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Profitability and Economic Efficiency Analysis of Dairy Farming In Faisalabad

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Article Details

ABSTRACT

Keywords: Technical efficiency, Profitability Employment of milk production methods in Pakistan falls well below the levels analysis, Gross margin, Net income observed in other developed countries, yet milk requirements continue to increase profitability analysis, Tobit model, Data each day. The determination of dairy farming efficiency remains an uninvestigated area in Pakistan. The study aimed to determine the technical, allocative, and economic efficiency levels of dairy farms. A well-structured questionnaire was used to acquire data from 100 dairy farms through convenient sampling. The Data Envelopment Analysis program calculates efficiency assessments at technical, allocative, and economic levels. The selected model for analyzing socio-economic determinants of economic efficiency is Tobit regression. The investigation employed the cost of medicine, vaccination, maintenance, feed, transportation, and semi-nation as input elements to analyze output revenue. This study utilizes experience, education level, marital status, and business location, and classification as socio-economic variables. The analysis of profitability makes use of gross margin (GM), together with net income (NI) and benefit cost ratio (BCR). The research findings indicated that cattle farming operations generated profit within the Pakistani market. The studied factors yielded technical efficiency at 67%, allocative efficiency at 43%, and economic efficiency at 31%. The second model, Tobit regression analysis, reveals that marital status and residential place, as well as business type, explain significantly, but education and experience of dairy farmers do not impact the results. Dairy farm profitability analysis in Faisalabad served the purpose of the third stage research by employing GM along with NI and BCR. The results demonstrated that dairy farms generated annual revenue of 194717390 Pakistani rupees with a gross margin of 146567390 and total production costs reaching 55110500, while the net income (NI) amounted to 139606890, leading to a cost benefit ratio of 3.53, indicating dairy farming profitability.

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INTRODUCTION

The economy of Pakistan places agriculture as its second-largest sector, which also serves as a crucial economic sector because it supplies basic elements to various industrial production processes. The GDP of Pakistan receives 22.7% of its value from the agriculture sector. The workforce in Pakistan consists mainly of agricultural workers who represent 37.4 percent of everyone employed (GOP, 2021-22).

The subsector of agriculture that holds primary importance is livestock. The share of animals from the agriculture sector reaches 61.9 percent, while it represents 14.7 percent of Pakistan's GDP. Statistical data indicate that the livestock sector shows yearly growth of 3% to 4% (Economic Survey of Pakistan, 2021-22). The agriculture sector owes its vital function to the livestock sector. A total of 35 to 40 million rural Pakistani citizens operate in livestock farming. The production of livestock is expanding at a quick pace because dairy product consumption has intensified. Pakistan holds the position of the fourth largest milk producer globally, following the FAO, Food and Agriculture Organization, statistics for 2021-22.

The livestock sector holds great importance for the development of both rural and urban socio-economic elements. The economic survey of Pakistan 2021-22 reveals that the livestock sector interacts with approximately 8 million Pakistani families. Production activities within the livestock sector yield 40% of the total revenue for various activities.

The primary purpose of the livestock sector is to meet national demands and reduce poverty rates while improving socioeconomic conditions. External revenue from dairy products reached 53.55 billion during 2003-04, accounting for 14% of the nation's total export earnings (Economic Survey of Pakistan 2021-22). The GDP of Pakistan receives 19.82% from livestock operations and 22.25% from agricultural activities according to the Economic Survey of Pakistan 2021-22.

In Pakistan, the dairy sector operates through the blended integration of traditional and commercial approaches. The conventional dairy system maintains its operations in rural zones, whereas the commercial dairy system operates throughout urban locations. The production of milk, together with milk products, characterises dairy practices. Milk production quantities in Pakistan demonstrated an average annual growth rate of 3.21% between 2006 to 2016. The dairy animal population expanded, although milk output remains scant relative to each milk-producing animal (Tahir et al., 2019).

The dairy cattle population has been displayed in this table.

TABLE 1.1: DAIRY CATTLE POPULATION IN PAKISTAN

Types	Unit	2018-19	2019-20	2021-22
Cows	Million Nos.	46.1	48.4	50.1
Buffalo	Million Nos.	38.8	40.3	42.8
Sheep	Million Nos.	30.5	31.1	32.5
Goat	Million Nos.	74.1	75.2	77.1
Camel	Million Nos.	1.1	1.1	1.1

Source: Ministry of National Food Security & Research, (2021-22)

Pakistan is a country with a huge livestock population, well-suited to the local weather and environmental conditions. The current total farm animal population in Pakistan consists of 50.1 million buffalos, 42.8 million cows, 32.5 million sheep, 77.1 million goats and 1.1 million camels (Ministry of National Food Security & Research, 2021-22).

TABLE 1.2: MILK PRODUCTION IN PAKISTAN

Cows			Buffaloes			Goats		
Average milk production per cows	No of cows	Per day milk production	Average milk production per Buffaloes	No of Buffalo	Per day milk production	Average milk production per Goats	No of Goat	Per day milk production
6.023	11762	708538	4.984	187485	943038	1.694	2476	41951
	1						1	

Source: Ministry of National Food Security & Research, (2021-22)

TABLE MILK 1.3: CONSUMPTION IN PAKISTAN

Milk consumption	Unit	2018-19	2019-20	2021-22
Cow	Tones	16722	19732	22634
Buffalo	Tones	28109	30398	33795
Sheep	Tones	40	44	47
Goat	Tones	915	1191	1376
Camel	Tones	896	965	1098

Source: Ministry of National Food Security & Research, (2021-22)

Pakistan is the 4th largest milk producer in the world. The cows produced 22634 tons of milk in the year 2021-22, and buffalos produced 33795 tons of milk in 2021-22. The other cattle, like sheep, goats and camels, are also contributing 2521 tons in milk production. Out of total milk production, 80 % is used for human consumption, and 20 % is wasted, as 15% in transportation and 5% in calving (Ministry of National Food Security & Research, 2021-22)

Milk is a perishable product of livestock farming, produced by millions of small and large-sized dairy farmers in Pakistan. Providing healthy, safe, and hygienic milk to consumers is a significant challenge. The consumers in Pakistan spend 26% of their food budget on milk and its products. Out of total milk production, 80% of the milk is obtained from rural areas, 15% from peri-urban and 5% from urban areas. The present milk production and marketing system is facing a number of problems, including poor infrastructure, milk quality, and financial insecurity (Farooq, 2016).

Faisalabad contributes over 21% of Punjab totals GDP and has an average annual overall contribution in GDP of Pakistan \$20.5 billion. The population has risen very fast from nine thousand one hundred and seventy one in 1901 and it increased 2,008,861 in 1998 and it more jumped during the last 20 years (1998-2018) total increase in the population of this region is 235,824,862 in 2022 (economic survey of Pakistan 2021-22).

Livestock breeds of Faisalabad are desi, cross breed, nili and ravi breeds, in goat beetal breed and sheep lohi breed, dairy population from 9212 system. The diseases of livestock in Faisalabad are infections and metabolic: infectious FM, HS, ND, BQ, metabolic red water and milk fever. All types of the vaccinations are available in Faisalabad. The animal health facilities in the district include 40 civil animal hospitals, 50 civil animal dispensaries, 3 mobile medical stores and 2 district checking scientific and biological laboratories for proper animal health care. In Pakistan, the milk deficit is 12.5 million liters per day and 4.57 billion liters per annum. A study is needed to calculate economic efficiency so that policy suggestions can be made to improve the situation. So, the current study also aims to estimate the socio-economic determinants of efficiency.

DATA AND METHODOLOGY

This section utilised a model, such as the data envelopment analysis program, to measure the technical, allocative, and economic efficiency of dairy farms in Faisalabad. Furthermore, Tobit regression is used to estimate the determinants of economic efficiency. Cross-sectional data is employed for the whole empirical analysis. The present study uses the questionnaire to collect

the data through proper convenient sampling technique from 100 dairy farms of District Faisalabad. The Faisalabad district is the second largest city of Punjab and its 2.5 million population need milk to fill its demand full. Data for 2022 was collected to achieve the desired objectives of efficiency and profitability analysis of dairy farms in Faisalabad. Only Faisalabad dairy farms from the whole dairy sector were selected for the study.

1ST STAGE VARIABLES

First stage variables are used to measure the technical, allocative and economic efficiency by using the data envelopment analysis in Faisalabad. Here total revenue of dairy farms is taken as output variable and all types of cost of production are taken as input variable. One output and seven input variables have been introduced in data envelopment analysis program (DEAP).

TABLE 2.1: VARIABLES AND THEIR DESCRIPTION

Types of variables	Variables	Abbreviation of Variables
Socio-demographic variables	• Age	AGE
	• Experience	EXP
	• Education	EDU
	• Marital status	MS
	• Type of business	TB
	• Location	LO
	Input variables	• Medicine cost
	• Vaccination Cost	VC
	• Feed cost	FC
	• Silage cost	SC
	• Building rent cost	BRC
	• Labor cost	LC
	• Electricity cost	EC
	• Transportation cost	TC
	• Maintenance cost	MAC
	• Insemination cost	SEC
	• Salt and minerals cost	SMC
	• Hay cost	HC

	• Insurance cost	IC
Output Variables	Number of animals	NA
	Quantity of milk	QM
	Types of animal	TA
	Revenue	REV
	Profit	PRO

THE CONCEPT OF EFFICIENCY

Efficiency explains the level of performance and obtained output level by utilizing the last unit of input refers efficiency. Efficiency decrease the number of unnecessary resources used to produce a given output including personal time and energy. Efficiency is a measurable concept that can be determined using the output to input use full ratio. Efficiency minimizes the waste of resources and produced the optimum level of output such as different types of inputs like physical material, energy, and time while accomplishing the desired output. Farrell (1957) briefly explains the concept of economic efficiency, when a firm is creating an optimum level of output by utilizing available resources. There are two parts of efficiency as follows:

TECHNICAL EFFICIENCY

The effectiveness with which used available inputs and to produce the maximum output is called technical efficiency. A firm is producing the optimum level of output with the minimum quantity of input utilization these types of firms are called technically efficient and producing the maximum level of output these inputs are like labor, capital and technology. A firm producing the maximum level of output by using given level of input is named technical efficiency. The limit of technical efficiency is bounded between 0 and 1. ($0 \leq TE \leq 1$).

The range of technical efficiency 0 and 1 shows that if $TE = 1$ means firm's production is at its maximum level and dairy farm is fully efficient. If $TE = 0$ means that dairy farm is inefficient and its production is at minimum level.

FIGURE OF TECHNICAL EFFICIENCY

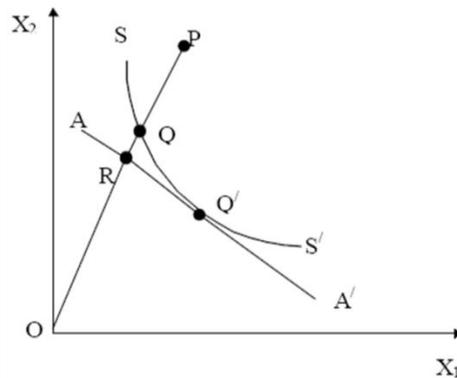


Diagram Source: Coelli et al., (2005)

The figure Q point shows the technical efficiency point of output because that point lies in the efficiency isoquant curve where the price of labor and price of capital ratio represents the ISO-cost line which is showed at figure by AA. Figure gives the basic idea of output and technical efficiency, other type of the efficiency is allocative and economic efficiency.

$$\text{Technical efficiency} = OQ / OP$$

This figure shows the economic efficiency is equal to the product of allocative efficiency and technical efficiency. Economic efficiency shows the ratio between OR and OP which is equal to the multiplication of both efficiencies technical efficiency and allocative efficiency and the ratio between OQ and OP shows the technical efficiency. The input efficiency shows the ratio between OR and OQ shows these points above figure the input oriented technique of efficiency.

$$\text{Technical Efficiency output oriented} = OQ / OP$$

$$\text{Allocative Efficiency input oriented} = OR / OQ$$

FIGURE OF ECONOMIC EFFICIENCY

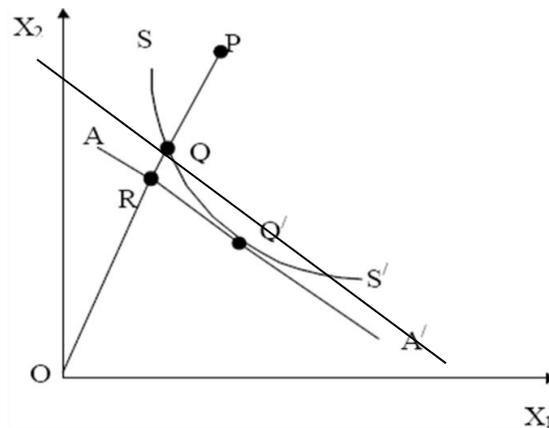


Diagram Source: Coelli et al., (2005)

Economic Efficiency equal = Technical Efficiency multiply to Allocative Efficiency

$$\begin{aligned}
 EE &= TE * AE \\
 EE &= OR / OP * OS / OR \\
 &= OS / OP
 \end{aligned}$$

The figure shows the economic efficiency, which is equal to the multiplication of technical efficiency (TE) and allocative efficiency (AE). The ratio between OS /OP shows the economic efficiency and the ratio OR/ OP shows the technical efficiency and the ratio between OS / OR shows the allocative efficiency.

Point Q' shows the MRTS of factor prices ratio

$$\text{Economic Efficiency (E.E)} = \text{MRTS} = \text{PL} / \text{PK}$$

Where MRTS shows input price ratio, PL shows the price of labor, PK shows the price of capital, marginal rate of technical substitution shows the input price ratio in a two goods labor and capital two inputs production isoquant curve.

METHODOLOGY

Data envelopment analysis (DEAP) is used to measure the efficiency of dairy farms in Faisalabad. Revenue is used as output variable and many other input variables are used feed cost, silage cost, medicine and vaccination cost, maintenance cost, transportation, electricity, labor, hay cost, salt and minerals cost.

TABLE 2.4: DAIRY FARM VARIABLES, UNITS AND THEIR STATISTICAL DESCRIPTION

Sr. No	Variables	Units	Mean	Median	Standard Deviation	Maximu m	Minimu m
1	Age	Year	47.73	50.00	10.959	75.00	24.00
2	Experience	Year	14.170	10.00	9.637	45.00	2.00
3	Education	Year	8.250	10.00	4.557	16.00	0.00

4	Marital Status	Married = 1 Unmarried = 0	0.890	1.00	0.314	1.00	0.00
5	Business	Family = 1 Self = 0	0.460	0.00	0.500	1.00	0.00
6	Location	Rural = 1 Urban = 0	0.650	1.00	0.479	1.00	0.00
7	Medicine cost	Rupees	17930.0	15000.0	13471.00	100000	2000
8	Vaccination cost	Rupees	25175.0	25000.00	14160.0	60000.0	3000.0
9	Feed cost	Rupees	445240	360000	437489	4100000	7500
10	Silage cost	Rupees	2597.50	0.00	11315.21	100000	0.00
11	Electricity cost	Units	6340.0	6000.0	3496.20	32000	1000
12	Workers cost	No of workers	58510	60000	28824.87	168000	3000
13	Transportation cost	Rupees	11455.0	10000	8678.050	54000	0.00
14	Maintenance cost	No of buildings	16475.0	15000.0	10072.31	50000	2000
15	Hay cost	Rupees	77950.5	60000	87036.95	720000	0.00
16	Semination cost	Rupees	4702.0	3000.0	4856.10	30000	0.00

17	Minerals	Rupees	11228.0	10000	6382.62	30000	1000.0
18	Salt	Rupees	2845.0	3000.0	1424.63	6000.0	500.0
19	Animals	No of animals	67.40	60.00	37.746	275.00	20.00
20	Milk	No of liters	398.220	350.00	223.94	1000.0	80.00
21	Revenue	Rupees	1947163. 90	1878000.0 0	1210068.667	5238000	180000

SECOND STAGE VARIABLES

The variables affecting the efficiency score in first stage has been categorized. Second stage variables are called personal and demographic determinants of economic efficiency in dairy farms in Faisalabad. Tobit model was used in second stage in the present research work to calculate the socio economic determinants of technical efficiency. In the present research work, economic efficiency score was taken as dependent variable. A famous economist Sir James Tobin presented the Tobit model in 1958. Tobit model explains the relationship between explanatory variables and non-negative dependent variable. Tobit model is also called the censored model and limited dependent variable.

TOBIT MODEL VARIABLES AND THEIR DESCRIPTION

Tobit model uses the explanatory variables and determinants of economic efficiency score of dairy farms in Faisalabad. Six variables are used age, education, experience, marital status, business type and residential location. These variables further detail given below.

AGE: Age has been taken as first variable to find out the determinants of economic efficiency. ADE was used as the abbreviation of age of dairy farmers. In questionnaire, the question of age shows number of years.

EXP: Experience has been as second variable the determinant of efficiency. EXP was used the abbreviation of experience of dairy farmers. In questionnaire experience shows number of years.

EDU: EDU was used as the abbreviation of education of dairy farmers. Education has been taken third variable as economic determinant of efficiency. Education shows the number of schooling years.

MS: MS was used as the abbreviation of marital status of dairy farmers. MS is a dummy variable its limit between 0 and 1. Assign the value 1 is used for married farmers and 0 is used for unmarried farmers.

BT: BT was used as the abbreviation of business type. Business type has been taken as fifth variable to find out the socio factor of economic efficiency score. BT is a dummy variable used to assign the value 1 for family and 0 for self.

RL: RL was used as the abbreviation for residential location. In questionnaire, it is assigned the value 1 for rural farmers and 0 for urban farmers.

EE: Economic Efficiency is used as a dependent Variable

THIRD STAGE VARIABLE

Third objective of the research work is to do a profitability analysis of dairy farms of district Faisalabad. Every producer has aim to maximize his profit so every firm is concerned with its profitability. Profitability analysis shows the dairy farm performance and efficiency. The purpose in this present research work is to do the profitability analysis for the purpose to check the efficiency and performance of dairy farms. To do the profitability analysis, gross margins, net income, and benefit cost ratio are used.

Gross Margin (GM): Gross margin is calculated by deducting total variable cost (TVC) from total revenue (TR).

$$(GM) = (TR) - (TVC)$$

GM = Gross Margin

TR = Total Revenue

TVC = Total Variable Cost

Net Income (NI): Net income is defined by subtracting the total cost (TC) from total revenue (TR)

$$(NI) = (TR) - (TC)$$

Benefit Cost Ratio (BCR): Benefit cost ratio is defined the divided by total revenue (TR) by total cost (TC)

$$(BCR) = (TR) / (TC)$$

RESULTS AND DISCUSSION

This section of the paper is giving discussion on the results. The following table is showing the results of descriptive analysis

PERCENTAGE DISTRIBUTION OF DAIRY FARMERS ACCORDING TO EDUCATION IN FAISALABAD

Education level	Frequency	Percentage	Cumulative percentage
0.00	2	2	2
5.00	22	22	24
8.00	21	21	45
10.00	24	24	69
12.00	26	26	95
14.00	3	3	98
16.00	2	2	100
Total	100.00	100.00	

The table 3.1 explains the educational level of farmers and also shows the frequency, percentage of education and cumulative percentage of education of farmers. It also explains that 2 percent farmers are illiterate, 22 percent farmers have 5 years of education, 21 percent farmers have middle education, 22 percent farmers have 10 years of education, 26 percent farmers have 12 years education, 3 percent farmers have 14 years education and only 2 percent farmers have 16 years education.

DATA ENVELOPMENT ANALYSIS (DEA) APPLICATION FOR DAIRY FARMS

Total revenue was taken as output variable and feed, silage, building rent, electricity, labor, transportation, medicine and vaccination, maintenance, hay, animal semi nation, salt and minerals cost was taken as input variables. The following table shows the result of data envelopment analysis program (DEA)

TABLE 3.2

Descriptive Statistics	(CRSTE)	(VRSTE)	(SE)
MEAN	0.565	0.672	0.849
MEDIAN	0.492	0.678	0.926
ST. DEVIATION	0.297	0.301	0.179
MINIMUM VALUE	0.000	0.011	0.011
MAXIMUM VALUE	1.000	1.000	1.000

The table presented the descriptive statistics results of data envelopment analysis program (DEAP) model. Results of descriptive statistic is with mean value, median, standard deviation, maximum value and minimum values of technical efficiency under assumption of constant return to scale, variable return to scale and scale efficiency. Mean values is greater than under the assumption of variable return to scale (VRSTE) as compare to the mean value of constant return to scale (CRSTE). The mean value is 0.565 under constant return to scale of technical efficiency and its value ranges from 0 to 1 with minimum value 0.00 and maximum value 1.000, standard deviation is 0.297 and median 0.492. In case of variable return to scale the average value of technical efficiency by using (DEAP) results is 0.672. It ranges from 0 to 1 with minimum and maximum value is 0.011 and 1.000, standard deviation is 0.301 and median is 0.678. The mean value under scale efficiency is 0.849 with the value of 0.0011 minimum and maximum 1.000 values and its range between 0 to 1, standard deviation is 0.179 and median is 0.926. Standard deviation value under variable return to scale is greater than constant return to scale. Range is the difference between maximum and minimum value, the range of minimum to maximum is greater of CRS efficiency.

CONCLUSION AND RECOMMENDATIONS

The result of average technical, allocative and economic efficiency in present research work in first stage technical, allocative and economic efficiency average values are 0.67, 0.44 and 0.31 respectively. Second stage result shows that five socio and demographic variables in which marital status, residential location, business type are significant determinants of economic efficiency, education and experience are insignificant determinants of economic efficiency. Third stage to do the profitability analysis by using gross margin is 146,567,390 (Rupees) and net income 139,606,890 (Rupees) and benefit cost ratio is 3.53 which shows that dairy farming business is profitable.

RECOMMENDATIONS

Data envelopment analysis results indicate mostly farmers are working under decreasing return to scale. There is no need to increase inputs. The only need is to utilize the existing inputs and increase the level of output. Adopt the new technologies and should make better of milking system. Government should provide subsidies to farmers to construct water pools for the purpose of animal drinking water. In urban areas availability of clean water is a major problem facing by farmers.

Government should motivate the dairy farmers and give subsidies in feed and minerals which

increase the milk and meat production. Farmers should adopt the better ways of medication and vaccination for animals and take proper care should increase the farm efficiency and production level. Government should provide subsidies in diversity of feed which makes according to the animal needs, increase the efficiency and production level of dairy farms. Government should give subsidy on medicine and vaccination too, as these are very expensive in market. Milk freezing system should also be provided by government so that milk can be protected in different diseases and environmental heat.

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