

IMPACT OF SHIFTING OF LAND UNDER CEREAL CROPS TO JUJUBE CULTIVATION IN SELECTED AREAS OF BANGLADESH

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Abstract

Area shift in favour of fruits has been suggested as a viable option to stabilize and raise farm income, enhance agricultural growth, and increase employment opportunities. Studies on micro-level decision taking for area shift in favour of fruits are very scanty. Therefore, an attempt was made to assess the socioeconomic status of jujube farmers, relative profitability of jujube cultivation, and factors influencing the shifting lands from cereal to jujube cultivation. The study was conducted in three districts, namely Pabna, Natore and Chapai Nababgonj during 2012-13. A total of 180 farmers taking 60 from each district were selected randomly for the study. The per hectare costs of jujube cultivation were Tk. 2,77,232 in the 1st year; Tk. 2,27,925 in the 2nd year; and Tk. 1,90,217 in the 3rd year. The average yields of jujube were found highest in the 3rd year (15.54 t/ha) followed by 2nd year (9.96 t/ha). Per hectare net returns from jujube cultivation were Tk. 1,45,978 in the 2nd year and Tk. 3,45,720 in the 3rd year. The total cost of jujube cultivation was around 50% higher than the costs incurred for different cropping patterns. The net return of jujube cultivation was 57% higher compared to different cropping patterns. The shifting of cereal lands to jujube cultivation was reported to be a profitable enterprise as indicated by higher BCR (1.47), net present value (Tk. 2,31,791), and internal rate of return IRR (94%) of jujube cultivation. Relative income and education turned out to be positively significant, whereas age and food crop requirements at home negatively significant for shifting decision from cereal crops to jujube cultivation. Disease and insect infestation, lack of training facilities, and lack of access to credit were the major constraints for jujube cultivation. Jujube cultivation may be encouraged from state authority to increase farmers' income.

Keywords: Shifting land, cereal crops, jujube, relative profitability, and net returns.

1. Introduction

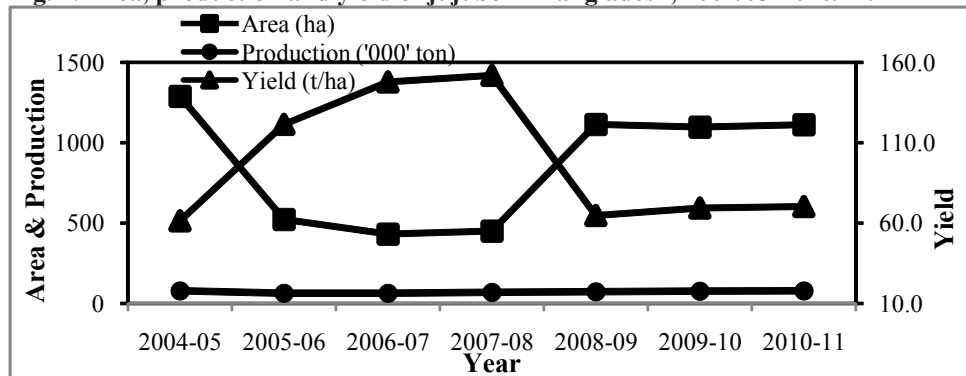
In farm planning, farmer as a decision maker generally takes three decisions - what to produce, how to produce, and how much to produce (Van and Keller, 2006). The farmer has to decide between alternative uses of resources at his/her disposal in order to address these three different but inter-related questions. While deliberating on these aspects, a farmer has to choose which crops to

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produce and to what extent to specialize or alternatively diversify the area. This directly or indirectly affects the aggregate output at the farm. In general, there are three major components of aggregate output- area, crop yields, and level of diversification. The growth of output could be improved by increasing the area under cultivation, either by extension or intensification of area or reducing the cost of production by introducing new technology that improves productivity of crops. In addition to these components or policy options, diversification is one of the major components of growth that influences output through its impact on cost, income, and risk (Grimes, 1929).

The sustained economic growth, rising per capita income and growing urbanization have caused a shift in the consumption patterns in favour of high value crops like fruits and vegetables from staple food crops, such as rice and wheat (Joshi, 2005). In the recent past, demand for these high-value crops, such as fruits has grown much faster than that of food grains. Fruits play a significant role in nutritional improvement, employment generation, food and financial security of the people of Bangladesh. In 2010-11, the national production and area of fruits were 4.38 million MT and 1.41 lakh hectares, respectively (BBS, 2011). Among the various fruits, mango and litchi are important fruits in Bangladesh. The cultivation of jujube has also been gaining popularity among farmers due to its ready market and profitability from several years. In 2010-11, national production of mango, litchi, and jujube were 8.9, 0.67, and 0.76 lakh MT, respectively, and corresponding areas were 0.27, 0.02, and 0.29 lakh hectares, respectively (BBS, 2011). Due to higher profit, the area and production of jujube is increasing year after year at an average growth rate of 7.1% and 1.6%, respectively (Fig. 1). Due to higher returns and productivity of fruits, this group emerged as an important area for diversification and as an alternative cropping pattern. With this backdrop, area shift in favour of fruits has been suggested as a viable option to stabilize and raise farm income, enhance agricultural growth and increase employment opportunities.

Fig. 1. Area, production and yield of jujube in Bangladesh, 2004/05-2010/11.



Source: BBS, 2012.

The land allocation decisions are generally analyzed at the macro level on the basis of distributive lag model that capture the role of several economic and non-economic factors in decision making. Nerlove (1958) was the first to initiate a study on this aspect where he endeavored to find the role of farmer's expectation of future prices in shaping their decisions on the extent of land allocation to these crops. He devised a model relating the expected normal price to "past-observed" prices. Later on, many studies used the Nerlovian model, with some modifications, to investigate the importance of price of crop in shaping farmer's supply response behaviour (Krishna, 1963; Behrman, 1968; Askari and Cummings, 1976; De, 2005; Mythili, 2006). However, studies on micro-level decision taking for area shift in favour of high value crops such as fruits are very scanty. Therefore, an attempt was made in this study to focus the profitability factors responsible and the problem of shifting of lands from cereal crops to jujube cultivation in Bangladesh.

1.1 Objectives: The specific objectives of the study are as follows:

- i. to assess the socio-economic profile of jujube cultivating farmers;
- ii. to estimate the relative profitability of jujube cultivation;
- iii. to identify the factors influencing the shift of land under cereal crops to jujube cultivation, and
- iv. to find out the constraints of jujube cultivation at farm level.

2. Methodology

2.1 Sampling procedure and sample size

A two stage stratified random sampling design was followed to select sample farmers for this study. At first, three districts were selected according to highest concentration. The selected districts were Pabna, Natore, and Chapai Nawabganj. Then one upazila from each district and two blocks from each upazila were selected according to the above mentioned criteria. Ishurdi upazila from Pabna district, Baraigram upazila from Natore district and Gomastapur upazila from Chapai Nawabganj district were selected. Because of common heterogeneity among agricultural household populations, it is necessary to undertake population stratification (Nyariki, 2009). To create relatively homogeneous groups, the population was classified into three categories 1st year, 2nd year, and 3rd year, garden. After this, an equal number of samples were randomly drawn from each group or stratum. A total of 180 farmers out of which 60 from each district were selected by using simple random sampling technique for interview.

District	Upazila	Planting category	No. of sample farms	Total sample
Pabna	Iswardi	1 st year	20	60
		2nd year	20	
		3rd year	20	
Natore	Baraigram	1 st year	20	60
		2nd year	20	
		3rd year	20	
Capai Nababganj	Gomastapur	1 st year	20	60
		2nd year	20	
		3rd year	20	
Total				180

2.2 Method of data collection and period of study

The study was mainly based on primary data collected through interviewing the farmers during January to March 2013. Field investigators under the direct supervision of the researcher collected field level cross-sectional data using pre-tested interview schedule. All the required information was collected based on input costs, price, yields, etc.

2.3 Analytical techniques

Collected data were edited, summarized, tabulated, and analyzed to fulfill the objectives of the study. Descriptive statistics using different statistical tools like averages, percentages and ratios were used in presenting the results of the study. The profitability of jujube production was examined on the basis of gross return, gross margin, and benefit cost analysis. Besides, the opportunity cost of family supplied labour was taken into consideration in estimating total cost. Land use cost was calculated on the basis of per year lease value of land. Project analysis was also done using the following equations.

Net present value (NPV): The NPV of an investment is the discounted value of all cash inflows and cash outflows of the project during its life time. It can be computed as

$$NPV = \sum_{t=1}^n \frac{B_t - C_t}{(1+r)^t} \dots\dots\dots [1]$$

Benefit cost ratio (BCR): The BCR of an investment is the ratio of the discounted value of all cash inflows to the discounted value of all cash outflows during the life of the project. It can be estimated using the following formula:

$$BCR = \frac{\sum_{t=1}^n \frac{B_t}{(1+r)^t}}{\sum_{t=1}^n \frac{C_t}{(1+r)^t}} \dots\dots\dots [2]$$

Internal rate of return (IRR): IRR is the rate of return at which the NPV of a stream of incomes is equal to zero (Peterson, 1971). The IRR is computed as:

$$r = \sum_{t=1}^n \frac{B_t - C_t}{(1+r)^t} = 0 \dots\dots\dots [3]$$

Where,

- B_t = Total benefit (Tk/ha) in time t
- C_t = Total cost (Tk/ha) in time t
- r = Rate of interest
- t = Number of years (t = 1, 2, 3, 4)

The IRR was calculated with the following formula:

Internal Rate of Return (IRR) =	Lower discount rate	+	Difference between two discount rates	×	$\frac{\text{Present worth of incremental net benefit stream (cash flow) at the lower discount rate}}{\text{Sum of the present worth of the incremental net benefit streams (cash flows) at the two discount rates, signs ignored}}$
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Functional analysis: The regression model was used to assess the factors affecting the extent of substitution by the farmers, while considering both the economic and non-economic factors as explanatory variables. The relative price and relative income were used as explanatory variables to test whether farmers cared for only price or also the income (included price and yield) in their crop substitution decisions. Relative price and relative income were measured by comparing the prices and income of jujube with the cereal crops. The following empirical multiple linear regression model was employed:

$$Y = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + e$$

Where,

Y= Area shifted (devoted) from cereal crops to jujube cultivation (ha)

x_1 = Relative price of the product (Tk./kg)

x_2 = Relative income (Tk./ha)

x_3 = Education level of the farmers (years of schooling)

x_4 = Farm size (ha)

x_5 = Age of the farmers (years)

x_6 = Annual non-farm income (Tk/HH)

x_7 = Food crop (wheat/rice) requirements at home (Tk/head)

a= Intercept

$b_1, b_2, b_3, \dots, b_7$ = Regression coefficients of the respective variables to be estimated

e = Random error

3. Results and Discussion

3.1 Socioeconomic profile of the respondent farmers

Socioeconomic profile of the respondent farmers is required to have an idea about the present farm activities, possible development opportunities and potentials for more efficient farming. Therefore, information regarding respondents' age, education, occupation, family size, farm size and experience in cultivation were recorded as discussed below:

Age: Age is an important factor that influences farmer's production decision, efficiency and adoption of improved technologies. In the study areas, majority of the farmers (50%) were in the age group of 30-49 years followed by the age group of 20-29 years. The lowest percent of farmers were under the age group of above 60 years (Table 1).

Literacy status: The sample farmers were classified into five categories based on their education level. In Natore, the proportion of illiterate farmers was found to be the highest (18%) followed by Chapai Nababganj (11%). However, on average 40% farmers belonged to secondary level, 34% had education up to primary level while 14% above secondary level. Overall literacy rate was 88%, which is higher than the national average of 58% (BBS, 2010).

Occupational status: The sample farmers have both primary and secondary occupation. The farmers of the study areas involved in various occupations such as agriculture, business, service and wage labour for their livelihood. On average about seventy percent farmers were engaged purely on agriculture and it was found the highest in Pabna (79%) and the lowest in Natore (61%) district. On the other hand, the main subsidiary occupation was reported to be business (36%) in the study areas.

Table 1. Socioeconomic profile of the vegetable farmers in the study areas.

Items	Pabna	Natore	Chapai Nawabganj	All areas
1. Age (% of farmers)				
20-29 years	20	30	15	22
30 - 49 years	45	50	55	50
50-59 years	25	13	25	21
60 and above	10	8	5	8
2. Literacy level (%)				
Illiterate	7	18	11	12
Primary (Class I-V)	40	30	31	34
Secondary (Class VI-X)	35	45	40	40
Higher Secondary (HSC)	15	2	13	10
Degree and above	3	5	5	4
3. Occupation (%)				
<i>Main occupation</i>				
a. Agriculture	79	61	70	70
b. Business	15	9	13	12
c. Service	6	32	17	18
<i>Subsidiary occupation</i>				
a. Agriculture	13	3	8	8
b. Business	44	20	30	31
c. Service	25	52	30	36
d. Student	9	17	22	16
e. Day labourer	9	8	10	9
4. Length of experience (%)				
Up to 3 years	37	55	42	45
4 – 6 years	35	25	31	30
6 & above years	28	20	27	25
5. Family size (person/HH)				
	5.20	6.10	5.70	5.7
6. Farm size (%)				
Small (0.5-2.49 acres)	18	28	30	25
Medium (2.5-7.49 acres)	33	35	25	31
Large (7.5 and above acres)	50	37	45	44

Experience in jujube cultivation: It is indicated in Table 1 that about 45% farmers cultivated jujube for the last 1-3 years while about 30% reported that they cultivated this crop during the period from four to six years. Remaining 25% farmers had six years and above experience in jujube cultivation. Most of the experienced farmers were found in Natore (55%) district.

Family size: Family size included the number of adult male, adult female, and children of the respondent households. Average family size of sample jujube farms was 5.7 persons, whereas the national average was 4.90 per farm (BBS, 2010). Average family size was higher in Natore (6.10 persons per farm) followed by Chapai Nawabganj district (5.70 persons per farm) (Table 1).

Farm size: In the study areas, 44% farmers had large farm size, 31% farmers had medium and 25% had small farm size. Proportion of large farm were higher in Pabna district (50%) followed by Chapai Nawabganj district (45%).

3.2 Level of input use for jujube cultivation

The account of input use by the farmers in different years is presented in Table 2. Higher number of labour was required in 1st year (326 man-day/ha) compared to other years. On an average, responded jujube farmers used 247 man-days of human labour per hectare of which 24% were family supplied and 76% were hired. They used on an average 1029 pieces of sapling per hectare. The amounts of manures used in jujube cultivation were 7090 kg per hectare. They used 776 kg urea per hectare in the 1st year, 596 kg in the 2nd year and 493 kg in the 3rd year. Farmers applied TSP 493 kg/ha in total. There were no highly significant differences among the cultivation years of TSP application. Farmers also used MoP and Gypsum at the rate of 257 kg and 77 kg per hectare, respectively, which were also higher in 1st year compared to others. In the study areas most of the farmers cultivated variety of BAUkul. Only a few farmers cultivated apple kul. The variety of BARI Kul was not found in the study areas.

Table 2. Level of input use per hectare for jujube cultivation.

Items	1 st year	2 nd year	3 rd year	All
Human labour (Man-days)	326	252	163	247
Family labour	62	38	76	59
Hired labour	264	214	87	189
Sapling (kg/ha)	1029	-	-	1029
Manures (kg/ha)	8668	7635	4966	7090
Fertilizers (kg/ha)				
Urea	776	596	493	622
TSP	574	475	431	493
MP	335	248	188	257
Gypsum	140	50	40	77

3.3 Cost of jujube cultivation

The cost of production included different variable cost items like land preparation, human labour, sapling, manures, fertilizer, insecticides, etc. Both cash expenditure and imputed value of family supplied inputs were included in the analysis. Besides, interest on operating capital was also considered for the estimation of cost of jujube cultivation. Data in Table 3 represents the cost of jujube cultivation in different years in the study areas. The total cost of jujube cultivation in all years was found Tk. 2,31,791 per hectare of which 73% were variable cost and the rest 27% were fixed cost. Higher cost was observed in the 1st year (Tk. 2, 77,232) followed by that in 2nd year (Tk. 2, 27,925) and 3rd year (Tk. 1, 90,217). It might be due to the cost of land preparation, saplings, human labour and the use of higher use of manures, fertilizers and insecticides. The land preparation cost and sapling cost were 1% and 4% of the total cost. But this two cost items were incurred only in the 1st year. In different years of cultivation, labour involvement incurred the largest share (30%) of the total cost. Fertilizer cost shared 14% of the total cost and 23% of total variable cost. Farmers spent on fertilizer more in the 1st year compared to other years. The cost of intercrop occupied 10% of the total cost in the study areas. In the first year, farmers did not cultivate other crops in the jujube field. That's why the cost of intercrop was considered zero in the first year. Land use cost occupied 20% of the total cost. In all years, the higher cost was incurred for human labour (30%) followed by land use (20%), fertilizers (13%) and intercrop (10%).

Table 3. Cost of jujube cultivation in the study areas.

Items	1 st year	2 nd year	3 rd year	All
A. Variable Cost	213049	170342	122184	168525 (73)
Hired labour	72600	58850	23925	51792 (23)
Land preparation	9937	0	0	3312 (1)
Seedling	24432	0	0	8144 (4)
Manures	6136	5295	4100	5177 (2)
Fertilizers				
Urea	16074	12516	10353	12981 (6)
TSP	15584	12825	11637	13349 (6)
MoP	5753	4216	3196	4388 (2)
Gypsum	840	300	240	460 (0.2)
Insecticides	16164	14963	8827	13318 (6)
Irrigation	15203	11353	9036	11864 (7)
Stick	25130	14050	10298	16493 (7)
Intercrops	0	31819	37592	23137 (10)
Interest on operating capital	5196	4155	2980	4110 (2)
B. Fixed Cost	64183	57583	68033	63266 (27)
Family labour	17050	10450	20900	16133 (7)
Land use cost	47133	47133	47133	47133 (20)
C. Total Cost (A+B)	277232	227925	190217	231791 (100)

Note: Figures in the parentheses indicate percentage of total cost.

3.4 Profitability of jujube cultivation

The return from jujube cultivation in different years is presented in Table 4. Farmers in the study areas obtained, on an average, 9.82 t/ha yield. In 1st year and 2nd year, the yield was estimated to be 3.95 t/ha and 9.96 t/ha, respectively. They obtained the highest amount of yield in the 3rd year (15.54 t/ha) of jujube cultivation.

The highest gross return of jujube was found in the 3rd year (Tk. 497284/ha). Farmers received Tk. 118567 per hectare in the 1st year and Tk. 328648 per hectare in the 2nd year as gross return from jujube cultivation. They received the highest amount of gross margin in the 3rd year (Tk. 413753/ha) followed by 2nd year (Tk. 203561/ha) of jujube cultivation. Similarly, the higher amount of net return was found in the 3rd year (Tk. 345720/ha) and lower amount in the 2nd year (Tk. 145978/ha). In the 1st year, farmers gained negative gross margin and net return. Jujube farmers cultivated different types of inter crops with jujube cultivation. They cultivated sweet gourd, chili, mungbean, onion, cucumber, brinjal, etc. But farmers did not cultivate any kind of intercrop in the 1st year. Because in the 1st year, farmers allow jujube sapling to grow intensively. The return of intercrop was found higher in the 2nd year which was Tk. 45,255 per hectare compared to 3rd year. Total gross return was found higher in the 3rd year (Tk. 535937 per hectare) compared to other years. Benefit cost ratio over full cost (2.83) and cash cost (4.39) basis was also found higher in 3rd year compared to other years.

Table 4. Profitability of jujube cultivation in the study areas.

Items	1st year	2nd year	3rd year	All
A. Total cost (Tk./ha)	277232	227925	190217	218747
Variable cost	213049	170342	122184	155182
Fixed cost	64183	57583	68033	63564
B. Yield of jujube (kg/ha)	3952	9959	15540	9817
C. Price (Tk./kg)	30	33	32	32
D. Gross return of jujube (Tk/ha)	118567	328648	497284	314833
E. Gross return of intercrop (Tk/ha)	-	45255	38653	39708
F. Total gross return (Tk./ha)	118567	373903	535937	354541
G. Gross margin (Tk./ha)	-94482	203561	413753	199359
H. Net return (Tk./ha)	-158665	145978	345720	135794
I. Benefit cost ratio				
i. Over full cost	0.43	1.64	2.83	1.62
ii. Over variable cost	0.56	2.20	4.39	2.28

3.5 Returns to investment in jujube cultivation

The results of project analysis are shown in Table 5 and 6. In the study areas, BCR was found 1.47 at 5.5% discount rate, which is greater than unity and acceptable. The estimated NPV of the project was Tk. 262206 per hectare which indicates that jujube cultivation was profitable in the study areas. The IRR was found to be 94%. It is highly acceptable because it is much higher than the opportunity cost of capital.

Table 5. Financial analysis of jujube cultivation in the study areas.

Year	Gross cost	Gross benefit	Discount factor at 5.5%	Present worth of cost at 5.5%	Present worth of benefit at 5.5%
1	277232	118567	0.9479	262779.15	112385.78
2	196106	328648	0.8985	176191.91	295274.59
3	152625	497284	0.8516	129977.54	423493.85
Total	625963	944499	2.6979	568948.59	831154.22

Table 6. Financial analysis of jujube cultivation in the study areas.

Year	Incremental benefit	Lower discount at 90%	NPV at lower discount rate	Higher discount at 95%	NPV at higher discount rate
1	-158665	0.5263	-83507.90	0.5128	-81366.70
2	132542	0.2770	36715.24	0.2630	34856.54
3	344659	0.1458	50249.16	0.1349	46482.11
Total			3456.50		-28.02

3.6 Profitability of cereal crops cultivation

Respondent farmers in the study areas mostly cultivated two crops in a year. Few farmers cultivated three crops per year. Before shifting land to jujube cultivation, they cultivated Boro, T.Aman, wheat, jute, and some short duration vegetables. Data in Table 7 shows the profitability of cereal crops. Total cost for Boro-T. aman (1) cultivation was Tk. 86166 and net return was Tk. 29224 per hectare. Total cost for Boro-Jute (2) cultivation was Tk. 89609, whereas it was Tk 85306 for wheat- T.Aman (3) cultivation. Wheat-Blackgram (5) cultivation required Tk 82473 per hectare. Total cost was found higher in the case of wheat-Jute-Vegetable (4) which was Tk. 113375 per hectare. Total variable cost was found higher in the case of cropping pattern (4) followed by pattern (2) and (1). Highest in the case of Wheat-Black gram cultivation, farmers received higher net return, which was Tk. 30383 per hectare, whereas lower net return was found in the case of Wheat-Jute-Vegetables cultivation (Tk. 22090/ha). BCR on total cost and

variable cost was estimated higher in the case of Wheat-Blackgram which was 1.37 and 2.07 respectively.

Table 7. Profitability of different cropping patterns in the study areas.

Items	Total cost	Total Variable cost	Gross Return	Gross Margin	Net Return	BCR on TC	BCR on TVC
Boro- T.Aman	86166	56625	115390	58765	29224	1.34	2.04
Boro –Jute	89609	59204	117249	58045	27640	1.31	1.98
Wheat - T.Aman	85306	55099	113163	58064	27857	1.33	2.05
Wheat – Jute – Vegetables	113375	77982	135465	57483	22090	1.19	1.74
Wheat-Blackgram	82473	54466	112857	58391	30383	1.37	2.07

3.7 Relative profitability of jujube cultivation

Table 8 depicted the relative profitability of jujube cultivation. The total cost of Jujube cultivation was 61% higher than Boro- T. Aman and Wheat- T. Aman cultivation. Again, total cost of jujube cultivation was 48% and 62% higher than the cost incurred for Wheat-Jute-Vegetables and Wheat-Blackgram cropping pattern cultivation. Jujube farmers got 68% higher gross return compared to Wheat-T. aman and Wheat-Black gram cultivation.

The gross margin and net return from jujube cultivation were also higher than any of the five cropping patterns. The gross margin of jujube was 72% higher than Wheat –Jute-Vegetables cropping pattern. The average net return was on an average 57% higher than the five cropping patterns. BCR on total cost and variable cost were also higher in jujube cultivation than this five studied cropping patterns.

Table 8. Comparative profitability of jujube cultivation with other competing crops.

Items	Magnitude of reduction (in %)				
	Boro- T.Aman	Boro –Jute	Wheat - T.Aman	Wheat – Jute –Vegetables	Wheat-Blackgram
Total cost lower than jujube (%)	60	59	61	48	62
Total cost lower than jujube (%)	60	59	61	48	62
Gross return lower than jujube (%)	67	67	68	62	68
Gross margin lower than jujube (%)	71	71	72	72	71
Net return lower than jujube(%)	57	57	58	59	57

3.8 Sources of information

The sample farmers mentioned various sources from which they got information to switch over from crops to jujube cultivation for the first time. The highly reported source was neighbouring farmers (49%). Farmers in the study areas were enthusiastic toward jujube cultivation by observing positive benefits and later seek help from neighbouring farmers. On an average, 21% farmers reported that they cultivated jujube at the first time without taking any help from others. They observed the technique of cultivation from others and did it themselves. Extension worker and businessman also helped farmers by supplying information for jujube cultivation. About 11% farmers received information from relatives (Table 9).

Table 9. Sources of information for cultivating jujube for the first time.

Items	% farmers opined			
	Pabna	Natore	Chapai Nawabganj	All areas
Neighbouring farmers	47	51	49	49
Own experience	21	19	22	21
Relatives	11	13	8	11
Extension worker	12	11	10	11
Businessman	9	6	11	9

3.9 Impact of jujube cultivation on income and livelihood pattern

Jujube cultivation has created tremendous impact to many of the respondent farmers in the study areas. Survey results exposed that 95% respondent farmers opined that switching from cereal crops to jujube cultivation brought them positive impacts to some extent on household income, food intake, and livelihood improvement (Table 10). More than 83% farmers obtained increased income and about 67% achieved increased livelihood. The amount of food intake was also increased to some extent for some of the responded households (48%).

Table 10. Impact on income, livelihood and food security.

	% farmers responded			
	Pabna	Natore	Chapai Nawabganj	All areas
Positive impact	93	100	91	95
No impact	7	0	9	5
Types of Positive Impact				
Increase in household Income	81	87	82	83
Increase in livelihood	67	72	63	67
Increase in food intake	46	51	47	48

3.10 Factors influence decision for shifting area in favour of jujube cultivation

A multiple linear regression analysis was carried out for studying the influence of different factors that affect farmers to substitute their land to jujube cultivation. The estimated regression coefficients and related statistics are presented in Table 11. The value of R^2 was 0.76 which indicated that around 76% of the variation in area shifted was explained by the independent variables included in the model. The F value was significant indicating the good fit of the regression model.

The results revealed that the relative income from the crop was positive and significant in explaining the crop substitution decisions of farmers. The relative price variable came out to be insignificant. This showed that farmers generally calculate the aggregate gain from the crop in their decision rather referring to only the price of the crop. This result is consistent with the findings of other studies conducted by Mehta, 2009. The variables age turned out to be negatively significant for shifting decision to jujube cultivation. It indicated that older farmers are less likely to be interested for shifting their land as compared to young farmers. Education had positive and significant effect implying that educated farmers were more concerned about profit and income and hence they preferred to have a higher level of substitution in their cropping pattern. The food crop requirement (the food crop which was substituted) had negatively affected the decision of substitution. It meant that higher food requirements at home inhibited the extent of crop substitution decision of the farmers.

Table 11. Results of linear regression analysis.

Regression variable	Regression co-efficient	t-value	Standard error	P- value
Constant	-0.945***	4.091	0.232	0.001
Relative price (Tk/kg)	0.025	1.267	0.024	0.591
Relative income (Tk /year)	0.085***	3.133	0.027	0.002
Age (year)	-0.026**	2.166	0.012	0.031
Education (year of schooling)	0.081**	2.384	0.034	0.021
Farm size (ha)	0.042	1.130	0.037	0.671
Non-farm income (Tk/farm/year)	0.142	1.404	0.102	0.470
Food crop requirements at home (Tk/head)	-0.153*	1.789	0.085	0.048
R^2	0.760			
F-values	4.270***			

‘***’, ‘**’ and ‘*’ indicates 1%, 5%, and 10% level of significance.

3.11 Willingness to increase or decrease jujube cultivation

The respondent farmers were asked to mention the possibility of expanding their cultivated area for jujube cultivation. About 72% famers reported that they will increase area for jujube cultivation in the next year (Table 12). Among all the responded farmers, farmers in Pabna district showed the highest (75%) and in Chapai Nababgonj (70%) district showed the lowest level of interest in increasing their cultivable area for jujube.

They want to shift their cultivable areas for jujube in the next year because, it is a highly profitable crop (65%), and its cultivation process is easy (55%) and less troublesome crop (49%). About 48% farmers stated that they want to increase area because they have enough cultivable land (48%) and jujube cultivation requires less labour (33%). Few farmers (26) also pointed out some reasons for not expanding their cultivable areas for jujube in the next year. The vital reasons were scarcity of land for jujube (25%). Besides, lack of credit (23%) and higher cost of production (21%) were also mentioned by the farmers as the reasons for not increasing land for jujube cultivation.

Table 12. Reasons for increasing jujube cultivation in the next year.

Items	Pabna	Nator	Chapai Nababganj	All areas
A. Willingness to				
Increase	75	72	70	72
Decrease	25	28	30	28
B. Reasons for increasing				
Highly profitable	69	67	62	66
Easy cultivation process	58	56	53	56
Less troublesome	49	52	45	49
Availability of cultivable land	47	50	44	47
Needs less labour	33	31	34	33
C. Reasons for not increasing				
Scarcity of land jujube cultivation	24	25	27	25
Lack of credit	21	26	24	24
Higher cost of production	18	22	23	21

3.12 Constraints to jujube cultivation

Although jujube is a profitable crop in the study areas, there are some constraints to its higher production. The first and foremost constraints to jujube cultivation in all areas were disease and insect infestation (70%).

Powdery mildew is a destructive disease of jujube causing decreasing of yield severely. Most of the farmers opined that leaves, flower, and young fruits were severely affected by disease. Affected flower and fruit dropped from plant and pathogen live on plant debris as well as alternative host. As a result, yield decreased drastically. In the study areas, most of the farmers were not trained about the technology of cultivation. That's why lack of training facilities was opined to be the second constraint, jujube cultivation required higher cost, especially in the 1st year of cultivation. So some marginal and small farmers did not cultivate this crop although they were very much enthusiastic to cultivate. Because of it, farmers reported lack of access to credit as one of the important constraints. Lack of transport facilities (38%), non-availability, and higher price of labour (37%) and price fall (27%) were orated to be the constraints to jujube cultivation (Table 13).

Table 13. Constraints to jujube cultivation in the study areas.

Constraints	% farmers responded			
	Pabna	Natore	Chapai Nababganj	All areas
1. Disease and insect infestation	66	68	75	70
2. Lack of training facilities	55	46	40	47
3. Lack of access to credit	43	47	38	43
4. Lack of transport facilities	50	25	40	38
5. Non-availability and higherprice of labour	40	33	38	37
6. Price fall	29	25	26	27

4. Conclusions and Recommendations

The study assessed that the profitability of jujube cultivation in comparison of cereal crops cultivation in the study areas. Although jujube cultivation involves higher cost, it received the higher net return as well as BCR compared to other crops. This is the main reason behind farmers' interest in shifting land from cereal crops to jujube. The rate of returns (i.e., BCR, NPV, and IRR) indicated that jujube cultivation is highly profitable for the farmers. Besides, farmer's attitudes toward area substitution for jujube seemed to be very positive. Most of the farmers opined in favour of increasing increase their land for jujube cultivation in the following year instead of cereal crops. Although jujube is a profitable crop in the study areas, due to some setbacks, few farmers have showed negative attitudes toward its production. They have experienced different constraints to its cultivation, such as diseases and insect infestation, lack of training facilities, lack

of access to credit and lack of transport facilities. Jujube cultivation also has positive impact to household income, livelihood pattern, and food security. Farmers in the study areas reported various sources from which they were motivated to jujube cultivation instead of cereal crops. Among them, neighboring farmers were opined to be as an important source. This study also finds out the factors that influence farmer's decision to shift from cereal crops to jujube cultivation. Income and education had positive effect, whereas age and food crop requirement at home have negative effect to substitute their land from cereal crops to jujube cultivation.

The following recommendations are put forwarded for ensuring higher production of jujube in one hand and higher income of the farmer on the other.

- As jujube is a highly profitable crop, Department of Agricultural Extension (DAE) should take attempt to motivate farmers to grow jujube for higher profit and income.
- Training on jujube cultivation should be organized by government and non-government organizations to develop technical knowledge of the farmers about improved cultivation practices of jujube.
- Credit facilities from both institutional and non-institutional sources should be made available for jujube cultivation.

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Appendix Tables**A-1. Total cost of different cropping pattern in the study areas.**

Items	Pabna	Natore	Chapai Nawabganj	All
Boro- T.Aman	86561	83345	88592	86166
Boro –Jute	89973	87459	91396	89609
Wheat - T.Aman	83480	85914	86523	85306
Wheat – Jute – Vegetables	100646	113570	125910	113375
Wheat- Black gram	81010	81912	84497	82473

A-2. Gross return of different cropping pattern in the study areas.

Items	Pabna	Natore	Chapai Nawabganj	All
Boro- T.Aman	116874	111402	117895	115390
Boro –Jute	120713	119320	111714	117249
Wheat - T.Aman	120730	105071	113689	113163
Wheat – Jute – Vegetables	126351	139532	140512	135465
Wheat- Black gram	109670	112570	116330	112857

A-3. Total variable cost of different cropping pattern in the study areas.

Items	Pabna	Natore	Chapai Nawabganj	All
Boro- T.Aman	54071	57577	58227	56625
Boro –Jute	59732	57829	60052	59204
Wheat - T.Aman	53421	56199	55677	55099
Wheat – Jute – Vegetables	75702	79521	78723	77982
Wheat- Black gram	53395	54572	55430	54466

A-4. Net return of different cropping pattern in the study areas.

Items	Pabna	Natore	Chapai Nawabganj	All
Boro- T.Aman	30313	28057	29303	29224
Boro –Jute	30740	31861	20318	27640
Wheat - T.Aman	37250	19157	27166	27857
Wheat – Jute – Vegetables	25705	25962	14602	22090
Wheat- Black gram	28660	30658	31833	30384

A-5. Gross margin of different cropping patterns in the study areas.

Items	Pabna	Natore	Chapai Nawabganj	All
Boro- T.Aman	62803	53825	59668	58765
Boro –Jute	60981	61491	51662	58045
Wheat - T.Aman	67309	48872	58012	58064
Wheat – Jute – Vegetables	50649	60011	61789	57483
Wheat- Black gram	56275	57998	60900	58391

A-6. BCR on total cost of different cropping pattern in the study areas.

Items	Pabna	Natore	Chapai Nawabganj	All
Boro- T.Aman	1.35	1.34	1.33	1.34
Boro –Jute	1.34	1.36	1.22	1.31
Wheat - T.Aman	1.45	1.22	1.31	1.33
Wheat – Jute –Vegetables	1.26	1.23	1.12	1.19
Wheat- Black gram	1.35	1.37	1.38	1.37

A-7. BCR on total variable cost of different cropping pattern in the study areas.

Items	Pabna	Natore	Chapai Nawabganj	All
Boro- T.Aman	2.16	1.93	2.02	2.04
Boro –Jute	2.02	2.06	1.86	1.98
Wheat - T.Aman	2.26	1.87	2.04	2.05
Wheat – Jute –Vegetables	1.67	1.75	1.78	1.74
Wheat- Black gram	2.05	2.06	2.10	2.07