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ECONOMIC EFFICIENCY AND PROFITABILITY ANALYSIS OF MILK PRODUCTION IN DISTRICT SARGODHA

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ABSTRACT: *The core objective of the research is to measure economic efficiency of milk production and to explore profitability of dairy farming in different Tehsils of district Sargodha. The study projected the factor disturbing the milk production and farmers efficiency. Primary data of 75 dairy farmers is collected from three different Tehsils of Sargodha district, during 2016. Non-parametric Data Envelopment Analysis (DEA) technique is applied to assess economic efficiency scores. Economic efficiency scores are regressed on certain farmer's characteristics to identify the sources of inefficiency using Tobit regression. The mean economic efficiency is 0.35. Technical and allocative efficiency of overall dairy farmers are 0.89 and 0.40 respectively. Outcome of Tobit regression revealed that dairy farmers with reference to age, education, operational area and herd size has positive and significant impact on economic efficiency but the farmer's family size has negative impact on economic efficiency of dairy farmers. Distance from pakka road is insignificant with reference to the efficiency of farmer. Herd size, green fodder cost, dry fodder cost, labour cost and number of milk animal have positive impact on income of the farmer while shed cost and disease treatment cost have negative impact on income of the farmer. Return to scale describes the investment condition of dairy farming as in this study is1.46, representing increasing returns to scale.*

KEYWORDS: *Allocative Efficiency, Technical Efficiency, Economic Efficiency, Profitability Analysis*

1. INTRODUCTION

Milk is nature's marvel drink. It is essential for human diet either that is a newborn baby or aged, man or woman. The dietetic importance of milk is also well known that people all around the globe use it as a staple part of their food. Using milk in our daily food can help us to attain a well-balanced diet. Milk is an ultimate supply of nutrients such as vitamin A, B12, phosphorous, D calcium, selenium, carbohydrates, magnesium, protein, zinc and riboflavin. People have many alternative sources for milk like buffaloes, cows, goats, and sheep and can also have from camels.

Dairy sector has a significant impact toward the economy of many countries in the world. Dairy is an active sub sector of agriculture. It's a very important sector to earn income for so many families, especially in under developed countries because a big number of people are engaged with this sector. The worlds total milk production is 703.99 (million tons) which was 695.68 (million tons) in 2010 (FAO, 2015). 35% of world's milk is produced in Asia while Europe is contributes 33.47% of total milk production (Sajjad et al., 2013).

Pakistan is an agro-based economy, so agriculture sector is the backbone of Pakistan's economy. The share of agriculture sector in GDP (Gross domestic product) is 20.9% (*Economic Survey of Pakistan*, 2015). Agriculture in Pakistan is divided in two parts that is crops and livestock sector. A large fraction of labor force in Pakistan is engaged in agricultural activities. It provides employment to the 52% of total labor force. Agriculture sector is generator of economic activities of Pakistan. It provides raw material to industrial sector because a strong industrial sector in a country ensures opportunities for employment that is further ensuring reduction in poverty of a country.

1.1 World Milk Production

According to FAO statistics of the year 2014 the total production of the milk in the world is 798 million tonnes, while Asia is producing316.9 million tonnes, from which Southern Asia is producing 210.3 million tonnes. Pakistan is situated in the South Asia and is contributing a large in milk production

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with the quantity 50.1 million tonnes.

India and the US are the largest and second largest of milk producing countries with a production of 54 billion liters and 21 billion liters respectively. Livestock sector plays very important role in developing countries. In Egypt 50%, Kenya 43%, Bangladesh 55% and in India 65% of people are engaged in this sector for their butter and bread (Sajjad et al., 2013).

1.2 Contribution of Milk in GDP

Pakistan dairy sector is not so different from other developing countries. Livestock sector has great importance for Pakistan's economy because it is contributing a major share in GDP of Pakistan. Livestock contributes approximately 58.6% to the agriculture value added and 11.6% to the overall GDP (*Economic Survey of Pakistan*, 2016). Gross value addition of livestock at constant cost factor of 2005-06 has increased from Rs. 1247 billion (2014-15) to Rs.1292 billion (2015-16), showing an increase of 3.63%.

According to survey, production of milk has increased from 50990 (thousand tons, 2013-14) to 52632 (thousand tons, 2014-15). While doing comparison with the last year, in 2013-14 Gross value addition of livestock was Rs. 778.3 billion but in 2014-15 it increased to Rs. 801 billion, recorded an increase of 3% (*Economic Survey of Pakistan*, 2015).

While discussing the employment opportunities there are approximately 8.0 million rural families are engaged in raising livestock. It provides bases to the livelihood of the rural poor and uneducated ones in the country and plays a vital role in poverty reduction and changes the socioeconomic conditions of rural areas positively (*Economic Survey of Pakistan*, 2015).

Pakistan is the third largest milk producing country in the world. Milk is produced by buffalo, cattle, sheep goat and camel. Study revealed that about 70% milk is produced by smallholder dairy farmers which have minimum 2 animals in their sheds (Ayaz, Anwar, Sial, & Hussain, 2011).There are about 188.9 million people in Pakistan, with around 11.7 million in-milk cows &12.9 million in-milk buffalos (FAO, 2015).

Table 1.1: Livestock Population (Million No.s)

Species	2013-14	2014-15	2015-16
Cattle	39.7	41.2	42.8
Buffalo	34.6	35.6	36.6
Sheep	29.1	29.4	29.8
Goat	66.6	68.4	70.3
Camels	1.0	1.0	1.0

Source: Ministry of National Food Security and Research, Government of Pakistan.

Total milk production per day from all types of in-milk animals was 141.44million liters (2006 Livestock Census). In this quantity of milk, the contribution of cows was 37.6 per cent (53.3 million liters), buffaloes 57.9 per cent (82.1 million liters) and goats 4.5 per cent (6.4 million liters). Punjab province of Pakistan is the largest contributor by producing 74.72 million liter per day, as compared to other provinces, as Sindh was producing 43.46 million, Baluchistan 62.4 million and KPK was producing 17.01 million liters per day(*Pakistan Livestock Census*, 2006).

Pakistan was 7th largest milk producing country in 1998 in all over the world and then became 5th largest milk producing country in 2009 (Sadaf & Riaz, 2012). So it is clear that since 1998 Pakistan is in the list of top ten milk producing countries of the world and Pakistan has improved its position in milk production.

Table 1.2: Production of Milk (000 Tones)

Species	2013-14	2014-15	2015-16
Milk(Gross Production)	50990	52632	54328
Cow	18027	18706	19412
Buffalo	31252	32180	33137
Sheep	38	38	39
Goat	822	845	867
Camel	851	862	873

Source: Ministry of National Food Security and Research, Government of Pakistan.

1.5 Significance of Study

Pakistan is third largest milk producing country in the world but still its production is insufficient to meet the national demand. Household made 30 percent of their expenditures on milk and dairy products (*Pakistan Livestock Census*, 2006). But this share is increasing day by day. To meet this demand Pakistan is importing powder milk from various countries every year. While comparing the import of powdered milk with previous year, import of powder milk has increased from 16,322 tons in 2013-14 to 29,296 tons in 2014-15. This change is showing an increase of 66% in terms of value.

Previous literature revealed that Pakistan is sharing almost same characteristics for dairy production with other developing countries. According to the study the factors/characteristics affecting milk production of the country are small herds, low quality of feeds, risks of epidemics, and lack of farming education, credit facilities and poor animal health. Dairy sector of Pakistan has been performing well but below its potential. So by overcoming the weaknesses and threats, profitability and number of job opportunities can be enhanced. As District Sargodha is having countable share of milk production. So the factors affecting its production must be determined to overcome on them.

As Sargodha is one of the major milk producing districts of Punjab. The trend of dairy farming is getting popularity day by day in Sargodha. Dairy farming is profitable business because cheese, butter and ghee are produced through dairy farms. Markets have a great demand for all these products in pure form for the goods like deep fried dishes, sweets, ice cream etc. Inefficiency in milk production is present in Sargodha region even now which checked through, if per farm production is compared with per farm production of the developed areas. So, it's necessary to produce maximum by using minimum inputs or minimizing cost which is called efficiency. Efficiency can be improve by producing maximum from given inputs (technical efficiency) or by minimizing the cost of production used in producing milk (allocative efficiency). So some policy or strategy should be made for Sargodha to enhance its productivity and efficiency.

Usually, in Pakistan, it is observed that increase in prices of dairy inputs has been much higher comparative to the increase in prices of dairy outputs (Sajjad et al., 2013). There is little possibility of decrease in prices of dairy inputs, but the study has a solution to improve the efficiency that is by reducing the cost of production through enhancement in the management practices. So, to develop the management structure, farm holder must be technically & allocatively efficient.

To the best of my knowledge, a major portion of research work is made on technical efficiency and supply chain of milk production in Sargodha. Most of the research studies e.g. (Burki & Khan, 2011; Rauf, Mushtaq, & Ghafoor, 2014; Sajjad et al., 2013; Shafiq & Rehman, 2000) undertaken so far are confined to other provinces and areas of Pakistan. Very few studies pertaining to milk efficiency have been carried out in Sargodha (Ayaz et al., 2011; Jamal, Syed, Farooq, Ahmad, & Hamid, 2003; Khan, 1998; Sadaf & Riaz, 2012).

Previous studies reveals that production of milk in Pakistan is much affected by climate, veterinary services available, education, farmer work experience, and distance from the pakka road and credit facilities to the farm holders etc. So, it is possible to increase production of milk in Pakistan by the better provision of above mentioned and of some other services also.

1.6 Objectives of the Study

The basic aim of the study is to find out the economic efficiency of milk production and policies that are valuable in increasing productivity of milk production. It is done by finding the improved engagement of the factors concerned in milk production progression. Being detailed it can be said that research is concerned to:

- Estimate the economic efficiency of milk production in Sargodha region.
- Identify and analyze the factors (variables) affecting the economic efficiency of milk production in Sargodha.
- To estimate the cost of milk production on Sargodha dairies to find financial and production trends that could lead to improved profitability.
- To suggest some policy recommendation for milk production on the basis of findings of the study.

This study is important in two ways; first, it practically measures the economic efficiency of milk production and identifies the factors that affect the production of milk.

Secondly, by analyzing the benefits and cost, it make easy for the people to make decision for investment or to adopt dairy farming as profitable business. This is also very helpful in making economic policies for betterment of this sector.

2. LITERATURE REVIEW

The literature is reviewed to be familiar with the work, studies and methods of research done previously at national and international level. This section has been divided into two sub-sections. Section 2.1 explains the literature about efficiency, while section 2.2 is containing the literature about profitability.

2.1 Reviews for Efficiency Analysis

(Lachaal, Chahtour, & Thabet, 2002) had discussed the technical efficiency of dairy production in Tunisia. The objective of the study was to twofold. First was to measure the technical efficiency while second was to find out the factor which affect the efficiency in the area. DEAP was used to compute average technical efficiency. TE score was 68%. The variables used for estimation were feed quality, labourer age, education, time devoted per cow and herd size. Feed quality was significant and had positive relation with efficiency score and farmer age had negative effect on technical efficiency that as the of farmer/labour increases efficiency tends to decrease.

(Kompas & Che, 2003) estimated a stochastic production frontier and technical efficiency model for Australian dairy farms, which shows the importance of each input in dairy production. For this purpose primary data was used. Input variables used in frontier production function were livestock capital, land area, materials, services, asset in technical efficiency. The type of dairy shed technology, classified as walk-through, swing over, herringbone, and rotary feeding concentration. This paper determined a stochastic production frontier which technical efficiency model to find inputs in dairy production. This also determined farm-specific characteristics of dairy farms in Australia. Estimated production frontier results examined that dairy production was constant returns to scale.

(So, 2003) examined the production and technical efficiency of poultry egg production in Osun state.

Stochastic Production Frontier was used. Primary data was used from 200 farmers. Variables used were interest of farmers, number of birds and operating cost were estimated coefficient values between zero and unity. The TE was ranges between 0.239 and 0.933 and mean value was 0.763. The deciles of data showed about 79% had TE exceeding 0.70 and about 21% had TE ranging between 0.239-0.69. Low formal education, experience and age of the farmer were the cause of low technical efficiency. Reducing the farm distance from cities can increase technical efficiency, because egg consumption is high in urban areas as compare to rural areas.

(Johansson, 2005) measured technical, allocative and economic efficiency of Swedish dairy farms in 2005. Data envelopment analysis and stochastic frontier production frontier were used for estimation. Beef and other product cost, fodder expense, labour cost, capital assets, energy cost, seed cost, fertilizer quantity were collected through a detailed questionnaire. The mean DEA, technical efficiency was 0.77, allocative efficiency was 0.57 and economic efficiency was 0.43. Minimizing cost factors were the biggest challenge for the country's dairy farms.

The research employed stochastic frontier production frontier to extract the factors which increase rice production in Punjab by (Abedullah, KOUSER, & MUSHTAQ, 2007). Data about 200 farmers was collected on area of crop, plowing hours, insect repellent cost, irrigation hours, age, labour hours, education, farm size and plant to plant distance. Mean technical efficiency was 91%. Insect repellent cost showed insignificant results related to efficiency but fertilizer cost was significant. Irrigation hours were positive and highly significant.

(Jabbar & Akter, 2006) had analyzed factors affecting farm specific production efficiency of poultry production in Vietnam by using stochastic frontier production function. Sample data was taken from 1118 poultry farms in 1999 from south and north region, through a detailed questionnaire. Average efficiency of North and South regions were respectively 76.8 percent and 69.7 percent. The elasticity of all inputs was less than one indicating decreasing return to scale. Results revealed that input cost was high and output cost was low therefore govt. should optimize public investment to improve production efficiency of poultry farmers. Technical education and uses of credit will lead to a substantial reduction of technical inefficiency.

(Çiçek & Tandoğan, 2007) had analyzed the effect of technical and socio economic factors on cost of milk production in dairy enterprises of turkey. Multiple regression models were used to examine the 77 enterprises. Results exposed that average variation in cost was 64.9 percent while marketing variables were significant at 5 percent level. Cost of production can reduce by increase the herd size.

(Yusuf & Malomo, 2007) estimated technical efficiency of poultry egg production in Ogun state using Data Envelopment Analysis (DEA) and OLS Regression. Both primary and secondary data; were used in this study. For this purpose, data of 49 poultry farms were collected through questionnaires. On the other hand secondary data was obtained from the publications. Household size, education and experience were important variables that affected the technical efficiency. The results revealed that experience and education were positively related with technical efficiency but size of household was negatively related with technical efficiency. The results showed that large sized farms were technically more efficient than medium and small farms. Results estimated the mean technical efficiency 87.3%. Large farms were more efficient than the mean value with the value 88.77%. Medium size farms were technically less efficient than mean value with the value 86.87% while small size farms were less technically efficient than mean value with the value 86.38%. The authors examined that farms were technically efficient in Ogun but improvements were required to eliminate the negative effects of less experience of labour and large house hold size by couple of well experience of labour with small

household size.

(Binuomote, Ajetomobi, & Ajao, 2008) estimated the Technical Efficiency of poultry producers in Oyo state by using "Cobb-Douglas stochastic production frontier modal". For this purpose, data of 51 poultry farms were collected through questionnaires. The objective of the study was to provide empirical information on the farm level technical efficiency of poultry egg producers in Oyo state of Nigeria. Important variables in this study were "Education, Family size, Experience, Management system". Study showed that level of education was negatively related with inefficiency by the coefficient 1.391. Family size was also negatively related with technical inefficiency by the coefficient 0.143. Management system also was negatively related with technical inefficiency by the coefficient 2.633. Experience had also negative coefficient of 0.484 mean value of TE was estimated 82.3%. And more than 90% of farmers were technically more efficient than 70%(70% is value of TE) Authors suggested, to increase technical Efficiency, poultry producers must pay attention to increase Education level and to family size as well as quality of feed for birds must be good.

Economic efficiency was composed by (Nganga, Kungu, De Ridder, & Herrero, 2010) for Meru. STFP was utilized for this study. A detailed questionnaire containing information about wage rate, feed cost, herd size, non-farm income, drugs, farmer's age, farming experience and family members was produced. The results concluded that farmer's efficiency varied between 26-73%. Average value of economic efficiency was 60%. Feed cost was significant at 1% level of confidence. Farmer's education was negative and significant implied that higher education will reduce profit inefficiency.

(Gelan & Muriithi, 2012) measured technical efficiency of smallholder dairy farmers of east Africa. They utilized DEA for estimation. Milk sales, consumption of milk, sale price, manure sale were used as output or dependent variables while as an input variables cattle shelter cost, hired labour, family labour, fodder cost, hired cost, water cost, animal health expenses, extension service cost and breeding cost were used. Efficiency score were 20%, 18% and 13% for Kenya, Rwanda and Uganda respectively. 32% of 371 farmers needed to enhance milk production by 75%. Dairy cooperatives were not statistically significant but they had positive impact on technical efficiency.

(Mugambi, Wambugu, Gitunu, & Mwangi, 2017) estimated milk production efficiency of dairy cow farms in Embu and Meru counties of Kenya in 2010. The aim of study was to determine the technical efficiency and cost efficiency of dairy farms. To achieve the goal STFP and maximum likelihood estimation technique was utilized. Herd size, milking animals in the shed, cow breed, roughages, concentrate and feed, mineral supplements, labour hours, land owned and chaff cutter were used as input variables. The results showed that production can be increased by 16.3% without bearing extra cost. While milking cost could be reduced by 4.4% without reducing the output. Mean technical efficiency score was 0.83 and cost efficiency score was 1.04.

(Kelly, Shalloo, Geary, Kinsella, & Wallace, 2012) aimed to estimate the factors affecting Irish dairy farms in 2012. The target of this research was to inspect the effect of commonly used techniques by dairy farmers and the consequences of intensification of the farms. Sample of 273 dairy farms were taken for estimation. DEA was applied to produce technical efficiency scores under assumptions of both constant returns to scale (CRS) and variable returns to scale (VRS).The mean technical efficiency score was 0.785 under CRS and 0.833 under VRS. The observed results indicated that production gave constant returns to scale and that farm efficiency had positive relationship with farm intensification, the involvement of family labor in the dairy farm and feeding method.

(Mor & Sharma, 2012) examined the technical efficiency and supply chain process in dairy farming for

India by using stochastic frontier production function. Primary data was collected on value of feed, laboring hour, shed cost, and fixed capital cost, cross breed cost, experience and education. Study revealed that building the supply chain can increase efficiency of dairy farmers. Technical efficiency of member dairy farmer was 79% while it was 66% for non-member dairy farmers. The possession of cross breed, livestock, and education were positively related to the efficiency. Results recommend that farmer can overcome on inefficiency by training and educational program to learn the new techniques and knowledge.

(Sajjad et al., 2013) analyzes the technical efficiency of milk production in Khyber Pakhtunkhawa. The data was drawn from 300 dairy farmers on herd size, dry fodder, green fodder, concentrate/oil seed, hired labour, permanent labour, vaccine cost and fee, educational years farming experience, age of farmer. STFP was used to find the technical efficiency. The value of technical efficiency was 0.70. The study concluded that rising age of farmer reduce the efficiency suggested that the strategy for improving dairy business must had focal point on how to encourage young community who are responsive and interested in dairy business. While education and farming experience relate positively with efficiency.

The mean technical efficiency calculated by (Al-Sharafat, 2013) was 39.5% for Jordan dairy farms. He applied STFP technique for results. The data was generated from 100 dairy producers. Questionnaire was having information about herd size, feed quantities, labour inputs, veterinary cost, fixed inputs and depreciation cost and about socio economic factors such as age, education, experience of farmer about dairy production and size of family. The results implied that the dairy farms were producing milk to only about 40% of the possible frontier production levels. To boost farm efficiency farmers' approach to extension services was required considerably.

(Bardhan & Sharma, 2013) estimated technical efficiency of milk production in under-develop production situation of India in 2013. They aimed to found the factor affecting milk production by using STFP. Farmer education, age, landholding, herd size, non-farm earnings, percentage of milk produced/sold and average price of milk received liter were the input variables. The study identified that small dairy farms were comparatively more efficient then their large dairy farms. The mean technical efficiency was 91% for plains while it was 89% for hilly households. Market contribution had significant but positive effect on technical efficiency. This gave exact suggestion that increasing the intensity of commercialization of dairy farms would have advantageous effect on production efficiency.

(Furesi, Madau, & Pulina, 2013) estimated technical efficiency of sheep dairy industry in Sardinia (Italy). Research was conducted because of dramatic reduction in profit of sheep dairy farming. Concentration was made on measuring the sheep dairy productivity by efficiently employing the available technical resources. Stochastic frontier analysis was applied on panel data of 36 sheep farms from 2004 to 2009. Results advised that technological homogeneity was prevailing between the sheep farms and private sheep farms. Technical efficiency was 0.905.

(Michalickova, Krupová, & Krupa, 2013) studied efficiency of milk production in Slovakia for dairy farming in 2013. DEA was applied on 83 dairy farms. The study concluded that average efficiency was scaled 0.96. Feeding cost, material costs, labour cost, depreciation cost, other direct cost, overhead cost were used as input variables. Statistically efficiency was only affected by feed cost.

Technical efficiency and Allocative efficiency was estimated by (Masuku & Masuku, 2014) for Switzerland's smallholder dairy farms. At second stage they also find the factors affecting the efficiencies of small farmers. An explanatory quantitative survey was conducted from 111 farmers.

STFP and cost frontier function was chosen to calculate technical efficiency. Average values of technical and allocative efficiencies were 66% and 78% respectively. The research implied that small dairy farmers were technically efficient and had potential to improve its production. The study suggested that soil testing must be done by farmers to regulate and to have progress in efficiency. Credit facility should be mobilized for the betterment of dairy farming.

(Kimenchu, Kairu, Mwangi, & Macharia, 2014) evaluated technical efficiency of dairy farms in Embu county of Kenya in 2014. According to research Kenya had major share of dairy production in national GDP but was facing low per capita milk availability that was 76.7 kg. Data was collected from 96 farms. Research information was analyzed via SPSS and Frontier 4.1 c computer software. STFP estimated the mean technical efficiency that was 85.5%. Milk production coefficient was 1.33. It was suggested that farmers must specialized in one dairy or crop farming.

(Zibaei, Kafi, & BAKHSHOUDEH, 2008) had determined "The effect of veterinary services on Iranian dairy production". Data envelopment analysis was used to measure the technical efficiency of milk production. Data was taken from 840 farms through questionnaire. The mean technical efficiency ranges between 44.5% and 59.5%. Results revealed veterinary services had negative effect on technical inefficiency. Illiteracy and low technology adoption were important estimators of farmer inefficiency. And improvements were required in veterinary services and dairy education to increase the milk production.

2.2 Literature Review for Profitability Analysis

Okara district was surveyed by (Chaudhry, Rafiq, Hanjra, Ahmad, & Hassan, 1997) to estimate the economics (profitability) of semi-commercial and commercial dairy farmers. Farmers were randomly selected for sample data/information. The study exposed that lactation period was not the same in different farm categories. A large variation was also observed during summer and winter milk production. Commercial farmers were bearing low per liter cost for producing milk but in contrast with semi-commercial farms they can sell on high prices.

(Sadiq, Ishaq, & Sadozai, 2003) investigated the cost and revenue of dairy animals in District Kohat. Farmer keeps 4.10 bulls and cows and 22.10 goats on average in a shed. Milk gives about 72 percent to the dairy production in large and medium farms. But 77 percent milk was contributed by small farmers. Large farmers get Rs.67632 from milk annually; medium farmers get Rs.39900 while small farms receive Rs.32324 annually from milk. About 22 percent for large, 23 percent for medium and 19 percent for small farms was contributed by the second livestock output which was young animals (heifers and animal less than 6 months). A large portion of cost for production was covered by labour cost and feeding cost. Labour cost established the 70 to 80 percent of the total cost. Feeding cost (green as well as dry) ranged from 15 % to 19% on farms. The enterprise show increasing return to scale. This gives good opportunities to farmers. Number of animals, feeding and Labour cost were the significant and positive factors to dairy output, while Medical and treatment Cost affects the dairy output negatively.

(Battese, Prasada Rao, & O'Donnell, 2004) estimated technical, allocative and economic efficiency of rice producers in Bangladesh for Amen and Boro seasons during 1997. 406 people were interviewed for the collection of data. The results revealed that modern amen rice producers were less efficient while comparing with boro rice producers. At second stage Tobit regression was run to find the factors affecting rice production in both seasons. Tobit regression results point out that due to disguised unemployment big families were negatively affected and were inefficient. Furthermore, a smaller amount of off-farm job and better access to market turn out to be the cause of growing efficiency.

(Dhungana, Nuthall, & Nartea, 2004) calculated inefficiency of 76 rice farmers. Data Envelopment

Analysis was utilized to measure the economic efficiency along with technical efficiency and allocative efficiency. The overall economic efficiency was 66 percent. The variables, as farmer's education and family labor participation had positive relation with economic efficiency.

Cost of milk production was estimated by (Shah, Saboor, & Ahmad, 2009). There is widespread effect of livestock in rural area of Pakistan. 30 to 35million people are raising an average having 2 to 3 animals in a shed. Net profit for livestock was the main plan of the study. The final result of this research attempt is to draw policy recommendations that can be of assistance, distortions in the milk bazaar.100 respondent were randomly selected from district Jhang. Data was composed on farmer land, herd size, number of milk animals, sale and purchase during the year, labor cost, shed cost, health treatment cost, feed cost and miscellaneous production cost. Multiple regression and Cobb-Douglas production function were projected by means of Ordinary Least Squares (OLS) method. Results revealed that average fixed cost was 14.8, 8.22 per animal per month while variable cost was Rs. 14263.11 per month. The average milk output was 7.99 per day/litter. The cost of milk production per litter was Rs. 8.37. Livestock production depicts increasing return to scale in the sample area.

Economic efficiency of milk production was estimated by (Nganga et al., 2010) in Kenya. Inefficiency is generally analyzed by economic efficiency, which is sum of technical and allocative efficiencies. A stochastic profit frontier and inefficiency model was utilized for estimation. The result concluded that profit efficiencies of the farmers ranging between 26 and 73% with a mean of 60%. Results suggested that about 40% dairy producers were inefficient. Education, experience, and farm size had positive impact but profit efficiency negatively related with age.

(Ahmad, Haq, Shah, Khan, & Khan, 2013) finds out profitability of farm animals in Peshawar. To achieve the objective data was collected about costs and returns of 31 dairy farmers. Profit function was estimated presupposing that profit will be the function of milk price, price of green fodder, labor cost and farm location. Results revealed that profit function was statistically important. Most elastic variable to the profit was price of milk rural dairy farms were earning low profit as compared to the urban farms. Study concluded that 8.278% profit was increased while increasing 1 rupee in the price of milk. Labor was reducing the profit of farmer by 1.8% when he/she add one more labour to work on farm. Author recommends that to improve profits of dairy producer govt. must give some subsidy on inputs or made some price support policies for rural farmers.

(Hussain, Aujla, & Hassan, 2014) aimed to estimate the profitability of main breeds of cattle in Sindh and Azad Jammu and Kashmir. Primary data was collected from 130 dairy farmers, randomly selected. Each feed resource share in total feeding cost was estimated and benefit-cost analysis of milk for producing milk according to the area was conducted in addition. Annually total feed cost sharing large variation with each feed source. Concentrate feeding was sharing more than half (54%) of the total feed cost annually in irrigated areas of Sindh. Whereas, in coastal areas and arid region of Sindh, and hilly areas of AJK dry fodder (wheat straw) was sharing 51% to 58% of the total feeding costs annually. Mean milk output of Red-Sindhi breeds were 1845 liter and in the irrigated areas were 1590 liter per lactating period. Productivity of Thari breed of AJK was 1411 liter per lactation period. Benefit-cost ratios were 1.5 in Sindh and 1.4 in AJK, revealing dairy farming as a profitable business in these areas.

(Stankov, 2015) estimated the economic efficiency of Bulgharian dairy cattle production. Dairy production was the most profitable sector of agriculture. The objective of this study was to capture the current situation and give analysis of its economic condition. Farm size results showed that large farm were performing better then small and medium farms for profits. Cost effectiveness was 69.1% for large and 74% for medium, which do extremely well that of small farms. The results also revealed that rate

of return can be improved by public support. Study recommends that to improve economic efficiency, Bulgarian stat must increase the rate of subsidy.

The objective of (Kibiego, Lagat, & Bebe, 2015a) was to evaluate economic efficiency in the dairy sector in Uasin Gishu County of Kenya. Cobb-Douglas stochastic frontier cost function was utilized to analyze the Zero, semi-zero and open grazing production methods. While censored regression was used estimate the factors affecting the efficiency at second stage. The results signify that all of the milk production systems were comparatively inefficient. Economic efficiency increased with the intensification of milk production, attaining open grazing 0.43, semi-zero grazing 0.51 and zero grazing 0.69. The maximum likelihood estimates of milk production were an increasing function of cost of feeds and equipment and were statistically significant at 5%. Education, social capital, land area and distance from market were positively related with economic efficiency.

2.3 Conclusion

Literature revealed that there are many methods to estimate efficiency but Data Envelopment Analysis and Stochastic Frontier Analysis technique is generally used for estimation. Some important variables which affect the Economic Efficiency of the farmers used previously were herd size, feeding cost, disease treatment expenditure, operational area, labour cost and shed cost. Study explains that disease treatment expenditure had negative relation with Economic Efficiency but operational area had positive and significant effect on efficiency. There were some socio economic factors who can affect the efficiency or may be became the cause to affect the efficiency of dairy farmers. Determinants or socio economic factors of Economic Efficiency were age of the farmer, distance from the pakka road, education, herd size, number of family members working on farm and experience of the farmer about dairy farming. Literature revealed that in some areas distance from pakka road didn't affect the efficiency because the milk produced sold on the farm instead of selling in the nearest market. Age and experience of dairy farming had significant effect on efficiency. It was observed that large herds were economically more efficient than the small ones but in some areas specifically in underdeveloped countries results were totally opposite. Small herd sized farms were more efficient then the large herds.

It was observed that credit availability on low interest rate to the dairy farmers could enhance the profitability and their efficiency. Previous study explains that dairy farming is a profitable job. Many people are using it as part time and full time source of earning. It was concluded from literature that increasing the number of in-milk animals to the herd could lead to the profitability or enhance the ratio of profit. Dairy farming is profitable as it had increasing return to scale even in under developed countries.

3. CONCEPT OF EFFICIENCY

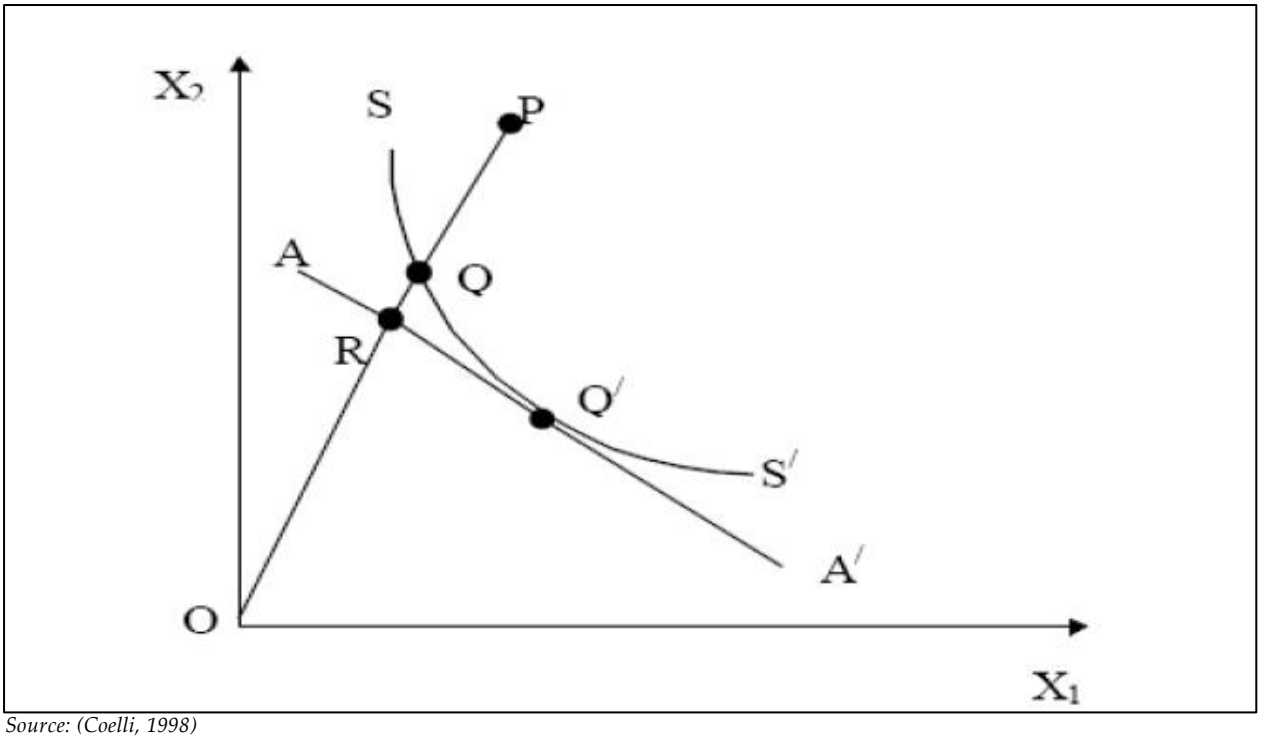
3.1 Efficiency Analysis Techniques

Measuring efficiency is not so simple. (Farrell, 1957) introduced the notion to assess efficiency. After that in 1978 charnes, Rhodes and cooper utilized Farrell's construction to gauge efficiency by explicating a linear programming under constraint of constant returns to scale, which renowned as Data Envelopment Analysis (DEA). Later (Banker, Charnes, & Cooper, 1984) extend the model to variable returns to scale. Farrell projected two kinds of efficiency measurements

3.1.1 Input-Oriented Efficiency Measures

Input orientation includes acquiring how much expected input can be reduced for an assumed output to be technically efficient.

Figure 3.1: Farrell's input oriented measure of Technical and Allocative Efficiency



Source: (Coelli, 1998)

In Figure 3.1 two inputs, X1 and X_2, are represented on the horizontal and vertical axes, respectively. SS′ is an Iso-quant showing different input bundles (X_1 and X_2) used in the production of certain output quantity (Y). All output quantities on this Iso-quant imitate technically efficient production. Suppose a firm is operating at a point P. At point (P), the particular firm produces the same level of output (Y) as produced on Iso-quant, SS′. To define the technical efficiency of the observed firm, a line is drawn from the origin to the point P. This line crosses the Iso-quant at the point Q. In the case of a technically efficient firm, the same amount of output (Y) is produced using inputs (X_1 and X_2) defined by the point Q. Inputs are not used efficiently by observed firm at point P. So the technical efficiency of the observed firm is defined as the ratio of the distance from the point Q to the origin, over the distance of the point P from the origin:

$$TE = \frac{OQ}{OP}$$

If the input prices are available, allocative efficiency could also be defined. An Iso-cost line, AA′, is drawn tangential to the Iso-quant, SS′, at the point Q′, which intersects the line OP at the point R. For the output quantity produced at the point Q, the best use of inputs is at the point Q′ because it incurs the minimum cost. Therefore, the point Q is not an optimal point because the distance, RQ (cost), can be reduced without any reduction in output. Allocative efficiency is defined as the ratio of the distance of the point R to the origin over the distance of the point Q from the origin:

$$AE = \frac{OR}{OQ}$$

Economic efficiency is the product of technical efficiency and allocative efficiency:

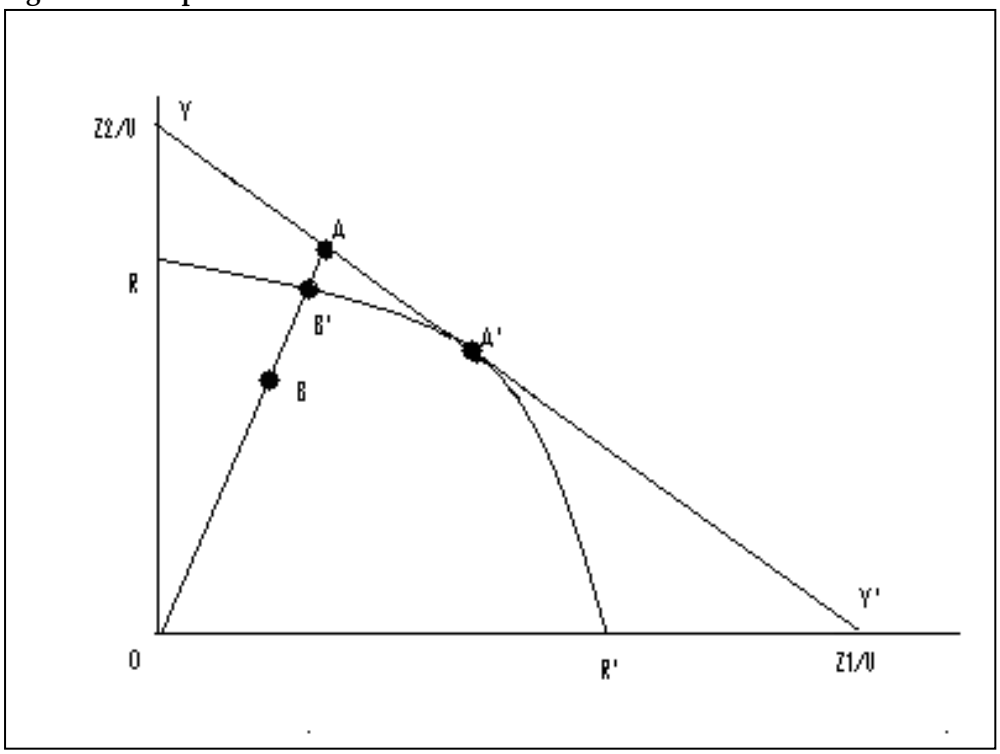
$$EE = \frac{OQ}{OP} \times \frac{OR}{OQ}$$

$$EE = \frac{OR}{OP}$$

3.1.2 Output Oriented Technique

The technique of input oriented efficiency estimation can be simply extended to output oriented techniques in which the foremost concern is how a firm can turn out maximum production by using given input. Let production involves two outputs (Z_1 and Z_2) and a single input (U) in figure 3.2. Then under Constant Return to Scale, RR′ represents the unit production possibility curve. The point B represents inefficient point lies below the maximum producible output.

Figure 3.2: Output oriented technical and allocative efficiencies



Source: (Coelli, 1998)

So technical efficiency is the distance of BB′ ,representing that Point B is inefficient in that sense as the output could be increased to the point B′ without utilization of extra input.

$$TE = \frac{OB}{OB'}$$

Price information under output oriented model is represented by the line known as Iso-revenue line represented by YY′, then allocative efficiency is as

$$AE = \frac{OB}{OA}$$

Then overall economic efficiency is the product of technical and allocative efficiency,

$$EE - \frac{OB}{OA}$$

Generally there are two approaches for efficiency analysis.

3.2 Stochastic Frontier Analysis (SFA)

SFA is a parametric approach for the reason that it makes an assumption on data and has a functional form on data generally in shape of Cobb-Douglas function, constant elasticity of substitution and in transom form. And it does not only relate all the deviations from frontier to the inefficiency of farm, but also with unexpected events like estimation errors and incorrect compiling of data etc.

3.3 Data Envelopment Analysis

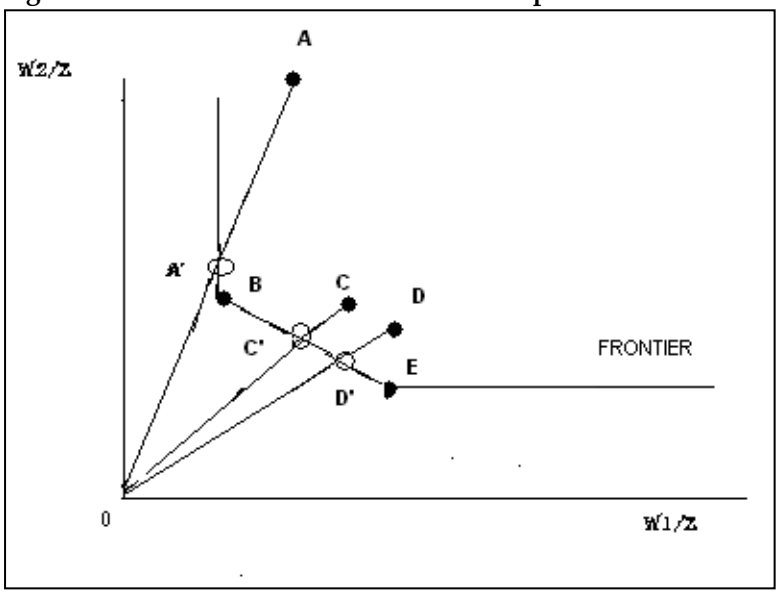
The DEA production frontier is estimated computing linear programming technique, which give a

piece-wise linear frontier that "envelops" the observed input and output data. Data envelopment analysis is non-parametric approach for efficiency analysis. After Farrell the significant contribution is mainly observed by (Charnes, Cooper, & Rhodes, 1978), where they utilized the word DEA for efficiency analysis first time. (Banker et al., 1984) extended this model into input oriented DEA under variable return to scale (Coelli, 1998). It is one of the most important advantages of DEA that there is no need to assume any specific functional form (Gonçalves, Vieira, Lima, & Gomes, 2008).

3.3.1 Constant Return to Scale under Input Oriented DEA

The input oriented DEA analysis can be carried out under both constant and variable returns to scale.

Figure 3.3: Constant return to scale under input oriented DEA



Source: (Coelli, 1998)

The figure 3.3 shows five firm observations which employ two inputs and one output. Firm B and E are efficient while firm A, C and D are inefficient in the logic that their input use can be decreased while having the same output level.

The inefficient firms can achieve efficient frontier by radically contracting their input use or by letting down the input slack. Firm C can reach efficient frontier at point C' by utilizing input bundles of firm B and E to produce output at frontier by utilizing given input efficiently. So firms B and E are peers of firm C. On the other hand, firm A has used surplus input (input slack) at A'. It can produce the same output by utilizing less input at point B.

The CRS is only suitable when all firms are working on most favorable scale. The mathematical programming problem for k inputs and m outputs for each of the n firms is as follow

$$\min_{\theta\lambda} \ \theta$$

$$\text{subject to} \quad -y_i + Y\lambda \geq 0,$$

$$\theta x_i - X\lambda \geq 0,$$

$$\lambda \geq 0$$

Where y_i is an m x 1 vector of output of the i^{th} firm, and x_i is a k x 1vector of inputs of the i^{th} firm. Y is an n x m matrix of outputs for all n firms. X is an n x k matrix of inputs for n firms. The parameter θ is the efficiency score for the i^{th} firm. If θ is equal to 1 then firm will be efficient, otherwise it will be inefficient firm. The parameter λ is a vector (n * 1) whose value is calculated to achieve optimum solution. So the weights of λ values are linear combination of other efficient firm, which influence the

inefficient firm to get the optimum frontier output (Gonçalves et al., 2008).

3.3.2 Variable Return to Scale under Input Oriented DEA

Under CRS, a firm is operating on best possible scale, but imperfect competition, and constraints on finance etc, may cause the firm operate at sub-optimal scale. (Banker et al., 1984) widen the constant return to scale into variable return to scale, as when not all firms are working on most advantageous scale, some kind of scale inefficiency exists there. The linear programming under variable return to scale is reformulate by imposing convexity restriction,

$$\min_{\theta\lambda} \ \theta$$

$$\text{subject to} \quad -y_i + Y\lambda \geq 0,$$

$$\theta x_i - X\lambda \geq 0,$$

$$N1' \ \lambda = 1$$

$$\lambda \geq 0$$

This N1 is an (n *1) vector of ones. If there is a difference between the value of efficiency scores for a particular firm under CRS and VRS then there exists scale inefficiency.

4. DATA AND METHODOLOGY

4.1 Description of Universe

The study measures the Economic Efficiency of the dairy farmers of district Sargodha. Three tehsils of Sargodha district are randomly selected. Those are Bhalwal, Shahpur and tehsil Sargodha. A number of farmers of these tehsils are keeping animals for dairy purpose, as well as to supplement their income.

Sargodha is the 11th biggest city in Pakistan. It was constituted in 1903. Due to some strategic location British Royal Air Force construct an airport here. Mostly area of Sargodha is consists flat, plain and fertile, because at western and southern side river Jhelum is flowing while at the eastern side river Chenab is increasing the fertility of its fields. Tehsil Sargodha is very rich in livestock and dairy farming.

Bhalwal is located at the centre of Punjab and about 32 km away from Sargodha. M-2 motorway is passing very near from Bhalwal. It is famous because of its citrus fruit. Its kinno is not only famous in Pakistan but internationally too.

Shahpur is situated on river Jhelum 36 km away from Sargodha. Shahpur was made in 1893 during British Raj. Sugarcane is its main crop and people are using livestock as supplement source of income.

4.2 Data Collection Procedure and Sample Size

The research is mainly based on primary data. The data is collected through a detailed interview. To meet the requirements of research objective a questionnaire was developed to interview the farm owners. Information is directly taken from landholders and laborers regarding research topic.75 farm owners are interviewed, 25 from each tehsil. For data collection a criteria is set, only those Farmers who own minimum 2 in-milk animal are interviewed.

4.3 The Questionnaire

An integrated questionnaire was prepared to collect information from the dairy farmer of randomly selected tehsils. The questionnaire is holding information about different activities performed on farm e.g. number of animals, number of in-milk animals, distance from the pakka road, disease treatment and its cost and information about fodder. Some other information is taken too and it is about dairy farmer's family members, education, experience, age of the farmer, total milk produced and sold daily and labour cost arises on milk production.

The research questionnaire was divided into three parts, which were in according to the particular end.

First part was supported the factors affecting EE (farm characteristics, socioeconomic factors and institutional factors), second part based on technical factors (milk production) and third part based on the cost of production for the dairy production.

4.4 Description of Variables

In this portion the strategy for the construction of different variables used in this study is discussed.

4.4.1 Economic Efficiency variables

4.4.1.1 Output Variable

A question regarding milk production was asked to have the information about milk produced per day. The milk production per day was constructed as

$$Milk\ \text{Pr}oduced\ Per\ Day(liters) = Average\ Milk\ \text{Pr}oduced\ From\ All\ In\ milk\ Animals$$

$$Value of\ Milk\ \text{Pr}oduced\ per\ year = Milk\ \text{Pr}oduced\ per\ day \times \text{Pr}ice(per\ liter) \times 365$$

Per liter price of milk received was different in all the Tehsils. Even within the tehsil milk price was varied. So for this average price of milk sold was taken to have the value.

4.4.1.2 Input Variable

Green Fodder Area and Cost

To estimate the green fodder cost, cultivated area of green fodder was required. So the cultivated area equals the area cultivated and used by the owner himself in a year (Rabi + Kharif) also adding the area purchased for green fodder but minus the fodder area that is sold out.

$$Fodder\ Area\ (in\ kanal) = Fodder\ Cultivated\ Area + Fodder\ Purchased\ Area - Fodder\ Sold\ Area$$

While the green fodder cost was calculated by multiplying the each fodder's area with its prevailing price in that tehsil.

$$Value\ of\ Total\ Green\ Fodder = Fodder\ Area(in\ kanals) \times Fodder\ \text{Pr}ice(per\ kanal)$$

Dry Fodder Cost

Dry fodder is the summation of all dry fodder (cotton seed, vanda, wheat straw, rice straw, maize, gur, oil etc.) used in a farm, multiplied with their prices.

$$Dry\ Fodder\ Cost = Quantity of\ Dry\ Fodder\ Used \times \text{Pr}ice$$

$$\begin{aligned} Total\ Dry\ Fodder\ Cost = {} & CSC\ Cost + Cotton\ Seed\ Cost + Maize\ flour\ Cost + Gur\ Cost + oil\ Cost + \\ & Salt\ Cost + Vanda\ Cost + Minerals\ Cost + Chokar\ Cost + Wheat\ Straw\ Cost \\ & + Rice\ Straw\ Cost + Wheat\ Flour\ Cost \end{aligned}$$

Disease Treatment Cost

It is constructed by adding all the expenses (de-worming, dipping, vaccination, disease treatment and doctor visiting fee) on all animals. Whereas, for per animal treatment cost, is taken by dividing the total disease treatment cost by the total herd size.

$$Disease\ Treatment\ Cost = Disease\ Treatment\ Expense + Vaccination\ Cost + Doctor\ Fee$$

$$Per\ Animal\ Treatment\ Cost = \frac{Disease\ Treatment\ Cost}{Herd\ Size}$$

Total Labour Cost

Labour cost is measured by adding the salaries of hired labour, value of annual wheat bags, milk, lunch and medicine. And then for per day labour cost annual labour cost is divided by 365 and dividing the per day labour cost with the herd size study gets per day labour cost of an animal.

$$Total\ Labour Cost(per\ day) = \frac{Salary of\ labourer + Value of\ Wheat Bags + Lunch and\ Medicine}{365}$$

$$Labour Cost(per\ animal\ per\ day) = \frac{Total\ Labour Cost}{Herd size}$$

Herd Size

Herd is the number of animals in a farm rather contributing in milk production or not, named as herd size.

$$Herd\ Size = Number of\ in milk\ buffalos or\ cows + Number of\ \ pregan ent buffalos or\ cows + Number of\ Heifers + Number of\ Animals less\ then\ 6\ months + Number of\ Bulls + Number of\ Donkeys + Number of\ Sheeps or\ Goats$$

Age of the Farmer

It is the age of the farmer who is working in dairy farm.

Total Operational Area

Total operational area is the total area where the activities related to dairy farming are performed. It is the cultivated area plus uncultivated area and also the area rented in for fodder purpose but the area rented out is not added in operational area because that land is not used for that farm owner or dairy production. Covered and uncovered area of the daira (where farmer is keeping his animals) is also included in total operational area.

Education

Variable for education is constructed as the year of schooling a famer taken before or during dairy farming.

Family Working Hour

Family working hours is time spent by the farmer and his family member on farm doing supervision or performing little jobs like milking the animals etc.

Dummy of Distance from Pakka Road

The distance of the daira from pakka road is measured in kilometers. If the farm is situated less than or equal to 1 km far from pakka road it is assigned the value as 1otherwise 0.

4.5 Profitability Analysis Variables

For profitability analysis data is collected on different types of cost which are essential in milk production. Farmers build different types of shed for their herd which are pakka and kacha sheds where they keep their animals to protect them from rain, heat, sunshine etc. land of daira/shed also vary among dairy farmers some are small in size and some are large according to their need. It is a common practice that in-milk animals and non in-milk animals are kept under the same shed and even they are feeding the same fodder to all the animals whether that is milking animal or none milking. For the purpose of shed cost, for in-milk animal following formula is used (Ahmad et al., 1996).

$$SCM = SC \times \frac{MA}{HD}$$

SCM= the shed cost for in-milk animals

SC= total shed cost in rupees

MA= number of in-milk animals

HD= total number of animals or herd size

Various types of utensils are used to feed the animals or to carry fodder, for example both type chuff cutters (manual and electric), carts, khurpa and fodder cloth etc. the cost of these tools are calculated on their original purchases.

Green and dry fodder contributes as an essential input in nurturing the milking animals. The cost of fodder is calculated on per kanal price prevailed in area from where the data is collected. The share of in milk animals can be derived from the total cost of green or dry fodder by using following formula (Ahmad et al., 1996).

$$GFC = TGFC \times \frac{MA}{HD}$$

$$DFC = TDFC \times \frac{MA}{HD}$$

GFC= green fodder cost for milk animals

DFC= dry fodder cost for milk animals

TGFC= total green fodder cost fed to all animals

TDFC= total dry fodder cost fed to all animals

MA= number of in- milk animals

HD= total number of animals.

4.5.1 The Average Production

It is the ratio between total gross production (main or secondary) to the number of animals from that production was obtained to or the average number of animals fed.

$$q = \frac{Q}{Na}$$

In which:

q =Average production per animal

Q =Total production (liter)

Na= average number of animals (in milk)

4.5.2Production Cost

Production costs represent the expenses reflecting productive consumption of resources incurred, in carrying on production (Gherasim, 2007).Cost of milk production is derived by adding variable and fixed cost. Variable cost included green fodder cost, dry fodder cost, disease treatment cost and labour cost, of each in-milk animal per day. While fixed cost carry shed cost (tools and equipments used on farm) of in-milk animals per day. This is estimated as:

$$TC = VC + FC$$

In which:

TC = total production costs

VC = variable costs

FC = fixed costs

Variable Costs

Variable costs are directly influenced by the changes in production volume. The main variable costs in the production of milk are:

$$VC = GFC + DFC + DTC + LC$$

GFC = Green fodder costs

DFC = Dry fodder cost

DTC = medicines and veterinary costs

LC = Labour cost

Fixed Costs

Fixed costs include those expenses that are not directly dependent on the volume of production include:

$$FC = DC + ECC + MCC + DC$$

DC = Daira cost

ECC = Electric chef cutter

MCC = Manual chef cutter

DC = Donkey cart

Cost Per Unit of Product

It highlights the total production costs incurred in carrying out a principal product unit (in this case, milk)

$$AC = \frac{TC}{Q}$$

In which:

AC = unitary cost of production

TC = total production costs

Q = total production

4.5.3Profit

It is the difference between revenues obtained and total production costs. The calculation formula of gross profit is:

$$\lambda = TR - TC$$

In which:

λ =Profit
TR = total income
TC = total costs

4.5.4 Rate of Return

It is a relative value that expresses the degree to which the whole capital brings profit.

$$Rr = \frac{\lambda}{TC} \times 100$$

In which:

Rr = rate of return
λ = Profit
TC = Production costs

The rate of return is a ratio between an indicator of results (profit or loss) and an indicator that reflects the resources consumed.

4.6 Model and Estimation Technique

As discussed earlier in chapter 3 that there are two methods to estimate economic efficiency i.e. Data Envelopment Analysis and Stochastic Frontier Analysis. In this study Data Envelopment Analysis is used for estimation. 75 dairy farmers are interviewed from district Sargodha for this study. The data is collected during 2016 and collected through a detailed questionnaire. Three tehsils of district Sargodha

(Bhalwal, Shahpur and tehsil Sargodha) are randomly selected. The main objective of the study is to find the Economic efficiency of the farmers.

Table 4.1: Input and Out Measures

Output measures	Input measures
Milk production (per day)	Green fodder cost
	Dry fodder cost
	Disease treatment cost
	Total labour cost

Socio economic characteristics like education, age group and family size etc. provides useful information to the researchers. They will help researcher to estimate inefficiencies in producing milk.

Table 4.2: Factor Affecting Efficiency of Milk Production

Family members working hours on dairy farm
Education
Age
Operational area
Distance from pakka road
Herd size

4.7 Tobit Regression Analysis

Tobit regression analysis is used in efficiency analysis to find the exogenous variables on inefficiency.

$$Inefficiency = \alpha + \beta_i X_i + \mu_i$$

β_i = vector of unknown parameters.

X_i= vector of external factors affecting the inefficiency of dairy farmer.

μ_i = error term.

4.8 Profitability Analysis and Returns to Scale

4.8.1 Econometric Model

For simple analysis, statistical package SPSS, mainly cross tabulation and frequency distribution is executed. F- Statistics used in order to judge whether the difference between the different areas are significant. The difference between the areas will be statistically significant, if the computed value of calculated F-statistics is greater than the tabulated F-statistics. Following econometrics model is used for income of the farm of livestock production (Sadiq et al., 2003).

$$Y = \beta_0 + \beta_1 GFC + \beta_2 DFC + \beta_3 DTC + \beta_4 MA + \beta_5 L + \beta_6 HD + \beta_7 TSC$$

Where

Y = income from milk animals

GFC= green fodder cost on in milk animals,

DFC= dry fodder cost for in milk animals,

DTC= disease treatment cost on in milk animals,

MA= number of in milk animals

LC= total labour cost on in milk animals

HD= herd size/total number of animal.

TSC= total shed cost

Production function is a physical, mathematical and technical relationship between outputs and inputs. To trace out the return to scale of milk production Cobb Douglas function was utilized, as follow (Sadiq et al., 2003).

$$Y=C\,(GFC)^{\beta 1}\,(DFC)^{\beta 2}\,(DTC)^{\beta 3}\,(MA)^{\beta 4}\,(LC)^{\beta 5}\,(HD)^{\beta 6}\,(TSC)^{\beta 6}$$

Where GFC, DFC, DTC, MA, LC, TSC and HD are the same as explained earlier but here C stands for the constant and depends on the units of measurement of GFC, DFC, DTC, MA, LC, TSC and HD, the coefficients β are the elasticity's of output with respect to GFC, DFC, DTC, MA, LC, TSC and HD inputs respectively. Taking log of equation:

$$\log Y = \log C + \beta_1 \log GFC + \beta_2 \log DFC + \beta_3 \log DTC + \beta_4 \log MA + \beta_5 \log LC + \beta_6 \log HD + \beta_7 \log TSC$$

OLS method is utilized to estimate this equation for sample farmers. By this return to scale was measured collectively. Thus if β1+ β2+ β3+ β4+ β5+ β6+ β7 = 1 constant return to scale, β1+ β2+ β3+ β4+ β5+ β6+ β7 < 1 decreasing return to scale, β1+ β2+ β3+ β4+ β5+ β6+ β7 > 1 increasing return to scale.

Following formula was used to estimate production cost of milk (Shah et al., 2009).

$$\text{cost of Milk Production} = \frac{Total\,Cost}{\sum MP}$$

It is utilized to find out the cost of milk production (per unit) in the sample areas. ∑MP is the sum of milk production. Cost benefit analysis was measured to estimate the profitability of the farmer (Hosking & Du Preez, 2004).

$$Benifit\,Cost\,Ratio = Total\,Benefit - Total\,Cost$$

5. RESULT AND DISCUSSION

5.1 Descriptive Statistics of Economic Efficiency

As explained earlier that all buffalos, cows, sheeps, goats, bullocks, camels and donkeys under a shed is called a herd. Average herd size, a farmer hold is 11 animals and maximum animals in a shed are 27 animals, while minimum animals in a shed are 3 animals. Average income received from milk production is 387120 rupees in a year.

Table 5.1: Summary of Input and Output Variables

	Total money value of milk production	Total labour cost	Total green fodder cost	Number of labour	Herd size	Total dry fodder cost	Disease treatment cost
Mean	**387120.1**	**193563.6**	**171700**	**1.813333**	**10.69333**	**105374.9**	**2384.507**
Median	**365357.4**	**192200**	**157500**	**2**	**10**	**100104**	**720**
Maximum	**703234.7**	**501000**	**441400**	**4**	**27**	**353604**	**20225**
Minimum	**171293.2**	**59212.3**	**42000**	**1**	**3**	**2916**	**40**
Std. Dev	**132502.6**	**108684.5**	**89099.31**	**0.74785**	**4.597218**	**66172.89**	**3662.481**

The maximum income received from milk is703234 rupees annually. Mean value of green fodder cost is 171700 rupees, cultivating 40 kanal (rabi and kharif fodder) and dry fodder cost have 105374.9 rupees per annum. 99% farmer gives vaccination to their animals twice in a year. Annual mean disease and breeding cost of a farm is 2384.507. Maximum expenditures arises on disease treatment were Rs. 20225 only. Average number of labours on farm is 2 who perform different type of works which may be cleaning; milking, giving fodder to animals, cutting fodder etc. average salary paid to the labour is

106744 per annum. Other expenses on labours included medicine, wheat bags, tea and lunch etc. these other expenses are normally for permanent labour.

5.2 Economic Efficiency Score

Table 5.2: Mean Efficiency Scores

	Technical Efficiency	Allocative Efficiency	Economic Efficiency
Mean	0.892	0.401	0.358
Minimum	0.624	0.164	0.133
Maximum	1.00	1.00	1.00

Mean technical efficiency of the farmer is .892 which implies that 89% of the farmers are technically efficient but they still have the capacity to utilize their inputs to increase their production and only 11% farmers are technically inefficient. Allocative efficiency score is .401, it signals that only 40% farmers are allocatively efficient and average economic efficiency of district is 0.358. It implies that 35% farmers are economically efficient in district Sargodha. 65% farmers have the capacity to improve their output. Maximum economic efficiency score is 1.00 while minimum efficiency is 1.33.

5.3 Comparison of Highly Efficient Firms with Relatively Inefficient Firms

Here we do a comparison between relative efficient firms who are economically more efficient with relativity less efficient or inefficient firms. Two groups of firms are constructed on the base of their efficiency score. The first group consists of firms whose Economic Efficiency ranges 0.00 to 0.30 called inefficient group. Then efficient group is formed with firms having Economic Efficiency ranges 0.80 to 1.00.In this study distance from pakka road have no effect on efficiency. Economic efficiency has no significant effect from distance from pakka road. Dairy farmer who belongs to efficient group are more educated then the inefficient group. The farmers who are educated, they are economically more efficient in milk production. Farmers who are efficient they are older than the inefficient farmers. Age of the farmer also tells the experience. Farmer who is older has more experience than the younger one. Operational area of the land owner has also effect on the efficiency. Efficient group own the large operational area. The farmers who belong to efficient group have big herd size. Family members of efficient group working on dairy farms are less than the number of family members of inefficient group.

Table 5.3: District-Wise Efficiency Score

	Technical Efficiency	Allocative Efficiency	Economic Efficiency
Sargodha			
Mean	**0.927**	**0.568**	**0.559**
Minimum	**0.657**	**0.262**	**0.278**
Maximum	**1.00**	**1.00**	**1.00**
Bhalwal			
Mean	**0.941**	**0.393**	**0.371**
Minimum	**0.767**	**0.136**	**0.133**
Maximum	**1.00**	**1.00**	**1.00**
Shahpur			
Mean	**0.940**	**0.555**	**0.524**
Minimum	**0.626**	**0.238**	**0.198**
Maximum	**1.00**	**1.00**	**1.00**

Tehsils Sargodha and Shahpur have economically most efficient dairy farms according to the tehsil

level comparison of results. The mean economic efficiency score of these farms were 0.55, and 0.52 respectively. Mean technical efficiency of Sargodhian dairy farmers were 0.92 while Bhalwal and Shahpur scored 0.94 which is very close to the frontier. Allocatively Sargodha's farmers are most efficient by scoring 0.56. Allocatively 61% and 45% farmers were inefficient in bhalwal and shahpur respectively.

5.4 Determinants of Efficiency

The results of DEA at first stage revealed that there exists economic inefficiency in sample farms. Now to sort out the factors affecting the economic efficiency, the efficiency scores obtained from DEA (using the computer software ***DEAP 2.1***) under variable return to scale are regressed on certain farm level characteristics using a Tobit model. Tobit model is utilized to check the significance of the factors instead of OLS regression, because the regressand has limited variable (censored variable) having upper limit of one. In this situation OLS regression did not give consistent results of parameters. Computer software Eviews9 is used to measure Tobit regression model.

Table 5.4: Tobit Regression Results

Variable	Coefficient	Std. Error	z-Statistic
DISTANCE	0.028921	0.041027	0.704915
EDUCATION	0.025814*	0.007764	3.325072
HERD SIZE	0.089267**	0.046544	1.917905
OPERATIONAL AREA	0.06637*	0.025482	2.604583
AGE	0.002926*	0.001332	2.196517
FAMILY MEMBERS	-0.015083**	0.008242	-1.830107
C	0.192529*	0.077701	2.477824

*Note: * significant at 0.01 levels*
*** Significant at 0.05 levels*

In Tobit analysis variables used for the efficiency analysis of farmer are distance from pakka road, education of the farmer, herd size, number of family members involved in milk production, operational area and age of the farmer.

The Tobit regression results revealed that distance from pakka road and family member's working hours are not statistically significant in explaining economic efficiency. This result is consistent with (Masuku & Masuku, 2014).

Education of the farmer plays vital role to increase efficiency because as education increase a farmer can easily understand the new ways and techniques. By using his best knowledge he can perform in best way overcoming on his losses. Increase in one year of schooling milk production can be increase by 0.01.Variable of education showed that education is significant in explaining the economic efficiency. This result is consistent with (Kibiego, Lagat, & Bebe, 2015b) and (Ayaz et al., 2011).

Age of the farmer also has positive effect on production. Because as age increases, the years of farming will also increased, which points that farmer experience increased too. So as experience increases the milk production efficiency tends to increase. Age of the farmer in Tobit analysis is significant at 5%. This result is consistent with (Nganga et al., 2010).

Operational area also effect the productivity of the farmer positively as the area increase by one unit there will be 0.0511 unit increase accrues in the production of milk. The coefficient of operational area showed that there exists positive relationship between economic efficiency and operational area, which indicates that as operational area increases it would lead to enhance the efficiency of dairy farmers.

The variable, size of the dairy farm (defined as herd size) is positively and significantly related to economic efficiency. This concludes that farmers who have large herd size are economically more efficient than the farmers with small herd size. This result is consistent with (Burki & Khan, 2011) and (Al-Sharafat, 2013).

Numbers of family members working on farm are significant but it has minus signs which show that as the numbers of family members working on farm are increased, the production/economic efficiency reduce. It is because of disguised unemployment in dairy and agriculture department. Numbers of worker are greater than requirement. There is no need of more labour or worker. (Alemdar, Bahadir, & Oren, 2010) and (Ayaz et al., 2011) had same consistent result with these results.

5.5 Profitability Results

Fixed Cost

In fixed cost, shed cost, utensils/equipment cost are included which were used on farm. Average fixed cost per day per in-milk animal is 6 rupee which is explained in the table.

Variable Cost

The several elements of variable cost were green fodder cost, dry fodder cost, disease treatment cost and labour cost. These costs were taken on average daily basis. Average variable cost on per milk animal per day was RS. 506.

5.5.1 Milk Production

Milk production is function of milk output per day per milking animal. Milk output is much affected by the feed in which dry fodder is most important. The data indicated that average milk production per day from each milking animal 12 liters while average milk price RS. 42 per liter. On average income generated per day 667 rupees per in-milk animal per day.

5.5.2 Cost of Milk Production

Cost of milk production derived by adding variable and fixed cost. Table explained that total variable cost of in milk animals Rs. 506.3371 per day per in-milk animal. Whereas fixed cost Rs. 5.8599 per day per in-milk animal.

5.5.3 Profit

Gross income is the summation of all the receipts from livestock products which in this studied milk production and produced by the owner of the farm. Output assessed at the current price per liter charged in the sample area. Table showed that Average milk production from in-milk animals 12.025 liters per day and gross income earned Rs. 667.4102 per day per in-milk animal. And overall net income from livestock production 155.2132 per day per in-milk animal.

5.5.4 Cost-Benefit Ratio

Cost benefit analysis estimated through taking the difference of gross income and total cost. In this study the ratio for investigated in livestock production 1: 1.30. It means if a person invested 1 rupee on livestock he will earn 1.30 rupee.

Table 5.4: Profitability Analysis

Cost	
Variable cost	
Green fodder cost	233.6887
Dry fodder cost	12.24121
Disease treatment cost	2.083779
Labour cost	258.3234

Total	506.3371
Fixed Cost	
Shed cost	5.85992
Total Cost(A+B)	512.1970
Revenue	
Milk yield	12.025
Gross income	667.4102
Profit ($\hat{\lambda}$ =2-1)	155.2132
Cost per liter	42.594
Cost-benefit ratio	1:1.30

5.6 Econometric Estimation

Following econometric model utilized for income of milk production (Sadiq et al., 2003). Study recommended that all the β1, β2, β3 and β4 have positive signs related to income. The herd size has positive effect on income of owner. While taking other variables constant as increased one animal in the herd the income of the farm owner will tend to increase. But β5 and β6 had negative signs related to income. Disease treatment cost has negative effect on farmer's income. If one rupee treatment cost increases it will reduce income of the farmer by 26 rupees. And same as with the shed cost it also decrease farmer's income if there shed cost enhanced while taking other variables constant.

$$Y = 792.46 + 0.37GFC + 8.40DFC + 105.24MA + 0.17LC + 28.25HD - 26.87DTC - 11.45TSC$$

(14.58) (2.23) (3.33) (5.35) (1.29) (3.39) (-3.83) (2.09)

R^2= 0.500 D.W = 1.85 F Value = 9.59

The above R^2 value represent that these independent variables are speaking good fitting (50%) for income accrued from livestock. On one unit increase in green fodder cost the average income of the farmer will increase by 0.374 rupees per day while other inputs remain same, other things remaining same, the positive t-value (2.23) at 5% level of significant support this statement. Average income of the farmer will increase if we increase one animal to the herd size or in total number of animals. It will increase by 28.25 rupees per day per animal.

5.7 Return to scale

Return to scale is important to measure because they will describe the investment position of dairy farming that whether someone invests in dairy farming or not. It highlights the current situation of returns of investment in dairy production. For this purpose, specified equation has been estimated by taking log. The results shows

$$Y = 5.09 + 0.42HD + 0.15GFC + 0.11LC + 0.83MA - 0.11DTC - 0.10SC$$

(10.95) (2.64) (2.83) (3.44) (1.90) (4.92) (3.58) (2.12)

R^2= 0.63 D.W=1.88 F Value= 11.12

The results written above indicate the idea of the result of the earlier model that the herd size (HD), number of milking animals (MA), quantity green fodder cost (GFC) dry fodder cost (DFC) disease treatment cost (DTC) shed cost (SC) and labor cost (L) engaged largely determine the returns from dairy farming. This result put light on two important components; first, the coefficient βs, in fact, represents the elasticity's and recommend that if herd size (HD), quantity green fodder cost (GFC) dry fodder cost (DFC), labor cost (L) and number of milking animals (MA), are individually increase by 10 per cent, these would increase return respectively, about 4.2 percent, 1.5 percent, 1.5 percent, 1.1 percent, 8.3 percent respectively while decreased for disease treatment cost (DTC) shed cost (SC) 1.1 percent, 1

percent respectively Second, the cumulative elasticity's of the all coefficients i.e. $\beta_1 + \beta_2 + \beta_3 + \beta_4 + \beta_5 + \beta_6 + \beta_7$ is greater than 1; i.e. 1.46, which showed that the dairy enterprises in the sampled areas was representing increasing returns to scale. It is concluded that increase in investment in dairy farming will increase the income of the farmer and will help in improving the socio-economic conditions of the farmers in Sargodha.

6. CONCLUSION AND POLICY RECOMMENDATIONS

Pakistan is an agro-based economy, so agriculture sector is the backbone of Pakistan's economy. Agriculture sector is the major contributor in the GDP (Gross domestic product) of Pakistan. The share of agriculture sector in GDP is 20.9% (economic survey2014-15). India and the US are the largest and second largest, producing 146.31 million tones and 93.5 million tonnes respectively. Pakistan is producing 50.1 million tones and stood at third position in the world (FAO, 2015). There are about 188.9 million people in Pakistan, with around 11.7 million in-milk cows & 12.9 million in-milk buffalos. Total milk production per day from all types of in-milk animals was 141.8 million liters (2006 Livestock Census). In this quantity of milk, the contribution of cows was 37.6 per cent (53.3 million liters), buffaloes 57.9 per cent (82.1 million liters) and goats 4.5 per cent (6.4 million liters).

Livestock sector has great importance for Pakistan's economy because it is a major contributor of agricultural GDP of Pakistan. Livestock contributed approximately 58.6% to the agriculture during 2015-16. According to FAO statistics of the year 2014 the total production of the milk in the world is798 million tonnes, while Asia is producing316.9 million tonnes, from which southern Asia is producing 210.3 million tonnes. Pakistan is situated in the southern Asia, contributing 50.1 million tonnes. Pakistan is the third largest milk producing country in the world. According to economic survey of Pakistan, milk gross production increased from 50990 (000 tons, 2013-14) to 52632 (000 tons, 2014-15).

The basic aim of the study is to find out the economic efficiency of milk production and draw policies that are valuable in increasing productivity of milk. It is done by finding the improved engagement of the factors concerned in milk production. Data envelopment analysis technique is used to estimate economic efficiency. Mean technical efficiency of the farmer is 0.892 and only 11% farmers are technically inefficient. Allocative efficiency score is 0.40 and average economic efficiency of district Sargodha is 0.358. It implies that 35% farmers are economically efficient in district Sargodha. 65% farmers have the capacity to improve their output. Milk production is function of milk output per day per milking animal. Milk output is much affected by the feed in which dry fodder is most important. Education, operational area and age of the farmer are significant at 01% and have positive relation with economic efficiency. Only herd size is significant at 5%. Distance from pakka road and number of family members working on farm are insignificant.

Mean income earned from in-milk animals is Rs. 668 comprising 5 in-milk animals in shed. Cost of milk production is derived by adding variable and fixed cost. Table explained that total variable cost of in milk animals is Rs. 506.3371 per day per in-milk animal. Whereas fixed cost is Rs. 5.8599 per day per in-milk animal. 12 kg milk is produce on average in a shed, bearing per liter price of Rs. 42 only. Elasticity of the coefficients is greater than 1 i.e. 1.46 showed increasing return to scale. Average milk production from in-milk animal 12.025 liters per day and gross income earned Rs. 667.4102 per day per in-milk animal.Net profit from per in-milk animal per day is 155 rupees only. In this study the estimated cost benefit ratio in dairy production is 1: 1.30. Overall net income from milk production is 155.2132 rupee per day per in-milk animal. the cumulative elasticity's of the all coefficients i.e. $\beta 1 + \beta 2 + \beta 3 + \beta 4 + \beta 5 + \beta 6 + \beta 7$ is greater than 1; i.e. 1.46, which showed that the dairy enterprises in the sampled areas was representing increasing returns to scale. It is concluded that increase in investment in dairy farming

will increase the income of the farmer and will also help in improving the socio-economic conditions of the farmers in Sargodha.

6.1 Policy Recommendation

On the basis of outcome/results of the research following recommendations are suggested.

- Study recommend that inefficiency in dairy milk production can be reduce significantly by improving level of education, larger operational area and herd size amongst the farmers.
- Results show that there are increasing returns in milk production so livestock and dairy department should organize some seminars and programs to attract new investors to invest in dairy sector of Sargodha.
- Results proved that increasing the number of in-milk animals in herd will increase profit.
- Disease treatment cost is a major factor affecting profitability of milk production, so dairy department must provide veterinary services at reasonable price to increase income of dairy farmer.

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QUESTIONNAIRE:

SERIAL #.....

UNIVERSITY OF LAHORE

DEPARTMENT OF ECONOMICS

QUESTIONAIRE

SURVEY OF DAIRY FARMS 2016

Interview date: ……..
Interviewers name: ……
Farmer name: ……
Phone no: ……..…….
Fathers name: …….
Caste: ……..…….
Village: ……..…….
District: ……..…….

Respondent type
Respondent area code: ……
Respondent type code: ……
If contract farmer, name of dairy/cooperative……

Codes:

respondent Area codes:	1=rural	2=peri-urban
Respondent type codes:	1=sale to traditional dodhi	2=contract sale to commercial dairy
	3=contract sale to cooperative	4=direct milk marketing

(1) Village characteristics:

Location on WC (1=head, 2=mid, 3=tail)		Canal/ditsy Name (e.g. South Branch)	
Distance from pakka road (km)		Distance from nearest town+Name	
Distance from market			

(2) Age, Education profle:

Farmer edu. (years)		Age (years)	
Experience in the field of livestock (years)			

(3) Farm size and tenure:

	In (acres)	Cultivated area (acre)	Un-cultivated wastes
A. Land owned			
B. Area rented-in			

C.	On fix-rent-in			
D.	On share rent-in			
E.	Area rent out			
F.	On fix-rent out			
G.	On share rent-out			
H.	Daira			
I.	Total operational area (A+B+C+D-E-F-G-H)			

(4) Education Profile:

	Male	**Female**
Number of family members		
Primary (upto 5)		
Middle (upto 8)		
Matric		
F.A, F.Sc		
Graduation		
Above graduation		

(5) Herd size & composition:

Buffaloes (No)		**Cows (No.)**	
In-milk		**In-milk**	
Pregnant		**Pregnant**	
Dry		**Dry**	
Heifers		**Heifers**	
Y.S<6 month		**Y.S<6 month**	
Bulls		**Bulls**	
Other animals			
Adult donkey		**Sheep**	
Goat		**Sheep/Goat Y.S<6 M**	

5.1 do you keep animals in village or in daira away from village (if in daira then what is the distance of daira from village in km).

5.2 What is the distance of daira from VMC (village milk collection centre) in km……?

(6) Fodder inputs:

Fodder	**How much area of fodder**	**Fodder area bought (kanal)**	**Fodder area sold (kanal)**	**Price of fodder per kanal (rupees)**

	harvested in kanals			
Rabi fodders				
Barseem				
Rapeseed				
Lucern				
Others specify				
How much area of fodder harvested yesterday (kanal)				
Kharif Fodders				
Maize fodder				
Sorghum fodder (chari, jowar)				
Other Kh. Fodder				
Roughages/grasses				

(7) Milk Production:

Buffaloes										
	Age of animal (year)	**No of lactations of that animal**	**Lactation stage**	**Milk produced yesterday (morning + evening)**	**Average milk yield/day (since last lactation)**	**Maximum milk yield / day**	**Maximum yield month (after lactation)**	**Milk consumed by suckler**		**Weaning month**
animal	year	No	Months	liters	liters	liters	liters	Beg %	End %	month
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										

(8)

Cows										
	Age of animal (year)	**No of lactations of that animal**	**Lactation stage**	**Milk produced yesterday (morning + evening)**	**Average milk yield/day (since last lactation)**	**Maximum milk yield / day**	**Maximum yield month (after lactation)**	**Milk consumed by suckler**		**Weaning month**
animal	Year	no	months	liters	Liters	liters	liters	Beg %	End %	Month
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										

8.1 total milk produced yesterday (lit) (morning+ evening)……..……

8.2 home consumption of milk yesterday (lit)……

8.3 made ghee/butter (kg/day)

(9) Flush and Lean season milk production:

9.1 flush season from……month to…….month.

9.2 average daily milk production for whole farm in flush season……..liter/day.

9.3 No of in-milk animal in flush season……

9.4 Lean season from……(month) to…….

9.5 Average daily milk production for whole farm in lean season……..liter/day.

9.6 Reason for drop in production (1=less in-milk animal, 2= shortage of feed and fodder, 3=other specify).

9.7 No of in-milk animal in lean season…….

(10) Sales of milk and milk products:

10.1 Milk sold yesterday to dodhi……..liter.

10/2 Price received from dodhi cow milk (Rs./lit)…….Buffalos milk …….. (Rs/liter).

10.3 Milk sold to commercial dairy VMC liter……fat…….%.

10.4 Price received from commercial dairy……. (Rs/ liter)

10.5 Milk sold yesterday at dairy cooperatives VMC……. Liter, fats ……%
10.6 Price received fromdairy cooperatives …… (Rs/liter).
10.7 Direct milk sold to shop or home …… (Rs/liter).
10.8 Price received from dodhi cow milk (Rs./lit)…….Buffalos milk ……..(Rs/liter).
10.9 How much advance received from dodhi during post 12 months (Rs).
10.10 Sold ghee/butter during last 6 months…….kg.
10.11 Price per kg of ghee/butter……

(11) Cost of production:

Concentrate and feed supplements	**Unit (bags with weight, kg)**	**Price per unit (rupee)**	**Quantity consumed per month**	**Given to animal (1=in-milk, 2=in-milk and pregnant, 3=all)**	**Brand name of concentrate or vanda**
Cotton seed					
CSC (khal)					
Vanda					
Mineral mixture					
Choker					
Wheat straw					
Rice straw					
Wheat grains					
Maize grains					
Gram					
Gram flour					
Pearmillet(bajra)					
Oil					
Gur					
Salt					
Other specify					

(12) Cost of animal health and breeding services:

service	**Y/N**	**How many time services given last year**	**Cost of health treatment per animal**	**Cost (Rs/year)**	**Satisfaction (1=high, 2=medium, 3=low)**
Vaccination					
De-worming					

Dipping (kirm)					
Breeding **AI**					
NI					
Other specify					

Note: A service is a one-time treatment/procedure performed to one animal.

(13) Record of animal diseases:

animal	**Type of disease**	**Animal affected (no.)**	**Animal affected (1=in-milk, 2=non milk)**	**Duration of disease, (months)**	**Mortality (no. died)**	**Reduction in milk production %**	**Expenditure on disease treatment, Rs**
1							
2							
3							
4							
5							
6							
7							

Codes: 1=FMD(munh khur), 2=HS (galghotu), 3=mastits (saru), 4=other

13.1 If you treated, what was the source of treatment?
Veterinary doctor
Assistant
Others

13.2 How far away……..

13.3 Are you satisfied for disease treatments (1=high, 2=medium, 3=low)…….

13.4 How many visit for treatment bear in one year (farmer visit)…… veterinarian visit……

13.5 How much expenditure bear on disease treatment in one year (medicine + fee)……..

(14) Dairy farming capital:

description	**Type**		**Structure**		**Present value of land (marla/kanal)**	**Expected life of the asset (years)**
	Katcha	**Pacca**	**Covered area (marlas)**	**Open area (marlas)**	**-**	**-**

Animal shed						
Equipments in shed			**Y/S**		**-**	**-**
Milking machine						
Chaf-cutter **1= electric, 2=animal driven**						
Chaf-cutter manual						
Cart						
Any other specify						

(15) Advances and loans:

15.1 How many time you received advances/loans in last year…….

15.2 What was the total amount of the advance…….

15.3 Source of advance (IK, 2=nestle, 3=bank, 4=relative, 5=other specify)…….

15.4 What purpose the advance was used for (1=production purpose, 2=social purpose, 3=both) ……..

15.5 Amount of outstanding debt…….rupee.

(16) Labour cost:

16.1 How many man hours family males used for livestock activities per day……

16.2 How many man hours family females used for livestock activities per day……What kind of work you do……..

16.3 No of hired labor work only on dairy farm men……..women……for livestock activities.

16.4 Hired labor hour per day men……..women……for livestock activities.

16.5 Is that hired labour permanent/temporary……

16.6 Cost of hired person per month…….rupee.

16.7 How much you gave money on contract per day……..rupee.

16.8 Is this money (loan) adjusted against salary……..?

16.9 Other expenditure on labour ……..

(17) Other activities:

17.1 How many time you gave water to animals……

17.2 Which water source you use for your dairy animals……..

(1=hand pump, 2=tap water, 3=tub well water, 4=canal water, 5=river water, 6=others specify.)

17.3 How much grazing time per day……

(18) Transaction cost:

18.1 green fodder procurement transaction cost:

18.2 source of procurement (self, market or firm)

Time cost:

18.3 Time taken, per trip to fodder field and back (including cutting time) …….hr/day.

18.4 What method you used to transport fodder from fields to farm……

Codes: 1=carry on head, 2=carry on donkey, 3=cart pulled by donkey, 4=tractor trolley, 5=other

18.5 Time taken to chop fodder……..hr/day.
18.6 What kind of chopping machine used (1=electric, 2=manual, 3=animal driven)…….

18.7 Concentrates/supplements/dry fodder transaction costs:
18.8 Where do you buy concentrates and supplements (place)……..
18.9 Distance from farm km…….
18.10 No of visits per month……
18.11 Transportation expenditure per month……. rupee.
18.12 Time spent in purchasing concentrates and supplements including travel time…….hr/month.