Technical efficiency of *Teff* producer farmers in Raya Kobo district, Amhara National Regional State, Ethiopia

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*Cogent Food & Agriculture* (2021), 7: 1865594
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Abstract: Teff is among the most widely grown cereal crop in Ethiopia and important in national food security. The study aimed to measure technical efficiency and sources of inefficiencies of teff producer farmers. Primary data was collected from 146 farmers selected by a three-stage sampling technique. A one-stage estimation approach of the stochastic frontier model was used. The stochastic frontier model result indicated that labor, oxen power, land allocated for teff, seed rate, and interaction of land and labor significantly affect output of teff. In addition, 96.5% of teff output variation from the frontier was attributed to technical inefficiency.

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PUBLIC INTEREST STATEMENT
Teff is among the most widely grown cereals in Ethiopia. It is a staple diet for the majority of the population and important in the national food security. Production and productivity can be boosted either through increased use of inputs and/or improvement in technology or by improving the efficiency of farmers given fixed level of input and technology. Given resource constraints of smallholder farmers in the country, it is difficult to adopt new technology to enhance productivity. In addition, in areas where there is inefficiency, trying to introduce new technology may not have the expected effect to increase productivity if existing technology is not efficiently utilized. Hence, working to improve production efficiency is best option on hand. Based on technical efficiency analysis in Raya Kobo District there is a possibility to increase teff output at the existing technology and input levels.
The mean technical efficiency of farmers was 76.4% indicating that in the short-run technical efficiency could be increased by 23.6% through better use of labor, oxen power, land allocated for teff, and seed. Moreover, the result of the inefficiency model confirmed that technical inefficiency of teff production was negatively affected by early harvesting, the experience of farmers, use of the improved seed, and education level of farmers while positively affected by the participation of farmers in non/off-farm activities, distance to district market and lodging. The finding implies that strengthening awareness to use improved seed; the need to strengthen informal education, experience sharing of farmers and development of market infrastructure, non/off-farm activities should be done during off-seasons and strengthen the extension service to let farmers use the recommended crop husbandry practices.

Subjects: Agriculture & Environmental Sciences; Environment & Resources; Environment & Society; Environment & Economics; Development Studies; Development Policy; Economics and Development; Economics; Environmental Economics; Business, Management and Accounting

Keywords: Stochastic frontier; Cobb-Douglas production function; Teff; Raya Kobo

1. Introduction

Teff [Eragrostis teff (Zucc.) Trotter] is originated in Ethiopia (Vavilov, 1951) and extensively cultivated cereal crop in Ethiopia (CSA [Central Statistical Agency], 2019). Teff is also known to be tolerant to extreme climatic and soil conditions; hence, it is a favorite crop in the semi-arid areas with moisture limitations (Tadele & Assefa, 2012). In recent years, teff is receiving global attention for its nutritional and health-related benefits (Provost & Jobson, 2014). It is an important cereal crop providing the livelihoods for the majority of smallholder farmers and a strategic crop with the potential to enhance commercialization of smallholder agriculture and improve food security in Ethiopia. In Ethiopia, Teff is mainly produced in Amhara and Oromia National Regional State (Kebebew et al., 201, CSA [Central Statistical Agency], 2019) and it is estimated to be the most important crop in Ethiopia’s agricultural and food economy (Hassen et al., 2018). Teff accounts more than 3 million hectare of grain crop area and as to production it accounts more than 54 million tone and over 6.5 million farmers grow teff, which is a major staple food for Ethiopians and important in the national food security (CSA [Central Statistical Agency], 2019).

The national productivity of teff in Ethiopia is about 1.756 tone/hectare. In Amhara Region from the total cereal crop area, teff accounts more than 1 million hectare and in terms of production it accounts more than 2 million tone. In addition, more than 2 million farmers are producing teff in the region and the productivity of teff is 1.8 tone/hectare. In North Wollo Zone from the total area of cereal crops teff accounts 31.6% and in terms of production, it accounts 27.6%. The Zonal average productivity of teff is 1.392 tone/hectare (CSA [Central Statistical Agency], 2019). According to the Raya Kobo District Office of Agriculture (2019a) report, from the total-cultivated land for teff production in North Wollo Zone, Raya Kobo district accounts 24%, from the total area of crop cultivation in the District teff accounts 32% and the productivity is 1.5 tone/hectare.

Although teff is the most important single crop by total-cultivated area in Ethiopia, its importance in agricultural production is far less. This is due to the relatively low yields of teff compared with most other crops, especially other cereals. The national productivity of teff is very low at around 1.8 tone/hectare (CSA [Central Statistical Agency], 2019), with the highest productivity farmers achieving 2.5 tone/hectare and research field trials of teff reaching 40-50 tone/hectare (Fufa et al., 2011). Hence, the result indicates the possibility of increasing teff productivity, if farmers improve inefficiencies. Compared to the teff producing zones of Amhara National Regional State, the productivity of teff in
North Wollo Zone is less except Wagihmra and Awi Zones (CSA (Central Statistical Agency), 2015). Raya Kobo district is the potential district of North Wollo Zone for teff production. However, the productivity of teff in the district is less by 0.3 tone/hectare and 0.256 tone/hectare than from Amhara National Regional State and the national teff productivity, respectively.

The problem of low agricultural productivity remains a major challenge to the overall development process with specific regard to food security in Ethiopia. According to Nisrane et al. (2015), performance in output-oriented technical efficiency is low and the relative total factor productivity levels could be nearly triple with the removal of inefficiency. Even if, teff is both a staple food for the population and source of cash for farmers in the district the productivity is generally low. In areas where there is limited resource and production inefficiency, trying to introduce new technology may not have the expected effect to increase productivity. In order to enhance teff productivity by adopting new technologies, it is important to know the technical efficiency of farmers. Hence, this research is conducted to determine the level of technical efficiency and identify sources of technical inefficiency of teff producer farmers in Raya Kobo district, North Wollo Zone.

2. Research methodology

2.1. Description of the study area

The study was conducted in Raya Kobo district which is shown in Figure 1 bellow. It is located in the North Eastern part of Amhara National Regional State, North Wollo Zone, Ethiopia. Based on CSA population projection, the district has a total human population of 260,170 in 2014 of which 130,772 (50.26%) are male and 129,398 (49.74%) are female (CSA (Central Statistical Agency), 2013). According to Raya Kobo District Office of Agriculture (2019a) and CSA (Central Statistical Agency) (2019), the district agroclimatic zone is classified into Dega (7.9%), Woinadega (37.2%)
and Kola (54.9%). The district is moisture stress characterized by low and erratic rainfall with mean annual rainfall of 670 mm. Moreover, the population's livelihood mainly consists of both crop and livestock production. The district is one of the major teff growing district of North Wello Zone. The total-cultivated land of the district is 47,784 hectare and among this 15,728.25 hectare is cultivated for teff production. The average productivity of teff during 2019 production year is 1.5 ton/ha. The average-cultivated land size is 0.75 ha and the average fragmentation is 3 plots. The source of labor for crop production is both family and hired labor. Different types of local teff varieties are cultivated in the district such as Magna, Tikurie, Bunign, Sergegna, and improve variety such as Zoble, Quncho and Boset.

3. Data types, sources and methods of collection
In this study, both primary and secondary data were used. Primary data were collected from cross-sectional survey of household head during 2014/15 production year using semi-structured questionnaire. Enumerators were recruited to collect the primary data and the researcher assists and supervise them to collect the required data. The selected enumerators were trained on the techniques of administering the survey. Published or unpublished data were collected from Raya Kobo agricultural office, North Wollo Zone agricultural office and Central Statistical Agency of Ethiopia.

4. Sampling technique and sample size
The study followed three-stage sampling technique where a combination of purposive and simple random sampling technique were used to select the district and sample household heads. Out of the 11 districts in North Wello Zone, Raya Kobo district was purposively selected due to long year experience in teff production and extent of teff production in North Wollo Zone. In the first stage, out of the three agro-ecologies of the district kola was selected purposively due to the major teff production part of the district. In the second stage, out of the total 24 kola kebeles, 4 kebeles were selected by simple random sampling. In the third stage, 146 sample teff producer farmers were selected using simple random sampling technique from each selected kebeles based on probability proportion to size sampling technique.

The sample size for the study was determined based on Taro (1967) since the population is homogenous in agro-ecology and production system. The simplified formula provided by Yamanes is used to determine the required sample size at 91.75% confidence level and 8.25% level of precision. The simplified formula used to determine the sample size of the study was specified as follows:

\[ n = \frac{N}{1 + N(e^2)} \]

Where: \( n \) = sample size; \( N \) = total number of teff producer farmers in kola kebeles (21,049); \( e \) = level of significance (8.25%). Based on this, the total sample size of the study was 146 farmers. The distribution of sample teff producer farmers across the sample kebeles based on the proportion to their total sizes is given in Table 1 below.

| Sample kebeles | Total number of teff producer farmers | Sample size | Number Proportion |
|----------------|--------------------------------------|-------------|------------------|
| Mendefera      | 1806                                 | 33          | 22.6%            |
| Aradum         | 1522                                 | 28          | 19.2%            |
| Robit          | 2092                                 | 39          | 26.7%            |
| Kobo zuria     | 2473                                 | 46          | 31.5%            |
| Total          | 7,893                                | 146         | 100%             |

Source: District Agricultural Office and own computation, 2015
5. Methods of data analysis
Both descriptive statistics and econometric models were used to analyze the data. The parametric stochastic efficiency decomposition approach, in which an additional random error $v_i$ is added to the non-negative random variable, $u_i$ specified as follows:

$$y_i = f(x_i; \beta) + v_i - u_i$$

Where:

- $i$—is the number of farmers
- $y_i$—is teff output measured in quintal
- $x_i$—is a vector of input quantities used by the $i^{th}$ sample farmers
- $\beta$—is a vector of unknown parameter to be estimated
- $f(.)$—is Cobb-Douglas production function
- $v_i$—is the random error term, independently and identically distributed as $v_i \sim N(0, \sigma^2_v)$ is intended to capture events beyond the control of farmers
- $u_i$—It is a non-negative random variable as $u_i \sim N(0, \sigma^2_u)$ is intended to capture technical inefficiency of the $i^{th}$ farmer.

Output-input data were transformed into linear by using natural logarism since Cobb-Douglas is not linear in parameters. Cobb-Douglas production function was selected based on log likelihood ratio test. The empirical model was specified as follows.

$$\ln output_i = \beta_0 + \beta_1 \ln seedrate_i + \beta_2 \ln urea_i + \beta_3 \ln dap_i + \beta_4 \ln land_i + \beta_5 \ln oxenpower_i + \beta_6 \ln chemical_i + \beta_7 \ln labor_i + \beta_8 \ln labor + \ln land_i + \beta_9 \ln land + \cdots + v_i - u_i$$

Where the subscript $i$ refer to the number of the $i^{th}$ sample farmer; $\ln$ is natural logarism; seed rate is the amount of seed farmers sowed during 2014/15 production year; urea is the amount of nitrogen fertilizer applied; dap is the amount of Di-ammonium phosphate fertilizer applied; chemical is the amount of pesticide and herbicide chemicals applied; land is cultivated land allocated for teff production, oxen power is oxen days farmers use to plough teff land, labor is man equivalent used in teff production.

The inefficiency model were specified as follows.

$$u_i = \delta_0 + \delta_1 education_i + \delta_2 land size_i + \delta_3 tropical livestock unit_i + \delta_4 extension contact + \delta_5 training + \delta_6 improved seed + \delta_7 soil fertility + \delta_8 off farm + \delta_9 distance to market + \delta_{10} lodging + \delta_{11} harvesting time + \delta_{12} experience of teff production + \delta_{13} crop rotation + \delta_{14} sex$$

In efficiency analysis, Battese and Coelli (1995) suggests two-stage and one-stage estimation approaches will be used to identify factors that affect technical efficiency based on stochastic production function. In contrast to two-step methods, one-step approach estimate the standored model and the effects of inefficiency variables on efficiency simultaneously. According to Wang and Schmidt (2002) the two-step procedures have sources of bias. These biases are substantial enough that two-step approach is not recommended against using one-step approach in identifying factors affecting technical inefficiency. Hence, in this study a single step estimation approach was used to estimate the level of technical efficiency and to identify factors affecting technical inefficiency of teff production simultaneously.
Table 2. Summary of input and inefficiency variables used in the econometric model

| Dependent variable | Explanatory variables | Measurement unit | Expected sign |
|--------------------|-----------------------|------------------|---------------|
| Output             | Labor                 | Manday equivalent | +             |
|                    | Land*Labor            | Hectare*manday equivalent | ±            |
|                    | DAP fertilizer        | Kilo gram         | +             |
|                    | Chemicals             | Liter             | +             |
|                    | Urea fertilizer       | Kilo gram         | +             |
|                    | Seed rate             | Kilo gram         | ±             |
|                    | Land size for teff    | Hectare           | +             |
|                    | Oxin power            | Oxen day          | +             |
| Technical inefficiency | Sex of the household head | Dummy | -             |
|                    | Education level of household head | Year of formal schooling | - |
|                    | Cultivated land other than teff | Ha | -/+           |
|                    | Size of Livestock holding | TLU | -/+           |
|                    | Extension contact     | Frequency         | -             |
|                    | Training              | Dummy             | -             |
|                    | Use of improved seed  | Dummy             | -             |
|                    | Soil fertility status | Dummy             | -             |
|                    | Participation of household heads in non/off-farm activities | Dummy | -/+ |
|                    | Distance to district market | Hour | + |
|                    | Lodging of teff      | Dummy             | +             |
|                    | Harvesting time of teff | Dummy | - |
|                    | Crop rotation        | Dummy             | -             |
|                    | Experience in teff production | Years | - |

The final one-stage estimation empirical model was specified as follows.

\[
\text{In output}_i = \beta_0 + \beta_1 \text{ In seed rate}_i + \beta_2 \text{ In urea}_i + \beta_3 \text{ In dap}_i + \beta_4 \text{ In land}_i + \beta_5 \text{ In oxen power}_i + \beta_6 \text{ In chemical}_i + \beta_7 \text{ In labor}_i + \beta_8 \text{ In labor + land}_i + \nu_i - (\delta_0 + \delta_1 \text{ education} + \delta_2 \text{ land size} + \delta_3 \text{ tropical livestock unit} + \delta_4 \text{ extension contact} + \delta_5 \text{ training} + \delta_6 \text{ improved seed} + \delta_7 \text{ soil fertility} + \delta_8 \text{ off farm} + \delta_9 \text{ distance to market} + \delta_{10} \text{ lodging} + \delta_{11} \text{ harvesting time} + \delta_{12} \text{ experience of teff production} + \delta_{13} \text{ crop rotation} + \delta_{14} \text{ sex}) + \epsilon_i
\]

Where \(\beta_1, \ldots, \beta_8\) are coefficients of input variables, \(\delta_1, \ldots, \delta_{14}\) are coefficients of inefficiency variables and \(\epsilon_i\) is the disturbance term included in the model. The model generates variance parameters that is lambda (\(\lambda\)), variance of the model sigma (\(\delta\)), variance of the stochastic model (\(\delta^2\)) and variance of the inefficiency model (\(\delta^2\)).

The presence of technical inefficiency was tested with log-likelihood ratio test in which the null hypothesis (\(H_0; \gamma = 0\)) and the alternative hypothesis (\(H_1; \gamma \neq 0\)) using the log-likelihood values of the inefficiency component. The discrepancy ratio (\(\gamma\)) can be calculated by
Table 3. Maximum Likelihood Estimate of Cobb-Douglas Production Function

| Variables       | Coefficients | Standard Error |
|-----------------|--------------|----------------|
| Intercept       | 2.3***       | 0.143          |
| Seed rate       | -0.04**      | 0.012          |
| Urea fertilizer | 0.001        | 0.003          |
| DAP fertilizer  | 0.007        | 0.005          |
| Oxen power      | 0.002*       | 0.0009         |
| Land            | 0.18*        | 0.105          |
| Chemical        | 0.005        | 0.011          |
| Land*Labor      | -0.05**      | 0.023          |
| Labor           | 0.14***      | 0.029          |

Model Diagnostic Statistics

|                      |               |
|----------------------|---------------|
| Total variance       | 0.037***      |
| Gamma                | 0.965***      |
| Lambda               | 5.26          |
| Log likelihood function | 173.5        |
| Wald ch2(7)          | 183           |
| Total number of observation | 146         |
| Mean technical efficiency | 76.4%        |

* , ** and *** denote significant at 10%, 5%, and 1% level of significance, respectively.
Source: model output, 2015

Table 4. Actual and potential teff productivity of sample farmers

| Statistics        | Actual yield | Potential yield |
|-------------------|--------------|-----------------|
| Mean              | 13.85        | 18.1            |
| Standard deviation| 2.3          | 2.3             |
| Minimum           | 8.6          | 11.03           |
| Maximum           | 18.4         | 21.8            |

Source: Own survey data, 2015

Table 5. Summary of estimated technical efficiency of sample farmers

| Statistics        | Technical efficiency scores |
|-------------------|-----------------------------|
| Mean              | 76.4%                       |
| Minimum           | 64.3%                       |
| Maximum           | 92.7%                       |
| Standard deviation| 5.1%                        |
| Skewness          | 0.34                        |
| Kurtosis          | 3.6                         |

Source: Own survey data, 2015

\[ \gamma = \frac{\delta_u^2}{\delta^2} \text{ where } \delta^2 = \delta_u^2 + \delta_v^2 \]

The \( \gamma \) parameter has a value between 0 and 1. A value of 0 for \( \gamma \) indicates that deviation of teff output from the frontier output are entirely due to random noise, while a value of 1 indicates that all deviations from the frontier are due to technical inefficiency. The variables used to fit Cobb-Douglas stochastic frontier production model were selected based on reviewing empirical studies done on technical efficiency of cereal crop production in general and teff production in particular.
Technical inefficiency of teff production depends on demographic and socioeconomic characteristics, farm attributes, institutional factors and crop-specific factors. The expected effect of input and inefficiency variables on output and technical inefficiency was hypothesized as follows.

6. Definition of variables and working hypotheses

7. Result and discussion

7.1. Productivity analysis

The input and inefficiency variables used to estimate technical efficiency and to identify sources of technical inefficiency are shown in Table 2. The model result, as presented in Table 3, shows that the variance of the technical inefficiency parameter gamma is 0.965 and significantly different from zero at 1% level of significance. The result revealed that 96.5% of variation in teff output from
the frontier among sample farmers was due to difference in technical inefficiency whereas the remaining 3.5% was due to random noises that are beyond the control of farmers. The result confirms presence of opportunity to increase teff output in the district by improving technical efficiency of farmers at the current level of input and technology. The result is similar with Bachew et al. (2018) that indicates the current relative total factor productivity levels can nearly triple with removal of inefficiencies and despite differences in magnitudes there is a significant potential for increase in output produced on current acreage if inefficiencies are removed. Among input variables used in Cobb-Douglas stochastic production function seed rate, land, labor, oxen power, interaction of land and labor had significant effect in explaining variation in teff output among sample farmers. The model result revealed seed rate, labor, land, oxen power and interaction of land and labor affects output of teff significantly. The positive elasticity of inputs implies any intervention that improves the use of that input would give significant improvement in teff output while negative coefficient of input lower output of teff.

The result in Table 3 confirms that labor measured in man equivalent has positive coefficient as expected. Labor has significant effect on teff output at 1% level of significance. According to the finding, a 1% increase in the quantity of labor in terms of man equivalent significantly increase teff output by 0.14% keeping other inputs constant. Similarly, the coefficient for land was positive as expected and significant at 10% level of significance, which implies a 1% increase in land increases output of teff by 0.18% keeping other inputs constant.

In addition, the coefficient of oxen power was positive and significant at 10% level of significance. The result indicates a 1% increase in oxen power increase output of teff by 0.002% assuming other inputs constant. The coefficient of seed rate was negative and significant at 5% level of significance. The negative elasticity of seed rate implies that over utilizing of seed or farmers sowing seed rate above the recommended level. The result confirmed a 1% reduction in seed rate up to the recommended level improves output of teff by 0.04% assuming other inputs constant. Finally, the coefficient of interaction terms of land and labor had negatively and significantly affects teff output at 5% level of significance. The result implies a 1% decrease in both land and labor will increase teff output by 0.05% assuming other inputs constant.

8. Actual and potential level of teff yield
The potential teff output was estimated for sample teff producer farmers by dividing the actual individual level of teff output by the predicted technical efficiency scores from stochastic frontier model. The result in Table 4 shows that, the average amount of actual and potential teff output during 2014/15 production year was 13.85 qt/ha and 18.1 qt/ha, respectively. The result indicated actual teff output was lower than the North Wollo Zone of 13.92 qt/ha and the national average of 15.75 qt/ha in 2015 (CSA (Central Statistical Agency), 2013). The result indicated in the short run there is a potential to increase teff output on average by 4.25 qt/ha at the existing input use and technology through improving technical efficiency of farmers.

9. Technical efficiency in teff production
The result in Table 5 indicates mean technical efficiency of sample farmers was 76.4% with a standard deviation of 5.1%. The result confirmed if the average farmer in the sample was to achieve the technically efficient level of its most efficient counterpart, then the average farmer could entertain 23.6% increase in teff output by improving only technical efficiency with existing input use and technology. The mean technical efficiency is comparable with the result of similar studies in Ethiopia. For example, Kassa et al. (2019) found that teff producers in Ethiopia are technically inefficient that is their mean efficiency is 73%; Hailu et al. (2015) found that the mean technical efficiency of teff production in Ethiopia was 75% while Hagos (2014) indicated that mean technical efficiency of teff production in Central Zone of Tigray Region was 99.2%.

Regarding the frequency distribution of technical efficiency of teff production, the result in Table 6 shows that, about 50% of the sample farmers operated above the mean technical efficiency and the
rest 50% operated below the mean technical efficiency level. The frequency distribution of technical efficiency of teff production indicated that significant number of teff producer farmers lie around the mean technical efficiency.

The coefficients of hypothesized technical inefficiency variables included in the technical inefficiency model were estimated simultaneously (one-step approach) with Cobb-Douglas stochastic production function by the maximum likelihood method as shown in Table 7. The dependent variable in the inefficiency model of stochastic frontier model is technical inefficiency.

There is statistically significant and negative relationship between experience of household heads and technical inefficiency of teff production at 5% level of significance. The negative effect of experience on technical inefficiency of teff production is consistent with the expected hypothesis. The result indicated that as experience of farmers increases their technical inefficiency level decreases. There is statistically significant and negative relationship between education level of household heads and technical inefficiency of teff production at 5% level of significance. The result indicated that more educated household heads can understand agricultural advice easily, perceive, interpret and respond to new information, have higher tendency to adopt improved agricultural technologies compared to less educated or uneducated household heads.

The finding of the study indicated non/off-farm activities affect technical inefficiency of teff production positively at 1% level of significance. The result revealed participant household heads in non/off-farm activities had higher technical inefficiency in teff production than those who had not participate. On the other hand, distance to district market affects technical inefficiency of teff production positively and significantly at 1% level of significance. The result confirmed that farmers whose residence is far from the district market had more inefficient than those whose residence is nearer to the district market. The finding is consistent with the result of Gebregziabher et al. (2012) and Nisrane et al. (2012). In addition, use of improved teff seed had negatively and significantly affects technical inefficiency of farmers at 5% level of significance. The result is in line with the finding of Assefa et al. (2011) and Elias et al. (2014).

The finding of the study confirmed that lodging positively and significantly affects technical inefficiency of teff production at 1% level of significance. The result implies that lodging of teff decreases production and productivity. The result is consistent with Assefa et al. (2011) and Fufa et al. (2011). More over the result shows a negative and significant relationship between early harvesting and technical inefficiency of teff production at 1% level of significance. The result is in line with Ketema (1997) and Fufa et al. (2011).

10. Conclusion and recommendation
The result of stochastic frontier model indicated that mean technical efficiency of farmers was 76.4% with a minimum of 63.4% and a maximum of 92.7%. The result confirmed that on average farmers could increase teff output by 23.6% through better use of significant variables in the short run without changing input and existing technology. The average level of actual and potential teff output during 2014/15 production year was 13.85 qt/ha and 18.1 qt/ha, with a standard deviation of 2.3 qt/ha. The result indicated in the short run there is a potential to increase teff output on average by 4.25 qt/ha at the existing input use through improving only technical efficiency. The stochastic frontier model output indicated that teff output was significantly affected by land, labor, oxen power, seed rate and interaction of land and labor. The inefficiency model confirmed that early harvesting, education level of household heads, use of improved teff seed and experience of farmers were negatively and significantly affects technical inefficiency of teff production while participation of farmers in non/off-farm activities, distance to district market and lodging were positively and significantly affects technical inefficiency of teff production. The conclusion stemming from this study is that their exist a considerable room to reduce the level of technical inefficiency of teff in Raya Kobo district. Based on the empirical result, researchers, agricultural office of the district and extension agents should focus on the significant variables to enhance smallholder production and technical efficiency of teff in the study area.
Funding
This work was supported by the Ministry of Science and Higher Education of Ethiopia [SGS 1830/07].

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Citation information
Cite this article as: Technical efficiency of Teff producer farmers in Raya Kobo district, Amhara Regional State, Ethiopia. Zinabu Tesfaw, Lemma Zemedu & Bosena Tegeng, Cogent Food & Agriculture (2021), 7: 1865594.

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