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Regression analysis of management efficiency of dairy farmers in animal husbandry practices

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Abstract

The livestock sector has been receiving significant priority in India in the last couple of decades. In the livestock sector, India is the world's single largest milk-producing country with a share of about 24.00 per cent in world milk production. Total milk production in India is 239.30 million tonnes during 2023-24. India ranks 1st in the world in terms of total milk production. Dairy farmers all over the world are working as managers of their own dairy enterprise. Irrespective of the economic, social, cultural, physical and technological environment, they manage a production system to get returns from it. In the present study, three district namely; Banaskantha, Mehsana, and Sabarkantha were selected purposively for this study because these districts have district cooperative milk unions. Two talukas from each district were selected based on higher milk production. Thus, a total of 6 talukas were selected for the study. 300 dairy farmers were selected for the study. In the present study, a multistage sampling technique was used. Some variable like education (X_2), mass media exposure (X_{10}), extension contact (X_{11}), economic motivation (X_{12}) and scientific orientation (X_{13}) were found highly significant relationship with the partial regression coefficient. Out of fourteen indicators, 69.50 per cent of the total variation was accounted by a set of six independent variables, *viz*., extension contact, herd size, mass media exposure, scientific orientation, economic motivation, and education put together in the management efficiency of the dairy farmers.

Keywords: Regression analysis, dairy farmer, animal husbandry, management efficiency

Introduction

Livestock is a source of subsidiary income for many families in India, especially the resource-poor who maintain few heads of animals. Cows and buffaloes, if in milk, provide regular income to the livestock farmers through the sale of milk. Animals like sheep and goats serve as sources of income during emergencies to meet exigencies like marriages, treatment of sick persons, children's education, repair of houses, *etc*. The animals also serve as moving banks and assets that provide economic security to the owners. Total milk production in India is 239.30 million tonnes during 2023-24. India ranks 1st in the world in terms of total milk production. (Source: FAO) The milk production has increased by 3.78% over the previous year. The percapita availability of milk is 471 grams per day. The top 5 milk-producing states are Uttar Pradesh (16.21%), Rajasthan (14.51%), Madhya Pradesh (8.91%), Gujarat (7.65%), and Maharashtra (6.71%). They contribute a total of 53.99% of total milk production in the country. (Source: Basic animal husbandry statistics - 2024) (GOI, DAH & D, Krishi Bhawan, New Delhi)

Regression analysis is a set of statistical methods used for the estimation of relationships between a dependent variable and one or more independent variables. It can be utilized to assess the strength of the relationship between variables and for modeling the future relationship between them. Regression analysis includes several variations, such as linear, multiple linear, and nonlinear. The most common models are simple linear and multiple linear. Nonlinear regression analysis is commonly used for more complicated data sets in which the dependent and independent variables show a nonlinear relationship.

Objective

To study the regression analysis of management efficiency of dairy farmers in animal husbandry practices

Methodology

North Gujarat was comprised of seven districts. From these districts, three district namely; Banaskantha, Mehsana, and Sabarkantha were selected purposively for this study because these districts have district cooperative milk unions. Two talukas from each district were selected based on higher milk production. Thus, a total of 6 talukas were

selected for the study. From Banaskantha district, Dhanera and Deesa talukas; from Mehsana district, Kheralu and Satlasana talukas; and from Sabarkantha district, Idar and Himatnagar talukas were selected randomly for the study. Total of 30 villages having Milk Producers' Cooperative Societies (MPCs) were selected for the study. Ten dairy farmers were selected randomly from each Milk Producers' Cooperative Societies (MPCs). Thus, 300 dairy farmers were selected for the study. In the present study, a multistage sampling technique was used.

Results and Discussion

Multiple regression analysis was conducted to examine the degree of variation in the management efficiency of dairy farmers based on fourteen selected independent variables. In this analysis, the fourteen independent variables were used to explain the changes in management efficiency of the dairy farmers.

These selected variables were used for multiple regression analysis using the following multiple regression model:

$$\hat{Y} = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + b_{10}X_{10} + b_{11}X_{11} + b_{12}X_{12} + b_{13}X_{13} + b_{14}X_{14}$$

Where,

$\hat{Y}$ = Predicted Management Efficiency

a = Intercept value

b_1 = Partial regression coefficient of Y on X_1

b_2 = Partial regression coefficient of Y on X_2

b_3 = Partial regression coefficient of Y on X_3

b_4 = Partial regression coefficient of Y on X_4

b_5 = Partial regression coefficient of Y on X_5

b_6 = Partial regression coefficient of Y on X_6

b_7 = Partial regression coefficient of Y on X_7

b_8 = Partial regression coefficient of Y on X_8

b_9 = Partial regression coefficient of Y on X_9

b_{10} = Partial regression coefficient of Y on X_{10}

b_{11} = Partial regression coefficient of Y on X_{11}

b_{12} = Partial regression coefficient of Y on X_{12}

b_{13} = Partial regression coefficient of Y on X_{13}

b_{14} = Partial regression coefficient of Y on X_{14}

Table 1: Multiple regression analysis of the selected independent variables with management efficiency of dairy farmers (n = 300)

Sr. No.	Independent variables	Regression Coefficient (b)	't' value	Sig.
1	a (Constant)	37.450	5.649	0.000
2	X_1 (Age)	-0.002	-0.019	0.985
3	X_2 (Education)	1.660**	2.730	0.007
4	X_3 (Size of family)	0.169	0.388	0.698
5	X_4 (Land holding)	0.048	0.191	0.848
6	X_5 (Social participation)	1.757	1.638	0.102
7	X_6 (Occupation)	0.930	0.909	0.364
8	X_7 (Herd size)	0.289	0.496	0.620
9	X_8 (Experience in dairy farming)	0.044	0.302	0.763
10	X_9 (Milk production)	0.048	0.724	0.469
11	X_{10} (Mass media exposure)	1.753**	5.969	0.000
12	X_{11} (Extension contact)	0.693**	7.126	0.000
13	X_{12} (Economic motivation)	0.882**	3.656	0.000
14	X_{13} (Scientific orientation)	0.831**	3.694	0.000
15	X_{14} (Level of knowledge)	0.108	0.854	0.394

Multiple R = 0.837, R^2 = 0.701

*Significant at 0.05 level of significance, ** Significant at 0.01 level of significance

It is accomplished from Table 1 that 70.10 per cent of the total variation in the level of management efficiency was explained through the variables considered as the regression equation. The unexplained variation was 29.90 per cent, which may be due to extraneous factors.

The calculated 't' values of the partial regression coefficient were highly significant in the case of education (X_2), mass media exposure (X_{10}), extension contact (X_{11}), economic motivation (X_{12}) and scientific orientation (X_{13}). The regression coefficient indicates that a one-unit change in education, mass media exposure, extension contact, economic motivation and scientific orientation would affect 1.660 units, 1.753 units, 0.693 units, 0.882 units, 0.831 units change in the management efficiency of the dairy farmers, respectively.

Relative importance of independent variables in explaining management efficiency

In order to assess the contribution (influence) of each independent variable to the dependent variable, the effect of others was held constant. The stepwise regression is one such method that has been widely adopted in multiple regression analysis. The variables were introduced stepwise in succession depending upon the contribution of each of the independent variables in explaining the variation in the dependent variable. The multiple regression co-efficient (R) represents the correlation between the dependent variable's actual score and the predicted score obtained from the multiple regression equation. The coefficient of multiple determinations (R^2) gives the average amount of change in the dependent variable when all independent variables were taken together and were tested with the 'F' test as their significance. Partial regression coefficients (b) represent the change in the dependent variable as a unit change in the independent variable, and it was tested with the 't' test for its significance. The various independent variables had their own units of measurement, which did not permit a comparison of the partial 'b' values. To facilitate the comparison, the partial 'b' values were converted into standard partial 'b' values which were free from the units of measurement. The independent variables were then ranked on the basis of standard partial 'b' values to find out their relative importance in predicting the dependent variable.

Table 2: Step-wise multiple regression analysis of the selected independent variables with management efficiency of dairy farmers, (n = 300)

Sr. No.	Independent variables	Partial regression coefficient (b)	Std. Error	Standardized partial regression coefficient (SPRC)	Rank
1	X_{11}	0.725	0.089	0.329	I
2	X_7	0.734	0.123	0.233	III
3	X_{10}	1.692	0.270	0.253	II
4	X_{13}	0.906	0.215	0.166	IV
5	X_{12}	0.906	0.234	0.141	V
6	X_2	1.517	0.570	0.091	VI

X_{11} = Extension contact, X_7 = Herd size, X_{10} = Mass media exposure, X_{13} = Scientific orientation, X_{12} = Economic motivation, and X_2 = Education.

According to standard partial 'b' values from Table 2, ranks were assigned to variables. Thus, the first rank was assigned to extension contact (X_{11}), followed by mass media exposure (X_{10}), herd size (X_7), scientific orientation (X_{13}), economic motivation (X_{12}) and education (X_2) with Standard Partial Regression Coefficient (SPRC) of 0.329, 0.253, 0.233, 0.166, 0.141 and 0.091, respectively.

Table 3: Step-wise variation accounted by selected independent variables in the management efficiency of dairy farmers, (n = 300)

Model	Independent variables	Multiple "R"	Total variation accounted (R^2)	Variation between steps
1	X_{11}	0.670	0.449 (44.90%)	44.9
2	$X_{11} + X_7$	0.763	0.583 (58.30%)	13.4
3	$X_{11} + X_7 + X_{10}$	0.797	0.635 (63.50%)	5.2
4	$X_{11} + X_7 + X_{10} + X_{13}$	0.818	0.669 (66.90%)	3.4
5	$X_{11} + X_7 + X_{10} + X_{13} + X_{12}$	0.829	0.688 (68.80%)	1.9
6	$X_{11} + X_7 + X_{10} + X_{13} + X_{12} + X_2$	0.834	0.695 (69.50%)	0.7
Total				69.5

X_{11} = Extension contact, X_7 = Herd size, X_{10} = Mass media exposure, X_{13} = Scientific orientation, X_{12} = Economic motivation, and X_2 = Education.

The data depicted in Table 3 report that 44.90 per cent of the variation was explained by extension contact. Extension contact along with participation in herd size accounted for 58.30 per cent variation; extension contact, herd size, and mass media exposure clarified for 63.50 per cent variation; extension contact, herd size, mass media exposure, and scientific orientation elucidated for 66.90 per cent variation; extension contact, herd size, mass media exposure, scientific orientation, and economic motivation explicated for 68.80 per cent variation; extension contact, herd size, mass media exposure, scientific orientation, economic motivation, and education illuminated for 69.50 per cent variation, respectively.

From the above data, it is accomplished that out of fourteen indicators, 69.50 per cent of the total variation was accounted by a set of six independent variables, *viz.*, extension contact, herd size, mass media exposure, scientific orientation, economic motivation, and education put together in the management efficiency of the dairy farmers.

Conclusion

From the above discussion, it can be concluded that education (X_2), mass media exposure (X_{10}), extension contact (X_{11}), economic motivation (X_{12}) and scientific orientation (X_{13}) were found highly significant relationship with the partial regression coefficient. In step-wise multiple regression analysis ranks were assigned to selected independent variables with management efficiency of dairy farmers. The first rank was assigned to extension contact (X_{11}), followed by mass media exposure (X_{10}), herd size (X_7), scientific orientation (X_{13}), economic motivation (X_{12}) and education (X_2) with Standard Partial Regression Coefficient (SPRC) of 0.329, 0.253, 0.233, 0.166, 0.141 and 0.091, respectively. It is accomplished that out of fourteen indicators, 69.50 per cent of the total variation was accounted by a set of six independent variables, *viz.*, extension contact, herd size, mass media exposure, scientific orientation, economic motivation, and education put together in the management efficiency of the dairy farmers.

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