

Research Paper

Estimation of Marketed Surplus Function of Milk in Madhya Pradesh

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Received: 09-09-2021

Revised: 22-11-2021

Accepted: 04-12-2021

ABSTRACT

The present study to estimate the factors affecting the marketed surplus of milk in Madhya Pradesh was carried out by collecting data from 80 producer households from two zones of Madhya Pradesh during 2020. The study revealed that milk production per animal was the most significant factor influencing the marketed surplus of milk followed by price of milk and operational land holding, respectively. Both in relative as well as in absolute terms, production and marketed surplus increased with the increase in the herd size implying positive relationship between production and marketed surplus of milk. Larger family size tends to decrease the marketed surplus as it is more consumed at producer level. This signifies that efforts should be made to improve the productivity of animals as states has highest indigenous cattle population whose productivity was found to be very low along with efficient marketing facilities to get remunerative prices.

HIGHLIGHTS

- The overall proportion of marketed surplus of milk to total milk was 74.77 per cent and was highest for large category households i.e., 81.50 per cent followed by medium and small category households.
- The milk production per animal of households was found to be very responsive, important, statistically significant ($p < 0.01$) and stimulating factor affecting the marketed surplus of milk followed by the price of milk and landholding.

Keywords: Milk, Marketed surplus function, Madhya Pradesh

The concerted efforts of dairy development have resulted in increasing milk production but increase in milk production does not necessarily mean increase in marketed surplus. The milk production in India has increased three-fold between 1990 and 2019 from just 55 million tonnes to 187.75 million tonnes which represents a sustained growth for meeting growing demand of milk (NDDB, 2019). Annual growth rate of milk production in India is 6.5 per cent, which is higher than the world's growth rate (1.2 per cent) during 2018-19 (FAO, 2019). By 2050, in order to maintain its topmost position in the world dairy markets and to meet the domestic demand for milk as well, India will have to register about three-fold increase in its milk production crossing 380-400 million tonnes (NDRI,

2015). Milk production is not only the ultimate goal of the economic progress as it is confronted with the problem of its marketing and distribution. Increase in milk production would be more beneficial from the consumer's point of view if it is followed by proportionate increase in marketed surplus of milk. This emphasizes the need to adjust demand and supply through orderly marketing as a means to prevent undue price fluctuations.

From marketing point of view, marketed surplus is more important than total production to increase

How to cite this article: Agrawal, A. and Raju, R. (2021). Estimation of Marketed Surplus Function of Milk in Madhya Pradesh. *Economic Affairs*, 66(04): 555-561.

Source of Support: None; **Conflict of Interest:** None



the income of farmers. Marketing is as critical to better performance in dairying as dairy farming itself. Importance of marketing of farm produces has been realized long ago. This fact has been supported by the report of the National Commission on Agriculture (1976) which emphasized that it is not enough to produce a crop or an animal product but it must be satisfactorily marketed. Out of the total milk production in India, 48 per cent is consumed at the producer level while 52 per cent is available for non-producers. In order to provide milk to millions of non-producers, the marketed surplus has to be increased substantially to meet the demand for milk from non-producers.

Dairy development has taken place in different states of India, but the progress of some states in terms of milk production and per capita availability is found significant. Madhya Pradesh is 3rd highest milk producing state (15.91 million tonnes) and ranks sixth in terms of per capita milk availability (538 g/cap/day) in 2019 in India (NDDDB, 2019). Being third in milk production, marketed surplus of milk for disposal to urban area in the state is also found significant. Milk being a perishable commodity, cannot be stored for sale at a later date and therefore, has to be disposed off immediately depending upon the demand for milk. To achieve this goal, it is necessary to ascertain the determinants of marketed surplus of milk which would help the policy makers in formulating policies for increasing the marketed surplus of milk through efficient marketing system. Number of factors influences the marketed surplus of milk-producing households like milk production, price of milk, demand, family size, herd size, education of head of sample household, income from other sources, member of cooperative etc.

Keeping the above points into consideration, an attempt has been made in this study to examine the empirical nature of relationship between marketed surplus of milk and its determinants in Madhya Pradesh.

DATA AND METHODOLOGY

Madhya Pradesh consists of 11 Agro-Climatic Zones, among which two zones, namely, Malwa (Western) and Kymore (Eastern) were purposively selected. Malwa region being very much advance in livestock farming, accounted for around 22.18 per cent of the bovine population of the state. It

contributes the highest share (23.18 per cent) to the total milk production in the state and having largest crossbred (37.05 per cent) and buffalo (25.83 per cent) population of the state (GOI, 2019). On the other hand, Kymore plateau is considered to be one of the backward region in livestock farming in the state, contributing 8.17 per cent to state's milk production. This region has largest population of indigenous cattle (15.25 per cent) but their productivity was very low (0.5 to 1.5 litres/animal/day). Multi-stage random sampling technique was adopted for selection of districts, *tehsils* and villages as shown in Fig. 1.

A predetermined sample of 80 producer households was drawn randomly from all four villages. The selected 80 households were post stratified into three categories using Cumulative Square Root Frequency Method on the basis of milch animals. The households were thus classified into three herd size categories namely Small (1-2 milch animals), Medium (3-4 milch animals) and Large (5 and above milch animals). Thus, the 80 households were distributed as 42 (52.50 per cent) in small herd size category, 26 (32.50 per cent) in medium and 12 (15 per cent) in large herd size category.

The data was collected with the help of well prepared pretested performa by personal interview method. The information collected includes demographic particulars, family size, education status of individual members, land holding, herd size, milk production from individual animal, milk consumption at home, quantity of milk sold and price realized.

Analytical framework

To achieve the objectives of the study, the data collected from respondents was scrutinised, tabulated and analyzed by employing various analytical tools. The analytical tools used for analysis of data are discussed in the ensuing sections.

Marketed surplus

Marketed surplus is that part of the produce which is actually brought to the market for sale by the producer after retaining some quantity for his family consumption. The total milk produced by all the milch animals in the sampled unit was reckoned as milk production for that unit. The quantity of milk

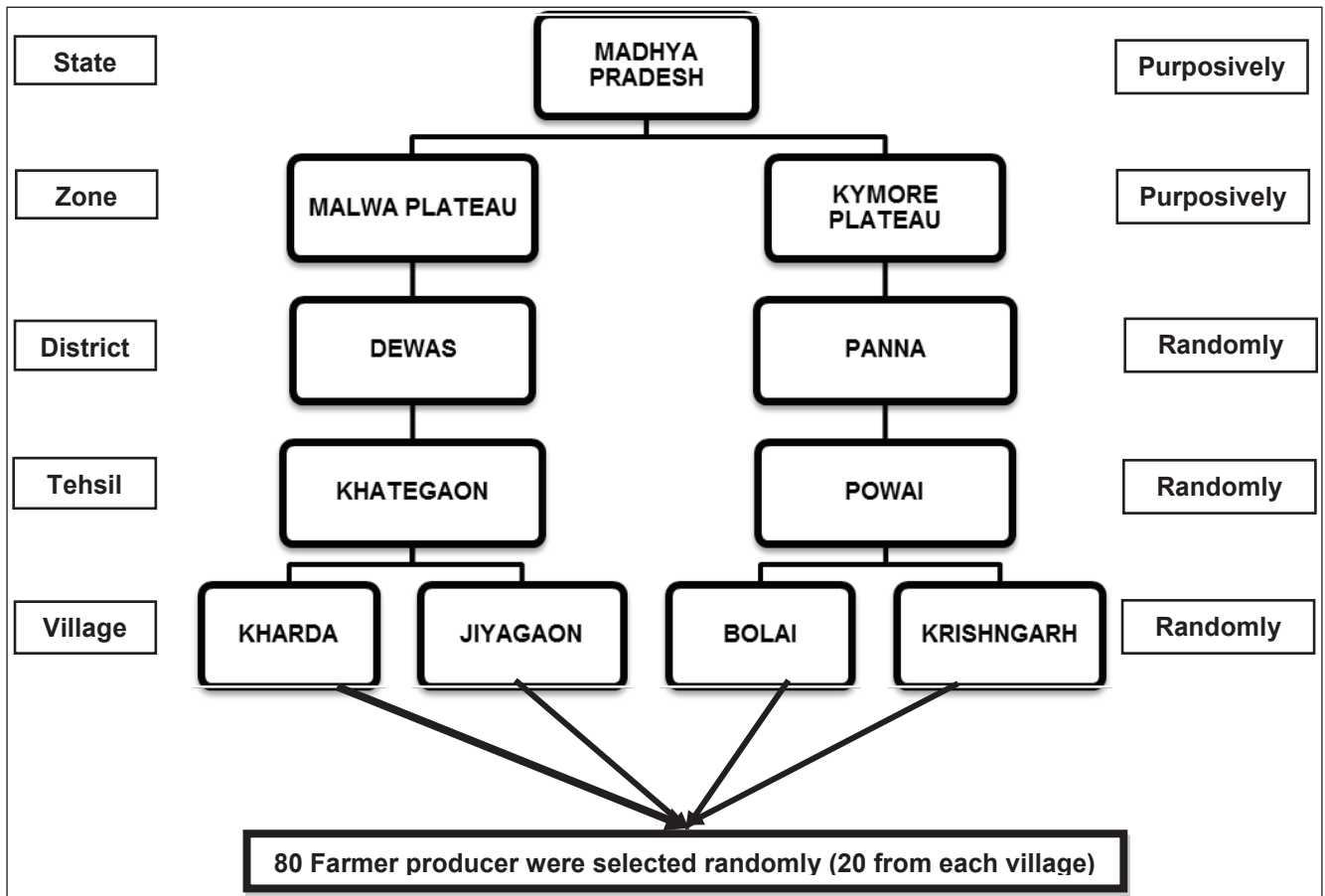


Fig. 1: Sampling Plan of the Study Area

which is retained by sampled unit for consumption as liquid milk or by conversion into different products has been taken as its total consumption, while the quantity of milk and milk products which is left over after meeting his consumption need will be available for marketing which is called marketed surplus of that sampled unit.

$$\text{Marketed surplus of milk} = \text{Total milk production} - \text{Total milk consumption}$$

Marketed surplus function

Number of factors influences the marketed surplus of milk-producing households. With a view to identify the factors responsible for marketed surplus of milk, the marketed surplus function was fitted.

(A) Dependent variable

Marketed surplus of milk: The actual quantity of milk sold per household per day was considered as the marketed surplus of that sampled unit.

(B) Explanatory variables

(i) Total milk production: The total daily milk production in quantity from bovines by the milk producing household was considered as an explanatory variable.

(ii) Price of milk: The price of milk differs for different type of milk i.e. buffalo, crossbred cow and indigenous cattle milk. Weighted average price of milk was calculated for each household by using the following formula:

$$\text{Weighted average price} = \frac{\sum P_i W_i}{\sum W_i}$$

Where,

P_i = Price per litre of the i^{th} type of milk

W_i = Total quantity of i^{th} type of milk sold by the household

(iii) Family size: The total number of members in the family irrespective of their age and sex constitutes the family size.

(iv) Educational score of the earner of household:

The consumption/marketed surplus of milk is influenced by the education level of the earner of household who are generally considered as decision makers and manager of household affairs. Thus, education level of earner of each household was considered as a variable affecting the marketed surplus of milk. The following scale to measure the education level of rural households was used, details of which are given as under:

Sl. No.	Education	Weightage
1	No formal education (Illiterate)	1
2	Primary (up to 5 th class)	2
3	Middle (up to 8 th class)	3
4	Secondary (up to 10 th class)	4
5	Higher Secondary (up to 12 th class)	5
6	Graduation and Above	6

Source: Bhuvaneshwari (2005).

(v) Herd size: Total number of adult milch animals, wet or dry reared by the household was considered as a separate explanatory variable.

(vi) Size of operational land holdings: Larger the operational land holding, higher would be the agricultural by-products (wheat straw, paddy straw etc) available for milk production. Hence, the operational land holding was considered as variable influencing the marketed surplus of milk.

(vii) Co-operative member: Cooperative society had an influence on its members to increase the marketed surplus of milk as they get the advantage of bulk selling.

Specification of marketed surplus function

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7)$$

Where,

Y = Marketed surplus of milk (litres/household/day)

X₁ = Herd size (No.)

X₂ = Average milk production (litres/household/day)

X₃ = Family size (No.)

X₄ = Educational score of the head of the household (1, 2,.....6)

X₅ = Weighted average price of milk (₹/litre)

X₆ = Size of operational land holding (acre)

X₇ = Member of co-operative society (0 or 1)

Different mathematical models like linear production function and Cobb-Dauglas forms were tried. The model which confirmed to various statistical considerations and economic logic was selected and considered best fit for the present study.

RESULTS AND DISCUSSION

Development of milk production activities in a particular area is guided by the available marketing facilities along with the demand, because milk is a highly perishable commodity and as such requires quick disposal or conversion into different milk products as soon as possible. The quantity of milk available for sale depends upon the number of factors like milk production, price of milk, demand, family size, herd size, education of head of sample household, income from other sources, member of cooperative etc. Therefore, it is of utmost importance to have an idea about the socio-economic profile of milk producer households disposing their milk to various marketing agencies.

This section provides insight to the socio-economic profile of farmer households, marketed surplus of milk and various factors affecting the marketed surplus of milk in the study area.

Socio-economic profile of milk producer households

Table 1: Socio-economic profile of milk producer households

Particulars	Small	Medium	Large	Overall
No. of sampled households	42	26	12	80
Family size (No.)	6.43	6.72	7.01	6.62
Mean education score	2.65	3.08	3.83	2.95
Average age of head (years)	43.79	42.12	45.75	43.54
Operational landholding (ha)	1.03	1.89	2.76	1.57
Area under fodder crop (ha)	0.10	0.16	0.22	0.14
Average milch animal per household	1.842	2.932	4.961	2.665
Price of milk (₹/litre)	34.36	36.38	40.16	36.00

Table 1 provides a glance on general information about the sampled households. Almost all the variables except average age of head of household were found to be increasing with the increase in

herd size category. The overall average size of operational land holding of the sample households was observed to be 1.57 ha, which was less than state's average size holding i.e., 1.78 ha. It is interesting to note that even though operational size of landholding was small in case of small herd size category of household but they were allocating higher percentage area of their operational holding for the cultivation of green fodder indicating a positive signal for animal rearing habit among them. Large category farmers realized the highest price for their milk among all the categories, which might be due to their sale to better marketing agencies.

Marketed surplus of milk

The average production and marketed surplus of milk per day was worked out for different categories of households and are presented in the Table 2. As evident from the Table 2 that the overall average milk production was 9.85 litres per day which varied from 5.73 litres in case of small category households to 20.04 litres in case of large category households. A perusal at the table indicates that consumption had direct relation with the family size i.e., consumption was increasing with the increase in family size.

Table 2: Average milk production, consumption and marketed surplus of milk across the herd size category

Particulars	Small	Medium	Large	Overall
Average milk production (litres/day)	5.73	11.80	20.04	9.85
Family size (No.)	6.43	6.72	7.01	6.62
Average milk consumption (litres/day)	1.92	2.85	3.67	2.48
Average marketed surplus (litres/day)	3.82	8.95	16.33	7.36
Marketed surplus as percent of total production	66.65	75.88	81.50	74.77

The overall average marketed surplus was 7.36 litres per day which is highest for large category (16.33 litres/day) followed by medium (8.95 litres/day) and small category (3.82 litres/day). The overall proportion of marketed surplus of milk to total milk was 74.77 per cent and was highest for large category households i.e., 81.50 per cent followed by medium (75.88 per cent) and small category

households (66.65 per cent). Both in relative as well as in absolute terms, production and marketed surplus increased with the increase in the herd size implying positive relationship between production and marketed surplus of milk. The finding is similar to that reported by Sharma (2012) in Malwa zone of Madhya Pradesh.

Marketed surplus function

The exact nature of the mathematical form of marketed surplus function is not yet known several authors have tried various mathematical models and selected the most appropriate one (Shah and Sharma (1992), Sharma (2012), Singh (2013) and Singh (2015)). In the present study, linear production function explained maximum variation in marketed surplus and the coefficients of explanatory variables were found to be consistent as per statistical sign and economic criteria. A critical examination of zero order correlation matrix among explanatory variables revealed that there was high correlation between the number of milch animals and milk production which created the problem of multicollinearity among these variables. Therefore, the ratio of average milk production to herd size was taken as an explanatory variable.

Table 3 gives insight to marketed surplus function of milk for sample households in the study area. The estimates revealed that the value of coefficient of multiple determination (R^2) to be 0.748, which indicates that 74.80 per cent of total variation in the marketed surplus of milk were explained by variables included in the regression function.

Table 3: Estimated parameters of marketed surplus function of milk

Variables	Coefficients	Standard error
Constant	-13.042	3.972
Milk production per animal	1.346**	0.201
Price of milk	0.339**	0.112
Landholding	0.873*	0.372
Education	0.243	0.266
Co-operative member	1.187	0.706
Family size	-0.129	0.239
R^2	0.748	
Number of observations	71	

*Significant at $p < 0.05$, **Significant at $p < 0.01$

The milk production per animal of sample households was observed to be very responsive, most important, statistically significant ($p < 0.01$) and stimulating factor, affecting the marketed surplus of milk. On an average, one per cent increase in milk production per animal resulted in an increase in marketed surplus of milk by 1.35 per cent. It was observed as per the expected sign, obviously when the production per unit herd of animal increases, the marketed surplus also increases.

The price of milk was observed to be the next important significant factor affecting the marketed surplus of milk. It had a positive and significant impact ($p < 0.01$) on the marketed surplus of milk. On an average, one per cent increase in price of milk will enhance the marketed surplus of milk by 0.34 per cent. Also this positive direction of the price coefficient had indicated that there still exists a possibility of raising the price of milk to induce the producer sellers to increase production and sparing more milk for marketing.

The size of operational landholding of sample households was found to be another determining factor in the marketed surplus of milk. The regression coefficient of land holding is 0.87 and was found to have positive and statistically significant ($p < 0.05$) impact on marketed surplus of milk. With the increase in one per cent area of landholding, marketed surplus of milk increased by 0.87 per cent. It can be looked through another way that marketed surplus in the study area will be more, if more area can be put under the cultivation of fodder crops via production enhancement of milk. From the previous discussion, it was clear that about 8-10 per cent area was used for green fodder cultivation. Thus to increase the marketed surplus of milk, it is better to increase the area under green fodder to get higher milk yield.

However, the regression coefficients of education of head of the household, co-operative membership and family size are as per the expected sign but are not statistically significant indicating non-significant impact on marketed surplus of milk. However, family size tends to show negative impact on marketed surplus of milk as larger family size tends to decrease their share in marketed surplus.

CONCLUSION

Overall marketed surplus of milk was found to be 74.77 per cent and was highest for large category households (81.50 per cent) followed by medium (75.88 per cent) and small category households (66.65 per cent) in the study area. The milk production per animal of sample households was observed to be very responsive, most important, statistically significant ($p < 0.01$) and stimulating factor affecting the marketed surplus of milk followed by the price of milk and landholding. While education, membership of cooperative societies and family size didn't seem to have any significant influence on marketed surplus of milk. This signifies that to make the dairy farming more remunerative and increase the producers share in consumer rupees, there is need to increase the productivity of animals through scientific know how, proper feeding and maintenance practices, better prices etc.

ACKNOWLEDGEMENTS

The authors thank the Director, ICAR-National Dairy Research Institute, for providing financial assistance and infrastructure to carry out the research work. First author also acknowledges financial assistance in form of institute fellowship during the period of M.Sc. research project. They are also grateful to the anonymous referee for their suggestions.

REFERENCES

- Bhuvaneshwari, S.V.B. 2005. Role of women in the conservation of agro-biodiversity. *Thesis Ph.D. (Ag. Eco.)*. Tamil Naidu Agricultural University, Coimbatore, Tamil Naidu.
- Food and Agriculture Organization. 2019. Dairy Market Review. Food and Agriculture Organization of the United Nations. Rome.
- National Dairy Development Board. 2019. Annual Report of National Dairy Development Board (2018-19). <http://www.nddb.coop>
- National Dairy Research Institute. 2015. Vision 2050. ICAR-National Dairy Research Institute. Indian Council of Agriculture Research, Karnal. Haryana.
- Shah, D. and Sharma, K.N.S. 1992. Marketed surplus function of milk in Bulandshahr district of Uttar Pradesh. *Ind. J. Ani. Sci.*, **63**: 1085-1093.
- Sharma, S. 2012. Economics of milk production and utilization pattern in Malwa plateau of Madhya Pradesh. *Thesis M.V.Sc. (Dairy Eco.)*. ICAR-National Dairy Research Institute (Deemed University), Karnal, Haryana.

Singh, V. 2013. Economic analysis of traditional milk marketing chain in Karnal district of Haryana. *Thesis M.V.Sc (Dairy Eco.)*. ICAR-National Dairy Research Institute (Deemed University), Karnal, Haryana.

Singh, P. 2015. Economic analysis of traditional milk supply chain in Ranchi district of Jharkhand. *M.Sc. Thesis* submitted to ICAR-National Dairy Research Institute (Deemed University), Karnal, Haryana.

