Cost and Return Analysis of Rain Fed Lowland Rice Production under Smallholder Farmers in Fogera District, North Western Ethiopia

Shewaye Abera[1*], Adam Bekele[2], Abebaw Assaye[1], Adane Melak[3]

[1, 3]*Fogera National Rice Research and Training center, Ethiopian Institute of Agricultural Research, Ethiopia*

[2]*Melkassa Agricultural Research Center, Ethiopian Institute of Agricultural Research, Ethiopia*

*Corresponding Author: *Shewaye Abera, Fogera National Rice Research and Training center, Ethiopian Institute of Agricultural Research, Ethiopia*

Abstract: *This study was designed to estimate cost of production of rice and assessing its profitability under smallholder farmers in lowland agroecologies of Fogera plain, Ethiopia. Descriptive statistics and enterprise budget were used to analyze data collected from selected farmers. The finding of the study reveals the average productivity of rice was 3.6 tone per hectare. The labor cost was the main cost item in rice production which took about 70% of the total variable cost, and followed by material and animal power costs. From the total operational costs weeding cost took the maximum share about 44.56%. The enterprise budget analysis result indicates that sampled farmers obtained a profit margin of 49.51% per hectare with benefit cost ratio of 1.98, and breakeven price and yield of 4.66 ETB per kg and 2064 kg per hectare. Moreover, gross margin of rice production is more sensitive for grain price and yield fluctuations than input costs. Thus, rice production is a profitable enterprise and the study suggest that research institution should focus on developing and promoting productivity improving and labor saving technologies. In addition, to reduce price fluctuation strengthen the market information delivery system and group marketing*

Keywords: *Smallholder farmer, Gross margin analysis, Sensitivity and Break-even analysis*

1. INTRODUCTION

Rice is a recent introduction in Ethiopia; an attempt to introduction of rice had probably been started in Ethiopia when the wild rice was observed in the swampy and waterlogged areas of Fogera and Gambella Plains (Gebey *et al.*, 2012). According to the report of MoA (2010), the potential rain fed rice production area is estimated about 30 million hectares, of which more than 5 million hectares are highly suitable.

The importance of rice is being well recognized in the country as the area under cultivation, production and productivity increased within the period of the two decades by 88%, 92% and 34%, respectively (FAOSTAT, 2015). In productivity base, it is the second more productive cereal crop next to maize (CSA, 2014). It has shown promise as to be among the major crops that can immensely contribute towards ensuring food security in Ethiopia.

Rice is cultivating in all regions of Ethiopia (MoA, 2010). Of all rice producing regions Amhara took the maximum share of rice production about 86% of the national rice production of which 91 % of the region rice production was came from Fogera plain (CSA, 2015).

The current five-year plan, GTP II, gave due consideration for rice production. Rice seen as a priority crop to ensure food security through increasing the average productivity from 2.7tons per ha in 2015 to 4.1 tons per ha in 2020 and increased the total volume of produce from 1300 tons in 2015 to 2030 tons by the year 2020.

Beside the increase in production and productivity of rice, the national production is being covering about 30% of the demand and hence country has been importing a huge amount of rice in order to cover the national demand (FAOSTAT, 2015, CSA, 2015). Thus, knowing the production economics of rice farming was became very important so as to show the possible avenues for technological

investment planning to enhance productivity, promote income generation and to serve the new entrants in to the enterprise for the utilization of the potential and fill the huge demand gap.

Therefore, the study was designed to estimate costs of production and assessing profitability of rain fed lowland rice cultivation under smallholder farmers' condition in Fogera plain. Hence, the analysis would provide a valuable insight on production cost components and input output relation of the enterprise.

2. METHODOLOGY

2.1. Description of the Study Area

The study was conducted in Fog era district of South Gondar Zone of Amhara Regional State, Ethiopia. The area is situated 11^0 46 to $11^0$59 latitude north and 37^0 30 to 37^0 52 longitude east. Altitude ranges from 1774 to 2410 meter above sea level with mean annual rain fall of 1216 mm and mean annual temperature of 19^0c. Farmer depends on long rainy season for crop production and crop - livestock mixed farming system is a common practice in the area. Rib and Gumera are the two major rivers that cross many of rice producing kebeles and flooding the plain. The two rivers have economic importance to the areas as they are used for irrigation purpose for vegetables production during the dry season.

2.2. Data Collection and Analysis

Two stage random sampling were used in the study. In the first stage four kebeles were selected randomly from the list of rain fed lowland rice growing kebeles of Fogera 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 as well as gross margin sensitivity and break even analysis.

2.3. Gross Margin Analysis

Gross margin analysis was employed to better understand the relationship between sales revenue and cost structures (Kay, 1986) 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 rice production under varying circumstance of price and yield. The grain price and yield of rice were varied by 10% and 25% above and below the received yield and price 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 that allows the firm to break even.

$$Break-even\ sale\ price = \frac{Total\ cost}{Total\ production(yield)}$$

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

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

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

3. RESULTS AND DISCUSSION

3.1. Socio-Demographic Characteristics of Respondents

The majority of the sample households (81%) were male. Regarding the education status of the household head, 54.2% of the sample households were illiterate, and 27.1% and 18.7% were capable of reading and writing and had attended at most primary school and above, respectively(Table 1).

Table1. *Socio-Demographic Characteristics of Respondents*

Variable	Frequency	Percent
Sex		
Male	39	81
Female	9	19
Total	**48**	**100**
Education		
Illiterate	26	54.2
Read &write/ Religious school	13	27.1
Primary and junior secondary(1-8)	8	16.7
Secondary school(9-12)	1	2.0
Total	**48**	**100**

Source: *own calculation*

The mean age of household head was 49 years and household size of the sample household's were4.73 persons. On average the sample households own 0.85 hectare of cultivated land of which on average 0.62 hectare were allocated for rice production. The sample households also owned 5.55 TLU of livestock (Table 2).

Table2. *Socio-Demographic Characteristics of Respondents*

Variable	Mean	Std.dev.	Min	Max
Age	49	14.75	19	77
Household Size	4.73	2.02	2	10
Cultivated land size	0.85	0.52	0.25	2.5
Rice cultivated land	0.62	0.34	0.25	1.88
Livestock Ownership(TLU)	5.55	2.78	0.76	14.52

Source: *own calculation*

On the basis of land allocated to rice production the sample households were categorized in to three groups, viz small (<0.5 ha), medium (0.5-1 ha) and large above 1 ha. Out of the total sample households the majority 65% were allocated medium land size for rice production followed by small land size and few of them were allocated land more than a hectare of land for rice production. Regarding the productivity all categories of land size were produced more than 3 tons per hectare which was more than the national average of 2.8 tons per hectare (Table 3).

Table3. *Land under rice production and attained yield by sample household*

Category	Frequency	Percent	Yield(tons)
Small (<0.5 ha)	13	27	3.5
Medium (0.5-1 ha)	31	65	3.8
Large (> 1 ha)	4	8	3.4
Total	48	100	

Source: *own calculation*

3.2. Cost of Rice Production

Table 4 indicates that the per hectare total variable cost of rain fed lowland rice has two components that are material cost and cost of cultural practices. The result reveals the total variable cost of rain fed lowland rice was ETB 16,737.68 per hectare.

Cost of cultural practices was the cost item which took the maximum share in total variable cost of rice production i.e. 79.66%. On average ETB 13,332.95 was incurred for cultural practices of rain fed lowland rice production of which weeding cost took the lion share (44.65%), followed by harvesting and pileup (15.62%), land preparation (14.72%) and threshing and winnowing (11.38%) costs were the major cost items of cultural practices.

Table4. *Per hectare costs of rain fed lowland rice production*

Cost Items	Obs	Mean (ETB)	Std.dev	% share of total variable costs(TVC)	% share within components	Min	Max
Material cost		**3,404.74**		**20.34**	**100**	**660**	**7334**
Seed	48	1906.45	641.45	11.39	56.0	660	3890
Fertilizer	48	1498.29	1074.12	8.95	44.0	0	3564
Cost of Cultural practices		**13,332.95**		**79.66**	**100**	**6275**	**34141**
Land preparation	48	1962.87	685.77	11.73	14.72	1165	4852
Water Management	48	62.38	94.33	0.37	0.47	0	345
Planting	48	548.65	341.82	3.28	4.12	137	1733
Weeding	48	5949.47	4262.65	35.57	44.65	2015	15660
Fertilizer Application	48	63.78	51.97	0.29	0.37	0	255
Harvesting and Pileup	48	2083.18	1979.54	12.45	15.62	543	11020
Threshing and winnowing	48	1516.92	684.52	9.06	11.38	706	3610
Transporting	48	1156.24	1325.59	6.91	8.67	360	6965
Total variable cost(TVC)		**16,737.68**		**100**		**8035**	**36241**

Source: *own calculation*

The material cost of rain fed lowland rice production was ETB 3,404.74 which includes the cost of seed and fertilizer. The contribution of material cost for total variable cost was 20.34%. About 56% of the total cost of material was seed cost and the rest 44% of the total material cost goes to fertilizer expenditure (Table 4).

Table5. *Per Hectare Returns of Rain fed Lowland Rice Production*

Item	Mean	Std. dev	Min	Max
Paddy	29,155.45	8,576.62	16,220	48,660
Straw	4,021.25	1,417.79	1,400	7,466.67
Total return(TR)	**33,176.70**	**9248.45**	**19,420**	**53,736.44**

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 5 the mean value of paddy ETB 29,135.17 and the value of straw ETB 4,021.25 with gross return of ETB 33,156.42 per hectare.

Table6. *Distribution of Revenue from Rice Production*

Total revenue (ETB/ha)	Frequency	percent	Cumulative Percent
<20000	1	2	2
20000-35000	32	67	69
35001-50000	11	23	92
>50000	4	8	100
Total	48	100	

Source: *own calculation*

The sample households earned total revenue of ranging from ETB 19,420 to ETB 53,736.44. Table 6indicates that the majority of the sample households (67%) were earned an income between 20,000 to35, 000 ETB /ha from rice production.

Table7. *Gross margin Analysis*

Variables	Obs	Mean	Std.Err	95% confidence interval	
Total Return(TR)	48	33,156.43	1,334.89	30,470.96	35,841.90
Total Variable cost(TVC)	48	16,737.65	1,031.73	14,662.94	18,814.09
Gross Margin(TR_TVC)	**48**	**16,417.92**	**1,590.04**	**13,219.16**	**19,616.67**
BenefitCost Ratio (BCR)		**1.98**			
Profit margin (%)		**49.51**			
Break even Yield (kg)		**2064**			
Breakeven price (ETB)		**4.66**			

Source: *own calculation*

Table 7: presents on average the sample households earned total revenue of ETB 33,156.43 per hectare and incurred a total variable cost of ETB 16,737.65 per hectare. Thus, an average rice farmer earned a gross margin of ETB 16 417.92 which constituting about 50% of the total revenue earned as a profit margin of rain fed lowland rice production with a benefit cost ratio of 1.98. The implication is that a one Birr investment on factors of production lowland rice production would earn birr 1.98. This implies that rice is a profitable enterprise in the study area.

The breakeven price was found to be ETB 4.66 per kilogram whereas break even yield was 2,064 kg. At this point of yield per hectare and price ETB per kg or a decline in yield up to 2064 kilogram per hectare or price drop of up to ETB 4.66 per kg, rain fed lowland rice would not be at loss or gain. The implication is that break even analysis of rice production resists a large drop of yield and price before incurring a loss.

Table8. *Sensitivity Analysis of Rain Fed Lowland Rice Production*

Item	Original	10% Increase in price	10% Decrease in price	10 % Increase in yield	10% Decrease in yield	10% Increase in input cost	10% Decrease in input cost	10 % increase in input cost and decrease in yield
TR (ETB/ha)	33,156	36,716	29,663	36,516	29,876	33,156	33,156	29,876
TVC (ETB/ha)	16,739	16,739	16,739	16,739	16,739	18,412.9	15,065.1	18,412.9
GM (ETB/ha)	16,418	19,977	12,925	19,777	13,138	14,743.1	18,090.9	11,463.1
BCR	1.98	2.19	1.77	2.18	1.78	1.80	2.20	1.62
% change in GM		22	-21	20	-20	-10	10	-30

Source: *own calculation*

3.4. Sensitivity Analysis

To assess the risk bearing ability of lowland rice production in relation to price and yield. Table 8: indicate that rain fed lowland rice production were likely to be sensitive for both price and yield and less sensitive to input cost. Ten percent decrease in price of rice brought about 21% decreases in GM. Similar percentage decrease in yield also resulted in about 20% decrease in GM. While similar percentage of increase in input cost brought about 10% decreases in gross margin. Therefore, rice production is more sensitive for price and yield than input costs.

4. CONCLUSION AND RECOMMENDATION

The study was designed to estimate the cost of production of rice and assessing its profitability in rain fed lowland agro ecology of Fog era plain. The major cost component of rice was labor cost which took the maximum share of the total variable cost 70 % in addition; about 80% of the total variable cost was operational costs of which weeding cost took about 44.65 % in lowland agro ecology. This indicates that the sector lacks appropriate labor saving technologies.

Regarding the profitability, an average farmer was earned a profit margin about 49.51% of the total revenue with a benefit cost ratio of1.98 and hence rice production was a profitable enterprise in lowland agro ecology. Moreover, sensitivity analysis result revealed that rice production by smallholder farmers was more sensitive for both fluctuations in price and yield than input costs.

Therefore, to improve profitability of rice production research institutions should focus on developing productivity improving and cost effective and environmental friendly labor saving weeding technologies and other management practices. In addition, development institution should focus on strengthen group marketing and market information system to minimize price fluctuation.

REFERENCES

[1] CSA (2015).Federal Democratic Republic of Ethiopia Central Statistical Agency Agricultural Sample Survey Report on Area and Production of Major Crops Private Peasant Holdings, Meher Season,VolumeI

[2] Gebey T, Lemma T, Hoekstra D, Tegegne A, Alemu B.(2012). Participatory smallholder dairy value chain development in Fogera woreda, Ethiopia: from IPMS project interventions. IPMS Case Study. Nairobi: International Livestock Research Institute

[3] MoA (2010).Ministry of Agriculture, National Rice Research and Development Strategy of Ethiopia

[4] FAOSTAT (2015). Food and Agriculture Organization of the United Nations Statistical Database.

[5] CSA (2015).Federal Democratic Republic of Ethiopia Central Statistical Agency Agricultural Sample Survey Report on Area and Production of Major Crops Private Peasant Holdings, Meher Season,VolumeI