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Comparative profitability of sole pineapple, pineapple-papaya and pineapple-banana-arum cultivation in Tangail District of Bangladesh

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Abstract

The focus of the study was to evaluate the comparative profitability of sole pineapple, pineapple-papaya and pineapple-banana-arum cultivation at Madhupur and Ghatail Upazilas of Tangail district in Bangladesh. Data from 90 randomly selected farmers, 30 each from sole pineapple, pineapple-papaya and pineapple-banana-arum categories, were collected through face-to-face interview using a set of pre-tested questionnaires. Profitability analysis was used to estimate the comparative profitability and Cobb-Douglas type production function technique was used to identify the factors influencing gross return. The major findings of the study revealed that sole pineapple, pineapple-papaya and pineapple-banana-arum cultivation in the study areas were profitable, among which, pineapple-papaya cultivation was relatively more profitable than the two other patterns. It was evident from Cobb-Douglas type production function that seed, human labour, fertilizer, insecticide, power tiller and manure had significant impact on gross return from sole pineapple, pineapple-papaya, pineapple-banana-arum production.

Introduction

Bangladesh is an agro-based country and predominantly an agrarian economy (Mohammad, 2012). The agriculture sector contributes 14.79 percent to gross domestic product (GDP) in which 7.92 percent comes from crops and vegetables, 1.60 percent from livestock, 1.66 percent from forestry and 3.61 percent from fisheries (MoF, 2017). Fruits play a vital role in the overall economic performance of Bangladesh. The production of fruits including pineapple is increasing day by day in Bangladesh (Khalil *et al.*, 2011). Apart from the consumption as a juicy and nutritious fruit, pineapple is also referred as a medical diet for certain diseased persons.

Pineapple is originated in Brazil in South America. It was imported to Europe later. It is also believed that Christopher Columbus and his crew members were probably the first few from the European continent to have tasted the fruit. The word pineapple in English was first recorded in 1938, when it was originated, used to describe the reproductive organs of conifer trees (now termed pine cones). When European explorers discovered this tropical fruits they called them pineapples (term first recorded in that sense in 1664) because of their resemblance to what is now known as the pine cone. The term pinecone was first recorded in 1694, and was used to replace the original meaning of pineapple (Gazi, 2013).

Pineapple is one of the major commercial and popular fruits in Bangladesh because of its exclusive flavor, pleasant aroma, delicious taste, nutritional and medicinal values. It is widely cultivated in Tangail, Mymensingh, Gazipur, Sylhet, Moulvibazar, Chattagram, Bandarban, Khagrachari and Rangamati districts. At least ninety varieties of pineapple are cultivated in the world. In Bangladesh, however three varieties of pineapple are mostly grown. These are: Giant Kew, Honey Queen, and Ghorasal (Hossain and Islam, 2017). Bangladesh produces 200701 tonnes of pineapple per annum from 33498 acres of land (BBS, 2016). Total area and production of pineapple has increased steadily during the last decades. Pineapple cultivation was found to be profitable in different studies (Hossain, 2018; Fakir, 2017; Swarna, 2017). Mono pineapple and pineapple intercrops study was also found profitable in Tangail district (Gazi 2013). Pineapple cultivation had positive impact on farmers' livelihood and they showed positive attitude towards pineapple cultivation with intercrops.

The present study focuses on assessing the relative profitability of sole pineapple, pineapple-papaya and

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pineapple-banana-arum cultivation in Tangail district of Bangladesh.

Materials and Methods

Selection of study area and sampling technique

The area in which a farm survey has to be carried out depends on the purposes of the survey and possible co-operation from the farmers (Yang, 1965). The present study was based on field survey method where primary data were collected from the respondents through direct interviews. Ninety randomly selected farmers from four villages of Madhupur and Ghatail Upazilas of Tangail district of Bangladesh were interviewed for the present study (Table 1).

Table 1. Distribution of Sample Farmers of the Study Area

Selected Upazila	Selected villages	Sample size (No.)			Total sample size (No.)
		Sole pineapple farmers	Pineapple - papaya farmers	Pineapple- banana-arum farmers	
Madhupur	Gachabari	10	10	5	25
	Aushnara	5	10	5	20
Ghatail	Kusharia	5	5	10	20
	Makrai	10	5	10	25
Total		30	30	30	90

Source: Field survey, 2015

Analytical Technique

Data were analyzed with a combination of tabular and functional analysis. Per hectare profitability of sole pineapple, pineapple-papaya, pineapple-banana-arum production from the view point of individual farmers was measured in terms of gross return, gross margin, net return and benefit cost ratio (undiscounted). Here we also used Cobb-Douglas type production function to estimate the effects of inputs on gross return.

Gross return

Gross return (GR) was calculated by multiplying the total volume of output of an enterprise by the average price in the harvesting period (Dillon and Hardaker, 1993).

The following equation was used to estimate GR:

Gross return, $GR = \Sigma QP$ … (1)

Where, GR= Gross return from product (Tk./ha); Q= Quantity of the product; P= Average price of the product(Tk./ha)

Gross margin

Gross margin was calculated by subtracting the total variable costs from the gross return, showed in the following equation.

GM = GR-TVC … (2)

Where,

GM = Gross margin (Tk./ha); GR = Gross return (Tk./ha); and TVC = Total variable cost (Tk./ha).

Net return

Net return was calculated by deducting total costs from gross return as shown in the equation 3. To determine the net return of pineapple production, the following equation was used in the present study:

Net Return, NR= Σ(GR-TC) … (3)

Where,

GR= Gross return from product (Tk./ha); TC= Total cost (Tk./ha)

Benefit cost ratio (BCR)

The BCR is a relative measure, which is used to compare benefit per unit of cost (Chowdhury *et al*., 2014). The BCR was estimated as a ratio of gross returns and gross costs. The formula of calculating BCR (undiscounted) is shown below:

Benefit cost ratio, $BCR = \frac{Gross return}{Total cost}$ ..... (4)

Functional Analysis

To explore the relationship between input and gross return, the Cobb-Douglas type production function was used. Since the model proved superior on theoretical and econometric grounds, this function was chosen on the basis of the best fit. The following model was used in this study:

$Y = aX_1^{b1} X_2^{b2} X_3^{b3} X_4^{b4} X_5^{b5} X_6^{b6} X_7^{b7} U$ … (5)

The model was made linear in the logarithmic form as follows:

$\ln Y = \ln a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + b_7 \ln X_7 + U$ … (6)

Where, Y =Gross return (Tk./ha); X_1=Seed cost (Tk./ha); X_2=Human labor cost (Tk./ha); X_3= Fertilizer cost (Tk./ha); X_4=Insecticides cost (Tk./ha); X_5=Power tiller cost (Tk./ha); X_6= Vitamin cost (Tk./ha); X_7= Manure cost (Tk./ha); ln=Natural logarithm; a =Constant/Intercept; b_1, b_2……b_7= Coefficients of the respective variables; and U = Error term.

Results and Discussion

Cost and Return of Pineapple Production

Estimation of cost was exclusively necessary for enterprise costing and subsequently determining the viability of the enterprise from the view point of producers. The farmers used different inputs for pineapple production.

Cost of human labour

Human labour was considered as the most important and largely used input in producing pineapple. It shared a large portion of total cost of production. Labour required for different farm operations were: land preparation, planting, mulching, weeding, irrigation, insecticide application, application of fertilizer, harvesting, carrying, drying, storing. It could be seen from Table 2 that the cost of human labour for sole pineapple,

pineapple-papaya, pineapple-banana-arum cultivation were Tk. 76300.00, Tk. 87500.00, Tk. 96250.00, respectively.

Cost of power tiller

Power tiller is time and labour saving modern tillage technology. It was used for cultivation of land for pineapple production. It is evident from Table 2 that per hectare power tiller cost for sole pineapple, pineapple-papaya and pineapple-banana-arum cultivation were Tk. 7700.00, Tk. 9500.00 and Tk. 9800.00, respectively.

Cost of seed

Seed is the most important input for pineapple production. Per hectare total cost of seed for sole pineapple, pineapple-papaya, pineapple-banana-arum were Tk.63700.00, Tk. 61500.00 and Tk. 61100.00, respectively (Table 2).

Cost of manure

In the study area, farmers generally used cow dung as manure in producing pineapple. Table 2 showed that per hectare cow dung costs for sole pineapple, pineapple-papaya, pineapple-banana-arum production were Tk. 5705.00, Tk. 8500.00, Tk. 5500.00, respectively.

Table 2. Total cost and return per hectare for sole pineapple, pineapple-papaya and pineapple-banana-arum production

Sole pineapple		Pineapple-papaya		Pineapple-banana-arum	
Items	**Total value (Tk.)**	**Items**	**Total value (Tk.)**	**Items**	**Total value (Tk.)**
A. Gross return		**A. Gross return**		**A. Gross return**	
Pineapple	508000.00	Pineapple	486400.00	Pineapple	472000.00
		Papaya	120312.00	Banana	74000.00
				Arum	40000.00
Total Return	508000.00	**Total Return**	606712.00	**Total Return**	586000.00
Human Labour :		Human Labour :		Human Labour :	
Land preparation	17500.00	Land preparation	21000.00	Land preparation	22750.00
Planting, fertilizer application	25550.00	Planting, fertilizer application	28000.00	Planting, fertilizer application	31500.00
Weeding	14700.00	Weeding	15750.00	Weeding	17500.00
Harvesting and carrying	18550.00	Harvesting and carrying	22750.00	Harvesting and carrying	24500.00
Total	76300.00	Total	87500.00	Total	96250.00
Power tiller	7700.00	Power tiller	9500.00	Power tiller	9800.00
Seedling	63700.00	Seedling of pineapple	61200.00	Seedling of pineapple	59500.00
		Seedling of papaya	3000.00	Sucker of banana	1000.00
				Seeds of arum	600.00
Manure: Cow-dung	5705.00	Manure: Cow-dung	8500.00	Manure: Cow-dung	5500.00
Fertilizer: Urea	12800.00	Fertilizer: Urea	12800.00	Fertilizer: Urea	9600.00
TSP	14950.00	TSP	16100.00	TSP	11500.00
MP	9000.00	MP	9750.00	MP	6750.00
Gypsum	5500.00	Gypsum	4950.00	Gypsum	4400.00
Total	42250.00	Total	43600.00	Total	32250.00
Insecticides	9681.00	Insecticides	9392.00	Insecticides	16793.00
Vitamin	12312.00	Vitamin	11500.00	Vitamin	12263.00
				Irrigation	9600.00
Total variable cost	**217648.00**	**Total variable Cost**	**234192.00**	**Total variable cost**	**243556.00**
Fixed Costs		**Fixed Costs**		**Fixed Costs**	
Interest on operating capital	17956.00	Interest on operating capital	19320.00	Interest on operating capital	20093.00
Land use cost	78590.00	Land use cost	78590.00	Land use cost	78590.00
Depreciation on farm implements	7361.00	Depreciation on farm implements	9202.00	Depreciation on farm implements	7837.00
Total Fixed Cost	**103907.00**	**Total Fixed Cost**	**107112.00**	**Total Fixed Cost**	**106520.00**
Total cost	**321555.00**	**Total cost**	**341304.00**	**Total Cost**	**350076.00**
C. Gross margin (GR-TVC)	**290352.00**	**C. Gross margin (GR-TVC)**	**372520.00**	**C. Gross margin (GR-TVC)**	**342444.00**
D. Net return (NR)=(GR-TC)	**186445.00**	**D. Net return (NR)=(GR-TC)**	**265408.00**	**D. Net return (NR)=(GR-TC)**	**235924.00**
E. Benefit cost ratio (GR/TC)	**1.58**	**E. Benefit cost ratio (GR/TC)**	**1.78**	**E. Benefit cost ratio (GR/TC)**	**1.67**

Cost of fertilizer

Application of recommended doses of fertilizer is important for crop production. In the study area, farmers used mainly four types of fertilizer namely Urea, TSP, MP, Gypsum. Table 2 showed that per hectare cost of urea, TSP, MP and gypsum for sole pineapple were Tk. 12800.00, Tk. 14950.00, Tk. 9000.00, Tk. 5500.00, respectively. Per hectare cost of above mentioned four fertilizers for pineapple-papaya were Tk 12800.00, Tk 16100.00, Tk 9750.00 and Tk 4950.00, respectively.

Whereas these cost figures for pineapple-banana-arum cultivation were Tk 9600.00, Tk 11500.00, Tk 6750.00 and Tk 4400, respectively.

Cost of insecticides
Farmers used different kinds of insecticides to protect their pineapple in the field from various insects and pests. Table 2 showed that per hectare cost of insecticides were Tk. 9681.00, Tk. 9392.00, Tk. 16793.00 for sole pineapple, pineapple-papaya, pineapple-banana-arum production, respectively.

Cost of vitamin
Farmers used vitamin for ripening of pineapple. Table 2 showed that per hectare cost of vitamin were Tk. 12312.00, Tk. 11500.00, Tk. 12263.00 for sole pineapple, pineapple-papaya, pineapple-banana-arum production, respectively.

Cost of irrigation
Irrigation water was very essential for pineapple-banana-arum production. Table 2 showed that cost of irrigation water was Tk. 9600.00 per hectare for pineapple-banana-arum production. It should be noted here that irrigation was not required for sole pineapple and pineapple-papaya cultivation.

Interest on operating capital
Interest on operating capital includes variable costs in the production of sole pineapple, pineapple-papaya, pineapple-banana-arum which was calculated for a period of 18 months. Table 2 showed that interest on operating capital for sole pineapple, pineapple-papaya, pineapple-banana-arum were Tk. 17956.00, Tk. 19320.00 and Tk. 20093.00 respectively.

Land use cost
Table 2 showed that land use cost per hectare was Tk. 78590.00 for sole pineapple, pineapple-papaya, pineapple-banana-arum cultivation.

Depreciation on farm implements
Depreciation on farm implements was estimated at Tk. 7361.00 per ha for sole pineapple production, where it was Tk. 9202.00 and Tk. 7837.00 for pineapple-papaya and pineapple-banana-arum, respectively (Table 2).

Total cost
Total cost was calculated by adding up total variable costs and total fixed costs. Table 2 showed that per hectare total cost for sole pineapple, pineapple-papaya and pineapple-banana-arum cultivation were Tk. 321555.00, Tk. 341304.00 and Tk. 350076.00, respectively.

Gross return
Gross return was estimated by multiplying the total amount of product produced by their respective prevailing market price. Table 2 showed that per hectare gross return from sole pineapple was Tk**.** 508000.00, whereas it was Tk. 606712.00 and Tk. 586000.00 for pineapple-papaya and pineapple-banana-arum, respectively.

Gross Margin
The argument for using the gross margin analysis is that the farmers of Bangladesh are more interested to know their return over variable cost. Table 2 showed that per hectare gross margin of sole pineapple was Tk. 290352.00, whereas it was Tk.372520.00 and Tk.342444.00 for pineapple-papaya and pineapple-banana-arum, respectively.

Net Return
Net return is calculated by subtracting gross cost from total return. Table 2 showed that per hectare net return of sole pineapple was estimated at Tk. 186445.00, whereas it was Tk. 265408.00 and Tk. 235924.00 for pineapple-papaya and pineapple-banana-arum respectively.

Benefit Cost Ratio (Undiscounted)
The undiscounted benefit cost ratio (BCR) was calculated as a ratio of gross returns and gross costs. Table 2 showed that BCR of sole pineapple production was 1.58, whereas it was 1.78 and 1.67 for pineapple-papaya and pineapple-banana-arum respectively.

Functional analysis
Considering the importance of the inputs affecting pineapple production, a number of inputs i.e. seedling, human labor, fertilizer, insecticides, power tiller, vitamin and manure were considered as explanatory variables. The individual effects of these inputs on the gross return can be explained to a certain degree by multiple regression analysis. Findings from a log-linear specification are presented in Table 3.

The estimated Cobb-Douglas production function for sole pineapple was:
$\ln Y=4.521+0.087\ln X_1 + 0.422 \ln X_2+ 0.068 \ln X_3+0.237 \ln X_4 + 0.065\ln X_5 -0.058\ln X_6+ 0.046 \ln X_7$
Cobb-Douglas production function for pineapple-papaya was:
$\ln Y=5.327+ 0.073\ln X_1 + 0.520 \ln X_2+ 0.449\ln X_3+ 0.179\ln X_4 + 0.056 \ln X_5 -0.053\ln X_6 + 0.078\ln X_7$
Cobb-Douglas production function for pineapple-banana-arum was:
$\ln Y=4.063+ 0.063\ln X_1 + 0.466 \ln X_2+ 0.039\ln X_3+ 0.116 \ln X_4 + 0.071\ln X_5 -0.046\ln X_6 + 0.036 \ln X_7$

Seed cost
It is observed from Table 3 that the production coefficient of seed cost were 0.087, 0.073, 0.063 which were positive and significant at 1 percent level. It implies that one percent increase in seed cost, keeping other factors constant, would increase gross returns of sole pineapple, pineapple-papaya and pineapple-nanana-arum by 0.087, 0.073, 0.063 percent respectively.

Table 3. Coefficients of Cobb-Douglas production function for sole pineapple, pineapple-papaya and pineapple-banana-arum

	Sole Pineapple	Pineapple-papaya	Pineapple-banana-arum
Explanatory variable	Coefficient	Coefficient	Coefficient
Intercept	4.521	5.327	4.063
	(0.808)	(1.613)	(1.881)
Seedling cost	0.087***	0.073***	0.063***
	(0.037)	(0.025)	(0.023)
Labour cost	0.422**	0.520**	0.466**
	(0.147)	(0.136)	(0.155)
Fertilizer cost	0.068	0.449	0.039
	(0.132)	(0.816)	(0.087)
Insecticides cost	0.237**	0.179	0.116*
	(0.069)	(0.232)	(0.045)
Power tiller cost	0.065*	0.056*	0.071
	(0.011)	(0.022)	(0.089)
Vitamin cost	-0.058	-0.053	-0.046
	(0.105)	(0.094)	(0.075)
Manure cost	0.046***	0.078***	0.036***
	(0.017)	(0.033)	(0.016)
R^2	0.641	0.773	0.685
F- value	19.84***	14.79***	12.28***
Return to scale	0.867	1.302	0.745

Source: Author's calculation based on field survey, 2015.
(Figures within parentheses indicate the standard error)
Note: *** Significant at 1 percent level
** Significant at 5 percent level
*Significant at 10 percent level

Human labour cost

The calculated regression coefficient of human labour cost were 0.422, 0.520, 0.466 in sole pineapple, pineapple-papaya, pineapple - banana - arum with a positive sign and were significant at 5 percent level. It implies that one percent increase in human labour cost, keeping other factors constant, would increase gross returns by 0.422, 0.520, 0.466 percent respectively.

Fertilizer cost

The estimated value of the coefficient of fertilizer in sole pineapple, pineapple-papaya, pineapple - banana - arum were 0.068, 0.449, 0.039 which were of positive but statistically insignificant. So it had no significant impact on gross return.

Insecticides cost

The estimated coefficient of insecticides cost of sole pineapple, pineapple - banana - arum were 0.237, 0.116 and significant at 5 and 10 percent level. It implies an increase in one percent of money spent on insecticides cost, keeping other factors constant, increase gross returns by 0.237, 0.116 percent respectively from sole pineapple and pineapple - banana - arum. But the coefficient of pineapple - papaya was positive and statistically insignificant and it had no significant effect on return from pineapple - papaya.

Power tiller cost

The calculated regression coefficient of power tiller cost were 0.065 and 0.056 in sole pineapple and pineapple - papaya with positive sign and significant at 10 percent level. It indicates that an increase in one percent of power tiller cost, remaining other factors constant, would increase gross return 0.065 and 0.056 percent respectively. But the coefficient of pineapple - banana - arum was positive and statistically insignificant and it had no significant effect on return from pineapple - banana - arum.

Vitamin cost

The calculated regression coefficient of vitamin cost were 0.058, 0.053, 0.046 in sole pineapple, pineapple - papaya, pineapple - banana - arum with negative sign and statistically insignificant. It indicates that vitamin cost had no significant impact on gross returns.

Manure cost

The coefficient of manure cost for producing sole pineapple, pineapple-papaya, pineapple - banana - arum were 0.046, 0.078, 0.036 respectively which were positive and significant at 1 percent level. It implies that one percent increase in manure cost, keeping other factors constant, would increase gross returns by 0.046, 0.078, 0.036 percent respectively.

Coefficient of Multiple Determination (R^2)

The coefficient of determination (R^2) is a summary that tells how well the sample regression line fit with the data (Mitu, 2013). It is evident from Table 3 that the value of the coefficient of multiple determinations (R^2) is 0.641, 0.773 and 0.685 for sole pineapple, pineapple-papaya,

pineapple-banana-arum which mean that the explanatory variables included in the model explained 64.1, 77.3 and 68.5 percent of the total variation in gross return from sole pineapple, pineapple-papaya, pineapple-banana-arum production.

F-value

The F-value was estimated for overall significance of the estimated model. The F-value of the model for sole pineapple, pineapple-papaya, pineapple-banana-arum were 19.84, 14.79 and 12.28, respectively which were significant at 1 percent level implying that the variation in gross return depends mainly upon the explanatory variables included in the model.

Returns to scale

In the present study, the sum of the coefficients of all inputs for sole pineapple, pineapple-banana-arum farmers was 0.867, 0.745. This implies that production exhibited decreasing returns to scale (Table 3). The sum of the coefficients of all inputs for pineapple-papaya was 1.302 which implies that production exhibited increasing returns to scale.

Conclusion and Recommendation

From the results of the present study, it can be concluded that considerable scope apparently exists in the study area to increase the productivity of pineapple. Pineapple is an important fruit because of its dietary values and sources of income for the pineapple farmers. Pineapple cultivation is attractive because it is labour intensive fruit crop. It is also considered more profitable and less risky as compared to the production of other fruit crops. This is a very pragmatic study in the context of Bangladesh.

- In order to improve profitability of the pineapple production, measures are essential to reduce the cost of production.
- Operating capital is a problem for the resource poor farmers of the study area. Without institutional credit support, it is difficult for the small farmers to cultivate pineapple in large area. It is, therefore, necessary that credit with easy terms should be provided to the farmers for the entire area under pineapple.
- So, Government and non-government research institutions should strengthen their human resources for pineapple production.

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Appendix 1. Total cost and return per hectare for sole pineapple production

Items	Unit	Quantity	Price per unit (Tk.)	Total value (Tk.)	Percentage
A. Gross return					
Pineapple	Pieces	31750	16.00	508000.00	100.00
Total Return				508000.00	100.00
B. Gross cost					
Variable costs					
Human Labour :	Man-days				
Land preparation		50	350.00	17500.00	5.44
Planting, fertilizer application		73	350.00	25550.00	7.94
Weeding		42	350.00	14700.00	4.57
Harvesting and carrying		53	350.00	18550.00	5.57
Total		218	350.00	76300.00	23.72
Power tiller				7700.00	2.39
Seedling	Pieces	31850	2.00	63700.00	19.80
Manure: Cow-dung	Kg	3803	1.50	5705.00	1.77
Fertilizer: Urea	kg	800	16.00	12800.00	3.98
TSP	kg	650	23.00	14950.00	4.64
MP	kg	600	15.00	9000.00	2.79
Gypsum	kg	500	11.00	5500.00	1.71
Total				42250.00	13.13
Insecticides				9681.00	3.01
Vitamin				12312.00	3.82
Total variable cost				217648.00	
Fixed Costs					
Interest on operating capital				17956.00	5.58
Land use cost				78590.00	24.44
Depreciation on farm implements				7361.00	2.29
Total Fixed Cost				103907.00	
Total cost				321555.00	100.00
C. Gross margin (GR-TVC)				290352.00	
D. Net return (NR)=(GR-TC)				186445.00	
E. Benefit cost ratio (GR/TC)				1.58	

Source: Field survey, 2015

Appendix 2. Total cost and return per hectare for of pineapple-papaya production

Items	**Unit**	**Quantity**	**Price per unit (Tk.)**	**Total value (Tk.)**	**Percentage**
A. Gross return					
Pineapple	Pieces	30400	16.00	486400.00	80.16
Papaya	Kg	10026	12.00	120312.00	19.83
Total Return				**606712.00**	100.00
B. Gross cost					
Variable costs					
Human Labour :					
Land preparation	Man-days	60	350.00	21000.00	6.15
Planting, fertilizer application		80	350.00	28000.00	8.20
Weeding		45	350.00	15750.00	4.61
Harvesting and carrying		65	350.00	22750.00	6.66
Total		250	350.00	87500.00	25.63
Power tiller				9500.00	2.78
Seedling of pineapple	Pieces	30600	2.00	61200.00	17.93
Seedling of papaya	Pieces	1500	2.00	3000.00	0.88
Manure: Cow-dung	Kg	5667	1.50	8500.00	2.49
Fertilizer: Urea	kg	800	16.00	12800.00	3.75
TSP	kg	700	23.00	16100.00	4.71
MP	kg	650	15.00	9750.00	2.85
Gypsum	kg	450	11.00	4950.00	1.45
Total				43600.00	12.77
Insecticides				9392.00	2.75
Vitamin				11500.00	3.37
Total variable Cost				**234192.00**	
Fixed Costs					
Interest on operating capital				19320.00	5.66
Land use cost				78590.00	23.02
Depreciation on farm implements				9202.00	2.70
Total Fixed Cost				**107112.00**	
Total cost				**341304.00**	**100.00**
C. Gross margin (GR-TVC)				**372520.00**	
D. Net return (NR)=(GR-TC)				**265408.00**	
E. Benefit cost ratio (GR/TC)				**1.78**	

Source: Field survey, 2015.

Appendix 3. Total cost and return per hectare for of pineapple-banana-arum production

Items	Unit	Quantity	Price per unit (Tk.)	Total value (Tk.)	Percentage
A. Gross return					
Main product	pieces	29500	16.00	472000.00	80.55
Banana	bunch	370	200.00	74000.00	12.62
Arum	kg	2000	20.00	40000.00	6.82
Total Return				**586000.00**	100.00
B. Gross cost					
Variable Costs					
Human Labour :	Man-days				
Land preparation		65	350.00	22750.00	6.49
Planting, fertilizer application		90	350.00	31500.00	8.99
Weeding		50	350.00	17500.00	4.99
Harvesting and carrying		70	350.00	24500.00	6.99
Total		275	350	96250.00	27.49
Power tiller				9800.00	2.79
Seedling of pineapple	pieces	29750	2.00	59500.00	16.99
Sucker of banana	pieces	400	2.50	1000.00	0.28
Seeds of arum	pieces	600	1.00	600.00	0.17
Manure: Cow-dung	kg	3667	1.5	5500.00	1.57
Fertilizer: Urea	kg	600	16.00	9600.00	2.74
TSP	kg	500	23.00	11500.00	3.28
MP	kg	450	15.00	6750.00	1.92
Gypsum	kg	400	11.00	4400.00	1.25
Total				32250.00	9.21
Insecticides				16793.00	4.79
Vitamin				12263.00	3.50
Irrigation				9600.00	2.74
Total variable cost				**243556.00**	
Fixed Costs					
Interest on operating capital				20093.00	5.74
Land use cost				78590.00	22.44
Depreciation on farm implements				7837.00	2.24
Total Fixed Cost				**106520.00**	
Total Cost				**350076.00**	**100.00**
C. Gross margin (GR-VC)				**342444.00**	
D. Net return (NR)=(GR-TC)				**235924.00**	
E. Benefit cost ratio (GR/TC)				**1.67**	

Source: Field survey, 2015.