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Cost and returns of soybean production in Assosa Zone of Benishangul Gumuz Region of Ethiopia

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In Ethiopia, the demand for soybean product is increasing as a result of increasing population growth, agro-processing and urbanization. Research needs to provide farm level evidence that could guide informed production decision-making. This research was conducted to assess costs and patterns of input use and determine the profitability of soybean production in Assosa zone of Benishangul-Gumuz region. Data for the study were collected from 59 randomly selected soybean farmers using a well-structured questionnaire. Descriptive statistics and enterprise budgets are used to analyze the data. Results of the gross margin analysis showed that total gross revenue of Birr 10566.38 ha^{-1} is generated from sales of soybean grain. The average variable cost incurred is 6634.43 Birr/ha. The gross margin and net-farm income was estimated to be 3931.956 and 3629.956 Birr/ha, respectively. The benefit cost ratio amounted to 1.52 which implies for every Birr incurred in costs, the farmer can expect a benefit of 1.52 Birr. Moreover, the sensitivity analysis indicated that profitability of soybean production is more sensitive to reduction in price than to increases in yield. The study therefore concluded that soybean production in Assosa Zone of Benishangul-Gumuz region is profitable enterprise. It is suggested that consistent government policies that would favor soybean production and market linkage between producers and soybean agro-industries in the area would attract investors and small-scale farmers would gain reasonable economic benefits from soybean production in Assosa zone.

Key words: Soybean, production, profitability, costs, returns, Benishangul-Gumuz.

INTRODUCTION

More than 70% of the sub-Saharan African (SSA) population is directly involved in agriculture as the primary source of income and food security (Adebayo, 2013). However, SSA agriculture productivity and the per capita value of agriculture output is the lowest in the world (FARA, 2006).

In Ethiopia, same as SSA, poverty and food insecurity still remain the major development challenges. The incidence of poverty is estimated at about 29.6% (MoFED, 2012). Furthermore, some nutrition and health indicators reveal the prevalence of high level of food insecurity problems in the country. Cognizant of these facts, Ethiopian development plans including the current growth transformation plan (GTP) have focused on greater commercialization of smallholder agriculture by promoting the production and marketing of industrial

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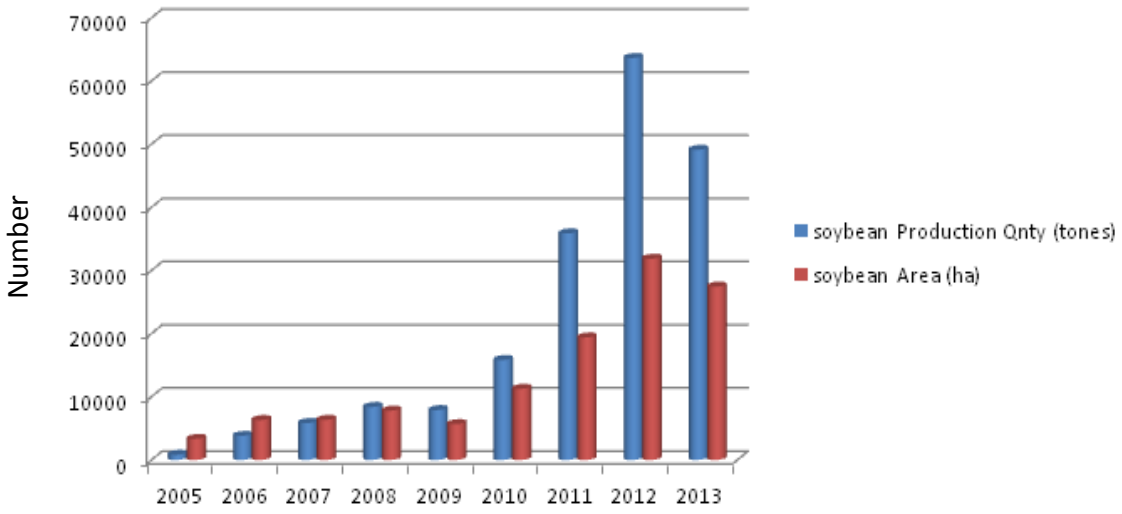

Figure 1. Soybean production and area covered in Ethiopia.
Source: Computed from FAO STAT (2014).

commodities that are competitive in local and export markets.

Soybean (*Glycine max*) is one of the most important food plants of the world and seems to be growing in importance as industrial and multipurpose crop. In Ethiopia, soybean is a multipurpose most nutritionally rich crop as its dry seed contains the highest protein and oil content. Thus, production of soybean in Ethiopia is very essential to overcome malnutrition and partially compensate the expensive source of animal proteins and as a source of income for small holder farmers. Production of this crop is indispensable in the country to enrich the staple cereal based food with sufficient and high-quality protein (Mekonnen and Kaleb, 2014).

Soybean is a drought tolerant crop that requires warm climates and is suitable for low to medium altitudes (Ogema et al., 1988; Urgessa, 2015). Since its introduction in Ethiopia in the early 1950s soybean has become one of the most important lowland grain legumes in the country that is highly adapted to diverse agro-ecological conditions including areas of marginal to the production of most of other crops. Furthermore, soybean is the primary source of edible oil globally with the highest gross output of vegetable oil among the cultivated crops with total cultivated area of 117.7 million ha and total production of 308.4 million tons (FAOSTAT, 2015).

In recent years, production and area cultivated under soybean in the country has increased trend (Figure 1). One of the reasons for soybean production increase is policy measures taken by the government. For example, GTP II plan has given focus for soybean production as industrial crop and its production is expected to increase from 0.72 million quintals in 2015 to 1.2 million quintals by the year 2020 to meet the market demand by creating a linkage with the industry and export market (GTP II, 2015). Soybean is one of the legume crops introduced to Benishangul-Gumuz region during the resettlement program in 1986. Predominantly, the crop is produced by smallholder and some commercial levels in the region with productivity potential of 16 to 17 qt/ha (BoARD, 2014). The productivity level of the crop is nearest to the national average yield which is around 17.2 qt/ha. The crop grows widely in those zones of the region mainly for its economic advantage in the local market and household consumption (AsARC, 2006).

Despite the significance of soybean to address food and nutrition insecurity problems prevailing in the country, little is known about the return to investment in soybean production to promote it as a profitable business to the farmers. However, Ayalew et al. (2018) has conducted analysis of cost and return of soybean production under smallholder farmers in Pawe district, North Western Ethiopia. Information on costs associated with soybean production and profit gained in potential soybean growing areas like Assosa zone is critical. Therefore, this study focused to examine the status of production, cost and benefits of soybean with a purpose of generating information that help understand and evaluate soybean production performance of commercial oriented smallholder farmers at Assosa zone.

The information is designed to enhance informed decision making of smallholders directly and commercial farming system indirectly and improve the competitiveness of the soybean sub-sector in Assosa zone of Benishangul-Gumuz region.

METHODOLOGY

Description of the study area

The study area is located in the Benishangul-Gumuz Regional State. Benishangul-Gumuz Regional State is found at 687 km away

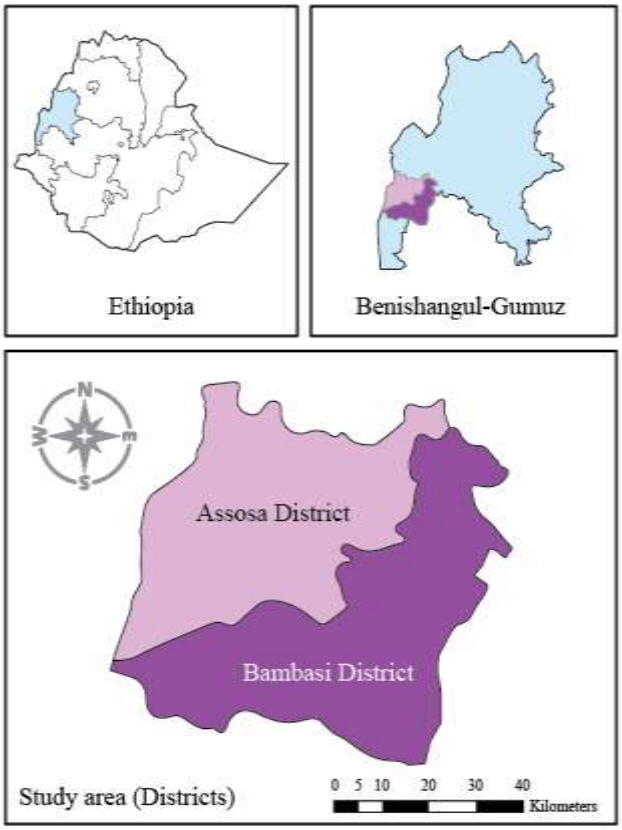

Figure 2. Map of the study areas.

from the capital city of the country, Addis Ababa, in the west. It is located at 9°30′ - 11°30′ latitude and 34°20′ - 36°30′ longitude. The region is bordered with the Sudan in the west, Amhara Regional state in the east and north, Oromiya Regional state in the east and south east and Gambella Regional state in the south. It covers a total area of about 5,038,100 ha. Plain undulating slopes and mountains characterize the topography of the region. The altitude of the region ranges mainly between 580 and 2731 masl. The agro-climatic zonation of the region can be categorized as 75% Kola, 24% Woina Dega, and 1% Dega. Major crops grown include: sorghum, maize, teff, soybean, groundnut, finger-millet, wheat, rice, noug, and sesame.

In Benishangul Gumuz region, there are three zones and one special district. However, the major soybean growing zones are Metekel and Assosa zones and soybean is produced by 31248 smallholders and covered an estimated area of 12806 ha (CSA, 2016) and almost half of the growers are from Assosa zone. Assosa zone was selected purposively on the basis of being a prominent soybean producing area. Three step sampling procedure was adopted in the choice of sample household heads for this study. The first step involved the purposive selection of two soybean producing districts, these are: Bambassi and Assosa districts. In the second stage, two and three soybean producing kebeles were randomly selected from Assosa and Bambasi each districts, respectively. In the third stage, a total of 59 soybean producing farmers with farm sizes of 0.5 ha and above in the two soybean producing districts, were selected with the help of Agricultural and Rural Development office experts and extension agents. Hence, 28 (47.46%) and 31 (52.54%) of the sampled households were from Assosa and Bambasi districts, respectively (Figure 2).

Data collection and analysis

A cross-sectional data was collected from 59 farm households located at five Kebele Associations (KAs) located in Assosa and Babmassi districts in 2015/2016 cropping season.

Primary data related to costs and income of the selected farmers was collected and generated using farm calendar hired enumerators at each Kebele and field observations collected from households based on their daily activity on soybean production. In addition, a well designed and pre tested semi-structured questions interview was conducted on the same households. Secondary data was also collected from all relevant organizations like Food and Agriculture Organization of the United Nations (FAO) and published and unpublished regional and Woreda level documents.

Descriptive statistical and quantitative methods were used to analyze the data collected. The descriptive statistics used were frequency distribution, mean, standard deviation, minimum and maximum. Enterprise budgeting method was followed and net returns analysis was used to determine the level of soybean profitability.

To determine the cost and returns of soybean production the gross margin (GM) analysis was employed. The gross margin is the difference between the total revenue (TR) and the average total variable cost (TVC). The total revenue is the product of soybean quantity in qt/ha and its price/qt. The total cost is given by sum of the total fixed cost (TFC) and the TVC (Katungi et al., 2011). Mathematically:

$$GM = GR - TVC \quad (1)$$

where GM = Gross Margin Birr/ha, Gr = Average Gross Return/ha, and TVC= Total Variable Costs (Birr/ha).

The net return was calculated to determine the level of profitability by:

$$NR = TR\text{-}TC \quad (2)$$

where NR = net return, TR = TR = Yield × price is total returns calculated as the product of yield (qt/ha) × field price per unit, TC=total costs, defined as the sum of total variable and fixed costs.

In order to ascertain the profitability of this venture, the benefit cost ratio was used as stated:

$$\text{Benefit Cost Ratio} = \frac{\text{Total Benefit (TR)}}{\text{Total Cost (TC)}} \quad (3)$$

Break-even analysis was also employed as a useful tool in enterprise analysis (Rod Sharp and Dennis Kaan, 2001). Break-even analysis can help you answer questions like: "What are the break-even prices at various yields?" and, similarly, “What is break-even yields at given prices?"

The break-even formulas employed in this study are:

$$Break\ Even\ \ Sale\ Price = \frac{Average\ Total\ Costs}{Average\ Total\ Production(Yield)} \quad (4)$$

$$Break\ Even\ Yield\ = \frac{Average\ Total\ Costs}{Break\ Even\ \ Sale\ Price} \quad (5)$$

Finally, a sensitivity analysis using the estimated economic benefit was undertaken to incorporate uncertainty into economic evaluation. To assess the stability of profitability of soybean production, the price of soybean grain was reduced by 10 and 30% and new gross margins were computed. Another scenario for

Table 1. Estimated variable costs of soybean production in Assosa zone of Benishangul-Gumuz in 2016 (in Birr).

Cost item	Average cost (Birr ha^{-1})	Std. Dev.	Min.	Max.	Total cost (%)
Cost of materials					**22.87**
Fertilizer	942.39	405.59	0.00	1251.50	14.20
Seed	420.00	-	-	-	6.33
Bags	155.00	69.34	-	-	2.34
Cost of field operations					**77.13**
Land preparation	520.59	491.39	16.60	2000.00	7.85
Ploughing	1107.90	878.69	144.00	3180.00	16.70
Planting	365.65	193.95	66.00	1000.00	5.51
Row planting	194.57	174.42	0.00	933.33	2.93
Fertilizer application	187.44	138.37	0.00	600.00	2.83
Cultivation/thinning	717.75	428.76	120.00	1733.33	10.82
Weeding	902.66	674.03	0.00	4000.00	13.61
Harvesting	542.36	261.52	99.60	1312.50	8.17
Threshing cost	578.20	255.97	166.60	1160.00	8.72
Average Total Variable Cost	6634.43	1973.03	3685	10366.5	100.00

Author's Computation (2016).

simulation was done for yield to assess the likely impact of a varietal improvement and or actual management as the average yield of soybean deviates by 40% from the mean for 1 ha of land.

RESULTS AND DISCUSSION

Breakdown of costs of soybean production

According to the field data, the farm size allocated for soybean on average was 0.56 ha. Table 1 shows the materials and operation costs incurred by smallholder farmers on soybean production. The average variable cost of producing soybean was Birr 6634.43 ha^{-1}. The variable cost constitutes both cost of materials and operation. Consequently, about 23 and 77% of the variable costs were cost of materials and field operations, respectively.

The cost of operation includes land clearing, ploughing, planting, fertilization application, cultivation/thinning, weeding, harvesting and threshing costs and accounted for about 77% of the soybean production cost. Among the operational costs, ploughing, weeding and cultivation costs were the major ones and constitute about 16.7, 13.61 and 10.82%, respectively as indicated in Table 1. This indicates that these are the major operational activities in the soybean production systems and have greater share of operational costs.

When the materials cost is look at, fertilizer cost has 14.20% share of the average variable cost. This could be due to the fact that the price of fertilizer was high. The seed and packing materials cost takes the remaining share as indicated in Table 1.

Labour cost for weeding, land preparation, sowing in soybean production takes the lion's share. Harvesting cost, threshing cost, input cost like fertilizer and basic seed, rent of oxen, the cost of packaging materials and the cost of capital are also the costs incurred for soybean production.

Profitability of soybean production

The average soybean yield was estimated at 1550.28 kg/ha in the study area, which is far below the average yield of improved soybean varieties which give 32 qt ha^{-1} at research field. Due to different agronomic practices of smallholder farmers, biotic and abiotic factors, soybean yield differs from 600 to 4000 kg ha^{-1}. This indicates that there is an option to double the yield of soybean per hectare at small scale level by adopting improved varieties, improving the management practices and employing recommended agronomic practices.

The average selling price of soybean grain was Birr 6.78 kg^{-1} with the minimum and maximum price of Birr 6.50 and 8.00 kg^{-1}, respectively. The price fluctuation is mainly due to seasonal variations and the farmers sold at low price at time of harvest and high price at sowing time. This implies that smallholder farmers may maximize their return by storing and selling their produce at summer seasons when the price increased.

The computed gross margin indicated that a total of Birr 3931.96 ha^{-1}, constituting 29.76% of the total revenue, was obtained under the smallholders' soybean production system (Table 2). This indicates that soybean production is a profitable enterprise for smallholders' commercialization in Assosa zone of Benishangul Gumuz districts.

Table 2. Yield, unit price and total revenue of soybean production in Assosa zone of Benishangul Gumuz.

Variable	Mean	Std. Dev.	Min.	Max.
Total harvest (kg)/ha	1550.282	695.0082	600	4000
Per kg price of soybean (Birr)	6.78	0. 29	6.5	8.00
Total revenue	10566.38	4931.175	3900	28000

Author's Computation (2016).

Table 3. Cost and returns from soybean production in Assosa zone of Benishangul Gumuz region.

Variable	Mean value	Min.	Max.	SD
Total revenue	10566.38	3,900.00	28,000.00	4,931.175
Total cost	6936.428	3922.5	10,604.00	2002.031
Total variable cost	6634.428	1973.031	10,366.5	1973.031
Total fixed cost	302.00	180	1,396.5	224.96
Gross margin	3931.956	(830)	20,213.33	3931.956
Profit margin/ha (%)	29.76	(21.28)	72.19	22.51
Net benefit/ha (Net profit)	3629.956	(1067.5)	19975.83	4288.632

Author's Computation (2016).

The break-even analysis

The breakeven point analysis revealed that, the breakeven sale price to cover operating costs and materials for soybean production in the study area was Birr 4.28 kg^{-1}. Furthermore, the breakeven yield to cover all variable costs was 978.53 kg/ha. Therefore, to minimize risk (loss) the smallholder farmers should produce at least 9.78 qt/ha and/or the minimum price of soybean above Birr 4.28 on average to cover the variable costs (Table 3).

Sensitivity analysis

Agricultural production is unpredictable due its gamble nature under environment. However, simulation may help to minimize risk and uncertainties in many cases. Table 4 shows the sensitivity analysis of soybean production in Assosa zone of Benishangul Gumuz region. Thus, 10% decrease in price would cause 7% decrease in profit whereas a 10% increase in yield would lead to 5.72% increase in profit. The results revealed that soybean production is highly sensitive to price reduction than to yield increase.

Further, as price decreased by 30%, the profitability of soybean production decreases by 26.9%, while 40% increase in yield increases the profit of the soybean production enterprise by 18.95%. The implication is that soybean profitability is highly sensitive to price decrease than to the increase in yield.

Gender role on soybean production and costs

The role of gender on soybean production is shown in Table 5. The results indicate that most of the activities of soybean production were made by men. Threshing is completely made by men followed by harvesting and ploughing accounts for 93.14 and 89.97%, respectively. However, women contribute for about 10 and 6.86% of the remaining activity during ploughing and harvesting time. However, the total cost for ploughing is higher even than the cost of weeding. As indicated in Table 5 and Figure 3, the large share of women was during planting followed by land preparation, cultivation/thinning, and weeding. The difference in cost for ploughing was due to some of the costs incurred was for rent of tractor and other materials.

Conclusion

Soybean production contributes to the livelihood of smallholder farmers in Benishangul Gumuz region due to the versatile nature and use of the crop. Soybean is the major source of income for smallholder farmers and source of protein. Hence, production of the crop would create job opportunities in the rural communities and contributes to economic growth. It has also been learned that the productivity level of soybean is by far below the potential in the area and can be doubled by applying appropriate packages. Thus, based on the present finding from the net return and margin analysis, the smallholders' commercialization in soybean production is promising and profitable enterprise in the study area even under the existing low productivity scenario. The study therefore suggests that policy directed towards market linkage among soybean producers and agro industries and wider adoption of improved varieties with its

Table 4. Sensitivity analysis of soybean production in Assosa zone of Benishangul gumuz region.

Description	Original	10% reduction in price	30% reduction in price	10% increase in yield	40% increase in yield
Total harvest (kg)	1550.28	1550.28	1550.28	1705.308	2170.392
Quantity of soybean sold (kg)	1550.28	1550.28	1550.28	1705.308	2170.392
Unit price (Birr) of soybean sold (kg)	6.78	6.102	4.746	6.78	6.78
Total revenue	10566.38	9509.75	7396.47	11623.02	14792.94
Profit (Birr)	3931.956	2875.32	762.04	4988.59	8158.51
Profit as % of total revenue	37.2	30.20	10.3	42.92	55.15

Author's Computation (2016).

Table 5. Farmers' labor use pattern and costs (Birr/ha).

Type of operation	Family		Total labor cost
	Male	Female	
Land preparation	5.67	2.4	520.59
Ploughing	10.05	1.12	976.39
Planting	9.16	4.37	560.12
Fertilizing	4.18	0.57	187.44
Cultivation/Thinning	10.06	4.21	717.75
Weeding	12.65	5.01	902.66
Harvesting	10.04	0.74	542.36
Threshing	6.61	0.00	578.20
Total	68.44	21.89	4985.51

Author's Computation (2016).

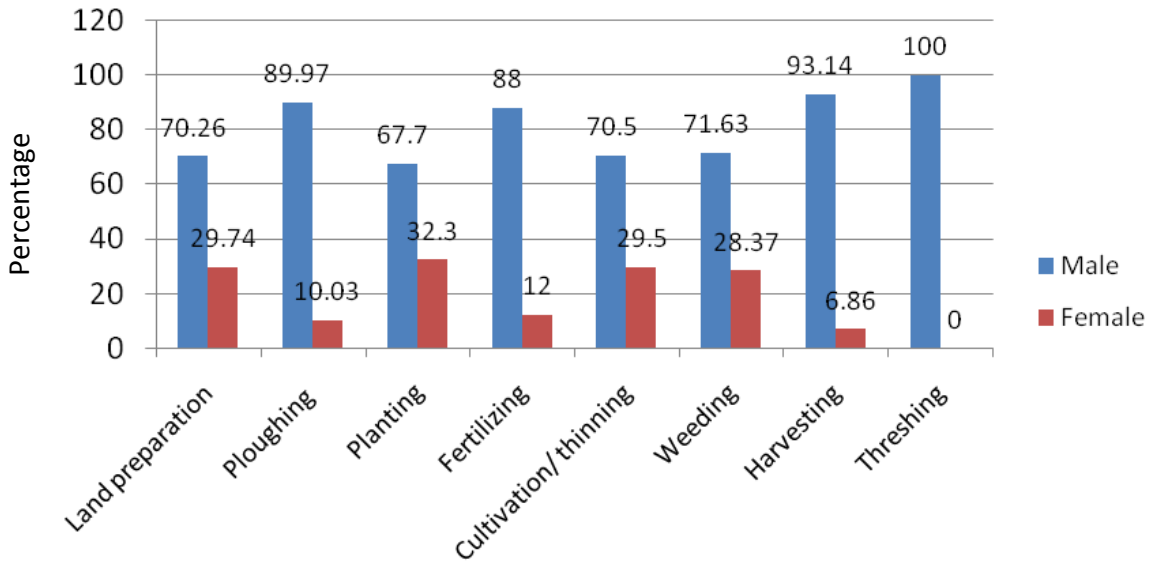

Figure 3. Total labor share of soybean production in Assosa zone of Benishangul gumuz region.

recommended agronomic practices by smallholder farmers would bring soybean profitability to a higher level than the current low input scenario in Assosa zone of Benishangul-Gumuz regional state.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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