

## Assessing Economic Efficiency in Teff Production: Evidence from Gombora Woreda, Central Ethiopia

Abraham Ababiya<sup>1\*</sup>, Genene Wosenyeleh<sup>2</sup>, Shefaraw Teshale<sup>3</sup>, Kacha Assefa<sup>4</sup>,  
Yisihak Ergicho<sup>5</sup>

<sup>1,2,3</sup>Department of Agricultural Economics, College of Agricultural Science, Wachemo University,  
Ethiopia

<sup>4,5</sup>Department of Economics, College of Business and Economics, Wachemo University, Ethiopia

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### ABSTRACT

Teff is a major cereal crop extensively cultivated in Gombora Woreda of Hadiya Zone, Central Ethiopia. Despite its importance, significant disparities in productivity exist among teff-producing farmers, largely due to differences in resource use efficiency. This study aimed to assess the level of economic efficiency in teff production and to identify key sources of inefficiencies among smallholder farmers in the study area. The research was based on primary cross-sectional data collected from 185 randomly selected producers using a two-stage sampling technique. A Stochastic Frontier Model (SFM) was employed to estimate economic efficiency levels and identify influencing factors. The results revealed that the mean economic efficiency of teff producers was 41.9%, indicating that there is potential to enhance output by 58.1% through improved resource allocation and utilization under existing technological conditions. The Stochastic Frontier Production (SFP) function identified several factors that significantly influenced economic inefficiency, including education level, soil fertility, livestock ownership, farm size, off-farm income, extension contact, training, and distance to market. Notably, farm size and distance to the nearest market were found to positively and significantly impact economic inefficiency, suggesting that larger and more remote farms face greater challenges in optimizing resource use. The findings highlight a considerable scope for improving economic efficiency among teff producers through interventions aimed at enhancing both technical and allocative efficiency. Strengthening extension services, improving market access, and promoting farmer training are recommended to boost productivity and ensure sustainable teff production in the study area.



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### Corresponding Author:

**Abraham Ababiya**

Department of Agricultural Economics, College of Agricultural  
Science, Wachemo University, Ethiopia

Email: [abrahamababiya2@gmail.com](mailto:abrahamababiya2@gmail.com)

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## INTRODUCTION

The agricultural sector remains a cornerstone for economic development, food security, and rural livelihoods, particularly in developing countries. With increasing pressure from rapid population growth, climate change, and limited natural resources, enhancing economic efficiency in agricultural production has become a critical priority. Economic efficiency, which encompasses both technical and allocative

efficiency, reflects a farmer's ability to maximize output and minimize costs given existing inputs and technology. In resource-scarce settings, improving economic efficiency is often a more immediate and cost-effective strategy than introducing new technologies ([Belay et al., 2013](#)). For countries struggling with food insecurity, inefficiencies in input use not only limit productivity but also undermine broader development efforts.

In Ethiopia, agriculture is the backbone of the economy employing over 85% of the labor force, contributing about 42% to GDP, and serving as the primary source of food and income for the majority of the population. However, despite its importance, the sector faces persistent challenges, including low productivity, land degradation, and limited technological adoption. One of the underlying causes of these issues is economic inefficiency in resource use, particularly among smallholder farmers ([Asfaw et al., 2012](#)). While the government has implemented strategies to promote agricultural intensification such as fertilizer subsidy programs and extension services the full potential of these initiatives remains unrealized due to inefficiencies in how farmers allocate and manage inputs.

Teff (*Eragrostis tef*), a staple cereal crop in Ethiopia, plays a vital role in the country's food system. It is cultivated by millions of smallholder farmers and occupies about 20% of the national cropland. In terms of both area coverage and household participation, teff ranks as one of the top crops, second only to maize in production volume. The demand for teff continues to rise due to its nutritional value and cultural significance. However, production has not kept pace with growing demand. National average teff yield stands at approximately 17.48 quintals per hectare, which remains significantly below its potential ([Central Statistical Agency \[CSA\], 2019](#)). The gap between potential and actual output is largely attributed to inefficient use of inputs such as land, labor, fertilizer, and improved seeds ([Hailemariam, 2015](#)).

In the Central Ethiopia Region, and particularly in Hadiya Zone, teff is among the most important cereal crops. Yet, yield levels are even lower than the national average. According to CSA (2019), the average teff yield in the region is 13.08 quintals per hectare, with Hadiya Zone at 14.09 quintals and Gombora Woreda slightly higher at 15.5 quintals per hectare. These figures, while relatively better, still reflect untapped productivity potential. The variability in teff output among farmers using similar resource endowments suggests considerable differences in economic efficiency across producers.

In Gombora Woreda, teff is the dominant crop both in terms of area cultivated and economic value. However, farmers face significant challenges in optimizing their input use. Despite the availability of improved technologies and extension services through local institutions such as the Gombora Woreda Agriculture Office (GWADO), disparities in yields persist. This indicates inefficiencies not only in production practices but also in resource allocation decisions. Organizational efforts aimed at improving productivity must therefore be guided by empirical evidence on efficiency levels and the determinants of inefficiency at the local level.

Improving teff productivity can occur via two pathways: the introduction of improved agricultural technologies or enhancement of economic efficiency with the current technology base. These are not mutually exclusive. However, introducing new technologies into a system characterized by low economic efficiency may fail to produce the desired improvements ([Mustefa, 2014](#)). Therefore, measuring economic efficiency which requires the joint estimation of technical and allocative efficiencies – is a crucial step in designing informed agricultural interventions.

This study seeks to assess the economic efficiency of smallholder teff producers in Gombora Woreda and to identify the major sources of inefficiency. By filling the existing knowledge gap at the micro (woreda) level, the research provides valuable insights for policymakers, extension agents, and local development planners to promote resource-efficient and productivity-enhancing strategies that align with the local context

## METHODS

### Descriptive Statistics

In the descriptive part of this study, tools like mean, standard deviation, frequency, percentage and inferential statistical tests like chi-square test for potential dummy explanatory variables and t-test was used to test the significance of the mean difference of continuous variables for the sample households.

### Econometric Analysis

The stochastic frontier production function was the most appropriate technique for efficiency studies which have a probability of being affected by factors like weather, pests, disease beyond control of decision making unit. This was because of the fact that this technique accounts for estimating inefficiency as a result of these factors and technical errors occurring during estimation and observation. *Teff* production at the study area was likely to be affected by natural hazards, unexpected weather conditions, pest and disease occurrence which were beyond the control of the farmers. Moreover, there is high variability of agricultural production due to weather fluctuations. Therefore, for this study a Cobb-Douglas production function approach was used, which requires the priori specification of the production function to estimate the level of economic efficiency. Among the possible algebraic forms, Cobb-Douglas and the translog functions have been the most popularly used models in most empirical studies of agricultural production analysis ([Jacob et al., 2016](#); [Kifle et al., \(2017\)](#) and [Getachew et al., \(2018\)](#)). Crop production is likely to be affected by random shocks such as weather, pest infestation and drought. In such a condition where random shocks and measurement errors are high. A model that accounts for the impact of noise is more appropriate to choose. Since stochastic frontier methods requires a prior specification of the functional form. Cobb-Douglas production function was selected stochastic frontier approach to estimate the level of economic efficiency of farmers, because for its ability to distinguish inefficiency from deviation

that caused from factors beyond the control of farmers.

Stochastic frontier model:-To determine the technical efficiency of *teff* producing farmers in the study area.

$$\ln(Y_i) = \alpha_o + \sum_{j=1}^n \beta_j X_{ij} + \varepsilon_i$$

Where,  $\ln$ =natural logarithm

$Y_i$ =shows the observed *teff* production of the  $i$ th farmers (*teff* output in qt);

$X_{ij}$ =inputs variables (seed, land, Urea, NPSB, labour, oxen) used in hectare;

$\beta_j$ = parameters to be estimated (they are elasticity coefficients in the case of Cobb-Douglas specification of the production function).

The disturbance term  $\varepsilon_i = v_i - u_i$  is composed of two components,

$V_i$ = accounts for the stochastic effects beyond the farmer's control, measurement error and other statistical noises (it is a zero-mean random error),  $U_i$  = are factors that are within the farmer's control responsible for technical inefficiency. and  $i=1,2,\dots,n$  farms or farm is defined as the ratio of observed output and the corresponding frontier output, given the state of available technology.

The technical efficiency is estimated as;

$$TE = \frac{y_i}{f(x_i, \beta) \exp(v_i)} = \frac{f(x_i, \beta) \exp(\varepsilon_i)}{f(x_i, \beta) \exp(v_i)} = \exp(-u_i)$$

Where,  $f(x_i; \beta) \cdot \exp(v_i - u_i)$  is the observed output ( $Y$ ) and  $f(x_i; \beta) \cdot \exp(v_i)$  is the frontier output ( $Y^*$ )

The production function could also be estimated through an alternative form called dual such as cost or profit function.. The self-dual functional form allows the cost frontier to be derived and is to estimate economic efficiency (EE) when farmers face same price.

The dual cost function of the Cobb- Douglas production function can specified as:

$$\ln C_i = \alpha_o + \sum_{j=1}^n \alpha_j \ln W_{ij} + \alpha_7 \ln Y^*_i$$

Where  $i$  refers to the  $i^{\text{th}}$  Sample farm;  $j$  is number of input;  $C_i$  is the minimum cost of production;  $W_i$  input prices;  $Y^*$  refers to farm output which is adjusted for noise  $v_i$  and  $\alpha_s$  are parameters to be estimated.

The corresponding dual cost frontier of the Cobb- Douglas production function can be

represented in the general form as follows:

$$C_i = C(W_i, Y_i^*; \alpha)$$

Where  $C_i$ : -is the minimum cost of  $i^{\text{th}}$  farm associated with output  $Y_i^*$ ;

$W_i$ :- is vector of input prices for the  $i^{\text{th}}$  firm and

$\alpha$ : is the vector of parameters to be estimated .

The economic efficient input vector of the  $i^{\text{th}}$  firm  $X_{ie}$  is derived by applying Shepard's lemma and substituting the firms input prices and adjusted level system of minimum cost input demand equation can be expressed as:

$$\frac{\alpha C_i}{\alpha W_n} = X_{ie}(W_i, Y_i^*, \alpha)$$

Where  $\alpha$  is vector of parameters and  $n=1,2,3\dots N$ (number of input used). The observed technically and economically efficient costs of production of  $i^{\text{th}}$  firm are equal to  $W'X_i$ ,  $W'X_{it}$  and  $W'_{ie}$ ; respectively.

The minimum cost is derived analytically from the production function, using the methodology used in Arega and Rashid (2005). Given input oriented function, the efficient cost function can be specified as follows:

$$\text{Min } \sum_x C = \sum_{j=1}^n X_j W_j (20)$$

$$\text{Subject to } Y_i^* = \hat{A} \prod X_j \beta_j$$

Where,  $\hat{A} = \text{Exp}(\beta_0)$

$X_j$ = input prices

$\beta$  = parameter estimates of the stochastic function and

$Y_i^*$ = input oriented adjusted output level from Equation

The solution for the problem in the above equation is basis for driving dual cost frontier.

After deriving the equation using Shepherd's lemma, the dual cost function can be written as follows:

$$C(Y_i^*, W) = H Y_i^* \prod W_j a_j$$

According to Sharma *et al.*, (1999), the above cost measures are used to estimate the technical, allocative and economic efficiencies respectively.

$$TE_i = \frac{W'_i X_{it}}{W'_i X_i}$$

$$EE_i = \frac{W'_i X_{ie}}{W'_i X_i}$$

Following Farrell (1957), the AE index of the  $i^{\text{th}}$  farmer can be derived as follows:

$$AE_i = \frac{EE_i}{TE_i} = \frac{W'_i X_{ie}}{W'_i X_{it}}$$

Thus the total cost or production inefficiency component of  $i^{\text{th}}$  firm ( $W'X_{ie} - W'_iX_i$ ) can be decomposed in to its technical ( $W'X_i - W'X_{ie}$ ) and allocative ( $W'X_{ie} - W'X_{ie}$ ) components.

After estimating the level of efficiency ( $E^*$ ) parameters, the following Tobit model was estimated to identify sources of inefficiencies of TE, AE and EE.

To determine the relationship between socioeconomic and institutional factors and the computed indices of efficiencies, a tobit model was utilized. The Tobit model was adopted because the efficiency scores are double truncated at 0 and 1 as the scores lie within the range of 0 to 1

Following Gujarati (2004) the Tobit model is estimated as follows:

$$E_i^* = \sum_i \beta_i X_i + v_i$$

$$E = \max(0, E^*)$$

$$E_i = 1 \text{ when } E_i^* \geq 1$$

$$E_i = E_i^* \text{ when } E_i^* < 1$$

Where  $E_i$  is an efficiency score which represents TE, AE and PE of the  $i^{\text{th}}$  farm in the sample and  $v \sim N(0, \delta^2)$   $\beta_i$  are the vector of parameters to be estimated ;  $X_i$  represents farm specific variable that affecting efficiency;  $E_i^*$  is latent variable with  $E[E_i^* / X_i]$  equals  $X_i\beta$

### Production Function Variables

These variables include both output (dependent) and inputs (independent) factors of production process for *teff*.

### Dependent Variable

**Output (outp):** It was the total output of *teff* produced in 2024 production year and it's measured by quintals.

**Land (L):** It was total area of land in hectare allocated for *teff* crop in 2024 by the  $i^{\text{th}}$  farmer and it's measured by hectare.

**Labor (LAB):** It was total labor force used for plowing; weeding, planting, cultivation and harvesting in 2024 production season which was measured in terms of man-days.

**Seed (SE):** It was total quantity of *teff* seed used by the  $i^{\text{th}}$  farmer for *teff* production during 2024 production season which was measured in kg.

**Oxen Power (OP):** It was total number of oxen days used by  $i^{\text{th}}$  farmer for land preparation and plowing. Oxen power would be used by the farmer in all oxen driven *teff* production activity in 2024 and measured in pair of oxen-days (OXs)

**Fertilizer (FRT):** It was total amount of chemical fertilizer applied by  $i^{\text{th}}$  farmer on *teff* field during 2024 production season which was measured in kg. Farmers commonly apply both NPSB and UREA for *teff* production in the study area.

**Table 1.** Definitions of production Function variables

Input Variable	Description	Unit of Measurement	Expected Sign
Ln(land)	Land cultivated for <i>teff</i> production	Hectare (ha)	+
Ln(labor)	Number of weighted labor	Man-equivalent day	+
Ln(seed)	Quantity of weighted <i>teff</i> seed	Kg	+
Ln(oxen power)	Number of weighted oxen	Oxen-days	+
Ln(NPSB)	Quantity of NPSB fertilizer	Kg	+
Ln(UREA)	Quantity of urea fertilizer	Kg	+

Source: Author's survey data, 2024

### Cost Function Variables

These variables were used in the dual frontier cost function derived from the stochastic Cobb-Douglas production function. These variables indicate the monetary values of inputs used for a given physical quantity of *teff* output. The measures of cost minimization and resource allocation were the level of cost and allocative efficiencies for sample households in the study area. These variables were expected to positively influence related to the total variable costs of *teff* production.

**Price of land (PLAND):**-Land do not have market price so rental price was used. For owned land rent paid to same quality and size paid in the locality in 2024 was taken

and for rented-in land the amount paid was taken as its price.

**Price of labor (PLAB):**-It was the average wage in Birr per day paid for hired labor in the 2024 *teff* production year was used as price of labor.

**Price of oxen (POX):**-The average price paid for pair of oxen per day used in *teff* production year of 2024 was used as price of oxen.

**Price of fertilizer (PFERT):**-The payment in Birr per kg for fertilizer by each sample farmer in 2024 *teff* production year in the study area was used.

**Price of seed (PSEED):**-The price of seed in Birr per kg for *teff* applied in the 2024 production season by sample farmers was used as price of seed.

**Output(Y):**-It was observed *teff* output expressed in quintal for the household in the study area during the 2024 production year.

**Table 1.** Cost Function Variable

Cost Variable	Description	Unit of Measurement	Expected Sign
Ln( $p_o$ land)	Rent of land per hectare	Birr	-
Ln( $p_o$ labor)	Wage of labor per day	Birr	+
Ln( $p_o$ oxen)	Cost of oxen power	Birr	+
Ln( $p_o$ NPSB)	Price of NPSB fertilizer	Birr	+
Ln( $p_o$ UREA)	Price of UREA fertilizer	Birr	+
Ln( $p_o$ seed)	Price of seed	Birr	+
Ln( $p_o$ output)	Teff output	Quintal	+
Ln(TP cost)	Total production cost	Birr	+

Source: Author's field survey, 2024

## RESULT AND DISCUSSION

### Descriptive statistics of variables used to estimate the production function

In the 2024 production season, on average sample households farmers produce 11.48 quintals per ha of *teff* output with minimum of 2 quintals and maximum of 25 quintals which is dependent variable in the production function. The land allocated for *teff* production, by sampled household farmers during the survey period, ranges from 0.125 to 2.25 ha with average of 0.79 ha. The amount of seed that sampled households used a minimum of 3.5 kg and a maximum of 30 kg of seed with a mean of 13.93 kg of *teff* seed was used for production. Like other inputs human and animal labor inputs were also decisive, given a traditional farming system in the study area. The survey result on labor force used for production of *teff* by sample respondents which changed in to man power per day shows that, the mean labor use was 30.83 man-days with minimum of 13.7 and maximum of 67.5 man-days. The labor force was assigned for land preparation, cultivation, weeding, mulching and crop management, and harvesting of output. Sampled households, on average 6.39 oxen days with minimum of 4 oxen days and maximum of 18 oxen days for the production of *teff* during 2024 production season. In the study area farmers used both NPSB and UREA for *teff* production. Fertilizer was one of the inputs which help farmers to improve the production and productivity of their farm output. On average farmers used 92.43 Kg per ha and 70.18Kg per ha of NPSB and UREA respectively.

**Table 4.** Summary Statistics of Variables Used to Estimate the Production Function

Variable description	Minimum	Maximum	Mean	Std. deviation
Yield (Qt)/ha	2.00	25	11.48	0.405
Land (ha)	0.125	2.25	0.79	0.033
Seed (Kg)	3.5	30	13.93	0.423
Labor (MDs)	13.7	67.5	30.83	0.762
Oxen (Oxen days)	4	18	6.39	0.110
NPSB (Kg)	75	100	92.43	0.514
Urea (Kg)	50	100	70.18	1.131

Source: Author's survey data, 2024

As the production function, the mean and standard deviation of each of the variables used in the cost function along with their contribution to the total cost of production are depicted as follows:

**Table 5.** Summary statistics of variables used to estimate the cost function

Variable description	Mean	Std. deviation	Minimum	Maximum
Yield (Quintal)/ha	11.48	0.405	2	25

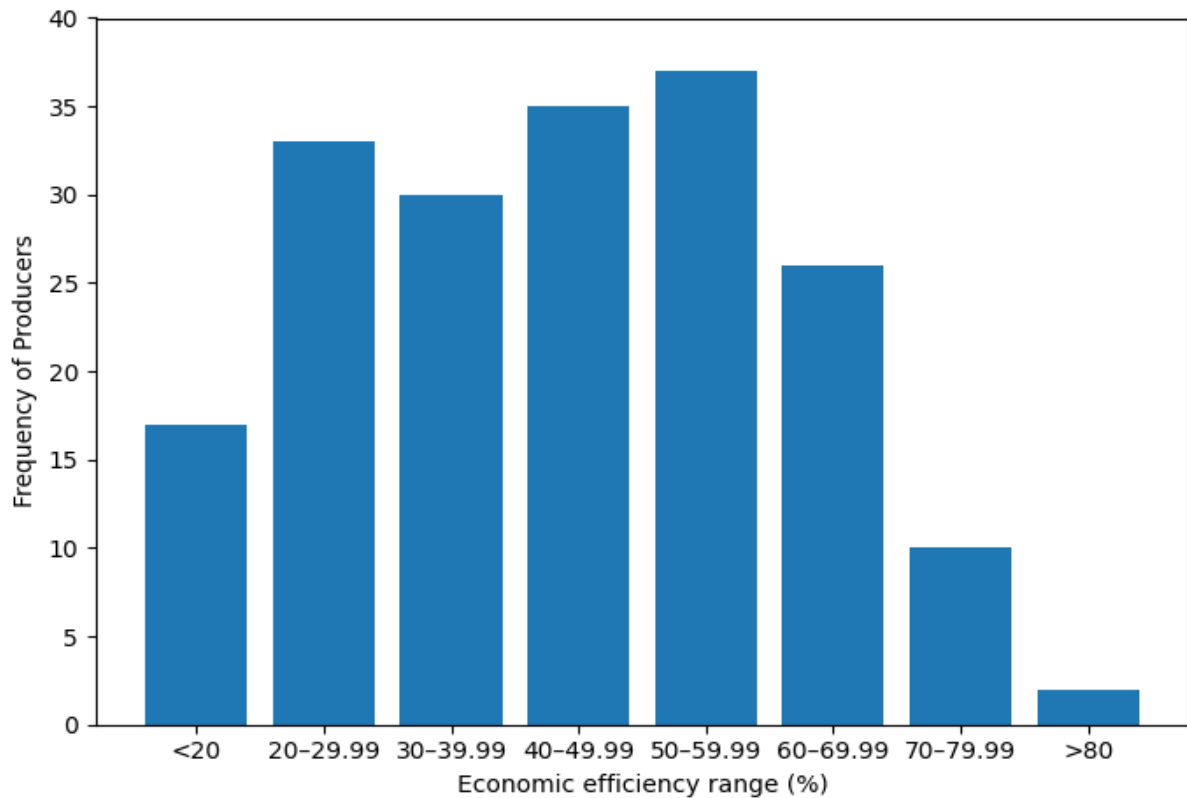
Total cost of production	4449.76	133.82	1989.12	16152.5
Cost of land (Birr)	127.83	4.56	40	494.5
Cost of seed (Birr)	290.34	14.34	133	1630
Cost of human labor (Birr)	1198.84	34.96	822	6750
Cost of oxen labor (Birr)	789.69	23.66	400	2700
Cost of NPSB (Birr)	1269.36	28.95	375	3656
Cost of urea (Birr)	973.70	27.35	219.12	3622

Source: Author's survey data, 2024

The total cost of 4449.76 was required to produce 11.48 quintals of *teff*. Among the various factors of production, the cost of labor accounted for the highest share (41.7%). Following the cost of labor, cost of NPSB takes major share out of total cost of production. Among other inputs, cost of land takes the smallest share (only 3%) share out of the total cost of *teff* production.

#### **Economic efficiency estimates**

The analysis from below figure1, shows that the majority of sample farmers of economic efficiency distribution scores level range from 10%-59.99% which were covers 77.84% from total sample respondents, whereas only 22.16% of sample farmers were producing above 60% level of efficiencies. These distribution of economic efficiency scores implies that the existence of economic inefficiency in *teff* production in the study area.



**Figure 1.** Distribution of Allocative Efficiency Scores

Source: Author’s survey data, 2024

### Sources of economic inefficiency in teff production

After estimating the level of economic efficiency and finding out sources causing inefficiency differentials among farmers, was the next most important objective of this study.

Before carrying out the analysis of sources of economic inefficiency different tests, like multicollinearity problem was computed to check, if the basic assumptions of a model were satisfied.

The multicollinearity problem was tested by using VIF. The test shows that all the VIF values are less than 10, which indicates that there is no serious multicollinearity problem among all hypothesized explanatory variables Table 6.

The results obtained from the Cobb-Douglas production function indicate that the average efficiency scores were low and there exists inefficiency variations among the *teff* growing farmers. To identify sources that explain variations of inefficiency across farmers the maximum likelihood estimate of the Tobit regression model was applied.

**Table 61.** VIF for the inefficiency variables entered into the efficiency model

No	Variable	VIF	1/VIF
1	Education level	1.83	0.546
2	Farm size	2.67	0.374
3	Extension contact	1.31	0.763
4	Livestock owners	1.27	0.787
5	Soil fertility	1.25	0.800
6	Off-farm income	1.36	0.735
7	Distance to market	2.28	0.438
8	Training	1.26	0.793
<b>Mean VIF</b>		<b>1.90</b>	<b>–</b>

Source: Author's survey data, 2024

Before discussing the significant sources that influence inefficiency in teff production, it is important to see how efficiency and inefficiency are interpreted. The result can be presented in terms of efficiency or in terms of inefficiency. The result in Table 6 is presented in terms of inefficiency and hence the negative sign shows the increase in the value of the variable attached to the coefficient means the variable negatively contributes to inefficiency level or conversely, it contributes positively to efficiency levels. Thus, any negative coefficient happens to reduce inefficiency, which implies its positive effect in increasing or improving the efficiency of the firm and vice versa.

**Level of education:** It had a significant impact with a negative expected sign on economic inefficiency at 5% significance level. A year increase in formal year of schooling of household heads decreased the probability of economic inefficiency by 5.4%. This implied that less educated farmers are not economically efficient than those that are relatively better educated. This could be because; educated farmers can use information from various sources and can apply the new information and technologies on their farm that would increase outputs of teff. In general, more educated farmers were able to perceive, interpret and respond to new information about use of fertilizers, pesticides and planting materials much faster than their counterparts. In line with this study, research done by [Endrias et al. \(2013\)](#), [Mesayet al. \(2013\)](#), [Michael and James \(2017\)](#).

**Soil Fertility:** It had a significant and negative influence on economic inefficiency level at 5% level of significance. This indicates that farmers having fertile land were more

efficient than those who have less fertile land. This may be associated with the fact that fertile lands require the application of lower amounts of fertilizer which leads to a reduction in cost and time, leading to a reduction in the inefficiency of farmers. This finding is similar to Tolesa, (2018); [Getachew, \(2018\)](#) and [Mekuriaw, \(2020\)](#).

**Livestock ownership:** It has negative and a significant impact on economic inefficiency at 10% significance level. This means that, farmers who increased their number of livestock holding by one TLU could decrease their economic inefficiency by 4.3%. The importance of livestock in the crop production system as source of draft power, income sources which help farmers to purchase agricultural input. The result also disclosed that farmers having largest number of livestock holding help to avoid cash constraint. This finding was in line with the result obtained from [Wassie \(2012\)](#), [Kifle \(2017\)](#).

**Farm size:** Total cultivated farm size by a household affected economic inefficiency level positively and significantly at 1% level of significance. As the total cultivated farm size of the farmers increase by a unit, the probability of economic inefficiency increase by 8.4%. This shows that a household operating on large area is less efficient than a household with small land holding size. As a result, with increase farm holding size the economic inefficiency of the farmer might increase. This finding was in line with results obtained by [Mwajombe and Mlozi \(2015\)](#) and [Kabiret al. \(2015\)](#).

**Off/non-farm income participation:** The result of this study revealed that engagement of off/non-farm income activities are affected technical and economic inefficiencies negatively and significantly at 5% and 10% significance level. This implies that compared to those farmers who had not participated on non-farm income activities, the economic inefficiency of farmers who had different non-farm income sources decreased by 5.8%. This indicated that, farmers used the income earned from different non-farm activities to cover their budget constraint to purchase the required farm inputs. This result was in line with the empirical study of [Solomon \(2012\)](#) and [Solomon \(2014\)](#).

**Extension contact:** As expected, the coefficient was negative and significantly affected the level of economic inefficiency at 10% level of significance. This might be due to the reason that, the information obtained from extension workers had a power to increase the awareness and know-how of farmers towards technologies and efficient utilization of the existing resource to decrease their inefficiency and wastage of resource use. As the extension workers frequently visit and follow up farmers more, farmers may obtain important and influential information to decrease their economic inefficiency level by 8.5%. This finding was in-line with [Mustefa \(2014\)](#).

**Access for training:** As expected it had negative and significant effect on economic

inefficiencies on teff production at 1% level of significance. This implied that compared to those farmers who had no access to farm training, the economic inefficiency of farmers who had access to training decrease by 7.2% .Hence that, farmers with training on teff tended to have lower inefficiency effects than farmers without training. That was, farmers with access to farm training were economically more efficient than farmers without access to training in teff production. This result was in line with the findings of [Getahun \(2014\)](#), [Birhan \(2015\)](#) and [Geda \(2014\)](#).

**Distance to the nearest market:** As expected, economic inefficiency were affected by distance from nearest market positively and significantly at 1% level of significance. As the distance to the nearest market from the farmer’s residence increased by 1 km, the economic inefficiency of farmer’s also increased by 5.6 %. This implies that since the farmers are far from market, their inefficiency increases because it incurs more cost to transport inputs and outputs, transaction costs and to get market information. The result was in line with [Tsegaye et al. \(2019\)](#) and [Gizachew et al. \(2018\)](#).

**Table 7.** Sources of Economic Inefficiencies

Inefficiency variables	Economic inefficiency	
	Marginal effect.	Std. error
Education Level	-0.054**	0.029
Soil fertility	-0.067**	0.056
Livestock owners	-0.043*	0.027
Farm size	0.084***	0.038
Off-farm income	-0.058*	0.026
Extension contact	-0.085*	0.074
Training	-0.072***	0.039
Distance to market	0.056***	0.027

Source: Author’s survey data, 2024

\*\*\*, \*\*, \* refers to 1, 5 and 10% level of significance, respectively.

## CONCLUSION

This study set out to evaluate the economic efficiency of smallholder teff producers in Gombora Woreda, Hadiya Zone, and to identify the socio-economic and institutional factors contributing to inefficiency. In doing so, it fills an important empirical gap in the existing literature on cereal productivity in Ethiopia and directly responds to the key research questions and objectives. It also provides a realistic and evidence-based foundation for future policy actions aimed at improving resource use efficiency and boosting agricultural output in the study area. The analysis was conducted using primary cross-sectional data collected from 185 randomly selected teff-producing households. A two-stage sampling technique was applied to ensure representative data collection. A Stochastic Frontier Production (SFP) function was estimated to determine economic efficiency scores, while a Tobit regression model was used to

identify the determinants of inefficiency. The findings revealed a considerable variation in economic efficiency among teff producers. The average economic efficiency was found to be 41.9%, implying that there is potential to increase output by as much as 58.1% if producers operated at full efficiency, using available resources and current technologies more effectively. This finding underscores the existence of significant untapped potential in teff production and points to critical inefficiencies that need to be addressed. The stochastic production frontier model showed that inputs such as labor, land, oxen power, NPSB fertilizer, UREA, and seed were positively and significantly associated with teff output, suggesting that increased investment in these inputs would likely result in higher productivity. The Tobit regression analysis identified several key variables that significantly influenced the level of economic inefficiency among farmers. Education level, soil fertility, livestock ownership, participation in off-farm income activities, access to training, and frequency of extension contact were all found to reduce inefficiency. Conversely, farm size and distance to the nearest market had a positive and statistically significant effect on inefficiency, meaning they are associated with a decline in economic efficiency. These findings suggest that inefficiencies are not solely the result of input shortages, but also stem from disparities in access to information, education, infrastructure, and institutional support. Therefore, improving economic efficiency requires both resource-based and institutional interventions. In sum, this study not only quantified the economic efficiency of teff production but also provided a rigorous diagnosis of the key drivers of inefficiency. The findings point to substantial room for improvement through better education, infrastructure, institutional support, and policy coordination. If translated into action by the responsible bodies including the Ministry of Agriculture, local governments, extension services, and development partners these recommendations have the potential to significantly enhance teff productivity, improve rural livelihoods, and contribute to broader agricultural development goals in the study area.

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