

Agro-Economic Performance of Jackfruit-Pineapple Agroforestry System in Madhupur Tract

M. K. HASAN^{1*}, M. M. AHMED² & M. G. MIAH³

¹On Farm Research Division, Bangladesh Agricultural Research Institute, Gazipur-1701, Bangladesh

²Training and Communication Wing, Bangladesh Agricultural Research Institute, Gazipur-1701, Bangladesh

³Department of Agroforestry and Environment, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur, Bangladesh

ABSTRACT

A survey was carried out in two villages of Durgapur union under Kapasia upazila of Gazipur district during January to March, 2005 to investigate profitability, problems and management system of practicing jackfruit-pineapple agroforestry practice. Result revealed that the existing jackfruit-pineapple agroforestry system is profitable and has a great contribution to the meet up of nutritional demand. There is a scope of adopting improved management practices and it may increase the total production. Among the various problems, jackfruit trunk borer is the major. Measures against insects, bat, hedgehog, squirrel etc., use of popular cultivar and training on improved management practices for development of jackfruit-pineapple agroforestry system were suggested to overcome these problems.

Key words: Agro-economic performance, jackfruit-pineapple agroforestry system.

INTRODUCTION

Agroforestry is a collective name for land-use systems and technologies where woody perennials (trees, shrubs, palms, bamboos etc.) are deliberately used on the same land-management units as agricultural crops and/or animals, in some form of spatial arrangement or temporal sequence (Lundgren and Raintree, 1982). Through agroforestry, important forest products and desirable forest environment may be obtained almost everywhere in the country (Manandhar, 1986). Jackfruit (*Artocarpus heterophyllus* Lam K.) is a multipurpose tree with a great importance for its fruit, timber, fodder and fuel wood. It is the national fruit as it is consumed by all classes of rural Bangladeshi people as well as it is native to the country (Rashid *et al.*, 1987). Jackfruit is rich in vitamin A and C, contains moderate qualities of minerals and high qualities of protein, calcium, thiamin, riboflavin and carotene than banana, but less in nutrition to mango (Hossain *et al.*, 1979).

Jackfruit is the principal fruit tree in Madhupur tract. It was identified as an important cash-generating crop (Ahmed, 1999). Pineapple (*Annanas comosus*) is a common fruit in Bangladesh and it is a good source of vitamin A, B and C (Mondal, 2000). Basher (1999) found that 50 per cent of all households at Kapasia upazila under Gazipur district had pineapple gardens adjoining their homesteads mostly under the jackfruit trees. In this system, farmers believe that the partial shade of the trees improves the physical environment for pineapple that ultimately enhances the yield and

* Corresponding author: Scientific Officer, OFRD, BARI, Gazipur-1701, Cell: 01818410770, E-mail: kamrulnk@yahoo.com

quality of the latter. The jackfruit trees not only provide suitable ecology for the under storey crop but also produce other basic requirements of the growers such as food, fodder, fuel wood and timber. The average annual net returns of the traditional agrisilvicultural practices were found much higher than the agriculture (Abedin and Quddus, 1991). But the farmers are losing their interest in such kind of agroforestry system due to some problems. Agroforestry system, more particularly, jackfruit-pineapple 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 jackfruit-pineapple agroforestry system as well as increasing jackfruit and pineapple 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. Therefore, the present study was undertaken to assess and describe the production practices of jackfruit-pineapple agroforestry system and its profitability, to identify the major constraints and potentials of jackfruit-pineapple agroforestry system.

MATERIALS AND METHODS

The study was carried out at Kapasia upazila of Gazipur district during January to March, 2005. Two villages under Durgapur union were purposively selected for farm level data collection. As the sampling farm was not readily available, a total of 60 farmers were selected randomly to collect primary data. A pre-design and pre-tested survey schedule was used for this purpose. The collected data were summarized and scrutinized carefully for statistical analysis using SPSS 10.0, computer software for analyzing data. In order to evaluate the jackfruit-pineapple agroforestry system, investment analyses were carried out considering the timing of benefit and costs throughout the rotation period of jackfruit-pineapple systems. Three discounted measures as suggested by Guittinger (1982) and followed by Hasan *et al.* (1991) and Uddin and Hasan (2003), among others for project appraisal were adopted in this study.

RESULTS AND DISCUSSION

Common production practices by the farmers in jackfruit-pineapple agroforestry system

Time of planting

All the respondent farmers opined that they plant jackfruit sapling during the rainy season *i.e.* in the month of July-August and the pineapple suckers in the month of September with about 120 saplings per hectare for jackfruit and about 30000 suckers per hectare for pineapple, respectively (Table 1).

Application of fertilizer

Usually farmers do not apply fertilizers. Some farmers use fertilizers and manure during the planting time. They used 10 kg cowdung, 250 g urea, 250 g TSP and 250 g of MP during the planting of jackfruit sapling. None of the farmers were found to apply fertilizers after the establishment of sapling. Therefore, immense scope and prospects exists for increasing the productivity of jackfruit through adopting appropriate fertilizer management practices. Although experimental evidence on nutritional requirement of jackfruit is not available, application of farmyard manure at 37 kg per plant in first year, 750 g ammonium sulfate, 625 g single superphosphate and 300 g muriate of potash per plant per year in the second and third year of planting and in the fourth year an increased dose of 938 g ammonium sulfate, 781 g single superphosphate and 375 g of muriate of potash were found to increase growth, flowering and fruiting in jackfruit (Mukherjee *et al.*, 1983). At the age of 6-10, 25-50 kg cowdung, 500-700 g urea, 300-600 g TSP and 300-400 g MP and in plants older than 10 years, 60-110 kg cowdung, 1-1.2 kg urea, 0.8-1.0 kg TSP and 1 kg of MP may be applied per tree (Mondal, 2000). As pineapple removes 123 kg of nitrogen, 33 Kg of phosphorus and 308 Kg of potash from one hectare of land yielding a crop of 40 tones (Sen, 1990), it requires a substantial amount of nutrients. India recommended 600-400-600 Kg/ha of N, P₂O₅ and K₂O for pineapple in (Roy *et al.*, 1986). Jackfruit and pineapple are grown in rainfed condition.

Weeding

Thirteenth 'Bhadra' (28th August) is the day when farmers start weeding pineapple orchard. They believe that it might bring curse if they do not start weeding on that day.

Harvesting time of the products

Usually the farmers harvested the jackfruit from April to July and in some cases up to September and pineapple from mid May to July.

Table 1. Production practice of jackfruit-pineapple agroforestry system in the study area

Item	Jackfruit	Pineapple
Planting period	July-August	September
Number of plants per ha (approximately)	120	30,000
Fertilizer per pit during planting		
Organic matter	10 kg	
Urea	250 g	
TSP	250 g	
MP	250 g	
Weeding		August-September
Pruning	After harvesting	
Harvesting period	April to July	Mid May to July
Fruit yield (No./ha.)	Around 2400	Around 12000
By product yield (per ha.) (approximately)		Sucker 30000

Sources of planting materials

Own sources plus local market are the prime source (60%) for jackfruit saplings followed by own source plus neighbor plus local market (32%). A very few farmers also purchased saplings from the private nursery.

Selling of the products

Most of the farmers (40%) sell their product to the middlemen (Bepari) at their farm gate followed by Bepari and local market (31.67%). Only 28.33% of the farmers, who were mostly under marginal and small category, sell their product at local market.

Some features about jackfruit-pineapple agroforestry system

Age and fruit bearing of jackfruit trees

The age of jackfruit trees varied from farm to farm. Most of the trees (35.68%) were at the age of 21-40 years followed by 5-10 years (27.15%) (Table 2). In few farms, the trees under 5 and <40 years were not found. Rasel (2004) found that maximum numbers of trees (38%) were under the age of 16 to 25 followed by 26 to 40 years (36.6%) in three villages of Sreepur upazila under Gazipur district. It is revealed that 23.19, 85.59, 88.09 and 86.44% were fruit bearing trees under the age groups of <5 years, 5-20 years, 21-40 years and above 40 years per hectare respectively. It was found that the trees under the five year bear fruits to some extent. Amin (2004) reported that the first fruiting starts in the jackfruit tree at the age of 4 years although Sammadar (1990) stated that the trees usually bear fruit at 7-8 years. In a study, Asaduzzaman (1993) found that 61.23 to 95.31% fruit bearing trees were >5 years old in different categories of farms. All the trees may not bear fruits due to physical factors (Mondal, 2000).

Table 2. Number of jackfruit trees in the jackfruit-pineapple orchards (per hectare)

Tree category	Number of jackfruit trees in orchard				Number of fruit bearing jackfruit trees in orchard			
	Minimum	Maximum	Average	S.D.	Minimum	Maximum	Average	S.D.
<5 years	00	75	19.70	18.43	00	60	4.57	11.67
5-20 years	12	115	38.18	21.39	12	98	32.68	17.84
21- 40 years	15	115	39.37	20.23	13	96	34.68	17.28
>40 years	00	75	20.13	20.16	00	67	17.40	18.14

On an average, highest numbers of fruit (32.93) were found in the trees aged of 21 to 40 years followed by 5 to 20 years-old trees (28.47 fruit per tree). Number of fruit declined in case of tree

>40 years (24.22). Few trees bear fruits at the age of 5 years. Amin (2004) found that the trees aged between 18 to 20 years bear on an average of 35.66 fruits per tree followed by the tree of 12 to 14 years (17.33 fruits per tree). Asaduzzaman (1993) observed that a jackfruit tree bears 21 to 27 fruits on an average.

Pattern of jackfruit and pineapple utilization

Pattern of jackfruit and pineapple utilization in different farm categories is presented in the Table 3 and 4, respectively. It was found that the number of jackfruits consumed per family varied from 81 to 173 depending upon the farm category. It varied mainly with the family size- larger family consumed more fruits. In terms of percentage, the consumption decreased with increasing the farm size which might be due to increased production in bigger farm. The percentage of sold fruits gradually increased in bigger farms. The wastage percentage was 6.36 to 6.66. Wastage of jackfruit caused mostly due to insect, diseases, vertebrates and natural calamities. On an average, 8.54, 80.11, 4.80 and 6.55% of the total production of jackfruit were consumed, sold, distributed (to the relatives, neighbors, mosques and others) and wasted, respectively. Asaduzzaman (1993) also found that 20-25, 60-75 and 5-10% of the total production of jackfruit were consumed, sold and distributed by the growers in case of homestead trees in different categories of farm, respectively. Ahmed (2002) found that the consumption, sale, distribution and wastage were 16.24, 74.70 6.49 and 2.57% of the total production, respectively of the growers.

Table 3. Pattern of utilization of jackfruit (number) in different farm categories

Farm category	Production (number/farm)	Consumed by the farm family	Sold by the farm	Distribution	Wastage
Marginal	733	100 (13.64)	550 (75.03)	33 (4.5)	50 (6.52)
Small	783	81 (10.23)	608 (76.77)	41 (5.24)	53 (6.66)
Medium	1092	95 (8.66)	879 (80.13)	49 (4.47)	74 (6.75)
Large	2624	173 (6.69)	2167 (83.87)	117 (4.46)	167 (6.36)
Overall (per farm)	1312	112 (8.54)	1051 (80.11)	63 (4.80)	86 (6.55)

Figures in the parentheses indicates the percentage

The consumption number of pineapple varied from 132 to 183 depending upon the farm size (Table 4). Major portion of the production (80.37 to 93.35%) is sold by all categories of farms. Distribution to relatives, neighbors, mosques and others varied from 1.42 to 5.17 percent. Due to various factors like hedgehog, animals and also diseases caused the wastage from 3.67 to 5.97% of the total production in different farms. Aziz (1976) observed that 5 percent of pineapple fruit was wasted in the process of bringing from producers to ultimate consumers. On an average, 2.64, 90.74, 2.12 and 4.51% of the total production were consumed, sold, distributed and wasted, respectively.

Table 4. Pattern of utilization of pineapple (number) in different categories of farmers

Farm category	Production (number/farm)	Consumed by the farm family	Sold by the farm	Distribution	Wastage
Marginal	1652	150 (8.61)	1400 (80.37)	90 (5.17)	102 (5.86)
Small	4362	132 (3.02)	3941 (90.3)	90 (2.06)	199 (4.56)
Medium	5183	144 (2.80)	4593 (89.46)	139 (2.71)	307(5.97)
Large	11783	183 (1.55)	11000 (93.35)	167 (1.42)	433 (3.67)
Overall (per farm)	5768	152 (2.64)	5234 (90.74)	122 (2.12)	260 (4.51)

Figure in the parenthesis indicates the percentage

Area of jackfruit-pineapple orchard in the total cultivable land

The average cultivable land, area under jackfruit-pineapple orchard and percent of jackfruit-pineapple orchard in the total cultivable land are presented in the Table 5. It was also found that all the farms devoted 15.89 to 47.37% of their cultivable land for jackfruit-pineapple orchard. A strong, positive and significant correlation was also found between the cultivable area and the area under jackfruit-pineapple orchard ($r = 0.765^{**}$) and between the area under jackfruit-pineapple orchard and income ($r = 0.595^{**}$).

Table 5. Area of jackfruit-pineapple orchard in the total cultivable land

Farm category	Cultivable land per farm (ha)	Area under jackfruit-pineapple orchard (ha)	Percent of jackfruit-pineapple orchard in the total cultivable land per farm
Marginal	0.38	0.18	47.37
Small	0.84	0.30	37.04
Medium	1.45	0.49	33.79
Large	7.05	1.12	15.89

Nutritional contribution of jackfruit-pineapple orchard to the farmers

Jackfruit-pineapple agroforestry systems can play a great role in alleviating our under nutritional problems. Contribution of jackfruit-pineapple orchard in nutrition is presented in the Table 6.

Nutritional value of jackfruit and pineapple was calculated considering the following points:

Average farm family sizes: 6.42. (at the study area found)

RDA (Recommended Dietary Allowance) was followed as Rashid (1999) for middle age of 20-49.

The number of jackfruit consumption: 112 (Table 3)

The average weight of mature and ripe jackfruit ranges from 3.24 to 7.39 kg (Hossain and Haque, 1977), considering a fruit is about 5 kg.

Duration of fruiting (jackfruit): 4 months.

Edible portion of a cell of jackfruit: 30% (Vaidya, 1982)

The number of consumption of pineapple: 152 (Table 4)

Duration of fruiting (pineapple): 2.5 months.

Average weight of a pineapple fruit: 739 g (Hossain, 1999)

The required energy was considered as 2212 K. cal./capita/day (FAO, 1985)

Table 6. Nutritional contribution from jackfruit-pineapple orchard in the recommended dietary allowance (per family per day)

	Energy (K. Cal.)	Protein (mg)	Vit. A (I.U.)	Thiamin (mg)	Riboflav in (mg)	Niacin (mg)	Vit. C (mg)	Calcium (mg)	Iron (mg)
Jackfruit	1234	26.6	2450	0.42	1.82	5.6	98	280	7
Pineapple	585	9	900	0.9	0.45	4.5	180	195	12
Total	1819	35.6	3350	1.32	2.27	10.1	278	475	19
RDA (for average family size)	14200	334	4815	9	9	118	193	2889	58
% of RDA	13	11	70	15	25	9	144	16	33

It was found (Table 6) that jackfruit-pineapple orchard has great contribution on family nutrition. The contribution of jackfruit-pineapple orchard for a farm family in recommended dietary allowance of energy, protein, vitamin A, thiamin, riboflavin, niacin, vitamin C, calcium and iron was 13, 11, 70, 15, 15, 25, 9, 144, 16 and 33%, respectively during cropping season. It revealed that daily requirement of vitamin C can fully satisfied solely by jackfruit-pineapple.

Utilization of sale proceeds from jackfruit and pineapple

The income generated from selling of jackfruit and pineapples were used for different purposes. On an average, major portion of sale proceeds were found to be used for meeting the daily household requirements (80%) followed by educational expenditure (27%), buying cloths and other necessaries (23%), loan repayment (22%), medical expenses (20%), buying agricultural equipments (17%), household construction (13%), marriage ceremony (7%), and business investment (7%). Larger group of farmers used their sale proceeds mainly in construction works while the poorer groups used it in daily expenditure, medical expenses, loan repayment etc.

Other tree association: Besides the jackfruit trees, there are various types of trees like Sal (*Shorea robusta*), Teak (*Tectona grandis*), Akasmony (*Acacia auriculiformis*), Mango (*Mangifera indica*), Litchi (*Licthi chinensis*), Blackberry (*Syzygium cumini*), Sonalu (*Cassia fistula*), Koroi (*Albizia* spp.), Raintree (*Samanea saman*), Mahogany (*Swietenia mahogoni*), Garjan (*Dipterocarpus* spp.), Giga (*Odina wodier*), Gamar (*Gmelina arborea*), etc. were found in the orchard. Farmers opined that the production of jackfruit as well as pineapple is declining due to introduction of timber species as a consequence of overcrowding of upper storey canopy.

Economic performance of jackfruit-pineapple agroforestry system

Intertemporal budgeting for jackfruit-pineapple agroforestry system

Intertemporal budgeting for jackfruit-pineapple agroforestry system is presented in Table 7. For intertemporal budgeting all costs incurred and benefits accrued from the trees have been taken into consideration. Initial cost incurred for jackfruit and pineapple plantation included saplings, suckers, bamboo stick, fertilizers, land and pit preparation and land rent which was Tk. 40158/ha. Jackfruit and pineapple became harvestable at the age of 4 and 2 years, respectively. During initial stage, cost was very high due to inputs. Benefits from Jackfruit-pineapple agroforestry production system started from second year of planting, which was Tk. 457449/ha. Benefit was increased with the passage of time. The benefit of second year and third year was constant due to no income from jackfruit.

Intertemporal budget for jackfruit-pineapple agroforestry production system showed that the cash flow in the first year was negative, but it became positive from second year and it continued in subsequent years (Table 7). At 12% discounted rate, gross cost, gross benefit and net present value were Tk. 303729/ha, 457449/ha and 153720/ha, respectively. Benefit cost ratio (1.51), net present value (Tk. 457449/ha) and internal rate of return (51%) clearly indicated the profitability of Jackfruit-pineapple agroforestry production system. The benefit cost ratio indicated that if a farmer invests Tk. 100, he would get Tk. 151.

Table 7. Benefit cost ratio of jackfruit-pineapple production for 25 years

Age of orchard (year)	Gross cost (Taka)	Gross return (Taka)	Cash flow (CF) (Taka)	Discounted CF at 30% DR (Taka)	Discounted CF at 40% DR (Taka)	Discounted gross cost at 12% DR (Taka)	Discounted gross return at 12% DR (Taka)	Net Present Value of Tk. at 12% DR (Taka)
1	40158	0	-40158	-40158	-40158	40158	0	-40158
2	22800	35000	12200	9382	8711	20360	31255	10895
3	22800	35000	12200	7222	6222	18172	27895	9723
4	23998	35700	11702	5324	4260	17087	25418	8332
5	24148	36000	11852	415	3082	15358	22896	7538
6	26072	39000	12928	3478	2405	14783	22113	7330
7	28072	43000	14928	3090	1985	14233	21801	7568
8	30920	47000	16080	2557	1528	13976	21244	7268
9	32920	51000	18080	2224	1229	13300	20604	7304
10	36192	55000	18808	1768	903	13065	19855	6790
11	38192	59000	20808	1519	728	12298	18998	6700
12	41040	63000	21960	1230	549	11778	18081	6303
13	43040	67000	23960	1030	431	11061	17219	6158
14	45888	71000	25112	829	326	10508	16259	5751
15	47888	75000	27112	678	244	9817	15375	5558
16	51160	79000	27840	529	167	9362	14457	5095
17	53160	83000	29840	448	149	8665	13529	4864
18	56432	87000	30568	367	92	8239	12702	4463
19	58432	91000	32568	293	65	7596	11830	4234
20	60432	95000	34568	242	69	7010	11020	4010
21	62280	97000	34720	174	35	6477	10088	3611
22	63280	99000	35720	143	36	5885	9207	3322
23	64280	101000	36720	110	37	5335	8383	3048
24	65280	103000	37720	75	0	4831	7622	2791
25	66280	903000	836720	1673	0	4374	59598	55224
Total				4641	-6906	303729	457449	153720

PV = present value, DR = discounted rate

Result: BCR at 12% = 1.51, NPV at 12% = Tk. 153720 per hectare, IRR is 51%

Sensitivity analysis

Sensitivity analysis of the jackfruit-pineapple agroforestry system for 25 years (Table 8) were done considering-

- (i) Cost increased by 10%
- (ii) Gross return reduced by 10% and
- (ii) Cost increased by 10% and gross return reduced by 10%.

Table 8. Sensitivity analysis of the jackfruit-pineapple orchard

Sensitivity analysis considering	Benefit cost ratio	Net present value	Internal rate of return
(i) Cost increased by 10%	1.37	Tk. 123347	35.5
(ii) Gross return reduced by 10%	1.36	Tk. 107975	34.2
(iii) Cost increased by 10% and gross return reduced by 10%	1.23	Tk. 77602	26.5

Sensitivity analysis showed that BCR and IRR might be very close if cost increased by 10% or gross return reduced by 10%. BCR, NPV and IRR may be at 1.37, Tk. 123347 and 35.5 respectively, when cost increased 10%. Considering gross return reduced by 10% the BCR, NPV and IRR were 1.36, Tk.107975 and 34.2 while the combination of cost increases by 10% and gross return reduce by 10%, the BCR, NPV and IRR might be 1.23, Tk. 77602 and 26.5, respectively, which shows that the practice is almost sure to remain profitable despite the uncertainties associated with the estimates of costs and returns used in the discounted benefit-cost analysis.

Problems faced by the farmers in practicing jackfruit-pineapple agroforestry system

The respondents face various problems in practicing jackfruit-pineapple agroforestry system in the area. The major problems were listed in Table 9.

Insects

All farmers opined that 'jackfruit trunk borer' caused severe damage to the jackfruit production. Jackfruit fruit borer also caused damage to fruit. Rasel (2004) recorded 25.3% of jackfruit trees were infested by borer in three villages under Sreepur upazila. This type of severity was prominent during last 10-15 years due to introduction of timber trees in the orchard. Initially, borer (caterpillar) attacks the trunk creating a hole. After a few years of infestation, the trees die. In case of fruit borer, the reddish brown larvae bore into the fruit and destroy them. The damage by borer is locally called 'cancer'. As a control measure, some farmers use cowdung at the infested site. Alam (1974) recommended the following control measures to control the trunk borer:

- i) The infested tree should be examined and the beetles and grubs whenever found are to be collected and destroyed.
- ii) Paradichlorobenzene may be introduced into the holes of borers and the holes may be sealed up with mud.

Squirrel and Bat

Squirrel and bat attack the jackfruit during the ripening stage. They make wounds on the ripe fruit which reduces the market value of the fruit. Seventy five and 55% of the respondents expressed this problem of jackfruit due to damage by squirrel and bat, respectively.

Hedgehog

As pineapple is a good source of food for hedgehog, it causes severe damages to pineapple. During daytime, it remains hidden in the holes and come out at night. Twenty-four farmers (40%) claimed that it was problem to pineapple.

Diseases

About 43% of the farmers claimed that disease causes damage to the jackfruit-pineapple agroforestry system. Fruit drop due to '*Rhizopus* rot' was identified as major disease in jackfruit. The rot starts near the stalk end which gets covered with the mycelium in case of small fruit. Spray application of Dithane M-45 (Mancozeb 75% W.P.) at 0.2% and Bavistin (Carbendazim) at 0.05%, three times at 14 day intervals starting in early March give the best control (Gupta and Pandey, 1985). 'Fruit rot' causes damage notably to pineapple when fruits are left too long before processing and become over-ripe. Dipping of the fruit stalk in benzoic acid is very effective to control of the fungus. The farmers did not take any control measures against the diseases due to lack of knowledge as well as high price of chemicals.

Low price of the products

That was applicable for pineapple. The prevailing cultivar *i.e.* 'ghorasa' generally produced in that area is not much as popular due to its sour taste. Due to less demand of 'ghorasa' cultivar, its price is low as compared to other cultivars like 'honey queen' and 'giant kew'.

Lack of capital

During the establishment of jackfruit-pineapple orchard, huge amount of capital is needed to purchase of inputs. Moreover, most of the farmers were under the small and medium farm categories and their annual income was not over Tk. 85000. Thirty five (58%) farmers expressed that lack of capital was a problem for the development of the orchard.

High price of inputs

Due to the high price of insecticides, fungicides and fertilizers, farmers were reluctant to use those. Forty-five (*i.e.* 75%) of the farmers consented such kind of problem.

Lack of storing facility

Due to lack of storage facility, farmers were not able to store the harvested jackfruit and pineapple any longer. Fifty percent of the farmers claimed that lack of storage facility was a problem.

Besides these problems, poor communication, labor crisis, stealing of fruit at the harvesting time, lack of skilled manpower, insufficient extension service, natural calamities etc. were the common problems faced by the farmers in the orchard.

Table 9. Problems faced by the farmers in practicing jackfruit-pineapple agroforestry system

Type of problem	No. of respondents	Percent of respondents	Rank order
A. Biological problem			
i) Insects	60	100	1 st
ii) Squirrels	45	75	3 rd
iii) Bats	33	55	5 th
iv) Hedgehogs	24	40	9 ^h
v) Diseases	26	43	8 th
B. Economic problem			
i) Low price of products	51	85	2 nd
ii) Lack of capital	35	58	4 th
iii) High price of inputs	45	75	3 rd
C. Marketing problems			
i) Lack of storing	30	50	6 th
ii) Poor communication	28	47	7 th
iii) Labour crisis	23	38	10 th
D. Social problem			
i) Problem of theft	12	20	12 th
ii) Lack of skilled manpower	14	23	11 th
iii) Insufficient extension service	12	20	12 th
E. Natural calamities	9	15	13 th

Farmers' suggestions for development of Jackfruit-pineapple agroforestry system

Respondent farmers gave their opinions for jackfruit-pineapple agroforestry system. These were taking proper control measures against insects, bats, squirrels and hedgehogs, introduction of popular pineapple cultivar, development of marketing system, improved management practices, arrangement of training and optimum fertilizer use etc.

CONCLUSION

From the above study it might be concluded that farmers use the planting materials from their own sources in most cases. They do not use fertilizer to the orchard after establishing the plants. There is a scope of different management practices specially balanced dose of fertilizer that can boost up the production. During cropping season, the daily requirement of vitamin C was fully satisfied but in case of other nutrients (eg. Riboflavin, Iron, Calcium, Thiamin, Protein etc.) requirement was partially fulfilled by jackfruit and pineapple. Economic analysis showed the profitability of the system. Some problems like jackfruit trunk borer, low price of pineapple, high price of inputs, attack of bats and squirrels on jackfruit and hedgehogs on pineapple etc. are being jeopardized the farmers to practice this system. There is a need to take measures to solve the problems as priority basis. Training on agroforestry is need for the orchard associates. Farmers and extension workers should be trained on improved management practices (fertilization, application of hormone etc.) to improve the productivity of jackfruit-pineapple agroforestry system. Steps should be taken to replace the local cultivar of pineapple with improved cultivar to increase productivity and profitability of the system. A sound marketing system should be developed. Besides, necessary processing plant should be established to prevent spoilage of fruits at the time of peak harvest. Appropriate research studies should be undertaken to develop control measures against the jackfruit borer.

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