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Profitability Analysis of Rain Fed Upland Rice Production Under Smallholder Farmers in Libokemkem District, North Western Ethiopia

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Abstract: Cultivation of rice in Ethiopia is a recent phenomenon and the crop provides advantages to rice farmers in regarding productivity basis compared to other cereal crops and contribute a lot towards ensuring food security in the country. With the advantage related to the higher productivity, the ever-increasing of domestic demand as a result of urbanization and population growth, rice production under smallholder farmers is expanding very fast. The study was designed to determine the cost of production and profitability of rice under smallholder farmers in the rain fed upland production ecosystem. Descriptive statistics and enterprise budget were used to analyze data collected from selected farmers. Descriptive analysis result reveals labor cost was the main cost item in rice production which took about 74% of the total variable cost, of which weeding cost took about 37%. The enterprise budget analysis reveals sampled farmers obtained gross margin of ETB 12,084.46 per hectare from rain fed upland rice production with benefit cost ratio of 1.44 and break even price and yield of 6.45 ETB per kg and 2157 kilogram per hectare, respectively and the gross margin was more sensitive for price and yield fluctuations. Thus, upland rice production is a profitable enterprise. Moreover, in order to make the enterprise more attractive, it is important to promote productivity-improving and labor-saving modern technologies and strengthen the market information delivery system and collective action by farmers.

Keywords: Upland Rice, Smallholder Farmer, Gross Margin Analysis, Sensitivity and Break even Analysis

1. Introduction

Rice is one of the earliest domesticated grain crops and a primary food source for nearly half the world population [1]. It is also the most rapidly growing source of food in Africa, and is of significant importance to food security and food self-sufficiency. In Ethiopia, rice cultivation is a recent phenomenon. Attempt to introduce rice were possibly initiated when the wild rice was found in the swampy and waterlogged areas of Fogera and Gambella Plains [2]. According to the report of Ministry of Agriculture and Rural Development [3] Ethiopia has 5 million hectares of highly suitable land for rain-fed rice production. Despite the potential nationally, rice ranks second in productivity among major cereal crops [4] and its overall trend shows an increase in the number of rice farmers, area, production and productivity. Rice is also considered as a multiuse crop. It is a major source of income and employment not only for farmers but also many others along the value chain and it is used as food in different preparations. Its byproducts such as straw and bran are a main source of animal feed and husk is used as fuel source [2, 5].

Among five major rice growing ecosystems; three ecosystems are existed in Ethiopia that are rain fed upland, rain fed lowland and irrigated [6]. In upland growing ecosystem now day rice is an important crop and expanding very fast. Despite the importance, it's also competes with major factors of production with other crops. Therefore the need to analyze the profitability of rice in the upland ecosystem becomes necessary to provide information for the new entrant in to the enterprise. This research was therefore designed to estimate

costs of production and profitability of rain fed upland rice cultivation under smallholder farmers' condition.

2. Methodology

2.1. Description of the Study Area

The study was conducted in Libo kemkem district of South Gondar Zone of Amhara Regional State, Ethiopia. The area is situated 11° 57'46.6" to 12° 25' 32.6" north of latitude and 37° 34' 48.9" to 38° 3' 30.9" east of longitude. Altitude ranges from 1800-3000 meter above sea level with annual rain fall ranging from 900 to 1400 mm and annual temperature ranging from 18°C to 25°C. Farmer depends on long rainy season for crop production and crop -livestock mixed farming system is a common practice in the area.

2.2. Data Collection and Analysis

Two stages random sampling technique was used. In the first stage four kebeles were selected randomly from the list of rain fed upland rice growing *kebeles* of Libo kemkem district. Then, given the selected *kebeles* households were selected randomly and the sample distribution followed probability proportional to size of households. Plot level data were collected from sample households through interview. The collected data was then analyzed using descriptive statistics such as mean, standard deviation, frequency and percentages and budgeting techniques like gross margin, sensitivity and break even analysis. Mean value was used as a measure of central tendency.

2.3. Gross Margin Analysis

Gross margin analysis was employed to better understand the relationship between sales revenue and cost structures [7] and used to evaluate the viability of rice production enterprise to enable better decision making

$$GM = TR - TVC$$

Where GM is gross margin per hectare, TR is total revenue calculated as the product of the prevailing market price per unit output and the amount of paddy and straw produced per hectare and TVC is total variable cost that varies with the level of production and includes expenditure on inputs like seeds, fertilizer and labor etc.

2.4. Sensitivity Analysis

A sensitivity analysis was undertaken to assess the risk bearing ability of an enterprize under varying circumstance of price and yield and variable costs [8]. This method used to assess the effect of grain price and yield and variable costs on the gross margin of the enterprise by varying 10% above and below the received price, attained yield and incurred costs of rice farming.

2.5. Break Even Analysis

An enterprise, whether or not a profit maximize, often finds it useful to know what price (or output level) must be for total revenue just equal total cost. This can be done with a break even analysis. This analysis is used to determine the minimum level of output or price that allows the firm to break even [9].

$$\text{Break- even price} = \frac{\text{Total cost}}{\text{Yield}}$$

If unit farm-gate prices are higher than the break-even price, the farm operation makes an economic profit

$$\text{Break - even yield} = \frac{\text{Total cost}}{\text{Sale price}}$$

If per hectare yields are higher than the break-even yield, the farm operation makes an economic profit

3. Result and Discussion

3.1. Socio-Demographic Characteristics of Respondents

The majority of the sample households, 88% were male. Regarding the education status of the household head, 46% of the sample households were illiterate, 28% had attended at least primary school and above and 26% were capable of reading and writing (Table 1).

Table 1. *Socio-Demographic Characteristics of Respondents.*

Variable	Frequency	Percent
Sex		
Male	44	88
Female	6	12
Total	50	100
Education		
Illiterate	23	46
Read &write/ Religious school	13	26
Primary and junior secondary (1-8)	12	24
Secondary school (9-12)	2	4
Total	50	100

Source: own calculation

The mean age of household head was 43 years and household size of the sample households were 4.8 persons. On average the sample households own 0.93 hectare of cultivated land of which on average 0.45 hectare were allocated for rice production with the average productivity of 2713 kg/ha it is almost similar to the national average [10]. The sample households also owned 5.3 TLU of livestock (Table 2).

Table 2. *Socio-Demographic Characteristics of Respondents for Continuous variables.*

Variable	Mean	Std.dev.	Min	Max
Age	43	15.8	22	83
Household Size	4.8	2.13	1	10
Cultivated land size	0.93	0.49	0.25	3
Land allocated for rice production	0.45	0.21	0.13	1.3
Livestock Ownership (TLU)	5.30	3.37	0.46	14.45
Quantity of output (kg/ha)	2713	15.31	1400	4800

Source: own calculation

3.2. Components of Cost of Rice Production

Table 3: indicated that the per hectare total variable cost of rain fed upland rice have two components that are material cost and cost of cultural practices. The result reveals the total variable cost of rain fed upland rice was ETB 13,071.97 per hectare.

Table 3. *Per hectare costs of rain fed upland rice production.*

Cost Items	Obs	Mean (ETB)	Std.dev	% share within components
Material cost		3374.44		26
Seed	50	1565.38	517.99	46
Fertilizer	50	1808.06	814.76	54
Cost of Cultural practices		9698.47		74
Land preparation	50	1656.15	341.47	17
Water Management	50	737.38	726.68	8
Planting	50	540.21	257.20	6
Weeding & fertilizer application	50	3577.98	1804.76	37
Bird scaring & Roughing out	50	488.51	768.19	5
Harvesting and Pileup	50	1010.47	477.64	10
Threshing and winnowing	50	1208.84	322.54	12
Transporting	50	478.93	157.47	5
Total variable cost (TVC)		13071.97		100

Source: own calculation

Cost of cultural practices was the cost component which took the maximum share in total variable cost of rice production i.e. 74%. On average ETB 9,698.41 was incurred for cultural practices of rain fed upland rice production of which weeding cost took the lion share (37%), followed by land preparation (17%) threshing and winnowing (12%) and harvesting and pileup (10%) costs were the major cost items of cultural practices. The cultural practices of rice farming accounts three fourth of the total variable cost. This indicates rice production under smallholder farmer is labor intensive farming. The finding confirms [11, 12]. The cost of labor took the largest portion of the total variable cost.

The material cost of rain fed upland rice production was ETB 3,374.44 which includes the cost of seed and fertilize. The contribution of material cost for the average total variable cost was 26%. About 54% of the total cost of material was fertilizer cost and the rest 46% of the total material cost goes to seed expenditure (Table 3).

Table 4. *Per Hectare Returns of Rain fed upland Rice Production.*

Item	Mean	Std. dev	Min	Max
Paddy	22,001.89	6579.39	11,354	38,928
Straw	3,154.51	1644.66	540	7,680
Total return (TR)	25,156.4		11,894	43,607.44

Source: own calculation

3.3. Returns of Rice Production

To generate returns of rice production under smallholder farmers have two components that are the paddy main component and the bi product (straw) component. The mean values of both components were considered to compute the gross returns of rice production. As indicated in Table 4 the mean value of paddy ETB 22,001.89 and the value of straw ETB 3,154.51 with gross return of ETB 25,156.4 per hectare (Table 4).

Table 5. *Distribution of Revenue from Upland Rice Production.*

Total revenue (ETB/ha)	Frequency	Percent	Cumulative percentage
<15,000	3	6	6
15,000-25,000	25	50	56
25,001-35,000	16	32	88
>35,000	6	12	100
Total	50	100	

Source: own calculation

The sample households earned total revenue of ranging from ETB 11,894 to ETB 43,607.44. Table 5 indicates the majority of the sample households, 82% were earned an income between 15,000-35,000 ETB /ha from rice production. Similarly, about 94% of the sample farm households received revenue which was above TVC indicates the sample smallholder rice farmers made a positive gross margin.

3.4. Profitability Analysis

The profitability analysis result on Table 6 presents on average the sample households earned total revenue of ETB 25,156.39 per hectare and incurred a total variable cost of ETB 13,071.93, total fixed cost 4,420.21 and total cost of 17,492.14 per hectare. Thus, an average rice farmer earned a gross margin of ETB 12,084.46 which is 48% of the total return.

Table 6. *Profitability Analysis.*

Variables	Obs	Mean
Total Return (TR)	50	25,156.39
Total Variable cost (TVC)	50	13,071.93
Total Fixed cost (TFC)	50	4,420.21
Total Cost (TC)	50	17,492.14
Gross Margin (TR_TVC)	50	12,084.46
Profit margin (%)		48
Average Return Rate (ARR)		0.92
Benefit cost Ratio		1.44
Breakeven yield		2157
Breakeven price		6.45

Source: own calculation

The average rate of return reveals for each one birr invested in rice production, a farmer received 0.92 birr as a gross margin. The Benefit cost ratio 1.44 indicates that the expected benefit exceeds the expected total cost. The implication is that the total cost has to rise by 44% or a fall in benefit up to 30.47% before the ratio would be reduced to breakeven point. Thus, from the overall profitability analysis result upland rice farming is a profitable enterprise in the study area. The result is in line with [13-15]. The total revenue of rice production outweighed the total cost.

3.5. Break Even Analysis

Break-even analysis is used to know the minimum level of output and price that ensure the enterprise will not experience loss. The break even price was found to be ETB 6.45 per kilogram whereas break even yield was 2157 kg. This implies that at this point of yield per hectare and price ETB per kg or a decline in yield up to 2157 kilogram per hectare or price drop of up to ETB 6.45 per kg, rain fed upland rice farming would not be at loss or gain (Table 6).

Table 7. *Sensitivity Analysis of Rain Fed Lowland Rice Production.*

Item	Actual	TVC (ETB/ha)		Price of rice Grain		Yield of rice grain	
		10% Increase	10% Reduction	10% Increase	10% Reduction	10% Increase	10% Reduction
Total variable cost (TVC	13072	14,379.2	11,764.8	13,072	13,072	13,072	13,072
Rice Grain Yield	2713	2713	2713	2713	2713	2984.3	2441.7
Unit price	8.11	8.11	8.11	8.92	7.29	8.11	8.11
Value Grain	22,002.43	22,002.43	22,002.43	24,202.673	19,802.18	24,202.67	19802.18
Value straw	3155	3155	3155	3155	3155	3155	3155
Total Return	25,157.43	25,157.43	25,157.43	27,357.67	22,957.19	27,357.67	22,957.19
Gross Margin (ETB)	12,085.43	10,778.23	13,392.63	14,285.67	9,885.18	14,285.67	9,885.18
% change in Gross Margin		-11	11	18	-18	18	-18

Source: own calculation

3.6. Sensitivity Analysis

Sensitivity analysis is used to assess the risk bearing ability an enterprise in relation to price, yield and total variable cost. In this case, a change of ± 10% in total variable cost, grain price and grain yield was considered. Table 7: indicate that rain fed upland rice production were likely to be more sensitive for both price and yield than total variable cost. A reduction or increase in total variable cost by 10% increases or decrease the gross margin by 11% while similar percent decrease or increase in price and yield of rice grain brought 18% decrease or increase in gross margin. The implication is that slight change in price and yield has a substantial effect on the profitability of upland rice production.

4. Conclusion and Recommendation

The Gross margin, the profit margin and benefit cost ratio obtained suggest that production of rain fed upland rice was a profitable enterprise. Though other enterprises are not incorporated in this study, the result reveals rice production in the upland ecosystem holds a promising outlook for the new entrant in the production ecosystem. Beside the profitability, upland rice production by smallholder farmers was sensitive for both fluctuations in price and yield variability. It is therefore recommended that profitability of rain fed upland rice production could be enhanced and more attractive through the use of productivity improving technologies that improve the yield and through group marketing and market information system to reduce price fluctuation. Regarding the cost, weeding cost was the major cost item which took the line share of cost of cultural practices and hence cost reducing mechanism should be in place related to labor intensive operations so as to minimize the costs of production of rice. Thus, research institution should focus on developing cost effective and environmental and gender friendly improved technologies for weeding and other cultural practices management.

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