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Economic efficiency in maize production in Ilu Ababor zone, Ethiopia

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Abstract

The agriculture is the backbone of Ethiopian economy, but its performance is unsatisfactory and food production stood at behind the population growth. Improving productivity through introduction of modern technologies and/or improving the efficiency of inputs will be an important alternative to fill the gap between demand and supply. However, as the potential to increase production by obtaining new technologies became more and more limited due to shortage of resource, the efficiency of the farmer that they cannot use the available resources has received the greatest attention. Maize is a leading crop in production and contributes a greatest share in the Ethiopian economy, increasing its productivity and efficiency of inputs in its production could be considered as an important base in bringing food security. Therefore, the current study is aimed at analysing the economic efficiency in maize production in Ilu Ababor Zone of Oromo Regional State using cross sectional data collected from randomly selected 240 sample households during 2014/15 production season. Cobb-Douglas production function was fitted using stochastic production frontier approach to estimate the efficiencies levels, whereas Tobit model is used to identify determinants that affect efficiency levels of the sample farmers. The estimated results showed that the mean technical, allocative and economic efficiencies were 81.78%, 37.45% and 30.62% respectively. It indicated that there was significant inefficiency in maize production in the study areas. Among 13 explanatory variables hypothesised to affect the level of efficiencies, education level of the sample household was the most important factor that found to be statistically significant to affect the level of technical, allocative and economic efficiency all together. Whereas, land fragmentation and soil fertility were the major factors that affect the level of technical efficiency. Besides, land fragmentation, livestock ownership and frequency of extension contact were important factors that affect allocative efficiency of farmers in the study area. The results also further revealed that extension contact was the most important factor that found to be statistically significant to affect economic efficiency. However, the sign of the coefficients for extension contact in allocative and economic efficiencies was not as expected. The result showed that in study area, there is an opportunity to increase the economic efficiency in maize production. Hence, in order to increase the economic efficiency level in maize production, all concerned bodies and stakeholders should give due attention in determining coping up mechanism to significant determinants.

Keywords: Smallholder, Maize-efficiency, Cobb-Douglas, Stochastic-frontier, Tobit.

Introduction

Agriculture is the primary activity in Ethiopia It employs about 84% of total labour force, contributes about 42% to the country's GDP and 90% of exports[1]. The sector plays a pivotal role to induce the industrialization process in the country. However, still now the country is food insecure mainly due to lack of improved technology and economic inefficiency in production. The smallholder farmers, who are providing the major share of the agricultural output in the country, commonly employ backward production technology and limited modern inputs[2]. Thus, adopting new technologies and use of modern input to improve agricultural production and productivity is the basic strategies of the Ethiopian government. Besides, for developing country like Ethiopia food self-sufficiency can be realized by enhancing crop production and productivity. The principal cereal crops grown in Ethiopia are teff, wheat, barley, maize, sorghum and millet[3]. Maize is the most widely distributed cereal crop in the world. In developed countries, 70% of maize is destined for feed, 3% consumed directly by humans and the remaining uses for bio-fuels, industrial products and seed. While in Sub-Saharan Africa outside of South Africa, 77% of maize is using as food and only 12% serves as feed.

Among crops grown in Ethiopia, maize (Zea mays L.) is the most important cereal crop in terms of total production, area coverage and better availability and utilization of new production technologies[1]. It is the highly demanded food crop in the study area as well as in the South-western part of Ethiopia. A number of studies have been conducted on efficiencies of smallholder farmers in Ethiopia. However, they were limited to the study on technical efficiency even though the overall crop efficiencies achieved by studying economic efficiency[4,5]. To the best of our knowledge, there has been no similar study conducted on economic efficiency of maize producers in the study area.

Objectives of the study: The general objective of this study was to analyze economic efficiency in maize production in Ilu Ababor Zone. Specifically: i. To estimate the level of technical, allocative and economic efficiencies in maize production. ii. To identify the major determinants that affect efficiencies in maize production in the study area.

Methodology

Sampling Technique and Sample Size: Ilu Ababor zone is selected purposively due to the presence of large number of maize producing households and a thematized research area for Mettu University. Then, a two stage stratified random sampling procedures were employed in order to determine the sample districts and households. Six districts selected as a study area, which are producing maize commercially. In the second phase, 240 households are selected randomly using simple random sampling technique from each district proportional to the total number of households of the districts. The sample size was determined based on the following formula.

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

Where: n is sample size, N is number of household head and e is the desired level of precision. By taking e as 6.4%, total number of household head 60,154 the sample size would be 243. However, data is gathered from 240 households. The distribution of sample size in accordance with the size of the districts in Table-1.

Table-1: Total number of sample household heads of the selected districts.

Districts	Total household heads	Sample
Cheweka	12,140	48
Bedele	13,100	52
Bure	10,300	50
Dega	8,050	30
Uka	8,260	30
Darimu	8,150	30
Total	60,154	240

Methods of data analysis: To address the objectives of the study, both descriptive and econometric methods of data analysis were used. In the descriptive part, mean, standard deviation, frequency and percentages were employed; where as in the econometric analysis, a stochastic production frontier approach were utilized to estimate the level of economic efficiency in maize production and the relation between hypothesized variables and farm level efficiencies were analyzed using the tobit model.

Efficiency estimation: Due to its sensible advantages over the other methods that are usually used in efficiency analysis, the stochastic production frontier approach was employed to estimate the level of efficiency. Besides, It is does not postulate deviation from the frontier is due to inefficiency as assumed by DEA. Furthermore, it introduces the disturbance term representing noise, measurement error and exogenous shocks that are beyond the control of a single unit and a component that captures deviations from the frontier due to inefficiency. Most available data on production are likely to be subject to measurement errors. Thus is why the stochastic production frontier was chosen as more appropriate methodology for this study.

The stochastic frontier production function can be written as:

$$Y_i = F(X_i;\beta)\exp(V_i - U_i) \quad I = 1, 2, 3,... n$$

Where: Y_i is the production of the i^{th} farmer, X_i is a vector of inputs used by the i^{th} farmer, β is a vector of unknown parameters, V_i is a random variable which is assumed to be N $(0, \sigma_v{}^2)$ and independent of the U_i which is nonnegative random variable assumed to account for technical inefficiency in production. Stochastic production frontier approach requires a prior specification of the functional form[3]. Therefore, for this study, Cobb-Douglas production function was selected.

Cobb-Douglas production function is selected for this study for several reasons. Foremost it was selected due to its simplicity and the logarithmic nature of the production function that makes econometric estimation of the parameters a simple matter. It is also very parsimonious with respect to degrees of freedom and it is convenient in interpreting elasticity of production. Besides, according to Coelli[6], in smallholders farming, the technology is unlikely to be substantially affected by variable returns to scale and therefore it is better to use Cobb-Douglas production function than translog function. Furthermore, computational advantage is provided to obtain the estimates of Technical and Economic efficiency. However, according to Kopp and Smith[8], functional specification has only a small impact on measuring efficiency as cited by Mustafa[3].

The linear functional form of Cobb Douglas production function used for this study is given by:

$$\text{In (output)} = \beta_0 + \beta_1 \ln(\text{AREA}) + \beta_2 \ln(\text{DAP}) + \beta_3 \ln(\text{UREA}) + \beta_4 \ln(\text{SEED}) + \beta_5 \ln(\text{LEBOUR}) + \beta_6 \ln(\text{OXEN}) + v_i - u_i$$

For driving the dual cost frontier, the following equation was employed.

$$\underset{x}{MinC} = \sum_n \omega_n x_n$$

Subject to (12)

$$Y_k^{i*} = \hat{A}\prod_n x_n^{\hat{\beta}_n}$$

Where: $\hat{A} = exp(\hat{\beta}_0)$, ω_n = input prices, $\hat{\beta}$ = parameter estimates of the stochastic production function and Y_k^{i*} = input oriented adjusted output level from Equation 11.

In the equation 12, by substituting we will get dual cost function by minimizing input quantities as follows

$$C(Y_k^{i*}, w) = HY_k^{i*\mu} \prod_n \omega_n^{\alpha_n} \quad (13)$$

Where: $\alpha_n = \mu \hat{\beta}_n$, $\mu = (\sum_n \hat{\beta}_n)^{-1}$ and $H = \frac{1}{\mu}(\hat{A}\prod_n \hat{\beta}_n^{\hat{\beta}_n})^{-\mu}$

Generally, the dual cost frontier function can be represented in general form as follows:

$$C_i = C(\omega_i, Y_i^{i*}; \alpha) \quad (14)$$

Where: C_i : is the minimum cost of i^{th} farm associated with output Y_i^{i*}, ω_i : is the vector of input prices for the i^{th} firm α : is the vector of parameters to be estimated.

The economic efficiency for the i^{th} farmer is derived by applying Shepard's Lemma and substituting the firms input price and adjusted output level into the resulting system of input demand equations.

$$\frac{\alpha C_i}{\alpha \omega_n} = X_i^e(\omega_i, Y_i^{i*}; \theta) \quad (15)$$

Where: θ is the vector of parameters and n = 1, 2, 3, ..., N inputs.

The observed, technically and economically efficient cost of production of the i^{th} farm are equal to $\omega_i' X_i$, $\omega_i' X_i^t$ and $\omega_i' X_i^t$. Those cost measures was used to compute technically and economically efficient indices of the i^{th} farmer as follows:

$$TE_i = \omega_i' X_i^t / \omega_i' X_i \quad (16)$$

$$EE_i = \omega' X_i^t / \omega_i' X_i \quad (17)$$

Following Farrell[7] allocative efficiency index of the i^{th} farmer could derive from Equations 16 and 17 as follows;

$$AE_i = EE_i / TE_i = \omega_i' X_i^t / \omega_i' X_i^t \quad (18)$$

Results and discussion

Land utilization and availability: Land is the most important factors of production for the rural people of the country in general and the study area in particular[8]. The survey result showed that the minimum and maximum land holding in the study area were 0.50 ha and 5.45 ha respectively. Among surveyed household, 15% of them have land not more than 0.5 ha whereas 24.58% of them had more than two ha of land (Table- 2).

Table-2: Distribution of the sample farmers by cultivated and owned land size.

Size(ha)	Cultivated land		Land owned	
	N	Percent	N	percent
≤ 0.5	21	8.75	36	15
0.51-1.0	62	25.83	66	27.5
1.01 – 2	79	32.92	79	32.92
> 2	78	32.5	59	24.58
Total	240	100.00	240	100.00

Production constraints: Soil factors were a serious problem that farmers were facing in the locality followed by crop pest and Animal shortage. About 28% of respondents reported that they were facing soil factors whereas 22.5% believes crop pest was the problem that they were facing. In addition to this, there was also shortage animal in the study areas. Farmers also reported that there was labour shortage during peak agricultural production seasons.

Table-2: Agricultural production constraints.

Production problems	Number of farmers	Percent
Crop Pest	54	22.5
Seed Shortage	6	2.5
Animal Shortage	40	16.67
Labour Shortage	32	13.33
Fertilizer affordability	36	15
Soil factors	68	28.33
Climate	4	1.67

Characteristics of Maize Farms: Farm size, fertility and slope of the land: The mean size of land allocated by sample farmers for maize crop in the study areas was 0.307 ha. About 23% of farmers allotted less than 0.5 ha, while 41% of the respondents allocated land, which was more than 0.5 ha whereas 36.25% allocated exactly half of a hectare for the same crop.

Table-4: Area allocation for maize production.

Area	Number of farms in the domain	Percent
Less than half a hectare	55	22.92
Half a hectare	87	36.25
More than half a hectare	98	40.83
Mean	0.307	
Std. Deviation.	0.149	

The result of the survey showed that 64.58% of respondents classified their maize farm as ”medium’’ class in fertility status and the remaining respondents graded it as “fertile” based on their perception. Thus, the farmers at least perceive that they did not allocated infertile land for maize production for the main rain season of 2014/15 production year.

Table-5: Farmers’ perception on fertility status of the land.

Soil fertility status	Number of respondents	Percent
Fertile	85	35.42
Medium	155	64.58
Total	240	100.0

Slope of land is a crucial factor in determining the rate of soil erosion so that it affects production and productivity. The survey indicated that, based on the perception of the sample farmers, 54.17% of the respondents perceive that the land they allocated for maize production was neither flatter nor sloppy and 25% of the respondents believed that the allocated land was flatter. As indicated in the Table-6 about 21% of the farmers believed that the allocated land is sloppy in its topography.

Table-3: Farmer’s perception on Slope of the land allocated for maize production**.**

Slope of the land	Number of farmers	Percent
Medium	130	54.17
Flatter	60	25
Sloppy	50	20.83
Total	240	100.0

Land preparation: The number of ploughing can indicate an intensity of land preparation that helps for appropriate germination of the seed and it was expected to have a direct impact on productivity. About 46% of the respondents ploughed their farm three times and 5.83% ploughed their farm two times (Table-7).

Table-4: Frequency of ploughing the maize land.

Frequency of ploughing	Number of respondents	Percent
Two times	14	5.83
Three times	110	45.83
Four times	98	40.83
Five times	18	7.5
Total	240	100.0

Maize farm proximity to homesteads: Out of the total household farmers surveyed for this study, about 46% of them were indicated that their maize farm was inside the radius of 0.5 kilometre from their home and 34.17% of them were indicated that their maize farm was inside the range of one km from their home whereas 7.92% were far from the home at least by two km.

Table-5: Proximity of farm to respondents’ residence.

Home to farm distance (km)	N	Percent
≤ 0.5	110	45.83
0.51-1.0	82	34.17
1.01 – 2	29	12.08
Above 2	19	7.92
Mean	0.6325	
Std. Deviation	0.5635	
Total	240	100.00

Summary of production function variables used in the model: On average, sample farmers got 18.23 quintal of maize. The land allocated for maize production by the sampled farmers ranged from 0.125 to 6 ha with an average of 0.452 ha. The amount of seed that sampled households used were 10.35Kg, on average. Like other inputs, human and animal labor inputs were also critical, given a traditional farming system in the study area. Sampled households, on average, used 38.28 man equivalent labor and 8.125 oxen days for the production of maize during 2014/15 production season. Sample farmers also on average, used 48.21 kg and 26.43 kg of DAP and Urea respectively.

Table-6: Summary of production function variables.

Variable	Mean	Std. Dev.	Min	Max
Output (qt)	18.230	9.552	3.00	30.000
Land (ha)	0.452	0.219	0.125	6.00
Seed (kg)	10.350	4.982	5.00	25.00
Labour (MD)	38.281	18.009	11.00	105.00
Oxen (OD)	8.125	3.036	2.00	18.00
DAP (kg)	48.211	24.111	0.00	100.00
Urea (kg)	26.432	26.076	0.00	100.00

Econometric Result: Estimation of Production and Cost Functions: The parameter of maximum-likelihood (ML) estimates of the stochastic production frontier were obtained using STATA version 13 by employing a two stage estimation procedures. The result of the survey indicated that except urea all of the input variables had positive and significant effect on the level of output. Besides, it indicated that an increase in these inputs would increase output of maize. Furthermore, a one percent increase DAP, seed, land, labour, and oxen would increase maize production by 0.0421%, 0.4831%, 0.2120%, 0.0991% and 0.1531% respectively.

The ratio of the standard error of u (σu) to the standard error of v (σv), known as lambda (λ), is 1.7850. The estimated value of gamma (γ) is 0.7611, which indicates that 76.11% of total variation in farm output is due to technical inefficiency (Table-10).

Table-7: The Cobb Douglas function of the stochastic production.

Variables	Coefficients	Std. Err.
Ln(DAP)	0.0421***	0.0061
Ln(Urea)	0.0033	0.0201
Ln (Seed)	0.4831**	0.2533
Ln(Land)	0.2120**	0.1110
Ln (Labour)	0.0991*	0.0481
Ln(Oxen)	0.1531**	0.0192
Constant	1.2110***	0.3390
Lambda	1.7850***	0. 0443
Sigma square	0.04330***	0.0092

***, ** and * show significance at 1%, 5% and 10% probability level, respectively.

The dual frontier cost function derived analytically from the stochastic production frontier shown in Table 10 is given as:

$$\ln C_i = 4.521 + 0.788 \ln Y_i^* + 0.047 \ln \omega DAP + 0.003 \ln \omega urea + 0.4233 \ln \omega_{seed} + 0.182 \ln \omega_{land} + 0.163 \ln \omega_{labour} + 0.1477 \ln \omega oxen$$

Where: C is per-farm costs of producing maize; Yi* is total maize output in Qt of the ith farm adjusted for any statistical noise; ω_{DAP} is the cost of DAP per kg; ω_{ure}ais the price of Urea per kg; ω_{seed} is the cost of seed per kg; ω_{land} the observed seasonal rent of a hectare of land; ω_{labour} is the daily wage of labor and ω_{oxen} is the daily rent of oxen.

Tests of hypothesis: Two hypotheses were tested. In both hypotheses, the λ value got was higher than the critical χ^2 value at a given degree of freedom. Hence, it showed that there exists considerable inefficiency and efficiency variation among maize-growing farmers in the study area. It is dependent on the result of log likelihood ratio test (Table-11).

Table-8: Generalized likelihood ratio tests of hypothesis for the parameters of SPF.

Null hypothesis	λ	Critical value (χ^2, 0.95)	decision
H_0: γ = 0	7.33	3.84	Rejected
H_0: = $\delta_0 = \delta_1 = \ldots = \delta_{13} = 0$	33.22	23.68	Rejected

Efficiency scores: The mean TE was found to be 80.52%. It indicated that in the short run farmers on average could decrease inputs (land, seed, labour and inorganic fertilizers) by 19.48% if they were technically efficient. In other words, it indicated that if resources were efficiently utilized, the average farmer could increase current output by 19.48% using existing resources and level of technology. Similarly, the mean allocative efficiency of farmers in the study area was 35.21%. It indicated that Maize-producing farmers could save 64.79% of their current cost of inputs by behaving in a cost minimizing way. Conversely, the mean economic efficiency of 28.44% prevails that an economically efficient farmer can produce 71.56% additional maize (Table-12).

Table-9: Summary of descriptive statistics of efficiency measures.

Type of efficiency	Minimum	Maximum	Mean	Std. Deviation
TE	0.32	0.96	0.8052	0.0724
AE	0.21	0.61	0.3521	0.0523
EE	0.12	0.48	0.2844	0.0425

Table-13 showed the TE, AE and EE level of sample households. Majority of the sample households had a higher technical efficiency levels. Among the total sample households, 26.25% of them were operating above 91% of and 37.50% of them were operating in the range of 81-90% of technical efficiency levels. The result indicated that potential of improving maize productivity for individual farmers through improvement in the level of TE is the smallest as compared to that of the AE and EE.

Determinants of efficiency in maize production: The result of the model showed that among 13 variables used in the analysis, determinants hypothesized to affect efficiencies of maize production; educational level of household head, land fragmentation, livestock ownership, frequency of extension contact and soil fertility were significant factors influencing efficiencies of farmers (Table-14).

Table-10: Frequency distribution of maize production.

Efficiency level	TE		AE		EE	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
0-10	0	0.00	0	0.00	0	0.00
11-20	0	0.00	5	2.08	25	10.42
21-30	0	0.00	33	13.75	44	18.33
31-40	0	0.00	100	41.67	86	35.83
41-50	0	0.00	89	37.08	85	35.42
51-60	5	2.08	13	5.42	0	0.72
61-70	23	9.58	0	0.00	0	0.00
71-80	59	24.58	0	0.00	0	0.00
81-90	90	37.50	0	0.00	0	0.00
91-100	63	26.25	0	0.00	0	0.00

Table-11: Determinants of efficiency in maize production among sample households.

Variables	TE		AE		EE	
	Marginal Effect	Stad. Err.	Marginal Effect	Stad. Err.	Marginal Effect	Stad. Err.
Education	0.00331*	0.00354	0.0053**	0.01735	0.00621*	0.00172
Family size(adult-eqt)	-0.0028	0.0025	0.0010	0.0000	0.0010	0.0030
Agehh	0.000013	0.00050	0.00242	0.00162	0.00041	0.0000
Cultivated land	0.0140	0.0050	0.1360	0.0080	0.0030	0.0010
Crop rotation	0.0231	0.02108	0.061	0.025	0.0660	0.0012
Land Fragmentation	-0.0310*	0.009	-0.004 *	0.002	-0.001	0.0000
Livestock (TLU)	0.0020	0.0020	0.0010**	0.002	0.007	0.0009
Extension contact	0.0083	0.0510	-0.030*	0.0160	-0.0021*	0.0440
Training	0.0115	0.0246	0.055	0.034	0.0133	0.0050
Credit	0.0282	0.0045	0.0210	0.015	0.003	0.007
Home to farm distance	0.0011	0.0022	0.0044	0.00133	0.001	0.0042
Off/non-farm activity	0.077	0.0122	0.003	0.024	0.055	0.000
Soil fertility	0.033***	0.0166	0.011	0.000	0.005	0.0031
Cons	0.6220**	0.078	0.453***	0.053	0.256***	0.048

***,** and * represents significant levels at 1%, 5% and 10% respectively.

Education was positive and had a significant effect on all types of efficiencies. Positive and significant impact of education on all types of efficiencies verifies the importance of education in increasing the efficiency of maize production. Because of their better skills, access to information and good farm planning, educated farmers are better to manage their farm resources and agricultural activities than uneducated one. The result was in line with the finding made by Abdul[9], Ayodele[10] and Himayatullah[11].

Land fragmentation had negative and statistically significant impact on TE and AE. The result was in line with expectation made. Fragmented land leads to inefficiency by creating shortage of family labour, wastage of time and other resources that should been available at the same time. Moreover, as the number of plots operated by the farmer increases, it may be difficult to manage these plots. In the study area, land is fragmented and scattered over different places. Thus, farmers that have large number of plots may waste time in moving between plots. The result was in line with the finding made by Fekadu[12].

Frequency of extension contact had statistically significant impact on allocative and economic efficiency. It shows that the efficiencies in resource allocation are declining as the frequency of extension of the contact raises. Besides, during the survey, most farmers explained that they do not have new skills and information they learn from development agents. There are development agents who agree with the farmers concern. If this is the case, the contact with extension agent will only result in under-utilization of resources, giving a negative relationship with allocative efficiency. The result is also similar to those obtained by Jude[13] and Mbanasor[14].

The coefficient for soil fertility was positive and had a significant impact on technical efficiency. The farmers who allocate fertile land were having good efficiency. Therefore, decline in soil fertility could be taken as cause for significant output loss. The result is in line with the arguments of Fekadu[12] and Alemayehu[15].

The coefficient for livestock holding (TLU) was positive and had a significant impact on AE, which confirms the considerable contribution of livestock in maize production. The result is in line with Solomon[16].

Conclusion

This study was undertaken with the objective of assessing the economic efficiency in maize production in Ilu Ababor Zone of Oromia National Regional State of Ethiopia. The study areas were selected purposively based on the production potential and the researchable area for Mettu University. The study employed the stochastic production frontier approach and both primary and secondary data were used. There are a number of studies that have dealt with technical efficiency of farmers in Ethiopia. However, there is only few studies that analyzed technical, allocative and economic efficiencies altogether.

The Cobb-Douglas stochastic production frontier and its dual cost functions were estimated from which TE, AE and EE extracted. The result of production function showed that except urea, all of the factors of production employed in the model were positively and significantly affect maize output. The study also indicated that 80.52%, 35.21% and 28.44% were the mean levels of TE, AE and EE, respectively. This in turn implies that farmers can increase their maize production on average by 19.48% when they were technically efficient. Similarly, they can reduce their cost by 64.79% given the optimum level of output. Furthermore it implies that using the subsisting resource base, improved efficiency can still be achieved and there exit a potential to increase the gross output and profit with the existing level of factors inputs.

In the second step of the analysis, relationships between TE, AE, and EE, and various variables that expected to affect farm efficiency were examined. Among 13 explanatory variables hypothesised to affect efficiencies; education, land fragmentation and soil fertility were found to be statistically significant to affect the level of technical efficiency. The model also showed that education, land fragmentation, livestock ownership and frequency of extension contact were important factors that affect allocative efficiency of farmers in the study area. However, the sign of the coefficients for extension contact in allocative and economic efficiencies was not as expected. The results also further revealed that educational level of the household head and extension contact were important determinants in determining economic efficiency in maize production.

Thus, the findings extend the utility of the appropriate policy formulation and guidance of implementation to enable farmers to improve their efficiency in production and to have a multiplier effect on maize production.

Government has to give due attention for training farmers through strengthening and establishing both formal and informal type of farmers' education. Additional effort should also be devoted to upgrade the skills and knowledge of the development agents so that farmers could gain from their presence. Such an effort must also focus on liking modern farming practice with the indigenous knowledge and to the institutional and socio-economic problems in the area. Finally, the farmers have to improve the land status by applying new fertility practices on their farm through improved land management practices and soil conservation practices. Policy makers need also to have soil fertility maintenance program and extension workers can play a great role in improving the status of the soil by working closely with the farmers in this regard.

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