

IJEAST

INTERNATIONAL JOURNAL
OF ENGINEERING APPLIED SCIENCE
AND TECHNOLOGY

VOLUME : 8 ISSUE : 03 Print / Issue Publication Date: 26-Sep-2023

ISSN : 2455-2143

DOI : 10.33564/IJEAST.2023.v08i03.015

Indexed In

Google SCHOLAR OPEN ACCESS doi Crossref

WWW.IJEAST.COM

editor@ijeast.com

International Journal of Engineering Applied Sciences and Technology, 2023
Vol. 8, Issue 03, ISSN No. 2455-2143, Pages 111-120
Published Online July 2023 in IJEAST (http://www.ijeast.com)

INTERCROPPING: PROSPECTS AND CHALLENGES IN BANGLADESH FOR SUSTAINABLE AGRICULTURE

Asia Akter
Ph.D. Candidate and Graduate Research Assistant
Department of Plant Sciences
University of Idaho
Moscow-83843, ID, USA

Kazim Khan Abul Ulie
Associate Professor
Department of Soil Science,
National University, Ministry of Education
People's Republic of Bangladesh

Samiha Suhrah Ali
Graduate Research Assistant
Department of Soil and Water Systems
University of Idaho
Moscow-83843, ID, USA

Abstract— **Intercropping, as an innovative and sustainable agricultural practice, offers a wide range of benefits that make it a valuable approach to modern farming systems. By simultaneously cultivating two or more different crop species within the same field or growing area, intercropping harnesses the power of biodiversity and ecological interactions to optimize resource utilization, enhance productivity, promote environmental sustainability, and contribute to the economic resilience of farming communities. Agriculture is the backbone of the Bangladeshi economy and plays a crucial role in GDP (12.5%, Fiscal year; 2021-2022). Intercropping has the potential to deliver several positive economic impacts on the Bangladesh's economy. Despite its numerous benefits, the adoption of intercropping in Bangladesh faces some challenges, including limited access to technical knowledge, availability of suitable crop combinations, and market demand for intercropped products. To promote intercropping effectively, there is a need for targeted extension services, farmer training, and policy support that incentivizes sustainable agricultural practices and financial support to adopt and implement intercropping practices effectively. By enhancing agricultural productivity, reducing input costs, and promoting sustainable practices, intercropping can contribute to poverty reduction, rural development, and improved livelihoods for smallholder farmers across the country.**

Keywords— **Agronomy, Intercropping, Mono-cropping, Sustainable, Climate change**

I. INTRODUCTION

Intercropping is an innovative and sustainable agricultural practice that involves the simultaneous cultivation of two or more different crop species within the same field or growing area, in a carefully planned and spatially organized manner. This agricultural technique is founded on the principles of polyculture, whereby multiple plant species are intentionally and strategically grown together, in contrast to the conventional monoculture approach that relies on the exclusive cultivation of a single crop in a given area. The practice of intercropping seeks to maximize the efficient utilization of available resources, including sunlight, water, nutrients, and space, in order to optimize overall productivity and ecological resilience. By harnessing the complementary interactions between the coexisting crops, intercropping offers a myriad of benefits that extend far beyond those achievable through monoculture systems(Mao et al., 2015).

One of the primary advantages of intercropping is its potential to enhance crop yield and productivity. The combined growth of diverse crop species can lead to a more efficient use of resources, as different plants often have varied root structures and nutrient requirements, effectively reducing competition for essential elements in the soil. Furthermore, certain crop

International Journal of Engineering Applied Sciences and Technology, 2023
Vol. 8, Issue 03, ISSN No. 2455-2143, Pages 111-120
Published Online July 2023 in IJEAST (http://www.ijeast.com)

combinations display a mutualistic relationship, where one species may provide support or protection to another, leading to a synergetic effect that boosts overall productivity(Jensen et al., 2006).

Intercropping also holds the promise of improved pest and disease management. By interspersing different crop species, the risk of pest and disease outbreaks can be minimized. Some plants have natural pest-repellent properties or act as "trap crops," luring pests away from the main crop. Additionally, certain crop combinations attract beneficial insects and predators, thus fostering a more balanced and ecologically diverse agroecosystem. The practice of intercropping contributes to the reduction of weed proliferation, which is a common challenge in monoculture systems. Well-planned intercropping arrangements can create a denser canopy and shade the ground, limiting weed growth and effectively reducing the need for herbicides and labor-intensive weeding efforts (Gebru, 2015). Beyond the immediate agronomic benefits, intercropping also plays a vital role in promoting soil health and conservation. Different crop species have varying root depths and architectures, which can enhance soil structure and nutrient cycling. This process contributes to the prevention of soil erosion, the maintenance of soil fertility, and the overall improvement of soil quality in the long term.(Francis & Francis, 1986)

Intercropping is also regarded as an essential strategy for fostering agrobiodiversity and preserving genetic resources. By cultivating multiple crops simultaneously, farmers can safeguard traditional and heirloom varieties, reduce the risk of crop failure due to unforeseen events, and contribute to the conservation of a wide range of plant genetic diversity. Furthermore, intercropping can have a positive impact on the economic sustainability of farming systems. Diversifying crops enables farmers to spread risk and reduce their dependence on a single crop, protecting them from market fluctuations and potential income losses. This diversification of income sources can improve the overall economic resilience of rural communities and contribute to local food security (Gebru, 2015).

The biodiversity inherent in intercropping systems enhances their resilience to climate change impacts, such as extreme weather events, droughts, and temperature fluctuations. Diverse crops are more likely to contain varieties with varied tolerances to different environmental stressors, making the overall system more adaptable and less vulnerable to climate-related risks. The presence of multiple crops and enhanced vegetation cover in intercropped systems reduces soil erosion caused by wind and water (Droppelmann et al., 2000).

While intercropping offers numerous benefits, successful implementation requires careful planning, knowledge of crop compatibility, and appropriate management practices. The selection of suitable crop combinations, the design of planting arrangements, and the timing of planting and harvesting operations are critical factors that influence the success of intercropping systems.

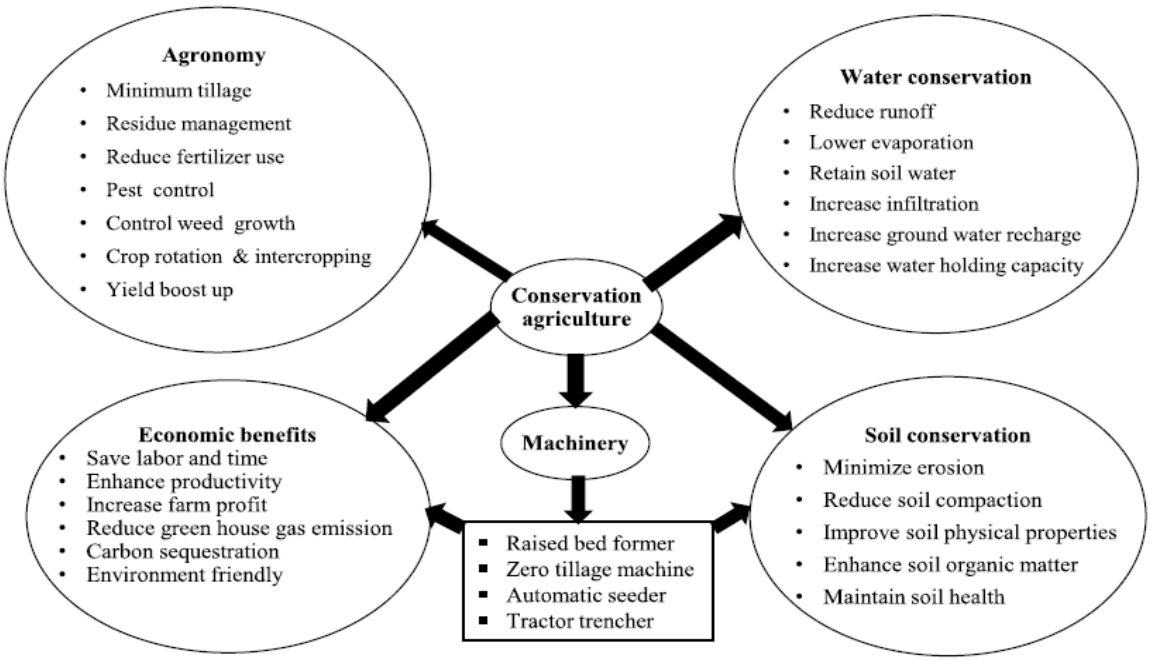


Figure 1: Potential Benefit of Intercropping

International Journal of Engineering Applied Sciences and Technology, 2023
Vol. 8, Issue 03, ISSN No. 2455-2143, Pages 111-120
Published Online July 2023 in IJEAST (http://www.ijeast.com)

II. BANGLASEDH: A LAND OF CROPPING DIVERSITY

Bangladesh: Bangladesh is located in South Asia and has a predominantly tropical monsoon climate, characterized by distinct wet (Monsoon) and dry seasons (Spring and Summer). The agro climate of Bangladesh plays a crucial role in shaping its agricultural practices and the overall economy (Bernzen et al., 2023). The country experiences a pronounced monsoon season from June to October, bringing heavy rainfall and high humidity. This period is crucial for agricultural activities as it replenishes water bodies and irrigates farmlands. The dry season lasts from November to April, during which the country experiences cooler temperatures and relatively lower humidity. Irrigation is essential during this time to sustain agricultural activities, as water sources can deplete after the monsoon season. Bangladesh has a warm and humid climate throughout the year. Average temperatures range from around 25°C to 30°C (77°F to 86°F) during the day, with slight variations between regions. The country's agro climate supports a wide variety of soils, including alluvial soils, clay soils, sandy soils, and saline soils in coastal areas. The fertility of the soil can vary significantly from region to region, affecting crop choices and yields. Bangladesh is prone to cyclones and flooding, especially during the monsoon season. These natural disasters can cause significant damage to crops, infrastructure, and livelihoods. Bangladesh is one of the countries most vulnerable to the impacts of climate change, including rising sea levels, increased frequency and intensity of cyclones, and changing precipitation patterns. These changes can have severe consequences for the agricultural sector and food security in the country. Efforts are being made to adapt agriculture to the changing climate and develop more resilient practices. Improved water management, crop diversification, and the promotion of climate-smart agricultural techniques are some of the strategies being employed to address the challenges posed by the agro climate of Bangladesh.

Bangladesh divided into several agro-ecological zones based on variations in topography, soil, climate, and other environmental factors. An agro ecological zone indicates an area characterized by homogeneous agricultural and ecological characteristics. This homogeneity is more prominent in the sub region and unit levels. The agro ecological zones of Bangladesh have been identified on the basis of four elements such as physiography, soils, land levels in relation to flooding and agro climatology. Bangladesh has been tentatively divided into 30 agro ecological zones. These 30 zones have been subdivided into 88 agro ecological sub-regions, which have been further subdivided into 535 agro ecological units. AEZ is the area of the nearly same ecological and soil characteristics agricultural crops production. So cropping pattern of a definite AEZ is mostly same.

Agro-Ecological Zones of Bangladesh determined on basis of physiography (it is defined as soil parent materials and land forms of a particular area), hydrology (it is determined on the basis of water holding capacity of soil and the water level of agricultural land), cropping pattern (it is done on the basis of Length of Rabi and kharif season and major and minor agricultural crops which are cultivated in a particular area), season (it is done on the basis of the Depth and duration of seasonal flooding in a particular area), soil types and tidal activity. The 30 AEZ of Bangladesh are given below - (according to the number)

1. Old himalayan piedmont plain
2. Active tista floodplain
3. Tista meander floodplain
4. Karatoya-bangali floodplain
5. Lower atrai basin
6. Lower purnabhaba floodplain
7. Active brahmaputra – jamuna floodplain
8. Young brahmaputra and jamuna floodplain
9. Old brahmaputra floodplain
10. Active ganges floodplain
11. High ganges river floodplain
12. Low high ganges river floodplain
13. Low ganges river floodplain
14. Gopalganj khulna bils
15. Arial bil
16. Middle meghna river floodplain
17. Lower meghna river floodplain
18. Young meghna estuarine floodplain
19. Old meghna estuarine floodplain
20. Esttern surma kushyara floodplain
21. Sylhet basin
22. Northern and eastern piedmont plains
23. Chittagong coastal plain
24. Martin’s coral island
25. Level barind tract
26. High barind tract
27. North eastern barind tract
28. Madhupur tract
29. Northern and eastern hills
30. Akhaura terrace

III. PREVALING CROPPING SYSTEM IN BANGLADESH:

In Bangladesh, cropping systems are diverse and vary across different regions due to agro ecological conditions, land availability, and cultural practices. The country's agriculture is predominantly characterized by smallholder farming, and farmers often adopt cropping systems that best suit their specific circumstances and needs. Here are some common cropping systems in Bangladesh:

Monoculture: Monoculture involves the cultivation of a single crop on a particular piece of land over consecutive growing seasons. This cropping system is widely practiced, with major crops like rice, wheat, jute, and pulses often grown in monoculture.

International Journal of Engineering Applied Sciences and Technology, 2023
Vol. 8, Issue 03, ISSN No. 2455-2143, Pages 111-120
Published Online July 2023 in IJEAST (http://www.ijeast.com)

Rice-based Cropping Systems: Rice is the staple crop of Bangladesh, and several cropping systems revolve around it. The two main rice-based cropping systems are:

Rice-Monsoon Crop System: In this system, farmers cultivate rice during the monsoon season (June to October) when water is abundant, followed by a dry-season crop (usually wheat or mustard) on the same land after the monsoon.

Rice-Aus Crop System: This system involves the cultivation of "Aus" rice during the pre-monsoon season (March to June), followed by another crop like maize, legumes, or vegetables during the monsoon season. Boro-Rabi-Crop System: Boro rice is grown during the dry season (November to April) when water is scarce. After harvesting boro rice, farmers plant rabi crops like wheat, mustard, or pulses during the winter season.

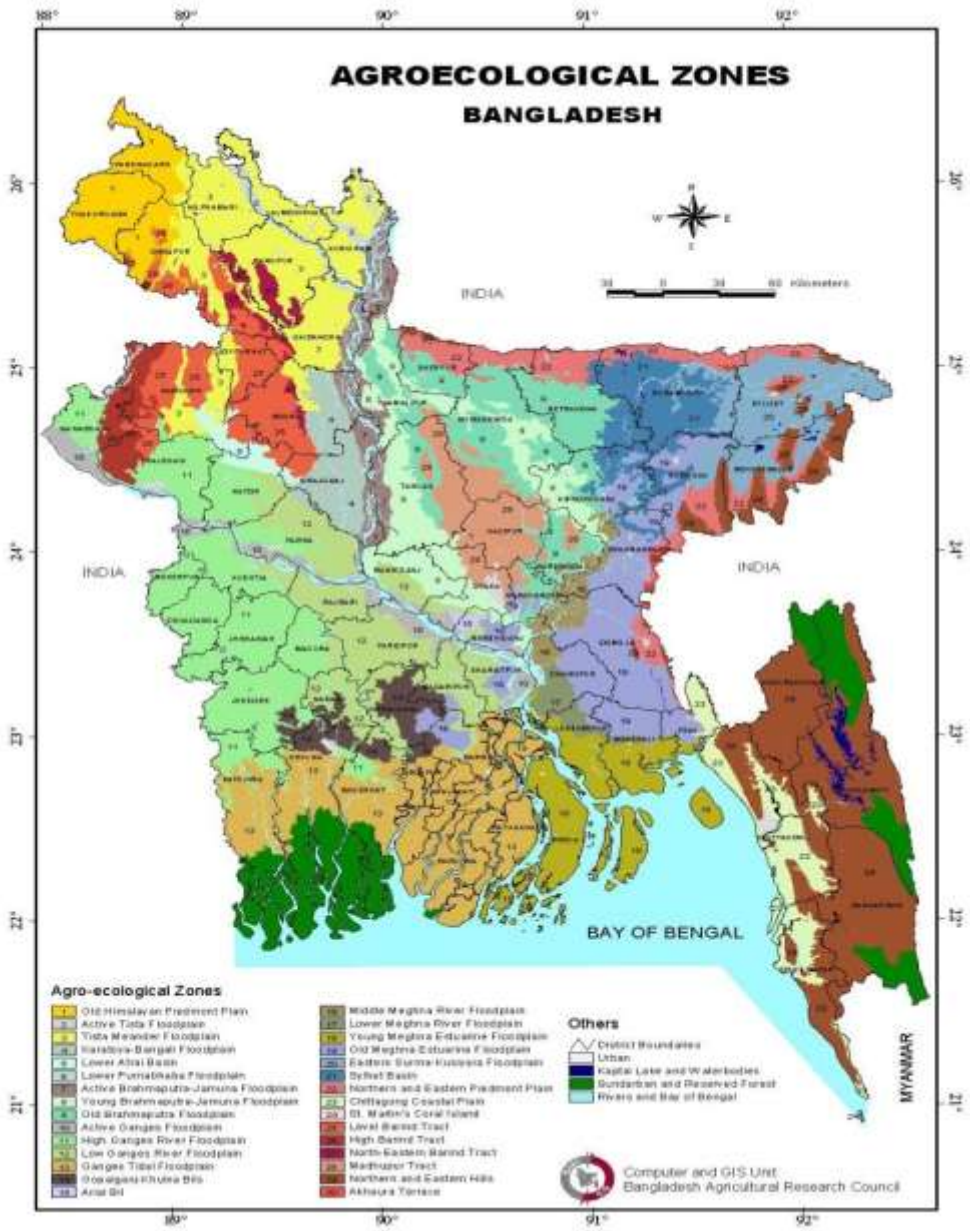


Figure 2: Map of AEZ of Bangladesh
Source: BAMIS, 2023

Intercropping: Intercropping involves growing two or more crops together in the same field simultaneously. This cropping system promotes resource use efficiency, enhances biodiversity, and offers economic benefits to farmers. Common intercropping combinations include legumes with cereals, or vegetables with staple crops.

Cash Crop Cropping Systems: Some regions in Bangladesh focus on cultivating cash crops such as jute, sugarcane,

International Journal of Engineering Applied Sciences and Technology, 2023
Vol. 8, Issue 03, ISSN No. 2455-2143, Pages 111-120
Published Online July 2023 in IJEAST (http://www.ijeast.com)

tobacco, and vegetables. These crops are grown either as monoculture or in rotation with other crops.

Agroforestry Systems: Agroforestry involves integrating trees or shrubs with crops. It provides multiple benefits, including improved soil health, climate change mitigation, and additional sources of income from fruits, nuts, or timber.

Fish-Rice Farming System: In areas with water bodies, farmers practice fish-rice farming systems. They grow rice during the monsoon season, and after the monsoon, they flood the fields to cultivate fish alongside rice, utilizing the field's waterlogged conditions(K. H. Kabir et al., 2022).

Mungbean-Rice Cropping System: Mungbean is a short-duration pulse crop commonly intercropped with rice during the monsoon season. It provides an additional source of income for farmers and improves soil health through nitrogen fixation.

Jute-based Cropping Systems: Jute is an important cash crop in Bangladesh. Farmers often intercrop jute with other crops like rice or vegetables to maximize land use and income. Bangladesh's agriculture is dynamic, and t farmers often adapt their practices based on changing circumstances, market demands, and environmental factors. Government policies and support also influence the adoption of specific cropping systems to promote sustainable agriculture and ensure food security in the country.

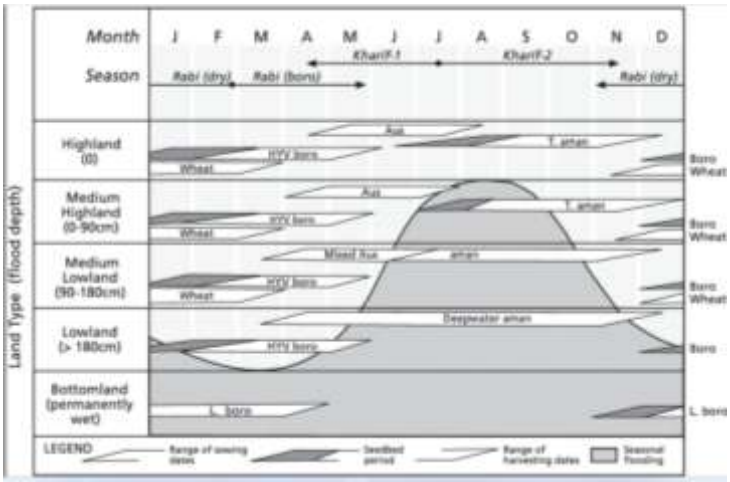
IV. INTERCROPPING PERSPECTIVE BANGLADESH

Intercropping has been practiced in Bangladesh for centuries and continues to play a significant role in the country's agricultural landscape. With its dense population and limited arable land, Bangladesh faces numerous challenges related to food security, resource management, and environmental sustainability. Intercropping has emerged as a promising solution to address these challenges and promote sustainable agriculture in the country. The choice of intercropping systems depends on factors such as regional climate, soil type, market demands, and farmer preferences. Intercropping practices offer several benefits, including increased land productivity, efficient resource utilization, risk reduction, and improved pest and disease management. As the agricultural landscape and practices evolve, farmers in Bangladesh continue to explore and adopt different intercropping systems to optimize their land use and enhance agricultural sustainability.

Throughout the world, intercropping is used to enhance productivity and food Security. Bangladesh is densely populated and one of the growing economies of the world.

Intercropping in Bangladesh could allow farmers to maximize the utilization of available land and resources, leading to increased agricultural productivity. By growing multiple crops together, farmers can diversify their food production and income sources, reducing their vulnerability to crop failures and market fluctuations. This diversification contributes to improved food security for farming households and the broader population.

Resource efficiency in agriculture refers to the effective and sustainable use of various resources, including land, water, energy, fertilizers, and other inputs, to maximize agricultural productivity while minimizing waste and negative environmental impacts. Efficient resource management in agriculture is crucial for ensuring food security, economic viability, and environmental sustainability. Bangladesh is predominantly an agrarian country with limited land and water resources. Intercropping optimizes resource use, as different crops can efficiently utilize sunlight, water, and nutrients, thereby reducing wastage and enhancing overall resource efficiency. This is particularly important in the context of climate change and increasing water scarcity in certain regions (Alam, 2015).



b

Figure 3: Prevailing Cropping Pattern of Bangladesh, Source: Mirza et al., 2005

Intercropping can be a valuable solution for mitigating the impact of climate change in Bangladesh. Climate change poses several challenges for agriculture, including increased temperatures, changing rainfall patterns, and more frequent extreme weather events like droughts and floods. Intercropping offers several benefits that make it a suitable adaptation strategy for climate change in Bangladesh. Bangladesh is highly vulnerable to climate change impacts, such as erratic rainfall, floods, and extreme weather events. Intercropping systems, with their diversified crop combinations, offer enhanced resilience to such climatic challenges. By spreading risks across different crops, intercropping can buffer against the negative effects climate-related risks and help maintain stable agricultural production (Bernzen et al., 2023).

Soil erosion is a significant environmental concern in Bangladesh, particularly in certain regions of the country. Bangladesh's geographical characteristics, including its extensive river networks, monsoon rains, and low-lying deltaic landscape, make it vulnerable to soil erosion. intercropping can indeed be a valuable solution for enhancing soil health and conservation in Bangladesh. Intercropping offers several benefits that contribute to improved soil health and sustainable land management practices. Intercropping contributes to improved soil health in Bangladesh by enhancing nutrient cycling, reducing soil erosion, and increasing organic matter content. The inclusion of leguminous crops in intercropping systems further enriches the soil with nitrogen through biological nitrogen fixation, reducing the need for synthetic fertilizers (Evans et al., 1989).

Intercropping systems often include leguminous crops, such as beans, peas, or lentils, which have the ability to fix atmospheric nitrogen and convert it into a form that can be utilized by plants. These legumes act as "green manure," enriching the soil with nitrogen and improving its fertility (Slinkard & Blain, 1988). Intercropping incorporates different crop residues into the soil, which increases the organic matter content. Higher organic matter levels improve soil structure, water-holding capacity, and nutrient retention (Ofori & Stern, 1987a).

The combination of different crops in an intercropping system provides better ground cover, reducing soil exposure to rain and wind erosion. This helps protect the soil from degradation and nutrient loss. Intercropping diversifies the nutrient demands of crops, resulting in more efficient nutrient utilization. Nutrient cycling is enhanced as different crops take up and release nutrients at different stages of growth, reducing nutrient imbalances and losses. Bangladesh faces pest and disease outbreaks that can negatively impact crop yields. Intercropping, with its ability to promote natural pest control, reduces the reliance on chemical pesticides, thereby minimizing environmental pollution and preserving beneficial insect populations.

Smallholder Agriculture Support:

Intercropping can be a valuable strategy to support smallholder agriculture in Bangladesh. Smallholder farmers, who typically have limited resources and land, can benefit from intercropping practices in several ways, like increased Crop Diversity and Efficient Land Use . Intercropping allows smallholder farmers to grow multiple crops in the same field simultaneously. This diversification of crops provides a more balanced and varied diet for the farmers and their families (M. R. Kabir et al., 2022). Additionally, it reduces the risk of crop failure, as different crops respond differently to varying environmental conditions. Smallholder farmers often have limited land available for cultivation. Intercropping enables them to maximize land use by growing two or more crops together, optimizing space and increasing overall productivity. Intercropping is well-suited for small-scale farming as it allows them to intensify their land use, improve their income, and diversify their crops without substantial additional investments (Raihan et al., 2022).

Agrobiodiversity Conservation: Intercropping practices in Bangladesh contribute to the conservation of agrobiodiversity. By cultivating diverse crop combinations, farmers help preserve traditional and locally adapted crop varieties, which are essential for maintaining genetic diversity and resilience in the face of changing environmental conditions (K. H. Kabir et al., 2022).

Community and Cultural Relevance: Intercropping aligns with traditional farming practices and cultural norms in Bangladesh. Many farmers have practiced intercropping for generations, and its adoption is often perceived as a viable and culturally accepted way of farming (Chowdhury et al., 2022).

Sustainable Livelihoods: Intercropping enhances the economic sustainability of rural communities in Bangladesh by creating diversified income streams and reducing the dependency on a single crop (M. R. Kabir et al., 2022). This economic stability contributes to poverty alleviation and improved livelihoods for farming households.

Promotion of Agroforestry: In certain regions, intercropping includes the integration of trees with crops, promoting agroforestry practices. Agroforestry enhances environmental resilience, provides additional ecosystem services (e.g., shade, windbreaks), and contributes to carbon sequestration. It could be a possible solution for the recent drought of Rajshahi division (Hossain et al., 2021).

Intercropping holds great promise for Bangladesh's agricultural sector, offering a sustainable approach to address food security, resource scarcity, and climate change challenges. By integrating intercropping into agricultural practices, Bangladesh can create a more resilient and environmentally responsible farming system that supports both farmer livelihoods and the conservation of natural resources.

International Journal of Engineering Applied Sciences and Technology, 2023
Vol. 8, Issue 03, ISSN No. 2455-2143, Pages 111-120
Published Online July 2023 in IJEAST (http://www.ijeast.com)

V. ECONOMIC IMPACT OF INTERCROPPING IN BANGLADESH ECONOMY

Intercropping can have several positive economic impacts on the Bangladesh economy, particularly for smallholder farmers and rural communities. While the scale of the economic impact can vary depending on the adoption rate and specific intercropping practices, the following are some of the key economic benefits of intercropping in the context of Bangladesh:

Increased Crop Yield and Income: Intercropping allows farmers to maximize the use of available land and resources, leading to increased crop yields per unit area. By cultivating multiple crops together, farmers can diversify their income sources and reduce the reliance on a single crop. This diversification can be especially valuable during times of market fluctuations and price volatility, providing a buffer against income risks (Ofori & Stern, 1987b).

Cost Savings: Intercropping reduces the need for synthetic fertilizers and pesticides. The inclusion of leguminous crops in intercropping systems provides natural nitrogen fixation, reducing the need for nitrogen-based fertilizers. Additionally, natural pest control in intercropped fields reduces the use of chemical pesticides, leading to cost savings for farmers (Alam, 2015).

Optimized Land Use: Bangladesh has limited arable land and a high population density. Intercropping enables farmers to intensify land use by growing multiple crops together, making more efficient use of available space. This optimized land use contributes to higher agricultural productivity and better utilization of scarce resources (R. Willey, 1985).

Improved Livelihoods: For smallholder farmers, intercropping can significantly improve livelihoods by increasing agricultural productivity and income. The additional income from intercropping allows farmers to invest in education, health, and other essential needs, contributing to poverty reduction and rural development (Rahman & Anik, 2020).

Risk Reduction: Diversification of crops through intercropping reduces the risk of crop failure due to pests, diseases, or adverse weather conditions. If one crop is affected, other intercropped crops may still thrive, providing some level of risk mitigation for farmers (R. W. Willey & Rao, 1980).

Enhanced Resilience to Climate Change: Bangladesh is highly vulnerable to climate change impacts, such as droughts, floods, and cyclones. Intercropping, with its diversified crop combinations, offers increased resilience to these climate-related challenges (Quisumbing et al., 2021). The ability to adapt to changing environmental conditions can help farmers maintain stable agricultural production in the face of climate variability.

Reduced External Input Dependency: Intercropping systems generally rely less on external inputs like fertilizers and pesticides. This reduction in input dependency means that farmers are less susceptible to fluctuations in input prices, providing a degree of economic stability.

Sustainable Agriculture Promotion: Intercropping aligns with sustainable agricultural practices, which are increasingly valued in global markets. By adopting intercropping, Bangladeshi farmers can position themselves favorably in markets that demand sustainably produced agricultural products, potentially commanding premium prices for their crops (Thorup-Kristensen et al., 2012).

Market Opportunities: Intercropping can diversify the types of crops produced, opening up new market opportunities for farmers. Different crop combinations may cater to niche markets or specific consumer demands, expanding the range of products available for sale.

Environmental Incentives: As the international focus on sustainable and environmentally responsible agriculture grows, intercropping can attract incentives and support from international organizations and environmentally conscious consumers. This can further boost the economic viability of intercropping for farmers. However, it's essential to note that the economic impact of intercropping can vary depending on factors such as crop choices, management practices, market access, and farmer knowledge.

VI. MAJOR CONSTRAINTS OF INTERCROPPING IN BANGLADESH

While intercropping offers numerous benefits, there are also several constraints and challenges that hinder its widespread adoption and successful implementation in Bangladesh. Some of the major constraints of intercropping in Bangladesh include:

Limited Knowledge and Awareness: Many farmers in Bangladesh may lack knowledge and awareness about the benefits of intercropping and how to effectively implement it. There is a need for targeted extension services and farmer training programs to educate farmers about intercropping practices and their potential advantages (Mamine & Farès, 2020).

Crop Compatibility and Suitability: Selecting appropriate crop combinations is crucial for successful intercropping. Some crops may not be compatible due to differences in growth habits, resource requirements, or competitive interactions. Identifying suitable crop combinations that complement each other can be challenging for farmers (Cruz & Soussana, 1997).

Market Demand and Marketing Challenges: Farmers may face difficulties in marketing intercropped products, especially if there is limited market demand for certain crops or crop combinations. Establishing market linkages and ensuring fair prices for intercropped produce can be challenging (Shohael & Hefferon, 2023).

Labor and Management Intensiveness: Intercropping can be more labor-intensive than monoculture, as farmers need to manage multiple crops with different growth rates and requirements. Labor scarcity during critical crop stages may affect the proper management of intercropped fields (Saeed-Ur-Rehman et al., 2013).

Land Tenure and Fragmentation: Land tenure issues and small landholdings are common in Bangladesh, leading to fragmented plots. Intercropping requires sufficient land area for each crop to be grown effectively, and land fragmentation can limit the adoption of intercropping practices.

Weed Management: While intercropping can help suppress weed growth, it may also present challenges in weed management. Some crop combinations may not effectively control weeds, and manual weeding may be required, increasing labor costs (Staton et al., 2022).

Pest and Disease Management: Intercropping can influence pest and disease dynamics, and certain crop combinations may lead to increased vulnerability to specific pests or diseases. Integrated pest management strategies may be needed to address these challenges effectively (Staton et al., 2022).

Water Management: In regions with limited water resources, intercropping may require careful water management to ensure equitable distribution among different crop types. Competition for water could be a concern, especially during critical growth stages (Abbate et al., 2004).

Seed Availability and Quality: Availability of quality seeds for intercropped crops may be limited, particularly for certain local or heirloom varieties. Ensuring a steady supply of high-quality seeds is essential for successful intercropping practices (Benites et al., 1993).

Credit and Financial Access: Adequate access to credit and financial resources is essential for farmers to invest in intercropping practices. Lack of credit facilities or high interest rates may deter farmers from adopting intercropping.

Cultural and Social Factors: Traditional farming practices and cultural beliefs may influence farmers' reluctance to adopt new agricultural techniques like intercropping. Convincing farmers to change established practices can be challenging.

Addressing these constraints requires a holistic approach that includes farmer training and capacity-building, market development, policy support, and investment in research and extension services. By overcoming these challenges, intercropping can become a more widely adopted and sustainable agricultural practice in Bangladesh, contributing to food security, environmental sustainability, and improved livelihoods for farmers

VII. CONCLUSION

Intercropping represents a sophisticated and ecologically sound approach to modern agriculture, effectively harnessing the power of biodiversity and ecological interactions to achieve sustainable food production while minimizing environmental impact. Its adoption contributes to the advancement of agro ecology and the pursuit of resilient and environmentally responsible farming practices, making it an integral part of the solution to address the challenges posed by an ever-changing agricultural landscape and a growing global population. With a growing awareness of environmental sustainability and climate change, intercropping offers benefits such as reduced soil erosion, better water retention, and pest control. Intercropping can help diversify crop production and enhance food security by providing a wider range of crops for consumption and income generation. As Bangladesh faces challenges related to population growth and changing dietary preferences, intercropping could contribute to meeting the diverse nutritional needs of its population. Advancements in agricultural research and development could lead to the identification of new intercropping combinations that are better suited to the local climate, soil conditions, and socio-economic factors in Bangladesh. These innovations could make intercropping more attractive and economically viable for farmers. Government policies and support for sustainable agriculture and intercropping initiatives can play a crucial role in encouraging farmers to adopt these practices. Financial incentives, subsidies, and extension services can facilitate the adoption of intercropping methods in Bangladesh.

VIII. REFERENCE

[1]. Abbate, P. E., Dardanelli, J. L., Cantarero, M. G., Maturano, M., Melchiori, R. J. M., & Suero, E. E. (2004). Climatic and water availability effects on water-use efficiency in wheat. Crop Science, 44(2), 474–483. https://doi.org/10.2135/cropsci2004.4740

[2]. Alam, K. (2015). Farmers' adaptation to water scarcity in drought-prone environments: A case study of Rajshahi District, Bangladesh. Agricultural Water Management, 148, 196–206. https://doi.org/10.1016/J.AGWAT.2014.10.011

[3]. Benites, J. R., McCollum, R. E., & Naderman, G. C. (1993). Production efficiency of intercrops relative to sequentially-planted sole crops in a humid tropical environment. Field Crops Research, 31(1–2), 1–18. https://doi.org/10.1016/0378-4290(93)90046-P

[4]. Bernzen, A., Sohns, F., Jia, Y., & Braun, B. (2023). Crop diversification as a household livelihood strategy under environmental stress. Factors contributing to the adoption of crop diversification in shrimp cultivation and agricultural crop farming zones of coastal Bangladesh. Land Use Policy, 132, 106796. https://doi.org/10.1016/J.LANDUSEPOL.2023.106796

[5]. Chowdhury, S., Khan, S., Sarker, M. F. H., Islam, M. K., Tamal, M. A., & Khan, N. A. (2022). Does agricultural ecology cause environmental degradation? Empirical evidence from Bangladesh. Heliyon, 8(6), e09750. https://doi.org/10.1016/J.HELIYON.2022.E09750

[6]. Cruz, P., & Soussana, J. F. (1997). Mixed Crops. Diagnosis of the Nitrogen Status in Crops, 131–144. https://doi.org/10.1007/978-3-642-60684-7_8

[7]. Droppelmann, K. J., Lehmann, J., Ephrath, J. E., & Berliner, P. R. (2000). Water use efficiency and uptake patterns in a runoff agroforestry system in an arid environment. Agroforestry Systems, 49(3), 223.

[8]. Evans, J., O'connor, G. E., Turner, G. L., Coventry, D. R., Fettell, N., Mahoney, J., Armstrong, E. L., & Walsgott, D. N. (1989). N2 fixation and its value to soil N increase in lupin, field pea and other legumes in south-eastern Australia. Australian Journal of Agricultural Research, 40(4), 791–805.

[9]. Francis, C. A., & Francis, C. A. (1986). Future perspectives of multiple cropping. Multiple Cropping Systems. Macmillan, New York, 351–370.

[10]. Gebru, H. (2015). A Review on the Comparative Advantage of Intercropping Systems. 5(7). www.iiste.org

[11]. Hossain, F., Rana, M. M. P., & Moniruzzaman, M. (2021). Modelling agricultural transformation: A remote sensing-based analysis of wetlands changes in Rajshahi, Bangladesh. Environmental Challenges, 5, 100400. https://doi.org/10.1016/J.ENVC.2021.100400

[12]. Jensen, E. S., Ambus, P., Bellostas, N., Boisen, S., Brisson, N., Corre-Hellou, G., Crozat, Y., Dahlmann, C., Dibet, A., Von Fragstein, P., & others. (2006). Intercropping of cereals and grain legumes for increased production, weed control, improved product quality and prevention of N-losses in European organic farming systems.

[13]. Kabir, K. H., Sarker, S., Uddin, M. N., Leggette, H. R., Schneider, U. A., Darr, D., & Knierim, A. (2022). Furthering climate-smart farming with the introduction of floating agriculture in Bangladeshi wetlands: Successes and limitations of an innovation transfer. Journal of Environmental Management, 323, 116258. https://doi.org/10.1016/J.JENVMAN.2022.116258

[14]. Kabir, M. R., Halima, O., Rahman, N., Ghosh, S., Islam, M. S., & Rahman, H. (2022). Linking farm production diversity to household dietary diversity controlling market access and agricultural technology usage: evidence from Noakhali district, Bangladesh. Heliyon, 8(1), e08755. https://doi.org/10.1016/J.HELIYON.2022.E08755

[15]. Mamine, F., & Farès, M. (2020). Barriers and levers to developing wheat-pea intercropping in Europe: A review. In Sustainability (Switzerland) (Vol. 12, Issue 17). MDPI. https://doi.org/10.3390/SU12176962

[16]. Mao, L. L., Zhang, L. Z., Zhang, S. P., Evers, J. B., van der Werf, W., Wang, J. J., Sun, H. Q., Su, Z. C., & Spiertz, H. (2015). Resource use efficiency, ecological intensification and sustainability of intercropping systems. Journal of Integrative Agriculture, 14(8), 1542–1550. https://doi.org/10.1016/S2095-3119(15)61039-5

[17]. Ofori, F., & Stern, W. R. (1987a). Cereal–Legume Intercropping Systems. Advances in Agronomy, 41(C), 41–90. https://doi.org/10.1016/S0065-2113(08)60802-0

[18]. Ofori, F., & Stern, W. R. (1987b). Cereal–Legume Intercropping Systems. Advances in Agronomy, 41(C), 41–90. https://doi.org/10.1016/S0065-2113(08)60802-0

[19]. Quisumbing, A., Ahmed, A., Hoddinott, J., Pereira, A., & Roy, S. (2021). Designing for empowerment impact in agricultural development projects: Experimental evidence from the Agriculture, Nutrition, and Gender Linkages (ANGeL) project in Bangladesh. World Development, 146, 105622. https://doi.org/10.1016/J.WORLDDEV.2021.105622

[20]. Rahman, S., & Anik, A. R. (2020). Productivity and efficiency impact of climate change and agroecology on Bangladesh agriculture. Land Use Policy, 94, 104507. https://doi.org/10.1016/J.LANDUSEPOL.2020.104507

[21]. Raihan, A., Muhtasim, D. A., Farhana, S., Hasan, M. A. U., Pavel, M. I., Faruk, O., Rahman, M., & Mahmood, A. (2022). Nexus between economic growth, energy use, urbanization, agricultural productivity, and carbon dioxide emissions: New insights from Bangladesh. Energy Nexus, 8, 100144. https://doi.org/10.1016/J.NEXUS.2022.100144

[22]. Saeed-Ur-Rehman, H., Cheema, A., Ahmad, A. U. H., Wahid, A., Farooq, O., Rehman, H. S. U., Naeem, M., Cheema, Z. A., Ahmad, A.-U.-H., Wahid, A., & Farooq, O. (2013). Agro-economic assessment of wheat (Triticum aestivum) canola (Brassica napus) intercropping systems under different spatial patterns. INTERNATIONAL JOURNAL OF AGRICULTURE & BIOLOGY Agro-economic Assessment of Wheat (Triticum aestivum) Canola (Brassica napus) Intercropping Systems under Different Spatial Patterns. Z. Int. J. Agric. Biol, 15, 1325–1330. http://www.fspublishers.org

[23]. Shohael, A. M., & Hefferon, K. L. (2023). Agricultural biotechnology in Bangladesh: The way forward. Agricultural Bioeconomy: Innovation and Foresight in the Post-COVID Era, 143–166. https://doi.org/10.1016/B978-0-323-90569-5.00012-3

[24]. Slinkard, A. E., & Blain, H. L. (1988). Production of pea, lentil, faba bean and chickpea in North America. World Crops: Cool Season Food Legumes: A Global Perspective of the Problems and Prospects for Crop Improvement in Pea, Lentil, Faba Bean and Chickpea, 1059–1063.

[25]. Staton, T., Walters, R. J., Breeze, T. D., Smith, J., & Girling, R. D. (2022). Niche complementarity drives increases in pollinator functional diversity in diversified agroforestry systems. Agriculture, Ecosystems & Environment, 336, 108035. https://doi.org/10.1016/J.AGEE.2022.108035

[26]. Thorup-Kristensen, K., Dresbøll, D. B., &



Kristensen, H. L. (2012). Crop yield, root growth, and nutrient dynamics in a conventional and three organic cropping systems with different levels of external inputs and N re-cycling through fertility building crops. European Journal of Agronomy, 37(1), 66–82.

[27]. Willey, R. (1985). Evaluation and presentation of intercropping advantages. Experimental Agriculture, 21(2), 119–133.

[28]. Willey, R. W., & Rao, M. R. (1980). A competitive ratio for quantifying competition between intercrops. Experimental Agriculture, 16(2), 117–125.

IJEAST

INTERNATIONAL JOURNAL
OF ENGINEERING APPLIED SCIENCE AND TECHNOLOGY

AUTHORS

- Asia Akter
- Kazim Khan Abul Ulie
- Samiha Suhrah Ali

ABOUT IJEAST

International journal of Engineering Applied Science and Technology (IJEAST) is a peer-reviewed, open access journal that publishes high - quality research paper in the field of Engineering, Applied Science and Technology.

IJEAST aims to provide a platform for researchers, academicians, and professionals to share their innovative ideas, research findings, and practical experiences with the global scientific community.

JOURNAL METRICS

H-INDEX	i10-INDEX	IJEAST CITATIONS	PEER-REVIEWED & OPEN ACCESS
33	154	9,647 (IJEAST CITATIONS)	PUBLISHED MONTHLY

PEER REVIEWED

All submission are rigorously peer reviewed to ensure quality.

AUTHORS ARE OUR PRIORITY

We value our authors and recognize their contribution to the advancement of research and knowledge.

OPEN ACCESS

Free and unrestricted access to research for all.

GLOBAL REACH

Connecting researchers and professionals worldwide.

TIMELY PUBLICATION

We ensure a swift and efficient publication process.

For more information, visit our website
www.ijeast.com

editor@ijeast.com
www.ijeast.com
India

2455-2143