MODEL FOR PREDICTION OF MILK PRICE IN KERALA

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Abstract

Various parsimonious models for predicting the price of milk in Kerala is developed in this study. The variables considered were, feed and fodder prices, labour charge, transportation cost, demand and milk production. Cluster analysis of all the variables showed that the price of milk, price of feed, labour charge, price of straw and transportation cost formed one cluster, whereas price of grass, demand for milk and milk production stand independently. Simple linear regression analysis revealed that the price of feed per kg was the maximum contributing factor to the milk price followed by labour charge, price of straw per kg and transportation cost. The model best suitable for fixing the price of milk based on price of feed is, milk price = 1.103+1.806feed price. This model explained 98.2 per cent of variability in the price of milk.

Key words: - *Price of milk, price of feed, Kerala, regression*

India is the largest producer of milk in the world, yet per capita availability is low compared to the world average. The dairy sector in Kerala could maintain a higher growth rate of 4.24 percent in the 1990s, compared to the national level of 4.16 per cent, in spite of a weak fodder base. During the Xth plan period (2002-03 to 2006-07) growth rate in the milk production of Kerala was - 4.6 per cent from 3.7 per cent in IXth Plan. For the period 2007-08 to 2011-12, a recovery has been marked in milk production of Kerala with an average annual growth rate of 5.1 percent compared to 4.4 per cent, at all India level (Economic Review, 2012). Unnikrishnan and Ashok (2012) reported that the increase in milk production was mainly due to the increase in the price of milk and explained the need for a price fixing model so that both consumer and farmer are protected by considering all the factors affecting price of milk. Mercey, *et al*. (2012) studied the price trend of milk using univariate ARIMA models and found that the best model for prediction of price of milk was ARIMA(1,1,0). In these circumstances, this study, to formulate a model for the

Materials and Methods

Yearly data on price of milk (Y), price of concentrate feed (X_1), labour charge (X_2), price of straw (X_3), transportation cost (X_4), demand for milk (X_5), milk production (X_6) and price of grass (X_7) were collected from Economic Review for the period from 1990 to 2012 (Department of Economics and Statistics, Kerala). Population size in Kerala for various years is taken into consideration for the variable demand for milk (X_5) as direct values are not available for demand of milk. Various techniques adopted for the statistical analysis of the data were correlation and regression analysis (Snedecor and Cochran, 1994). Cluster analysis using average linkage was used to assess the cohesiveness of the clusters formed

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by the variables. This procedure attempted to identify relatively homogeneous groups of variables based on the Pearson's product moment correlation, using an algorithm that starts with each variable in a separate cluster and combines clusters until only one is left (Johnson and Wichern, 2009).

Results and Discussion

Correlation between price of milk and other independent variables is given in Table 1. Price of feed and labour charge were highly correlated with price of milk followed by price of straw, transportation cost, demand, milk production and price of grass.

Inter correlation between independent variables is given in Table 2. From Table 2, it is clear that independent variables considered in the study were highly correlated. Hence cluster analysis was done to identify relatively homogeneous groups of variables. A dendrogram was drawn by taking the eight variables employed in the study.

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Dendrogram for clustering the variables is shown in Fig. 1. The price of milk, price of feed, labour charge, price of straw and transportation cost formed one cluster, whereas price of grass, demand for milk and milk production stand independently.

Simple linear regression analysis was done with price of milk (Y) as independent variable and price of feed (X_1), labour charge (X_2), price of straw (X_3), transportation cost (X_4) demand for milk (X_5), milk production (X_6) and price of grass (X_7) as independent variables (Table 3). The two criteria for selecting the best model in regression analysis is taken as adjusted $R^2$and mean absolute percentage error. The adjusted $R^2$is maximum and mean absolute percentage error (MAPE) is least for the regression equation of price of milk on price of feed (Table 3). The regression coefficient of price of milk with all the independent variables are highly significant ($p<0.001$).

In multiple linear regression equation, it is common to have independent variables that are highly interrelated. Multicollinearity occurs when an independent variable is strongly related to a linear combination of the other independent variable. Since severe multicollinearity occurs

Table 1. Correlation between price of milk and other variables

Variables	Price of feed	Labour charge	Price of straw	Transportation cost	Demand	Milk production	Price of grass
Pearson's correlation coefficient	0.991**	0.991**	0.970**	0.964**	0.846**	0.732**	0.679**

*** significant at 0.01 level of probability*

Table 2. Correlation matrix of the independent variables

Independent variables	Price of feed	Labour Charge	Price of straw	Transportation Cost	Demand	Milk Production	Price of grass
Price of feed	-						
Labour Charge	.989**	-					
Price of straw	.967**	.963**	-				
Transportation Cost	.955**	.954**	.936**	-			
Demand	.839**	.803**	.848**	.895**	-		
Milk Production	.723**	.671**	.751**	.632**	.691**	-	
Price of grass	.680**	.627**	.760**	.736**	.886**	.679**	-

**. Correlation is significant at the 0.01 level of probability

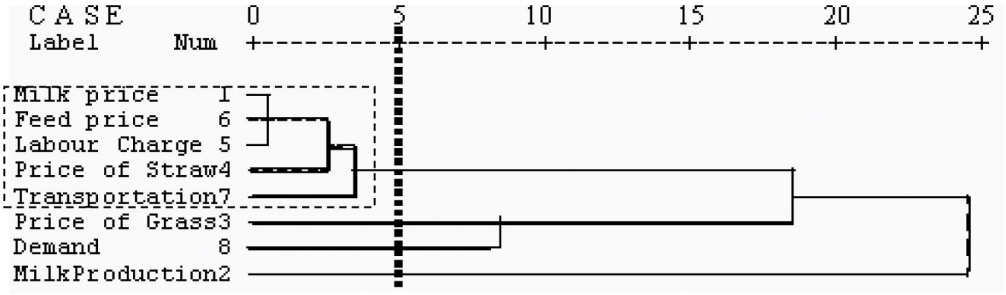

Fig . 1. Dendrogram for clustering the variables

among the variables formed in the first cluster, price of feed is selected as the most important contributing variable to price of milk from the variable included in that cluster. Multiple linear regression analysis with more than one independent variable was performed by taking price of feed as one variable and price of grass, demand for milk and milk production as other independent variables (Table 4).

In all the regression equations attempted in Table 4, the partial regression coefficient of price of milk on price of concentrate feed was found to be significant ($p<0.001$) and the partial regression coefficient of price of milk on other independent variables were not significantly different from zero ($p>0.05$). Hence from Table 3., the most suitable model that can be suggested for fixing price of milk based on price of feed is, milk price=1.103+1.806feed price. This model explained 98.2 per cent of variability in the price of milk. Considering

Table 3. Various Simple Linear Regression Equations

Sl. No	Regression Equation	t- Value	Adjusted R^2 (%)	MAPE
1	$Y=1.10+1.81X_1$	34.76**	98.2	4.67
2	$Y=5.02+0.06X_2$	33.87**	98.1	6.55
3	$Y=2.54+2.96X_3$	18.13**	93.7	9.60
4	$Y=1.20+0.41X_4$	16.59**	92.6	8.89
5	$Y=-107.29+1.81X_5$	7.27**	70.2	16.815
6	$Y=-22.49+1.60X_6$	4.93**	51.4	26.252
7	$Y=4.98+4.09X_7$	4.24**	43.6	21.62

Table 4. Various Multiple Linear Regression Equations

Sl. No	Regression Equation	Adjusted R^2 (%)	MAPE
1	$Y=-5.403+1.73X_1+2.23\ X_5$	98.2	4.41
2	$Y=-0.192+1.76X_1+0.07\ X_6$	98.2	4.26
3	$Y=1.06+1.80X_1+0.06\ X_7$	98.1	4.64
4	$Y=-12.569+1.711X_1+4.759\ X_5-0.316\ X_7$	98.2	4.45
5	$Y=-0.218+1.766X_1+0.072X_6-0.014X_7$	98.1	4.26
6	$Y=-5.474+1.709X_1+1.91X_5+0.054X_6$	98.1	4.23
7	$Y=-15.294+1.668X_1+5.168X_5+0.087X_6-0.431X_7$	98.1	4.30

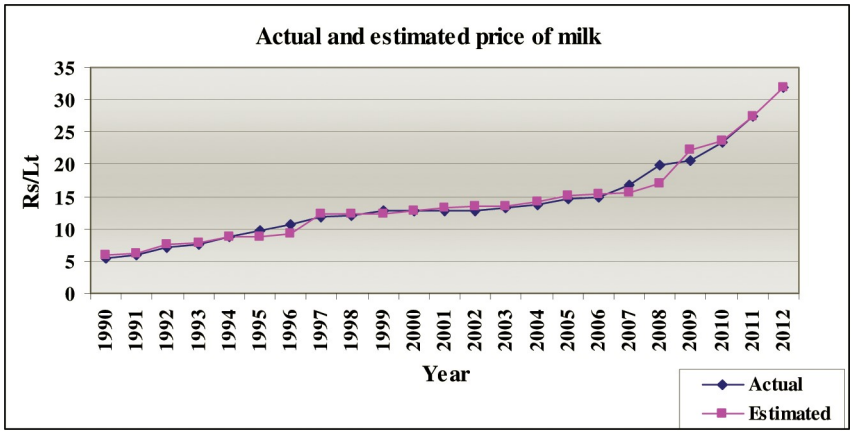

Fig. 2. Actual and estimated price of milk in Kerala using price of feed/kg

the parsimonious nature of this equation, it is recommended as the most suitable model for prediction of price of milk in Kerala. The actual and estimated price of milk per litre in Kerala using the above model for the period 1990 to 2012 is given in Fig. 2.

This study reports that the price of feed is the highest contributing factor to the price of milk followed by wage of men, price of straw and transportation cost. It was found that 98.2 per cent of variability in price of milk was explained by price of feed. In the same way, it was found that the labour charge explained 98.1 per cent of variability, price of straw explained 93.7 per cent variability and transportation cost explained 92.6 per cent variability.

As far as Kerala is concerned, cost of milk production is increasing day by day. Recent cattle census report suggests that dairy farmers started to evade from the system and the annual decline in cattle population in the state is 7.5 per cent. It is mainly due the increase in the cost of production. In tune with the increase in the cost of production and taking into consideration the cost of feed and other variables identified in the project, predicted formula will form a benchmark for the policy makers and scientists to fix the price of milk and to make dairying a sustainable venture in the State.

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References

Economic Review. 2012. *Agriculture and allied sectors*, State Planning Board, Kerala. Available: http://www.spb.kerala.gov.in/images/pdf/er12/index.html [01May2013]

Johnson, A.R. and Wichern, W.D. 2009. *Applied Multivariate Statistical Analysis*. Fifth edition. PHI Learning Pvt.Ltd, 767 p.

Mercey, K.A., Gleeja,V.L., Rini George and Sujatha, K.S. 2011. Forecasting price of milk in Kerala with ARIMA model. Abstract of the national seminar on stochastic modeling and simulation. March 24-25. Organised by the Department of Statistics, Cochin University of Science and Technology. Cochin. p13-14.

Snedecor, G.H. and Cochran, W.G. 1994. *Statistical methods*. 8th ed. Iowa State University Press, USA, 564p.

Unnikrishnan,T. and Asok, B. (2012). Statistical tools for the pricing issues in milk production in Kerala. *J. Ind. Vet. Assoc. Kerala*. **10**: 17-23.