Research in
AGRICULTURE, LIVESTOCK and FISHERIES
ISSN : P-2409-0603, E-2409-9325
An Open Access Peer-Reviewed Journal

Open Access **Res. Agric. Livest. Fish.**
Research Article **Vol. 6, No. 1, April 2019 : 35-43.**

ECONOMIC ANALYSIS OF KHIRSHAPATI (*Mangifera indica L.*) MANGO CULTIVATION IN SELECTED AREAS OF BANGLADESH

Muhammad Shahrukh Rahman[1]* and Mashrufah Khatun[2]

[1]Agricultural Economics Division, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur-1701, Bangladesh; [2]Department of Agricultural Finance, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh.

***Corresponding author:** M. Shahrukh Rahman; E-mail: msr_30bau@yahoo.com

ARTICLE INFO

Received
04 April, 2019

Accepted
20 April, 2019

Online
30 April, 2019

Key words:
Mango
Khirshapati
Profitability
Production function
Rates of return

A B S T R A C T

The study was conducted to assess the profitability of Khirshapati variety mango cultivation and to analyze factors affecting productivity of this variety in four districts namely Khagrachori, Bandorban, Naogaon, and Satkhira of Bangladesh during February to March, 2018. Data were collected from 72 mango orchards using random sampling method. Descriptive statistics, profitability analysis and Cobb-Douglas type production function was used to analyze data. The per hectare gross cost, gross return and net return were Tk. 507817,Tk. 72,8419 and Tk. 22,0602 respectively for the 6-7 years of Khirshapati mango orchard. Net present value was Tk. 65,343 and benefit cost ratio was 1.16 which ensures that investment in mango cultivation is financially feasible. Mango cultivation was also found to be a profitable enterprise since internal rate of return was 20%.The functional analysis indicates that per hectare yield were significantly positively influenced by age of the orchard, number of tress and amount of fertilizer. The results also show that area and amount of manure had significant negative effects. So a proper initiative should be taken to disseminate this information among the mango growers to sustain the yield of Khirshapati mango in Bangladesh.

To cite this article: Rahman M. S. and M. Khatun, 2019. Economic analysis of Khirshapati (*Mangifera indica L.*) mango cultivation in selected areas of Bangladesh. Res. Agric. Livest. Fish. 6 (1): 35-43.

INTRODUCTION

Mango (*Mangifera indica L.)* is one of the most luscious fruit of the world, which occupies a prime position in the international fruit processing industry of the world. It is the most choicest and popular fruit among the people of orient and is designated as the 'King of Fruits' (Purseglove, 1972) because of its excellent flavour, attractive fragrance, beautiful shades of colour and delicious taste with high nutritive value (Singet al.,2013). Generally mango is consumed at all stages of fruit development from the tiny imperfectly set fruits, that shed abundantly on to develop beyond the initial stage to the fully mature ones and the nutritional value of mango varies from variety to variety and developmental stages of the fruit including mature and ripened stage (Leghari et al., 2013; Rahman and Khatun, 2018). Mango is the national tree of Bangladesh. Among the fruits in Bangladesh mango ranks second in terms of area coverage (25%) and production (24%) (Rahman and Khatun, 2018). It has a strong economic impact on the economy of Bangladesh. Bangladesh is the world's eighth largest mango producing country contributing 3.9 percent of total mango production in the world (Rahman and Khatun, 2018). Mango was cultivated in 50694 hectares of land and production was 187375 metric tons in 2001-02 (Rahman et. al. 2019). In 2015-16, mango acreage was 37823 hectares with the highest level of production i.e., 1161685 metric tons (Rahman and Khatun 2018). Area under mango production is fluctuated over the last decades whereas total production has been increased in Bangladesh. But production of fruits is still far behind the countries present requirement. About 78gm fruit is available per person in Bangladesh whereas 200gm is the daily requirement (BBS, 2017; Rahman et. al. 2019). In order to overcome these, there is a necessity to boost production as well as strengthen the mango-related economy of the country. Khirshapati mango is one of the most popular and tastiest variety that are produced in Bangladesh, making up about 20-25% of the total mango production in the country each season. This variety is also on the top of the mango export list. Meeting the local demands, Khirshapati is exported to many countries of Europe and the Middle East. The Khirshapati mangoes popularly known as Himsagar, has received the Geographical Indication (GI) as the third product from Bangladesh (Daily Prothom Alo, 2019).

The inside of Khirshapati is yellow to orange in color and does not have any fiber. The fruit is medium-sized and weighs between 250 and 350 grams, out of which the pulp content is around 77%. It has a good keeping quality. Flavor is delightful, well blended with a tinge of turpentine and taste is very sweet having abundant juice. It is an early variety of mango (Srivastava, 1998; Laureate et al., 2017). Khirshapati ripens in May and it is available in the market from the second week of June to the end of June. Laureate et al. (2017) conducted a study to develop post-harvest management options that can optimize marketing of Himsagar mango without loss of quality. Singh et al. (2013) studied the suitability and profitability aspects of different intercrops for young mango orchard cv. Himsagar. Matin et al. (2008) analyzed the marketing of mango in selected areas of Bangladesh. Postharvest handling of key actors in mango supply chains and the post-harvest losses at different stakeholder level were assessed by Miah et al. (2018). However, some studies were conducted on BARI released mango varieties by Rahman and Khatun (2018), Rahman et al. (2019), Barua et al. (2013), Shiblee (2015) and Uddin et al. (2018). But there is no in depth study for measuring profitability of Khirshapati mango variety cultivation and identifying the major factors that affect the yield of this variety. Therefore, the present study was conducted to assess the profitability of Khirshapati mango cultivation and also to estimate the factors affecting the productivity of Khirshapati mango orchard.

MATERIALS AND METHODS

Primary data were collected from four districts namely Khagrachori, Satkhira, Bandarban, and Naogaon of Bangladesh by using interview schedule during the month of February to March, 2018. A preliminary survey was conducted in Sadar Upazila of Khagrachori district for pre-testing the survey schedule. Two Upazilas from each district were purposively selected for selecting sample orchards. A total of 72 mango orchards were randomly selected for the study. The distribution of sample orchards is presented in the following Table 1.

Table 1. Distribution of sample orchards

Locations		Khirshapati Orchard (No.)				Total
		Up to 1 year	1-3 year	3-5 year	> 5 year	
Khagrachori	Khagrachori Sadar	1	1	1	6	9
	Dighinala Upazila	1	1	1	6	9
Bandorbon	Bandorban Sadar	1	1	1	6	9
	Ali Kadam Upazila	1	1	1	6	9
Satkhira	Satkhira Sadar	1	1	1	6	9
	Kaliganj Upazila	1	1	1	6	9
Naogaon	Naogaon Sadar	1	1	1	6	9
	Sapahar Upazila	1	1	1	6	9
	Total	8	8	8	48	72

Source: Field Survey, 2018

Table 2. Average cost of Khirshapati mango cultivation (Tk. / ha)

Items	Age of mango tree (year)						All years	% of total cost
	Up to 2	2-3	3-4	4-5	5-6	6-7		
A. Variable Cost (Tk.)	64240	20849	38367	26782	29383	34397	214018	82
Hired labor	13832	5187	21400	6805	8810	10824	66858	25
Saplings	41990						41990	16
Manures	494	988	1976	1580.8	1785.81	1679.6	8504.21	3
Fertilizers								
Urea	395	1186	1581	1778	1976	1976	8892	3
TSP	1037	1176	1383	1729	2075	3112	10512	4
MoP	445	1467	1556	1667	1867	2001	9003	3
Insecticides	2470	5291	6422	8233	8645	9386	40446	15
Irrigation	1057	1156	2999	3075	2680	3631	14598	6
Miscellaneous	2519	4399	1050	1914	1544	1788	13215	5
B. Fixed cost (Tk.)	53171	45717	54233	46100	46631	47947	293799	18
Family Labour	8210	2841	11278	2964	3458	4594	33345	13
Interest on operating capital (Tk.)	3794	1709	1788	1969	2006	2186	13452	5
Rental value of land (Tk./year)	41167	41167	41167	41167	41167	41167	247002	1
C. Total Cost (A+B) (Tk.)	117411	66566	92600	72882	76014	82344	507817	100

Source: Field Survey, 2018

Analytical Techniques

Descriptive Statistics

Descriptive statistics i.g. sum, average and percentages were used to analyze the data.

Statistical technique

The profitability of mango production was measured by the following analytical techniques as did in Rahman et al. (2019).

Gross return

Gross return was calculated by multiplying to total volume of output by per unit price in the harvesting period. The following equation was used to estimate gross return:

$$GR = P \times Q$$

Where,

GR = gross return (Tk.);
P = price of product (Tk. /kg) and
Q = quantity of product (Kg)

Gross margin

Gross margin was the difference between gross or total return and variable cost. The following equation was used to assess the gross margin:

$$GM = GR - TVC$$

Where,

GM = gross margin;
GR = gross return and
TVC = total variable cost

Net return

Net return analysis considered fixed costs i.e., land tax value, interest on operating capital, etc. It was calculated by deducting all costs (variable and fixed) from gross return. Net return of mango production was calculated as:

$$\Pi = GR - TC = GR - TVC - TFC$$

Where,

Π = net return (Tk.) and
TFC = total fixed cost (Tk.)

Capital budgeting

Capital budgeting is the decision making process by which an organization evaluates its capital investment. For proper evaluation, time value of money is important. There are three capital budgeting methods considering time value of money which are NPV, BCR and IRR (Pandey, 2005). These methods are discussed below.

Net present value (NPV)

NPV is the difference between the present value of cash inflows and the present value of cash outflows. NPV was calculated by using the formula:

$$\text{Net present value (NPV)} = \sum_{t=1}^{t=n} \frac{B_t - C_t}{(1+i)^t}$$

Where,

B_t= Benefit in each year;
C_t= Cost in each year;
t= Number of years and
i= Interest (discount rate)

Acceptance rule:

NPV>0; the investment is accepted;
NPV<0; the investment is rejected and
NPV = 0; indifferent

Benefit cost ratio (BCR)

The benefit cost ratio (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. In the present study, BCR was calculated as

$$\text{Benefit Cost Ratio} = \sum_{t=1}^{t=n} \frac{B_t}{(1+i)^t} \Big/ \sum_{t=1}^{t=n} \frac{C_t}{(1+i)^t}$$

Acceptance rule:

BCR>1; the investment is accepted;
BCR<1; the investment is rejected and
BCR=1; indifferent

Internal rate of return (IRR)

IRR reflects the income earning capacity of an investment. It is a discount rate that makes NPV of a particular project equal to zero, i.e., in the case of IRR,

$$\text{Internal rate fo return (IRR)} = \sum_{t=1}^{t=n} \frac{B_t - C_t}{(1+i)^t} = 0$$

Alternatively, IRR can be calculated as

$$\text{IRR} = \text{LDR} + \frac{\text{NPV}_{\text{LDR}}}{|\text{NPV}_{\text{LDR}} - \text{NPV}_{\text{HDR}}|} \times (\text{HDR} - \text{LDR})$$

Where,

LDR = lower discount rate (%);
HDR = higher discount rate (%) and
‖ = absolute value

Acceptance rule:

IRR> RRR; the investment is accepted; RRR = required rate of return (%);
IRR<RRR; the investment is rejected and
IRR=RRR; indifferent

The discount rate or interest rate should be equal to the opportunity cost of capital, that is, the rate of interest which could be obtained in the best alternative investment or the rate of interest on borrowed capital. The discount rate was specified by assuming the opportunity cost of capital which is 12% for most of the developing countries (Gittinger, 1984).

Production function analysis

The form of Cobb-Douglas production function was used to identify the factors influencing the yield of mango. In order to estimate the function, all the variables were considered on per hector basis.
The functional form is as follows-

$$\ln Y = ln\alpha_1 + \beta_1 lnX_1 + \beta_2 lnX_2 + \ldots\ldots\ldots + \beta_7 lnX_{7+} u_i$$

Where,

Y = Yield (kg/ha)
X_1 = Age of the orchard (years)
X_2 = Area under mango production (ha)
X_3 = Number of trees/ha
X_4 = Use of human labour (man days/ha)
X_5 = Use of manures (kg/ha)
X_6 = Use of insecticides (Tk/ha)
X_7 = Fertilizer (Tk/ha)
$\beta_1, \beta_2, \ldots\ldots\ldots, \beta_7$ are the regression coefficients of $X_1, X_2, \ldots\ldots\ldots, X_7$ respectively and u_i is the error term

RESULTS AND DISCUSSIONS

Profitability of Khirshapati Mango Farming

Table 2 depicts the per hectare average cost of Khirshapati mango cultivation by items in the study areas. Hired labour was the highest costing items (25%) following by sapling cost (16%) and cost for insecticides (15%). The highest used fertilizer was TSP (4%), while the lowest was the Urea (3%) and MoP (3%). From the establishment year to two years per hectare total cost was Tk. 117411 where the major cost item was cost of saplings. Only three items were considered as fixed cost for the mango orchard viz., family labour, interest on operating capital (IOC) and rental value of land in the study areas as did in Rahman et aI. (2019). The total cost of one hectare of Khirshapati mango orchard was estimated to Tk. 507817for a 6-7 years orchard.

The per hectare average return from Khirshapati mango orchard in the study areas are shown in Table 3.The study found that it is not possible to get commercial yield from Khirshapati trees up to 3-4 years of the plant. Therefore, gross returns were assumed zero up to this time and gross margin and net return becomes negative as total cost is high enough at that time. Returns were considered from the start of 4-5 year and onward because during that period, output was produced in such amount that could be marketed. As much as the plant age of Khirshapati, its yield was also increased. Net return was Tk.220602 from one hectare of orchard up to 6-7 years old.

Capital budgeting of khirshapati mango orchard

Net present value (NPV)

NPV appeared to be positive and greater than zero which is Tk. 65343 (Table 4). So, this mango production is acceptable and profitable investment. Further, it implies that the owner became able to increase his wealth by Tk. 65343 per hectare of mango production at the end of 6-7 years of plants age.

Benefit cost ratio (BCR)

BCR was found to be 1.16 which indicates that the mango growers earned an extra earning of Tk. 116 by investing Tk. 100 per one hectare of Khirshapati mango orchard (Table 4). It also shows that investment in mango cultivation is economically justifiable.

Internal rate of return (IRR)

Trial and error approach produced IRR of Khirshapati mango orchard was 20% which is greater than the existing bank interest rate (Table 4). So, it assures that investing in Khirshapati mango orchard was secured reasonably which ensured a satisfactory profit for the investors.

Table 3. Profitability of Khirshapati mango cultivation

Items	Age of mango tree (year)						All years
	Up to 2	2-3	3-4	4-5	5-6	6-7	
No. of tree	100	100	100	100	100	100	600
A. Total cost (Tk./ha)	117411	66566	92600	72882	76014	82344	507817
Variable cost (Tk./ha)	64240	20849	38367	26782	29383	34397	214018
Fixed cost (Tk./ha)	53171	45717	54233	46100	46631	47947	293799
B. Average yield (kg)	--	--	--	4661	7069	7957	19687
C. Average price (Tk/kg.)	--	--	--	35	38	39	37
C. Gross return (Tk./ha)	--	--	--	163135	268622	310323	728419
F. Gross margin (Tk./ha)	-64240	-20849	-38367	136353	239239	275926	514401
G. Net return (Tk./ha)	-117411	-66566	-92600	90253	192608	227979	220602

Table 4. Per hectare rate of returns to investment on Khirshapati mango orchard

Year	Gross cost (Tk)	Gross benefit (Tk)	Present worth of gross cost at 12%	Present worth of gross benefit at 12%
0	117411	0	117411	0
1	66566	0	59434	0
2	92600	0	73820	0
3	72882	163135	51876	116116
4	76014	268622	48308	170714
5	82344	310323	46724	176086
Total			397573	462916
NPV			65343	
BCR			1.16	
IRR			20%	

Table 5. Regressing coefficients of log linear function

Sl. No.	Resource	Regressing coefficients
1	X_1 = Age (Year of the orchard)	.998 (.002)***
2	X_2= Area (ha)	-.203 (.071)***
3	X_3= Trees (No./ha)	.952 (.023)***
4	X_4 = Human labour (man days)	-.005 (.016)
5	X_5 = Manures (kg)	-.041 (.020)**
6	X_6 = Insecticides (Tk)	.176 (.105)
7	X_7 = Fertilizer (Tk.)	.067 (.024)***
	Intercept	.434 (.009)
	R^2	.99

(Figures in the parenthesis indicate standard error); (***) Significant at 1% level; (**) significant at 5% level

Functional analysis

In order to find out the effect of various inputs on productivity of Khirshapati mango log linear forms of function (CD type) for per hector of orchard input were estimated. Estimated values of co-efficient and related statistics of Cobb-Douglas production function is presented in Table 5. It is found that the elasticity coefficients of year of the orchard (X_1), number of trees (X_3) and amount of fertilizer (X_7) were positively significant at 1% level of probability which indicated that 1% increase of these variables would increase the productivity by 0.998, 0.952 and 0.067 percent respectively keeping other factors constant. The elasticity coefficient of mango cultivation area (X_2) was negatively significant (-.203) at 1% level indicating productivity decreases by including more area in mango cultivation. Besides, the elasticity coefficient of manures was also found to be negatively significant at 5 % level means that keeping other factors constant productivity decreases by using more manure. The value of R^2 was .9979 indicated 99.79% variation in the yield of mango was explained by all the variables included in the analysis.

CONCLUSION AND RECOMMENDATION

Khirshapati mango cultivation is profitable in the study areas because it gives higher net return. Major costs were incurred for hired labor, cost of saplings and insecticides. Based on the results of BCR, NPV and IRR, it signifies that Khirshapati mango cultivation has a good potentiality in Bangladesh. It is also found that the coefficient of age, area, number of trees, manure and fertilizer have significantly impact on yield of mango. As mango cultivation is a profitable enterprise so the combined efforts of government and other research institutions are essential to expand mango production. Thus the present study might be useful for the researcher, policy makers and to other concerned authorities for conducting further research and formulating appropriate policy for widespread cultivation of mango in Bangladesh.

ACKNOWLEDGEMENT

Authors are thankful to Director General, Bangladesh Agricultural Research Institution, Gazipur for funding the research. Authors acknowledged their thanks to the Agricultural officer of study areas as local facilitator to conduct the survey and also the mango farmers for sharing valuable inputs. The authors are grateful to the anonymous reviewers for their valuable comments to improve the paper.

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