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PROFITABILITY ANALYSIS OF *Aloe vera* (L.) PRODUCTION IN SELECTED AREAS OF BANGLADESH

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ABSTRACT

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Medicinal plants serve as important therapeutic agents as well as valuable raw materials for manufacturing numerous traditional and modern medicines. *Aloe vera* is a top ranked medicinal plant in Bangladesh. The objective of this study is to investigate the costs, returns and profitability of *Aloe vera* medicinal plant. The data were collected from the selected farmers of Bogura and Natore districts in Bangladesh during 2018. The total sample size is 123. The study applies the profitability analysis, break-even points and margin of safety percentage techniques. Surveyed farms are found at ranged from 0.01 to 0.41 hectares. Average cost of production per hectare is found at Tk. 876468.80, of which Tk. 647156.40 for operational cost and Tk. 229312.40 for fixed costs accounting for 73.84% and 26.16% of the total cost, respectively. The average yield of *Aloe vera* is stood at 41487.62 kg per hectare which is sold to two different markets: contract markets and local market. The mean price is estimated at Tk. 32.42 per kg in study area. The gross margin and net margin per hectare are found to be Tk. 698068.02 and Tk. 468755.61, respectively. The breakeven analysis showed that in the case of yield and price, the margin of safety percentage of *Aloe vera* is -53.48. It is also found at 42.01, 67.15 and 34.85 for variable cost, fixed cost and total cost of *Aloe vera* production. Therefore, the study noted that the *Aloe vera* medicinal plant production is profitable in the study area. Farmers have a great opportunity to allocate more land to *Aloe vera* production, which will make them more profit. Break-even analysis of *Aloe vera* production resists a large drop of yield and price before incurring a loss, which gives the farmers a comfortable margin of safety and a risk bearing ability.

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INTRODUCTION

Export policy 2015 has identified the pharmaceutical sector as the highest priority sector. As a part of that, medicinal plants have been recognized as a sector having enormous potentials for export (BFTI, 2016). World health organization (WHO) forecasted that it is likely to hit the US\$ 5.0 trillion market by 2050, as the global market of herbal medicine is growing at a fast pace (BFTI, 2016). Inventory of medicinal plant lists 21,000 species of medicinal plant in the world (WHO, 2003). Among those only about 700 plants are used in Bangladesh (Yusuf et al., 2009). Bangladesh is endowed with a rich diversity of plant species (Barua et al., 2001; Chowdhury, 2001; Hossain, 2001; Nishat et al., 2002). In Bangladesh *Aloe vera* is a top ranked medicinal plant based on cultivating area. Its' local name is *Ghritokumari* (Hossain et al., 2013).

Aloe vera medicinal plant producers encounter two outstanding sources of risk. First, they encounter yield risk because the medicinal plant is exposed both to weather conditions and to pests and diseases. The second source of risk stems from the market and relies on medicinal plant quantities that are distributed through each available market channel. The risks also make risky the farm revenue (Vassalos, 2013). Farm revenues from *Aloe vera* medicinal plant production are inherently volatile, subject to debilitating diseases, lack of quality varieties, and the vagaries of harsh weather. In addition, it represents long-term investments and higher initial cost of crop establishment. As a result, most of the time, medicinal plant farmers take switching decision to next alternative crops. Thus, planned or commercial production of medicinal plant is virtually non-existent or in some cases at a very preliminary stage in Bangladesh, though commercial production of medicinal plant started in the early 1990s in Natore district (Dixie et al., 2003). The farmers have cultivated MPs for periods varying from 2 to 20 years (Rashid et al., 2010).

In general, farmers are predicting about production costs and return with some confidence and then allocate land to new crops only if the economic returns from these crops are at least equal to returns from the most profitable conventional alternatives (Jain et al., 2010; James et al., 2010; Kells and Swinton, 2014). Sharmin (2006) founds that the farmers are motivated to cultivate medicinal plants because of its profitability. Profitability is a critical factor to adopt a new crop like medicinal plant, which also affected by different risks (Ghadim et al., 2005; Marra et al., 2003; Chavas, et al., 2009). Sharmin (2006) also found the sugarcane cultivation as more profitable than *Aloe vera*. Despite of lower yields of *Aloe vera*, the highest gross returns are observed under coconut based multistoried agroforestry systems compared to sole cropping (Bari and Rahim, 2012). Rashid et al. (2010) founds the *Aloe vera* as a viable way of earning a livelihood of the farmers in Nator district. They also identified one key challenge in managing the production of *Aloe vera* and other medicinal plant is to integrate the needs of farmers with available knowledge and technological support. On the choice of *Aloe vera* medicinal plant production, farmers need a clear picture about costs, returns and profitability of current production practices. Taking into consideration the present hindrance settings, the present study has been undertaken to find out the costs, returns and profitability of *Aloe vera* production in the study locations.

MATERIALS AND METHODS

Study area

The study was conducted in the districts of Bogura and Natore in Bangladesh as these are the much medicinal plant growing area in Bangladesh (BFTI, 2016). From these districts the Laxmipur union of Nator district and Hoibotpur union of Bogura district were selected based on the concentration of area allocation of *Aloe vera* production. *Aloe vera* is commercially producing in these unions (Hossain et al., 2013; Rashid et al., 2010; Sharmin, 2006). From the unions the *Aloe vera* farmers were selected purposively.

Data collection

Data were collected through personal interviews by the researchers themselves during 2018, using pretested questionnaire. The farmers were identified by consulting with DAE personnel. Both primary and secondary data were used for this study. Primary data were collected from the farmers who producing *Aloe vera* medicinal plant. The total number of sample was 123.

Data analysis

The study applies the profitability analysis, break-even points and margin of safety percentage techniques. Total cost (TC) includes all types of variable and fixed cost items involved in the production process. The total cost was estimated as follows:

$$TC_i = \sum_{j=1}^n P_{x_{ij}} x_{ij} + TFC_i$$

where, $\sum_{j=1}^n P_{x_{ij}} x_{ij} = TVC_i$ = Total variable cost; x_{ij} = Quantity (kg/ha) of the j^{th} variable; $P_{x_{ij}}$ = Per unit price (Tk/kg) of the j^{th} variable input; and TFC_i = Total fixed cost.

The gross return (GR) of *Aloe vera* was calculated by multiplying the total output at the farm gate price.

$$GR_i = \sum_{i=1}^n p_i * y_i$$

where, y_i = Quantity of the main product; and P_i = Per unit price.

Farmers' profit was estimated in two ways: (a) gross margin (GM) and (b) net margin (NM). GM is estimated where variable cost is deducted from total return, and then NM is estimated by deducting fixed costs from gross margin. For this purpose, the following equation proposed by Dillon and Hardaker (1993) was used.

$$GM_i = GR_i - TVC_i$$

$$NM_i = GM_i - TFC_i$$

Profitability ratio is further used to examine the cost and return of the farmers. Profitability ratio is also known as gross profit ratio. Hence, the formula of gross profit ratio (GPR_i) is:

$$GPR_i = \frac{GM_i}{GR_i} \times 100$$

The decision rule is that; a high ratio may indicate high net sales with a constant cost of sold or it may indicate a reduced direct cost with constant net sales. Similarly, a low ratio may indicate low net sales with a constant cost of sold or it may also indicate an increased direct cost with constant net sales.

One of the important indicators of success of the commercial farmer is the break-even point. Breakeven equations were calculated by arithmetic manipulation of the profit equation and solving for the item of interest. In breakeven point $NM_i = 0$, thus $p_i y_i - VC_i - FC_i = 0$. Therefore, the breakeven points can be written as:

$$\text{the break-even points for output, } y_{be} = \frac{VC_i + FC_i}{p_i};$$

$$\text{the break-even points for output price, } p_{be} = \frac{VC_i + FC_i}{y_i};$$

$$\text{the breakeven points for variable cost, } VC_{be} = p_i y_i - FC_i;$$

$$\text{the breakeven points for fixed cost, } FC_{be} = p_i y_i - VC_i;$$

$$\text{the breakeven points for total cost, } TC_{be} = p_i y_i.$$

Finally, the study estimates the margin of safety percentage (MSP) using the following formula:

$$MSP_i = \frac{Y_i - y_{bei}}{Y_i} \times 100$$

where, Y_i = actual value; and y_{bei} = breakeven value.

The study was derived margin of safety percentage for yield, price, variable cost, fixed cost, and total cost for *Aloe vera*. No doubt, a greater margin of safety indicates the soundness of the business. The unsatisfactory margin of safety can be rectified by lowering variable or fixed cost, by increasing selling price or by substituting unprofitable product by profitable product.

RESULTS AND DISCUSSION

With regard to *Aloe vera*, surveyed farms are found at ranged from 0.01 to 0.41 hectares. The detected *Aloe vera* cultivar is local varieties. It is also found that *Aloe vera* is a perennial plant and it is normally not propagated through seeds. Vegetative propagation is easy and convenient for this. Farmers used either pulps¹ or mature plants² in planting time. The average planting density ranged from 52393 to 99787 plants per hectare. The planting months ranged from November to April. It is also detected that in all surveyed *Aloe vera* farms, the manual farming system for planting, weeding and harvesting is utilized.

Table 1 revealed that the average total cost of production per hectare is Tk. 876468.80, of which Tk. 647156.40 for operational cost and Tk. 229312.40 for fixed costs accounting for 73.84% and 26.16% of the total cost, respectively. This is largely attributed to the high cost of human labour worth Tk. 415366.17 which is 47.39% of the total cost in the study area, indicating that the *Aloe vera* crop production is labour intensive mostly come from hired labour sources (35.33%). Farmers also utilize family labor when needed. Imputed value of the family labour is calculated using the prevailing wage rate in the study area. The family labor contributes to approximately 12.06% of the total cost. The human labor is required for farm operations like land preparation, sowing, earth filling, weeding, irrigation, insecticide application, fertilizer application, harvesting, carrying, etc. In the study area, rate of human labor, on an average, is Tk. 431.88 per man-day. Cost of seedling shows the second highest in the study area accounting for 7.62% of total cost, where cost of fertilizers shows the third highest and accounting for 5.73%. Farmers used four types of fertilizer, namely urea, Triple Super Phosphate (TSP), Murrieta of Potash (MP) and gypsum for *Aloe vera* cultivation. The average costs of urea, TSP, MP and gypsum per hectare are found at Tk. 8217.07 (0.94%), Tk. 29564.88 (3.37%), Tk. 7442.88 (0.85%) and Tk. 4977.78 (0.57%) respectively. Manure cost per hectare is Tk. 21040.80 (2.40%). Farmers are used irrigation water in the *Aloe vera* fields during cultivation period. The average cost of irrigation is Tk. 32842.31 which constitutes 3.75% of total cost. The average cost of power tiller is Tk. 7951.02 per hectare which accounts for 0.91% of the total cost. The farmers are observed to have used different kinds of insecticides in their *Aloe vera* fields. The average cost of insecticides per hectare is Tk. 11065.93 (1.26%). The farmers also used a significant amount of lime in the *Aloe vera* field to control pest and diseases instead of others available pesticides in the view of their past experiences. The cost of lime contributes 1.08% (Tk. 9425.51) of total cost. Land use cost and Interest on Operating Capital (IOC) are estimated at Tk. 200190.36 and Tk. 29122.04 per hectare which comprises 22.84% and 3.32% of total cost, respectively. Interest on operating capital is calculated based on a period of one year considering simple interest at a flat rate of 9% per annum as it prevailed at the time of investigation.

Table 2 shows the yield, price and returns of *Aloe vera* production at farm level. The average yield of *Aloe vera* is stood at 41487.62 kg per hectare. The per hectare gross return is calculated at Tk. 1345224.42, which is calculated by summing the value of produce sold at different markets. The return from each market is calculated by multiplying of total yield of *Aloe vera* produced by proportion of absorption by the market and farmers' price in that market during the time of harvesting. The farmers sell their *Aloe vera* produces at different markets and at different prices. The markets are of two types: contract markets and local market. The estimated price of *Aloe vera* is Tk. 33.29 per kg in contract markets and Tk. 32.29 per kg in local markets, respectively. The mean price stood at Tk. 32.42 in study area. Contract market price is found higher than local market price, due to the high perishability of *Aloe vera* which results in limited storage opportunities and the supply in the short run is highly inelastic. As a result, producers are compelled to accept the lower price during

¹Pulp: Common *Aloe* will produce "pups" (little miniatures of itself) around the base of the "mother" plant, which can be separated and replanted when they are big enough. *Aloe* produces more pups when it has outgrown its canopy ([http://www.wikihow.com/PlantAloe vera](http://www.wikihow.com/PlantAloe%20vera), retrived on 06/02/2019).

²Mature plant: In the maturity stage after harvesting of *Aloe* leaves, the plants are called "mature plant" which can be replanted for next cycle.

the harvesting period. The gross margin and net margin per hectare are found to be Tk. 698068.02 and Tk. 468755.61, respectively. The undiscounted benefit cost ratio is estimated at 1.53, which indicates that *Aloe vera* production is profitable as the farmers earned profit at Tk. 53 by investing Tk. 100. The profitability ratio result implies that for every Tk.1 generated in sales of *Aloe vera* produces, the farmer has Tk.0.52 left over to cover basic operating costs and profit. The study therefore concluded that *Aloe vera* production in the study area is profitable. This finding is in consonance with Samsai and Praveena (2016) who examined the production and processing of *Aloe vera* among the districts of Tamil Nadu, India. The study revealed that the average yield of *Aloe vera* is 35 tonnes per hectare.

Table 1. Annual production cost of *Aloe vera* (Tk. per hectare)

Cost Items	Unit price	Cost (Tk.)	Percentage (%)
Variable cost	-	647156.40	73.84
Labor	-	415366.17	47.39
<i>Family Labor</i>	Tk. 431.88 per man-day	105740.67	12.06
<i>Haired Labor</i>	Tk. 431.88 per man-day	309625.50	35.33
Machinery	Total Taka	7951.02	0.91
Seedling	Tk.4.64 per seedling	66797.97	7.62
Compost/manure	Tk. 1.23 per kg	21040.80	2.40
Fertilizer	-	50202.62	5.73
<i>Urea</i>	Tk. 24.46 per kg	8217.07	0.94
<i>TSP</i>	Tk. 16.07 per kg	29564.88	3.37
<i>MP</i>	Tk. 30.57 per kg	7442.88	0.85
<i>Gypsum</i>	Tk. 16.66 per kg	4977.78	0.57
Irrigation	Total Taka	32842.31	3.75
Pest and disease control	-	20491.44	2.34
<i>Pesticide</i>	Total Taka	11065.93	1.26
<i>Lime</i>	Tk. 23.44 per kg	9425.51	1.08
Packaging and transportation	Tk. 39.13 per bundle	32464.07	3.70
Fixed cost	-	229312.40	26.16
Land use cost	Total Taka	200190.36	22.84
Interest on operating capital	at 9% rate	29122.04	3.32
Total cost	-	876468.80	100

Source: Authors' own calculation, based on the field survey, 2018

A summary of the results from the breakeven analysis is included in table 3 focusing results to the medicinal plants of *Aloe vera* upon calculations for yield, output price, variable cost, fixed cost and total cost for net returns above total cost. Result in table 3 shows that the break-even point of yield of *Aloe vera* is found at 27030.89 kg per hectare. This means that production of *Aloe vera* will be profitable if their yield turns out to be above 27030.89 kg per hectare. Similarly, it will be profitable if the farmers able to receive their prices above Tk. 21.13 per kg. Table 3 also shows that in the case of yield and price, the margin of safety percentage of *Aloe vera* is -53.48. It means that at the current level of sales and with the farm's current prices and cost structure, a reduction in sales of 53.48% will result in just breaking even. As indicated in table 3, the breakeven levels of variable cost, fixed cost and total cost for the *Aloe vera* production farms are Tk. 1115912.01, Tk. 698068.02 and Tk. 1345224.42 per hectare, where margin of safety percentages are 42.01, 67.15 and 34.85 respectively. The implication is that break-even analysis of *Aloe vera* production resists a large drop of yield and price before incurring a loss, which gives the farmers a comfortable margin of safety and a risk bearing ability.

Table 2. Returns from *Aloe vera* production

Indicators	Unit	Value
Yield	kg/ha	41487.62
Absorption of yield	%	100
<i>by the local market</i>	%	86.18
<i>by the contract market</i>	%	13.82
Producer's price (average)	Tk/kg	32.42
<i>in the local market</i>	Tk/kg	32.29
<i>in the contract market</i>	Tk/kg	33.29
Gross returns	Tk/ha	1345224.42
Gross margin	Tk/ha	698068.02
Net margin	Tk/ha	468755.61
Benefit Cost Ratio	Ratio	1.53
Profitability Ratio	Ratio	0.52

Source: Authors' own calculation, based on the field survey, 2018

Table 3. Break-even points and margin of safety percentage for *Aloe vera*

Break-even points for	Unit	Break-even points
Yield	Kg/ha	27,030.89 (-53.48)
Price	Tk/kg	21.13 (-53.48)
Variable cost	Tk/kg	11,15,912.01 (42.01)
Fixed cost	Tk/kg	6,98,068.02 (67.15)
Total cost	Tk/kg	13,45,224.42 (34.85)

*Margin of safety percentage is indicated in parenthesis

CONCLUSION AND POLICY RECOMMENDATIONS

The study critically looked into the *Aloe vera* production in the study areas to explore information about how much it actually costs to produce and make returns; therefore, farmers can assess which activities have the most potential for highest net profit. Profitability analysis shows that the *Aloe vera* production is profitable in the study area and farmers can earn noteworthy profit from *Aloe vera*. It is largely attributed that the cost of human labour accounts for the largest proportion among all cost items, indicating that the *Aloe vera* medicinal plant production is labour intensive, mostly comes from hired labour sources. Farmers also utilize family labour when needed. However, the land use cost shares a large portion in the total cost structure. Therefore, the farmers have a great opportunity to allocate more land to *Aloe vera* production, which will make them more profit. But the evidence from the study survey clear that absorption of whole *Aloe vera* produces should be ensured. It may possible by establishing processing industries of medicinal plants. To motivate the farmers for *Aloe vera* production Government can take some initiatives with line departments.

CONFLICT OF INTEREST

The author declares that there is no conflict of interest.

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