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ECONOMIC ASPECTS OF DIFFERENT AGROFORESTRY PRACTICES IN TANGAIL DISTRICT

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Abstract

The present study was carried out on agroforestry at Madhupur upazilla under Tangail district to identify the different agroforestry practices and determine the profitability of mostly practiced agroforesty system. The important practices are Akashmoni-Pineapple-ginger, Akashmoni-Pineapple-Aroid, and Jackfruit-Pineapple-Aroid. Primary data were collected from 120 farmers from four villages under Madhupur Upazilla of Tangail district. Per hectare total return was the highest in case of Akashmoni-Pineapple-Ginger practice Tk. 3446300 followed by Akashmoni-Pineapple-Aroid practice Tk. 3180400 and Jackfruit-Pineapple-Aroid practice Tk. 2470790. Inter temporal budget for Jackfruit-Pineapple-Aroid agroforestry production system for 20 years explained that the cash flow in the 1st year was negative but it became positive from second year and it continued in subsequent years. Sensitivity Analysis shows that Jackfruit- Pineapple-Aroid agroforestry system for 20 years was sensible to increment and reduction of cost and gross returns. On the basis of farmers' opinion, the major problems for different agroforestry systems were jackfruit borer, low price of pineapple, high price of inputs, attack of bat and squirrel on jackfruit and hedgehog on pineapple.

Keywords: Fruits, gross margin, net returns, BCR, profitability.

Introduction

Bangladesh has poor forest resources which is decreasing day-by-day due to several reasons. Furthermore, the land hungry agricultural sector is converting forest land to agricultural uses to feed the burgeoning population of Bangladesh. Due to this deforestation, serious imbalances have already been created in the eco-systems.

Multiple productions from homesteads and croplands are indispensable for a country like Bangladesh where the population growth rate is very high and faster than its agricultural growth rate. The country cannot produce enough food to meet up the ever increasing demand of over population, i.e. cereals, vegetables, fish, meat, milk and egg due to lack of modem techniques, inputs and available land.

Agroforestry system having multipurpose tree plantation increased soil fertility, supplied fuel wood, generated work and improved socioeconomic condition of the farmers (Alam *et al*., 2004). Farmer also gets their basic need such as food, fodder, fuel wood and timber from the same piece of land by practicing different agroforestry system. As agroforestry provides multiple products including fruits, vegetables, nutrition, fuel wood, fodder etc to the households, it could be a good option to overcome the aforementioned situation.

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The human civilization initiated with the cultivation of crops by the ancient humans close or nearby their inhabitancy in the forest. It was agroforestry. At this state of advanced civilization, the modem people are going back to agroforestry with the principle of growing trees in all possible places including homesteads and crop field. In both the cases, there is an association of trees with other food/ feed producing plants and/or useful animals which constitute the fundamental principle of agroforestry (Haque *et al*., 1996). However, due to lack of modem knowledge, the potential benefits of agroforestry are still remaining entrapped. To take the full advantage of perceived potentials, there is an urgent need to identify and strengthen efforts to develop sustainable agroforestry production and utilization systems for maximizing production and income by knowing the existing opportunities and limitation, and scope for future improvement. Agroforestry system, more particularly, tree- pineapple in association with vegetables system may be popular among the farmers if some positive steps are taken for improving its production and different management practices. Before giving any policy options on the development of tree-pineapple in association with vegetables system as well as increasing fruit, vegetable and pineapple as well as timber production, relevant and adequate information on various aspects of the system at farm level is required. But such information is very limited due to lack of adequate research in the field. Different researchers also suggested detailed studies in the existing agroforestry systems (Aktar *et al*., 1989; Singh *et al*., 2001; Baten, M. A. 1992; Abedin *et al*., 1990; Miah *et al*., 2001; Hasan, M. K. 2005). The generated information of the study will be helpful to the researchers, farmers, planners and development workers who will conduct further studies of the similar nature and encourage them in conducting more comprehensive and detailed investigation in the particular field. Therefore, the present study was undertaken (i) to identify the different agroforestry practices in the study area and (ii) to determine the profitability of mostly practiced agroforesty system in the study area.

Materials and Methods

Study area

The selected villages were Chuniadanab Bandha and Beribadh of Auronkhola union and Naim para and Moterbazar of Ausnara union under Madhupur Upazilla of Tangail district.

Sampling procedure

At the first phase of the study, homesteads having potential agroforestry practices of the four villages were recorded with the cooperation from the Sub Assistant Agricultural Officer. From the documented homesteads, three hundred sixty homesteads/ farmers taking ninety homesteads/ farmers from each village were randomly selected for data collection. At the second phase, detail information on agronomic and economic aspects of the three top most agroforestry practices was investigated. For this purpose, 40 sample homesteads/farmers for each agroforestry practice was randomly selected. Therefore, a total of 120 sample homesteads/ farmers for the 3 agroforestry systems/ practices were selected for the study and investigated. There were 860 households in

the study area. Among them 120 households were selected following simple random sampling technique. The distribution of the respondent households against each village is shown in Table 1 below:

Data collection and period of the study

The study was conducted during the period from April, 2012 to September, 2012 by direct interviewing of the respondents through interview schedule and discussion with the concerned experienced farmers.

Estimation of benefit from crop (Pineapple, Aroid, Ginger)

Benefits of each crop were calculated by multiplying the total output by their prevailing average unit market price. By-products prices were computed according to estimation provided by the farmers.

Estimation of cost of Jackfruit and Akashmoni tree cultivation

Generally, at planting time, farmers do not use any sort of fertilizers in pits. Pits were 0.3 m x 0.3 m x 0.3 m in size. Farmers themselves provided labor in all production and management activities. Therefore, opportunity cost principle was applied in calculating labor cost. Farmers did not use any kind of chemicals for pest or disease management.

Estimation of benefit from Jackfruit and Akashmoni tree cultivation

Generally, Jackfruit trees start bearing fruits at 4-5 years age. On the basis of farmer's statements, jackfruit benefit was calculated by multiplying average price of the Jackfruit with the total number of Jackfruit. Jackfruit tree take at lest 5-10 year to produce economic valuable log of those tree. On the basis of farmer's statements, Jackfruit trees benefit was calculated by multiplying expected average price of the log of jackfruit tree with the total number of jackfruit trees. Akashmoni tree take at lest 5-10 year to produce economic valuable log of those tree. On the basis of farmer's statements, Akashmoni trees benefit was calculated by multiplying expected average price of the log Akashmoni tree with the total number of Akashmoni trees.

Analytical techniques

The information so selected was tabulated and analyzed for achieving the objectives of the study. Different analytical techniques are described below.

Table 1. Distribution of population and sample respondents

Name of Union	Name of village	Total number of households	Respondent household heads interviewed
Arankhola	Chuniadanab bandha	220	30
Arankhola	Beri badh	180	30
Ausnara	Moter Bazar	250	30
Ausnara	Naim para	210	30
Total		**860**	**120**

Profitability analysis

Profit or net return is the difference between total revenue (gross return) i.e. total value product (TVP) and total factor cost (TFC). Total factor cost included all kinds of variable and fixed cost concerned with the production process. A farmer will not know maximum profit unless the TVP is compared with TFC. Farmer's profit was also shown by gross margin (GM) analysis, where only variable costs were deducted from total revenue.

Benefit Cost Ratio (BCR)

To assess the profitability level of different agroforestry practices, grower's simple tabular form and benefit cost ratio (BCR) was checked. BCR of different agroforestry practices was estimated by the ratio of gross return to variable cost and gross return to total cost. It is also defined as the difference between the value of goods and service produced by a farm and cost of resource used in production. The undiscounted BCR was worked out using the following formula.

Where,

Net Present Value (NPV)

This is the present value of cash flow stream. It can be computed by subtracting the total present value of cost from the total present value of benefit.

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

Where,

B_t = Gross benefit in i^{th} year

C_t = Total cost in i^{th} year

t = Number of year (1, 2, 3, 4……n)

i = Interest (discount) rate (assuming 0.12)

Results and Discussion

Profitability analysis of different agroforestry practice

Total costs, Fixed costs, and Variable costs

Table 3 shows that per hectare total variable cost (TVC) was highest in case of Jackfruit-Pineapple-Aroid practice (Tk. 376060) followed by Akashmoni- Pineapple-ginger practice (Tk. 319270) and Akashmoni-Pineapple-Aroid practice (Tk. 318140). Total Fixed Cost (TFC) was estimated taking rental value of land for 24 months and it was found Tk. 163020 per hectare for different agroforestry system. Thus, per hectare total costs were estimated as the highest in case of Jackfruit-Pineapple-Aroid practice (Tk. 539080) followed by Akashmoni-Pineapple-ginger practice (Tk. 482287) and Akashmoni- Pineapple-Aroid practice (Tk. 481160) (Table 2).

Table 3 also shows that per hectare labor cost was highest incase of Jackfruit-Pineapple-Aroid practice (Tk. 207380) followed by Akashmoni- Pineapple-Aroid practice (Tk. 155970) and Akashmoni- Pineapple-Ginger practice (Tk. 151416).

Yield and Gross Return (GR)

Per hectare yields of Pineapple was highest (25011 piece) in case of Akashmoni-Pineapple-ginger practice followed by Akashmoni- Pineapple-Aroid practice (23474 piece) and Jackfruit-Pineapple-Aroid practice (22550 piece). The yield of jackfruit was 1164 piece/ha incase of Jackfruit-Pineapple-Aroid system. The average price of pineapple and jackfruit was 20 Tk/Piece and 30 Tk/Piece

respectively. The yield of ginger was 2.49 MT/ha in case of Akashmoni- Pineapple-Ginger practice. The yield of aroid was highest (5.28 MT/ha) in case of Akashmoni- Pineapple-Aroid practice compare to Jackfruit-Pineapple-Aroid system (4.4 MT/ha). The average price of Aroid and Ginger was 17.5 Tk/kg and 50 Tk/kg respectively (Table 4).

Table 5 shows that per hectare total return was highest in case of Akashmoni- Pineapple-Ginger practice (Tk. 695801) followed by Jackfruit-Pineapple-Aroid practice (Tk. 688250) and Akashmoni- Pineapple-Aroid practice (Tk. 589930).

Gross Margin (GM) and Net Return (NR)

Gross margin was estimated by deducting total variable costs from gross return and per hectare gross margin was highest (Tk. 213514) in case of Akashmoni-Pineapple-Ginger system followed by Akashmoni-Pineapple-Aroid practice (Tk. 149170) and Jackfruit-Pineapple-Aroid practice (Tk. 108770) (Table 6).

Benefit Cost Ratio (BCR)

Benefit cost ratio was estimated at 1.44 incase of Akashmoni- Pineapple-ginger system

Table 2. Per hectare costs of input for all agroforestry practice

Cost per hectare (Taka)	Name of the system								
	Akashmoni-Pineapple-Aroid			Akashmoni-Pineapple-Ginger			Jackfruit- Pineapple-Aroid		
	Mean	Percent	SE*	Mean	Percent	SE*	Mean	Percent	SE*
A. Variable cost									
Total labor cost	155970	32.4	6004	151416.4	31.3	1948	207380	38.6	42351
Sapling cost	3258	0.7	212	2965.495	0.6	201	1207	0.5	22
Suckers cost	41933	8.7	1053	42032.75	8.7	656	40961	7.5	932
Rhizome/Seedling cost	20930	4.5	778	30132.94	6.3	2914	21052	3.9	752
Urea	28517	5.8	2067	26771.09	5.5	973	32419	6.3	1825
TSP	24077	5.0	2012	23543.95	4.8	961	25409	4.7	1112
MP	16416	3.4	1372	16052.69	3.4	655	17324	3.4	758
Cow dung	6578.4	1.4	148	6880.243	1.4	178	6512.3	1.2	227
Pesticide & ethylene	2470	0.5	0	1399.667	0.4	0	2470	0.5	0
Interest on operating capital	17987	3.8	685	18071.5	3.8	342	21324	3.2	2571
Total variable cost	318140	66.2	11877	319270	66.2	5959	376060	69.8	45325
B. Fixed cost									
Land Cost	163020	33.8	512	163020	33.8	512	163020	30.2	512
Total fixed cost	163020	33.8	512	163020	33.8	512	163020	30.2	512
Total cost	481160	100	11877	482286.8	100	5959	539080	100	45325

*SE = Standard Error

Table 3. Human labor cost for diferent agroforestry practice

Operations	Name of the system								
	Akashmoni-Pineapple-Aroid			Akashmoni-Pineapple-Ginger			Jackfruit- Pineapple-Aroid		
	Man-days	Tk	Percent	Man-days	Tk	Percent	Man-days	Tk	Percent
Land preparation (pineapple)	29	7203	4.8	24	6199	4.1	24	6175	2.9
Land preparation (vegetable/ spices)	19	4541	2.9	16	4092	2.7	15	3773	1.8
Ploughing	19	4814	3	18	4551	3.1	17	4466	2.2
Sucker sowing	31	7939	5	28	6996	4.5	30	7647	3.6
Vegetable/ spices sowing	24	5919	3.8	37	9255	6.1	21	5431.7	2.6
Covering cost	47	11638	7.5	44	11100	7.3	44	11161	5.4
Fertilizer application	24	6025	3.8	30	7463	4.9	32	8161	3.9
Herbicide application	7	1857	1.2	7	1673	1.1	6	1649	0.84
Insecticide application	0	0	0	6	1723	1.1	0	0	0
Intercultural operation	117	29413	18.8	164	41124	27.1	180	45169	21.8
Hormone application	8	2070	1.5	6	1576	1.1	3	750	0.36
Transport (pineapple)	187	46795	30	199	49816	32.8	340	85169	41.2
Transport (jackfruit)	0	0	0	0	0	0	23	5819	2.9
Transport (vegetable/ spices)	111	27756	17.7	25	6233	4.1	88	22001	10.5
Total labor	623	155970	100	607	151416	100	828	207380	100

Table 4. Per hectare yield of product for all agroforestry practice

Yield per hectare	Name of the system					
	Akashmoni-Pineapple-Aroid		Akashmoni-Pineapple-Ginger		Jackfruit-Pineapple-Aroid	
	Mean	SE	Mean	SE	Mean	SE
Pineapple (piece)	23474	509	25011	390	22550	672
By product (piece)	43659	1079	47278	858	105550	42518
Jackfruit (piece)					1164	155
Ginger (MT)			2.49	0.24		
Aroid (MT)	5.28	0.24			4.4	0.48

*SE = Standard Error

Table 5. Per hectare gross return of product for all agroforestry practice

Return per hectare (Taka)	Name of the system								
	Akashmoni-Pineapple-Aroid			Akashmoni-Pineapple-Ginger			Jackfruit-Pineapple-Aroid		
	Mean	%	SE	Mean	%	SE	Mean	%	SE
Pineapple	469470	79.5	10191	500219	71.8	7811	451000	65.5	13446
By product	65489	11.1	1618	70917.6	10.3	1287	158320	23.1	63777
Jackfruit		0			0		34920	5.1	4663
Ginger		0		124664	17.9	7553		0	
Aroid	54963	9.4	3457		0		44003	6.3	4659
Gross Return	589930	100	13510	695801	100	10579	688250	100	66306

*SE = Standard Error

Table 6. Per hectare cost, return, gross margin and BCR of diferent agroforestry practice

Cost & Return per hectare	Name of the system					
	Akashmoni-Pineapple-Aroid		Akashmoni-Pineapple-Ginger		Jackfruit-Pineapple-Aroid	
	Mean	SE	Mean	SE	Mean	SE
Total Cost (Taka)	481160	11877	482286.8	5959	539080	45325
Total Return (Taka)	589930	13510	695801.2	10579	688250	66306
Gross margin(Taka)	108770	8195	213514.1	9372	149170	37103
BCR	1.22	0.01	1.44	0.02	1.27	0.07

*SE = Standard Error

followed by Jackfruit - Pineapple-Aroid practice (1.27) and Akashmoni-Pineapple-Aroid practice (1.22) (Table 6).

Yield and Gross Return (GR) from tree species

The number of Akashmoni tree was highest incase of Akashmoni- Pineapple-Aroid practice (299/ha) followed by Akashmoni-Pineapple-Ginger practice (285/ha). The number of jackfruit tree was 95/ha incase of Jackfruit-Pineapple-Aroid system (Table 7). The price of 10 years aged Akashmoni tree was on an average of 4500 Tk. and the price of 10 years aged Jackfruit tree was at 3500 Tk. (approximately).

Table 7 also shows that per hectare total return from tree log was highest for Akashmoni tree incase of Akashmoni- Pineapple-Aroid practice (Tk. 1348700) followed by Akashmoni tree incase of Akashmoni-Pineapple-Ginger practice (Tk. 1285800) and Jackfruit tree incase of Jackfruit-Pineapple-Aroid practice (Tk. 333790).

Cost, Return, Gross Margin and BCR after compounding for 10 years

In agroforesty system trees are most important component. But in the calculation of cost, return, gross margin and BCR of the diferent agroforestry systems, tree component was

Table 7. Per hectare log and return of trees of diferent agroforestry practice after 10 year

Return per hectare	Name of the system					
	Akashmoni-Pineapple-Aroid		Akashmoni-Pineapple-Ginger		Jackfruit-Pineapple-Aroid	
	Mean	SE	Mean	SE	Mean	SE
Tree (No.)	299	13.1	285	16.4	95	4.32
Return (Taka)	1348700	59061	1285800	73615	333790	15135

*SE = Standard Error

neglegile because of tree were not mesurable before the maturity of the tree. Akashmoni and Jackfruit tree take 5-10 year to produce economic value of log of those tree. So the return from tree components were calculated in the 10 years aged log of the tree (aproximately). For this reason compounding of cost, return, gross margin of other components of different agroforesty system for 10 years was necessary to include the product of tree species in calculation. After compounding the result are discussed bellow.

The total cost and return from Akashmoni-Pineapple- Ginger agroforestry system was Tk. 1497500/ha and Tk. 3446300/ ha, respectively, and the net return was Tk. 1948800/ha. The benefit cost ratio derived at 2.12 (Table 8).

The total cost and return from Jackfruit-Pineapple-Aroid agroforestry system was Tk. 1673800/ha and Tk. 2470790 /ha, respectively, and the net return was Tk. 796990/ha. The benefit cost ratio derived at 1.47 (Table 8).

The total cost and return from Akashmoni-Pineapple-Aroid agroforestry system was Tk. 1494000/ha and Tk. 3180400/ha, respectively, and the net return was Tk. 1686400/ha. The benefit cost ratio derived as 2.12 (Table 8).

The net return from Akashmoni- Pineapple-Ginger agroforestry system was the highest than other agroforestry system .The differences in net return between Jackfruit-Pineapple-Aroid and Akashmoni- Pineapple-Ginger agroforestry systems, the differences in net return between Akashmoni- Pineapple-Aroid and Akashmoni-Pineapple-Ginger agroforestry systems and the differences in net return between Jackfruit-Pineapple-Aroid and Akashmoni- Pineapple- Aroid agroforestry systems were Tk. 1151810/ha, Tk. 262400/ ha and Tk. 889410/ha respectively. The findings stated that the differences in net return between Jackfruit-Pineapple-Aroid and Akashmoni- Pineapple-Ginger agroforestry systems was the highest Tk. 1151810/ha, while it was the lowest Tk. 262400/ha in return between Akashmoni-Pineapple–Aroid and Akashmoni- Pineapple- Ginger agroforestry systems (Table 8).

The net return from Akashmoni-Pineapple-Ginger agroforestry system was higher than other agroforestry system before and after compounding because gross return of ginger is higher than the aroid. The net return from Jackfruit-Pineapple-Aroid agroforestry systems was higher than Akashmoni-Pineapple-aroid agroforestry system before compounding but The net return from Akashmoni-Pineapple-

Table 8. Data adjustment between the per hectare cost, return, gross margin and BCR of diferent agroforestry practices after compounding for 10 years and per hectare cost, return, gross margin and BCR of tree species

Cost, Return & Gross margin per hectare	Name of the system					
	Akashmoni-Pineapple-Aroid		Akashmoni-Pineapple-Ginger		Jackfruit-Pineapple-Aroid	
	Mean	SE	Mean	SE	Mean	SE
Total Cost (Taka)	1494000	36879.7	1497500	18504.3	1673800	140734
Total Return (Taka)	3180400	101011	3446300	106465	2470790	221016
Gross margin(Taka)	1686400	64131	1948800	87960	796990	80282
BCR	2.12	0.01	2.30	0.02	1.47	0.07

Source: Field survey, 2012, *SE =Standard Error

aroid agroforestry system was higher than and Jackfruit-Pineapple-Aroid agroforestry systems after compounding, because of the log value of jackfruit is less compare to Akashmoni and the shade of jackfruit tree also deteriorate the quality of pineapple. In spite of the extra product (fruit) of jackfruit farmer are interested to practice Akashmoni based agroforestry system because of less log value of Jackfruit as well as shade problem of jackfruit tree. On the other hand disease and insect are more susceptible to Jackfruit tree than Akashmoni tree.

Inter temporal budgeting for Jackfruit – Pineapple- Aroid agroforestry system

Inter temporal budget for Jackfruit-Pineapple- Aroid agroforestry production system showed that the cash flow in the 1st year was negative but it became positive from second year and it continued in subsequent years. Each cash flow varied from year to year and it depends on the season of crops because the cost and return varied within this time. Inter temporal budgeting for Jackfruit-Pineapple- Aroid agroforestry system is presented in Table 9. For inter temporal budgeting all costs incurred and benefit was accrued from the trees has been taken into consideration.

Costs

For the calculation of the cost of Jackfruit-Pineapple- Aroid agroforestry system, farmers' assumption had been considered. Questionnaire was supplied to respondents to calculate the cost of orchard of Jackfruit-Pineapple- Aroid agroforestry system which was established with all initial cost. During initial stage cost was very high due to inputs .On the other hand pineapple became harvestable at the age of 2 and 4 years, respectively and after each 4 year orchard of Pineapple was established newly. So inputs cost after each 4 year was very high. Aroid became harvestable at the age of 2 years and after each 4 year orchard of Pineapple was established newly. So inputs cost after each 4 year was also high. In this way cash flow varied year to year. Initial cost incurred for Jackfruit and pineapple plantation included saplings, suckers, bamboo stick, and fertilizers.

Table 9. Benefit cost ratio of jackfruit–pineapple-aroid agroforestry system for 20 years

Age of orchard (year)	Gross cost (Taka)	Gross return (Taka)	Cash flow(CF) (Taka)	Discounted Gross cost at 10% DR (Taka)	Discounted Gross return at 10% DR (Taka)	Net present value at 10% DR (Taka)
1	957420	96856	-860564	870382	88051	-782331
2	402760	509720	106960	332860	421256	88397
3	144720	170420	25700	108730	128039	19309
4	190520	508870	318350	130128	347565	217437
5	243800	250020	6220	151381	155243	3862
6	288250	347830	59580	162710	196341	33631
7	152030	155180	3150	70923	79632	1616
8	191140	504270	313130	81062	235246	146077
9	342290	352230	9940	131968	149380	4216
10	188910	424940	236030	66212	163833	91000
11	159280	228730	69450	50752	80168	24342
12	192220	504160	311940	55679	160641	99394
13	346390	397980	51590	91215	115281	14944
14	190680	388150	197470	45647	102212	52000
15	155840	164370	8530	33915	39349	2042
16	195230	513920	318690	38625	111844	69356
17	349230	351970	2740	62812	69635	542
18	195700	411670	215970	31999	74042	38844
19	161970	188490	26520	24076	30820	4336
20	200110	522720	322610	29745	77699	47954
Total				**2570820**	**2826277**	**176969**

PV= present value, DR= discounted rate

Present Value (NPV) at 10 percent was Tk. 49517/ha. BCR at 10 percent discounted rate (1.12) indicate that, if farmers' invest Tk100, he would get Tk.112

Benefits

Benefits from Jackfruit- Pineapple- Aroid agroforestry system started from second year of planting. Pineapple became harvestable at the age of 2 and 4 years, respectively. So benefits each 2 and 4 year were high. Aroid became harvestable at the age of 2 years. So benefits each 2 year were also high. The log of jackfruit tree were considered to harvest in the season of establishing new orchard to meet up the extra cost of establishing new orchard within jackfruit–pineapple-aroid production time for 20 year.

Benefit cost ratio (BCR) of jackfruit–pineapple-aroid production for 20 year at 10 percent discounted rate was 1.12 and Net.

Sensitivity analysis

Sensitivity analysis of the jackfruit-pineapple agroforestry system for 20 years (Table 10) were done considering -

(i) Cost increased by 10 percent

(ii) Cost increased by 5 percent

(iii) Cost decreased by 5 Percent

(iv) Gross return reduced by 10 percent

(v) Gross return increased by 10 percent

(vi) Cost increased by 10 percent and gross return reduced by 10 percent.

(vii) Cost increased by 10 % and Gross return increased by 10%

Sensibility Analysis showed that, when Cost increased by 10 percent, the Net Present Value (NPV) was TK. -87962/ha, when cost increased by 5 percent the Net Present Value was Tk 44503/ha, when cost decreased by 5 percent the NPV was Tk 309434, when Gross return reduced by 10 percent the Net Present Value were TK. – 105659/ha, when gross return increased by 10% the NPV was Tk 459596, when cost increased by 10 percent and gross return decreased by 10 percent then NPV was Tk -370590 and when cost increased by 10 percent and gross return increased by 10% then NPV was Tk 194665. Sensitivity analysis shows that Jackfruit-Pineapple- Aroid agroforestry system is sensible to increment and reduction of cost and gross returns.

Conclusion

The indentified top-ranked three agroforestry systems were Akashmoni- Pineapple- ginger practice, Akashmoni- Pineapple-Aroid practice and Jackfruit-Pineapple-Aroid practice. The net return from Akashmoni-Pineapple-Ginger agroforestry system was higher than other agroforestry system in both cases before and after compounding. The net return from Jackfruit-Pineapple-Aroid agroforestry systems was higher than Akashmoni-Pineapple-Aroid agroforestry system before compounding but lower after compounding. Inter temporal budget for Jackfruit- Pineapple-Aroid agroforestry production system for 20 years showed that the cash flow in the 1st year was negative but it became positive from second year and it continued in subsequent years and sensibility analysis shows that Jackfruit- Pineapple-Aroid agro forestry system for 20 years was sensible to increment and reduction of cost and gross returns. The generated information

Table 10. Sensitivity analysis of the jackfruit-pineapple-Aroid agroforestry practice for 20 years

Sensitivity analysis considering	Net Present Value (Taka)
i. Cost increased by 10 percent,	-87962
ii. Cost increased by 5 percent	44503
iii. Cost decreased by 5 Percent	309434
iv. Gross return reduced by 10 percent	-105659
v. Gross return increased by 10 percent	459596
vi. Cost increased by 10 percent and gross return reduced by 10 percent	-370590
vii. Cost increased by 10 % and Gross return increased by 10%	194665

of the study will be helpful to the researchers, planners and development workers who will conduct further studies of the similar nature and encourage them in conducting more comprehensive and detailed investigation in the particular field.

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