of open water bodies, disruption in the haor ecosystem, reckless fishing, and lack of awareness are the main challenges in haor areas. Fish cultures, the development of open water bodies, a reduction in the cost of fish feed, and improved soil health to keep the phytoplankton alive are the tentative solutions to increase productivity.

NGOs: There are many regional, national, and international NGOs (FIVDB, BRAC, Padakhep, etc.) working in hair regions to improve the life standards of vulnerable people. The aims and objectives are to provide credit facilities to those who cannot access the banking sector because of a lack of property or assets to mortgage. The FIVDB and Padakhep are providing loans to the destitute and poor, both men and women, without any collateral. Sometimes, they provide training to the farmers about modern cultivation techniques, but this is not enough. Apart from these, FIVDB runs three primary schools in Shantiganj Upazila with its own costs to provide elementary education for the children. BRAC is the only NGO that actively engages in mitigating climate change issues.

Farmers: Farmers are the beneficiaries of the haor regions and the ultimate actors of the production process. The challenges they face are lacking quality seeds for crop production, the lack of proper sales (pricing policy), The case of crop production during drought season, the scarcity of tube wells, and cold injuries (reduced night temperatures of 14-15 degrees in March-April). Increasing awareness, building embankments and digging rivers where necessary, and increasing investment in education are the key strategies to deal with climate change issues.

SWOT analysis

Strengths:

1. Farmers exhibit resilience and determination against hazards.
2. Farmers possess valuable knowledge and expertise.
3. Existing technology provides support.
4. Extension departments and other relevant institutions are available.
5. Traders contribute to market access and distribution.

Weaknesses:

1. Supportive policies that favor agricultural development.
2. Advancements in technology and their application.
3. Development of linkages, supported by government investments in mega projects.
4. Improved climate and weather forecasting services benefit farmers.

5. Opportunities for research and development initiatives.

Opportunities:

1. Risks of early flash floods affecting agricultural productivity.
2. Potential outbreaks of diseases causing havoc in crops or livestock.
3. Communication disruptions during flood situations.
4. Malnutrition poses a threat to community health.
5. Persistent challenges related to low literacy rates among stakeholders

Threats:

1. Early flash flood
2. Disease havoc
3. Communication during flood
4. Malnutrition
5. Literacy

Recommendations for dealing with climate change issues

1. Introduce integrated farming systems (IFS)
2. Develop early varieties/short duration for rice
3. Construction of river embankment and sluice gate
4. Integrated pest management (Organic+inorganic fertilizers)
5. Restricted the dewatering and encourage cage culture to increase the productivity of fish.
6. Separate the cows to combat inbreeding problems and cultivate fodder to feed them.
7. Build more educational institutions to increase the literacy rate among the *haor* peoples
8. Credit/Marketing.

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Pictures


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IV. Conclusion and next steps

All five FDGs clearly identified strengths, weaknesses, opportunities and threats, as well as recommendations for the different stakeholders in the agricultural and the agrifood value chain to deal with climate change issues and these will be considered and integrated both in the design of (open) innovation models and clusters of stakeholders, and the education curricula of the universities to meet the demand for solving these issues. It must be bared on mind that changes often come at a cost, and many modern agricultural practices to counteract climate change (climate proofing practices) require significant investment in technology, equipment, and training, which can be prohibitively expensive for smallholder farmers or those operating on tight budgets. Interestingly, all FDGs reported that the quality of agricultural products like rice, potatoes, and fruits deteriorated from pests, rodents, and fungal infestations, while limited access to modern storage technologies with cold storages leads to poor market prices. Therefore, education at all scales is required and economic incentives or plausible sustainable finance models without "captive" lending are urgently required in both Cambodia and Bangladesh.

Digitization in agriculture, including applications for education, ease of weather forecasting, agricultural resource planning and application, is often reported to gain momentum more in the economically developing than the economically developed countries, which is a paradox and its efficiency remains unknown. However, in Cambodia and Bangladesh there remains a large untapped potential as the protrusion of such tools is low and they need to be carefully designed or adopted to meet the local circumstances. From the government side, agricultural systems involving low-value crops, including food cereals such as rice are strategic effort of self-sufficiency at macro-level, and these are also the systems the most negatively affected by climate change. But from farmers side, their unprofitability fails to compete with subsidized foreign exports. The studies we have reviewed all reflect a response of the agricultural and agrifood systems of Cambodia and Bangladesh to the increasing pressure due to multiple drivers including stemming from not only climate change but also population growth, urbanization, and lack of education and innovation. Although a few studies have looked at the future of specific agricultural systems under the various scenarios, particularly rice and fish, we are not aware of analyses that examines the implications of enhanced education and innovation, as well as the use of digital tools in agriculture on employment, agriculture investment cost, food nutrition and poverty, GHG emissions and environmental quality. Future research is needed to explore these impacts.

The HEIs are aware for the potential of training program organized for farmers for usage of resources, chemical fertilizer, pesticide and other energies to use energy efficiently. They also master the role and the potential of all other stakeholders in the agrifood value chain. Therefore, the HEIs innovation clusters must involve stakeholders and policymakers to design, support adaption and mitigation techniques which are region-specific, or crop-specific or farm specific, to reduce the negative impact

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of climate change on agricultural productivity. Moreover, governments must introduce new, independent and sustainable policies regarding improved technologies to achieve sustainable production of key crops for the population, followed by export crops. Given data availability, regional-based impact, crop-specific impact, and renewable energy impact on food security in Cambodia and Bangladesh may be taken up in future research.

Our next step is to assemble D2.1 and D2.2 in a research paper to be published in an open-access scientific journal and focused on the needs' validation and innovation demand for the agricultural sector in Cambodia and Bangladesh. The main aim is to eventually design institutional strategy for stakeholder engagement and institutional change through innovation clusters.

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