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Allocative efficiency of dairy enterprises and their determinant factors in Hadiya zone, Southern Ethiopia

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Abstract
The study was estimated the allocative efficiency estimation and analyzing their determinant factors of 212 enterprises selected by multi-stage sampling techniques. In addition to these focus group and key informants stakeholders participants were used to sharpen the data collected from sample to fill the identified research gaps and to address the research objectives of the study. The data were analyzed using descriptive statistics and econometric model called stochastic frontier model. The overall average enterprises allocative efficiency (AE) scores of total sampled enterprises obtained from stochastic frontier model results was 59.92% (it were 60.89% for micro level enterprises and 63.69% for small level enterprises) respectively. The AE of total sample enterprises were statistically and significantly determined by number of employee, experience of manager and access to market in the study area at different levels of significance. Furthermore, the AE of micro level enterprises were statistically and significantly influenced by number of employee and gender of manager at different levels of significance. Finally, the AE of small level enterprises were statistically and significantly affected by age of enterprises, number of employee, experience of manager and access to credit in the study area at different levels of significance in the study area at different levels of significance. Generally, there is no single policy and strategy that can be recommended to improve the AE as well as to limit their determinant factors. Hence, the findings of this study unveil the need for implementing different policies and strategies that separately target and address the enterprises AE and their determinant factors.

Keywords: Dairy enterprises, allocative efficiency, stochastic frontier

1. Introduction
In Ethiopia, various economic policies and strategies are introduced by the government in the past to ensure sustainable economic growth has significantly reduced the level of poverty. The Ethiopian government recognizes the significance of this sector and shows its dedication to promote the enterprises development by the Issuance of National Micro and Small Enterprises Strategy in 1997 and the Establishment of the Federal Micro and Small Enterprises Development Agency. In addition to this, the growth and transformation plan (GTP) of Ethiopia ensure that the promotion of enterprises as an important tool of poverty reduction and economic growth (MoFED, 2012) [9]. Ethiopia's industrial development strategy also singled out the promotion of enterprises development as one of the important instruments to create productive and dynamic private sector. The promotion of this sector is justified on the grounds that enhancing growth with equity, creating long-term jobs, providing the basis for medium and large companies and promoting exports.

Enterprises are the main source of rapid economic growth and the basic transformer of the structure of economic system from agriculture to industrialization. These makes enterprises a major area of concern for government and NGOs with the objectives of investing in human capital, employment creation, saving promotion, asset building, income generation and income inequality reduction, import substitution, innovation etc. However, the intense studies in both academic and policy making circles about the relationship between the allocative efficiency and determinant factors were not much of the views about the links.

Based on the enterprises development strategy 1997 division of enterprises by sector, this study deals with the agricultural sector enterprises engaged in milk production in the study area. The allocative efficiency and determinant factors of the micro and small dairy enterprises in Hadiya zone in current status of enterprises are therefore very essential. In this regard, any studies are not available in the study area. This paper was explored the allocative efficiency and determinant factors of enterprises in Hadiya zone, Southern Ethiopia.

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Because of this, the study gives high emphasis on the relationship to establish statistical nexus between allocative efficiency and their determinant factors on the basis of annual cross sectional data of sample enterprises and households. Hence, this study is deemed to estimate the allocative efficiency and to identify the determinant factors of enterprises in the study area, which have not been adequately studied. Recognizing this fact the effort was made to fill the gap by conducting research on allocative efficiency (AE) and determinant factors of enterprises in the study area.

2. Objectives of the Study
The general objective of this study was to estimate the allocative efficiency and to identify the determinant factors of micro and small dairy production enterprises in Hadiya Zone, Southern Ethiopia. The specific objectives of the study were:
i)   To estimate allocative efficiency of micro and small dairy production enterprises;
ii) To identify the determinant factors of allocative efficiency differentials among micro and small dairy production enterprises in the study area.

3. Research Methodology
3.1 Description of the study area: This study was undertaken in Hadiya zone. It is located at a distance of 232 km away from the Addis Ababa, capital city of the country, to south and 180 km away from regional capital city, Hawassa to North West. The estimated total area of the zone is 346,958.5 hectares. It is characterized by temperate type of climate with daily temperature ranging from 18^0c to 27^0c, and is located 1900 meters above sea level. It have low to high rainy season for 7 months from February to August and for the remaining 5 months from September to January have bright and conducive air condition throughout the year. The total population of the zone as per the national census of 2007 was estimated to be male 769,584 (49.7%) and female 778,262 (50.3%) the total of 1,547,846 hard-working, peace-full, multi-ethnic and religious people are found. It is divided into 13 *Woreda* administrations and 7 town administrations. Hosanna town is a capital of the zone Administration.

Mixed farming, business activities public and private sectors employments are the dominant economic activities in the zone. It is suitable for living and highly productive in nature. Farmers in the study area practice mixed farming system, which is mainly concerned on the rearing of different types of livestock like cattle, sheep, and goat and production of multiple agricultural products such as cereals (wheat, *teff*, maize, barley and bean), fruits and vegetables. The area is specialized in wheat production and its productivity is about 65 quintals per hectare. The area is known as "*the basket of wheat /smaller Canada*" Great Leader Late Prime Minister Meles Zenawi speech (Hadiya Zone Administration). In addition some cash crops like *khat* and coffee are also produced.

3.2 Description of population and sampling methods: To estimate AE and to identify the determinant factors of the enterprises, the study was performed at dairy enterprises level. The study was used stratified and simple random sampling techniques in order to select the required sample. Stratified random sampling is used when the population is divided into two or more relevant strata based on one or more attributes. The advantage of stratified sampling is said to be its ability to ensure inclusion of subgroups, which would otherwise be omitted entirely by other sampling methods because of their small number in the population. It is appropriate for any social science research when a sample size of more than 30 and less than 500 (Ruth, 2015) [10]. In general the size of the sample in each stratum is taken in proportion to the size of the stratum i.e. proportional allocation among levels of enterprises.

Accordingly, to select the representative sample from the population, this study was employed multi-stage and combination of different sampling procedures. In the first step, three *woredas* was selected by simple random sampling method from the study area. The three sample *woredas* were *Lemmo, Analemmo and Misha* from ten *woredas* in the zone. The three sample *woredas* was representative of the 13 *woredas* of Hadiya zone. In the second stage, identification of *kebeles* where enterprises exist with two stages (micro and small) and which are engaged in dairy production business activity within the respective *woredas*. Following this, six *kebeles* was selected by simple random sampling method. In the third step, the existing enterprises which are found in the six *kebeles* of the study area were classified into major development stages. In the study area, there are two establishment stages in which enterprises are engaged as shown below in Table 1. To select representative sample enterprises from each stratum simple random sampling method was used.

Table 1: Sampling distribution of dairy enterprises

Enterprises level	Number of enterprises	Proportion (Percentage)	Sample size
Micro	285	54	114
Small	243	46	98
Total	528	100	212

Source: Own design based on Hadiya zone enterprises development office (2022)

There are several ways to determine the sample size. These include using a census for small populations, imitating a sample size of similar studies, using published tables and applying formulas to calculate a sample size. To determine the sample size of enterprises for AE estimation and to identify their determinant factors, this study was used simplified formula provided by Watson (2001) [13] to determine the required sample size at 95% confidence level, estimated variance in the population 50% and margin of error 5%.

$$n = \left[\frac{P[1-P]}{\frac{A^2}{Z^2} + \frac{P[1-P]}{N}} \right] \tag{1}$$

Where *n* is the sample size required (212), *N* is the population size (528), *P* is estimated variance (50%), *A* is margin of error (5%), *Z* is confidence level (95%) and *R* is estimated response rate (96%). So according to the above formula the sample size *n* was 212 enterprises and this study was carried out on 212 enterprises for AE estimation and to identify their determinant factors. A total of 212 enterprises (114 from micro level and 98 from small level) were randomly selected based on probability proportional to size

of the enterprises. To capture the representative sample of enterprises from each stratum, simple random sampling method was used. The qualitative data was collected by using key informant interviews and focus group discussions. Such an approach was helpful to build a comprehensive understanding as well as identification and ranking of some of the proxy indicators as well as to quantify and analyze the relationships among significant variables.

3.3 Types of Data and Data Collection Methods: The study was used both primary and secondary data collected from various sources. The primary data was collected from the sample enterprises through observation and structured questions and interview which are the main instruments of data collection, supported by key informants interview and focus groups discussion and observation checklists which are pre-tested prior to its use to answer the research questions and to attain the research objectives of the study in the field. Moreover, key informants' interview was carried out using checklists prepared for the purpose of obtaining the qualitative information in order to supplement the primary data. Finally, the respondents were asked whether in their opinion their enterprises are successful or not, their recommendations to government and NGOs to help in the development of enterprises sector. The secondary data was obtained from published books and journal articles, as well as unpublished annual reports and records from government offices and other relevant organizations. All data collection process was completed under close supervision of the researcher.

3.4 Methods of Data Analysis: The study was employed both descriptive statistics and econometric model. The descriptive statistics was run in SPSS while the empirical models were run in STATA computer soft-wares. Specifically, descriptive statistics was used to describe sample demographic and socio-economic characteristic in the study area. Since descriptive statistics was important tools to present research results clearly and concisely. In case of that to compare and contrast different categories of sampled units with respect to the desired characteristics, so as to draw some important conclusions. The econometric models was employed to estimate AE and to identify the determinant factors of their efficiency differential was carried out using econometric method called, stochastic frontier model was used.

A number of techniques have been developed to estimate allocative efficiency indicators index. Several authors broadly classified them into two main groups: parametric and non-parametric. Generally, the parametric method uses a stochastic frontier technique by specifying a stochastic production function. It is composed of allocative efficiency and statistical noise. The non-parametric approach is often associated with data envelopment analysis which is based on a mathematical programming model to estimate the optimal level of output and does not distinguish between allocative efficiency and statistical noise (Coelli *et al.,* 2008 and Viet; Charles, 2010) [3, 12].

As recommended by different scholars, the stochastic frontier approach is most relevant for this study. Stochastic frontier model (SFM) was first introduced by (Aigner *et al.*, 1977; Meeusen and Van den Broeck, 1977; Battese and Coelli, 1977) [1, 7, 2]. In this model there is a composed error term which captures the effects of exogenous shocks beyond the control of the analyzed units in addition to incorporating allocative inefficiency. Errors in measurement of inputs and observations are also taken into consideration. Based on the suggestion of different scholars like, Kushnirovitch and Heilbrunn (2008) [4]; Sibylle (2011) [11] and Melaku (2013) [8], the inputs and outputs were arranged for the for the study by taking in to account the particularities of Enterprises which were defined in the following way: The dependent variable in the production function (y) is milk, the vector of inputs includes cow (number), labor (number), concentrated feed (kilogram), unconcentrated feed (kilogram), land (hector) and veterinary medicine (dose).

The allocative efficiency measures enterprise's success in choosing optimal proportions. The Enterprises is said to be cost effective when the Enterprises is both technically and allocatively efficient. For the Enterprises to realize allocative efficiency there should be an optimal combination of inputs so that output is produced at minimal cost and profit could be increased by simply reallocating resources (Coelli *et al.*, 2008) [3]. Therefore, the Enterprises have to choose a combination of inputs to be used in right proportions and technically efficient at low prices so that output is produced at minimal costs that were results into profit maximization. Thus, for the Enterprises to maximize profit, it require the extra revenue (marginal value product) was generated from the employment of an extra unit of a resource, must be equal to its unit cost (marginal factor cost is equal to unit price of input).

Generally, if the Enterprises are to allocate resources efficiently and maximize its profits, the condition of marginal value product is equal to marginal factor cost should be achieved. The estimation of allocative efficiency was achieved using the Cobb-Douglas cost function analysis. The five conventional inputs commonly used to estimate efficiency of Enterprises in Stochastic Frontier Production Function Analysis were cow, labor, concentrated feed, unconcentrated feed, land and veterinary medicine. Accordingly, to estimate allocative efficiency, the following Stochastic Frontier Cobb-Douglas Cost Function was applied:

$$ln\, C_i = \beta_0 + \sum_{i=1}^{n} \beta_i \ln X_i + v_i + v_i \qquad (2)$$

Where

C_i is total cost of production in birr,

X_i is price of cow, labor, concentrated feed, unconcentrated feed, land and veterinary medicine.

β_0 and β_i are parameters to be estimated

v_i and v_i are as specified earlier but with positive sign of the inefficiency term since inefficiency factors raise the cost of production.

The allocative efficiency was then estimated from the Cobb-Douglas Stochastic Frontier Cost Function. Before fitting the Cobb-Douglas Cost Function, all the data on each variable was transformed into natural logarithms. Therefore, estimation of β_i can be expressed as:

$$\frac{\partial \ln Y}{\partial \ln X} = \left[\frac{X}{Y} * \frac{\partial Y}{\partial Y}\right] = \beta_i \qquad (3)$$

The marginal product (MP_i) of the ith factor X was calculated as:

$$MP_i = \frac{\partial Y}{\partial X_i} = \beta_i \frac{Y}{X_i} \qquad (4)$$

But average product $(AP) = \frac{Y}{X_i}$

Where

Y is the mean of natural logarithm of output

X_i is the mean of natural logarithm of input i

β_i is the estimated coefficient of input i

The value of marginal product of input i (VMP) can be obtained by multiplying marginal physical product (MP_i) by the price of output (P_y).

Thus, $VMP_i = MP_i * P_y \qquad (5)$

Allocative Efficiency $(AE) = \frac{VMP_i}{P_i}$ but $P_i =$ Marginal cost of the ith input. $\qquad (6)$

The allocative efficiency was determined by comparing the value of marginal product of input i (VMP_i) with the marginal factor cost (MIC_i). Since Enterprises are price takers in the input market, the marginal cost of input i approximates the price of the factor i, P_{Xi}. If $VMP_i > P_{X\,i}$,

the input is under used and then Enterprises output could be raised by increasing the use of this input. But, if $VMP_i < P_{X\,i}$, the input is over used and then to raise Enterprises output then, the input use should be reduced. The point of allocative efficiency (maximum revenue) is reached when $VMP_i = P_{X\,i}$. Finally, the economic efficiency of the Enterprises was determined by multiplying technical efficiency with allocative efficiency of the MSAEs.

4. Results and Discussion
4.1. Descriptive Statistics
4.1.1 Allocative Efficiency Indicators of MSAEs: There are many factors that determine allocative efficiency of MSAEs. Hence, to understand these factors it is important to know the descriptive statistics of the milk obtained from individual Enterprises and inputs used. Generally, the intensity of allocative efficiency depends greatly on the allocation of production inputs such as land, labor, cow, concentrated feed, unconcentrated feed and veterinary medicine. As shown in Table 2 below, the mean milk amount obtained by sample Enterprises was 492.06 liter/cow for total sampled enterprise (it were 526.11 liter/cow for micro enterprise and 543.18 liter/cow for small enterprise).

Table 2: Descriptive statistics of output and production inputs

MSAEs	Descriptive statistics	Variables						
		Milk (liter/cow)	Cow (number)	Labor (man day)	Concentrated feed (kg/cow)	Unconcentrated feed (kg/cow)	Land size (ha)	Veterinary medicine (dose/cow)
Total sample	Mean	492.06	4.29	8.70	199.42	497.55	0.39	1.83
	Std. dev.	382.04	1.81	4.52	280.03	724.65	0.06	0.87
Micro level	Mean	526.11	4.26	8.85	220.53	571.37	0.41	1.96
	Std. dev.	413.09	1.80	4.92	295.92	966.94	0.06	0.94
Small level	Mean	543.18	4.24	8.66	228.86	588.86	0.41	2.02
	Std. dev.	422.81	1.86	4.65	309.41	1038.42	0.06	0.96

Source: Author's survey data (2017)

4.1.2 Characteristics of sample MSAEs: The age of Enterprise simply that duration of time the enterprises stay in the business. In the study area, Enterprises were established and started operating following national enterprise development strategy of 1997. About 4% of total sampled Enterprises and 8.2% of small level enterprises were established before ten years ago; 21% of total sampled Enterprises(it was 11.4% of micro level enterprises and 32.7% of small level enterprises) were organized since 7-9

years, 26% of total sampled Enterprises(it was 35.1% of micro level and 15.3% of small level enterprises) were joined the sector before 4-6 years and 49% of total sampled Enterprises(it was 53.5% of micro level enterprises and 43.8% of small level enterprises) were organized during the past 1-3 years (Table 3). Thus almost half of the Enterprises had age one to three years were passed since their establishment.

Table 3: Age of Enterprises stay in the business

Age of MSAEs	Total Sample		Micro level		Small level	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
1-3 years	104	49	61	53.5	43	43.8
4-6 years	55	26	40	35.1	15	15.3
7-9 years	45	21	13	11.4	32	32.7
10 years and above	8	4	0	0	8	8.2
Total	212	100	114	100	98	100

Source: Author's survey data (2017)

4.1.3 Number of employees in the enterprises: According to national enterprise development strategy of 1997 micro level of enterprise set the number of employee up to 10 employees in the enterprise but in the study area 62% of micro level enterprises accommodate less than 4 employees in each enterprise to run their business. This indicates that

62% of micro level enterprises were less than the necessary number of employees and do not practically occupy and create job opportunity in line with the standard of the strategy. On the other hand 53% of small level enterprises actually handle not more than 9 employees even if the strategy put the number of employee could be from 10-50 in

small level enterprises. It is clear that in small level 53% enterprises do not fit the minimum requirement to accommodate and create job opportunity as stated in the strategy as shown in Table 4 below.

Table 4: Number of employees in the Enterprises

Enterprises level	Number of Employees	Frequency	Percentage
Micro level	1-4	71	62
	5-8	43	38
Total		114	100
Small level	1-9	52	53
	10-14	46	47
Total		98	100
Grand total		212	100

Source: Author's survey data (2017)

4.1.4 Amount of initial capital: As stated in 1997 national enterprise development strategy the amount of initial capital for micro level enterprises is up to Birr 20,000, but the amount of initial capital of 67% of the enterprises in the study area was started their business not more than half of the stated amount of initial capital that is Birr 10,000 and even if the strategy clearly showed that the amount of initial capital for small level of enterprises from Birr 20,000-50,000, by fact 56% of small level of enterprises in the study included in the study started their business below the given range of initial capital. This indicates that the majority

of Enterprisesin the study area started their business with insufficient amount of initial capital as summarized in Table 5 below.

Table 5: Amount of initial capital

Enterprises level	Amount of initial capital	Frequency	Percentage
Micro level	Less than 10,000 Birr	76	67
	10,000-20,000 Birr	38	33
Total		114	100
Small level	Less than 20,000 Birr	48	56
	20,000-50,000 Birr	50	44
Total		98	100
Grand total		212	100

Source: Author's survey data (2017)

4.1.4 Characteristics of sample managers/operators of MSAEs: About 71% and 29% of total sampled Enterprises(it was 66.6% and 33.3% of micro level enterprises and 76.5% and 23.5% of small level enterprises) managers were male and female respectively as indicated in Table 6 below. This indicates that there was not proportional participation of men and women in managing position of Enterprisesin the study area. This may be encountered due to various reasons, which could be the problem of economic position of female managed MSAEs, including shortage of labor, limited access to information and required inputs due to social attitude.

Table 6: Gender of Enterprises managers

	Total sample		Micro level		Small level	
Gender of managers	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Male	151	71	76	66.7	75	116.5
Female	61	29	38	33.3	23	23.5
Total	212	100	114	100	98	100

Source: Author's survey data (2017)

Regarding the experience of the managers of Enterprises included in the sample most of them (52% of total sample MSAEs, it was 60.5% of micro level and 41.8% of small level enterprises) were under the year group of 1-3, 24% of total sample Enterprises(it was 21% of micro level and 27.6% of small level enterprises) were in between 4-6, 19% of total sample Enterprises(it was 15% of micro level and 23.5% of small level enterprises) were in between 7-9 age

group and 5% of total sample Enterprises(it was 3.5% of micro level and 7.1% of small level enterprises) were in age group 10 years and above. This shows that almost half of the Enterprises in the study area were managed by managers who do not have sufficient experience to lead, inspire and champion the followers to be successful in the sector (Table 7).

Table 7: Experience of managers

	Total sample		Micro level		Small level	
Experience of managers	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
1-3 years	110	52	69	60.5	41	41.8
4-6 years	51	24	24	21	27	27.6
7-9 years	40	19	17	15	23	23.5
10 years and above	11	5	4	3.5	7	7.1
Total	212	100	114	100	98	100

Source: Author's survey data (2017)

About 43% of the total sample Enterprises managers (it was 48.2% of micro level and 36.7% of small level enterprises managers) attained from grade 1-8 (elementary level of education), 32% of the sample Enterprises managers (it was 32.5% of micro level and 31.6% of small level enterprises managers) attained from grade 9-12 (high school level), 18% of total sample Enterprises managers (it was 16.7% of micro level and 19% small level enterprises managers) had

preparatory level of educational background and 7% of the total sample Enterprises managers (it was 2.6% of micro level and 12.3% small level enterprises managers) have upgraded their academic status up to TVT and above level of education (Table 8). This indicates that the majority of Enterprises managers have attained elementary and high school level of education.

Table 8: Educational level of mangers

Educational level	Total sample		Micro level		Small level	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Elementary	91	43	55	48.2	36	36.7
High school	68	32	37	32.5	31	31.6
Preparatory	38	18	19	16.7	19	19.4
TVT and above	15	7	3	2.6	12	12.3
Total	212	100	114	100	98	100

Source: Author's survey data (2017)

4.1.5 Entrepreneurial skill of the operators in the MSAEs: In the study area about 69% of the total sample Enterprises(it was 61.4% of micro and 77.6% small enterprises) included in the study had organized by operators who had entrepreneurial skill or had ability to do something well which leads the Enterprises to achieve their intended goals of establishment. On the other hand, the study ensures that 31% of the total sample Enterprises (it was 38.6% of micro level and 22.4% small level enterprises) did not have operators who have adequate entrepreneurial skill in doing their tax in the MSAEs. Many of the managers of Enterprises indicated that most of the problems they faced could be solved if they have entrepreneurial skill to run their obligations in the Enterprises as indicated in the following Table 9.

Table 9: Entrepreneurial skill of the operators'

Entrepreneurial skill	Total sample		Micro level		Small level	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Yes	146	69	70	61.4	76	77.6
No	66	31	44	38.6	22	22.4
Total	212	100	114	100	98	100

Source: Author's survey data (2017)

4.2. Econometric Model Analysis

4.2.1 Test of hypothesis: In this section we tried to estimate the extent of MSAEs' AE of milk production in the study area. SFM was opted for executing multiple inputs and single output and it is possible to test various hypotheses using maximum likelihood ratio test. In order to choose an appropriate model for further analysis, hypotheses tests are critical before discussing about parameter estimates of production frontier function and the inefficiency effects. Because of this, three hypotheses were tested, to select the correct functional form for the given data set, for the existence of inefficiency and for variables that explain the difference in efficiency.

Table 10: Generalized likelihood ratio tests of hypothesis for the parameters of the SFM

For total sampled Enterprises					
Null hypothesis	LH0	LH1	Calculated χ2 (LR) value	Critical χ2 value	Decision
Production function is CD, (i.e. H0: = βij = 0)	-170.74	-161.03	19.42	32.67	Not reject
Absence of inefficiency, (i.e. H0: γ = 0)	-187.4	-170.74	33.32	2.71	Reject H0
Joint efficiency effects are insignificant, (i.e. H0: = δ1=…. δ 14 = 0)	-188.3	-170.74	36.6	32.67	Reject H0
For Micro Level Enterprises					
Production function is CD, (i.e. H0: = βij = 0)	-95.4	-88.6	13.6	32.67	Not reject
Absence of inefficiency, (i.e. H0: γ = 0)	-101.6	-95.4	12.4	2.71	Reject H0
Joint efficiency effects are insignificant, (i.e. H0: = δ1=…. δ 14 = 0)	-115.12	-95.4	39.4	32.67	Reject H0
For Small Level Enterprises					
Production function is CD, (i.e. H0: = βij = 0)	-85.9	-78.4	15	32.67	Not reject
(Absence of inefficiency), H0: γ= 0	-90.5	-85.9	9.2	2.71	Reject H0
Joint efficiency effects are insignificant, (i.e. H0: = δ1=…. δ 14 = 0)	-107.7	-85.9	43.6	32.67	Reject H0

Source: Author's survey data (2017)

The first test identifies an appropriate functional form between restrictive Cobb Douglas and the more flexible Translog production function which specifies that square and cross terms are equivalent to zero. The Translog frontier function turns into Cobb-Douglas when all the square and interaction terms in the translog are zero. The test is made based on the value of likelihood ratio (LR) statistics, which can be computed from the log likelihood value obtained from estimation of Cobb-Douglas and Translog functional specifications. Then, this computed value is compared with the upper 5% critical value of the chi-square at the degree of freedom equals to the difference between the numbers of explanatory variables used in the two functional forms (in this case df = 14). For the sample MSAEs, the estimated log likelihood values of the Cobb-Douglas and Translog production functions for total sample Enterprises were -170.74 and -161.03, (It is -95.4 and -88.6 for micro level enterprises and -85.9 and -78.4 for small level enterprises) respectively. The computed value of likelihood ratio (LR) = 19.42 for total Enterprises(13.6 for micro level enterprises and 15 for small level enterprises) is lower than the upper 5% critical value of the chi-square with its respective degree

of freedom as shown in Table 10. Thus, the null hypothesis that all coefficients of the square and interaction terms in Translog specification are equal to zero was not rejected. This implies that the Cobb-Douglas functional form adequately represents the data.

The second null hypothesis was H0: $\gamma = 0$, which specifies that the inefficiency effects in the SPF were not stochastic, i.e., milk producing Enterprises are efficient and have no room for efficiency improvement. After the appropriate production function is selected, the next step is a test for adequacy of representing the data using SPF over the traditional mean response function, OLS. The null hypothesis, H0: $\gamma = 0$, which specifies that the inefficiency effects are absent from the model (that is all milk producers are fully efficient). Whereas, the alternative hypothesis, H1: $\gamma > 0$, states that there is inefficiency in production of milk in the study area. Since this study is using the STATA version computer programs, after fitting the function with the required defined variables the computer output displays results which include the test of null hypothesis about inefficiency component. From this computer program output it is found that, log likelihood value = -187.4, ($\chi 2$ (01)-value = 33.32 and p = 0.001) for total sample Enterprises(but it is log likelihood value = -101.6, ($\chi 2$ (01)-value = 12.4 and p = 0.025 for micro level enterprises and log likelihood value = -90.5, ($\chi 2$ (01)-value = 9.2 and p = 0.04 for small level enterprises). Therefore, the decision of null hypotheses H0: $\gamma = 0$, which specifies that the inefficiency effects are absent from the model is rejected at 1% level of significance for the total sampled enterprises (but it is 5% level for both micro and small level enterprises).

The coefficient for the discrepancy ratio (γ) could be interpreted in such a way that for the total sampled Enterprises was about 85.41% (it was 83.63% for micro level enterprises and 84.00% for small level enterprises) of the variability in milk output in the study area was attributable to inefficiency scores effect, while the remaining 14.59% variation in output for total sampled Enterprises was due to the effect of random noise (it was 16.37% for micro level enterprises and 16.00% small level enterprises in the study area). This implies presence of scope for improving output of milk by first identifying those institutional, socioeconomic and farm attribute factors causing this variation. Therefore, this data can be better represented by the stochastic production frontier than the average response function. The null hypothesis was rejected (Table 10). This implies the traditional average production function does not adequately represent the data. Therefore, the inclusion of the technical inefficiency term is an important issue to the model. The third null hypothesis that the explanatory variables associated with inefficiency effects are all zero (H0: $\delta_1 = \delta_2 \dots = \delta_{14} = 0$) was also tested. To test this hypothesis likewise, LR (the inefficiency effect) was calculated using the value of the Log-Likelihood function under the stochastic production function model (a model without explanatory variables of inefficiency effects:

H0) and the full frontier model (a model with explanatory variables that are supposed to determine inefficiency of each: H1).

For the total sample MSAEs, the calculated value λ_{LR} = -2(170.74 – 188.3) = 36.6 (for micro level enterprises λ_{LR} = -2(95.4 – 115.12) = 39.4 and for micro level enterprises λ_{LR} = -2(85.9 – 107.7) = 43.6) is greater than the critical value of 32.67 at 14 degree of freedom (Table 10) the value of LR implying that, the null hypothesis (H0) that explanatory variables are simultaneously equal to zero was rejected at 5% significance level. Hence, these variables simultaneously explain the sources of efficiency differences among sample farmers in the study area. Thus the observed inefficiency among the milk producing Enterprisesin Hadiya zone could be attributed to the variables specified in the model and the variables exercised a significant role in explaining the observed inefficiency. Therefore, the result confirms as the null hypothesis was rejected, implying that there is at least one variable that explain the difference in efficiency.

4.2.2 Estimation of parameters of production function model: The output variable was milk production defined as quantity of milk produced in liters whereas the inputs were cow, unconcentrated feed, concentrated feed, labor, veterinary medicine and land. The result of the Cobb-Douglas stochastic production frontier for the total sampled Enterprises showed that inputs like cow (at 10% significance level), concentrated feed (at 1% significance level), labor (at 1% significance level) and land (at 5% significance level) allocated for milk were found to positively and significantly explained the level of efficiency of milk production (Table 11), which are important variables in shifting the frontier output to the right. This indicated that at each and every unit of these variables there is a possibility to increase the level of output. But the increase of unconcentrated feed and veterinary medicine was insignificant. In the case of micro level enterprises the result showed that inputs such as cow at 10% significance level, concentrated feed at 5% significance level, labor at 5% significance level and land at 5% significance level explained the level of efficiency of milk production positively (Table 12), the remaining inputs like unconcentrated feed and veterinary medicine affect the production system insignificantly. On the other hand the number of cow allocated for milk production at 10% significant level, concentrated feed used at 5% significance level, labor used at 1% significance level and land at 5% significance level explained the level of efficiency of milk production positively for small level enterprises. In similar way the unconcentrated feed and veterinary medicine allocation has insignificant effect on small level enterprises of milk producers (Table 13).

Table 11: Maximum likelihood estimate of SPF model (total sample MSAEs)

Types	Variables	Parameters	Coefficients	Std. Err.	Z-value
For total sampled MSAEs	Constant	β0	1.3099*	2.1908	0.55
	Ln(cow)	β1	0.3454*	0.1798	1.92
	Ln(unconce)	B2	0.1814	0.2530	-0.72
	Ln(conce)	B3	0.1325***	0.0189	6.98
	Ln(labor)	B4	0.4749***	0.1729	2.75
	Ln(vet)	B5	0.3399	0.7269	0.47
	Ln(land)	B6	0.1528**	0.0707	2.16
	Sigma- square	δ^2	0.6795***		
	Gamma	γ	0.8541		
	Lambda	λ	2.4208***		
	Log likelihood function		-170.74		
	Returns to scale		1.6269		

Source: Author's survey data (2017)
*, **, ***, Significant at 10%, 5% and 1% level of significance

Table 12: Maximum likelihood estimate of SPF model (micro level enterprises)

Types	Variables	Parameters	Coefficients	Std. Err.	Z-value
For micro level	Constant	β0	2.2890*	3.1123	0.74
	Ln(cow)	β1	0.4598*	0.2499	1.84
	Ln(unconce)	B2	0.3602	0.3980	0.91
	Ln(conce)	B3	0.0845**	0.0384	2.20
	Ln(labor)	B4	0.0993**	0.4782	0.21
	Ln(vet)	B5	0.2559	1.0994	0.23
	Ln(land)	B6	0.1566**	0.1017	1.54
	Sigma- square	δ^2	0.7011	0.1378	
	Gamma	γ	83.63		
	Lambda	λ	2.26		
	Log likelihood function		-95.41		
	Returns to scale		1.4163		

Source: Author's survey data (2017)
*, **, ***, Significant at 10%, 5% and 1% level of significance

Table 13: Maximum likelihood estimate of SPF model (small level enterprises)

Types	Variables	Parameters	Coefficients	Std. Err.	Z-value
For small level	Constant	β0	3.8546***	3.7466	1.03
	Ln(cow)	β1	0.3621*	0.2722	1.33
	Ln(unconce)	B2	0.4323	0.4383	0.99
	Ln(conce)	B3	0.0889**	0.0419	2.12
	Ln(labor)	B4	0.0743***	0.5276	0.14
	Ln(vet)	B5	0.3232	1.2869	0.25
	Ln(land)	B6	0.1766**	0.1198	1.03
	Sigma- square	δ^2	0.7639		
	Gamma	γ	0. 84		
	Lambda	λ	2.2933***	0.1638	
	Log likelihood function		-85.92		
	Returns to scale		1.4574		

Source: Author's survey data (2017)
*, **, ***, Significant at 10%, 5% and 1% level of significance

As shown on the table 11, 12 and 13 above, the parameter estimate for unconcentrated feed and veterinary medicine turned out to be insignificant. Given unconcentrated feed and veterinary medicine are the important production input in the study area, the insignificance of the estimated coefficients for unconcentrated feed and veterinary medicine which implies that use of this input has no significant effect on productivity was contrary to the expectation.

Out of total inputs allocated for milk production, the elasticity of cow is very high implying that these have more effect in determining the output level at the best practice (the maximum technical efficiency score). The positive coefficients of inputs indicate a 1% increase in cow, concentrated feed, labor and land yields 34.54%, 13.25%, 47.49%, 15.28%, increase in milk output improvement, respectively for total sample MSAEs; in the case of micro level enterprises 1% increase in cow, concentrated feed, labor and land yields 45.98%, 8.45%, 9.93% and 15.66% increments on milk yield. In the same manner for the small level enterprises 1% increase in cow, concentrated feed, labor and land yields 36.21%, 8.89%, 7.43% and 17.66% increments on milk output respectively.

The estimated stochastic production frontier model indicates that labor for total sampled enterprises (cow for micro enterprises and cow for small enterprises) was a key input in improving milk productivity since its response is one of the moderate perhaps, due to the low application level of the input. This implies that there is a need to increase the current level of these inputs usage along with good farm management. In other words, as indicated on the above tables if all the inputs are improved by 1%, milk output would increase by 1.63% for total sampled Enterprises (1.42% for micro level enterprises and 1.45% for small level enterprises). The results showed that micro level enterprises are operating in the stage one of production process (increasing return to scale) and have ample opportunities to increase output by improving their efficiencies.

Another essential outcome in the analysis is the variance ratio parameter γ which found to be significant at 1% level expressing that about 85.41% of milk output for the total Enterprises (83.63% for micro level enterprises and 84.00% for small level enterprises) deviations are caused by differences in farm level technical efficiency as opposed to the random variability that are outside their control of the producers. In order to decrease inefficiency (technical as well as noise) specifically for small level enterprises it is advisable to internalize external technologies like improved breed to boost productivities.

Table 14: Summary statistics of estimated AE of sampled MSAEs

Types of sample	AE estimates of MSAEs			
	Maximum	Minimum	Mean	Standard deviation
Total sampled MSAEs	0.9381	0.1684	0.5992	0.1856
Micro level	0.9232	0.1830	0.6089	0.1743
Small level	0.9406	0.1843	0.6369	0.1900

Source: Author's survey data (2017)

The SFA model results showed that the mean total sampled Enterprises AE was 59.9% (it was 60.8% for micro level enterprises and 63.6% for small level enterprises), indicating the AE of total sampled Enterprises AE was revealed 40.1% increase (that means 39.2% for micro level enterprises and 36.4% for small level enterprises) in output by improving AE, with the existing technology. Therefore, this result shows the existence of significant allocative inefficiency in milk production among Enterprises in the study area. The result of this study means levels of efficiencies were comparable to those other similar studies like (Masuku *et al.,* 2014; Mawa *et al.,* 2014) [5, 6].

4.2.3 Estimation results of sources of inefficiency: After measuring levels of MSAEs' efficiency and determining the presence of efficiency differences among MSAEs, finding out factors causing inefficiency disparity among Enterprises was the next most important step of this study. To see this, inefficiency levels of sample Enterprises were regressed on factors that were expected to affect inefficiency levels using a MLE estimation procedure. The marginal effects of changes in explanatory variables from regression were computed for the purpose of interpretation. That is, the derived values for the significant explanatory variables indicated that the effects of a unit change in those variables on the unconditional expected value of efficiency scores and expected value of efficiency scores conditional upon being between 0 and 1, and probability of being between 0 and 1.

Table 15: Determinants of efficiencies score differentials among MSAEs

Variables	Total sampled MSAEs	Micro level enterprises	Small level enterprises
	AE	AE	AE
	Coefficient	Coefficient	Coefficient
Age	-0.119	-0.099	-0.193**
Education	-0.108	-0.218	-0.204
No. of employee	-0.255**	-0.229*	-0.362**
Initial capital	-0.900	-0.006	-0.306
Entrepreneur skill	-0.144	-0.260	-0.030
Experience	-0.276*	-0.185	-0.166*
Access to training	-0.048	-0.523	-0.320
Access to market	-0.564*	-0.461	-0.569
Gender of manager	-0.083	-0.512**	-0.298
Consultancy service	-0.797	-0.767	-0.985
Access to premises	-0.284	-0.194	-0.106
Access to infrastructure	-0.719	-0.875	-0.721
Customer networks	-0.657	-0.066	-0.007
Access to credit	-0.215	-0.050	-0.294**

*, **, ***, Significant at 10%, 5% and 1%, level of significance
Source: Author's survey data (2017)

4.2.4 Age of enterprises (age): The coefficient estimated for age of enterprises variable shows a negative and significant effect on AE of small level enterprises engaged in milk production implying that the older Enterprises are more allocatively efficient than new ones. The result also supports the hypothesis that long stay in the dairy business has been found to be statistically significant at 5% level which indicates that older Enterprises tend to have more efficiencies than younger ones. This could be explained in terms of adoption of modern technology. As the age young, the Enterprises tend to be more risk averse and hesitate to adopt new technologies making the production process efficient. Another reason might be that dairy production is very strenuous giving older Enterprises advantageous than

the younger dairy production Enterprises in the study area.

4.2.5 Number of employee (Emplo): The coefficient of number of employee was observed negative and statistically significant at 5% probability level for total sampled Enterprises AE. Similarly, it is found to be negative and statistically significant at 10% probability level for micro level enterprises AE. It is also found to be negative and statistically significant at 5% and 10% probability level for small level enterprises AE of the enterprises respectively. The negative sign of this inefficiency parameter establish the fact that inefficiency of Enterprises decreases with increase in number of employee with in the appropriate work load of the MSAEs. This may be due to the fact that increased number of employee means increasing available labor force for dairy production activities.

4.2.6 Experience of manager (Exp): The variable experience of manager may be defined as knowledge and skill gained by contact with facts and events with staying in the business for long period of time. By its nature, it is a product of the past and therefore limited to and controlled by previous exposures. Number of years a manager has spent in the Enterprises business may give an indication of practical knowledge he/she has acquired on how to cope with the inherent dairy farm production, processing and marketing problems leading to higher levels of efficiency scores. The coefficient of the variable experience of manager was found to be negative and statistically significant at 5% probability level for total sampled Enterprises AE. Similarly, it is found to be negative and statistically significant at 10% probability level for small level enterprises AE of the enterprises. This indicates that there is decrease in the level of inefficiencies as the manager has experienced in the field of Enterprises business in the study area.

4.2.7 Access to market (Mkt): Another factor worth considering, as a variable affecting AE, was access to markets. The hypothesis in this study is that Enterprises create different market accesses for their products insure the higher level of market access results the greater level of production efficiency. This might be due to the fact that as Enterprises which did not have sufficient market access, there would be limited access to input and output markets linkages and market information. The coefficient of access to market was observed negative and statistically significant at 10% probability level for total sampled Enterprises AE. The Enterprises which have sufficient market access for their product have better chance to increase the profitability opportunities of Enterprises with higher returns than Enterprises with limited access to market.

4.2.8 Gender of manager (Sex): The gender of manager coefficient measured as dummy variable with value of one for male and zero for female was found to be negative and statistically significant at 10% probability level for total sampled Enterprises TE. Similarly, it is found to be negative and statistically significant at 5% probability level for micro level enterprises AE of the enterprises in the study area. There were significant differences in efficiency scores among male-managed and female-managed MSAEs. Male managed Enterprises were more likely to be efficient than female managed MSAEs. This is due to the fact that female

managed Enterprises have additional responsibilities within their household. This suggests that Enterprises which are managed by females were less efficient than Enterprises managed by men which are fund in the study area.

4.2.9 Access to credit (Credit): The coefficient of the dummy variable for access to credit was found to be negative and statistically significant at 5% probability level for small level enterprises AE of the enterprises. The results indicate that Enterprises which have more access to credit had less inefficient than those which had not sufficient access to credit.

5. Conclusions and Recommendations
This study was undertaken to estimate the technical efficiency and to identify the determinant factors Enterprises in Hadiya Zone, Ethiopia. For this end, the study examined relevant literature, the national enterprise development strategy and programs and carried out the study to attain the intended objective. The study was mainly based on the primary data which were collected from sampled 212 Enterprises that were randomly drawn from Hadiya zone three *Weredas* and six *Kebeles* through multi-stage sampling technique. The secondary data were also obtained from published and unpublished annul reports and other relevant organization documents to support the primary data and describe the study area.

From the total inputs allocated for milk production, unconcentrated feed and veterinary medicine turned out to be insignificant. But cow, concentrated feed, labor and land were significant. The elasticity of cow is very high implying that these have more effect in determining the output level at the best practice (the maximum technical efficiency score). The positive coefficients of inputs indicate a 1% increase in cow, concentrated feed, labor and land yields 34.54%, 13.25%, 47.49%, 15.28%, increase in milk output improvement, respectively for total sample MSAEs; in the case of micro level enterprises 1% increase in cow, concentrated feed, labor and land yields 45.98%, 8.45%, 9.93% and 15.66% increments on milk yield. In the same manner for the small level enterprises 1% increase in cow, concentrated feed, labor and land yields 36.21%, 8.89%, 7.43% and 17.66% increments on milk output respectively.

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the random variability that are outside their control of the producers.

The AE of total sample Enterprises were also statistically and significantly determined by number of employee, experience of manager and access to market in the study area at different levels of significance. Further the AE of micro level enterprises were statistically and significantly influenced by number of employee and gender of manager at different levels of significance. Finally, the AE of small level enterprises were statistically and significantly affected by age of enterprises, number of employee, experience of manager and access to credit in the study area at different levels of significance.

The overall results of the study implies that the major improvements related to MSAEs' allocative efficiency as well as on their determinant factors would require attention on the identified significant factors. Generally, there is no single policy and strategy that can be recommended to improve the allocative efficiency as well as their determinant factors. Hence, the findings of this study unveil the need for implementing different policies and strategies that separately target and address the specific issues of MSAEs' allocative efficiency and their determinant factors.

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