Cost-Benefit Analysis of Sesame Production under Improved and Traditional/ Farmer's Practice/ in Kafta-humera, Tigray Region, Ethiopia

Abstract

This study aimed to investigate the cost-benefit of sesame production per hectare under improved and (traditional sesame production) farmer's practice. The primary data were collected from the sesame farmers who cultivate both improved and traditional sesame production (plot with improved sesame agronomic technologies on one side and farmers practice on the other side) were selected randomly from the participants of households on the cluster-based large scale demonstration of sesame production during 2019 in kafta-humera district, Western Zone of Tigray, Ethiopia. The study found that farmers were able to generate an average gross income of Ethiopian Birr (ETB) 28997 per hectare (ha) from the improved sesame production, whereas, ETB 19215.21 per ha from their practice, respectively. The average cost of cultivation for improved sesame production was ETB 11857.89 ha and ETB 9259.63 per ha under (traditional sesame production) farmers practice. Therefore, the net profit of sesame production under improved and traditional sesame production was ETB 17139.69 and ETB 9955.58 respectively. This implied that farmers could earn an additional net income of 7184.11 per ha by practicing the recommended sesame technologies. This shows that although the net profit under the improved production system was higher than traditional/farmers practice, higher costs of production were also recorded in improved sesame production than traditional /farmers practice as farmers spend a lot of money on sesame cultivation especially weeding and harvesting. Hence, the government and private sectors should give more emphasis to introduce mechanized row planter, captivators, and combined harvester machines to reduce labor costs especially when the cost of labor is high. Moreover, the price of sesame seed was lower than the previous three-four years. Hence, agricultural economists should consider setting up a sesame price policy to help farmers to gain more profit from selling sesame.

Keywords: Sesame, Profitability, Cost, Benefit, Production, Traditional, Improved

Introduction

In Ethiopia, agriculture has played and continues to play a vital role in the national economic development of the country, contributing 41.4% of the country's gross domestic product (GDP) and 83.9% of the total exports [1]. Among the agriculture sectors practiced in Ethiopia, oilseed production is an integral part of the livelihood of the household level and contributes significantly to the national economy of Ethiopia in earning foreign currency. While coffee remains the main foreign exchange earner, Ethiopia is diversifying different exports, and commodities such as gold, sesame, khat, livestock, and horticulture products are becoming increasingly important. Sesame is a major cash crop and the second most important agricultural commodity next to coffee in Ethiopia which is mainly produced as an export crop [2, 3]. Sesame is grown primarily for its oil-rich seeds and used as a cash crop, export commodity, raw materials for industries and pharmaceutical [4], and a source of employment opportunity that supports the livelihoods of thousands of small farmers, hundreds of medium-to-large-scale private farms along with thousands of other actors [5,6].

Having all these importance, sesame production continues to face several problems and challenges. The major ones are weather uncertainties, limited use of improved agricultural technologies, pest outbreaks, and absence of a business-oriented production system, resulting in lower crop productivity and then limited or no profitability [7,8]. To overcome the problems, the government of Ethiopia has been promoting the new extension program as an effective mechanism to bring about the desired growth in the agricultural sector. The intervention is composed of packages of improved sesame technologies and the success of sesame production will depend upon the effectiveness of the technological packages and the extent to which a significant number of peasant households are willing and able to adopt the package and employ it continuously and sustainably [9].

When considering farming practices, the main practices are traditional (conventional) and improved sesame production system. The traditional sesame production system is the cultivation of sesame through farmer's practice, whereas, improved sesame production system is producing sesame by adopting the improved sesame technologies which are recommended by different researches and studies in different times. So far, many improved sesame technologies were

recommended by national and regional research institutions. For a successful sesame production, improved sesame varieties, land preparation, method of planting (row planting), time and frequency of weeding, seed and fertilizer rate, time and method of fertilizer application, pest and diseases management measures, harvesting, removing/minimization of post-harvest loss, and other technologies were suggested by different researches and studies in different periods [9].

Adoption by smallholder farmers for improved agricultural technologies can provide the basis for increasing their production and income. A decision to adopt or reject agricultural technologies depends on smallholder farmer's objectives, their constraints as well as the cost and benefits of the technology [10]. Although knowing the production costs and benefits of sesame production is a prerequisite for determining how well the farm business is doing, there is limited empirical information about the difference between the value of yield per ha and total expenses in the sesame production chains. Therefore, this study was carried out to assess the costs and benefits to farmers from the improved and traditional sesame production practices in Western Tigray, Ethiopia.

2. Methodology

2.1. Description of the Study Area

Kafta-Humera district is located in north-western Ethiopia and western part of Tigray Regional State (Figure 1) and 991 km away from Addis Ababa. It is bordered on the south by Tsegedie, on the west by Sudan, then by the Tekeze river which separates Kafta Humera from Eritrea on the north Tahtay-Adiyabo on the east, and on the southeast by Wolkayt. The district administrative center is Setit-humera town. The district covers an area of 632,877.75 ha which is about 50.06% percent of the western zone of Tigray. The geographical location of this study area is ranging from 13°45' to 14°28' north latitude and 36°20' to 37°31' east longitude within an altitude range of 560-1849 m a.s.l. The area is located in a semi-arid agro-climatic zone. It has two agro-ecologies, of which 85.7% Lowland (*kola*) and 14.3 % midland (weinadega). The mean total rainfall ranges from 400-650 mm. The mean maximum temperature varied between 33^0C in April and 41.7^0C in May, while the mean minimum temperature is between 17.5^0C in August and 22.2^0C in July. [11].

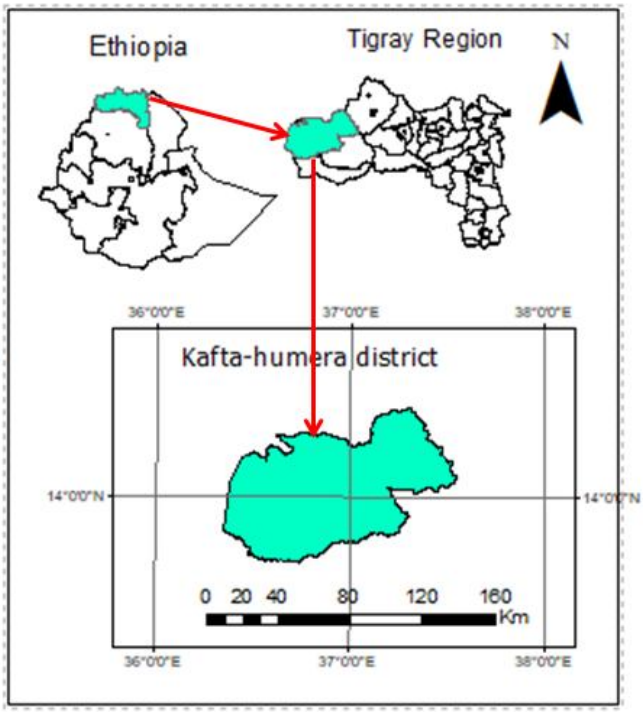

Figure 1: Location map of the study area (own picture)

The district holds a total of 115,580 populations whom 60,226 of them are male and 55,354 are female. This population is also made of a total of 29,324 household heads; with 19,576 of the households are male-headed and 9,748 female-headed households. The land-use system was characterized by a mixed farming system dominated by open crop cultivation; and this included cereals (31.24%), pulses (5.94%), oilseeds (60.87%), and vegetables (1.95%). Many farmers (68.8%) are practicing a mix of cereal-livestock farming, while 27.97% cultivating annual crops and 3.23% livestock raring [12].

2.2 Sampling Technique and Sample Size Determination

The study was conducted within the kafta-humera district of Western Tigray, Ethiopia. The district was selected purposively based on the information large sesame production area, many sesame growers, the potential for sesame production, accessibility, and representativeness of the farming system. Once the district was selected, an equivalent procedure and selection criteria were wont to select the study Kebeles, namely Adebay and Rawyan. The population for this study comprised of all sesame farmers who participate in cluster-based large scale sesame

technologies demonstration within the selected kebeles. Since the numbers of participants under the cluster-based large scale sesame technologies demonstration were limited, 83 respondents who cultivate both improved and traditional sesame production (plot with improved sesame technologies on one side and farmers practice on the other side were selected randomly from the participants of households on the cluster-based large scale demonstration of sesame production during 2019.

2.3 Data Collection and Method of Data Collection

A pretested questionnaire was used to elicit information on costs and benefits through face to face interviews. Detailed information was collected on all the variable production costs incurred from land preparation to harvesting and post-harvest handling, as well as materials used in sesame production. Efforts were made to value purchased and non-purchased inputs, such as family labor participated in the sesame production chain such as land preparation, weeding, harvesting, threshing, etc. Each respondent was asked to estimate the cost of labor he/she would be willing to pay to accomplish the task if he/she was to hire labor.

2.4 Data Analysis

Financial analysis was used because it takes into consideration both the output and the cost of all variables and inputs. Production cost is obtained by adding up all the costs [13]. The output only included the yield of sesame seed produced at the crop season which is converted into monetary value. It was performed using the prevailing average market prices for all cost of production and sesame grain yield (output). Descriptive tools like mean, standard devotion, minimum, and maximum were used to analyze the data. To determine the level of profitability, the net benefit was calculated as the difference between the gross benefit and the total production cost. Mathematically:

$$NR = TR - TC \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots . (1)$$

Where NR = net return (ETB/ha), TR = total revenue (Yield × price) is total returns calculated as the product of sesame yield (quintal/hectare) × price per quintal, and TC = total production costs, defined as the sum of total expenses to produce the sesame.

To determine the profitability of sesame production practices, the benefit-cost ratio was used as stated:

$$Benefit\ Cost\ Ratio = \frac{Total\ Revenue(TR)}{Total\ Cost\ (TC)} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (2)$$

The difference of mean yield, crop income, production cost, and financial profitability was tested using paired t-test inferential statistics as the data were subjected to t-test for significance test.

3. Result and Discussion

Table 1: Average Sesame Grain yield across the two production systems

	Mean	Std. Dev.	Min.	Max.	t-value
Full-package	7.07	2.03	3.5	10	t= 10.4760
Farmers practice	4.69	1.29	2.75	8	P= 0.0000
Difference	2.38				

The productivity of sesame under improved production technology ranged between 3.5 and 10 qt/ha with a mean yield of 7.07 qt/ha as against a yield range between 2.75 and 8 qt/ha with a mean of 4.69 qt/ha under farmer's practices (traditional sesame production practice). The result also revealed a significant difference (t = 10.4760; P<0.0001) between sesame productivity under improved production technology and farmer's practices.

Table 2: **Cost of Sesame production**

	Improved sesame production system				Farmers practice			
Variable	Mean	Std. Dev.	Min.	Max.	Mean	Std. Dev.	Min.	Max.
Cost of land preparation/ha	374.64	132.54	145.45	500	348.80	185.17	125	833.33
Cost of 1st plowing /ha	402.98	92.61	300	600	412.51	74.67	300	500
Cost of 2nd plowing /ha	419.85	95.98	300	600	345.66	192.72	0	600
Cost of 3rd plowing /ha	1200.00	0	1200	1200	0.00	0.00	0	0
Cost of seed/ha	231.53	34.74	198	297	269.85	11.70	231	297
Cost of fertilizer /ha	1833.45	84.89	1595	1875	494.24	678.78	0	1875
Cost of fertilizer transportation /ha	39.60	9.96	20	50	12.58	15.05	0	30
Cost of labor for fertilizer application /ha	45.05	31.18	20	100	32.90	49.54	0	200
Cost of 1st weeding /ha	1226.774	265.1966	600	1500	1595.04	407.291	1250	2250
Cost of 2nd weeding/ha	1071.667	394.2574	500	1650	1175	255.542	750	2000
Cost of 3rd weeding/ha	921.697	380.9571	109.0909	1500	1790.149	347.3579	1111.111	2571.428
Cost of chemical /ha	66.61	63.76	45	300	4.35	13.52	0	45
Cost of chemical spraying /ha	26.29	37.33	15	200	2.90	9.02	0	30
Cost of harvesting /ha	2310.902	986.33	1000	4000	1631.942	1125.58	700	4857.14
Cost of threshing /ha	790.91	274.47	300	1200	447.73	97.33	400	825
Cost of transportation /ha	154.26	86.74	50	300	115.68	77.73	0	240
Cost of foods and related /ha	588.39	241.04	500	1280	557.07	247.44	0	1305
Cost of others/ha	153.29	87.92	120	378	23.23	48.19	0	120
Total cost of production/ha	11857.89	1564.93	9167	14673.5	9259.631	2418.145	4160.5	14426.86

The higher cost of cultivation of 11857.89 birrs/ha is involved in the case of improved sesame production as compared to 9259.63 birrs under Farmer's practice (Table 3).

Table 3: Cost-Benefit Analysis

Variable	Improved production system				Farmers practices				t-test
	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max	
Gross income	28997	8315.33	14350	41000	19215.21	5292.23	11275	32800	t = 10.4760 P= 0.0000
Total cost	11857.89	1564.93	9167	14673.5	9259.631	2418.145	4160.5	14426.86	t = 5.1683 P=0.0000
Net income	17139.69	7875.942	3776.5	30367	9955.576	4841.906	3009.5	25419	t = 7.0824 P=0.0000
BCR	2.448578	.6693	1.257369	3.85592	2.171543	.7061618	1.291745	4.443842	t = 1.9394 P= 0.0310

Beneficiary farmers were able to generate an average gross income of 28997 birrs per ha from the improved sesame production, whereas, 19215.21Birr/ha from their practice, respectively (Table 3). After deducting all the cost of production, the average net income was 17139.69 birr/ha in the case of improved sesame production system, whereas, 9955.58 Birr/ha, in a similar field with farmers practice. This implied that farmers could earn an additional net income of 7184.11 /ha by practicing the technologies.

Conclusions and recommendation

This study can conclude that the average sesame yield under an improved sesame production system was higher (7.07 quintal/ha) than the yield of sesame under farmers practice 4.69 quintals/ha. Although both the sesame yield and net profit under the improved production system were higher than traditional/farmer's practice, the costs of production were also higher in improved sesame production than traditional /farmers practice as farmers spend a lot of money for sesame cultivation especially weeding and harvesting. Therefore, the government and private sectors should give more emphasis to introduce mechanized row planter, cultivator, and combined harvester machine to reduce the labor cost especially when the cost of labor is high. Moreover, the price of sesame seed was lower than the previous three-four years. Hence, agricultural economists should consider setting up a sesame price policy to help farmers to gain more profit from selling sesame.

Reference

1. Blandford, D. (2011). The contribution of agriculture to green growth. *Report to the OECD*.
2. Matous, P., Todo, Y., & Mojo, D. (2013). Roles of extension and ethno-religious networks in acceptance of resource-conserving agriculture among Ethiopian farmers. *International Journal of Agricultural Sustainability*, *11*(4), 301-316.
3. Girmay, A. B. (2018). Sesame production, challenges and opportunities in Ethiopia. *Agricultural Research & Technology: Open Access Journal*, *15*(5), 555972.
4. Trade, M. O. (2013). Oilseed production and marketing situation in Ethiopia. *C: Documents and Settingsuser1Desktop Crop Profiles. mht (15/01/08)*.
5. Anilakumar, K. R., Pal, A., Khanum, F., & Bawa, A. S. (2010). Nutritional, medicinal and industrial uses of sesame (Sesamum indicum L.) seeds-an overview. *Agriculturae Conspectus Scientificus*, *75*(4), 159-168.
6. Abera, H. (2009). Analysis of Sesame production, supply, demand and marketing issues in Ethiopia. *Addis Ababa, Ethiopia: Ethiopia Commodity Exchange Authority*.
7. Gelalcha, S. D. (2009). Sesame trade arrangements, costs and risks in Ethiopia. *Ministry of Foreign Affairs, The Haque*.

8. Bezabih, E. (2010). Market Assessment and Value Chain Analysis in Benishangul Gumuz Regional State.
9. Terefe, G., Wakjira, A., Berhe, M., & Tadesse, H. (2012). Sesame production manual. *Ethiopia: Ethiopian Institute of Agricultural Research Embassy of the Kingdom of the Netherlands*.
10. Tadesse, M., & Belay, K. (2004). Factors influencing adoption of soil conservation measures in southern Ethiopia: the case of Gununo area. *Journal of Agriculture and Rural Development in the Tropics and Subtropics (JARTS)*, *105*(1), 49-62.
11. Kafta-humera District office of Agriculture and rural development (KHDOARD) report. (2018). Annual report. unpublished Tigrigna Version.Setit-humera, Tigray, Ethiopia.
12. Kafta-humera District office of finance and economic development plan (KHDOFEDP) report. (2018). Annual report. unpublished Tigrigna Version.Setit-humera, Tigray, Ethiopia.
13. Takele, E. (1990). How to determine your cost of production. *Family farm series (USA)*.

Conflicts of Interest

The authors stated that no conflicts of interest.

Abbreviations

ETB: Ethiopian Birr
ha: hectare
GDP: Gross Domestic Product
NR: Net Return
TR: Total Revenue
TC: Total Costs
BCR: Benefit-Cost Ratio
qt: quintal