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Determinants of the Milk Marketing Channel Options among the Dairy Farmers of Punjab

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ABSTRACT

Background: Dairying is an integral part of farming system of India. In 2019-20, milk production in Punjab was 13,347 thousand tonnes and growth rate was about 5.60 per cent per annum. Milk production is only profitable if there are proper marketing facilities. The objective of the present study is analyzing the determinants that affect the choice of milk marketing channels by the dairy farmers of Punjab.

Methods: The present study is based on primary data, collected through a detailed schedule from 420 dairy farmers in 2019 belonging to different farm size categories from 21 villages situated across three different agro-climatic zones of Punjab state of India, using a multi-stage sampling technique. Binary Logistic Model has been used for the purpose of analysis.

Result: The significant variables affecting the choice of milk marketing channels by the dairy farmers are found to be the presence of milk collection centre in the village and herd size of the dairy farmer. The value of Cox and Snell R-square indicates that around 17.00 per cent of the variations in the choice of marketing channels are attributed to the variations in the explanatory variables included in the study.

Key words: Binary logistic model, Cox, Determinants, Marketing channels, Snell R-Square.

INTRODUCTION

Dairying is an integral part of farming system of India. The sector involves millions of resource poor farmers and is the source of livelihood of rural poor. It is of vital importance in alleviating poverty and unemployment in rural areas. The direct contribution of dairying to rural sector through additional income and employment especially to the weaker section is well recognized (Anonymous, 1976). The operation flood programme, launched in 1970s, has helped in linking milk producers from rural areas with the urban consumers and has created a vast network for milk procurement, processing and distribution of milk in rural India (Tanwar *et al*., 2015). Moreover, due to predominance of dairy farming in rural areas and rising consumer demand for healthy food products, organic farming can become blessing for Indian dairy farmers (Maji *et al*., 2017).

In 2019-20, milk production in Punjab was 13347 thousand tonnes and growth rate was about 5.60 per cent per annum. Out of the total milk produced in the state, buffalo milk was nearly more than half of the total milk produced in the state (Anonymous, 2020). Milk production is only profitable if there are proper marketing facilities, so that milk, being its perishable nature, can be quickly disposed to particular place (Kashish *et al*., 2014). The level of adoption of modern technologies among the dairy farmers is found highly variable across the states (Kumar and Parappurathu, 2014). Different market players provide different set of choices to the dairy farmers. Marginally higher than four-fifth of the milk is sold to unorganised marketing channels and one-fifth of the milk is handled by organised milk marketing channels. Milk marketing through unorganised sectors is likely to dissuade small milk producers from expanding milk production (Rajendran and Mohanty, 2004).

Various Issues relating to milk marketing channels and their comparative profitability have been examined by researchers like Kumar *et al.* (2011); Sharma (2015); Prusty and Tripathy (2016); Brar *et al.* (2017); Brar *et al.* (2018); Kumar *et al.* (2018) and Zirmire and Kulkarni (2019). They have found that socio-economic characteristics such as age, education, herd size, price risk and distance from market and milk collection centres have influenced the preference of dairy farmers between the marketing channels. But a few works is done on this aspect in Punjab, particularly about the determinants of choice of milk marketing channels. Hence, the objective of the present study is analysing the determinants that affect the choice of milk marketing channels by the dairy farmers of Punjab.

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MATERIALS AND METHODS

The present study is based on primary data, collected through a detailed schedule. A multi-stage sampling technique has been used to select the villages and dairy farmers in the study area. The actual data collection has been done in year 2019. Altogether, 420 dairy farmers belonging to different farm size categories (landless, marginal, small, medium and large) from 21 villages situated across three different agro-climatic zones of Punjab state of India have been chosen. Out of all, 220 dairy farmers are selected from Shivalik Foothills Zone and 100 each from South West Dry Zone and Central Plains Zone. Binary Logistic Model has been used for the purpose of analysis. Consider a class of binary response models of the form:

$$P_i (Y_i = 1 \mid X_i) = G (\beta_o + \beta_1 X_{i1} + ...+ \beta_k X_{ik}) = G (\beta_o + \beta X_i) \quad ....(1)$$

Where,

$0 < G (Z_i) < 1$, for all real numbers Z_i;

$$Z_i = \beta_o + \beta X_i \quad ...(2)$$

This ensures that the estimated response probabilities are strictly between zero and one.

$$X_i\beta = \beta_1 X_{i1} + ...+ \beta_k X_{ik} \quad ...(3)$$

In binary logistic model, G is the logistic function:

$$P_i = G (Z_i) = \frac{\exp (Z_i)}{1 + \exp (Z_i)} \quad \text{(Wooldridge, 2018)} \quad ...(4)$$

$$\text{Or} \quad Z_i = \text{Log} \left(\frac{p_i}{1 - p_i}\right) \quad ...(5)$$

Where, $\log \left(\frac{p_i}{1 - p_i}\right)$ = logit for choice of milk marketing channels by the dairy farmers.

$\left(\frac{p_i}{1 - p_i}\right)$ = Odd ratio in the favour of adoption of organised milk marketing channel by the dairy farmers.

Cox and Snell R squared are used to check the goodness of fit of the model.

$$R^2_{cs} = 1 - \exp \left[-\frac{2}{n} (LL_B - LL_o)\right] \quad ...(6)$$

Where,

R^2_{cs} = Cox and Snell R-squared.

LL_B = Full log-likelihood model.

LL_o = Refers to the model with fewer coefficients.

RESULTS AND DISCUSSION

Description of the determinants of dairy farmers' marketing channels options

Table 1 explains the description about the explanatory variables included in the binary logistic model. Milk marketing channel is taken as response binary variable. It contains value one if the dairy farmers choose organised milk marketing channels and contains value zero if the dairy farmers choose unorganised milk marketing channels. Age, sex as well as education of family head, herd size, distance to market, road connectivity, presence of milk collection centre in village and milk price are taken as explanatory variables for binary logistic model. Age of head of the family is taken as continuous variables. The expected sign of household head is taken as negative. This is because the younger household heads are tend to be more enterprising and have the capacity to adopt organised marketing channels as compared to older household heads who tend to adopt unorganised marketing channel. Sex of family head is a binary variable. It has value one if head is male and zero if the head is female. Education of family head is also taken as binary variable. It has value one if the head is literate and zero if the head is illiterate. Literate household head opt for organised milk marketing channels as they are aware about possible benefits of adopting milk marketing channels. Herd size is a discrete variable, revealing total number of buffaloes kept by the dairy farmers. There is positive association with larger herd size and adoption of organised milk marketing channels. Distance to market is a continuous variable and is measured in kilometers. Long distance to market may induce the dairy farmers to opt for unorganised milk marketing channels to avoid transportation cost. Road connectivity is taken as binary variable having value one if there is metallic road connectivity to the sampled village and zero if there is no metallic road connectivity to the sampled village. The milk collection centre's presence in the village, whether private dairy or cooperative dairy, is a binary variable. It contains value one if there is presence of milk collection centre in the village and zero if there is absence of milk collection centre in the village. The presence of milk collection has a positive impact on the choice of organised milk marketing channels by the dairy farmers. Milk price (` per litre) is a continuous variable. The farmers will choose that milk marketing channel from where they get higher milk price.

The model can appropriately forecast about 66.00 per cent of the observed values. The explanatory variables have expected sign at 5 per cent level of significance. The variables, such as education of household head, herd size, milk collection centre and milk price are expected to have positive sign, whereas age of household head and distance to market are expected to have negative sign.

Determinants of dairy farmers' marketing channels options in Punjab

Table 2 reveals the results of binary logistic model for determinants of dairy farmers' milk marketing channel choice. Out of all, only two explanatory variables, *i.e.* absence of milk collection centre and herd size, are found to be statistically significant because their p value is less than 0.05. The coefficient of presence of milk collection centre is 1.090. As expected, the positive sign of the coefficient of presence of milk collection centre indicates that adoption of organised milk marketing channels become more likely with the availability of milk collection centre. The odd ratio of 2.975 indicates that odds of opting organised milk marketing channel by the dairy farmers is approximately

Table 1: Description of the determinants of dairy farmers' marketing channels options.

Variable	Measurement of variable	Type of variable	Expected sign
Age of family head	Years	Continuous	-
Sex of family head	Binary: 1 = Male, 0 = Female	Binary	+/-
Education of family head	Binary: 1 = Literate, 0 = Illiterate	Binary	+
Herd size	Total number of in-milk buffaloes	Discrete	+
Distance to market	Kilometers	Continuous	-
Road connectivity	Binary: 1 = Yes, 0 = No	Binary	+/-
Milk collection centre	Binary: 1 = Yes, 0 = No	Binary	+/-
Milk price	` per litre	Continuous	+

Table 2: Determinants of dairy farmers' milk marketing channels choice.

Variables	Coefficients	Standard error	Odds ratio
Age of family head	-0.001	0.010	0.999
Sex of family head	-0.382	0.407	0.683
Education of family head	0.331	0.269	1.393
Milk collection centre	1.09*	0.273	2.975
Herd size	0.596*	0.118	1.815
Milk price	0.006	0.020	1.006
Distance to market	-0.016	0.025	0.984
Road connectivity	-1.698	1.253	0.183
Correct prediction	66		
Cox and snell R square	0.17		
Nagelkerke R square	0.23		

Source: Researcher's own calculations.

*Means statistically significant at 5% level of significance.

3 times higher where there is presence of milk collection centre. This result is in line with the results of Sharma (2015) who has found that presence of milk collection centre is a significant variable affecting the choice of dairy farmers to sell milk to private sector. The coefficient of herd size is associated with high probability that dairy farmers will adopt organised milk marketing channels. The odd ratio of 1.815 shows that every one unit increase in herd size is associated with twice, approximately, increase in likelihood of dairy farmers selling milk to organised marketing channels. This finding is in line with the study of Moturi *et al.* (2015); Brar *et al.* (2018) and Kumar *et al.* (2018), where they have found that herd size has positive and significant impact on farmers' participation in organised milk marketing channels. The negative coefficient of age of family head (-0.001) indicates that opting organised milk marketing channels become less likely with older household heads as they prefer to choose traditional means of milk marketing. This result is in contrast to the study of Bardhan *et al.* (2012) in which they have found age of household head to be statistically significant in affecting the likelihood of the dairy farmers to sell milk to dairy cooperatives.

The odd ratio of sex of family head is 0.683 and it reveals that likelihood of choosing organised milk marketing channel is approximately 0.7 times higher when family head is male as compared to the females being the head of the family. This result is in conformity with the study of Moturi *et al.* (2015), in which they have found that sex of household head has insignificant affect on the probability of choosing organised milk marketing channels in Kenya. As expected, the sign of coefficient of education (0.331) is positive, indicating that the choice of organised milk marketing channel becomes more likely when dairy farmers are literate. But Bardhan *et al.* (2012) and Brar *et al.* (2018) have revealed negative coefficient for education of household head to sell milk in dairy cooperatives. The odd ratio of 1.393 predicts that the odds of choosing organised milk marketing channels are approximately one and half times higher when the head is literate as compared to illiterate family head. Kumar *et al.* (2018) have revealed that educational attainment has a significant impact on the choice of organised milk marketing channels. The odd ratio of milk price is 1.006 figures out that every one unit increase in milk price leads to 1.01 times increase in the probability of opting organised milk marketing channel by the dairy farmers. The present study finds it an insignificant variable but Brar *et al.* (2018) have revealed the price of milk as a significant variable in influencing the choice of dairy farmers to sell milk to organised channels.

The sign of coefficient to distance to market (-0.016) is negative predicting that adoption of organised milk marketing channels by the dairy farmers become less likely with higher distance to market because in case of higher distance to market, the dairy farmers opt for unorganised milk marketing channels due to high transport cost and perishable nature of milk. Sharma (2015) has found distance to market as a significant variable affecting the choice of dairy farmers regarding the milk marketing channels. The coefficient of road connectivity is -1.698 and its negative sign means that all things being equal, road connectivity is associated with lesser likelihood to opt organised milk marketing channels by the dairy farmers. These findings are in line with the study of Kumar *et al.* (2011). The value of Cox and Snell R-square indicates that around 17.00 per cent (0.17) of the variations in the choice of marketing channels are attributed to the variations in the explanatory variables included in the study.

Determinants of dairy farmers' marketing channels options in shivalik foothills zone

Table 3 depicts the determinants of choice of milk marketing channels by the dairy farmers of Shivalik Foothills Zone.

Table 3: Determinants of dairy farmers' milk marketing channels options in Shivalik Foothills zone.

Variables	Coefficients	Standard error	Odds ratio
Age of family head	0.018	0.017	1.019
Sex of family head	-0.38	0.689	0.684
Education of family head	0.693	0.477	2
Milk collection centre	0.837*	0.394	2.308
Herd size	0.892*	0.207	2.439
Milk price	0.04	0.021	1.04
Distance to market	0.049	0.034	1.051
Road connectivity	-5.032*	1.65	0.007
Correct prediction	78		
-2 log likelihood	167.72		
Cox and snell R-square	0.348		
Nagelkerke R-square	0.464		

Source: Researcher's own calculations.

*Means statistically significant at 5% level of significance.

Table 4: Determinants of dairy farmers' milk marketing channels options in Central Plains zone.

Variables	Coefficients	Standard error	Odds ratio
Age of family head	-0.004	0.022	0.996
Sex of family head	-1.446	0.902	0.235
Education of family head	0.208	0.703	1.231
Milk collection centre	2.01*	0.711	7.461
Herd size	0.399	0.212	1.49
Milk price	-0.024	0.019	0.977
Distance to market	-0.093	0.08	0.911
Road connectivity	0.068	1.899	1.07
Correct prediction	78		
-2 log likelihood	93.509		
Cox and snell R-square	0.344		
Nagelkerke R-square	0.459		

Source: Researcher's own calculations.

*Means statistically significant at 5% level of significance.

Table 5: Determinants of dairy farmers' milk marketing channels options in South-west dry zone.

Variables	Coefficients	Standard error	Odds ratio
Age of family head	-0.005	0.022	0.995
Sex of family head	0.656	0.833	1.927
Education of family head	0.576	0.532	1.778
Milk collection centre	0.558	2.656	1.746
Herd size	0.872*	0.347	2.392
Milk price	-0.026	0.042	0.975
Distance to market	-0.103	0.077	0.902
Correct prediction	64		
-2 log likelihood	97.805		
Cox and snell R-square	0.188		
Nagelkerke R-square	0.25		

Source: Researcher's own calculations.

*Means statistically significant at 5% level of significance.

In this zone, three variables, *viz*. milk collection centre, herd size and road connectivity, are found to be statistically significant in affecting the choice of dairy farmers for milk marketing channels. The first significant factor is milk collection centre and its odd ratio of 2.308 means that likelihood of opting organised milk marketing channels is approximately two times higher in the presence of milk collection centre as compared with the absence of milk collection centre in the village. The second important variable is herd size having odd ratio 2.439 and it indicates that one unit increase in increase in herd size leads to twice increase in odds of choosing organised milk marketing channels by the dairy farmers. The negative coefficient of road connectivity (-5.032) shows that the adoption of organised milk marketing channels become less likely as road connectivity improves. The Cox and Snell R-square (0.348) reveals that 34.80 per cent (0.348) of the variations in response variable are explained by the explanatory variables.

Determinants of dairy farmers' marketing channels options in central plains zone

Just one variable, *i.e.* milk collection centre, is found to be statistically significant in Central Plains Zone. Its' odd ratio (7.461) means that presence of milk collection centre is associated with 7 times increase in the probability of opting organised milk marketing channels (Table 4). 34.40 per cent (0.344) variations as indicated by Cox and Snell R square in the response variable stand explained by the variations in explanatory variable.

Determinants of dairy farmers' marketing channels options in South-West dry zone

Table 5 presents the results that in South-West Dry Zone, herd size is found to be statistically significant. The odd ratio of herd size is 2.39 revealing that with every one unit increase in herd size, the likelihood of opting organised milk marketing channels increases twice approximately. The Cox and Snell R-square shows that the explanatory variables explain 18.80 per cent (0.188) of the variations in the response variable.

CONCLUSION

The results of the study reveal that the Binary Logistic model is found to be significant and can correctly predict about two-third of the observed outcomes. Almost all variables have expected sign at 5 per cent level of significance. The significant variables affecting the choice of milk marketing channels by the dairy farmers are found to be milk collection centre and herd size. The value of Cox and Snell R-square indicates that around 17.00 per cent of the variations in the choice of marketing channels are attributed to the variations in the explanatory variables included in the study.

In Shivalik Foothills Zone, three variables, *viz*. milk collection centre, herd size and road connectivity, are found to be statistically significant in affecting the choice of dairy farmers for milk marketing channels. Just one variable, *i.e.*

milk collection centre, is found to be statistically significant in Central Plains Zone. The odd ratio of herd size in South-West Dry Zone reveal that with every one unit increase in herd size, the likelihood of opting organised milk marketing channels increases twice approximately. New dairy cooperatives could be set up in the remote areas to increase the membership of dairy cooperatives by the milk producers of rural areas. This will, in turn, also help in promoting income and employment opportunities in rural areas. There is need to strengthen the dairy cooperative chain so that small milk producers can participate in organised milk marketing channels and can make dairying a profitable enterprise.

Conflict of interest

All authors declared that there is no conflict of interest.

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