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Climate Change Adaptation and Economic Profitability: Crop Land Shifting to Mango Orchard in Rajshahi Region

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ABSTRACT

Barind ecosystem (Rajshahi Region) is unfavourable for field crop production but suitable for production of fruits like mango, litchi and jujube etc. Thus, an investigation was made to find out the causes, challenges and opportunity of crop land shift to mango orchard in Barind areas. A total of 85 mango growing farmers were randomly selected for interviewing. The dominant mango orchard based patterns are: i) Wheat-Fallow-T. Aman (30%); and ii) Mustard-Fallow-T. Amam (29%). About 75% farmers are transforming crop land into mango orchard because of water scarcity, high profitability, easy cultivation process, land suitability and favourable environment for mango cultivation. Mango farmers obtained on average 231 kg/ha yield in 1st quarter (year 1-3) and then production increased sharply and reached 2,190 kg/ha in 5th quarter (year 13-15). The highest gross return of mango was found in the 5th quarter. The estimated net present worth (NPW) of the project was Tk 99,588 per hectare, which indicates that mango cultivation was profitable in Rajshahi area. The internal rate of return (IRR) was 28%, which is higher than the opportunity cost of capital. However, increasing life span of mango orchard increases yield loss of both rice and non-rice crops. In 11-year-old mango orchard, intercrop yield reduced drastically (65%). More than 83% farmers obtained increased income and about 67% achieved better livelihoods due to mango cultivation. However, there is a possibility to decrease food grain, pulses, oil seed and vegetable production in the long run. Therefore, planned mango cultivation is needed along with ensured credit facilities through both institutional and non-institutional sources for mango cultivation, preservation and marketing.

Key words: Barind, land shifting, mango orchard, climate change, adaptation and economic profitability

INTRODUCTION

There are multifaceted problems of crop production in northwest Barind area (Rajshahi region) of Bangladesh. Barind ecosystem is characterized by drought, extreme temperature, erratic rainfall and drawdown of groundwater, which restricts economic use of natural resources (particularly, land and water) for field crop production. The total area of the northwest region of Bangladesh is 3.49 Mha, out of which 76% (2.63 Mha) is net cultivated area. The estimated existing population of the area is around 35 million. Boro is the main irrigated crop and covers above 48% rice land. Aus and Aman rice cover 10 and 69% rice areas respectively. Groundwater irrigation is the main source of irrigation. But groundwater table has been depleted by 2.1 meter per year from 1985 to 2012 (Biswas, *et al*. 2014). Moderate to severe drought and soil nutrient depletions are adding more pressure on natural resources for sustainable crop production. Thus, farmers in the region have started to shift crop land into fruits (mango, litchi and jujube) cultivation due to low water requirement, favourable agro-ecological condition, ready market and profitability.

In farm planning, farmer decided 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 disposal in order to address these three different but inter-related questions. In general, there are three major components of aggregate output - crop area, yield and level of diversification. The growth of output could be improved by increasing the area, either by extension or intensification or reducing the cost of production, either by decreasing the prices of inputs or by introducing new technology that improves productivity of crops. In addition, government policy options, diversification is one of the major components of growth that influences output through its impact on cost, income and risk (Van and Keller, 2006).

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The sustained economic growth, rising per capita income and growing urbanization have caused a shift in the consumption patterns in favour of high valued crops like fruits and vegetables from staple food crops such as rice and wheat. In the recent past, demands for these high-valued crops such as fruits have grown much faster than that of food grains. Fruits play a significant role in nutritional improvement, employment generation, food and financial security of the farmers. In 2009-10, the national production and area of fruits were 1.09 million ton and 2.42 lakh hectares respectively.

The cultivation of mango has gaining momentum among the farmers in the Rajshahi region (especially in Barind area) due to its low water requirement, favourable agro-ecological conditions, ready market and profitability. In 2009-10, national production of mango, litchi and jujube were 10.48, 0.65 and 0.76 lakh ton respectively and corresponding areas were 3.35, 0.23 and 0.29 lakh hectares respectively (BBS, 2012). Due to land suitability, 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 shifting in favour of fruits has been suggested as a viable option to stabilize and augment farm income, enhance agricultural growth and increase employment opportunities (BARI, 2013). However, there is inadequate information about micro-level decision for area transformation/shifting of high valued crops such as fruits in Barind areas. Therefore, an attempt was taken to focus the profitability, factors responsible, challenge and opportunities of crop land transformation/shift into mango orchard in Barind area of Bangladesh.

METHODOS

Sampling technique and sample size: The study was conducted in Rajshahi and Chapai Nawabganj districts during June to August 2014. Tanore and Godagari upazilas of Rajshahi district and Gomastapur upazila of Chapai Nawabganj district were selected for the study. Field investigators under the direct supervision of researchers collected field level cross-sectional data using pre-tested questionnaire. A total of 85 mango growing farmers (55 from Rajshahi and 30 from Chapai Nawabganj) were randomly selected for interviewing. Out of 85 sample farms 8% farmers newly started mango farming and 30% have 10-12 years mango farming experiences (Table 1).

Table 1. Distribution of sample farmers by location

Location	Mango farming experience (year)					Total
	1-3	4-6	7-9	10-12	13-15	
Tanore	6	4	4	7	4	25
Godagari	1	13	6	8	2	30
Gomastapur	-	5	10	11	4	30
Total	7	22	20	26	10	85
Percentage	8	26	24	30	12	100

Analytical techniques

Collected data were edited, summarized, tabulated and analyzed to fulfil the objectives of the study. Using different statistical tools descriptive statistics like averages, percentages and ratios were used in presenting the results. The profitability of crops and mango 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. In addition, project appraisal technique was used to measure returns to investment on mango orchard using 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 lifetime. It was computed as:

$$NPV = \sum_{t=1}^{n} \frac{Bt - Ct}{(1+r)t}$$

Benefit cost ratio (BCR). The BCR of an investment is the ratio of discounted value of all cash inflows to the discounted value of all cash outflows during project life span. It was estimated as follows:

$$BCR = \sum_{t=1}^{n} \frac{Bt/(1+r)t}{Ct/(1+r)t}$$

Internal rate of return (IRR). The IRR is the rate of return at which the NPV of a stream of payments/incomes is equal to zero. It was computed as:

$$IRR = \sum_{t=1}^{n} \frac{Bt-Ct}{(1+r)t} = 0$$

Where,

Bt = Total benefit (Tk/ha) in time t

Ct = Total cost (Tk/ha) in time t

r = Rate of interest (discount rate)

t = Number of years (t = 1, 2, 3, ….n)

IRR = Lower discount rate + (Difference between the discount rates)*

$$\frac{\textit{Present worth of cash flow at the lower discount rate}}{\textit{Abslute differen between the present worth of the cash flow}}$$

RESULTS AND DISCUSSION

Socio-economic profiles of the farmers

Socio-economic 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, farm size and farming experience in cultivation were recorded for the study.

Age distribution: Age is an important factor that influences farmer's production decision, efficiency and adaptation of improved technologies. Farmers were older (46 years) in Godagari followed by Tanore area (40 years). Average age of the farmers was 42 years, which ranged from 27 to 64 years (Table 2).

Literacy status: Mean schooling years (around nine years) was almost similar among locations, which ranged from four to 14 schooling years (Table 2). Among the farmers, 34% belonged to primary level, 40% to secondary and 14% to above secondary levels.

Occupational status: A number of respondent farmers have both primary and secondary occupations. The respondent farmers of the study areas involved in various occupations such as agriculture, business and service for their livelihoods. About 84% farmers were engaged purely on agriculture and it was the highest in Gomastapur (90%) upazila followed by Tanore (83%) area (Table 2).

Farming experience: Mean farming experience was 21 years, which ranged from 8 to 45 years. Though farmers in the localities were more experienced in farming but their average mango farming experience was only nine years (Table 2). Only 25 and 50% farmers reported that they have been cultivating mango during the last 10 to 15 years and five to nine years respectively and the rest 25% farmers had one to four years of experience on mango cultivation.

Farm size: Average farm size was 1.81 ha (ranged from 0.62 to 4.09 ha) and mango orchard was 0.29 ha (ranged from 0.13 to 0.80 ha), which was 16% of the cultivated areas (Table 2). But farmers' reported that they are interested to increase mango area year by year.

Table 2. Socio-economic profile of the mango producing farmers

Item	Rajshahi		Chapai Nawabganj	All locations
	Tanore	Godagari	Gomastapur	
Age (yrs)				
Mean	40	46	38	42
Range	28-70	27-65	25-55	27-64
Education level (schooling yrs)				
Mean	9	9	8	9
Range	5-16	3-12	5-14	4-14
Occupation (%)				
Agriculture	83	80	90	84
Business	11	12	6	10
Service	6	8	4	6
Agril. farming experience (yrs)				
Mean	18	23	23	21
Range	6-50	8-46	10-40	8-45
Mango farming experience (yrs)				
Mean	9	8	10	9
Range	1-15	3-15	5-15	3-15
Total cultivated land (ha)				
Mean	1.89	1.96	1.57	1.81
Range	0.66-4.00	0.40-5.33	0.80-2.93	0.62-4.09
Mango cultivated land (ha)				
Mean	0.27	0.23	0.38	0.29
Range	0.13-0.80	0.13-0.80	0.13-0.80	0.13-0.80

Mango based cropping pattern: Table 3 shows the major mango based cropping patterns. It reveals that Wheat-Fallow-T. Aman (30%) and Mustard-Fallow-T. Aman (29%) patterns were dominant.

Table 3. Area coverage (%) under mango based cropping patterns

Cropping pattern	% area coverage			All locations
	Rajshahi		Chapai Nawabganj	
	Tanore	Godagari	Gomostapur	
Boro-Fallow-T. Aman	7	10	5	7
Wheat-Fallow-T. Aman	30	15	45	30
Mustard-Fallow-T. Aman	36	15	35	29
Chickpea-Fallow-T. Aman	15	30	-	15
Tomato-Fallow-T. Aman	-	20	-	7
Vegetable-Fallow-T. Aman	12	10	15	12
Total	100	100	100	100

Cost and return for crop production

Financial profitability of crop production was examined on the basis of gross margin (GM) analysis. Farmers allocated their land and other resources in crop production on the basis of land suitability, relative financial profitability and family needs. It also depends on prices of the products, cost of production and availability of production technologies. Table 4 shows the details of financial profitability of crop production or gross margin of crops grown in selected locations. In Rajshahi region, non-rice crops were more profitable (BCR ranged from 1.20 to 2.02) than rice crops (BCR ranged from 1.29 to 1.59). Among rice crops, HYV Boro rice was less profitable than T. Aman rice due to high irrigation and fertilizer costs associated with Boro rice cultivation (Table 4).

Table 4. Goss margin (Tk/ha) for rice and non-rice crops under mango based patterns

Crop	Yield (t/ha)	Sale price (Tk/kg)	Total variable cost (TVC) (Tk/ha)	Gross return (GR) (Tk/ha)	Gross margin (GM = GR-TVC) (Tk/ha)	Undiscoun-ted BCR = GR/TVC
Godagari, Rajshahi						
T. Aman	5.13	16.25	70,794	88,493	17,699	1.25
HYV Boro	5.30	16.12	77,552	90,736	13,184	1.17
Mustard	1.07	45.06	33,756	49,284	15,528	1.46
Tomato	18.50	8.25	75,550	1,52,625	77,125	2.02
Wheat	3.66	18.80	52,896	72,468	19,572	1.37
Chick Pea	1.26	48.06	45,750	60,550	14,800	1.32
Vegetables	10.16	10.25	66,500	1,04,140	37,640	1.56
Tanore, Rajshahi						
T. Aman	5.45	16.25	77,060	94,013	16,953	1.22
HYV Boro	5.70	16.12	84,856	97,584	12,728	1.15
Mustard	1.04	45.06	31,935	47,902	15,967	1.50
Wheat	3.53	18.80	49,924	69,894	19,970	1.40
Chick Pea	1.22	48.06	43,950	58,633	14,683	1.33
Vegetables	10.10	10.15	64,300	1,02,515	38,215	1.59
Gomastapur, Chapai Nawabganj						
T. Aman	5.42	16.25	74,202	93,495	19,293	1.26
HYV Boro	5.60	16.12	85,600	95,872	10,272	1.12
Mustard	1.11	45.06	35,753	51,127	15,374	1.43
Wheat	3.35	18.80	48,750	62,980	14,230	1.29
Vegetables	9.75	10.15	62,500	98,963	36,463	1.58

Cost and return for mango cultivation

Cost of production includes variable items like land preparation, human labour, sapling, manures, fertilizer, bamboo stick, insecticides etc. Both cash expenditure and imputed value of family supplied inputs were included in the analysis. Table 5 represents the cost of mango cultivation in study areas. Total cost of mango cultivation varied among years. Average higher production cost (Tk 47,003/ha) was observed in 1st quarter (year 1-3) followed by Tk 27,983/ha in 2nd quarter (year 4-6) and so on in Tanore area. Similar cost trend was observed in Godagari and Gomastapur areas. Table 5 presents the return from mango cultivation. In the 1st year, farmers did not get any product. Mango farmers usually start getting yield from the 2nd year of cultivation. They obtained on average 231 kg/ha mango yield in 1st quarter (year 1-3) and then production sharply reached to 2,190 kg/ha in 5th quarter (year 13-15). Almost similar trend was found in Godagari and Gomastapur areas. The highest gross return of mango was found in 5th quarter in all locations, which were Tk 1,01,358/ha, 1,06,432/ha and 1,09,408/ha in Tanore, Godagari and Gomastapur respectively. In 1st quarter, farmers gained negative gross return. The BCR (undiscounted) of 1st, 2nd, 3rd, 4th and 5th quarters were 0.29, 2.05, 3.19, 4.40 and 5.20 respectively in Tanore area, which indicates that increasing life span of mango orchard increases profitability. The analyses reveal that mango cultivation is more favourable in Gomastapur than Tanore and Godagari areas. Appendix 1 shows the details of year-wise cost and return estimation.

Table 5. Cost and return (Tk/ha) analysis for mango cultivation

Item	Life span of mango orchard (year)				
	1st quarter (1-3)	2nd quarter (4-6)	3rd quarter (7-9)	4th quarter (10-12)	5th quarter (13-15)
Tanore, Rajshahi					
Yield (kg/ha)	231	1211	1635	1906	2190
Sale price (Tk/kg)	47.5	47.5	47.5	47.5	47.5
Total return (Tk/ha)	10973	57349	76063	90519	101358
Total cost (Tk/ha)	47003	27983	23667	20600	20000
Gross return (Tk/ha)	-36030	29365	52396	69919	84025
BCR	0.29	2.05	3.24	4.40	5.20
Godagari, Rajshahi					
Yield (kg/ha)	240	1219	1604	1905	2241
Sale price (Tk/kg)	47.5	47.5	47.5	47.5	47.5
Total return (Tk/ha)	11400	57903	75905	90503	106432
Total cost (Tk/ha)	46003	28117	24033	20767	20000
Gross return (Tk/ha)	-34603	29785	51872	69737	86432
BCR	0.30	2.06	3.19	4.37	5.32
Gomastapur, Chapai Nawabganj					
Yield (kg/ha)	244	1233	1616	1926	2303
Sale price (Tk/kg)	47.5	47.5	47.5	47.5	47.5
Total return (Tk/ha)	11590	58583	76744	91469	109408
Total cost (Tk/ha)	45303	28116	23767	21200	20000
Gross return (Tk/ha)	-33980	30467	52978	70269	89408
BCR	0.31	2.09	3.26	4.33	5.47

Returns to investment in mango cultivation

Table 6 shows the results of project appraisal analysis (estimation of NPV, BCR and IRR). In this estimation we consider life span of mango orchard is 15 years. In study areas, discounted BCR was 1.44 at 15% discount rate, which is greater than unity and highly accepted. The estimated NPV of the enterprise was Tk 99,588 per hectare, which indicates that mango cultivation is profitable in Rajshahi area. The IRR was 28.09% that is highly acceptable because it is much higher than the opportunity cost of capital

Table 6. Estimation of NPV, BCR and IRR of mango cultivation in Rajshahi area

Discount rate	Discounted total benefit	Discounted total cost	Net present value (NPV)	Benefit cost ratio (BCR)
15	327141.40	227553.90	99587.50	1.44
20	243396.80	200224.90	43171.90	1.22
25	187082.00	180369.30	6712.70	1.04
30	147877.70	165438.10	-17560.40	0.89
IRR (%)				28.09

Agro-physiological information

Agro-physiological characteristics like canopy coverage (% of shading area), crops yield loss (%) due to shading and land loss (%) due to pit formation were estimated (Table 7). Increasing life span of mango orchard increases yield loss of both rice and non-rice crops. In 11-year-old mango orchard, intercrop yield reduced drastically (65%) indicating that intercrop production was not economically profitable.

Table 7. Agro-physiological information of mango orchard

Item	Life span of mango orchard (year)													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14-15
Tanore, Rajshahi														
Canopy coverage (%)	6	8	12	14	20	22	25	28	35	40	50	65	70	75-90
Yield loss (%)	6	8	12	15	18	25	28	35	40	50	60	65	75	80-85
Rice crop	5	7	10	13	15	20	22	30	35	40	50	55	65	75
Non-rice	7	9	14	17	21	30	34	40	45	60	70	75	80	85
Land loss (%) for pit	4	4	4	7	7	7	10	10	10	15	15	15	20	25
Godagari, Rajshahi														
Canopy coverage (%)	7	8	12	14	20	22	25	30	35	40	50	60	70	75-90
Yield loss (%)	6	8	12	15	18	25	28	35	40	50	60	65	75	80-85
Rice crop	5	7	10	13	15	20	22	30	35	40	50	55	65	75
Non-rice	7	9	14	17	21	30	34	40	45	60	70	75	80	85
Land loss (%) for pit	4	5	5	7	7	8	10	10	12	15	18	20	20	25
Gomostapur, Chapai Nawabganj														
Canopy coverage (%)	5	8	12	14	20	22	25	28	35	40	50	68	70	75-90
Yield loss (%)	6	8	12	15	18	25	28	35	40	50	60	65	75	80-85
Rice crop	5	7	10	13	14	20	22	32	35	40	48	55	65	75
Non-rice	7	9	14	17	22	30	34	38	45	60	72	75	80	85
Land loss (%) for pit	5	5	6	7	8	8	10	10	12	15	15	18	20	25

Information sources for land shifting

The sample farmers mentioned various sources from which they got information to switch over crop lands to mango cultivation for the first time. Major reported source was neighbouring farmers (43%). Farmers in the study areas were enthusiastic toward mango cultivation by observing positive benefits and, later seek help from neighbouring farmers. On average, 34% farmers reported that they cultivated mango for the first time without taking any help from others. They observed the technique of cultivation from others and did it themselves. Extension worker also helped farmers by supplying information on mango cultivation. About 14% farmers received information from relatives/friends (Table 8).

Table 8. Information sources for first time mango cultivation

Source of information	% respondent farmer			All locations
	Rajshahi		Chapai Nawabganj	
	Tanore	Godagari	Gomastapur	
Neighbouring farmers	35	43	52	43
Own experience	40	32	30	34
Relatives/friends	15	18	10	14
Extension worker/dealer	10	7	8	9
Total	100	100	100	100

Reasons for mango cultivation

The farmers were asked to mention the possibility of expanding their cultivated area for mango cultivation. They reported that they might increase mango area next year. Among all the responded, farmers in Chapai Nawabganj district showed higher level of interest than Rajshahi district farmers in increasing their cultivable area for mango orchard due to scarcity of water and favourable climate for mango cultivation. They want to shift their cultivable areas for mango in coming years because it is highly profitable enterprise (83%) and its cultivation process is easy (67%). About 70% farmers stated that they want to increase area because they have suitable mango land (70%) and favourable environment (71%) for mango cultivation (Table 9).

Table 9. Reasons for increasing mango cultivation

Item	% respondent farmer			All locations
	Rajshahi		Chapai Nawabganj	
	Tanore	Godagari	Gomastapur	
High profitable	81	87	82	83
Easy cultivation process	67	72	63	67
Climate change/water scarcity	70	60	95	75
Availability of suitable mango land	65	60	85	70
Favourable environment for mango	70	68	75	71
Needs less labour	68	62	65	65

Impact of mango cultivation on farm income

Mango cultivation has created tremendous impact on farm income. About 92% respondent farmers mentioned positive impacts to some extent on household income, food intake and livelihoods improvement due to shifting of crop lands to mango orchards (Table 10). More than 83% farmers obtained increased income and about 67% achieved better livelihoods. The amount of food intake has also been increased to some extent for some of the respondent households (48%). But farmer also reported that in the long run, mango cultivation may decrease both rice and non-rice land (65%) and thus lead to decreased food grain, pulses, oil seed and vegetables production (55%), which may threaten food security in the area (Table 10).

Table 10. Impact of mango cultivation on farm income, livelihood and food security

Item	% respondent farmer			All locations
	Rajshahi		Chapai Nawabganj	
	Tanore	Godagari	Gomastapur	
Positive impact	94	85	97	92
Negative impact	6	15	3	8
Types of positive impact				
Increase in household income	81	87	82	83
Increase in livelihoods	67	72	63	67
Increase in food production/intake	46	51	47	48
Less water requirement	90	85	95	90
Types of negative impact				
Decrease food grain/pulses/oil seed/vegetable production	50	45	55	50
Decrease non rice land	65	75	55	65

Constraints to mango cultivation

Although mango is a profitable crop, there are some constraints to its higher production (Table 11). The first and foremost constraints to mango cultivation reported by farmers were lack of technological support and training (75%) followed by disease and insect infestation (71%). As mango tree plantation in crop land is a new idea, many of the farmers were not trained about the technology of cultivation. Mango cultivation required higher cost, especially in 1st year. Therefore, some marginal and small farmers were not able to cultivate this crop, although they were very much enthusiastic to cultivate it. Lack of transport facilities (64%) and marketing facilities (63%) were other constraints to mango cultivation (Table 11).

Table 11. Constraints to mango cultivation in Barind area

Item	% respondent farmer			All locations
	Rajshahi		Chapai Nawabganj	
	Tanore	Godagari	Gomastapur	
Insect and disease infestation	63	74	75	71
Lack of technological support and training facilities	75	70	80	75
Lack of credit access	60	45	70	58
Lack of transport facilities	70	45	75	64
Lack of marketing facilities	64	55	70	63
Lack of suitable mango land	52	54	45	51

CONCLUSIONS

The study assessed the profitability of mango cultivation in comparison to rice/non-rice crops cultivation. Although mango cultivation required initial higher cost, it received higher net return as well as BCR compared to other crops. This is the main reason for which farmers are more interested to shift their crop land to mango. Besides, farmers' attitudes toward area substitution for mango orchard seemed to be very positive due to water scarcity, high profitability, easy cultivation process, land suitability and favourable environment for mango cultivation. Although mango is a profitable crop, 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 insects infestation, lack of training, credit and marketing facilities. Mango cultivation also has positive impact on household income and livelihoods pattern but some farmers reported that increasing mango area may decrease rice and non-rice production. Farmers reported various sources from which they were motivated to cultivate mango.

RECOMMENDATIONS

Following recommendations are put forwarded for crop land transformation and sustainable mango cultivation with respect to climate change impact adaptation, food security and economic profitability.

- Cultivation of mango is gaining popularity due to its low water requirement, favourable agro-ecological conditions, ready market and profitability, which leads to increasing mango area year by year in Barind region. So, there is a possibility to decrease food grain, pulses, oil seed and vegetables production in the long run that may threaten food security in the area. Therefore, government should take necessary steps for planned mango cultivation retaining crop land for food grain along with ensured credit facilities for orchard cultivation, preservation and marketing.

- Researchers and extension workers may provide technological support and training to mango growers for better and sustainable production under changing climatic situations.

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Appendix 1. Cost and return (Tk/ha) analysis for mango cultivation.

Item	Life span of mango orchard (year)													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14-15
Tanore														
Yield (kg/ha)	0	177	516	965	1242	1415	1518	1562	1724	1842	1886	1989	2070	2250
Sale price (Tk/kg)	-	47.5	47.5	47.5	47.5	47.5	47.5	47.5	47.5	47.5	47.5	47.5	47.5	47.5
Total return (Tk/ha)	0	8408	24510	45838	58995	67213	72105	74195	81890	87495	89585	94478	98325	106875
Total cost (Tk/ha)	66500	35710	38800	28450	27750	27750	26000	22500	22500	21400	20400	20000	20000	20000
Gross eturn (Tk/ha)	-66500	-27302	-14290	17388	31245	39463	46105	51695	59390	66095	69185	74478	78325	86875
BCR	-	0.24	0.63	1.61	2.13	2.42	2.77	3.30	3.64	4.09	4.39	4.72	4.92	5.34
Godagari														
Yield (kg)	0	190	530	965	1242	1450	1508	1562	1724	1810	1886	2020	2122	2300
Sale price (Tk/kg)	-	47.5	47.5	47.5	47.5	47.5	47.5	47.5	47.5	47.5	47.5	47.5	47.5	47.5
Total return (Tk/ha)	0	9025	25175	45838	58995	68875	71630	74195	81890	85975	89585	95950	100795	109250
Total cost (Tk/ha)	64500	35310	38200	28450	28150	27750	26700	22900	22500	21400	20900	20000	20000	20000
Gross eturn (Tk/ha)	-64500	-26285	-13025	17388	30843	41125	44930	51295	59390	64575	68685	75950	80795	89250
BCR	-	0.26	0.65	1.61	2.10	2.48	2.68	3.24	3.64	4.02	4.29	4.80	5.04	5.46
Gomastapur														
Yield (kg)	0	182	550	985	1250	1465	1548	1575	1724	1842	1910	2025	2210	2350
Sale price (Tk/kg)	-	47.5	47.5	47.5	47.5	47.5	47.5	47.5	47.5	47.5	47.5	47.5	47.5	47.5
Total return (Tk/ha)	0	8645	26125	46788	59375	69587	73530	74813	81890	87495	90725	96188	104975	111625
Total cost (Tk/ha)	62300	35110	38500	28850	26750	28750	26300	22500	22500	22200	21400	20000	20000	20000
Gross eturn (Tk/ha)	-62300	-27265	-12375	17938	32625	40837	47230	52313	59390	65295	69325	76188	84975	91625
BCR	-	0.25	0.68	1.62	2.22	2.42	2.80	3.33	3.64	3.94	4.24	4.81	5.25	5.58