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Assessing the Financial Risks in Guava Cultivation in the Pabna District of Bangladesh

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

Guava cultivation in Bangladesh is vital for being the sources of cancer prevention agents, vitamin, beta-carotene, zinc, copper, manganese, etc, which are fundamental for human body. The major objective of the study was to measure the financial risks in guava cultivation in Pabna district of Bangladesh. In order to measure the financial risks in guava production, the research studied the nature of NPV of guava orchards in the Pabna district of Bangladesh. For this purpose, the study estimated the average total net cash flows of each year by considering all the possible costs and benefits associated guava production for the selected orchards to determine their NPVs. A set of cross-sectional data on the selected variables has been used for the analyzing purpose of the research. A multi-stage sampling technique consists of purposive, cluster and simple random sampling has been applied for the selection of 100 guava orchards, from two upazilas of the district. Subsequently, a structured questionnaire composed of both open and closed-ended questions has been used for collecting data from the sample guava producers with the help of face-to-face interview method. The study employed simulation analysis to assess the financial risks in guava

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production in the selected area. The results revealed that the values of total net return in the first five years are negative, it become positive in the sixth year and thereafter. The value of total net return in the seventh year is BDT 63433 per bigha (1 bigha equals about 0.1335 hectare) and it continues to be stable up to 25 years of age of the guava plantation. The 1000 runs of simulation of NPV of guava orchard given that the NPV ranges from -BDT 18302.3 per bigha to BDT 184866 per bigha with a mean value of BDT 80649.51 per bigha. The distribution of the NPV which evident that the probability of a higher value or negative value of NPV is very low. The moderate value of NPV is the most likely outcome. The results of the simulation analysis inferred that the investment in the guava orchard is neither highly profitable nor loss-making which means that investment in this project bears a very low financial risk.

Keywords: Financial risk; net present value; operational cost; simulation analysis.

1. INTRODUCTION

It is indispensable to take an appropriate investment decision in order to get the maximum return from a financial project. Generally, farmers make cropping decisions based on the assumptions about some future events which are out of their control. However, all of the events don't occur as per the assumptions made by the farmers; this is known as risk. In such situations, farmers often fail to achieve their targeted level of output because all of their predictions don't come true. The magnitude of the deviation of actual output of a farm from its targeted level depends on the extent of risk associated with project; the greater the extent of risk, the greater the deviation of output. Since, agricultural farming inherently contains a wide variety of risks, the farmers have to deal with different types of risks continuously [1]. For the presence of three types of risk such as production, marketing and financial risks in agricultural farming, it is considered as the most volatile sector of an economy [2].

Unlike the other activities, agriculture intensively dependent on climate which is random in nature. Consequently, identification and evaluation of risk is very crucial for getting the better performance of agricultural farming [3]. Besides, risk assessment is important because knowing the level of risk of alternative projects the farmers may choose the low risky project. Moreover, if a farmer determines the risk level of a project by identifying the sources of risk, he gains the ability to minimize risk by bypassing avoidable unfavorable outcomes. In this regard, the level of fruitfulness of the initiative taken by the farmer to reduce risk depends on how much well risk management strategy will be adopted by him. A risk management strategy may be considered as a good strategy if it incorporates a greater volume of reliable information in formulating that strategy. That means in making appropriate farming decisions, the farmers must use not only the available information but also the information which may be attain by exploration. Adjustment in production and various non-market institutional arrangements may play a vital role in attaining the ability for stabilizing the consumption and lowering the cost of risk in traditional societies [4,5].

Psidium guajava is the scientific name of guava which is popularly known as the apple for the poor and contains moisture, dry matter, protein, fat, ash and pectin and their volume as a percentage are 74-84%, 13-26%, 0.8-1.5%, 0.4-0.7%, 0.5-1.0% and 1.15% respectively. It is evident from the researches that 100g of guava embodies 299mg of vitamin C, the fruit is treated as an important source of vitamin C [6]. It is also an excellent source of minerals such as each 100g guava contains 23-37mg of phosphorus, 14 - 30 mg of calcium, 0.6 - 1.4 mg of iron; it supplies some other vitamins like vitamin A, niacin, thiamine and riboflavin too [7,8]. As a significant source of vitamin C, guava is considered as one of the most significant defending fruits in Bangladesh [9]. In Bangladesh, guava is cultivated in a land area of about 10,000 ha and annual production of it is approximately 45,000 m. tons [10]. However, it is matter of regrate that the return from guava cultivation is not satisfactory and for various reasons about 20-25% of produced guava are damaged [11].

Although guava cultivation has a bright prospect in generating substantial earnings for the farmers, it contains a remarkable number of sources of financial risks. The notable sources of risks are: production risk, price risk, climate risk etc. To fulfil the growing demand of guava in Bangladesh, it is needed to expand the commercial cultivation of guava all over the

country. However, the production of guava hasn't increased to a satisfactory level even having favorable climate and suitable land pattern in many districts of Bangladesh. In this context, research questions have been arisen for this study are: Is the profit from guava cultivation enough to make the farmers satisfied for producing it? What is the nature and extent of risk in guava cultivation? What are the reasons for inadequate production of guava production in Bangladesh? The principal objective of the research was to identify the nature of risks in guava cultivation in the study area and quantify them.

2. LITERATURE REVIEW

Agubata & Odubuasi [12] examined the influence of unfavorable market price risk on earning capacity of farms in Nigeria. Based on their research finding concluded that variation in interest rate and variation in exchange rate have significantly positive impacts on farms' earning capacity. However, the effect of commodity price change on farms' earning capacity was significantly negative. Roger, et al. [13] conducted study in Central South Chile with a view to identify the most connected sources of risk in agriculture and rank them according to their significance. In ranking the four factors: climate, price and direct cost variability, commercialization, and human factor; they used the multi-criteria Analytical Hierarchical Process (AHP) method and concluded that price and direct cost variability has the highest importance and climate has the lowest importance. Djanibekov & Finger [14] conducted a study on cotton production in Uzbekistan by using a recursive programming model and found that scale of operation, resource allocation and farm enlargement are influenced by production, market, and institutional risks. Meuwissen, et al. [15] conducted a research on the Dutch livestock farms and identified the production costs minimization and insurance as the two most significant strategies for dealing with risk. Because, they found that among many of the sources of risks, price and production risks are the most significant to the Dutch livestock farmers. Contrarily, Miller, et al. [16] argued that a variety of terminologies are used in different research for introducing various types of risks in agriculture, but production, financial, marketing, legal and human risks are considered as the most important ones. By studying the recognition of risk sources by the blueberry growers in Chile, Labos, et al. [17] ranked the sources of risks as per their importance. In that ranking climatic events were identified as the most significant source of risks in blueberry cultivation perceived by the growers in Chile. The study also identified the price of blueberry as well as the currency exchange rate as the other two significant sources of risks for the owners of the land. Agir, et al. [18] showed that insufficiency of production capacity is the most significant source of risk for the strawberry growers and they suggested sustainable income as the best risk management strategy.

3. METHODOLOGY

Assessing the nature and extent of risk in guava cultivation in the Pabna district of Bangladesh is the principal goal of this research. As per the objectives of the study, the farmers who produce guava commercially in the Pabna district are the targeted population of the study. In order to select the sample in a convenient way, the study collected a list of the farmers who produce guava commercially from the agriculture office of the selected Atghoria Upazila and Ishwardi Upazila of Pabna district of Bangladesh. The research used a two-stage sampling technique consists of purposive (for the purpose of studying guava cultivation in Pabna district of Bangladesh) and cluster random sampling for the selection of 100 guava cultivators from two upazilas of the district. A structured questionnaire composed of both open and closed-ended questions has been used for collecting data. Finally, personal interview method was used for collecting data from the sample guava cultivators. This research found the same factors of costs and benefits of guava orchard as Kumar, et al. [19] and applied the same tabular calculations for determining its costs and benefits. The study employed simulation analysis method to measure the magnitude of financial risks in guava cultivation in the selected area. The following steps are involved in simulation analysis [20]:

1. First of all, it is necessary to identify all the factors affecting the NPV of the guava farming project and prepare a model to show the relationships of the factors with the NPV of the project. The factors included in the model are classified into two categories, one category is known as parameter and another is exogenous variable. Parameters are considered as the constant for the whole life time of the project and can be specified by the farmers. Contrarily, exogenous variable

are the factors beyond the control of the guava farmer and their values are taken from the outside of the model.

2. The researcher determined the values of parameters using the relevant sources of information.

3. The researcher also accepted the probability distributions of the exogenous variables portraited by the experts in the relevant fields.

4. For pursuing the simulation analysis, a value was selected, at random, from the probability distributions of each of the exogenous variables.

5. With the help of the specified model of NPV, the magnitude of net present value (NPV) was determined by using the randomly generated values of exogenous variables and pre-specified parameter values.

6. A large number of simulated net present values were assembled by repeating steps (4) and (5).

7. A frequency distribution was plotted by using the assembled net present values.

4. FINANCIAL RISK ANALYSIS

4.1 Establishment Cost of Guava Orchard

Every project requires a set of activities to be accomplished for its initiation. By the same way, the establishment of guava orchard was decomposed into the different tasks. The tasks and their respective costs are listed in the table. Table 1 shows the total establishment cost of the guava orchards in the Pabna district of Bangladesh. The average cost per bigha was estimated BDT 34113. The highest cost item was permanent fencing BDT 6197 per bigha, which accounted for 18.16 percent of the total establishment cost.

The cost of making and filling planting hole was BDT 5092 per bigha contributed 14.92 percent to the total establishment cost, while cost of plants was BDT 3230 accounted for 9.47 percent. The cost of manure and fertilizer was BDT 3085 per bigha contributed 9.04 percent to total establishment cost, and plantation cost was BDT 3625 accounted for 10.63 percent of the total. The cost of equipment was BDT 2746 contributed 8.05 percent, while the cost of soil preparation was BDT 2543 contributed 7.45 percent, and the cost of plant conveyance was BDT 2220 contributed 6.51 percent.

4.2 Operational Cost of Guava Orchard

After the establishment of any project, a certain type of cost is necessary to run the project is called the operational cost. The operational costs of guava orchard in different years are listed in the following Table 2. The data in Table 2 disclosed the fact that, as the expenses on different inputs and picking costs are increasing with time which cause to increase operational cost per bigha also. The increase trend of the operational cost is the reflection of increasing physical requirements of different inputs with plants age. The per bigha annual operational cost was BDT 19898 in the first year and increased to BDT 39122 in the seventh year.

Table 1. Establishment cost of guava orchard in Pabna district of Bangladesh

Sl. No.	Particulars	Cost (BDT/Bigha)	Percent
1	Soil preparation	2543	7.45
2	Making and filling planting hole	5092	14.92
3	Irrigation	1636	4.80
4	Plants	3230	9.47
5	Damaged plant replacement	825	2.42
6	Manures and fertilizer	3085	9.04
7	Plant conveyance	2220	6.51
8	Plantation	3625	10.63
9	Intercultural operation	1957	5.74
10	Fencing	5597	16.41
11	Equipment	2746	8.05
12	Miscellaneous	1557	4.56
Total		**34113**	**100.00**

Source: Researcher's Estimation Based on Field Survey in July, 2023

Table 2. Operational cost of guava orchard in Pabna district of Bangladesh (BDT/Bigha)

Sl. No.	Particulars	Years							Total cost	Average cost per annum	Percent
		1	2	3	4	5	6	7			
1	Manure and fertilizer	4689	4911	5018	5158	5387	5473	5636	36272	5182	17.68
2	Plant protection	5486	5760	5905	6131	6046	6144	6256	41727	5961	20.34
3	Pruning and cutting	-	-	2087	2234	2490	2651	2831	12294	1756	5.99
4	Intercultural and hoeing	3368	3784	3808	4010	4287	4373	4495	28124	4018	13.71
5	Irrigation cost	2820	3590	4041	4159	4385	4426	4545	27967	3995	13.63
6	Replacement and causality	327	343	390	420	451	466	620	3018	431	1.48
7	Watch and ward	2706	2902	3015	3239	3285	3328	3504	21979	3140	10.72
8	Picking cost	-	-	-	2897	5656	8683	9875	27111	3873	13.22
9	Miscellaneous	502	769	827	868	1068	1232	1360	6626	947	3.23
Total operational cost		**19898**	**22059**	**25091**	**29116**	**33055**	**36776**	**39122**	**205118**	**29303**	**100**

Source: Researcher's Estimation Based on Field Survey in July, 2023

Table 3. Cost and return from guava orchard in Pabna district of Bangladesh (BDT/Bigha)

Sl. No.	Particulars	Years						
		1	2	3	4	5	6	7
1	Rental value of land	24400	25800	27200	28300	29100	30700	31900
2	Amortized fixed cost	3985	3985	3985	3985	3985	3985	3985
3	Operational cost	19898	22059	25091	29116	33055	36776	39122
4	Expected depreciation on fixed cost investment @4%	1365	1365	1365	1365	1365	1365	1365
5	Interest on operational cost @12% PA	2388	2647	3011	3494	3967	4413	4695
6	Total cost (1 to 5)	52036	55856	60652	66260	71472	77239	81067
7	Production (maund)	-	-	-	33	72	115	170
8	Price (BDT/maund)	-	-	-	650	720	790	850
9	Gross returns#	-	-	-	21450	51840	90850	144500
10	Net returns	-52036	-55856	-60652	-44810	-19632	13611	63433
11	Return from inter cropping	17225	14550	11400	8700	6900		
Total net returns		**-34811**	**-41306**	**-49252**	**-36110**	**-12732**	**13611**	**63433**

 # Gross return has been worked out by taking average price (BDT 850 per maund) received by farmers during peak marketing season of the current period in Pabna market

Source: Researcher's Estimation Based on Field Survey in July, 2023

The rising patterns of operational cost continues to increase up to seven years age of the orchard and thereafter it becomes almost steady. The major components of per bigha annual operational cost of guava orchard from beginning to seventh years were found to be BDT 5961 on plant protection (20.34%), BDT 5182 on manure and fertilizers (17.68%), BDT 4018 on intercultural and hoeing (13.71%), BDT 3995 on irrigation (13.63%), BDT 3873 on picking (13.22%), BDT 3140 on watch and ward (10.72%) followed by BDT 1756 on pruning and cutting (5.99%). Naphade and Tingre [21] found the same results which also consistent with the findings of the research conducted by Sharma, et al. [22].

4.3 Cost and Return from Guava Orchard

The total net return of a project is difference between the sum of the all returns and the sum of the relevant costs. The higher total net return of a project makes it more attractive to the investors. Table 3 represents the per bigha annual costs and returns in the first seven years from the guava orchard. As the guava trees start to bear fruits after three years of their age, the table showed that there was no production of guava up to the age of three years.

The per bigha production of guava in the fourth year was 33 maund and it increased to 170 maund in seventh year age of the orchard. However, as the orchards reach the age of seven years the production of guava become almost steady throughout its life time. Hence, the gross returns per bigha shows the same trend as the production exhibits. The gross returns in the seventh year, the full bearing stage of the guava trees, was BDT 144500 per bigha. It was expected that the gross return will be same up to the age of 25 years. The total cost of guava orchard over time has been calculated based on the rental value of land, operational cost, amortized fixed cost, expected depreciation on fixed investment and interest on operational cost. The total cost per bigha in the first year as BDT 52036 and reached to BDT 81067 in the seventh year. The maximum net returns per bigha from inter cropping was BDT 17225 in the first year and reached to BDT 6900 at its minimum at the fifth-year age of the guava orchard. Even after having a considerable amount of returns from intercropping in the first five year age of the guava orchards, it incurs a loss of BDT 34811, BDT 41306, BDT 49252, BDT 36110 and BDT 12732 per bigha in first, second, third, fourth and fifth year, respectively. The orchards start to provide positive net returns from the sixth year and the value was BDT 13611 per bigha in that year. The net return was BDT 63433 per bigha in the seventh year and after that it is expected to be nearly stable up to the age of 25 years. Since, the total costs in the initial five years were greater than their corresponding gross returns, net returns were negative in those years. The net return become positive in the sixth year which saturated in the seventh year and stay stable onwards. The reasons for stabilizing the net returns from the seventh year is that the orchards become fully matured at this age and the costs and returns reached in a steady situation. The values of the net returns in the initial seven years from guava orchard are shown in Fig. 1.

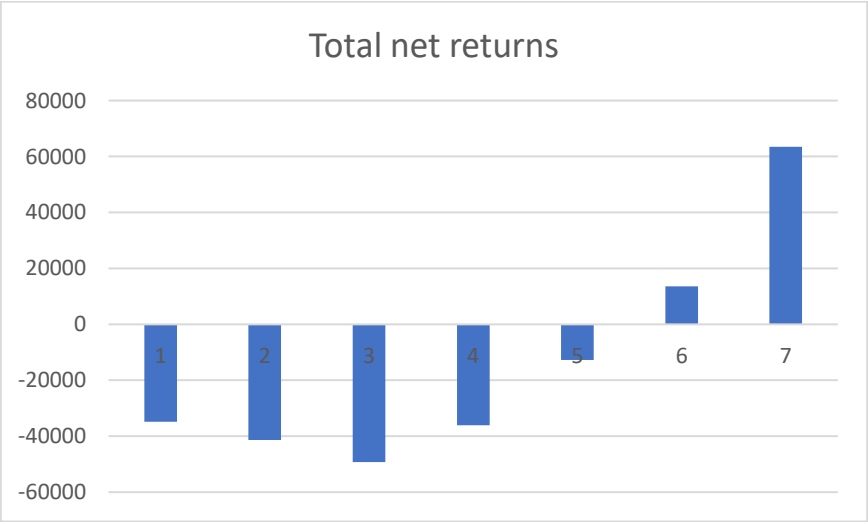

Fig. 1. Year Wise Total Net Returns from Guava Orchard
(Source: Researcher's Estimation Based on Field Data)

Table 4. Summary of simulation analysis

Statistics	Value
Maximum NPV	184866
Minimum NPV	-18302.3
Mean NPV	80649.51
Standard Deviation of NPV	30105.02

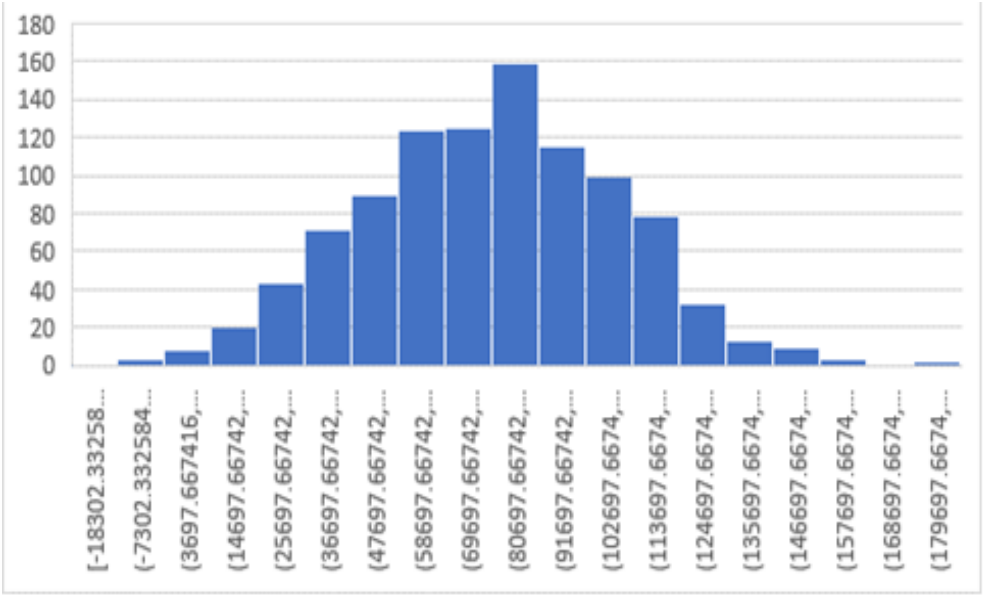

Fig. 2. Distribution of NPV of guava orchard
(Source: Researcher's Estimation Based on Field Data)

4.4 The Result of Simulation Analysis

The Table 4 and Fig. 2 show the results of 1000 runs of simulation for the NPV of guava orchards, it was found that the minimum and maximum values of NPV are -BDT 18302.3 and BDT 184866 respectively. The NPV has mean value of BDT 80649.51 with a standard deviation of 30105.02. Fig. 2 represents the distribution of the NPV indicated that the likelihood of a higher NPV or a negative NPV is extremely low. The medium NPV value is the most probable value. Based on the simulation results, it can be concluded that the investment in the Guava Orchard is not very profitable or loss-making. Therefore, the financial risk of investing in this project is very low.

5. CONCLUSION AND POLICY RECOMMENDATIONS

Fruit growing is an essential agricultural activity related to the cultivation of fruit for human consumption. Fruits are an excellent source of nutrients, vitamins and minerals needed to maintain a healthy body. The cultivation of fruits has existed since ancient times and is practiced today in many countries around the world. Fruits are one of the primary sources of income for farmers and merchants in Bangladesh. These fruits are frequently exported to foreign countries, thus providing Bangladesh with substantial foreign exchange earnings. The results showed that the total net return was negative in the first 5 years, but it turned around in the 6th and 7th years. The total net return was 63433 bigha in the 7th year and stayed stable up to the 25th year of the orchard. We ran 1000 simulations of the net present value (NPV) of the orchard, and it ranged from -BDT 18302.3 to 184866 bigha, with an average value of 80,649.51. The results showed that the chances of getting a higher or a lower NPV are very low, so the most likely result is a moderate NPV. The simulation analysis also showed that the orchard isn't making a lot of money or losing a lot, so the financial risk of investing in this project is really low. Ting-Ting Sun, et al. [23] concluded that by enhancing the abnormal climate monitoring system, the countries can minimize the losses in agriculture incurred due to unforeseeable weather.

The research findings support that the guava production is not loss-making but the profit is not sufficient due to high operational costs for attracting new farmers to increase its production. Therefore, reducing or subsidizing operational costs may be a way to increase the guava production in Bangladesh. The findings disclosed that guava production requires a substantial amount of initial investment which creates significant amount of interest cost and making it less profitable. So, a possible arrangement of initial investment at low interest may increase the profitability of guava production. Many guava producers complained at the time of survey that they have to sell guava at less than market price if unfavourable situations is created. The guava cultivators may get rid of this problem if they have enough storage facility.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author hereby declared that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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