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# PRODUCTION AND MARKETING EFFICIENCY OF DAIRY FARMS IN HIGHLAND OF ETHIOPIA- AN ECONOMIC ANALYSIS

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**ABSTRACT**

Ethiopia has the largest livestock population in Africa but the contribution of this resource to the economy is limited and yet the country is in poverty. Dairy development has a big role for the contribution of income generation and employment. Demand for dairy products seems to exceed supply in the country in general and the study area in particular. Hence, the situation of dairy production and marketing issues is needs to be discussed and analyzed. This paper is based on a research study among 168 dairy farms (85 cross breed and 83 local breed) in a town (Mekelle) of northern Ethiopia. A two stage stratified random sampling procedure was used to select the specific farm households. Farms owning 1-3, 4-10 and greater than 10 dairy cows were classified as small, medium and large farms, respectively and only small and medium size farms were considered for further data collection. In this study an attempt has been made to evaluate the efficiency of inputs use, assess profitability and analyze the efficiency differentials of modern (cross breed) and traditional (local breed) dairy farms. Cobb-Douglas production, cost-benefit and break-even ratios are employed to assess resource use efficiency, profitability and financial efficiency of both cross and local breed dairy farms.

The results indicate that the regression coefficients with respect to concentrate for medium and small size cross breed farms are positive and significant at 10% level. The coefficient of dry fodder for medium size cross breed and local breed are positive and significant at 10% level. The marginal value products (MVPs) and the ratio with price for concentrate were higher for medium size than small size cross breed farms. The MVP for dry fodder, the return is higher in medium size cross breed and local breed farms. There is difference between the present and optimum levels of inputs.

The C:B results indicated that cross breed farms were profitable (1.0:3.02) than local breed farms (1.0:2.18). Both medium and small categories of cross breed farms were

profitable (1.0:3.45 and 1.0:2.74). Among local breed, medium size farms are profitable (1.0:2.19). The ratio of break-even milk output for cross breed and local breed cows farms needed 13% and 18% additional milk production to cover fixed cost, respectively. To conclude, dairy cow's owners should be advised to use the optimum levels inputs and replace their indigenous cow with cross breed cow. Moreover, the herds should be medium size and feeding mainly depends on concentrate.

***Key words:*** Dairy farms, Production, Marketing, Efficiency, Profitability, Marginal Value products

## Background

Now a days people are thinking not only about the future for better life, meet the millennium goals in integrated fashion and reducing environment pollution but also incorporating mainly livestock & their products supported with research and development tools. Dairy sector is a major contributor to economic development, especially among the developing countries, both driving economic growth and benefiting from it. As an engine of growth, it provides increased income, employment, food and foreign exchange earnings as well as better nutrition. As income increases with economic development, the share of animal products in total food budget increases faster than that of cereals. This occurs because of the relatively high-income elasticity of demand for animal products *(*Ehui S. 2008).The dairy industry may be viewed as a distinct sector of the livestock economy.

To resolve the overall food, health and education problems occurring in the world today, international development goals were set that are directly or indirectly associated with livestock sector even more too dairy farming (DFID, 2005). According to the trend analysis done by Cristopher et al. (1999) annual growth for milk demand has increased from the lowest 0.2% in developed countries to the highest 3.3% in developing world and in sub-Saharan Africa 3.8% during the period of 1993-2020. This explained generally that the per capita milk consumption will be 30 Kg, 62 Kg and 189 Kg for sub-Saharan Africa, developing and developed countries respectively by 2020.

There is also a belief that total consumption of milk in the developing countries is projected to increase from 64 million metric tones in 1993 to 391 million metric tones by the year 2020, which is 138 percent increase. In the same token, per capita consumption is expected to increase from 38 kg to 62 kg /person. Much of this increased demand will be in urban centers in which population is to grow at a rate of 5-6 between 1990-2025 *(Mihre, 2006)*. There are cases now that the rapid growth in consumption has been covered by imports of substituting nature for dairy products such as powder milk (Amha, 2008). Moreover, the trends of population increase; income growth and urbanization will fuel this tremendous growth in demand. It is also natural that urbanization accompanied by modern style of life demands for a shifting of dietary preferences towards better quality food items such as meat, milk and eggs (Harold G.Halcrow, 2007).

Marketing is another dimension which needs serious focus other than the available potentials. Despite the need for food and pertinently for livestock products mainly in undeveloped countries, small scale producers have constraints on global markets. This is more sensitive in milk and milk products. Therefore the need for technologies and access to transport in turn stimulating establishing of dairy farms in urban and peri-urban areas that are more feasible relatively than rural areas (DFID, 2005).

Marketed dairy production is already increasing in the urban centers as a direct response to consumer demands either by smallholders or commercial dairy enterprises. For smallholders, dairying allows year round employment for the family labor force, and milk often plays the role of a “cash crop", hence increasing regular income (Mahamed, 2007). Even though in a process of dynamic change, market oriented dairy production is facing several constraints in its sustainable development. These address the different components: animal feed resource upgrade, genotype and management of reproduction, disease, marketing mechanisms, environmental impact, and policy environment.

As a consequence of the magnitude of the challenge and the good prospects of market oriented dairy production in many African countries, dairy systems have become a priority area for research and development. This could have a significant implication in bringing to a harmony-dairy production and urbanization.

Ethiopia is one of the countries of Sub-Saharan Africa has the largest livestock population, and is ranked to be the ninth in the world. Yet its contribution to the economy is limited and remained to be a quantitative boost (Amha, 2008). Population in Ethiopia is growing at a rate of 2.9% per year while the urban population increases at the rate of 4.4%. Therefore, an increasing population size and consumer income in the future is expected to increase liquid milk consumption. Dairy production is an important issue in Ethiopia’s-livestock-based society where livestock and their products are important source of food and income, and dairy has not been fully exploited and promoted (Tangka et al., 2006).

The country holds large potential for dairy development due to its large livestock population; the favorable climate for improved, and the relatively disease-free environment. Given the considerable potential for smallholder income and employment generation from high-value dairy products, development of the dairy sector can contribute significantly to poverty alleviation. Like other sectors of the economy, the dairy sector in Ethiopia has passed through three phases; these include the imperial regime, characterized by almost a free market economic system and the emergence of modern commercial dairying (1960-1974), the socialist Derg regime that emphasized central economic system and state farms (1974-1991), and the current phase under the structural adjustment program and market liberalization (1991 to present), following the economic and political policy in the country. In the most recent phase, characterized by the transition towards market-oriented economy, the dairy sector appears to be moving towards a takeoff stage. Subsequently, several macro and sectoral economic policy changes were implemented. The federal government launched a national development strategy namely, Agricultural Development Led Industrialization (ADLI) and this seeks to bring about an

improvement in the livestock sector by enhancing the quality and quantity of feed, and improved extension services, increasing livestock health services and improved productivity of local cows by artificial insemination while preserving the indigenous breeds (Mohamed et al., 2007).

Efficient milk production is a key to sustainable development of dairying. Feed cost can be a major burden to use animals of good genetic merit. High disease incidence in the context of developing countries also compounds the main problem of research. In summary development and extension services in animal breeding, feeding and animal health are the core elements to underpin efficient milk production.

Peri-urban and urban dairy production system is becoming an important supplier of milk products to urban centers, where the demand for milk and milk products is remarkably high. As a result of this, peri-urban and urban dairying is being intensified through the use of cross breed dairy cows, purchased and conserved feed and stall-feeding. These production systems are favored due to the proximity of the production sites to centers of high fresh milk demand, easy access to agro-industrial by- products, veterinary services and supplies (Azage et al., 2006). Nonetheless, the existing dairy farming practices in peri-urban and urban areas of the country in general and that of Mekelle town (study area) in particular is largely traditional characterized by low inputs and management of indigenous genotype breed, zebu cattle that are low in milk production. However, it accounts for the greater proportion of dairy farming and milk production in peri-urban and urban areas. On the other hand, modern dairy farming practices cover a range of intensive management practices and zero grazing. This production system also involves the use of exotic crossbreed genotypes that give high yield as compared to the traditional dairy farms. Both practices are confronted with the problem of competing for scarce resources. Nonetheless, these resources have to be optimally and efficiently utilized on the bases of their marginal value productivity in order to get maximum income from dairy enterprises.

At the national level and the regional level (Tigray), cattle population respectively is believed to be 30 million and 3,426,269. Thus, out of the total cattle population of the country, Tigray region accounts for 7.16 percent. It is also estimated that 50% of the cattle in Tigray are cows out of which 25% to be lactating for 3-4 months. This gives a total milk production of 2.4 million litters per year for a population of 4,334,996, and the total calorie intake of dairy products is below the national level (Hailu, 2005). In the study area, currently the total livestock population is estimated to be about 60,000 (Regional Bureau of Agriculture, 2007). The total numbers of lactating (milking) cows are estimated to be 7,584 in which a cow gives an average of 10 liters/day. This means there is a daily supply of 75,840 liters in the town. However, as compared to the total population of Mekelle (236,000), the supply of milk is very small regardless of the culture and milk consumption pattern of the society (CSA, 2007).

The herd size kept by dairy farmers in Mekelle town is not evenly distributed. There is a herd size variation ranging from one cow to the largest size even greater than ten. The majority of farms keep up to 6 cows. It is believed that this variation in herd size in turn lead to differences in efficiency of resource use and profitability of farms. However, the

variation in economic efficiency and profitability of milk production among farms of various size of this important sector in Ethiopia in general and urban dairy (Mekelle) in particular has not been extensively studied. Even though dairy farms are a source of income and job opportunities to the dwellers and dairy farms households, the variation in cost, return and usage of important inputs between traditional (local) and modern(cross breed) urban dairy farms need the gap to be filled. Hence this study has been carved out to assess the status of dairy farming system and marketing in Mekelle town.

**Objectives:** The overall objective of the study is to assess the production and marketing efficiency of dairy farms in the study area and the specific objectives are….

- To assess the overall dairy production and marketing system in Mekelle town.
- To analyse the profitability of local and cross breed dairy farms of varying herd sizes (small and medium).
- To evaluate the contribution of dairy sector on employment and income generation.
- To pinpoint the challenges faced by dairy farmers in the study area.

**Materials and methods**

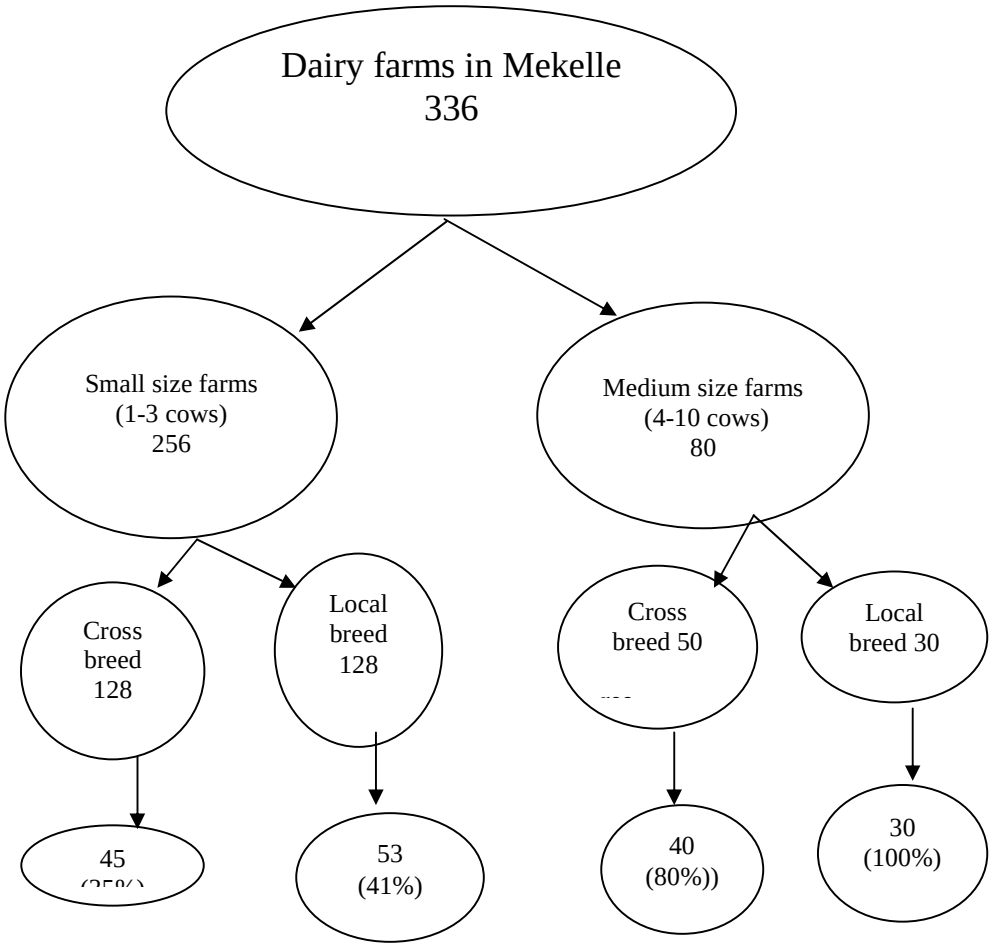
This study has been carried out in one of the towns (Mekelle) in northern Ethiopia. It is observed that mostly there are two categories of dairy farms (small and medium) practiced in the town. The research mainly focused on the situational assessment and analysis of dairy production, distribution and marketing pattern in the town. It attempted to address the efficiency differentials between small and medium size farms comprising both traditional (local cows) and modern (cross breed) dairy cows.

A two stage stratified random sampling procedure was used to select the specific farm households. Prior to sampling, complete listing of all the dairy farms in the town was conducted including breed types (local and cross) and herd sizes. For the purpose of present study the dairy farms were categorized into small, medium and large based on the herd size. The dairy farms categories and herd size of the farm used by Woldu Techane (2006) in Mekelle town and the surrounding peri-urban areas was adopted. Accordingly, farms owning 1-3, 4-10 and greater than 10 dairy cows were classified as small, medium and large farms, respectively. The result indicated that there were only few large dairy farms of both local and cross breeds. Therefore, only small and medium size farms were considered for further data collection. Out of the cross breed cows forms, 128 households were categorized as small farm size group and the remaining 50 households categorized as medium size group. Regarding local cows owners, 128 households belong to small size group and the remaining 30 households belong to medium size group.

From the total 336 dairy farms in the selected town, 168 dairy farms were considered for the study and is account for 50%. Out of this, the number and the respective proportion of small and medium size were 98 and 70, respectively. The total number of medium sized farms with local breed cows was 30; hence, all of the 30 medium size

farms were included. Out of 50 medium size cross breed dairy owners, 40 household were selected. Similarly from 98 small farms, 45 small size cross breed and 53 local breed cow farms were randomly selected. Summary of the dairy farms included under each of the four farm size categories are shown in figure 1.

**Figure 1: Sample farm size categories**




To study the production and marketing of dairy farming, one year (2010) cross-sectional data was collected using pre-tested structured interview schedule. The primary data mainly include the quantities and monetary value of the various inputs and outputs for one year, herd structure of current stock (calves, bulls, heifers, cows etc), breed type, and current value of the animals, income sources (including sales of milk and milk products), types of feed, amount and sources of feed (purchased and/

or produced), price and amount of each input, milk and milk by-products produced and consumed, number of milking cows, age and stage of lactation etc., current liabilities, fixed assets: types and year of purchase, sources and amount of labor (family, hired labor) etc. In addition, secondary data was also exploited to the desired level to strengthen the report.

To summarize the primary data simple analytical tools like tables and percentages are used to describe households and farms characteristics. In addition, data on quantities of inputs, cost incurred in milk production, amount of milk produced, return obtained from milk and milk by-products are summarized by using production function model as well as cost-benefit and break-even analysis for the four categories of farms.

**Production Function Analysis:** The Cobb-Douglas production function model was fitted to data collected from sampled dairy farms. The model was fitted separately to data collected from the four categories of farms. The following specific equation has been used.

$$Y=b_0X_1^{b1}X_2^{b2}X_3^{b3}X_4^{b4}X_5^{b5}X_6^{b6}X_7^{b7}e^u \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \textbf{(1)}$$

Were,

Y= Milk output/cow in Liters

$X_1$= Concentrate / cow/ in quintals

$X_2$ =Dry fodder/ cow/ in quintals

$X_3$= Green fodder / cow / in quintals

$X_4$ = Labor / cow/ in man days

$X_5$= Cost of miscellaneous / cow/ in Birr

$X_6$= Stage of lactation / cow

$e^u$= error term

$b_0$ is the constant term (intercept) and $b_1$, $b_2$, $b_3$, $b_4$, $b_5$, $b_6$ are partial regression coefficients of Y with respect to $X_1$, $X_2$, $X_3$, $X_4$, $X_5$, $X_6$ variables, respectively. $e^u$ is the random error term; assumed to follow Normal distribution with zero mean and constant variance. Zero order correlation was estimated to assess whether the multicollinearity exist between explanatory variables. Cobb-Douglas production function was estimated using ordinary least squares (OLS). Cobb-Douglas production function is a power function; it was transformed into linear form by taking the logarithm of the Y and 'X' values. The resulting transformed form of the equation was used to estimate the parameters.

$$\text{Log}Y = \text{Log}\, b_0 + b_1 \text{Log}\, X_1 + b_2 \text{Log}\, X_2 + b_3 \text{Log}X_3 \; b_4 \text{Log}\, X_4 + b_5 \text{Log}\, X_5 + b_6 \text{Log}\, X_6 + \text{Log}E$$

A multiple linear regression analysis was estimated and the independent variables considered were quantities of concentrate, dry fodder, green fodder in quintals, and labor in man-days and miscellaneous expenses in Birr (National currency). In addition, stage of lactation of a cow was also included as independent variable. These variables were selected because they are used as inputs in the milk production process. Similar studies (Sharma et al, 2005 and Deepak et al., 2003) also used most of these variables to assess their influences on milk production.

**Definition and measurements of variables**

***Milk output:*** The whole milk produced in the study year in terms of liters was considered as dependent variable. The produced milk sold and/or consumed in the home as well as feed for calves were recorded as a whole milk. In this study produced milk was evaluated as price of Birr 6/ liter.

***Concentrate:*** Concentrate is one of the feed types used in most of the dairy farms in the study area. Concentrate feed is formulated mainly from bran mixed with bone meal and salt. In some farms bran is mixed with by-product of local drinks. The price of concentrate is determined based on the type of bran and mixed materials. The price offered by farmers for a quintal of concentrate was fluctuating in the study period. For this study the purchasing price of concentrate was taken as Birr 178/ quintal (100kgs).

***Dry fodder:*** Dry fodder can be in the form of hay, straw of barley, wheat and teff as well as maize stalk. Most farmers used a combination of the above fodder type purchased at harvest time and stored to be utilized in the forthcoming dry period. The price of dry fodder depends on the type of fodder and their availability. One fodder type can be a substitute for other. Farmers can use barely in place of maize stalk and wheat straw in place of barely straw or vise versa. Therefore, the price for a quintal of dry fodder is estimated at Birr 30 average for each fodder type in the study area.

***Green fodder:*** It includes wet grasses and leaves of maize. The supply was mainly at rainy time in case of grass and at early (succulent) stage of maize plant. Green fodder used by most of those dairy farms located at the boundary of the rural areas. The price offered by the dairy farmers depends on the amount, type and the distance of the suppliers. For this study the purchased price was taken as Birr 25 for a quintal.

***Labor:*** Family and hired labors are the sources of labor input in the study area. The family labor used was evaluated on the bases of man-days, which is eight working hours considered as one man-day. For hired labors the actual payment was taken as cost of labor input by converting man-days. The wage rate was estimated at Birr 5/ person/day.

***Miscellaneous cost:*** This cost is part of operating expenses incurred to purchase miscellaneous inputs other than those inputs indicated above but used for milk production in the study area. Since the expense was part of capital, the opportunity cost for one Birr additional cost on these inputs taken as one Birr plus the interest charge at prevailing 4%, which comes to be Birr 1.04.

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***Stage of lactation:*** The potential of cows in milk production could be directly related with the age and stage of lactation. Cows at early and late stage of lactation produce relatively lower yield than those cows at an intermediate lactation stage. Stage of lactation of a cow is directly related to age, there is a considerable variation in the persistency of milk production following peak production in early lactation (Compbell et al, 2006).

**Estimation of marginal productivity**: Factors of production were derived at the mean of each factor (input) used and output. Thus marginal value of productivity of each factor was computed as derivative of output i.e. income from milk with respect to input at its mean level computed using the respective $b_i$ of the Cobb Douglas production function, other things held constant. The MVPs in monitory term of input was computed for those inputs statistically significant in the estimated production functions.

$$MVP_{xi} = b_i \frac{\overline{Y}}{\overline{X}_i} \quad \text{..... (2)}$$

Where;

$b_i$ =Elasticity coefficient of $i^{th}$ input in production function

$\overline{X}_i$ =Geometric mean of $i^{th}$ input

$\overline{Y}$ = Estimated levels of return from milk when all inputs are at geometric mean level

Production was said to be efficiently organized under perfectly competitive condition in the output and input markets when the marginal products were equal to their respective factor costs. And $\overline{Y}$ was computed when all inputs were fixed at their sample mean and, multiplied this quantity with $b_i$ the coefficient of $X_i$ and divided by $\overline{X}_i$ obtained the MVP of $X_i$ when input was at the mean level.

**Return to scale:** One of the most important measures in the study of production and resource use is the concept of elasticity. The elasticity of production indicates the change in output relative to the change in input. Partial regression coefficients of the production function equation were considered as elasticity coefficients of the independent variables and indicate the contribution of those inputs in the value of milk and milk by-products. Thus, partial regression coefficients measure the individual contribution of the respective inputs. These $b_i$ values were then summed up to measure the aggregated percentage share of the independent variables of milk production for the four categories of farms. The sum of elasticity coefficients measure the percentage changes in dependent variable for a percent change in the independent variable. The sum of elasticity equals to one, less than one and greater than one

indicated constant, decreasing and increasing return to scale change in the independent variable, respectively.

**Farm Efficiency and Profitability Analysis:** In this study, cost-benefit ratio and break-even analysis were carried out to measure the efficiency and profitability differences among the four categories of dairy farms. Cost-benefit ratios were computed for the four categories of farms studied. To this effect, the annual total production cost and gross return values were estimated for four categories of farms. The following formula was employed.

$$\text{Cost} - \text{Benefit Ratio} = \frac{\text{Gross return}}{\text{Total production cost}} \quad \text{---------- (3)}$$

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Break-even output was computed based on total fixed cost per animal and the differences between price and variable cost per liter of milk. The following formula was employed.

$$\text{Break – even output} = \frac{\text{Total fixed cost per animal}}{\text{Price per liter – variable cost per liter}} \quad \text{----------(4)}$$

Break-even output is the output level at which farms needs to produce to cover their fixed cost incurred in the production. The estimation of break-even output consider the average fixed cost and milk produced per cow, variable cost and selling price of a liter of milk. The variable cost per liter was obtained from average variable cost divided by average milk yield of a cow. For the analysis the average market price of 6 Birr/litter over the study period was considered. The percentage share of break-even output from the actual milk produced was derived from the break-even output divided by the actual average milk production to assess the efficiency and profitability of farms and to make comparison among the four categories of farms studied.

**Results and discussion**

***Dairy production and marketing system in the study area:*** Generally there are two major milk production systems viz. (a) Modern/intensive dairy farms and (b) Smallholders dairy farms exist in the study area. Under the first category three modern dairy farms namely: *Kalamino, Agazi* and *SOS* dairy farms are available***.*** They have modern management systems and supply better quality milk and milk products. These farms in establishments have their own respective motives besides their common practical supply of fresh milk to the market. *Kelamino* dairy farm is located in the southern part of Mekelle and was established in 1996 by Tigray Development Association (TDA) as part of its development schemes with the objective of producing and supplying fresh milk to the people. The market outlets are government and non-government employed clients mainly on contract or monthly payment basis, and also on daily basis, which accounts insignificant in amount. *Agazi* dairy farm is situated in the northern part of the town, was established by rehabilitating members of the Tigray People Liberation Front war veterans in 1994, considering Mekelle as its target market. However, SOS dairy farm was established in 1978 intended to supply dairy products to the children of Mekelle SOS Children's Village, since it is a welfare organization. The total milk production for each dairy farm is given in Table-1

**Table 1. Milk production in the study area by the modern dairy farms, 2010**

| Name of the farm | Nº of lactating cows | Total milk production/day | Average milk /cow |
|---|---|---|---|
| Kalamino | 72 | 600 liters (54.5%) | 8.33 liters |
| Agazi | 44 | 400 liters (36.4%) | 9.10 liters |
| SOS | 10 | 100 liter (9.1%) | 10 liters |

| | | | |
|---|---|---|---|
| **Total** | 126 | 1100 liters | 8.7 |

***Source:*** Respective (Kalamino, Agazi and SOS) working documents of the farms

As can be observed from the table 1, the total daily production of milk is high in *kelamino farm* and the lowest being in *SOS* farm that corresponds to the existing proportional number of lactating cows in each respective farm. However, the average milk production per cow is high in SOS dairy farm, which is 10 liters. This might be due to the small size of the milk cows (10) in number that increases efficiency in management and there by productivity.

The second category of the dairy farms in the study area has been under taking at household level and the production system is not a uniform pattern. Different features of these farms are (i) Small holders who purely produce and supply fresh milk to the Market. (ii) Small holders who produce milk but supply their products to retail shops (iii) Mixed small holders mainly located in the peripheral of the city and cereal production is their main occupation but they also raise animals for draught and produce milk to sell in the market.

***Farm and household characteristics:*** The results show that out of total farms surveyed (168), 75% owners are male-headed household and the remaining female-headed households. Cross breed farms owned by female headed households are less compared to male-headed households. The educational status shows that majority (60.2%) of the respondents have studied up to $6^{th}$ standard. Regarding input use for dairy cattle, majority (52%) of cross breed cow owners used concentrate (bran and oilcake), as well as rouphage (hay and green fodder) where as, majority (60%) of local breed farms used mainly green fodder. It was also observed that cross breed farm owners spent 10% of their income for electricity, water, medicine and veterinary service etc. Some households incurred transportation expenses for disposing cow dung.

Both hired and family labors were used in the study area in dairy farming activities. Majority of cross breed dairy farms owners (73%) used hired labors while majority (77%) of local breed farm owners' used family labors. Utilization of family and hired labor in different activities of dairy farming was also assessed. In case of local breed farms, milking, feeding and cleaning activities were done by family labor as reported by 99% of the sample. With regard to division of labor among female and male in case of cross breed farms, milking, managing the farms and selling of milk and milk by-products were performed by females while, feeding, cleaning, guarding and purchasing of inputs were done by male.

The average age of the surveyed cows was 7.2 years for local breed and 6.05 years for cross breed farms. Thus, cross breed cows are younger and relatively started producing milk at earlier age than local breed cows. The overall stage of lactation (the number of calving time by a cow) for local breed farms was 3.2 and that of cross breed farms was 3.1. The average milking days of local breed cow farms was 227 days while it was 237 days for cross breed cows/year. The milking days of a cow for medium size cross breed cows owner farms (288) were larger than a cow in medium size local breed farms (199). The overall average milk production for cross breed cows owning farms

was 2292 liters per cow per year and that of local breed cow farm was 573 liters per cow/year. The average milk production of a cow was 2162 and 2598 liters per year for medium and small size cross breed farms respectively and that of local breed cow was 533 and 647 liter per cow per year for medium and small farms respectively

As the survey indicates, most dairy farmers do not take dairying as sole career except 27% of the respondents. However, 50% of them have supplemented their life earning by other private activities and 23% are civil servants. Therefore, dairy farming is not taken as an exclusive means of earning income by at least 73% of the total respondents.

Most of the dairy farmers are not using grazing system. 90**%** of the households depend on zero grazing, thus purchase feed for their cattle and only 5% of the dairy farmers use their own grass lands and the remaining using both. According to 80% of the respondents, animal feed is too expensive and also price varies with the changes in seasons, especially that of hay and crop residues. Due to this the production cost is high since the region is draught prone and the scarcity of factories that provide their by products as feed. This obviously negatively affects the profitability of milk in the market.

It is interesting to note that market oriented milk production system was started in the study area before 30 years. On the demand side the consumers of milk are different natures among which 60% are households' and the remaining 40% are institutions like colleges and hospitals. More than 80% of the respondents agreed that they get market to their products at the minimum price of Birr 6/liter. However, there is no smooth process of selling their milk products all year round. Rather about 83% of them are suffering from absence of market during the Christian fasting that accurse at different intervals of the year, particularly, the longer fasting period before Easter and 15 days in August.

Though the unsold milk is used in different forms (self consumption, distributing to neighbors and relatives), they realized this milk as wastage. Some of them are converting the milk into butter. 10 liters of milk almost produces 1 kg butter that could get a selling price of Birr 60. Since the shelf life of butter is long the producers could accumulate and sell it during the non-fasting period. But all the producers not uses modern machine (chroner) to separate butter from milk. They rather use the cultural method of separation which yields less output.

### Production Function Analysis Results

The estimates of the production function analysis and associated parameters, standard error, t-test value of the estimates as well as the adjusted $R^2$ the coefficients of determination, the sum of regression coefficients, the F-test values are presented in table 2. The coefficients of determination, the adjusted $R^2$ values for medium and small size cross breed farms are 0.49 and 0.52, respectively. The values for medium and small size local breed farms are 0.57 and 0.47. The value of adjusted $R^2$ shows that 49% and 52% of the variation in milk production for medium and small size cross breed farms as well as 57% and 47% of the variation in milk output for

medium and small size local breed farms would be explained by the explanatory variables in the production function. Hence, inputs are critically limiting the production of local and cross breed farms. The F-values of the regression analysis are also significant at 10% level for all farm size categories.

The regression coefficients ($b_i$) estimated in the production function, the values of concentrate are positive and significant at 10% level for medium and small size cross breed farms. Same in the case of local breed farms. This means the analyst has 90% confident that this input contributes in medium and small size crossbreed farms for output but has small difference whether this input is used or not in the case of medium and small size local breeds farms. Therefore this input accounted for a significant share in cross breed owning farms than local breed owning farms from the point of production cost. The over all annual production cost for cross breed and local breed are 39% and 26%, respectively.

The coefficients for dry fodder are positive for all farm size categories, but significant at 10% level for medium size cross and local breed farms and significant at 5% level for small size local breed farms. Where as dry fodder is insignificant for small size cross breed farms. As the test result indicated using dry fodder was more precise in small size local breed than medium cross breed and medium local. This input accounted for a significant share of production cost in local breed farms than cross breed farms.

The coefficients for green fodder are positive but insignificant for medium and small size cross breed and positive and significant at 5% level for medium size local breed farms, while negative and insignificant for small size local breed farms. The test result indicated that there is no more difference to use this input for medium and small cross breed but significant at 5% in the case of medium size local breed. Green fodder accounted for a significant share from the total production cost for local breed farms than cross breed farms but the negative and insignificant coefficient indicates the absence of green fodder to milk output.

Regarding the coefficients for labor, they are negative and insignificant for medium size, positive and significant at 5% level for small size cross breed farms and positive and insignificant for medium and small size local breed farms. As it is estimated, the analyst has 95% confident that labor contributes highly for small size cross breed farms and has less contribution both for medium and small size local breed but this input indicated the absence of its contribution to milk output incase for medium size cross breed farms. This input accounted for a significant share of production cost in small size cross breed farms.

The coefficients for miscellaneous cost are negative and positive for medium and small size cross breed farms, respectively, while positive and significant at 10% level for medium and small size local breed farms. As it is estimated, the analyst has 90% confident that miscellaneous cost has highly needed for medium and small size local breed but it indicated the absence of its contribution to milk output for medium size cross

breed. Therefore this input accounted for a significant share in local breed farms than cross breed farms in terms of cost. Because the over all annual production cost of local breed was 7% which is less than cross breed farms (10%).

With respect to the coefficients for stage of lactation, they are positive and insignificant for medium and small size cross breed and medium size local breed farms. It is negative and insignificant for small size local breed farms. As it is estimated, the share of stage of lactation has small difference for medium and small size cross breed and medium size local breed farms. These negative and insignificant coefficients of the respective independent variables indicate the absence of their contribution to milk output in the study area.

In general the regression coefficients of the production function indicates, cross breed farms are more beneficiary from the inputs concentrate and labor than other inputs. These farms need more production cost for these inputs so as to get more return. On the other hand using more dry fodder and green fodder is more important for local breed farms in terms of cost-benefit analysis. These farms need high cost for green and dry fodder but need less miscellaneous cost to get more return. Hence local breed owning farms prefer to use these inputs.

**Table 2. Estimated production function coefficients**

| Inputs | Farm size categories | | | |
|---|---|---|---|---|
| | Cross breed | | Local breed | |
| | Medium | Small N=45 | Medium | Small N=53 |
| Constant term | 5.78 | 5.15 | 4.19 | 4.99 |
| Concentrate (qt) | | | | |
| $b_i$ | 0.36* | 0.26* | 0.015 | 0.12 |
| SE | 0.19 | 0.12 | 0.059 | 0.08 |
| t | 1.88 | 2.20 | 0.261 | 1.45 |
| Dry fodder (qt) | | | | |
| bi | 0.15* | 0.097 | 0.26* | 0.136** |
| SE | 0.08 | 0.069 | 0.142 | 0.065 |
| t | 1.86 | 1.42 | 1.83 | 2.08 |
| Green fodder (qt) | | | | |
| $b_i$ | 0.017 | 0.06 | 0.184** | -0.012 |
| SE | 0.082 | 0.06 | 0.076 | 0.036 |
| t | 0.21 | 0.99 | 2.41 | 0.341 |
| Labor (man day) | | | | |
| $b_i$ | -0.029 | 0.27** | 0.063 | 0.036 |

| | | | | |
|---|---|---|---|---|
| SE | 0.23 | 0.14 | 0.219 | 0.156 |
| t | 0.13 | 1.87 | 0.288 | 0.23 |
| Miscellaneous cost (Birr) | | | | |
| $b_i$ | -0.04 | 0.145 | 0.157* | 0.179* |
| SE | 0.15 | 0.098 | 0.088 | 0.104 |
| t | 0.28 | 1.48 | 1.782 | 1.85 |
| Stage of lactation | | | | |
| bi | 0.16 | 0.022 | 0.09 | -0.103 |
| SE | 0.21 | 0.142 | 0.22 | 0.125 |
| t | 0.76 | 0.142 | 0.22 | 0.83 |
| $R^2$ | 0.49 | 0.52 | 0.57 | 0.47 |
| F-test | 7.68 | 9.75 | 7.95 | 9.40 |
| Sumof$b_i$ | 0.62 | 0.85 | 0.77 | 0.36 |

***Note:*** N= Sample size
$b_i$ = Elasticity coefficient
SE= Standard error
t =' t'- value
** = Significant at 5% level
* = Significant at 10%
level qt= quintal (100kgs)

**Return to scale**

The return to scale relationship between inputs and output could be seen from the sum of the regression coefficients (elasticities). It is assumed that the sum of elasticities of one, the return to scale is constant, if the sum is less than one, the return to scale is decreasing, and the sum of elasticities is greater than one indicates increasing return to scale. That means for equal proportion increase in inputs, the response of milk output is at equal proportion, the scale is constant, the response is less than proportional, the scale is decreasing, and the response is greater than proportional, the scale is increasing.

The sum of regression coefficients (elasticities) for medium and small size cross breed farms is 0.62 and 0.85, respectively. For medium and small size local breed, the sum of the regression coefficients is 0.77 and 0.36, respectively. The scale relationship between input and output (return to scale) are in the range of decreasing return to scale for all farm size categories. These results indicate that, for 100% increase of the inputs in the production, the milk output would increase by 62% and 85% for cross breed medium and small size, 77% and 36% for local breed medium and small size farms, respectively. The decreasing return to scale might be the results of diseconomies of scale because of some indivisible factors of production may become inefficient and less productive. And, the coefficients of input in the production function are negative. Therefore it can be concluded that for 100% increase inputs in the

production, the milk output would not necessary to increase by equal amount of proportion.

**Table 3. Marginal value product derived for significant coefficients by farm size categories**

| Inputs | Size categories | | | |
|---|---|---|---|---|
| | Cross breed | | Local breed | |
| | Mediu m N=40 | Small N=45 | Mediu m N=30 | Small N=53 |
| **Production elasticities ( $b_i$)** | | | | |
| Concentrates( qt) | 0.36 | 0.26 | - | - |
| Dry fodder ( qt) | 0.15 | - | 0.26 | 0.14 |
| Green fodder (qt) | | | 0.184 | |
| Labor (man days) | | 0.27 | | |
| Miscellaneous ( Birr) | | | 0.157 | 0.18 |
| **Sample means ( Birr)** | | | | |
| Concentrates( qt) | 24.74 | 28.08 | | |
| Dry fodder ( qt) | 24.82 | | 12.15 | 24.66 |
| Green fodder (qt) | | | 9.71 | |
| Labor (man days) | | 136.65 | | |
| Miscellaneous ( Birr) | | | 114.27 | 228.89 |
| **Milk output ( Liters)** | 2181.16 | 2484.83 | 493.57 | 639.1 |
| **Income from milk (Birr)** | 6543.48 | 7454.49 | 1480.71 | 1917.3 |
| **Marginal value products (MVPs) ( Birr)** | | | | |
| Concentrates | 96.66 | 67.91 | | |
| Dry fodder | 40.21 | | 31.69 | 10.88 |
| Green fodder | | | 28.06 | |
| Labor | | 14.73 | | |
| Miscellaneous | | | 2.07 | 1.51 |

***Note:*** N= Sample size
qt= quintal

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### Marginal value products (MVPs) of inputs

The efficiency of resources (inputs) was examined through marginal value products. The estimates of the MVPs worked out for those inputs found significant in the production function and they are given in value terms. Each value of the marginal product indicates that the expected increase in milk output (income) generated from the use of an additional unit of input factor, the value of other inputs remaining unchanged. The MVPs of any resource depends on the quantity of it already being used and on the level of the other resources with which it is combined in the production process (Heady and Dillon, 2003). Therefore, the value of marginal productivity of input factors are derived at the mean of each input factor level and output (milk). The marginal value productivity is computed as derivative of output (milk) with respect to mean level of inputs which found to be significant in the production function. The results of MVPs derived are given in table 3.

**Table 4. Estimated ratio of marginal value product to factor cost**

| | Categories of farm size | | | |
|---|---|---|---|---|
| | Cross breed farms | | Local breed farms | |
| **Description** | **Medium size** | **Small size** | **Medium size** | **Small size** |
| **MVPs (Birr)** | | | | |
| Concentrate | 96.66 | 67.91 | | |
| Dry fodder | 40.21 | | 31.69 | 10.80 |
| Green fodder | | | 28.06 | |
| Labor | | 14.73 | | |
| Miscellaneous cost | | | 2.07 | 1.51 |
| **Inputs cost (Birr)** | | | | |
| Concentrate /qt | 178 | 178 | | |
| Dry fodder/qt | 30 | | 30 | 30 |
| Green fodder/qt | | | 25 | |
| Labor/man day | | 5 | | |
| Miscellaneous cost | | | 1.04 | 1.04 |
| **MVPs/ Inputs cost** | | | | |
| Concentrate | 0.54 | 0.38 | | |
| Dry fodder | 1.34 | | 1.06 | 0.36 |
| Green fodder | | | 1.12 | |
| Labor | | 2.95 | | |
| Miscellaneous | | | 1.99 | 1.45 |

***Source:*** Primary data, 2010
***Note:*** N= Sample size

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### Comparison of MVPs of input factors with their respective costs

Production said to be efficiently organized under perfectly competitive condition in output and input relationship when MVPs are equal to their respective factor costs. To evaluate the efficiency of inputs and to perform comparison between MVPs and respective costs, the cost of the inputs have to be estimated on the bases of the nature of inputs and the prices offered in the milk production process in the study area. For the purpose of testing the resource efficiency, the ratio of MVPs to input factor cost is computed and the results are presented in table 4.

With respect to labor input, the MVPs for small size cross breed farms are 14.73 Birr but the input cost of labor/man/day is 5 Birr. That means the MVPs of these farms is more than the input cost of labor/man/day. Therefore, this input needs adjustment in the production process. The MVPs of miscellaneous cost is double than its price Birr 1.04 for medium size and higher for small size local breeding farms. For every one Birr additional investment incurred on miscellaneous inputs (1.51 Birr to 2.07 Birr) return. Thus, computation of optimal levels of inputs becomes evident which will be applied by the various sizes of dairy farms in the study area.

### Present and optimal levels of inputs

The results of Cobb-Douglas production function enable us to derive the optimum application of inputs for dairy farms in the study area. From the MVPs computed, it is possible to estimate the quantity of each input with other inputs at mean level, required to cause productivity to equal to factor price. The following formula was applied to determine the optimal input levels.

$$Px_i = \frac{bi}{x_i} y \text{ ---------- (5)}$$

$$X_i = \frac{b_i}{p_{xi}} y \text{ ---------- (6)}$$

Where, y is the output estimated at the mean level of inputs ($X_i$), $b_i$ is production function parameters, and $P_i$ is the market price of the $i^{th}$ input. In equation 5, MVPs is equated to market price of inputs, where satisfying the profit maximization criteria in perfectly competitive conditions of both output and inputs markets. Using equation 6, the optimum level of each input employed found to be significant in production functions were computed and presented in table 5.

The results of the computed optimum levels as compared to present levels of inputs shows that, the optimum level of inputs are increased by significant amount for the majority of inputs except for concentrate in small size cross breed and for dry fodder in small size local breed farms. The MVPs of optimum concentrate for medium size

cross breed has changed from 96.66 Birr to 178 Birr and that of small size cross breed farms has changed from 67.91 Birr to 178 Birr. With respect to dry fodder, the MVPs for optimum dry fodder have changed from 40.21 Birr to 30 Birr for medium size cross breed, and 10.80 Birr to 30 Birr for small size local breed farms.

**Table 5. Present and optimum levels of inputs/cow**

| Description | Categories of farm size | | | |
|---|---|---|---|---|
| | Cross breed farms | | Local breed farms | |
| | Medium size N=40 | Small size N=45 | Medium size N=30 | Small size N=53 |
| **Present levels of inputs** | | | | |
| Dry fodder/qt | 24.37 | 28.54 | | |
| Green fodder/qt | 24.41 | | 12.15 | 24.66 |
| Labor/ man day | | | 9.71 | |
| Miscellaneous cost | | 136.65 | | |
| **Optimum levels of inputs** | | | 114.27 | 228.89 |
| Concentrate /qt | 30.21 | 24.82 | | |
| Dry fodder/qt | 32.70 | | 12.84 | 8.88 |
| Green fodder/qt | | | 10.88 | |
| Labor/ man day | | 403.12 | | |
| Miscellaneous cost | | | 228.54 | 336.47 |

***Note:*** N= Sample size

**Table 6. Marginal value products derived for inputs at their optimum level**

| Description | Categories of farm size | | | |
|---|---|---|---|---|
| | Cross breed farms | | Local breed farms | |
| | Medium size N=40 | Small size N=45 | Medium size N=30 | Small size N=53 |
| **Coefficients** | | | | |
| Concentrate | 0.36 | 0.26 | | |
| Dry fodder | 0.15 | | 0.26 | 0.14 |
| Green fodder | | | 0.184 | |
| Labor | | 0.27 | | |
| Miscellaneous cost | | | 0.16 | 0.18 |
| **Optimum levels of Inputs / cow** | | | | |
| Concentrate /qt | 30.74 | 24.82 | | |
| Dry fodder/qt | 32.70 | | 12.84 | 8.88 |
| Green fodder/qt | | | 10.88 | |

| | | | | |
|---|---|---|---|---|
| Labor/ man day | | 403.12 | | |
| Miscellaneous cost | | | 228.54 | 336.47 |
| **MVPs/ Inputs cost / Birr** | | | | |
| Concentrate | 178 | 178 | | |
| Dry fodder | 30 | | 30 | 30 |
| Green fodder | | | 25 | |
| Labor | | 5 | | |
| Miscellaneous | | | 1.04 | 1.04 |

***Note:*** N= Sample size

The MVPs of miscellaneous inputs has changed from 2.07 Birr to 1.04 Birr for medium size local breed farms and from 1.51 Birr to 1.04 Birr for small size local breed farms (Table 6). Therefore the input changed for the variables at present level and optimum level is due to market price of the inputs. The present level of inputs is not efficient so farmers have to use the optimum level of inputs in order to get more profit.

**Farm Financial Efficiency and Profitability**

The farm efficiency and profitability of the four categories of cross and local breed farms were assessed and comparisons were made among categories using cost-benefit and break - even analysis.

***Production cost of dairy farms:*** The production cost comprises of variable and fixed costs. The variable cost of inputs included cost of concentrates, green fodder, dry fodder (hay, straw and aftermath), labor, medicine and veterinary service, interest on working capital and miscellaneous cost. Fixed costs include depreciation costs of animals, building and dairy equipments as well as interest on fixed capital. The average production cost of cross breed cow per year was Birr 5,690 and that of local breed cow per year was Birr 2,211. Out of this variable costs accounted for 83% (Birr 14,042) and fixed cost accounted for 17% (Birr 2963). The proportion of variable and fixed costs for small size cross breed farm was 85% and 15% and that of medium size crossbreed farm was 79% and 21%, respectively (Table 7).

The total production costs of local breed medium and small size farms were Birr 7,144 and Birr 4,009 per farm, respectively. For medium size local breed farms, variable cost accounted for 85% (Birr 6,108) and fixed cost accounted for 15% (Birr 1,036). In case of small size farms the variable cost accounted for 90% (Birr 3,605) and fixed cost 10% (Birr 404). Variable cost was bit higher (5%) and fixed cost was lower (about 5%) for small size farms as compared to medium size of both cross breed and local breed cow farms. The fixed cost is different mainly because of herd size and fixed investment associated to the size of the farms. One important reason for the low variable cost is the variability nature of the items with the herd size, as the herd size increases the amount of inputs incurred for some of the items do not make a

significant increase. Efficiency of the farms in the utilization of the cost items increases as herd size increases.

The overall share of variable and fixed costs was nearly in line with study done by Kalra et al.(2005) on economics of milk production and disposal in rural areas of Harayana, India. They reported that, the share of fixed and variable costs was approximately 85% and 15%, respectively. The findings were also in agreement with similar studies carried out by Alam et al. (2007) on the economics of dairy farms in selected areas of Bangladesh. According to them the share of variable and fixed costs was 87% and 13%, respectively. However, the results of this study were not in agreement with the study done by Bordoloi et al. (2006) on milk production under different categories of farms in India. They reported that the share of variable and fixed costs was 91.39% and 8.61%, respectively.

An examination of costs of cross breed farms, shows that, cost of concentrates was the major cost accounting for 39% (Birr 6,715), followed by dry fodder 16% (Birr 2,645), labor cost accounting for 11% (Birr 1,875), depreciation of cows accounting

**Table 7. Annual production cost of a dairy farm (Birr)**

| Cost items | Categories of farms | | | | | |
|---|---|---|---|---|---|---|
| | Cross breed | | | Local breed | | |
| **Variable cost** | Small | Medium | Overall | Small | Medium | Overall |
| Concentrates | 3790 (39) | 8210 (38) | 6715 (39) | 1226 (31) | 1521 (21) | 1333 (26) |
| Interest on operating | | | | | | |
| Dry Fodder | | | | | | |
| Green Fodder | | | | | | |
| Labor | | | | | | |
| Miscellaneous costs | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 468 | 793 | 621 | 400 | 994 | 615 |
| 1704 | 3260 | (5) | (4) | (4) | (10) | (14) | (12) |
| | 2645 | | | | | | |
| 848 | 1507 | 1120 | 2229 | 1875 | 734 | 1393 | 972 |
| | 1086 (18) | (12) | (10) | (11) | (18) | (20) | (19) |
| | (15) | | | | | | |
| | (16) | 869 | 2021 | 1697 | 291 | 515 | 372 |
| | (21) | (9) | (9) | (10) | (7) | (7) | (7) |
| | (21) | | | | | | |
| | (21) | 238.52 | 495 | 488 | 105 | 178 | 131 |
| Capital | | (2) | (2) | (3) | (3) | (2) | (3) |
| | | 8190 | 17007 | 14042 | 3605 | 6108 | 4510 |
| **Total variable Cost** | | (85) | (79) | (83) | (90) | (85) | (88) |
| **Fixed cost** | | | | | | | |
| ~~Depreciation of Cows~~ | | ~~32~~ | ~~128~~ | ~~77~~ | ~~14~~ | ~~20~~ | ~~170~~ |
| shed | | 1 | 7 | 5 | 8 | 9 | (3) |
| | | (3) | (6) | (5) | (4) | (3) | |
| Depreciation of Cows | | 765 | 2126 | 1406 | 154 | 470 | 268 |
| | | (8) | (10) | (8) | (4) | (7) | (5) |
| | | 61 | 174 | 114 | 11 | 121 | 51 |
| Depreciation of equipments | | (0.63) | (0.80) | (0.67) | (0.27) | (1.69) | (0.98) |
| | | 333 | 1044 | 668 | 92 | 236 | 144 |
| Interest on Fixed cost | | (3) | (5) | (4) | (2) | (3) | (3) |
| | | 1479 | 4631.50 | 2963 | 404 | 1036 | |
| **Total fixed Cost** | | | 632.50 (15) | | (21) | (17) | (10) |
| | | | (14.51) | | (12) | | |
| | | ~~9670~~ | ~~21639~~ | ~~17005~~ | ~~4009~~ | ~~7144~~ | ~~5142~~ |

Figures in parenthesis denotes

for 8% (Birr 1,406), miscellaneous cost accounting for 10% (Birr 1,697), depreciation of cows shed accounting for 5% (Birr 775), interest on fixed capital accounting for 4% (Birr 668), green fodder accounting for 4% (Birr 621), interest on working capital accounting for 3% (Birr 488), medicine and veterinary services accounting for 1% (Birr 212) and depreciation of equipments and others accounting for 1% (Birr 114).

The leading share of concentrate cost for cross breed farms was in line with study done by Kalra et al. (2005) and Alam et al. (2007) on small, medium and large size farms. They reported that concentrate was the major cost item. However, the rank and share of the remaining cost items were not in agreement with the results of this study. Moreover, the findings were not in line with the study carried out by Sayeed et al. (2004) on economics of dairy farms in Bangladesh. They reported that labor was the major cost followed by concentrates. Majority of cross breed farms used concentrates especially bran as main inputs and dry fodder (hay and aftermaths) as a main source of fodder than green fodder because farmers don't have land for fodder production. The depreciation of cows is the fourth important cost item because of the higher amortization value of cows in the study area.

***Annual average input cost/cow (Birr*)**: The overall average cost of concentrates for cross breed cow was Birr 2247 and that of local breed was Birr 573. The overall average cost of dry fodder for cross breed cow was Birr 885 and that of local breed was Birr 467. The overall average cost of green fodder per cow was Birr 207 and Birr 264 for cross breed and local breed respectively. And the overall average cost of labor per cow was Birr 627 and Birr 418 for cross breed and local breed respectively. The overall input cost of cross breed cow was Birr 3967 and that of the local breed was Birr 1722. Therefore this indicates cross breed farms take the highest input use than local breed farms. So it is advisable for the farmers to use some of the inputs like green fodder and dry fodder of their own. The Government should also give attention for the farm owners to get these inputs with affordable price.

***Returns from dairy farms:*** Revenue from dairy farms estimated by considering milk sold and consumed, sale of cattle, appreciation of cattle (i.e., calves heifers and young bull), cow dung and manure. On average milk price received by owners of all farm categories was Birr 6 per liter.

The highest share of total returns for the categories of cross breed farms was from milk and milk by-product (85%) followed by appreciation of calves and heifers (13%), sales of cattle (2%) and cow dung (1%). Sale of cattle contributed relatively more to the total revenue than cow dung for medium size farms because cow dung relatively incurred cost to dispose. Cow dung generates income for the majority of small size farms, since it is used as a source of fuel and manure (Table 8). The highest share of total returns for all local breed farms was also from milk and milk by products (81%), appreciation of calves and heifers (15%) followed by cow dung (3%), and sale of cattle (1%). The majorities of small size farms household are poor and resides at the periphery of the town, and used cow dung as sources of fuel and manure as compared to medium

size farms. Share of return from cross breed and local breed owning farms are almost in agreement with similar study done by Sadiq et al. (2006) in India. He reported that milk constituted the highest share (71%) followed by appreciation of calves and heifers (21%). Alam et al. (2007) also found that return from milk constituted the highest share (69.43%).

**Table 8. Annual return (Birr) and C: B ratio of dairy Farms**

| Return Components | Category of farms | | | | | |
|---|---|---|---|---|---|---|
| | Cross breed | | | Local breed | | |
| | Small | Medium | Overall | Small | Medium | Overall |
| Milk (Birr) | 25532 (96) | 64182 (86) | 43720 (85) | 4568 (81) | 12724 (81) | 9200 (81) |
| Sale of Cattle (Birr) | 252 (1) | 1603 (2) | 888 (2) | 55 (1) | 207 (1) | 110 (1) |
| Appreciation of Calves and Heifer (Birr) | 378 (1) | 8803 (12) | 6460 (13) | 774 (14) | 2465 (16) | 1630 (15) |
| Dung and manure (Birr) | 352 (1) | 234 (0.3) | 291 (1) | 248 (4) | 314 (2) | 291 (3) |
| Gross return (Birr) | 26514 | 74822 | 51359 | 5675 | 15710 | 11231 |
| Gross margin (Birr) | 18324 | 57815 | 34354 | 2070 | 9602 | 6721 |
| Net return (Birr) | 16844 | 53183 | 34354 | 1666 | 8566 | 6089 |
| **C:B (on total cost)** | **1.0:2.74** | **1.0:3.45** | **1.0:3.02** | **1.0:1.41** | **1.0:2.19** | **1.0:2.18** |

***Note:*** Figures in parenthesis denotes percentages

The gross return was higher for both medium size cross breed and local breed farms. On average a local breed owning farm earned a net return of Birr 6,089 per annum. Cross breed owning farm generated a net return of Birr 34,354 per year that was almost five folds greater than local breed farms. The net return of local breed per cow per year was Birr 2,619 and that of cross breed was Birr 11,496. The net benefit

increased as farm size increases both for cross breed and local breed farms. These results are almost in agreement with similar study done by Reijo (2007) in Northern Shewa Sellalie area in Ethiopia. Alam et al. (2005) also reported similar result that, medium size farms had higher gross margin than small size farms for both cross and local breed farms. However, this study results are not in agreement with the results of Chand et al. (2002) that gross margin of small size farms were highest (70%) than medium size farms (64%).

Overall cost-benefit (C: B) ratio of cross breed farm was 1:3.02 and for local breed farms 1.00:2.18. The average cost-benefit ratio (C:B) was 1:2.74 and 1:3.45 for small and medium size cross breed farms, and it was 1:1.41 and 1:2.19 for small and medium size local breed farms. These results indicate that, both cross breed and local breed dairy farms are profitable at Mekelle town. Cross breed medium size farms are making more profit than small size farms. Same in the case of local breed farms. These results wer in agreement with similar studies carried out by Sayeed et al. (2004) Also, Alam et al. (2005) reported similar results that medium size farms had highest C: B ratio (1:1.04) than small size farms (1:1.02).

**Break-even analysis**

The break-even level of output is an output level required to cover the fixed cost employed in the farm. The overall break-even average point for cross breed farms showed that the farm produced 2292 liters of milk per cow per year with a fixed cost of Birr 1,219 and variable cost of Birr 4,129 per cow per year. The break-even output was 290 liters per cow per year, which was 13% of the average actual milk yield of a farm per year. Similarly, for local breed farms a cow producing an average of 573 liters of milk per cow per year with fixed cost of Birr 273 per cow and variable cost of Birr 1,944 per cow per year, the break-even output was 104 liters. The small size farms owners were able to cover their fixed cost at lower milk production than medium size farms.

**Table 9. Break-even level of milk production across category of farms**

| Items | Farm types and categories | | | | | |
|---|---|---|---|---|---|---|
| | Cross breed | | | Local breed | | |
| | Small N=45 | Medium N=40 | Overall N=85 | Small N=53 | Medium N=30 | Overall N=83 |
| Milk yield/ farm/year (liter) | 4387 | 9620 | 6850 | 818 | 2168 | 1306 |
| Milk yield /cow/year (liter) | 2598 | 2162 | 2292 | 647 | 533 | 573 |
| Fixed cost/ cow/year(Birr) | 876 | 1041 | 1219 | 321 | 247 | 273 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Variable cost/ cow /year (Birr) | 4850 1944 | 3822 | 4129 | 2861 | 1454 | |
| Total cost/ cow/ year (Birr) | 5726 | 4863 | 5348 | 3181 | 1701 | 2216 |
| Variable cost/ liter of milk (Birr) | 1.87 | 1.77 | 1.8 | 4.42 | 2.73 | 3.39 |
| Price/ liter of milk (Birr) | 6 | 6 | 6 | 6 | 6 | 6 |
| Break-even out put / cow/ year (Liter) | 212 | 246 | 290 | 203 | 75 | 104 |
| % Of break-even milk output to total milk output | 8 | 11 | 13 | 31 | 14 | 18 |

***Note:*** N=Sample size

The break-even output results of local breed farms indicated that both farms were relatively inefficient than cross breed. Small size cross breed farms were at better position and efficient as compared to medium size cross breed farms, as they needed only 8% of the average milk yield to cover their fixed costs than medium size farms (11%). According to the estimated data in table 9, the cross breed farms are relatively efficient to cover their fixed cost than local breed farms. So it is preferable for the farmers to have cross breed cows than local breed because of high yield of milk.

**Challenge to dairy farms**

Different problems related to the dairy production and marketing in the study area were also explored from the dairy farmers. According to them credit is available almost all the time, however the loan repayment period is short and the interest rate is high which is discouraging from availing credit. The cost and availability of breed are the major problems and the average cost of breed cow was around 10,000 Birr which is beyond the capacity of many farmers; even if one can afford they are not available in the area. They have to bring them from places like Addis Ababa situated more than 800kms. Lack of feed and its cost is another major problem that may threaten the very existence of the Dairy farms. There is shortage of rain fall which results in poor grazing land. Dairy farmer's attempts to grow quality feed such as Alfa-Alfa, Lucinea, Suspenea but they have been aborted due to lack of water. Since quality feeds are not available in the market, the farm households are forced to buy poor quality fodder which has a negative effect on the milk yield. They also have shortage of land to cultivate quality feed. The other challenge is the non - availability of veterinary services at all times, particularly during the weekends and holydays. Poorly developed infrastructure particularly roads are major challenge in this area. Feed has to be brought in and product has to be taken mostly on foot and some times on donkey and horse carts. This exposes them to unnecessary expenses and loss of time as well as energy.

Interruption in the supply of electric power limited the capacity to store their products. There is no organized and established market for milk and milk products; no milk processing units, the product is sold directly to consumers like cafeteria, hotels and households. The other main problem is that there is long Christian fasting period accounting for almost 51% of a year. During this time there is wastage of milk since milk and other animal products are not consumed by the followers. From the problems stated above feed price and the long fasting period are the main problems as reported by Mekelle Bureau of Agriculture.

**Conclusion and Recommendations**

Ethiopia has the largest livestock population in Africa but the contribution of this resource to the economy is limited and yet the country is in poverty. Demand for dairy products seems to exceed supply in the country in general and the study area in particular. Dairy development has a big role in contributing income and employment. Hence, the research on the situation of dairy production and marketing issues in Mekelle is warranted. Empirical experiences proved that the goals of milk production are not the same in the

rural and urban areas. The latter is exclusively market oriented, be it at a household level or in the modern farms. However, whether the sector progresses in accordance to the pace of urbanization is under big question. In this study an attempt has been made to evaluate the efficiency use of inputs, assess profitability and analyze the efficiency differentials of modern (cross breed) and traditional (local breed) dairy farms.

Dairy production systems are of different varieties among which market oriented small holders and modern production systems are peculiar features to the urban centers. Research also proved that mixed farming system, which is dominant in the rural areas, also exists in the peri- urban areas of Mekelle. Dairying is considered as a supplementary job for the majority of the dairy farmers in Mekelle town. Farmers in both cases (small holders and modern) use different varieties of feed sources mainly agricultural products. However, the farmers entirely apply *zero grazing system*, which is expensive to attain it. The price of feed is too sour in the study area since it is drought prone area and the limited nature of agro processing industries that could supply industrial bi-products as source of animal feed.

The production function analysis indicates that concentrate is the most important inputs affecting milk production in the study area. The regression coefficients of this input were positive and statistically significant especially for cross breed cows farms with higher MVPs as compared to other inputs indicating that farmers can increase their milk output by feeding more concentrate to the animals on both categories of farms. The regression coefficients of dry fodder were also positive and significant mainly in local breed farms of both sizes. These results indicate the possibility of diverting part of capital from significant inputs to concentrate and dry fodder. The utilization of inputs should be adjusted to the optimal level until the MVPs equate the factor price of the respective inputs. The quantity of dry fodder presently used has to be increased from 24.41 quintals/cow to 32.70 quintals/cow for medium size cross breed and small size local breeds. Green fodder has to be increased from 9.71 quintals/cow to 10.88 quintals/cow for medium size local breed farms. Cross breed cows farms are profitable and efficient with higher benefit over cost and lower ratio of break-even output from actual milk production than local breed farms. Similarly, medium size is profitable than small size farms. The average production cost of cross breed cow per year was Birr 5,690 and that of local breed cow was Birr 2,211. From this, local breed farms are efficient in input use than cross breed farms. On the basis of the findings the following recommendations are forwarded to achieve the production and marketing efficiency of dairy sector in the study area.

- It is essential to transform local breed cow farms to cross breed farms because cross breed cows are profitable and efficient.
- Medium size is profitable than small size farms. Therefore, it is better for the dairy farm business to increase the herd size above three.
- Farm owners have to be encouraged and advisory services (animal health service, extension service) should be promoted through agriculture offices on how to increase their productivity.

- Feed is the major cost aspect of the dairy farms specially that of concentrate. Therefore, dairy farm owners should have their own farm land to grow animal feed and they should be encouraged to establish linkage with near by out growers. Moreover, out growers should also be encouraged to involve in fodder development activities. For these effects, the research institution, Mekelle town and the Agriculture and Rural Development Offices should work jointly in promoting and extending fodder development and marketing in the area.
- Government or other concerned body should establish animal feed processing factory that could overcome the shortage of concentrate.
- Dairy cooperatives could play a big role by supplying all the necessary inputs including animal feed at normal price.
- Establishment of milk-processing factories that could mainly resolve the market problem of the milk producers since the shelf life of milk is short.
- Farm owners should be educated because cross breed cows are more sensitive and they need more treatment than local breed cows.
- Dairy farmers should take dairying as sole career in order to earn better profit.
- Market price should be fixed on the basis of the cost of the ingredients so as to achieve reasonable profit.

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