



Multi-Cropping Practices in Bangladesh: Present Status, Impact and Challenges

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ABSTRACT

Multi-cropping is an important agricultural practice in Bangladesh that enables farmers to grow two or more crops sequentially or simultaneously on the same piece of land within a year. It contributes to increasing cropping intensity, land-use efficiency, crop productivity, farm income and food availability. This paper reviews the present status, major patterns, impacts and challenges of multi-cropping practices in Bangladesh. Data were collected from several database and websites and following inclusion and exclusion criteria. The review indicates that multi-cropping is widely practiced in different agro-ecological regions, particularly where irrigation facilities, suitable soil conditions, improved crop varieties and market opportunities are available. The practice can enhance annual production from limited land, generate additional employment and income, improve household food security and increase the efficient use of land, water and other farm resources. However, farmers face several constraints, including limited access to irrigation, rising input costs, labor shortages, pest and disease problems, soil fertility depletion, climate variability, inadequate technical knowledge, fragmented landholdings and unstable market prices. Sustainable promotion of multi-cropping therefore requires improved irrigation and input management, access to quality seed, extension services, appropriate cropping-pattern recommendations, market support and climate-resilient technologies.

Keywords: Multi-cropping, cropping intensity, crop productivity, farm income, food security, sustainable agriculture.

INTRODUCTION

Despite accounting for only 11.2% of Bangladesh's GDP, agriculture remains the backbone of the country's economy, employing nearly 45% of the workforce and supporting over 70% of rural households (BBS, 2026). Vegetable cultivation is one of the crop farming enterprises that ensures the country's food and nutritional security. In Bangladesh, nearly four million people, including over a million women, work in commercial or homestead vegetable cultivation. Vegetable cultivation in Bangladesh is growing at a rapid pace these days. Currently, 2.57 percent of Bangladesh's total land area is used for vegetable cultivation and Bangladesh produces approximately 17.09 million tones of vegetables per year. Farmers benefit far more from vegetables than from other crops. So, vegetables have the potential to improve the nutritional status of huge amount of malnourished population of our country (Haque, and Hoque, 2021).

Multi-cropping is an agricultural production system in which two or more crops are cultivated on the same piece of land during a single year. It promotes the intensive utilization of available agricultural resources, including land, time, water, labour, and farm equipment. Compared with mono-cropping, multi-cropping allows climatic conditions, land, labour, and farm machinery to be utilized more efficiently and can result in



greater total grain production (Crabtree et al., 1990). It also extends the period during which land remains productive, thereby providing opportunities to increase farm profitability (Pullins et al., 1997). Furthermore, multi-cropping can improve agricultural productivity and promote more efficient utilization of limited land resources. This production system has been widely practiced in different parts of the world, particularly where farmers seek to obtain greater output from limited land within a given season through more intensive use of land and labour, ultimately contributing to improved farm income and profitability (Joshi, 2007).

Multiple cropping can be practiced in different ways depending on how crops are grown on the same land. Multi-cropping can be broadly classified into sequential cropping and simultaneous cropping based on the timing of crop cultivation. Sequential cropping refers to growing two or more crops one after another on the same piece of land within a year. Depending on the number of crops grown, it may be classified as double cropping, where two crops are grown; triple cropping, where three crops are grown; and multiple cropping, where more than two crops are cultivated during the year. Relay cropping is another form of sequential cropping in which the next crop is planted before the previous crop is completely harvested. In contrast, simultaneous cropping involves growing two or more crops at the same time on the same land. Intercropping is a major form of simultaneous cropping in which crops are generally arranged in distinct rows or patterns, while mixed cropping involves growing two or more crops together without a specific row arrangement. These different forms of multi-cropping enable farmers to increase land-use efficiency, diversify production and potentially improve farm productivity and income.

The ultimate potential of multiple cropping can be particularly observed in adverse and harsh environments, where it can contribute to increased agricultural production, improved livelihoods, and enhanced farm income.

In general, multiple cropping systems are more widely practiced in developing countries, where farmers seek to maximize the productivity of limited land and other agricultural resources (Paudel, 2016). Although the practice of multiple cropping has a long history, it has received relatively limited attention from agricultural scientists and researchers. In recent years, however, increasing attention has been given to multiple cropping as a potential strategy for adapting to the adverse effects of climate change (Degla et al., 2016). In this context, immediate attention from policymakers, agricultural scientists, and development practitioners is needed to promote sustainable cropping systems that can address the growing challenges of food and nutritional security for the expanding population of the twenty-first century (Rezitus, 2016).

Therefore, understanding the present status, impacts and challenges of multi-cropping is important for assessing its contribution to sustainable agricultural development in Bangladesh. This review examines the existing multi-cropping practices and major cropping patterns in Bangladesh, their effects on agricultural productivity, land-use efficiency, farm income, food and nutritional security and resource utilization, as well as the major constraints faced by farmers. It also highlights opportunities for improving and promoting sustainable multi-cropping practices under changing socioeconomic and climatic conditions.

Objectives of the Study

- To assess the present status and major patterns of multi-cropping practices in Bangladesh.
- To evaluate the impacts of multi-cropping practices on crop productivity, land-use efficiency, farm income, farmers' food and income security.
- To identify the major challenges faced by farmers in adopting and practicing multi-cropping systems.

METHODOLOGY

Review Design

This review adopted a structured literature-review approach to assess the present status, major patterns, impacts, and challenges associated with multi-cropping practices in Bangladesh. The review focused on published scientific literature, institutional reports, government documents, and other credible sources relevant to crop diversification, multiple cropping, cropping intensity, land-use efficiency, agricultural productivity, farm income, food security, and livelihood outcomes in Bangladesh.



Literature Search Strategy

A comprehensive literature search was conducted using major academic databases and relevant institutional websites. The principal databases considered were Scopus, Web of Science, Science Direct, Google Scholar, and CAB Abstracts. Additional information was obtained from the websites of relevant national and international agricultural organizations, including the Bangladesh Bureau of Statistics (BBS), Department of Agricultural Extension (DAE) and Agriculture Information Service (AIS).

The search used combinations of keywords and Boolean operators. Major search terms included “multi-cropping,” “multiple cropping,” “cropping pattern,” “cropping system,” “crop diversification,” “cropping intensity,” “farm productivity,” “farm income,” “food security” and “challenges”. Where appropriate, these terms were combined using AND and OR operators. Reference lists of relevant articles and review papers were also examined to identify additional studies that were not retrieved through the electronic database search.

Eligibility and Inclusion Criteria

Studies were considered eligible for inclusion when they met the following criteria:

1. Studies providing clearly identifiable evidence relevant to agricultural and multi-cropping systems in Bangladesh.
2. Research addressing multi-cropping, multiple cropping, crop diversification, cropping patterns, cropping intensity, or related land-use practices.
3. Studies containing sufficient methodological or contextual information to allow interpretation of their findings.
4. Where several publications reported substantially similar findings from the same study, the most comprehensive or relevant publication was prioritized.

Exclusion Criteria

Studies were excluded when they:

1. Were unrelated to multi-cropping, cropping systems, crop diversification, or associated agricultural practices.
2. Did not address any of the review objectives.
3. Were duplicate records identified across databases or sources.
4. Were inaccessible in full text or did not contain sufficient information for meaningful assessment.

Data Synthesis

The findings were synthesized using a narrative and thematic approach. The evidence was organized into three major themes corresponding to the objectives of the review: (i) present status and major patterns of multi-cropping in Bangladesh, (ii) effects on crop productivity and land-use efficiency, farm income and food and income security, and (iii) challenges and constraints affecting the adoption and sustainability of multi-cropping practices.

RESULTS & DISCUSSION

Present Status and major pattern of Multiple Cropping in Bangladesh:

Agriculture is the backbone of Bangladesh's economy, employing nearly 45% of the labor force and contributing significantly to rural livelihoods. Double cropping, triple cropping, quadruple cropping and ratoon cropping are practiced in Bangladesh as sequential cropping. Quadruple cropping technology is under experimentation (Begum et al., 2013). Ratoon cropping is only practiced for sugarcane. Some sequential cropping practiced in Bangladesh is given in table 1.

Table 1: Some important crop sequence in Bangladesh according to AEZ

Land & soil characteristics	Type of cropping	Crop sequence
High & medium highland AEZ: 1, 3, 5, 7, 11, 12, 20	Single crop	Sugarcane
Medium highland AEZ: 12, 14	Double	Rabi crops-Aus rice – Fallow
		Rabi crops-Jute- Fallow
		Fallow-T. Aus-T.Aman
		Fallow-Jute-T.Aman
High & medium highland AEZ: 9, 11, 12	Triple crop	Potato - Boro - T.Aman
		Onion-T. Aus-T. Aman
		Maize-Mungbean-T.Aman
		Mustard- Boro - T.Aman
High & medium highland AEZ: 3, 11	Quadruple crop	Mustard-Boro rice-T. Aus-T. Aman rice
		Potato-Boro rice- T. Aus-T. Aman rice
		Mustard-Mungbean-T. Aus-T. Aman rice
High & medium highland AEZ: 1, 3, 11	Ratoon crop	Sugarcane

Musa et al., (2013)

There are different forms of intercropping such as relay intercropping, mixed intercropping, row intercropping and strip intercropping. Such as, at its early growth stage up to 1/2 months, different crops like, bean, mung bean, chickpea, ginger may be grown as inter crop with Turmeric. After harvesting of those crops ginger/turmeric could be grown as second crop. About 51% of the net cropped area is covered by double cropping and 23% area under triple cropping and 26% of single cropping in Bangladesh.

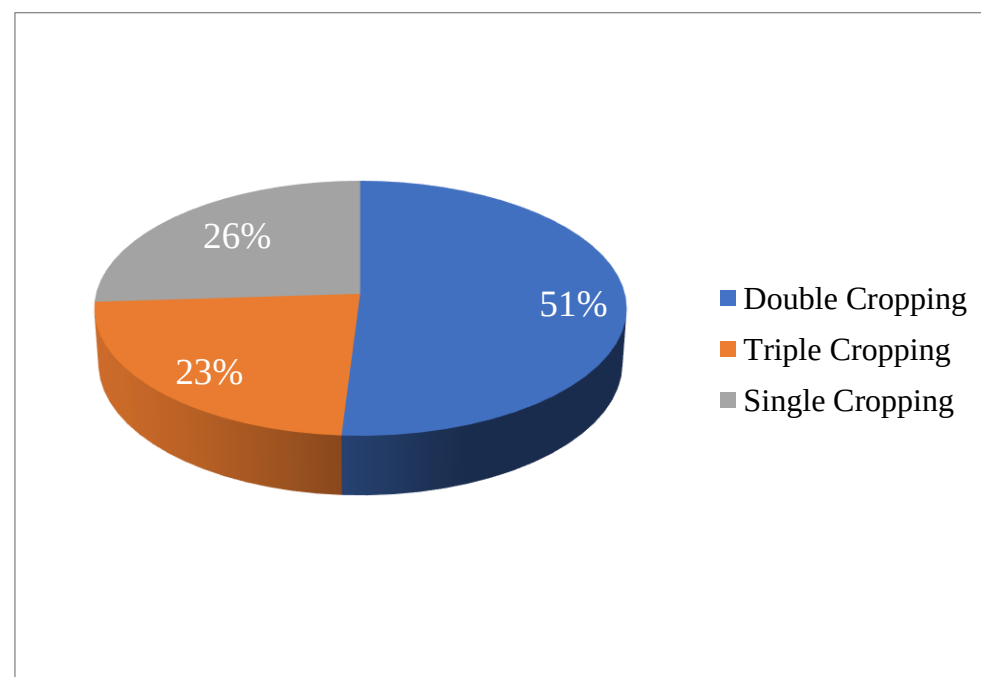


Figure 1: Distribution of net cropped area in Bangladesh. Source: AIS, 2025

Multiple Cropping in Different Soil Types/Areas

The appropriate crop combinations for different soil types with respect to sequential cropping and intercropping are given below:

1. Sequential cropping

Multiple cropping in the form of sequential cropping is predominant in different areas of Bangladesh. Depending upon land type and availability of irrigation water, more than two crops can be grown in a year. Some improved crop sequences of different regions and land types are given in table 2:

Table 2: Multiple cropping in the form of sequential cropping at different regions

Regions/ land types	Crop sequences/ Cropping pattern
Coastal (Saline & non saline areas)	1. Mungbean-T. Aus-T. aman
	2. Chili-Fallow-T. Aman
	3. Groundnut-T. Amam
	4. Fallow-sesame-T. Aman
	5. Boro-Fallow-T. Aman
	6. Soybean-Fallow-T. Aman
	1. Mustard-Boro-T. Aman
High Barind Tract (Drought prone areas)	2. Wheat-Fallow-T. Aman
	3. Potato-Fallow-T. Aman
	4. Chickpea-GM (<i>Sesbania</i>)-T. Aman
	5. Chickpea-Fallow-T. Aman
	1. Wheat- Mungbean- T. Aman
	2. Potato - Boro (HYV) - T. Aman
High (Plain land)	3. Pulses - Jute – Fallow
	4. Wheat - Jute- T. Aman
	5. Potato- Maize-T. Aman
	1. Potato - Boro - T. Aman
	2. Onion-T. aus-T. Aman
Medium (Plain land)	3. Maize-Mungbean-T. Aman
	4. Mustard- Boro - T. Aman
	5. Wheat- Fallow-T. Aman
	1. Potato – Boro- B. Aman
	2. Fallow-Boro - T. Aman
Low (Haor & inundated areas)	3. Fallow- Kaon - T. Aman
	4. Wheat - Boro - T. Aman
	5. Fallow- Jute - T. Aman

Musa et al., (2013)

Intercropping

Besides sequential cropping, a large number of crops can be grown as inter/mixed/relay crop with rice, hybrid maize, sugarcane, banana, taro etc. Combination of different crops under inter cropping depends on climate, location and other site specific factors. Some of the important intercropping systems are given table 3:

Table 3: Some multiple cropping in the form of intercropping at different regions

Regions	Intercropping
Southern part	T. Aman rice + relay cowpea/relay sunflower
Greater Kushtia	Broadcast (B) Aman + B. Aus as mixed cropping
	T. Aman + relay grass pea/relay field pea/relay lentil/relay chickpea
Northern part, Comilla, Kushtia, Jessore	Hybrid maize + spinach/ red-amaranth/ stem amaranth/ carrot/ French bean/ coriander/ black cumin/ fennel/ grass pea/ groundnut/ soybean as intercropping
	Potato + relay pointed gourd/relay bitter gourd/relay sweet gourd/relay ribbed gourd/ relay snake gourd/relay hybrid maize
Northern part, Kushtia, Pabna	Sugarcane + potato/ onion, garlic/ lentil/ chickpea/ mustard/ linseed/ knolkhol/ carrot/ lettuce/ cabbage/ broccoli/ cauliflower/ spinach/ red amaranth as intercropping
	Banana + lentil/mustard/coriander/grass pea/ chili as intercropping
	Fruit/forest tree + wheat/ lentil/fodder crop/cotton as intercropping
Jessore, Pabna, Comilla	Taro + Red amaranth/ stem amaranth as intercropping
Chittagong Hill Tracts	Cotton + rice +maize + sesame + cotton + mungbean as “Jhum”
	Cotton + mungbean as intercropping
Kushtia, Pabna	Lentil + linseed, chickpea + linseed, lentil + mustard, chickpea + coriander as mixed cropping
Northern part	chili + coriander, chili + red amaranth, onion + stem amaranth mixed cropping

Musa et al., (2013)

Scenario of Single, Double, Triple and Quadruple Cropped Area:

Bangladesh's agricultural sector is diversified, with about 8.7 million hectares of cropped area. Typically, the cropped area is classified under the frequency of crops grown there, and it is crucial to estimate the overall cropped area. This study examined the changes in the size of the single cropped area (SCA) and revealed that the SCA decreased. The SCA was about 2,607,000, 2,237,000, 2,133,000, and 2,110,000 hectares respectively in 2010, 2011, 2019, and 2020. This study presented a linear projection of the potential decline in the area under SCA based on the area in 2010. The results indicated a projected decrease of -32.4%, -40.4%, and -27.9% in 2028, 2029, and 2030 respectively. The double cropped area (DCA) was about 3,980,000, 4,107,000, 4,073,000, and 4,125,000 hectares in 2010, 2011, 2019, and 2020, respectively. It forecasts by 2010, there will be an expected increase of 18%, 22%, and 17% in the DCA by 2018, 2029, and 2030 respectively (Fig:2)

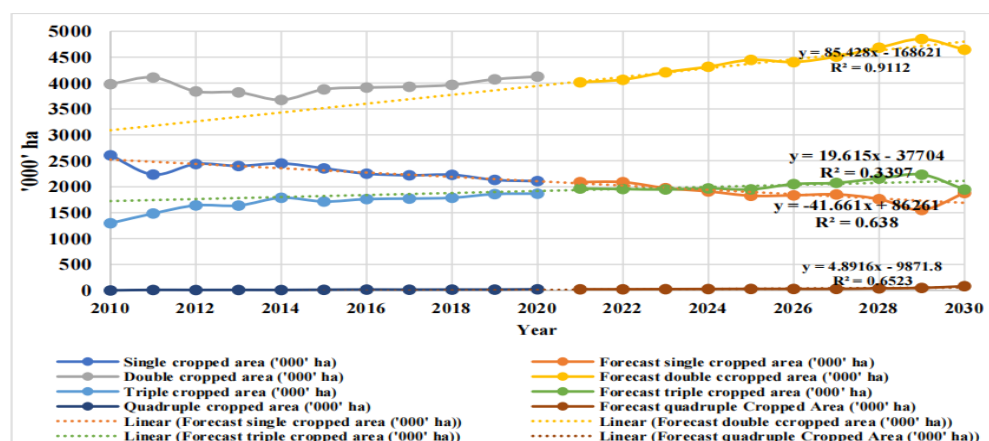


Fig. 2. Trend and prediction of SCA, DCA, TCA and QCA Source: Fuad et al., 2023

Table:4 Major Cropping Patterns in Bangladesh

No.	Cropping pattern	Main crops
1	Boro – Fallow – T. Aman	Boro rice → Fallow → Transplanted Aman rice
2	Boro – Fallow – Fallow	Boro rice → Fallow → Fallow
3	T. Aman – Fallow – Boro	Transplanted Aman → Fallow → Boro rice
4	Aus – T. Aman – Boro	Aus rice → T. Aman rice → Boro rice
5	Boro – T. Aus – T. Aman	Boro rice → Transplanted Aus → T. Aman
6	Potato – Boro – T. Aman	Potato → Boro rice → T. Aman rice
7	Mustard – Boro – T. Aman	Mustard → Boro rice → T. Aman rice
8	Wheat – Jute – T. Aman	Wheat → Jute → T. Aman rice
9	Vegetable – Boro – T. Aman	Vegetable → Boro rice → T. Aman rice
10	Potato – Maize – T. Aman	Potato → Maize → T. Aman rice

Source: DAE

The impacts of multi-cropping practices on crop productivity, land-use efficiency, farm income and farmers' food and income security.

Multi-cropping practices play an important role in enhancing crop productivity, land-use efficiency, farm income, and farmers' food and income security. By growing two or more crops on the same piece of land within a year, farmers can maximize land utilization and increase annual agricultural production. These practices enable efficient use of available resources, including land, labour, water, and fertilizers, while reducing the period during which land remains fallow. Multi-cropping can improve farm income by increasing crop yields, diversifying production, and providing multiple harvesting and marketing opportunities throughout the year. Crop diversification also reduces farmers' dependence on a single crop, thereby minimizing the risks associated with crop failure, price fluctuations, and adverse climatic conditions. Increased agricultural production improves household food availability and dietary diversity, contributing to food security. Moreover, higher and more regular earnings help farmers meet household expenses, purchase nutritious food, invest in agricultural inputs, and improve their living standards. However, the benefits of multi-cropping depend on factors such as soil fertility, irrigation facilities, suitable crop combinations, access to quality seeds, labour availability, and market opportunities. Therefore, the adoption of appropriate multi-cropping practices can contribute significantly to sustainable agricultural productivity and strengthen farmers' food and income security. Following section provides a brief summary impact of multiple cropping. (Fig:3)

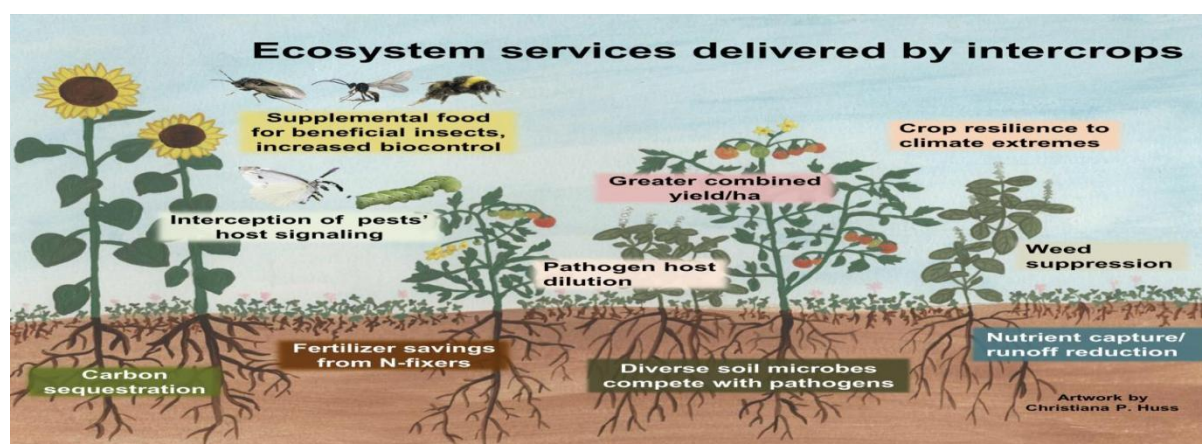


Fig. 3. Illustration of impact of multiple cropping for crop resilience and crop yields, management of soils, weeds, pests, and pathogens, along with environmental benefits of carbon sequestration and reduction of fossil fuel inputs. Source: P. Huss et al., (2022)

Benefits of Multiple Cropping

Multi-cropping has several advantages over mono-cropping (growing a single crop), especially in terms of productivity, sustainability, and economic gain. Increased crop productivity by growing multiple crops makes better use of land, sunlight, water, and nutrients. It helps maximize output per unit of land area. Improved soil health of different crops use and return different nutrients to the soil. Crop rotation and diversity reduce nutrient depletion and promote long-term soil fertility. Diverse crops reduce the risk of widespread pest or disease outbreaks. Some crops naturally repel pests, protecting companion crop. If one crop fails due to weather, disease, or market prices, others may still succeed. Reduces dependency on a single source of income and reduces risk. Crops with different root depths and water needs can share resources without competition. Reduces water wastage and improves nutrient cycling. Producing multiple crops can lead to multiple harvests and income streams. Access to diverse markets and reduces reliance on a single commodity price. Promotes biodiversity and reduces the need for chemical fertilizers and pesticides. It helps in carbon sequestration and climate change mitigation. Produces a variety of food crops, contributing to household and national food security. Reduces dependence on imports and enhances local nutrition. Mono-cropping may be easier and profitable short-term but risks environmental degradation and economic losses over time. On the contrary, multi-cropping is more sustainable, risk-resilient, and productive in the long run. Following are the comparisons of Multi-cropping with mono-cropping:

Table 5: Comparisons of Multi-cropping with Mono-cropping

Criteria	Multicropping	Monocropping
Crop Diversity	Grows two or more crops in a season/year	Grows only one crop repeatedly
Income Stability	Higher and more stable (multiple sources)	Less stable (depends on single crop price/yield)
Soil Health	Maintains/improves soil fertility (less depletion)	Often depletes nutrients, needs more fertilizers
Pest & Disease Control	Lower risk due to crop diversity	High risk of pest/disease outbreaks
Risk Management	Lowers production risk (weather/disease affects one crop, others may survive)	High risk (total loss if single crop fails)
Productivity (per hectare)	Generally higher overall productivity	Lower, especially over time
Input Use Efficiency	Better utilization of sunlight, water, and nutrients	Lower efficiency
Environmental Impact	More sustainable, biodiversity-friendly	Can lead to erosion, salinity, and biodiversity loss
Labor Demand	Higher (more crop care, management needed)	Lower (simpler operations)
Market Dependence	Flexible (multiple crops to sell)	Dependent in one crop

Impacts of multi-cropping on land-use efficiency, farm income, farmers' food and income security:

Rice equivalent yield (RY), rice grain yield, total grain yield and LER

It was observed that all vegetable–rice intercropping treatments produced significantly higher total rice equivalent yields than sole rice cultivation, despite some reduction in rice grain yield caused by the above-ground effects of the trellis, as mentioned earlier. The highest rice equivalent yield (7.88 t ha⁻¹) was recorded in the snake gourd + rice combination, whereas the lowest (6.35 t ha⁻¹) was obtained from the white gourd + rice treatment (Table 06). Bottle gourd + rice combinations showed moderate rice equivalent yields, ranging from 6.0 to 7.9 t ha⁻¹. The maximum rice grain yield was 6.9 t ha⁻¹ in the sole rice plot, while rice grain yield

was reduced in some intercropping combinations (Table 06). However, when the vegetable yields were converted into rice equivalent yield, the total grain yield of all intercropping treatments exceeded that of sole rice (6.9 t ha⁻¹). The highest total grain yield, 13.15 t ha⁻¹, was recorded in the yard-long bean + rice combination (Table 06). In another intercropping experiment, corn and soybean grown in a 1:1 ratio generated the maximum monetary return, with a total land equivalent ratio (LER) of 1.35 and partial LER values of 0.70 for corn and 0.65 for soybean. These results suggest that competition between corn and soybean was comparatively lower at the 1:1 ratio, resulting in partial LER values greater than 0.5 for both crops, a total LER above 1.0, and greater combined productivity. The LER results (Table 06) further indicated that sole rice cultivation was less profitable than rice combined with vegetables. Overall, the yield advantage of multiple cropping over monoculture became evident from the total LER values exceeding 1.0, demonstrating greater productivity from multiple crops grown on an equivalent area of land.

Rice Yield

Rice–vegetable intercropping can significantly influence rice yield and its associated attributes. Hossain et al. (2017) reported that sole rice produced the highest grain yield (6.90 t ha⁻¹), straw yield (9.70 t ha⁻¹), biological yield (16.60 t ha⁻¹), and harvest index (41.87%). In contrast, the bottle gourd + rice combination recorded the lowest grain yield (5.16 t ha⁻¹), straw yield (8.16 t ha⁻¹), and biological yield (13.31 t ha⁻¹). However, diverse cropping systems may enhance overall biomass production; Cardinale et al. (2007) found that biomass production in species-diverse systems was, on average, 1.7 times greater than in monocultures.

Vegetable yield

Our climbing vegetable species were grown with rice (cv. Surjamoni) on the rice-field levees using bamboo scaffolding and jujube branches as support structures. All the vegetables showed satisfactory performance when cultivated alongside rice, although their yields varied considerably among the combinations. The highest vegetable yield, 14.5 t ha⁻¹, was obtained from the white gourd + rice combination, whereas the lowest yield, 5.5 t ha⁻¹, was recorded from the yard-long bean + rice combination (Table 06). These results indicate that vegetable species selection can substantially affect productivity in rice–vegetable cultivation systems.

Table 06. Vegetable yield and rice equivalent yield of the vegetable-rice cultivation system

Treatment	Vegetable Yield (t/ha)	Rice equivalent yield (G1) (t/ha)	Grain yield (G2) (t/ha)	Total grain yield (G1+ G2) (t/ha)	Land Equivalency Ratio (LER)
T0	-	-	6.9	6.9a	1a
T1	5.9	7.675	5.475	13.15c	4,12b
T2	6.05	7.875	5.175	13.05c	4,18b
T3	11.95	6.35	5.2	11.55b	4,04b
T4	9.45	7.1	5.175	12.275bc	4,10b

Here, T0 = Rice only, T1= Yard long + rice, T2= Snake gourd + rice, T3= White gourd + rice, T4= Bottle gourd+rice. (Hossain et al., 2017)

Total cost of production:

The production economics of the rice–vegetable system were assessed by considering input costs, overhead costs, and total production costs. Vegetable cultivation on the levees of rice fields required additional expenditure compared with sole rice cultivation. The average production cost of sole rice was 70,647.8 BDT ha⁻¹, which was the lowest among the treatments. In contrast, all rice–vegetable combinations incurred higher production costs (Table 07). The higher cost was mainly due to the additional inputs and management expenses required for cultivating two crops simultaneously in the same field.

Table 07. Cost of production of vegetable-rice intercropping

Input cost (BDT/ha)								Overhead cost			
Treatment combination (Crop combination ×Trellis)			Material cost					Interest of input cost @ 12% for growth period	Interest of the value of land 125000 (BDT/ha) @12% for growth period		
	Non material cost	Seed cost	Total fertilizer cost	Pesticide cost	Trellis cost	Total material cost (BDT/ha)	Total input cost (BDT/ha)			Miscellaneous cost (BDT/ha)	Total cost production (BDT/ha)
T0	28000	650	29280	700	-	30630	58630	3517	7500	1000	70647
T1	30000	900	31000	850	17900	50650	80650	4839	7500	1300	94289
T2	30000	900	31000	850	17900	50650	80650	4839	7500	1300	94289
T3	30000	900	31000	850	17900	50650	80650	4839	7500	1300	94289
T4	3000	900	31000	850	14000	46750	76750	4605	7500	1300	90155

Note

T0	= Rice only	Organic manure	=	9.9 ton @2.00 (BDT/kg)	Curator	=	250 (BDT/ha)
T1	= Yard long bean + rice	Urea	=	270 kg @ 12.00 (BDT/kg)	Microthial	=	250 (BDT/ha)
T2	= Snake gourd + rice	TSP	=	180 kg @ 23.00 (BDT/kg)	Nogos100 EC	=	200 (BDT/ha)
T3	= White gourd + rice	MOP	=	160 kg @ 15.00 (BDT/kg)	Bamboo cost	=	100 (BDT/ha)
T4	= Bottle gourd + rice	Gypsum	=	70 kg @ 10.00 (BDT/kg)	Labour cost	=	80 (BDT/day)
		Zinc sulphate	=	10 kg @ 68.50 (BDT/kg)	Bullock pair	=	80 (BDT/day)

Source: Hossain et al., (2017)

Gross return: The economic evaluation revealed that integrating vegetables with rice generated greater gross returns than growing rice alone (Table 08). The yard-long bean + rice combination produced the highest gross return of 280,650.00 BDT ha⁻¹, whereas the sole rice treatment recorded the lowest return of 157,400.00 BDT ha⁻¹. The superior economic performance of intercrop systems is consistent with findings reported by Jana et al. (1999), Mandal et al. (1990), Zaman et al. (1999), and Moorthy and Das (1999), who also documented higher yields and economic returns from intercropping systems.

Net return: Net return serves as a key measure for determining the economic profitability of different crop combinations. The economic assessment of the rice–vegetable production system showed that the yard-long bean + rice combination generated the highest net return of 187,394.5 BDT ha⁻¹ over the total cost of production (Table 08). In contrast, the sole rice treatment provided the lowest net return of 86,752.2 BDT ha⁻¹. The greater yield and economic benefits obtained from intercrop systems are also supported by the findings of Mandal et al., (1990).

Treatment	Total cost of production (BDT/ha)	Return		Gross return (a+b) (BDT/ha)	Net return (BDT/ha)	Benefit cost ratio (BCR)
		Due to product (a) (BDT/ha)	Due to bi-product (b)(BDT/ha)			
T0	70647.8	138000	19400	157400	86752.2a	1.23a
T1	93255.5	263000	17650	280650	187394.5e	2.01e
T2	93255.5	261150	16550	277700	184444.5d	1.98d
T3	93255.5	231300	16800	248100	154844.5b	1.668b
T4	93255.5	245500	16300	261800	168544.5c	1.81c

Yard long bean, Snake gourd and Yard long bean@26 BDT/ha, Rice grain@20 BDT/ha, Bottle gourd@15 BDT/ha, White gourd@10 BDT/ha and Rice straw@2 BDT/ha.

Source : Hossain et al., (2017)

Intercropping of vegetables (potato, onion, garlic, carrot, lettuce, cabbage, broccoli cauliflower, spinach and red amaranth), lentil, chickpea, mustard, soybean and linseed with sugarcane has helped to diversity the crops and increase total production. After harvesting of those crops, mungbean could be grown as a second crop.

Table 9: Income from multi-storied cropping systems in coconut and mango orchard

Multi-storied cropping systems			Income (Tk ha ⁻¹)
Higher stratum	Medium stratum	Lower stratum	
Coconut	Banana	Taro	1,50,960
Coconut	Banana	Ginger	2,71,320
Coconut	Banana	Pineapple	2,18,280
Mono crop coconut	-	-	36,720
Mango	Papaya	Pineapple	2,18,960
Mono crop mango	-	-	1,02,686

(Musa et al., 2013)

The multicropping practices (Coconut+banana+ginger) make farmer's income much higher than monocropping (mango or coconut.) (Table 09)

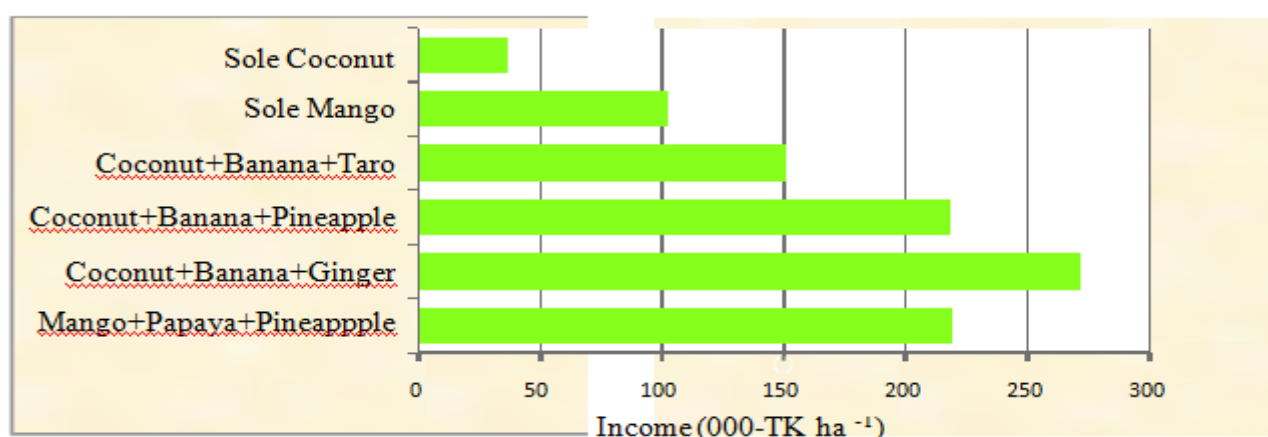


Fig. 4: Income from multi-storied cropping systems in coconut and mango orchard. (Musa et al., 2013)

One of the major advantages of multiple cropping is its ability to enhance productivity per unit area of land (Inal et al., 2007). The ultimate outcome of multiple cropping could be visualized in adverse or harsh environment for increase agriculture production, livelihood and income (Fig:4) Despite the pros and cons of multiple cropping, there are enough evidences that multiple cropping is beneficial over mono or sole cropping. Sole crops might be fully damaged by drought, floods, hailstorms, hurricanes and epidemics. As a result farmers will lose the whole crop and investment, and this will be disastrous for poor farmers.

Challenges of Multi-cropping in Bangladesh

Multi-cropping has many benefits, but in Bangladesh, farmers face several challenges when trying to implement it effectively. Here are the key challenges of multi-cropping in Bangladesh:

1. Limited availability of irrigation water – Dry-season crops depend heavily on irrigation, while declining groundwater levels and irregular water supply can restrict multi-cropping.
2. Small and fragmented landholdings – Fragmented plots make it difficult to plan, mechanize, and manage multiple crops efficiently.
3. High production costs – Increasing costs of seeds, fertilizers, pesticides, irrigation, labour, and machinery reduce farmers' profitability.
4. Labour shortages – Multi-cropping requires timely land preparation, planting, weeding, harvesting, and post-harvest operations, but labour shortages can delay these activities.
5. Pest and disease problems – Continuous cultivation of several crops can increase pest and disease pressure if proper crop rotation and integrated pest management are not followed.
6. Climate change and extreme weather – Floods, droughts, cyclones, waterlogging, heat stress, and irregular rainfall can disrupt cropping sequences and reduce yields.
7. Soil fertility depletion – Intensive cropping may remove nutrients from the soil rapidly, particularly when adequate organic matter and balanced fertilizers are not used.
8. Lack of technical knowledge – Some farmers have limited access to information about suitable crop combinations, planting schedules, nutrient management, and improved technologies.
9. Marketing and price instability – Fluctuating market prices, weak storage facilities, and poor transportation can reduce returns from additional crops.
10. Limited access to quality inputs and credit – Timely access to quality seed, fertilizers, machinery, and affordable credit remains a constraint for some farmers
11. Short time between crops – Delays in harvesting one crop can shorten the planting window for the following crop, affecting the entire cropping sequence.
12. Limited mechanization – Lack of suitable machinery for small and fragmented farms increases labour requirements and production costs.

CONCLUSIONS

The population of Bangladesh is increasing and land is decreasing. In such condition, ensuring desired production is going to be challenged day by day. Multi-cropping is essential for food security and rural livelihoods in Bangladesh given the high population density and limited land. While it successfully boosts overall productivity and lowers economic risks, long-term success requires shifting toward climate-smart, eco-friendly intensification. Multi-cropping is an important agricultural practice in Bangladesh that enables farmers to use limited land more intensively and efficiently throughout the year. The practice contributes to increased cropping intensity, crop production, farm productivity, employment opportunities, and household income. It also supports food and nutritional security by increasing the availability and diversity of crops. However, the expansion of multi-cropping faces several challenges, including soil fertility decline, water scarcity, climate variability, pest and disease pressure, high production costs, labour shortages, limited access to quality inputs and technology, and inadequate market facilities. Overall, sustainable multi-cropping can play a significant role in improving agricultural productivity and farmers' livelihoods in Bangladesh. Therefore, an integrated and sustainable approach to multi-cropping is necessary to enhance its benefits while minimizing its environmental and economic risks.



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