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DEVELOPMENT OF VEGETABLE BASED CROPPING PATTERN IN CUMILLA REGION

S.K. Bhowal[1*], M.H. Hossain[2], M.M. Bashir[3] and A.S.M.M.R. Khan[4]

[1]Scientific Officer, [2] Principal Scientific Officer, [3]Senior Scientific Officer, OFRD, BARI, Cumilla, Bangladesh
[4]Chief Scientific Officer, OFRD, BARI, Gazipur, Bangladesh
*Correspondng E-mail: shamal.bau@gmail.com

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Abstracts

A field experiment was conducted at MLT site, Chandina under on-farm research division (OFRD), Bangladesh Agricultural Research Institute, Cumilla during 2015-16 and 2016-17 to study an economically profitable vegetable based cropping pattern in Cumilla region for increasing cropping intensity and productivity as well as to meet the vegetable demand for farm family as well as the country. The studied vegetable based cropping patterns were CP_1: Red amaranth-Potato-Coriander-Indian Spinach-Ladies finger-Cauliflower and CP_2: Red amaranth-Potato-Indian spinach-Ladies finger-Coriander-Red amaranth, respectively. The results showed that six vegetable crops could be grown successfully one after another in a sequence in the farmer's field instead of two or three crops based pattern in a piece of land. From the research results it was revealed that the highest Potato equivalent yield (PEY) 226.66 t ha^{-1} was obtained from cropping pattern CP_1: Red amaranth-Potato-Coriander-Indian Spinach-Ladies finger-Cauliflower where the lower PEY (171.38 t ha^{-1}) in CP_2: Red amaranth-Potato-Indian spinach-Ladies finger-Coriander-Red amaranth cropping pattern. From the economic analysis, it was observed that the highest gross return Tk. 22,66,600 ha^{-1} was obtained from cropping pattern CP_1: Red amaranth-Potato-Coriander-Indian Spinach-Ladies finger-Cauliflower which leads to the highest gross margin (Tk. 18,94,542 ha^{-1}) as well as the highest BCR (6.09) from that cropping pattern compared to CP_2.

Introduction

Crop diversification is the growing of different species of crops in a farm or area or region or nation either in succession or simultaneously or both together in the course of the year. While crop intensification is the growing of crop with intensive care and management by utilizing modern technique and technology to maximize production in a unit of land with the accommodation of more number of crops per year. Horticulture, is the largest single sub-sector of the economy, accounting for about 13 percent of the country's (Government of Bangladesh, 2006). Several studies have pointed out that there is considerable potential for growing horticultural crops in Bangladesh (FAO, 1997; Bouis, 2000). Farmers who are engaged in the production of vegetables often earn higher incomes than those engaged in the production of cereal crops alone (Weinberger and Lumpkin, 2005). Vegetables like eggplant, radish, cabbage, cauliflower, and pumpkin gave returns at least three times higher than rice (Ateng, 1998). In addition, the economic returns in terms of domestic resource cost at export parity also indicate that there is a comparative advantage in the production of vegetables in Bangladesh (Shahabuddin and Dorosh, 2002). Therefore, the natural and comparative advantages of Bangladesh create promising opportunities for the

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sector (ADB, 2004). Vegetables are a very popular crop and grown all over Bangladesh which supply enormous nutrient for us. Farmers of the Cumilla, specially Sayadpur, Nimsar, Korpai and Chandina areas grow 3-5 vegetables whole the year haphazardly. Most of the farmers grow hybrid vegetable varieties in their field due to the high yielding potentiality and seeds availability in the local market. The Coverage of Vegetable-Vegetable-T. Aman cropping Pattern in Cumilla district is 6300 ha (DAE, 2017). So, the present study was carried out to establish and selection of suitable vegetable based cropping pattern in Cumilla region of Bangladesh.

Materials and Methods

The vegetable based intensive cropping pattern study was conducted during 2015-16 and 2016-17 at the farmers' field of Nimsar and Sayadpur at MLT Site of Chandina, Cumilla under AEZ 19 to study an economically profitable vegetable based cropping pattern in Cumilla region for increasing cropping intensity and productivity as well as to meet the vegetable demand for farm family whole the year round. The experiment was laid out in a randomized complete block design with three dispersed replications. There were two vegetable based cropping patterns i.e., CP_1: Red amaranth-Potato-Coriander-Indian Spinach-Ladies finger-Cauliflower and CP_2: Red amaranth-Potato-Indian spinach-Ladies finger-Coriander-Red amaranth. The unit plot size was 02 decimal. Red amaranth was the first crop of both the crop sequences. Average weather data (2015-17) of Cumilla district was presented in Figure 1. The soil sample collection and analysis before and after the cropping pattern are presented in the Table 1. Fertilizer management and other intercultural operations were done according to Azad *et al.* (2017) and Fertilizer Recommendation Guide (2012). The details of the crop management for the cropping patterns have been presented in the Table 2. Plant protection measures were taken when required. Intercultural operations were done as and when necessary. Data on yield of the all crops were recorded carefully. The gross economic return was calculated on the basis of prevailing market price of the commodities.

Potato Equivalent Yield (PEY) = [Vegetable yield (kg) x Vegetable price (Tk. kg^{-1})] / Price of Potato (Tk. kg^{-1}) was also calculated.

Table 1. Initial and final soil properties of the farmer's field at MLT site Chandina, Cumilla during 2015-16 and 2016-17

Soil Properties	Land type	pH	Organic matter (%)	K	Total N (%)	P	Zn	B
				Meq100 ml^{-1}		μgml^{-1}		
Initial	MHL	5.4	1.85	0.14	0.14	10.5	1.78	0.20
Final	MHL	5.3	1.89	0.16	0.15	10.9	1.76	0.21
Critical Level	-	-	-	0.12	0.12	8. 0	0.6	0.20

Source: SRDI, Regional Laboratory, Cumilla

Vegetable Based Croping Pattern

Table 2. Crop Management practices in the experimental plot under different cropping patterns at Cumilla during 2015-16 & 2016-17

Parameters	Cropping Pattern (CP_1)					
Crop	Red amaranth	Potato	Coriander	Indian Spinach	Ladies finger	Cauliflower
Variety	BARI Lalshak-1	BARI Alu-46	BARI Dhonia-2	BARI Puishak-1	BARI Dherosh-2	Meradona
Planting date	22-24, Oct.	25-27, Nov.	20-22, Feb.	02-05, April	29-30, May	15-18, August
Spacing (cm)	Broadcasting	60 cm x 20 cm	Broadcasting	Broadcasting	50 cm x 40 cm	60 cm x 40 cm
Fertilizer dose (N-P-K-S-Zn-B kg ha^{-1})	25-7-12-3-1-0.5	47-12-80-7-1.5-1	27-15-18-6-0.8-0.5	37-15-22-5-0.5-0.5	42-19-22-7-0.8-0.5	48-25-38-10-1-0.5
Field duration	18-20	77-80	32-34	45-50	45-65	61-65
Turn around time	1	12-13	3	5-7	1	7
Harvesting date	12-15 Nov.	15-17 Feb.	25-27 March	20-28 May	15 July-10 August	18-22 Oct.
Parameters	Cropping Pattern (CP_2)					
Crop	Red amaranth	Potato	Indian Spinach	Ladies finger	Coriander	Red amaranth
Variety	BARI Lalshak-1	BARI Alu-46	BARI Puishak-1	BARI Dherosh-2	BARI Dhonia-2	BARI Lalshak-1
Planting date	22-24 Oct.	25-27 Nov.	20-21 Feb.	8-10 April	18-20 July	5-7 Sep.
Spacing (cm)	Broadcasting	60 cm x20 cm	Broadcasting	50 cm x40 cm	Broadcasting	Broadcasting
Fertilizer dose (N-P-K-S-Zn-B kg ha^{-1})	25-7-12-3-1-0.5	47-12-80-7-1.5-1	37-15-22-5-0.5-0.5	42-19-22-7-0.8-0.5	27-15-18-6-0.8-0.5	25-7-12-3-1-0.5
Field duration (days)	19	77-80	40-46	56-86	30-40	20-22
Turn around time	23	12-13	2-3	1	1	5
Harvesting date	10-12 Nov.	15-17 Feb.	3-8 April.	05 June-18 July.	20-30 August	27-29 Sep.

Planting/transplanting and harvesting dates are the ranges of 2 years (2015-16 & 2016-17)

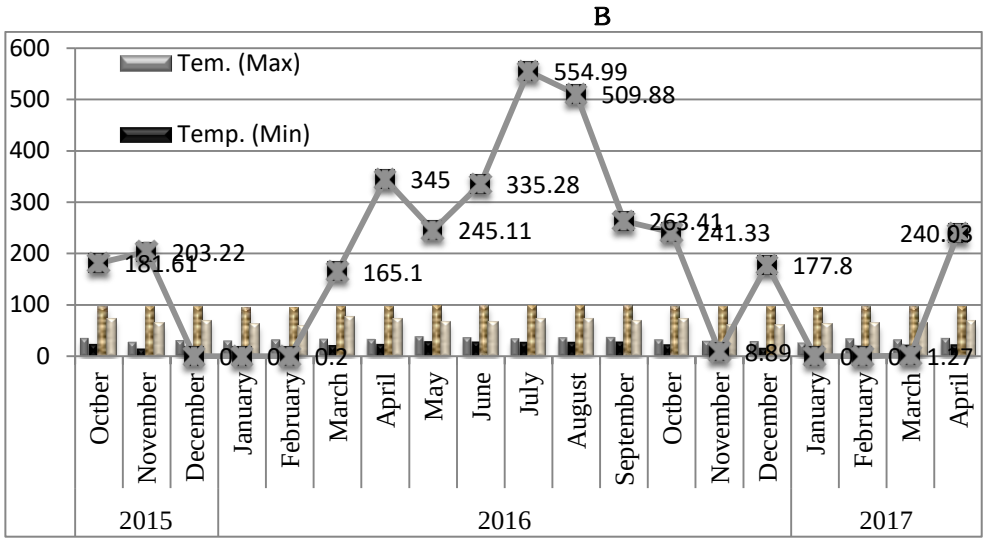

Fig. 1. Average monthly weather data of Cumilla region (October, 2015 to April, 2017)

Source: Meteorological department, Regional station, BRRI, Cumilla

Results and Discussion

Yield of Vegetables

Average yield and economic performance of vegetable based cropping pattern during 2015-16 and 2016-17 are presented in Table 3 and 4. From the result, it was observed that the average vegetable yield of Red amaranth-Potato-Coriander-Indian Spinach-Ladies finger-Cauliflower cropping pattern were recorded as 10.74, 35.7, 4.4, 30.99, 16.55 and 20.13 t ha^{-1}, respectively where another pattern (Red amaranth-Potato-Indian spinach-Ladies finger-Coriander-Red amaranth) produced yield of 10.37, 39.52, 33.95, 15.85, 4.2 and 10.42 t ha^{-1}, respectively.

Potato Equivalent Yield

Total productivity of different cropping sequences was determined by Rice Equivalent Yield (REY) due to rice based cropping pattern but in this study cropping patterns are vegetable based cropping patterns which were calculated from the yield of component crops. Total productivity of studied cropping patterns was calculated by Potato equivalent yield (PEY) which was different under different cropping sequences. From the two years result of vegetable based cropping pattern, it was found that the average highest PEY (226.66 t ha^{-1}) was recorded from the cropping sequence of Red amaranth-Potato-Coriander-Indian Spinach-Ladies finger-Cauliflower and lowest (171.38 t ha^{-1}) was found from the cropping sequence of Red amaranth-Potato-Indian spinach-Ladies finger-Coriander-Red amaranth. Potato equivalent yield (PEY) in CP_1 was almost 32 % higher than the cropping pattern CP_2 due to the inclusion of high value summer vegetable (Cauliflower). Research findings of Mandal *et al.* (2014) and Mandal *et al.* (2015) closely related to the present study & also stated that inclusion of one oil crop or tuber crop in three or four crops based cropping pattern sharply increase the Potato equivalent yield or Rice equivalent yield of cropping pattern.

Soil Fertility Amendment

Vegetable Based Croping Pattern

In both the vegetable based cropping patterns soil organic matter, available P, B and exchangeable K increased after two year cycles (Table 1). Total N also increased to some extent. After completion of six vegetables in two cropping pattern, it was observed that all the parameters increased with some exceptions. Due to intensive cropping, substantial amount of well decomposed cowdung was applied before every vegetable in both the patterns. Residues of some crops or vegetables such as potato, cauliflower, Indian spinach etc. were also incorporated in the soil. For these reasons there were no depletion of soil nutrients in the subsequent years but more or less some soil organic matter and nutrients increased (Table 1). Therefore, soil fertility can be maintained by proper fertilizer management in intensive crop cultivation. Furthermore, adequate intercultural operations, soil amendment and soil treatment along with proper fertilizer management produced higher crop yield. From the above results, it can be suggested that intensive vegetables based cropping patterns, which include potato, are suitable for rich farmers. Growing of six vegetables in a year in a land and inclusion of summer cauliflower into the fallow period in a cropping pattern (CP_1) could increase the cropping intensity and productivity. Hossain *et al.* (2014) and Hossain *et al.* (2017) also reported the soil fertility management in four crops based cropping pattern or intensive cropping that supports the vegetable based cropping pattern.

Economic Analysis

Economic analysis was done on the basis of prevailing market price of the commodities. Economics of system productivity of vegetable based cropping sequences showed in Figure 2. It was revealed that the gross return varies from one cropping pattern to another cropping pattern due to inclusion of high value vegetable crop. Higher gross return (Tk. 2266600.00 ha^{-1}) and gross margin (Tk. 1894542.00 ha^{-1}) were obtained in Red amaranth-Potato-Coriander-Indian Spinach-Ladies finger-Cauliflower cropping pattern and comparatively lower gross return (Tk. 1713800.00 ha^{-1}) and gross margin (Tk. 1387043.00 ha^{-1}) was found in Red amaranth-Potato-Indian spinach-Ladies finger-Coriander-Red amaranth cropping pattern. Higher total cultivation cost (Tk. 372057 ha^{-1}) was recorded from cropping sequence CP_1 due to the inclusion of Summer Cauliflower where the lower (Tk. 326757 ha^{-1}) was obtained from the cropping sequence CP_2. The higher MBCR (6.09) was calculated in improved CP_1 (Red amaranth-Potato-Coriander-Indian Spinach-Ladies finger-Cauliflower)cropping pattern compared to cropping pattern CP_2: Red amaranth-Potato-Indian spinach-Ladies finger-Coriander-Red amaranth (5.24). Hossain *et al.,* also reported that four crop based cropping pattern Potato-Boro-T. Aus-T.Aman is agronomically feasible and economically profitable compared to existing farmers cropping pattern Potato-Boro-Fallow-T. Aman.

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Table 3. Average yield of Red amaranth-Potato-Coriander-Indian Spinach-Ladies finger-Cauliflower and Red amaranth-Potato-Indian spinach-Ladies finger-Coriander-Red amaranth cropping patterns and PEY at MLT site Chandina under Cumilla district during 2015-16 & 2016-17

Cropping Patterns	Yield (t ha^{-1})						Potato Equivalent Yield (PEY)
CP_1	Red amaranth	Potato	Coriander	Indian Spinach	Ladies finger	Cauliflower	226.66
	10.74	35.7	4.4	30.99	16.55	20.13	
CP_2	Red amaranth	Potato	Indian spinach	Ladies finger	Coriander	Red amaranth	171.38
	10.37	39.52	33.95	15.85	4.2	10.42	

CP_1: Red amaranth-Potato-Coriander-Indian Spinach-Ladies finger-Cauliflower, CP_2: Red amaranth-Potato-Indian spinach-Ladies finger-Coriander-Red amaranth, Unit price/Kg: Red amaranth Tk. 16, Potato Tk. 10, Coriander Tk. 20, Indian spinach Tk. 14, Ladies finger Tk.22, summer cauliflower Tk. 50

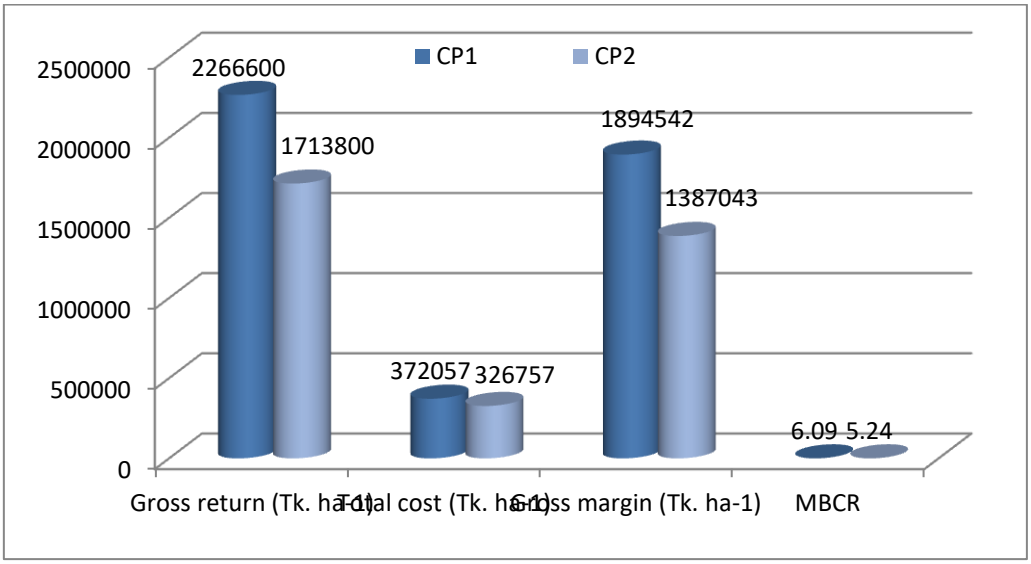

Fig. 2. Economic performances of vegetable based cropping patterns at MLT site Chandina under Cumilla district (2015-16 & 2016-17).

Farmers' opinion

Farmers opined that six vegetable crops could be grown successfully in the same field in a year but sometimes they are not more benefited from vegetables due to increased labor cost at pick period and lower market price in a wholesale market.

Conclusion

From the two years study on the vegetable based cropping pattern, it could be concluded that six vegetable crops based cropping pattern such as Red amaranth-Potato-Coriander-Indian Spinach-Ladies finger-Cauliflower and Red amaranth-Potato-Indian spinach-Ladies finger-Coriander-Red amaranth are agronomically feasible and economically profitable cropping pattern in Cumilla region. Due to intensive growing of six vegetable crops in a year in the same piece of land cropping

intensity and productivity were sharply increased. More employment opportunity for male and female labors is generated at the same time due to the increased production of seasonal and off season vegetables. The food and nutritional security is ensured for the farmers and the nation as a whole.

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