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COMPARATIVE PROFITABILITY OF DOMINANT CROP ROTATION IN SOME SELECTED AREAS OF BHOLA DISTRICTS IN BANGLADESH

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ABSTRACT

Three villages namely Southcharpata of sadar upazilla, Togbi of Borhanuddin upazilla and Maddajoynagar of Daulatkhan upazilla of Bhola districts were purposively selected for this survey. A focus group discussion was conducted in each village by using a brief cheek list and structure schedule for collecting necessary data. Survey was conducted during 31/07/07 to 02/08/07. A group of farmers like land owner, share cropper and laborer were included in each focus group discussion. Proportion of area coverage by the chilli and wheat was comparatively low whereas these two crops are comparatively more profitable than that of other Rabi crops. Findings of all three villages indicated that the gross return and gross margin of any cropping pattern could be increased substantially with the inclusion of chilli or wheat into the existing rice based dominant cropping patterns of the farmers. It is due to the comparatively good yield potentiality and good market price of chilli and wheat than that of other Rabi crops.

Key words*: Chilli, crop rotation, dominant crops, profitability, wheat, rice*

INTRODUCTION

Consumption of wheat is around 4 million tonnes per annum in Bangladesh. It is increasing at 3% per annum, whereas production is now under 2 million tonnes and is decreasing over the years. The situation has created serious concerns for food security and for diminishing foreign currency reserves. Agricultural land is mainly extensively farmed in the country but an estimated 800,000 ha of land in southern Bangladesh that could have potential for production of wheat and other crops remains uncultivated during the dry (*rabi*) season. This is because of irrigation resources are very limited due to the general unsuitability of the area for deep and shallowtube wells. Other constraints have added to the perception that the area is too risky for wheat in a rice-wheat rotation. Sowing of wheat is delayed than optimum planting date because of long duration T. Aman rice, soil suitability for seeding seed become late for monsoon rain and land preparation takes more time with bullock-drawn plough. Furthermore, this area is hotter with a shorter winter (average 3ºC) than the northern districts and soil salinity decrease potentiality of wheat in the costal areas (Carberry et al., 2006).

Assuming 400,000 ha of fallow land is available for *rabi* cropping season and the yield is around 2.5 t/ha. These southern zones have the potential to produce 1 million tonnes of wheat annually and it could have positive impact on the national deficit. Assuming a conservative adoption rate of 10 % within 5 years of project completion equates to an annual benefit of approximately Tk 1.4 billion ($ A28 million). The consequences of bringing high levels of agricultural production to an area that

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normally remains largely fallow for six months of the year will flow on to increase activity and wealth for the region. Farmers will able to double their income from a very low support on modern technology. They currently depend primarily on one rice crop per year to provide income for their families from farms that are not sufficient (commonly less than 1 ha) (Rawson et al., 2006).

The coastal districts of the current southern lands of Bangladesh have been created by siltation, particularly over the last 70 years. The land growth is still occurring (Rawson et al., 2006). They began as very saline mud flats but as the years have passed and they have been leached annually by monsoonal rains, they have become progressively less saline and more suitable for cropping. During the *rabi* season they are cropped with *T aman* or *T aus* rice, irrigated by the fresh waters of the monsoon, but in the *rabi* season the salt rises as the land dries and crusts the surface, seemingly making it unsuited to productive cropping. Historically it may have been wise for farmers to leave the land fallow during *rabi* season because of salt, but that situation is changing due to the annual leaching process (Rawson et al., 2006).

Sustainability of rice-wheat systems is now a major concern for researchers (Ahmed, 1996). Neoclassical theory posits that producers are profit-maximizes who take decisions based on expected profitability. Generally, while making production decisions, the farmers consider returns against expected cost. Sometimes it is mentioned that the yield they receive does not cover the cost of production. A number of new cropping pattern are being practiced by the farmers, it is very much important to identify the profitability of dominant cropping patterns for under varying farming situations for selecting best suitable option. Furthermore, the rate of expansion of any pattern depends on yield and profit potentiality of the cropping systems. Mandal, M. A. S., (1986) conducted a study on An Economic Analysis of Design Versus Farmers Cropping Patterns in Two Villages in Mymensingh' and found that Yields of crops grown under alternate improve pattern with improve management were significantly higher than the yields of the same crops under farmers' management in existing pattern. Farming System Research and Development Programme (FSRDP), 1987 carried out a research work at Kazirshimla of Mymensingh district. The researcher monitored the cropping pattern in the FSRDP area. It was found that the farmers were continuously changing cropping pattern keeping aman rice constant. However, they were changing the varieties of aman rice. Farmers considered aman rice as the main crop, which faces relatively less natural hazard and uncertainty. Rashid, H., (1994) conducted a research on 'An Economic Study of Farmers Growing Crops with Potato and Without ptato in Selected Area of Dinajpur' and found that the cropping patterns with potato generated higher net income than those without potato patterns Wheat – Purbachi – BR_{11} and Wheat–Purbachi–Pajam. Hossain (1996) conducted a study on relative profitability of alternative cropping patterns in two villages Telehara and Dakshimbhag under Kotwali Thana of Bogra district. He found that farmers in the study area followed 5 cropping patterns, which were basically rice based. He also found that the return over cash cost as well as gross margin of the cropping pattern Potato - HYV Boro - T. Aman were the highest. Baksh. E (2004) did a research on Economic Efficiency and Sustainability of Wheat Production in Wheat Based Cropping Systems in North-West Bangladesh and found that among the selected wheat and Boro-based cropping patterns, farmers received the highest gross margin (Tk. 32,294/ha) as well as net return (Tk. 21,999/ha) from the cropping pattern T. Aman-Wheat-Jute both in Dinajpur and Rangpur. However study on profitability of dominant cropping patterns adopted in the southern costal areas of Bangladesh is scarce. The present study gives detailed information about these aspects on the costal districts of Bhola. Realizing the importance of the above goal, the research was formulated with following specific objectives:

i. to identify the major cropping pattern;
ii. to explore the agronomy of those cropping pattern and
iii. to determine the economic viability of wheat and other major Rabi crops in the study area

MATERIALS AND METHODS

Three villages namely Southcharpata of sadar upazilla, Togbi of Borhanuddin upazilla and Maddajoynagar of Daulatkhan upazilla were purposively selected for this survey. A focus group discussion was conducted in each village by using a brief cheek list and structure schedule for collecting necessary data. Survey was conducted during 31/07/07 to 02/08/07. The researcher himself collected the data from the selected farmers. A group of farmers like land owner, share cropper and laborer were included in each focus group discussion. Farmers were interviewed on agronomy of different crops like sowing, harvesting time, variety used, practiced cropping pattern and area coverage by each cropping pattern in the villages. Farmers were asked on average rate of input use for producing selected crops, yield of each crop, per unit purchase and selling prices of relevant input and output. The main difficulty to collect data in the context of Bangladesh is that the investigator has to relay upon the memory of the farmers (Kabir, 1999). To deal with the problem, all possible efforts were made by the researcher to ensure the collection of reasonably accurate data from the farmers.

RESULTS AND DISCUSSIONS

Prevailing cropping patterns

Most widely adapted cropping pattern of Southcharpata village were, Boro rice-Fallow-T.Aman rice (18%), Boro rice-T.Aus rice-T.Aman rice (18%), Wheat-D.Aus rice-T. Aman rice (12%), Grass pea-D.Aus rice-T.Aman rice(12%), Mustard-D.Aus rice-T.Aman rice (9%), Chilli-Fallow/T&D-T.Aman rice (8%), etc.

Significant cultivated area of Togbi village was practiced by patterns Boro rice-Fallow-T.Aman rice (44%), Mungbean-D.Aus rice/Fallow- T.Aman rice (17%), Chilli- Fallow/D &T.Aus rice-T.Aman rice (13%), Grass pea -D.Aus rice- T.Aman rice (6), Groundnut-D.Aus rice-T.Aman rice (3%) and Wheat-D.Aus rice- T.Aman rice (2%).

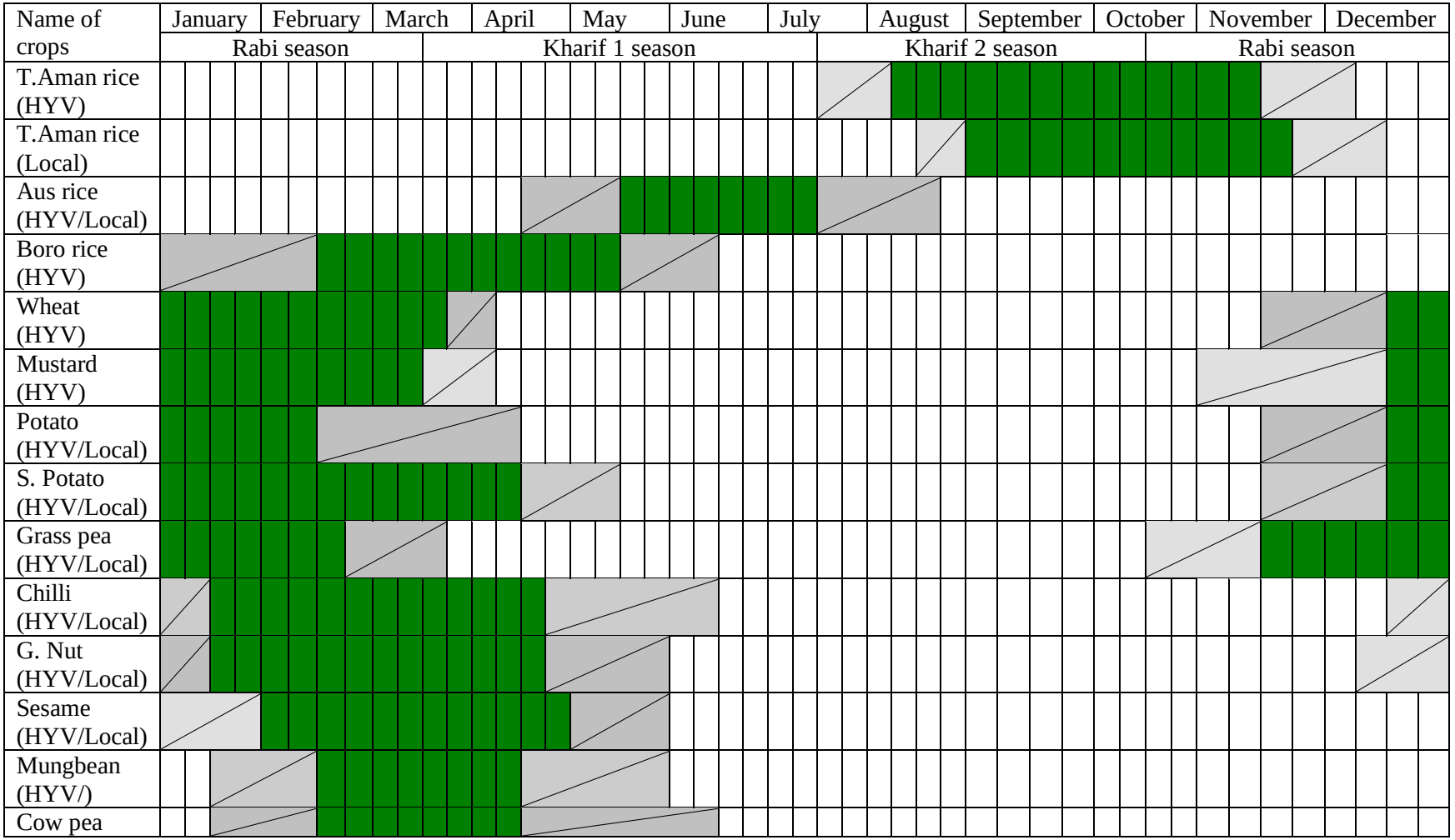
Among of the prevailing cropping patterns at Maddajoynagar village, bulk share of area was adopted by cropping patterns like Grass pea- D. Aus rice-T.Aman rice (14%), Mungbean-D. Aus rice- T.Aman rice (13%), Chilli-T.Aus rice-T.Aman (13%), Cowpea-D.Aus rice-T.Aman rice (12%), Groundnut-T.Aus rice-T.Aman rice (12%), Sweet potato-D.Aus rice-T.Aman rice (11%) and wheat-D.Aus rice-T.Aman rice (7%).

It was observed from the findings that farmers were cultivated rice in both Kharif 1 and Kharif 2 seasons and results indicated that there was no significant difference in the prevailing Rabi crops in the survey villages. But Boro rice was not cultivated in Maddajoynagar village. It is needed to be identified the major causes of adaptation of different Rabi crops in each village.

Sowing and harvesting time of crops

Time of sowing is an important factor for getting good yield from Rabi crops (Kabir 2002). It was found from the following crop calendar that some farmers of the villages were shown and transplanted within optimum time and some were shown and transplanted in late of their Kharif 1 and Kharif 2 crops. It was observed from the crop calendar that most of farmers could not show and transplant their Rabi crops within optimum time. There were differences in sowing/transplanting and harvesting time of crops among the survey villagers. Farmers were mentioned that sometimes they were delay to transplant T.Aman rice due to late maturity of Aus rice, drought and flood at transplanting time. They also mentioned that due to late maturity of T.Aman rice and late Zo (proper moisture in soil for seed germination) are the main causes of late sowing of Rabi crops.

Table 1. Crop Calendar of Southcharpata village



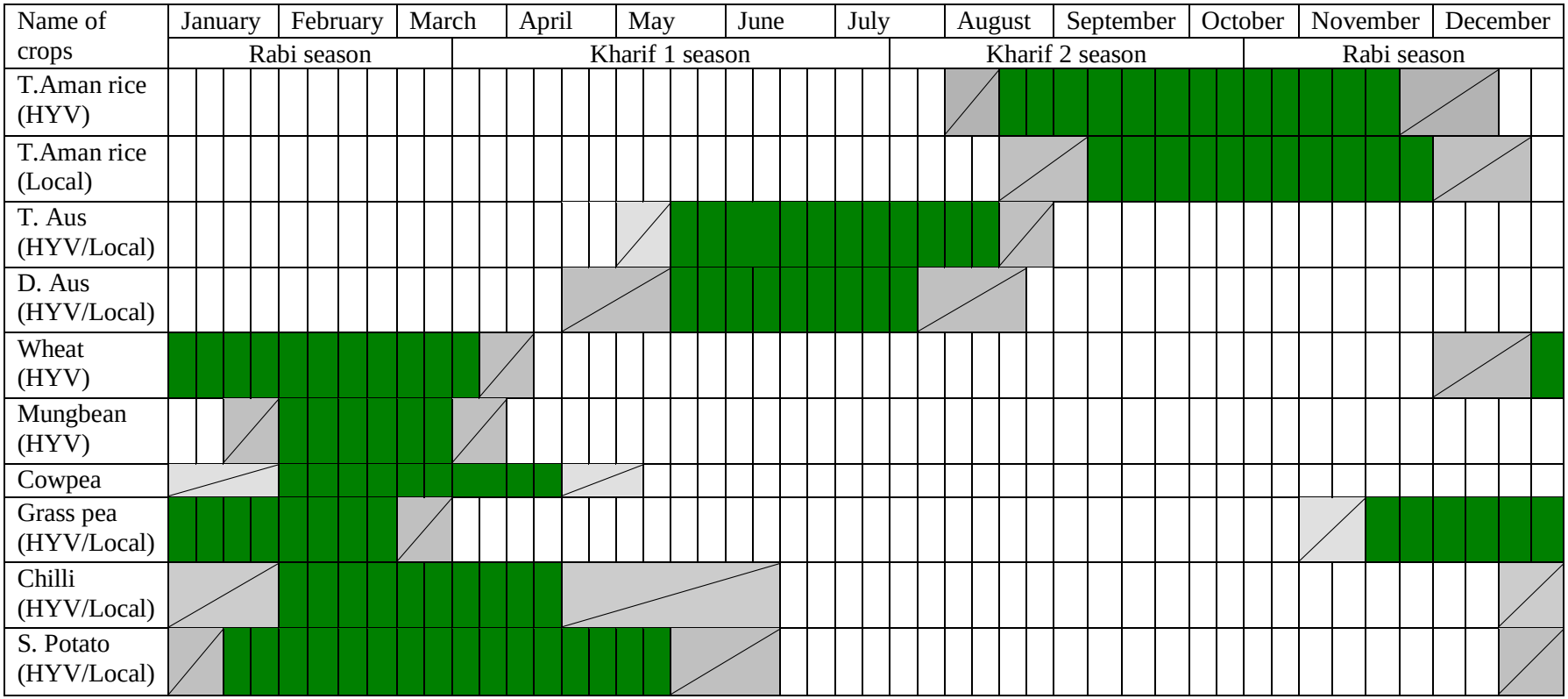
Source: Survey, 2007

Table 2. Crop Calendar of Togbi village

Name of crops	January	February	March	April	May	June	July	August	September	October	November	December
	Rabi season			Kharif 1 season				Kharif 2 season			Rabi season	
T.Aman rice (HYV)												
T.Aman rice (Local)												
T. Aus rice (HYV/Local)												
D. Aus (HYV/Local)												
Boro rice (HYV)												
Wheat (HYV)												
Mustard (HYV)												
Potato (HYV/Local)												
Grass pea (HYV/Local)												
Chilli (HYV/Local)												
G. Nut (HYV/Local)												
Mungbean (HYV/)												

Source: Survey, 2007

Table 3. Crop Calendar of Maddajoynagar village



Source: Survey, 2007

Costs and Returns of dominant crops in the survey villages

Estimating cost is exclusively necessary for enterprise costs and subsequently determining the viability of the enterprise from the view of farm families because it influences the decision making process of the producers. For determining costs and returns, enterprise budgeting technique was followed. On the basis of gross margin analysis, the relative profitability of wheat and other major Rabi crops were calculated. Reason to choose this analysis is that the farmers of Bangladesh are very eager to know their return over their variable cost (Kabir 1999).

For estimating the total variable cost of producing each crop included costs of human labor, plowing, seed, fertilizer, irrigation and insecticide etc. For purchased inputs actual cost paid was considered. But for the home supplied inputs, like family labor, seed etc cost was calculated by applying the principle of opportunity cost. Per hectare gross return was determined by multiplying the farmers received output of each crops with their respective market price. Limitation of determining gross return was that it did not consider return received from by product like straw of rice and wheat etc because farmers do not sale straw.

Gross return was calculated by using the following formula: $GR=Y_i \text{ X } P_i$

GR=Gross Return, Y_i=Total quantity of output (kg), P_i =Per unit price (Tk/kg)

Details average rate of input use, yield, cost and return was presented in Table 1, 2 and 3 and Figure 1, 2 and 3. Item wise cost and return was briefly discussed as follows:

Human labor cost

Human labor was the most important and largely used input for producing crops in Bangladesh. It is due to that most of the intercultural operation of crop cultivation was done by manually (Kabir 1999). Labor was required for different operation such as land preparation, seed sowing, transplanting, weeding, fertilizer application, harvesting, carrying, threshing and drying etc. There was variation in rate of labor used among different group of farmers even for producing same crops. Average rate of labor used for different operation was considered for estimating labor cost. Farmers used hired and family labor for different inter cultural operations of crops. Both hired and family labor cost was considered for estimating labor cost. In case of family labor, opportunity cost of labor was considered. There was a difference in wage rate between male and female labor but for this report average wage rate of male labor in the survey area was considered because female labour were hired for harvesting pulses, chillies, sometimes for weeding Rabi crops and paid as kinds.

In Southcharpata village, the highest number of human labor was used for producing chilli which was 131 man-days/ha and respective cost was Tk. 15720/ha followed by Boro rice (120 man-days/ha and Tk. 14400/ha), wheat (106 man-days/ha and Tk.12720/ha), Aus rice (107 man-days/ha and Tk.12840/ha), T.Aman rice (104 man-days/ha and Tk.12480/ha), mustard (40 man-days/ha and Tk.4800/ha) and grass pea (24 man-days/ha and Tk. 2880/ha) (Table 1).

In Togbi village, highest number of human labor was used for producing chilli which was 125 man-days/ha and respective cost was Tk. 15000/ha followed by Boro rice (117 man-days/ha and Tk. 14040/ha), wheat (108 man-days/ha and Tk.12960/ha), Aus rice (106 man-days/ha and Tk.12720/ha), T.aman rice (102 man-days/ha and Tk.12240/ha), mungbean (88 man-days/ha and Tk.10560/ha), groundnut (78 man-days/ha and Tk.9360/ha) and grass pea (31 man-days/ha and Tk. 3720/ha) (Table 2).

In Maddajoynagar village, highest number of human labor was used for producing chilli which was 130 man-days/ha and respective cost was Tk. 15600/ha followed by Aus rice (105 man-days/ha and Tk. 12600/ha), wheat (104 man-days/ha and Tk.12480/ha), T. Aman rice (101 man-days/ha and Tk.12120/ha), mungbean (82 man-days/ha and Tk.9840/ha), cowpea (41 man-days/ha and Tk.4920/ha) and grass pea (33 man-days/ha and Tk. 3960/ha) (Table 3).

Findings of the report point out that chilli, Boro rice and wheat were comparatively labor intensive than other Rabi crops. For getting clear conception on labor employment in different Rabi crops further details survey of farmers and laborer is essential. It is needed to find out that whether there is any yield variation or not in Rabi crop on labor employment.

Ploughing Cost

Animal power and power tiller both were used for land preparation in the survey villages. Power tiller was mainly used for land preparation by all most all the farmers. Animal power was usually used for final pass of plough or leveling purpose. Since cost of tillage of power tiller and animal power is about to same so that all groups of farmers have special preference to power tiller. It may be due to power tiller is available, save time for land preparation and reduce turn around time between two consecutive crops. There was variation in number of plough among the Rabi crops and different group of farmers. Average number of plough for each crop and rental charge of power tiller was considered for estimating tillage cost. In Southcharpata village per hectare costs of tillage for T.Aman rice, Aus rice, Boro rice, chilli, wheat, and mustard grass pea were Tk.2409/ha, Tk.3212/ha,Tk.2409/ha, Tk.3212/ha, Tk.3212/ha, Tk.2409/ha, Tk.0 /ha, respectively (Table 1). In Togbi village per hectare costs of tillage for T.Aman rice, Aus rice, Boro rice, chilli, mungbean, grass pea, groundnut and wheat were Tk.2409/ha, Tk.2409/ha, Tk.2409/ha, Tk.3212/ha, Tk.3212/ha, Tk.0/ha, Tk.2409/ha, Tk.3212/ha, respectively (Table 2). In Moddajoynagar village per hectare costs of tillage for T.Aman rice, Aus rice, grass pea, mungbean, chilli, wheat, and cowpea were Tk.2409/ha, Tk.2409/ha, Tk.0/ha, Tk.2409/ha,Tk.3212/ha, Tk.3212/ha, Tk.2409/ha, respectively (Table 3). Grass pea was shown in T.Aman rice field as relay crops so that no tillage cost was considered for grass pea in survey villages. It is needed to find out that whether there is any yield variation or not with by the number of plough.

Cost of seeds

Farmer used home supplied and purchased seed or seedlings for producing crops. There was variation in seed rate among of the different group of farmers. Average seed rate and market price of seed and seedlings was considered for estimating seed cost. Opportunity cost was considered for home supplied seed. Seedling development cost was not considered in this study. In Southcharpata village per hectare seed costs was highest for wheat cultivation (Tk.4158/ha) followed by Boro rice (Tk.1550/ha), chilli (Tk.1543/ha), grass pea (Tk.1400/ha), T.Aman rice (Tk.1160/ha), Aus rice (Tk.1136/ha) and mustard (Tk.320/ha) (Table 1). In Togbi village per hectare seed costs was highest for groundnut cultivation (Tk.4320/ha) followed by wheat (Tk.3915/ha), chilli (Tk.11843/ha), Boro rice (Tk.1475/ha), mungbean (Tk.1240/ha), Aus rice (Tk.1155/ha), T.Aman rice (Tk.1140/ha) and grass pea (Tk.1080/ha) (Table 2). In Maddajoynagar village per hectare seed costs was highest for wheat cultivation (Tk.3807/ha) followed by chilli (Tk.1721/ha), cowpea (Tk.11380/ha), mungbean (Tk.1360/ha), grass pea (Tk.1325/ha), Aus rice (Tk.1073/ha) and T.Aman rice (Tk.972/ha) (Table 3).

Findings of the report specify that seed cost of wheat and groundnut was comparatively high among of the Rabi crops in all three villages. It indicated that initial investment in wheat and groundnut was high.

Cost of Fertilizer

Fertilizer plays an important role in yield variation of all crops. Timely fertilizer application with recommended dose is very essential for getting good yield from all crops (Kabir 2002). It was observed in exploratory field that there was a wide gap between timely fertilizer application with recommended dose and applied dose of fertilizer for producing crop in the survey villages. Most of the farmers used different type of fertilizer namely urea, TSP, MP, Gypsum for cultivation of crops in the survey villages. There was wide variation in fertilizer dose among different group of farmers even for producing the same crop. Average amount of fertilizer dose used by farmers for producing different

crops and prevailing market price of respective fertilizer was considered for calculating fertilizer cost. In Southcharpata village per hectare fertilizer costs was the highest for producing chilli (Tk.8102/ha) followed by Boro rice (Tk.6786/ha), wheat (Tk.4780/ha), T.Aman rice (Tk.4232/ha), Aus rice (Tk.3359/ha), mustard (Tk.3302/ha) and grass pea (Tk.211/ha) (Table 1). In Togbi village per hectare fertilizer costs was the highest for producing chilli (Tk.7977/ha) followed by Boro rice (Tk.6609/ha), wheat (Tk.3784/ha), T.Aman rice (Tk.3472/ha), groundnut (Tk.3293/ha), Aus rice (Tk.3027/ha), mungbean (Tk.777/ha) and grass pea (Tk.504/ha) (Table 2). In Maddajoynagar village per hectare fertilizer costs was the highest for producing chilli (Tk.5958/ha) followed by T.Aman rice (Tk.3474/ha), Aus rice (Tk.3019/ha), wheat (Tk.2633/ha), mungbean (Tk.763/ha), cowpea (Tk.572/ha), and grass pea (Tk.202/ha) (Table 3).

Findings of the report point out that for producing chilli, Boro rice and wheat farmers are to invest more than that of other Rabi crops. However farmers were spent very minimum amount of money for fertilizer purpose for producing grass pea, mungbean, cowpea etc. It was observed from report that there was a variation in fertilizer application among the villages. It may be due to lack of knowledge on fertilizer dose or insufficient money with farmers for fertilizer purpose.

Table 4. Per hectare cost and return of majors Rabi crops of Southcharpata village of sadar upazilla of Bhola districts

Items	T. Aman rice		Aus rice		Boro rice		Wheat		Grass pea		Mustard		Chilli	
	Qty.	Tk./ ha	Qty.	Tk./h a	Qty.	Tk./ha	Qty.	Tk./ha	Qty.	Tk./ ha	Qty.	Tk./ ha	Qty.	Tk./ha
Plowing (No.)	3	2409	4	3212	3	2409	4	3212	-	-	3	2409	4	3212
Human labor (man-days/ha)	104	12480	107	12840	120	14400	106	12720	24	2880	40	4800	131	15720
Seed/Seedling (kg/ha)	58	1160	71	1136	62	1550	154	4158	56	1400	8	320	-	1543
Fertilizer: Urea (kg/ha)	185	4232 1202	154	3359 1001	247	6786 1606	185	4780 1203	34	211 211	151	3302 982	146	8102 949
TSP (kg/ha)	93	1860	77	1540	154	3080	90	1800	-	-	110	2200	224	4480
MP (kg/ha)	46	736	31	496	77	1232	70	1120	-	-	-	-	108	1728
Gypsum (kg/ha)	62	434	46	322	124	868	77	537	-	-	-	-	135	945
Insecticide	-	771	-	617	-	-	-	-	-	-	-	-		2161
Irrigation	-		-	-	-	7718	-	-	-	-	-	-		1643
Total cost	-	21052	-	21164	-	33789		24750		4491		10711		32381
Yield	2975		2835		4414		2470		659		547		3115	
Gross Return	-	26775	-	24806	-	41993	-	48165	-	14220	-	13675	-	62300
Gross Margin	-	5723	-	3642	-	8204	-	23415	-	9729	-	2964	-	29919

Human Labor @ Tk 120/man-days, Bullock Power and power tiller @ Tk 803/Plough/ha, Manure @ Tk 0.5/kg, Urea @ Tk 6.5/kg, TSP @ Tk 20/kg, MP @ Tk 16/kg, Gypsum Tk @ Tk 7/kg, Zinc @ Tk 120/kg, T.Aman rice @ Tk 9/kg, Aus rice @ Tk 8.75/kg,Boro rice @ Tk 9. 5/kg, Wheat @ Tk 19.5/kg, Grass pea Tk 20/kg, Mustard Tk 25/kg, Chilli Tk 20/kg, T.Aman rice seed @ Tk. 20/kg, Aus rice seed @ Tk. 16/kg,Boro rice seed @ Tk. 25/kg, Wheat seed @ Tk. 27/kg, Grass pea seed @ Tk. 25/kg, Mustard seed @ Tk. 40/kg.

Table 5. Per hectare cost and return of majors Rabi crops of Togbi village of Borhan uddin upazilla of Bhola districts

Items	T.Aman rice		Aus rice		Boro rice		Chilli		Mungbean		Grass pea		Ground nut		Wheat	
	Qty.	Tk./ha	Qty.	Tk./ ha	Qty.	Tk./ ha	Qty.	Tk./ ha	Qty.	Tk./ ha	Qty.	Tk./ ha	Qty.	Tk./ ha	Qty.	Tk./ha
Plowing (No)	3	2409	3	2409	3	2409	4	3212	4	3212			3	2409	4	3212
Human labor (Mandays /ha)	102	12240	106	12720	117	14040	125	15000	88	10560	31	3720	78	9360	108	12960
Seed (kg/ha)	60	1140	77	1155	59	1475	-	1843	31	1240	54	1080	108	4320	145	3915
Fertilizer:	-	3472	-	3027		6609	-	7977		777		504		3293		3748
Urea (kg/ha)	148	962	125	813	235	1528	173	1125	35	227	37	240	30	195	180	1170
TSP (kg/ha)	74	1628	63	1386	136	2992	210	4620	25	550	12	264	86	1892	82	1804
MP (kg/ha)	49	882	46	828	62	1116	124	2232	-	-	-	-	25	450	43	774
Gypsum	-	-	-		139	973	154	1078	-	-	-	-	108	756	-	-
Insecticide	-	673	-	618	-	1080	-	2245	-	798	-	-	-	-	-	-
Irrigation	-		-		-	7410	-	1240	-	-	-	-	-	-	-	-
Total cost	-	19934	-	19929	-	33023	-	32595	-	16587	-	5304	-	19382	-	23835
Yield	2995		2794		4786	-	3242	-	679		710		1420	-	2099	
Gross return	-	26206	-	23749	-	44271	-	64840	-	23795	-	11360	-	25560	-	40931
Gross Margin	-	6272	-	3820	-	11248	-	32245	-	7178	-	6056	-	6178	-	17096

Human Labor @ Tk 120/man-days, Bullock Power and power tiller @ Tk 803/Plough/ha, Urea @ Tk 6.5/kg, TSP @ Tk 22/kg, MP @ Tk 18/kg, Gypsum Tk @ Tk 7/kg, Zinc @ Tk 80/kg, T.Aman rice @ Tk 8. 75/kg, Aus rice @ Tk 8.5/kg, Boro rice @ Tk 9. 25/kg, Wheat Tk 19.5/kg, Grass pea Tk 20/kg, Mungbean Tk 35/kg, Chilli Tk 20/kg, T.Aman rice seed @ Tk. 19/kg, Aus rice seed @ Tk. 15/kg, Boro rice seed @ Tk. 25/kg, Wheat seed @ Tk. 27/kg, Grass pea seed @ Tk. 25/kg, Mungbean seed @ Tk. 40/kg.

Cost of Irrigation

Supplementary irrigation is very essential for getting desired yield from Rabi crops. It was observed in survey villages that there was scarcity of irrigation sources. Farmers were applied irrigation for producing Boro rice and chilli. Farmers of Maddajoynagar did not grow Boro rice due to the lack of irrigation facilities. In the Southcharpata village farmers used irrigation for crops like Boro rice and chilli while T.Aman rice, Aus rice, wheat, grass pea, and mustard were grown under the rain-fed condition. It was apparent from Table that per hectare irrigation cost for Boro rice and chilli were Tk. 7718 and Tk. 1643 respectively (Table 4). In the Togbi village farmers used irrigation for crops like Boro rice and chilli while T.Aman rice, Aus rice, wheat, grass pea, mungbean and groundnut were grown under the rain-fed condition. It was apparent from Table that per hectare irrigation cost for Boro rice and chilli were Tk. 7410 and Tk. 1240 respectively (Table 2). In the maddajoynagar village farmers were grown all crops in rain fed condition but chilli. It was apparent from Table that per hectare irrigation cost for Chilli were 1464 (Table 6).

Cost of Insecticides

Farmers were applied insecticides for T.Aman rice, Aus rice, Boro rice, mungbean and chilli. Farmers usually do not applied insecticide for cultivation of grass pea, groundnut, wheat, mustard and cowpea, etc (Table 4, 5 and 6).

Table 6. Per hectare cost and return of majors Rabi crops of Maddajoynagar village of Daulatkhan upazilla of Bhola districts

Items	T. Aman rice		Aus rice		Grass pea		Mungbean		Chilli		Wheat		Cow pea	
	Qty.	Tk./ha	Qty.	Tk./ha	Qty.	Tk./ha	Qty.	Tk./ha	Qty.	Tk./ha	Qty.	Tk./ha	Qty.	Tk./ha
Plowing (No.)	3	2409	3	2409			3	2409	4	3212	4	3212	3	2409
Human labor (man-days/ha)	101	12120	105	12600	33	3960	82	9840	130	15600	104	12480	41	4920
Seed/Seedling (kg/ha)	54	972	74	1073	53	1325	34	1360	-	1721	141	3807	46	1380
Fertilizer:	-	3474	-	3019	-	202	-	763	-	5958		2633		572
Urea (kg/ha)	158	1027	154	1001	31	202	39	254	185	1203	170	1105	23	150
TSP (kg/ha)	77	1698	62	1364	-	-	23	509	216	4755	70	1528	20	422
Insecticide	-	749		654	-	-		874		1543	-	-	-	-
Irrigation	-	-	-	-	-	-	-	-	-	1464	-	-	-	-
Total cost	-	18975		19101		5487		15246		29498	-	22132	-	9281
Yield	2779	-	2689	-	681	-	645	-	3180		1914	-	566	-
Gross Return	-	24316		23503	-	13620	-	22575	-	63600	-	37323	-	15565
Gross Margin	-	5341		4402	-	8133	-	7329	-	34102	-	15191	-	6284

Human Labor @ Tk 120/man-days, Bullock Power and power tiller @ Tk 803/Plough/ha, Urea @ Tk 6.5/kg, TSP @ Tk 22/kg, T.Aman rice @Tk 8.75/kg, Aus rice @Tk 8.75/kg, Grass pea Tk 20/kg, Mungbean Tk 35/kg, Chilli Tk 16/kg, Wheat @Tk 19.5/kg, Cow pea @ Tk 27.5/kg, T.Aman rice seed @ Tk. 18/kg, Aus rice seed @ Tk. 14.5/kg, Grass pea seed @ Tk. 25/kg, Mungbean seed @ Tk. 40/kg Wheat seed @ Tk. 27/kg, Cow pea seed @ Tk. 30/kg.

Comparative cost and return of major crops

In Southcharpata village per hectare production cost of Boro rice was higher (Tk.33789/ha) followed by chilli (Tk.32381/ha), wheat (Tk.24750/ha), Aus rice (Tk.21164/ha), T.Aman rice (Tk.21052/ha), mustard (Tk.10711/ha) and grass pea (Tk.4491/ha). But the highest gross return and gross margin were obtained from chilli (Tk.62300/ha and Tk.29919/ha) followed by wheat (Tk.48165/ha and Tk.23415), Boro rice (Tk.41993/ha and Tk.8204/ha), T.Aman rice (Tk.26775/ha and Tk.5723/ha), Aus rice (Tk.24806/ha and Tk.3642/ha), grass pea (Tk.14220/ha and Tk.9729/ha) and mustard (Tk.13675/ha and Tk.2964/ha). It indicated that farmers were get comparatively less profit from Boro rice than chilli and wheat by investing less in these crops than Boro rice (Table 1).

In Togbi village per hectare cost of production was higher in Boro rice (Tk.33023/ha) followed by chilli (Tk.32595/ha), wheat (Tk.23835/ha), T.Aman rice (Tk.19934/ha), Aus rice (Tk.19929/ha),

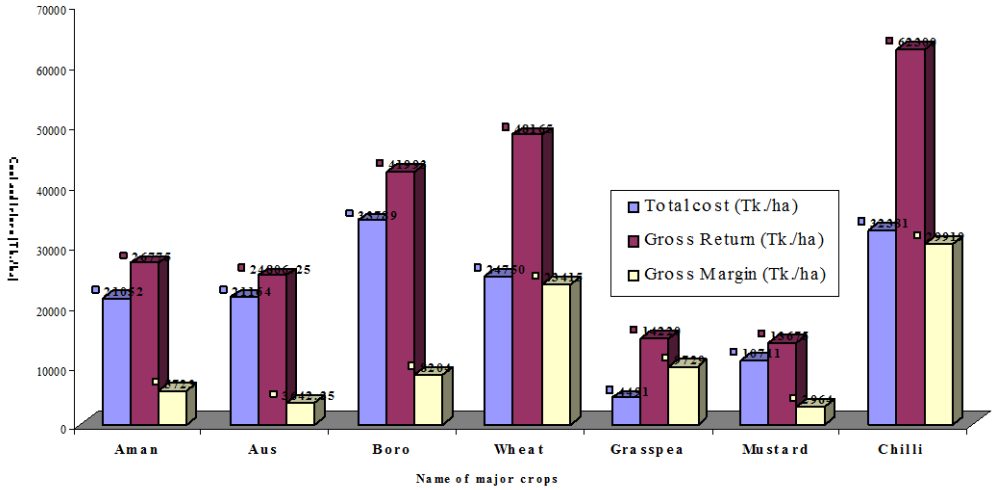


Figure 1 . Profitability of major crops at Southcharpata village

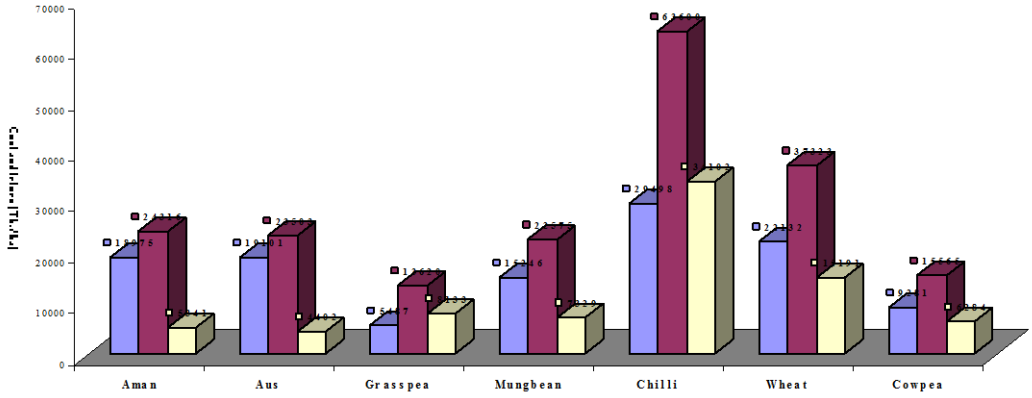


Figure 2. Profitability of major crops at Maddajoynagar village

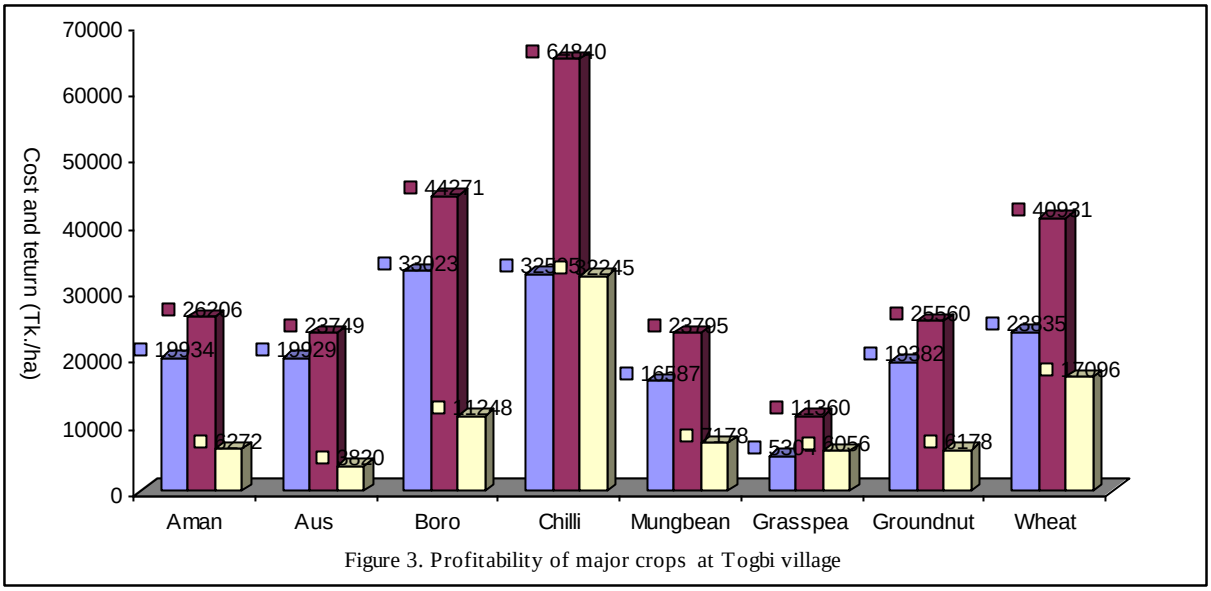


Figure 3. Profitability of major crops at Togbi village

groundnut (Tk.19382/ha), mungbean (Tk.16587/ha) and grass pea (Tk.5304/ha) whereas the highest gross return and gross margin were obtained from chilli (Tk.64840/ha and Tk.32245/ha) followed by wheat (Tk.40931/ha and Tk.17096), Boro rice (Tk.44271/ha and Tk.11248/ha), T.Aman rice (Tk.26206/ha and Tk.6272/ha), mungbean (Tk.23795/ha and Tk.7178/ha), groundnut (Tk.25560/ha and Tk.6178/ha), Aus rice (Tk.23749/ha and Tk.3820/ha) and grass pea (Tk.11360/ha and Tk.6056/ha). Farmers were achieved a good amount of gross return and gross margin from chilli and wheat than that of other Rabi crops (Table 5). In Maddajoynagar village per hectare cost of production was higher in chilli (Tk.29498/ha) followed by wheat (Tk.22132/ha), Aus rice (Tk.19101/ha), T.Aman rice (Tk.18975/ha), mungbean (Tk.15246/ha), cowpea (Tk.9281/ha), and grass pea (Tk.5487/ha). The highest gross return and gross margin were also obtained from chilli (Tk.63600/ha and Tk.34102/ha) followed by wheat (Tk.37323/ha and Tk.15191/ha) T.Aman rice (Tk.24316/ha and Tk.5341), Aus rice (Tk.23503/ha and Tk.4402/ha), mungbean (Tk.22575/ha and Tk.7329/ha), cowpea (Tk.15565/ha and Tk.6284/ha) and grass pea (Tk.13620/ha and Tk.8133/ha) (Table 6).

Findings of the report point out that among of the Rabi crops, cost of production of chilli, Boro rice and wheat were comparatively higher than that of mungbean, cowpea, groundnut, mustard and grass pea whereas gross return from chilli and wheat was comparatively higher than that of other Rabi crops of the survey villages.

A Comparison among dominant Cropping Patterns

From Southcharpata, Togbi and Maddajoynagar village Six, Six and five cropping patterns respectively were selected by considering the intensity of existing of the patterns in these villages for determining the viability of the existing cropping patterns. It was observed from the table 4, 5 and 6 and figure 4, 5 and 6 that all selected cropping patterns were profitable as a whole considering both per hectare gross return and gross margin in all three villages. In Southcharpata village, farmers obtained the highest per hectare gross return (Tk.113881) and gross margin (Tk.39284) from the pattern P_6 (Chilli - Aus rice -T. Aman rice) followed by P_3 (wheat - Aus rice -T. Aman rice) where gross return and gross margin were Tk.99746/ha, Tk.32780/ha respectively, P_2 (Boro rice - Aus rice -T. Aman rice) where gross return and gross margin were Tk. 93574/ha and Tk. 17569 /ha respectively (Table 4). The highest gross return (Tk.114795/ha) and gross margin (Tk.42337/ha) were provided by the pattern P_3 (Chilli - Aus rice -T. Aman rice) in Togbi village whereas farmers got the lowest gross return and gross margin by practicing pattern P_4 (Grass pea - Aus rice -T. Aman rice). Lower yield potentiality of grass pea may be the cause of getting lower amount profit since the production cost of grass pea is very low (Table 5).

Table 4. Profitability of the selected dominant cropping pattern at Southcharpata village

Cropping patterns	Total Variable Cost (Tk./ha)	Gross Return (Tk./ha)	Gross Margin (Tk./ha)	Ranking		
				TVC	GR	GM
Pattern P_1 : Boro rice-Fallow-T.Aman rice	54841	68768	13927	4	4	4
Pattern P_2 : Boro rice- Aus rice-T.Aman rice	76005	93574	17569	1	3	3
Pattern P_3 : Wheat- Aus rice - T.Aman rice	66966	99746	32780	3	2	2
Pattern P_4: Grass pea – Aus rice – T.Aman rice	46707	65801	19094	6	6	5
Pattern P_5 :Mustard- Aus rice -T.Aman rice	52927	65256	12329	5	5	6
Pattern P_6 :Chilli- Aus rice - T.Aman rice	74597	113881	39284	2	1	1

Incase of Maddajoynagar village, farmers earned the highest per hectare gross return (Tk. 111419) and gross margin (Tk. 43845) from the pattern P_3 (Chilli - Aus rice -T. Aman rice). The second highest gross return (Tk. 85142/ha) and gross margin (Tk.24934/ha) was obtained by the pattern P_5 (wheat - Aus rice -T. Aman rice) (Table 6).

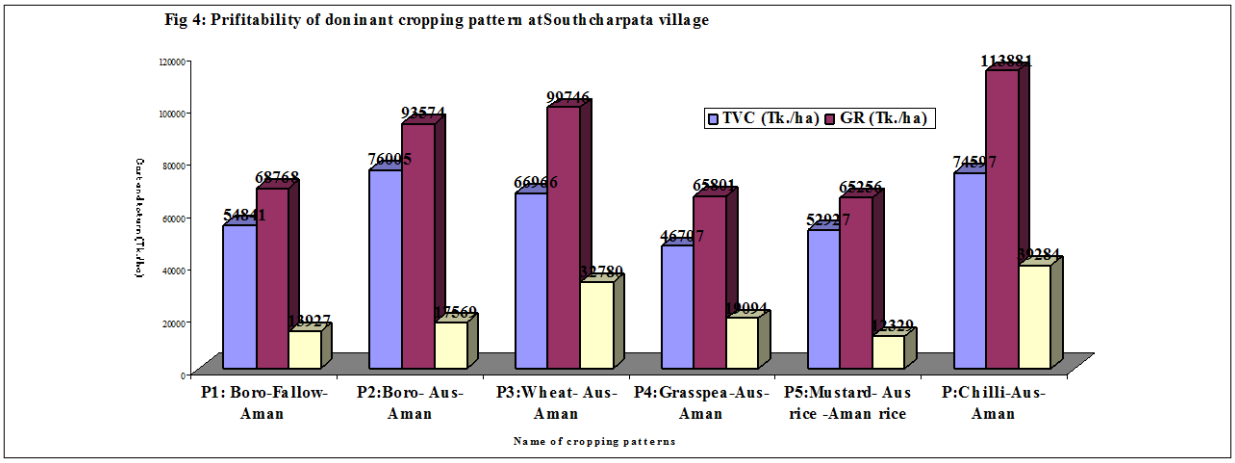
It was observed from the comparative profitability of the selected dominant cropping patterns that farmers were achieved more profit from comparatively lower adapted patterns. It is needed to identify the major causes of adoption of Rabi crops.

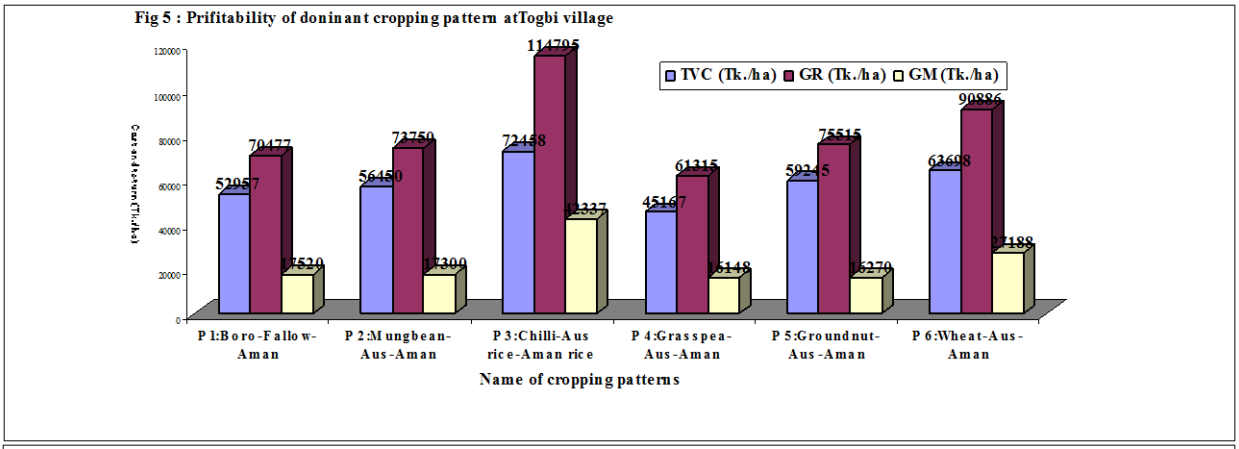
Table 5. Profitability of the selected dominant cropping pattern at Togbi village

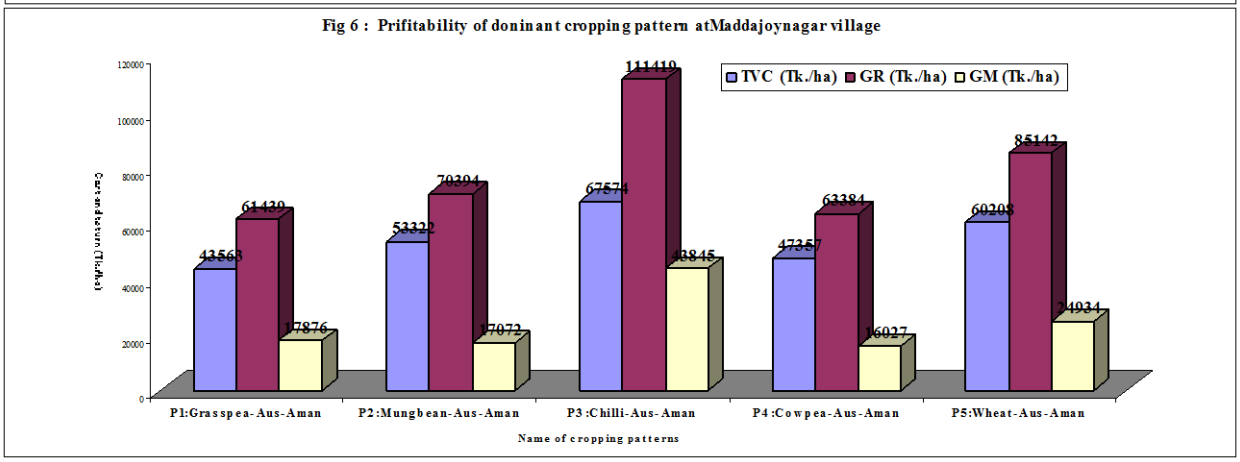
Patterns	Total variable cost (Tk./ha)	Gross return (Tk./ha)	Gross margin (Tk./ha)	Ranking		
				TVC	GR	GM
Pattern P_1 : Boro rice-Fallow-T.Aman rice	52957	70477	17520	5	5	3
Pattern P_2 : Mungbean -Aus rice-T.Aman rice	56450	73750	17300	4	4	4
Pattern P_3 : Chilli-Aus rice-T.Aman rice	72458	114795	42337	1	1	1
Pattern P_4: Grass pea-Aus rice-T.Aman rice	45167	61315	16148	6	6	6
Pattern P_5: Groundnut -Aus rice-T.Aman rice	59245	75515	16270	3	3	5
Pattern P_6 : Wheat-Aus rice-T.Aman rice	63698	90886	27188	2	2	2

Table 6. Profitability of the selected dominant cropping pattern at Maddajoynagar village

Patterns	Total Variable Cost (Tk./ha)	Gross Return (Tk./ha)	Gross Margin (Tk./ha)	Ranking		
				TVC	GR	GM
Pattern P_1 : Grass pea –Aus rice-T.Aman rice	43563	61439	17876	5	5	3
Pattern P_2 : Mungbean -Aus rice-T.Aman rice	53322	70394	17072	3	3	4
Pattern P_3 : Chilli – Aus rice –T.Aman rice	67574	111419	43845	1	1	1
Pattern P_4 : Cow pea -Aus rice-T.Aman rice	47357	63384	16027	4	4	5
Pattern P_5: Wheat-Aus rice-T.Aman rice	60208	85142	24934	2	2	2







CONCLUSIONS

It was observed from the findings of crops statistics and prevailing cropping pattern, 36%, 47 %, and 0 % percent cultivated area of Southcharpata,Togbi and Maddajoynagar village respectively was occupied by Boro rice in Rabi season. It was also observed that there were about 12%, 2% and 7% cultivated area of Southcharpata,Togbi and Maddajoynagar village respectively was occupied by wheat. Remaining cultivated area was mostly occupied by grass pea, cowpea, mustard and mungbean

etc. Farmers of survey villages mentioned that there was scarcity of supplementary irrigation facilities that is why they prefer to grow Rabi crops which were possible to grow under rain-fed condition.

Farmers of survey villages also said that they have affinity to grow Boro rice in Rabi season where there are supplementary irrigation facilities. It may be due to that rice is their first preferred cereal crops. They grow wheat, grass pea, cow pea, mustard, mungbean etc. in rain-fed condition. Findings of the report point out that among of the Rabi crops, cost of production of chilli, Boro rice and wheat were comparative higher than that of mungbean, cowpea, groundnut, mustard and grass pea whereas gross return from chilli and wheat was comparatively higher than that of other Rabi crops of the survey villages.

Results of this report also point out that proportion of area coverage by the chilli and wheat was not significant whereas these two crops are comparatively more profitable than that of other Rabi crops. Findings of all three villages indicated that the gross return and gross margin of any cropping pattern could be increased substantially with the inclusion of chilli or wheat into the existing rice based dominant cropping patterns of the farmers. It is due to the comparatively good yield potentiality and good market price of chilli and wheat than that of other Rabi crops. In future survey needs to be identifying the major causes of not adopting and not all Rabi crops.

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