Article

A comparative profitability of pineapple-mono crop and pineapple intercrops of Modhupur area in Tangail district of Bangladesh

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Abstract: A survey study was conducted to estimate the cost, returns, relative profitability and practices of Pineapple mono-crop and Pineapple inter-crops production in Madhupur area of Tangail District. Data was collected personally through prepared interview schedule from 60 randomly selected Pineapple growers from Ausnara, Oronkhola, Sonia and Motel bazar union under Madhupur Upazila of Tangail District during July to October 2013. A simple random sampling was followed to select the farmers in the study area. Both tabular and statistical analyses were applied in this study. Cost and return analysis showed that total cost incurred for producing Pineapple mono crop, Pineapple+Papaya and Pineapple+Banana+Aroid were Tk.312849.72, Tk.395894.01 and Tk.377013.25 per hectare respectively. Per hectare net return for Pineapple + Papaya and Pineapple + Banana + Aroid production were Tk.492111.00 and Tk.195704.75 which were higher than that of Pineapple mono crop (Tk.157675.28). On the other hand BCR for Pineapple + Papaya and Pineapple + Banana + Aroid production were 2.24 and 1.52 which were higher than that of Pineapple mono crop (1.50). It represents that both pineapple mono-crop and pineapple inter-crops production are profitable among them Pineapple-inter crops cropping pattern is more profitable then Pineapple-mono crop. About 80% of pineapple growers grow papaya, banana, zinger, turmeric and aroids as intercrops with pineapple. The study identified some crucial problems and probable solutions suggested by the farmer. Finally, some policy recommendations were suggested and avenues for further research were shown.

Keywords: profitability; yield gap; constraints; strategies; pineapple

1. Introduction

Pineapple is one of the major commercial and popular fruits in Bangladesh because of its distinct flavor, pleasant aroma, delicious taste, nutritional and medicinal values. Giant kew and Honey Queen are the two popular and commercially important varieties grown in Bangladesh, but they cover the area concentrated in Tangail, Sylhet, Chittagong, Rangamati Hilly tract and Comilla district. Bangladesh produces 15.8thousand MT of pineapple per annum from 14.85 thousand hectares of land. In respect of total production it ranks 4th among the major fruits grown in this country (BER, 2016).

In addition to serving as food, with its natural sweetness, the pineapple has served in history as a symbol and an artistic motif. According to Levins (2004), the rarity, reputation, expense, and visual attractiveness of the pineapple made it an item of celebrity and the "ultimate exotic fruit." Pande (2009) stated that processing of fruit and vegetables is getting higher attention for enabling farmers to get higher price for the produce.

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Internationally, countries like the U.S, India are into large scale processing of fruits into various forms. Altman and Eite-man (2009) stated that about 1.8 million tonnes of watermelon were produced in the U.S. The pineapple was so coveted and uncommon that in the 1600s King Charles II of England posed receiving a pineapple as a gift in an official portrait. In colonial America, the pineapple became a symbol of hospitality, and served as the pinnacle of an entertaining household's feast, even being rented to households during the day for display on the table and then sold to more affluent clients who actually ate it (Levins, 2004). As a symbol of hospitality and friendship, the pineapple became a favorite motif of architects, artisans, and craftsman in the American colonies, and would be seen on the main gate posts of mansions, in the weather vanes of public buildings, and on walls, canvas mats, tablecloths, napkins, the backs of chairs, in china, and so forth (Levins, 2004). Some have claimed that pineapple has benefits for some intestinal disorders, while others claim that it helps to induce childbirth when a baby is overdue. These enzymes can be hazardous to someone suffering from certain protein deficiencies or disorders. Pineapple can also be used to enhance digestion. The specific objectives of the study are: i) to document the socio demographic characteristics of farmers growing Pineapple mono crop and Pineapple inter crops; ii) to assess the relative profitability of adopting Pineapple inter crops over Pineapple mono cropping pattern; iii) to determine the factors influencing gross returns of Pineapple mono crop and Pineapple inter crops production; iv) to identify the problems and constraints associated with the production and marketing of Pineapple mono crop and Pineapple inter crops; and v) to suggest some policy guidelines for further implementation.

2. Materials and Methods

The reliability of a scientific research depends to a great extent on the appropriate methodology used in the study. Methodology refers to the way in which a research is accomplished. This hilly area was selected from Modhupur Upazila of Tangail district in Bangladesh. In fact, five adjacent villages namely Maguntinogor, Jalchatra, Oronkhola, Chunia, Ausnara, and have purposively been selected for the research investigation. Hilly area was chosen because selected five villages have similar types of land and soil characteristics. Therefore, 60 farmers selected randomly from each of the selected cropping patterns (Table 1).

Table 1. Distribution of sample farmers of the study area.

Selected villages	Sample size (Nos.)			Total sample size (Nos.)
	Pineapple farmer	Pineapple-Papaya farmer	Pineapple-Banana-Aroid farmer	
Maguntinogor	4	4	4	12
Oronkhola	4	4	4	12
Jalchatra	4	4	4	12
Chunia	4	4	4	12
Ausnara	4	4	4	12
Total	**20**	**20**	**20**	**60**

2.1. Descriptive statistics

The descriptive statistics technique was used to determine averages, percentages, means, deviations, ratios, etc. Descriptive statistics were employed for testing the hypothesis (a). It is very simple in calculation, widely used and easy to understand. Descriptive statistics technique included in socioeconomic profiles of Pineapple mono crop and Pineapple inter crops farmers, production practices and input use, costs and returns of pineapple mono crop and Pineapple inter crops farming. Profitability can be measured on yearly basis or over or the lifespan of an investment whiles the lifespan profitability measure is employed to enable in re-source allocation decision. Return on profit margin and return on equity are also well known profitability measures (Ross *et al.,* 2001). Once cost and benefits has been identified, if they are to be compared, they must be valued. Underlying all financial analysis is the assumption that prices reflect value, or can be adjusted to do so (Gittinger, 1996).

2.2. Activity budgets

Activity budget is the most common method in determining and comparing the profitability of enterprise activities followed the concerned farmers taking into account different techniques of production. Profit is defined as the difference between the total revenue and total cost. The following algebraic profit (π) equation was employed for testing the set hypothesis (b). In fact, this equation was employed to prepare activity budgets of the concerned selected crops like Pineapple mono crop and Pineapple inter crops from the view point of individual farmers:

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π=TR-TC

Or, π= TR - (VC + FC)

$\pi = \sum Q_y . P_y + \sum Q_b . P_b - \sum_{i=1}^{n}(X_i . P_{xi}) - TFC$

Where,

π = Net returns (Tk/ha);

Q_y= Total quantity of the relevant outputs (kg/ha);

P_y= Per unit prices of the relevant outputs (Tk/kg);

Q_b= Total quantity of the concerned by-products (kg/ha);

P_b = Per unit prices of the relevant by-products (Tk/kg);

X_i = Quantity of the concerned i^{th} inputs;

P_{xi} = Per unit price of the relevant i^{th} inputs;

TFC = Total fixed cost involved in the concerned crops production;

i= 1, 2, 3, ..., n (number of inputs).

3. Results and Discussion

One of the most important aspects of this study was to evaluate the profitability of selected crop. A quick way to assess the profitability was to calculate net return and gross margin. To the value of net return, at first the cost of production and then the value of output (gross return) have been calculated. First of all, activity budgets of Pineapple mono crop and then Pineapple inter crops were presented.

3.1. Estimation of cost

Farmers had to pay cash for the purchased inputs like fertilizers, insecticides/pesticides, vitamin, irrigation water charge etc., and it was, in fact, very easy and straightforward to calculate the costs of these items. The average cost of seedling for Pineapple mono crop was Tk.66000.00 per hectare which covered 21.1 percent of total cost (Table 2). The costs of seed for per hectare Pineapple inter crops were Tk. 64606.00 and Tk 63618.00 for (Pineapple+papaya) and (Pineapple+Banana+Aroid), respectively which covered 16.32 percent and 16.87 percent respectively of total cost (Table 3 and Table 4). In the study area, on an average wage rate was Tk. 300.00 per man-day during the study period.

From Table 2, Table 3 and Table 4 it can be seen that Pineapple mono crop and Pineapple inter crops growers used on an average 800 kg/ha of Urea, 650 kg/ha of TSP, 500 kg/ha and 600 kg/ha of MOP and800 kg/ha of Urea, 600 kg/ha of TSP, 450 kg/ha and 600 kg/ha of MOP for (Pineapple + papaya) and 600 kg/ha of Urea, 500 kg/ha of TSP, 400 kg/ha and 500 kg/ha of MOP for (Pineapple+Banana+Aroid) respectively (Mondal, 2000). The average prices of Urea, TSP, MOP and Gypsum were Tk. 810, Tk. 1200, Tk. 7.20 and Tk. 550 per 50 kg, respectively. Per hectare insecticide cost was Tk 4950.00 for Pineapple mono crop which was 1.6 percent of the total gross costs and Tk 4690.00 and Tk. 35430 for (Pineapple + papaya) and (Pineapple + Banana+Aroid) which was 1.18 and 9.4 percent of the total gross costs respectively (Roy *et al.,* 1986). However, per hectare cost of irrigation for (Pineapple+Banana+Aroid) production Tk 6300.00 which constituted 1.67 percent of the total gross costs (Table 4).

It can be observed from Table 2 that Pineapple mono crop growers used on an average 4 times and total vitamin cost is Tk. 19600.00, which 6.26 percent of the total gross costs of Pineapple mono crop production. Tables 3 and 4 reveal that Pineapple inter crops growers used on an average 4 times and total vitamin cost is Tk.16400/ha and Tk. 19680/ha for (Pineapple + papaya) and (Pineapple+Banana+Aroid) crop. The total land cost for Pineapple mono crop, (Pineapple + papaya) and (Pineapple+Banana+Aroid) crop is Tk. 9898/ha which was 3.16, 2.5 and 2.63 percent of the total gross costs respectively. In the study area, on an average marketing rate was Tk. 2.50 per pineapple during the study period. It can be observed from Table 6.1 that Pineapple mono crop growers used on an average 33000 pieces of Pineapple cost is Tk. 82500/ha, which 26.37 percent of the total gross costs of Pineapple mono crop production. Pineapple inter crops growers used on an average 60525 pieces and51920 pieces of Pineapple inter crops, cost is Tk. 151312.00/ha and Tk. 129800.00/ha for (Pineapple+papaya) and (Pineapple+Banana+Aroid) which is 38.22 percent and 34.43 percent respectively. It is seen that the marketing cost for Pineapple inter crops cultivation was much higher than Pineapple mono crops cultivation. In the study area interest on operating capital per hectare were Tk. 21826.725 which was 6.98 percent of total gross costs of production of Pineapple mono crop and Tk. 27620.00 and Tk. 26303.25 for (Pineapple + papaya) and (Pineapple + Banana + Aroid) production which was 6.98 percent and 6.98 percent respectively (Table 2, Table 3 and Table 4). In our country land tax is imposed on those farmers whose farm

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size is greater than 33 *bigha*, but in the study area the sampled farmer's farm size was less than 33 *bigha*. That's why the cost of land tax was ignored in the study. Per hectare total cost of Pineapple mono crop is Tk. 312850 and Pineapple inter crops production were estimated at Tk. 395894 for (Pineapple+papaya) and Tk. 377013.247 for (Pineapple+Banana+Aroid) respectively (Table 2, Table 3 and Table 4).

3.2. Estimation of gross return

Per hectare yield of Pineapple mono crop was found to be 32450 peaces Table 2 shows that per peace values of main product of Pineapple was Tk. 14.50 and the gross return was Tk. 470525.00 per hectare (Table 2). It can be seen from Tables 3 and 4 that gross returns for Pineapple inter crops farming were Tk. 888005.00 for (Pineapple + papaya) and Tk. 572718.00 for (Pineapple + Banana + Aroid) respectively (Kayitesi, 2011). It is noted here that for Pineapple inter crops there was no by product so gross return was calculated by multiplying the total amount of product with respective price. In the present study, gross margin was estimated at Tk. 179502.00, Tk. 519731.50 and Tk.222008.00 per hectare for Pineapple mono crop, (Pineapple + papaya) and (Pineapple + Banana + Aroid), respectively. Per hectare net returns of Pineapple mono crop, (Pineapple + papaya) and (Pineapple + Banana + Aroid) were Tk. 157675.28, Tk. 492111.00 and Tk. 195704.75 respectively (Table 2, Table 3 and Table 4).

Table 2. Activity budgets: per hectare pineapple mono crop production.

Items of costs/ returns	Total quantity/ha	Per unit price(Tk.)	Costs/returns (Tk./ha)	% of total
A. Gross Returns				
Main product (Pineapple)	32450 peaces	14.50	4,70,525.00	100
By-product	n.a	-	-	-
Total returns	-	-	4,70,525.00	100
B. Gross Costs				
C. Variable Costs				
Vitamin	2 times	9800/time	19,600.00	6.26
Seedlings	33000 peaces	2/peace	66,000.00	21.10
Land preparation	36 Man-day	300/Man-day	10,800.00	3.45
Transplanting	33000 peaces	0.5/ peace	16,500.00	5.27
Weeding	26 Man-day	300/Man-day	7800.00	2.49
Harvesting	45 Man-day	300/ Man-day	13,500.00	4.32
labour	-	-	48,600.00	15.53
Marketing	33000 peaces	2.5/ peace	82,500.00	26.37
Urea	16 bags	810/bag	12,960.00	4.14
TSP	13 bags	1200/bag	15,600.00	4.99
MOP	12 bags	720/bag	8640.00	2.76
Gypsum	10 bags	550/bag	5500.00	1.76
Fertilizer cost	-	-	42,700.00	13.65
Pesticides	n.a	-	4950	1.58
Land cost	n.a	-	9898.00	3.16
Others	n.a	-	16,775.00	5.36
Total	-	-	2,91,023.00	93.02
D. Fixed Costs				
Interest on OC	-	@10%	21,826.73	6.98
Total	-	-	21,826.73	6.98
E. Total costs	-		312849.72	100.00
F. Gross Margin (A-C)	-		1,79,502.00	-
G. Net Return (A-E)	-		1,57,675.28	-

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Table 3. Activity budgets: per hectare pineapple-papaya production.

Items of costs/ returns	Total quantity/ha	Per unit price(Tk)	Costs/returns (Tk/ha)	% of total
A. Gross Returns				
Pineapple	31850 peaces	14.50	4,61,825.00	52.01
Papaya	71030 kg.	6.00	4,26,180.00	47.99
By-product	n.a	-	-	-
Total returns			8,88,005.00	100
B. Gross Costs				
C. Variable Costs				
Vitamin	2/times	8200/time	16,400.00	4.14
Seedlings(Pineapple)	32303/ peaces	2/ peace	64,606.00	16.32
Seedlings(Papaya	2884/ peaces	2/ peace	5768.00	1.457
Land preparation	40/ Man-day	300/ Man-day	12,000.00	3.03
Transplanting	41433/ peaces	0.5/ peace	20,716.50	5.23
Weeding	26/ Man-day	300/ Man-day	7800.00	1.97
Harvesting	48/ Man-day	300/ Man-day	14,400.00	3.64
Labour cost	-	-	54,916.50	13.87
Marketing	60525/ peaces	2.5/ peace	1,51,312.50	38.22
Urea	16 bags	810/ bag	12,000.00	3.03
TSP	12 bags	1200/ bag	20,716.50	5.23
MOP	12 bags	720/ bag	8640.00	2.18
Gypsum	9 bags	550/ bag	4950.00	1.25
Fertilizer cost	-	-	46,306.50	11.70
Pesticides	n.a	-	4690.00	1.18
Land cost	n.a	-	9898.00	2.50
Others	n.a	-	14,376.00	3.63
Total	-	-	3,68,273.50	93.02
D. Fixed Costs				
Interest on OC	-	@10%	27,620.51	6.98
Total	-	-	27620.51	6.98
E. Total costs		-	395894.01	100.00
F. Gross Margin (A-C)		-	519731.50	-
G. Net Return (A-E)		-	492111.00	-

Table 4. Activity budgets: per hectare pineapple-banana-aroid production.

Items of costs/ returns	Total quantity/ha	Per unit price(Tk.)	Costs/returns (Tk./ha)	% of total
A. Gross Returns				
Pineapple	30837 peaces	14.00	4,31,718.00	75.38
Banana	375 bunch	180.00	67,500.00	11.79
Aroid	210 mand	350.00	73,500.00	12.83
By-product	n.a	-	-	-
Total returns	-	-	5,72,718.00	100.00
B. Gross Costs				
C. Variable Costs				
Vitamin	2 times	9840/time	19,680.00	5.22
Seedlings(Pineapple)	31809 peaces	2/ peace	63,618.00	16.87
Seedlings(Banana	405 peaces	2/peaces	810.00	0.21
Seedlings(Aroid)	18 Mand	468/Mand	8424.00	2.23
Land preparation	32 Man-day	300/ Man-day	9600.00	2.55
Transplanting	32260 peaces	0.5/ peace	16,130.00	4.29
Weeding	17 Man-day	300/ Man-day	5100.00	1.35
Harvesting	42 Man-day	300/ Man-day	12,600.00	3.34
labor	-	-	43,430.00	11.52
Marketing	51920/ peaces	2.5/ peace	1,29,800.00	34.43
Urea	12 bags	810/ bag	9720.00	2.58
TSP	10 bags	1200/ bag	12,000.00	3.18
MOP	10 bags	720/ bag	7200.00	1.91
Gypsum	8 bags	550/ bag	4400.00	1.17
Fertilizer cost	-	-	33,320.00	8.84

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Items of costs/ returns	Total quantity/ha	Per unit price(Tk.)	Costs/returns (Tk./ha)	% of total
Pesticides	n.a	-	35,430.00	9.40
Irrigation	18	350	6300.00	1.67
Land cost	n.a	-	9898.00	2.63
Total	-	-	3,50,710.00	93.02
D. Fixed Costs				
Interest on OC	-	@10%	26,303.25	6.98
Total	-	-	26,303.25	6.98
E. Total costs		-	37,7,013.25	100.00
F. Gross Margin (A-C)		-	19,6,539.50	-
G. Net Return (A-E)		-	1,70,236.25	-
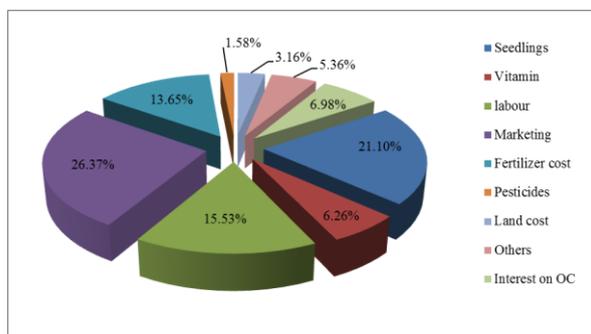
Figure 1. Percentage shares of costs for pineapple mono crop production.
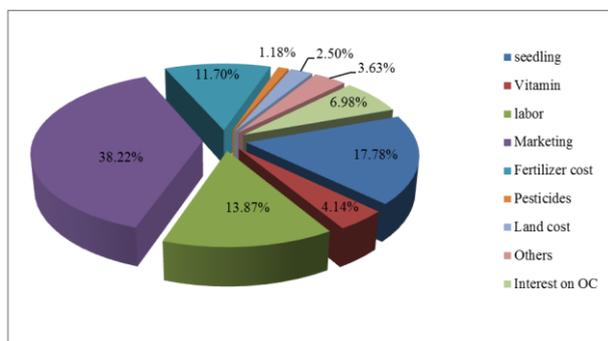
**Figure 2. Percentage share of costs for (pineapple + papaya) production.**
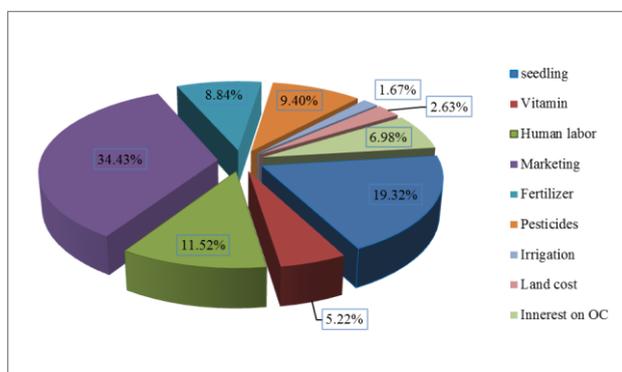
Figure 3. Percentage share of costs for (pineapple + banana + aroid) production.

The results of Pineapple mono crop, (Pineapple + papaya) and (Pineapple + Banana + Aroid) farming are summarized in Table 5.

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Table 5. Comparative performance of pineapple mono crop, (pineapple + papaya) and (pineapple + banana + aroid) production in the study area.

Items	Pineapple mono crop	Pineapple + Papaya	Pineapple + Banana + Aroid
A. Gross returns (Tk./ha)	4,70,525.00	8,88,005.00	5,72,718.00
B. Variable costs (Tk./ha)	2,91,023.00	3,68,273.50	3,50,710.00
C. Gross margin (A-B)	1,79,502.00	5,19,731.50	2,22,008.00
D. Total costs (Tk./ha)	3,12,849.72	3,95,894.01	3,77,013.25
E. Net returns (A-D)	1,57,675.28	4,92,111.00	1,95,704.75

Source: Adapted from Table 2, Table 3 and Table 4.

In the present study, gross margin was estimated at Tk. 1,79,502.00 per hectare for Pineapple mono crop production and was estimated at Tk. 5,19,731.50 and Tk. 2,22,008.00 per hectare for (Pineapple + papaya) and (Pineapple+Banana+Aroid) respectively. So gross margin was higher for Pineapple inter crops production.
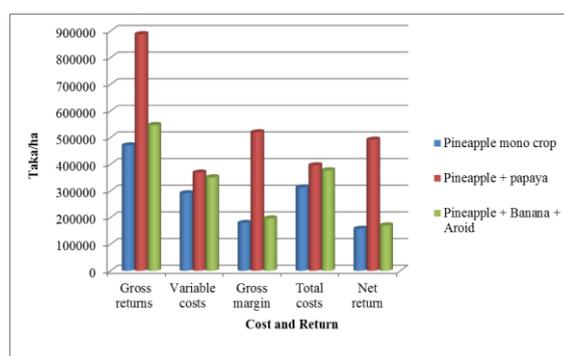

Figure 4. Per hectare return, gross margin, net return of pineapple mono crop, (pineapple + papaya) and (pineapple + banana + aroid) farming.

Net return was higher for Pineapple + papaya crops while it was lower for Pineapple mono crops cultivation. Per hectare net return of Pineapple mono crop was Tk. 1,57,675.28 and for Pineapple inter crops production the net returns were Tk. 4,92,111.00 for (Pineapple + papaya) and Tk. 1,95,704.75 for (Pineapple + Banana + Aroid) respectively.
The result presented in the Table 5 indicates that production of Pineapple mono crop and Pineapple inter crops was profitable from the viewpoints of individual farmers, but there is a difference in profitability.

3.3. Profitability following different cropping patterns
As stated earlier, the farmers of the polder area was following two cropping patterns (Pineapple mono crop and Pineapple inter crops). In this sub-section, an attempt has been made to compare the profitability between the followers of Pineapple mono crops and Pineapple inter crops cropping pattern which has been shown in Table 6.

Table 6. Comparison of profitability following different cropping patterns.

Cropping pattern	Net return (Tk. /ha/season)
A. Pineapple mono crop	1,57,675.28
B. Pineapple + Papaya	4,92,111.00
C. Pineapple + Banana + Aroid	1,95,704.75
Difference (B-A)	3,34,435.72
Difference (C-A)	38,029.47

It can be seen from Table 6 that there is a significant difference in profitability between two categories of farmers, the farmers, who were following the Pineapple inter crops cropping pattern, much higher profit than Pineapple mono crops farmers. The main reason was, as mentioned earlier that per hectare yield of Pineapple inter crops was much higher in polder area than traditional Pineapple mono crops. In fact, Pineapple inter crops farmers got per hectare Tk. 334435.72 for (Pineapple + Papaya) and Tk. 38,029.47 for (Pineapple + Banana +

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Aroid) more profit than the Pineapple mono crops farmers. Figure 6 shows the net returns incurred from different cropping patterns.
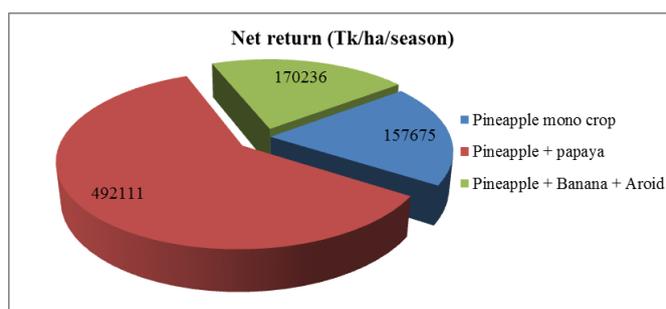

Figure 5. Net returns of pineapple mono crop, (pineapple + papaya) and (pineapple + banana + aroid) crops farmers.

3.4. Benefit cost ratio

Benefit cost ratio (undiscounted) is a measure to determine the efficiency of resource use which was applied in the present study on the basis of total cost and cash cost. Undiscounted, BCR was found 1.50 on total cost basis for Pineapple mono crops and for Pineapple inter crops it was as 2.24 (Table 7).

Table 7. Comparative costs and returns of pineapple mono crops and pineapple inter crops production.

Particulars	Pineapple mono crops	Pineapple + Papaya	Pineapple + Banana + Aroid
Gross return	470525.00	888005.00	572718.00
Total cost	312849.72	395894.01	377013.25
BCR (Undiscounted)	1.50	2.24	1.52

4. Problems and Policy Recommendations

Problems and Constraints of Pineapple mono crops and Pineapple inter crops Production
For the sake of analytical convenience the problems and constraints were classified into four general groups:
  (a) Economic problems: Seasonal labour shortage and high wage rate, lack of capital or institutional credit, high price of inputs, lack of good quality seedlings and low price of output (Fakayode *et al.,* 2012);
  (b) Technical Problems: Insufficient water availability for irrigation, lack of scientific knowledge and method, lack of extension services, attack of disease and insecticides, attack by monkey and harvesting problem (FAOSTAT 2009);
  (c) Marketing problems: Inadequate demand, lack of proper marketing channel, lack of storage facilities and lack of transportation facilities; and
  (d) Social Problems: Adulteration of fertilizers and shortage of electricity.

Based on the results of the study some important policy recommendations for Pineapple mono crop and Pineapple inter crops farming arises which are highlighted in this sub-section. First of all, policy on Pineapple mono crop farming and then on Pineapple inter crops are presented here.
  i. Newly released high yielding varieties of Pineapple should be popularized in the study area. High quality seedling of those varieties must be available to the farmers in time a cheap rate;
  ii. The availability of adulterated fertilizers and seeds in the market must be stopped with immediate effects. The Department of Agriculture Extension (DAE) and law enforcing agency must pay an attention to control malpractices of the dishonest traders;
  iii. Training on scientific cultivation of Pineapple mono crop should be imparted to the local farmers by the extension personnel or NGO officials for improving production efficiency;
  iv. Labour-saving technology could be expanded in this area for reducing cost of production and improving per hectare yield of rice;
  v. Marketing and communication facilities from primary producers to organized markets should be improved for having fair prices of the outputs; and

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vi. A required amount of funds could be allocated for renovation activities of this polder so that repairing works could be done within the shortest possible time. Thus, lives and properties of general people can be saved from natural hazards.

5. Conclusions

From the above discussions and the results presented in Table 6.5 clearly indicate that there is wider variation in the profitability of Table 6.5 Comparative costs and returns of Pineapple mono crops and Pineapple inter crops production. It was found that profitability of Pineapple inter crops growing farmers was higher than the profitability of Pineapple mono crop growing farmers. It indicates the rejection of null hypothesis (b). Moreover, it was found from the study area that Pineapple inter crops farmers used more human labour and fertilizer on their field and better yield was realized by the farmers as compared to Pineapple mono crops growing farmers. Pineapple inters crops cultivation provided high return to its high yield Potential thus Pineapple inters crops cropping pattern gaining popularity in the study area very quickly.

Conflict of interest

None to declare.

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