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Socio-Economic Impacts of Mixed Crop Cultivation in Gopalganj District of Bangladesh

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ABSTRACT

This article focused on the socio-economic benefits of mixed crop cultivation by farmers based on primary and secondary data in the District of Gopalganj covering 5 Upazilas. A total of 270 marginal farmers participated in the survey of two subsequent researches. Findings demonstrated that mixed cropping system enhanced standards of living of farmers through the channels of income generation, increased in rural employment through increased participation of family farm labour, improved rural transportation, and higher enrolment in primary education, although dietary diversity had not improved that much. Overall, the multifunctional agricultural system upgraded the socio-economic rural profiles of the marginal farmers. These findings had important policy implications for government and non-government organizations of Bangladesh.

Keywords: Mixed crop farming, Intercropping, Yield, Production, Socio-economic benefits

INTRODUCTION

Growing two or more crops concurrently without distinct row arrangement is called mixed firming and with distinct row arrangement is called intercropping. Farmers in the sub-continent especially in India, have been applying this cultivation technique since time immemorial (Gupta et al. 2012). It is evident that multiple cropping expedites productivity of the land, protects soil from water and wind erosion, generates employment opportunities and gives additional income (Gupta and Gupta, 2016). Intercropping provides farmers with an opportunity to diversify risk from single crop production, to use labour more efficiently, to have a source of cash for purchasing farm inputs and to add value to crops or crop by-products. Mixed cropping involves integrating crops using land and labour more efficiently (Baldy and Stigter, 1997) and allows crop intensification which increases the productivity and biodiversity of the land (Vandermeer, 1992).

Multiple cropping ensures greater yield stability under marginal environmental condition and soil conservation practices, socio-economic reasons of this type of farming include the magnitude of inputs and outputs and their contribution to the stabilization of household food supply (Beets, 1982). Recently intercropping or mixed cropping has drawn greater attention in sub-continent agriculture, because of stable yield advantage, especially under adverse weather condition (Rathore, 2014). To realize the optimal production in intercropping it is important to choose the right combination of crops to grow concurrently in the field. This farming system requires less number of nutrient inputs for the production compare to conventional mono-culture farming (Picasso et al., 2008). Mixed cropping has advantages for small scale farming where the harvesting is done manually; the byproducts could be used to feed the livestock. Irrigation is not required in large scale as it does in case of traditional cultivation. Mixed cropping is environment friendly, because it ensures the optimal use of crop residues which is incorporated directly into the soil instead of getting burned in mono-culture farming which causes carbon di-oxide emission. Cropping intensity is also enhanced and this farming helps to preserve water which could act as a suitable habitat for birds. Financial risks are distributed over diverse production of crops and livestock. There is less dependence on the purchased inputs and over time crops maintain productivity with less number of inputs. This system is a powerful tool for the sustainability of the agricultural production.

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Mixed cropping is a variety of poly-culture farming system, where two or more crops are being cultivated in the same area. Such system promotes diet diversity in local communities. This system is harmonized with climate variability and more resilient to pest and diseases. These intercropping practices augment soil fertility, which could enhance the crop productivity of the land and allows crop rotation and intensification.

Mixed cropping system makes the soil less vulnerable to pest (Izulike and Igwatu, 1993; Gold, 1993) and diseases attacks and the risk of absolute crop failure (Ahohuendo and Sarkar, 1995). Such cropping system ensures proper utilization of intercrops resources otherwise economically lost (Akobundu,1981; Unamma and Ene, 1984; Zuofa et al.,1992; Olasantan et al., 1994). The fertility status of the soil also improves (Obiawgu, 1995; Leihner et al., 1996; Lusembo et al., 1998). Multiple cropping system increases labour efficiency (Odurukwe and Ikeorgu, 1994) enhances the diversity of farmers' diet and provides them with additional income (Gold, 1993), though there are disputes about these outcomes (Benites et al., 1993). Further investigation is needed to test this cropping pattern at different locations with changing environmental conditions over considerably long period of time (Daellenbach et al., 2005). Although there are production risks associated with mixed farming system in terms of volatility of net profit at farm level, this helps to diversify the production risk when fodder and milk productions are combined in one enterprise (Kurosaki, 1997). Intercropping does play an important role in alleviating weeds to a greater extent in a sustainable manner (Weerarathne, 2017). Mixed cropping is a common practice in Gopalganj District.

Gopalganj emerged as a District on 1st February, 1984 as one of the five divisions of Faridpur District. This District is under Dhaka Division. The maximum and minimum average temperature varies from 23.3°C to 8.6°C. Total rainfall is recorded as 1620 mm. The surface area is about 1,490 km. Gopalganj is subdivided into five Upazilas e.g. Gopalganj Sadar, Kashiani, Kotalipara, Muksudpur and Tungipara. About 30% of agricultural land in Gopalganj District uses river water for irrigation. Gopalganj is known as low lying land in Bangladesh. In Gopalganj, floating garden agricultural practice is common to grow vegetables and spices suited to grow in wetlands. Floating garden is based on hydroponic production system. Farmers apply their expertise to grow agricultural products using this production technique. Floating garden system is practiced extensively in the Districts of Barisal, Gopalganj and Pirojpur of Bangladesh (Irfanullah, 2009). Floating agriculture ultimately leads to mixed culture.

There are a few studies available to examine and evaluate the socio-economic advantages from mixed cropping in rural life of Bangladesh. Our study fulfills this gap in the existing literature. The main objectives of the study were to examine the connectedness between mixed crops cultivation and its socio-economic consequences in typical rural life of marginal farmers in the Gopalganj District, Bangladesh. This study intends to make comparison between socio-economic aspects in terms of employment creation, income generation, poverty alleviation, improvement of living standards of conventional integrated farming with that of mixed farming.

METHODOLOGY

Random sampling technique had been applied through a survey conducted in June- July, 2018 in Gopalganj District. The sampling was done in two phases. In the first phase, the data were collected from Gopalganj Sadar and Tungipara Upazila. In the second phase, data were collected from Kashiani, Kotalipara and Muksudpur Upazila. Both the qualitative and quantitative data were collected from questionnaire, interview and direct field observation of the study area. Secondary data was collected from research articles, books, periodicals, officials and unpublished reports from government and non-government organizations. Close ended questions were included in the questionnaire. Each respondent was asked to choose particular option according to his viewpoint from the multiple options of answers. Draft questionnaire was tested with 10 farmers prior to the formal field study was undertaken. Upazila Agriculture officer, Settlement officer, Local Government Engineering Department (LGED) officer helped to collect the survey results. Detailed and free discussions were allowed with the farmers to proceed with the questionnaire to grasp their actual viewpoint.

RESULTS AND DISCUSSION

Demographic Characteristics of Gopalganj Sadar and Tungipara Upazila: The Table 1 showed general information regarding qualitative and quantitative variables of the participants in our study which included gender distribution, age, occupation, education level, and family members of the five Upazilas of Gopalganj District. We observed that our field survey consisted of predominantly male respondents and nearly one third (33%) of the respondents age ranged from 40 to 49 (Table 1). Around half of the sample farmers had primary education and one third was illiterate. Farming was the most prevalent livelihood which constituted more than two third of the sample. Family size was relatively small, from 1 to 3 for more than two third of the participants (Table 1).

Mixed cropping and its relationship with enrollment in primary school (EPS) and economic status of Gopalganj Sadar and Tungipara Upazila: Around 81% farmers were engaged with mixed cropping technique (Table 2), because the District had low arable land, which could be easily flooded and hence this system allowed farmers to continue the cultivation process up to 9 months of the year. Mixed cropping had been cultivated by nearly 50% marginal famers around 2 to 3 decades ago, and more than one third adopted this system 3 decades ago (Table 2). This implied that mixed cropping was the predominant technique of cultivation among the households in Gopalganj Sadar and Tungipara Upazila.

At present, it was observed that the enrollment in primary school was about 90% (Table 2). No doubt, this is very high percent of primary school enrollment. Only about 10% children do not attend school in Gopalganj Sadar and Tungipara Upazila. It was believed that the higher enrollment in primary school was most probably due to the impact of mixed cropping. Other causes may also be involved which demand further study. Around 82% agreed that they experienced improvement in their well-being, while 3% reported deteriorated condition of economic status. About 15% told that the economic condition was unchanged (Table 2). About 73% people perceived that their economic or financial condition was poor before introduction of mixed cropping system, and about 22% thought that their economic condition was costant as before, implying mixed cropping failed to change their economic condition.

Table 1: Demographic characteristics of the respondents of Gopalganj District (n1 + n2 = 150 + 120 = 270).

Categories	Sub-categories	Gopalganj Sadar and Tungipara Upazila (150)		Kashiani, Kotalipara and Muksudpur (120)	
		Respondents	(%)	Respondents	(%)
Gender	Male	141	94	101	84
	Female	9	6	19	16
Age	20-29	25	17	15	13
	30-39	15	10	30	25
	40-49	50	33	36	30
	50-59	36	24	25	21
	⩾ 60	24	16	14	11
Level of Education	Illiterate	43	29	18	15
	Primary	72	48	37	31
	Secondary	18	12	17	14
	Higher Secondary	11	7	12	10
	Graduates	6	4	10	18
Occupation	Unemployed	3	2	0	0
	Farmer	111	74	85	71
	Business	17	11	3	2
	Transport	3	2	5	4
	Service	4	3	10	8
	Others	12	8	17	15
Family Members	1-3	112	74	18	15
	4-6	25	17	70	58
	⩾ 6	13	9	32	27

N.B.: This research was conducted in two phases. In the first phase, we did the survey of Gopalganj Sadar and Tungipara Upazila. In the second phase, we did the survey of Kashiani, Kotalipara and Muksudpur Upazila of Gopalganj District.

Table 2: Mixed cropping and its relationship with enrollment in primary school (EPS) and economic status in Gopalganj District

Mixed Cropping(%)				EPS (%)		Economic Status (%)		
							After	Before
Gopalganj Sadar Upazila and Tungipara Upazila.								
Involved	81	10 Years ago	16	Enrolled	90	Improved	82	5
Not involved	19	20-30 Years ago	49	Un enrolled	10	Deteriorated	3	73
		⩾ 35 Years ago	35			Unchanged	15	22
Kashiani, Kotalipara and Muksudpur								
Involved	67	10 Years ago	37	Enrolled	85	Improved	67	29
Not involved	33	20-30 Years ago	42	Un enrolled	15	Deteriorated	21	59
		⩾ 35 Years ago	21			Unchanged	12	12

EPS = Enrollment in Primary Schools.

Table 3: Summary of survey results on socio-economic profiles of Gopalganj Sadar Upazila and Tungipara Upazila based on the answers of the participating households in percentage (%).

Household Structure	After	Before	Income	Range and (%)		Unemployment (%)	
Earthen	23	61	Extreme poor	4,000-6,000/-	32	Increased	9
Tin Shed	54	30	Very poor	7,000-9,000/-	27	Decreased	63
Semi-Brick	15	6	Lower Middle	10,000-12,000/-	17	Unchanged	28
Brick-Building	8	3	Higher Middle	13,000-15,000/-	12		
			High	⩾15,000/	12		

Household Structure, Income and Unmployment Rate:

Table 3 depicted some of the salient socio-economic features of the households. After the cultivation of mixed cropping, the most noticeable and striking change was observed in households' residential structure from earthen to tin shed house. Before introducing mixed cropping system about 61% houses were earthen but after using mixed cropping system earthen house decreased to 23% and the tin shed house risen to 54% (Table 3). All of these are indicators of development of economic well-being, because constructing tin shed building is costly.

Present income distribution revealed that more than half of the households (32% + 27% = 59%) were still 'very poor' or worse than the marginal level, while about 41% (17% + 12% + 12%) succeeded to elevate their position from the cut-off point (Table 3). On the other hand, current unemployment decreased substantially, amounting to 63%. These findings suggested that though more than 50% of the households were very poor or extreme poor, mixed farming expedited and encouraged the family farm labour to participate in cultivation process but probably these family labourers were unpaid. Table 3 manifests the impact of mixed crop cultivation on some socio-economic outcomes for the sampled households in our studied area.

Table 4: Social acceptability demonstration of Gopalganj District.

Gopalganj Sadar and Tungipara Upazila						
	Increased		Decreased		Unchanged	
Mixed Cropping	After	Before	After	Before	After	Before
Social Acceptability	72	5	12	79	16	16
Preset Transportation Facilities	65	3	9	74	26	23
Literacy	66	10	6	77	13	28
Quality of Attire	88	17	12	83	----	-----
Food Habit /Diet Diversity	Improved		Average		Worse	
	After	Before	After	Before	After	Before
	63	55	32	36	5	9
Kashiani, Kotalipara and Muksudpur Upazila						
Mixed Cropping	After	Before	After	Before	After	Before
Social Acceptability	42	29	25	38	33	33
Preset Transportation Facilities	59	42	16	33	25	25
Literacy	65	25	12	54	21	21
Quality of Attire	72	42	12	42	16	16
Food Habit /Diet Diversity	Improved		Average		Worse	
	After	Before	After	Before	After	Before
	29	12	50	29	21	59
Internet	25	----				
Sanitary Latrine	67	33				
Electricity	94	6				

SOCIAL ACCEPTABILITY:

Social acceptability of this unconventional farming culture had increased considerably from 5% to 72% for Gopalganj Sadar and Tungipara Upazila (Table 4). This was because the earning of the farmers increased substantially from mixed cropping system. Similarly, road network, local transportation system, literacy and quality of attire improved for the sampled household's farmers. But the dietary diversity did not increase considerably. Three fourth of the participating households agreed that assistance had been obtained from the government agencies while the support of NGO's had not been considerably high. It was believed that mixed cropping may had positive impact on the socio-economic condition, other causes might also be involved which demand further study.

ROBUSTNESS TEST OF THE STUDY

Demographic Characteristics of Kashiani, Kotalipara and Muksudpur Upazila: Our study conducted another field survey by incorporating three more three Upazilas of Gopalganj District e.g.- Kashiani, Kotalipara and Muksudpur Upazila. The Table 1 displayed some demographic characteristics; gender, age, occupational distribution of Kashiani, Kotalipara and Muksudpur Upazila. In this case, we also observed our field survey consisted of mainly male respondents and 31% of the respondents age ranged from 40 to 49 (Table 1). Around one third of the sample farmers had primary education and 15% were illiterate. Farming was the predominant occupation to earn livelihood which constituted more than two third of the participants. Family size was relatively larger, from 4 to 6 of 58% of the responding households. Thus the demographic characteristics were similar to that of other two Upazila e.g.- Gopalganj Sadar and Tungipara Upazila. Literacy rate and family size were higher in second round field survey of the study.

Mixed cropping and its relationship with economic status of Kashiani, Kotalipara and Muksudpur Upazila: Table 2 manifests that two third farmers were engaged in multiple cropping and majority of the households had been practicing these 2 to 3 decades ago. Around two third of the respondents experienced that their status of economic well-being had improved, concurrently, more than 50% respondents agreed that rural unemployment declined, but in our first round study, unemployment had reduced by 63% (Table 3). Mixed cropping had beneficial effect in generating more employment opportunities in Gopalganj Sadar and Tungipara Upazilla. After the enactment of intercropping; social standing, transportation and communication facility, literacy and attire quality improved considerably for the sampled households in the second phase of study. However, access to sanitary latrine and electricity experienced considerable progress compared to internet facility (Table 4). Diet quality was 'average' according to the opinions of 50% farmers and better for 29%. 'Larger family size' might be responsible for this in the second round survey. Comparatively, in the first round survey, greater proportion of the respondents opted for improved quality of the diet. Overall, our findings in the first round survey were supported strongly by second round field study in other three Upazilas. Multiple cropping pattern shad more or less beneficial socio-economic consequences in the district of Gopalganj, as it ensures continuity in farming activities throughout the year, through cultivation in floating garden even in the rainy seasons.

Practice of multiple cropping was not yet very common in existing farming culture in Bangladesh. Growing population exerts pressure on available arable land, under this circumstances mixed cropping system could be adopted by the marginal farmers in other parts of Bangladesh. Especially, as this technique allows cultivation process to be continued throughout the year particularly suitable for 'flood prone agricultural land'. Intercropping was found to be cost effective for farmers as it ensured the optimal utilization of farm resources.

CONCLUDING REMARKS

Our field investigation revealed that majority of the marginal farmers had experienced favorable socio–economic outcomes as a result of this unconventional cultivation practice. But households did not experience considerable positive changes in dietary diversity, though they had been involved with this cropping method 2 to 3 decades ago. Government and non-government organizations should come forward to promote awareness and to introduce the perception of this new method for farmers and to provide credit and appropriate training for adopting this multiple-cropping system.

Future research should be undertaken to examine its impact on productivity, yield rate and soil fertility. Intercropping when combined with livestock production has helped farmers to diversify the production risk in many parts of the world including developed economics. Future research could shed light on mixed cropping as an emerging cultivation technique for sustainable agriculture and for sustainable economic development in developing countries like Bangladesh.

REFERENCES

Ahohuendo B.C. and Sarkar S. (1995): Partial control of the spread of African cassava mosaic virus in Benin by intercropping. *Journal of Plant Disease and Protection, 102(3): 245-256.*

Akobundu I.O. (1981): Weed control in maize-cassava intercrop. Les mauvaisesherbesdans les cultures mixtes de maiset de manioc. In: Terry E.R., Oduro K.A., Caveness F. (Eds.), 1. Triennial Root Crops Symposium of the International Society for Tropical Root Crops. Tropical Root Crops: Research Strategies for the 1980s. Plantes-racinestropicales: strategies de recherches pour les annees 1980. IDRC, Ottawa, Canada.

Baldy C. and Stigter C.J. (1997): Agro-meteorology of multiple cropping in warm climates. Editions Quae.

Beets W.C. (1982): Multiple cropping and tropical farming systems. Gower Publishing Com..

Benites J.R., McCollum R.E. and 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.

Daellenbach G.C., Kerridge P.C., Wolfe M.S., Frossard E., and Finckh M.R. (2005): Plant productivity in cassava-based mixed cropping systems in Colombian hillside farms. *Agriculture, Ecosystems and Environment, 105(4):595-614.*

Ezulike T.O. and Igwatu R.I. (1993): Effects of intercropping cassava and pigeon pea on green spider mite Mononychellustanajoa (Bondar) infestation and on yields of the associated crops. *Discovery and Innovation, 5(4): 355-359.*

Gold C.S. (1993): Effects of cassava intercropping and varietal mixtures on herbivore load, plant growth, and yields: applications for small farmers in Latin America. In: Altieri, M.A. (Ed.),Crop Protection Strategies for Small Farmers. West View Press, London, 117-141.

Gupta R.D. and Gupta S.K. (2016): Strategies for increasing the production of oilseed on a sustainable basis. In: *Breeding Oilseed Crops for Sustainable Production, 1-18.*

Gupta V., Rai P.K. and Risam K.S. (2012): Integrated crop-livestock farming systems: A strategy for resource conservation and environmental sustainability. Indian Research Journal of Extension Education (Special Issue), 2: 49-54.

Irfanullah H.M. (2009): Floating gardening in Bangladesh: Already affected by climate variability? In: Biodiversity conservation and response to climate variability at community level, (IUCN, UNEP, UNU, Dhaka, Bangladesh), 7-14.

Kurosaki T. (1997): Production risk and advantages of mixed farming in the Pakistan Punjab. The Developing Economies, 35(1): 28-47.

Leihner D.E., Ruppenthal M., Hilger T.H., and Castillo J.A. (1996): Soil conservation effectiveness and crop productivity of forage legume intercropping, contour grass barriers and contour ridging in cassava on Andean hillsides. *Experimental Agriculture, 32(3): 327–338.*

Lusembo P., Ebong E., and Sabiiti E.N. (1998): Integration of cassava tuber and forage legume seed production for sustained soil fertility. *Tropical Agriculture (Trinidad and Tobago),* 75(1), 18-20.

Obiagwu C.J. (1995): Estimated yield and nutrient contributions of legume cover crops intercropped with yam, cassava, and maize in the Benue River Basins of Nigeria. *Journal of Plant Nutrition,* 18(12): 2775-2782.

Odurukwe S.O., Ikeorgu J.E.G. (1994): Effects of fertilizer and time of introduction of cassava in yam/maize/cassava intercrop on component yield. *Acta Horticulturae,* 380, 72–77.

Olasantan F.O., Lucas E.O., Ezumah H.C. (1994): Effects of intercropping and fertilizer application on weed control and performance of cassava and maize. *Field Crops Research,* 39: 63–69.

Picasso V.D., Brummer E.C., Liebman M., Dixon P.M. and Wilsey B.J. (2008): Crop species diversity affects productivity and weed suppression in perennial polycultures under two management strategies. *Crop Science,* 48(1):331-342.

Rathore V. (2014): Economic viability of different cropping systems prevailing in indoor district of Madhya Pradesh (Doctoral dissertation, RVSKVV, Gwalior (MP).

Unamma R.P.A., Ene L.S.O. (1984): Weed interference in cassava–maize intercrop in the rain forest of Nigeria. In: TerryE.R.et al. (Eds.), Tropical root crops: Production and uses in Africa. International Development Research Centre, Ottawa, Canada.

Vandermeer, J.H. (1992): The ecology of intercropping. Cambridge University Press.

Weerarathne L.V.Y., Marambe B. and Chauhan B.S. (2017): Does intercropping play a role in alleviating weeds in cassava as a non-chemical tool of weed management? – A review. *Crop Protection,* 95: 81-88.

Zuofa K., Tariah N.M., Isirimah N.O. (1992): Effects of groundnut, cowpea and melon on weed control and yields of intercropped cassava and maize. Field *Crops Research,* 28(4): 309–314.