Econometric Analysis of Production And Marketing of Milk in Odisha

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I. INTRODUCTION

The Milk production in India has increased from 20 million tones to a level of 132 million tones during 1970 to 2012-13. The major milk producing states in India are Uttar Pradesh, Madhya Pradesh, Rajasthan, Punjab, West Bengal and Maharashtra. These states together contribute 53 percent of the country's total value of milk output. The share of Uttar Pradesh, Madhya Pradesh, Rajasthan, Punjab, West Bengal and Maharashtra are 17.59%, 6.67%, 10.54%, 7.37%, 3.66% and 6.59% respectively during 2012-13. Milk production in India differs from region to region. During the period of last 25 years, Northern region of the country shares 43% of the total milk production in India as compared to 23% in western region, 15% in southern region and 14% by eastern region.

Various studies (Naik, D. in 1997 and Naik, D and D. Dwivedi in 2015) made in eastern India indicate that milk markets are unorganized and fully controlled by the intermediaries involved in the process of milk marketing. Even price is fixed in many places by the traders without making any cost study on milk. In late milk cooperatives have been formed at the state level including in some districts/ block with the intervention of the government. It helps in collecting the milk from the member farmers, process it and make it available with the urban consumers.

Still traders and processers play a major role in milk marketing. Many times dairy farmers protest to get a remunerative price. In Eastern region, Odisha is one of the states, which contributes only 1.29 per cent of the total milk output of India during 2012-13. The milk productivity in the state stands today at 500 gms per day per animal. The milk yield per animal per day in different districts of Orissa varies from 0.162 kg (Kalahandi) to 0.935 kg (Puri), 0.925 (Malkanagiri) to 4.950 (Puri) and 0.665 kg (Malkanagiri) to 2.657 kg (Cuttack) respectively per indigenous cow, cross bred cow and buffalo. The per day milk yield in most of the districts are less than 0.350 kg per indigenous cow, less than 2.5 kg per crossbred cow and less than 2kg per buffalo. Another study made in eastern India (Naik, D. in1997) indicates that among three categories of the dairy farmers, the size class II categories of farmers(having 5 to 8 cows) are found to be operative at an increasing return to scale. The status of this dairy farm can be increased by an increasing level of resources. But the dairy farms grouped under size class I (1 to 4 cows) and III (9 and above) are found to be uneconomic indicating their operational level at decreasing return to scale. The study recommended for improving the quality of animals to make the dairy farms more cost effective as well as resource responsive compared to the existing farms. Dairy plays an important role not only in stabilizing the farmers income but it generates daily income to the farmers, since 85% of the states farmers are small and marginal in nature, the integration of dairy enterprise in their farming system will play an important role in the quantum of income as well as level of employment.

Higher milk yield should be associated with a dependable market support, which provides a remunerative price to the cow owners. Thus a dependable market support makes the enterprise sustainable. Profitability of any product depends more on the re muner ativeness of the product price. Adoption of yield raising activities is feasible only when it becomes economically profitable. In the absence of a dependable market support the cow owners fail to receive a fair price which constrains them to provide yield raising feeds. Keeping in view the results of the earlier studies , Farmers need a change in diary sector in Odisha and thus an attempt has been made to study the production and marketing of milk in rural Odessa by using econometric tools with the following twin objectives.

1. To estimate the cost of production per litre of milk and to compare it with market price.
2. To study the impact of price changes on milk production.

II. METHODOLOGY

The study was conducted in Odessa, a state in eastern India, where productivity of milk is less as compared to other regions, majority of the dairy farmers sell their milk to the traders ,farmers have no role in fixing price and few farmers operate through milk cooperatives . Further Dhenkanal is one of the milk producing districts of the State is selected for detail investigation where more than 40 percent of the farmers keep dairy animals for supporting their livelihood.

The field study was undertaken in two blocks i.e., Kamakhya Nagar and Gondia, selected on random from among 16 blocks of undivided Dhenkanal district. A cluster of villages in each block based on the concentration of dairy farms were also selected. The data were collected through

the pre-tested questionnaires by personal contact during 2010-11.

A. Data On Cost Of Production Of Milk

The information on cost of production of milk is collected from the selected dairy farmers of Kamakhyanagar Block and Gondia block of Dhenkanal district. The data are collected through a well designed pretested questionnaire by direct interview. The dairy farmers are classified into three groups depending upon the size of cattle population i.e., size class 1 (1 to 4 cows), size class II (5 to 8 cows) size class III (9 and above). 30 dairy farmers from each group are selected to collect data on cost of production. The cost of production includes cost of green feed, dry feed, concentrates, human labor and value of hired labor, medicine, rental value of owned cow, rental value of leased in cows, interest on working capital, interest on fixed capital and imputed value of family labor etc.

B. Cost Concepts

For estimating the cost of production of milk with its market price, the following cost concepts are worked out.

- Cost A1 = It includes cost of green feeds, dry feed, concentrates, value of hired labor and medicine.
- Cost A2 = Cost A1 + Rental value of leased in cows.
- Cost B = Cost A2 + Rental value of owned cow + interest on owned fixed capital.
- Cost C = Cost B + imputed value of family labor.
- Cost D = Cost C – dung value.

C. Nerlovian's Price Expectation Model

In this study an attempt has been made to examine the effect of market prices on production and productivity of milk. The model is as follows:

$$MP=a+b, Mp_{1-1}+b_2MP_{1-1}+ut\ldots\ldots\ldots\ldots \quad (1)$$

$$*P_1P_{1-1}=B(P_{1-1}-P_{1-1})\ O<\beta<\ldots\ldots\ldots \quad (2)$$

Where

M_p=Actual production in year't'

P_1=Expected price of milk in year't'

P_{t-1}= Expected price of milk in year (t-1)
P_{t-1}=Actual price of milk in year (t-1)
U_t=Disturbance term

B=The coefficient of price expectation and 'a' and 'b' are parameters to be estimated.

The hypothesis described through equation (2) is price expectation hypothesis. The expression on the left hand side of this equation is the revision in price expectation from year to year. On the right hand side, the expression (Pt-1- pt-1) is the error made by farmers in predicting the price during (t-1) the year (Previous Year). The Co-efficient of Price expectation (b) indicates that only a fraction of last year's error in Price Prediction is translated into revision in expected Price during the Current year. Now using the hypotheses given in equation (2) above, an expression for expected price (Pt) can be obtained as given below.

$$P_1=\beta P_{1-1}+\beta(1-\beta)\ P_{t-2}+\beta(1-\beta)^2\ P_{1-3}\ldots\ldots$$

Thus in this formulation, the expected price is weighted moving average of Past Prices since O<β<1, the weights are in declining geometric series.

There are three Parameters (a,b and β) to be estimated from the above two equations (1) and (2) are manipulated to obtain the estimate of a, b and β.

Now equation (1) can also be written as:

$$MP_{1-1}= a+bp_{1-1}+U_{1-1} \quad \ldots\ldots\ldots\ldots\ldots(3)$$

$$Or \quad P_{1-1}=\frac{1MP\ 1-1}{b} - \frac{a}{b} - \frac{IU1-1}{b} \quad \ldots\ldots\ldots\ldots(4)$$

Subtracting the equation (3) from (1) where

$$MP_1-MP_{1-1}= b\ (P_1 – P_{1-1}) + U_1 – U_{+1}\ \ldots\ldots(5)$$

Substituting the equation (2) in equation (5) we get

$$MP_1 – MP_{1-1} = b\ [\beta(P_1 – P_{1-1})]\ U_1 –U_{1-1}\ \ldots\ldots(6)$$

Now substitution equation (4) in equation (6) we have

$$MP_1- MP_{1-1} = b\ [\beta(P_{1-1} – (\frac{1}{b} Mp_{1-1} - \frac{a}{b}\ \frac{1}{b} U_{1-1})] + U_1 – U_{1-1}$$

$$=b[\beta Pt\text{-}1 - \frac{\beta}{b} mpt\text{-}1 + \frac{a\beta}{b} + \frac{\beta}{b} ut\ \text{-}1] + u_1 + u_{1-1}$$

$$=b\beta P_{1-1} –\beta MP_1 + a\beta + \beta u_{1-1} + u_1 – u_{1-1}$$

$$=a\beta + b\beta P_{1-1} – a\beta MP_{1-1} + [ut\ \ (ut\text{-}(1\text{-}\beta)\ u_{1-1}]$$

$$Or\ Mp = a\beta =b\beta P_{p-1} +(1\text{-}\beta)\ Mp_{1-1} +[u_1 – (1\text{-}\beta)\ u_{1-1}]$$

Now let

$$\pi_u = a\beta.\pi_1= b\beta.\pi_2\ \text{-}1\text{-}\beta \text{ and } V_1 – U_1 – (1\text{-}\beta)\ U_1\ \text{-}1$$

Then

$$Mp=\pi_1\ P_{1-1} + \pi_1\ P_{1-1} + \pi_2\ MP_{1-1} + V_1\ \ldots\ldots\ldots\ldots(7)$$

From this equation π_0, π_1 and π_2 can be estimated. The values of a, b and β can be calculated as follows;

$$A= \pi_1 / 1- \pi_2 \; b= \pi_1/1- \pi_2 \; \& \; \beta - 1 \; \pi_2$$

The shortrun and longrun elasticity of production is calculated as follows.

Short run elasticity - π_1

Long rrun elasticity = b x_1/y

Where x_1 =1 Mean of average annual wholesale Prices of milk during the study period y= Mean of milk produced during the study period.

In the present study, the modified price expectation model is presented in equation (7) has been utilized to study the impact of price changes on production. The procedural details are discussed below. The model for Production of milk,

$$Mp= \pi_0 + \pi_1 P_{1-1} + \pi_2 MP_{1-1} – V_1$$

Where MP = Production of milk in 't' th year

Pt-1= Production price of milk in (t-1) th year

Mpt-1 = Production of milk in (t-1)th year

Vt = Random component

π_1 is a constant and π_1 and π_2 are the regression coefficients.

With the help of this model, short run ad long run elasticity of production is calculated to study the impact of price changes on production of milk.

- *Computation Procedure*

For estimating π_0, π_1 and π_2 in the above discussed model, we have to adopt the following designations.

a- Corrected Sum of sturaes

$$\sum y2=y2 – \frac{(\sum y)2}{n}$$

$$\sum x21 = \sum X\ 21 - \frac{(\sum x2)2}{n}$$

$$\sum x22= \sum x22 - \frac{(\sum x2)2}{n}$$

b- Corrected Cross Product

$$\sum YX1 =\sum YX1-(\sum Y)\ (\sum X1)/N$$

$$\sum YX2=\sum YX2-(\sum Y)\ (\sum X2)/N$$

$$\sum x1X2=\sum X1X2-(\sum X1)\ (\sum X2)/N$$

The estimates of Л1, Л2 and Л0 are as follows

$$Л1= (\sum X_2)^2\ (\sum YX_1)-(\sum X1X_2)\ (\sum YX_2)/\ (\sum X1^2)\ (\sum X2)^2- (\sum X1X2)^2$$

$$Л2= (\sum X_1)^2\ (\sum YX_2)- (\sum X1X2)\ (\sum YX1)/\ (\sum X1)^2\ (\sum X2)^2- (\sum X1X2)^2$$

$$Л0=Y=Л1X_1- Л2\ X_2$$

The standard errors of Л1 and Л2;

$$\text{S.E. of } Л1=6\ \sum X2^{2\,/}\ \sum X2/1\sum X2/2-\sum X1X2)/1$$

$$\text{S.E. of } Л2=6\ \sum X2/1/\sum X^2\ \sum X^2 – (\sum X1x2)2$$

Where

$$62 = \sum i2/n-^3 = \text{Total s.s- explained s.s./n-}^3$$

And

$$\text{explained s.s.} = Л\ \sum YX1 + Л1\sum Y\ x\ 2/2$$

d= Coefficient of Multiple determination

It is usually denoted by R^2 which is as follows:-

R^2 = Explained s.s / Total s.s = Л1 ∑yx1 + Л2 ∑yx 2/∑y 2

The production price elasticity's are obtained as follows

$$\text{Short run elasticity} = Л\ 1\ x1/y$$

$$\text{Long run elasticity} = b\ xt1/y$$

Where

$$b – Л/1-.\ Л/2\ Л$$

III. FINDING

A. *Cost Of Production And Market Price Of Milk*

The average cost of production of milk in Dhenkanal district (cost A_1) is Rs.10.85, Rs.10.90 and Rs.10.70 respectively in size class-I, size class-II and size class-III (As presented in Table 1). It clearly indicates that the variable cost per litre of milk is lowest in size class-I categories of dairy farms. However the variable cost per litre of milk is highest in size class-II categories of dairy farms due to more number of heifers and less number of cows which become uneconomic to maintain. Further the size of cow shed of both size class-II and size class-III are similar and due to less number of cows in size class-II, the unit cost per cow becomes more. The actual cost of production of milk (Cost 'D') is Rs. 15.50, Rs.15.65 and Rs.15.70 respectively in size class-I, size –II and size-III.

B. *Return Per Litre Of Milk Over Various Costs At Market Price*

The return per liter of milk over various costs at market price during 2010-11 in different size class of dairy farms in Dhenkanal district is calculated and presented in Table 2. It indicates that the return per liter of milk over variable cost is highest in size class-I categories of dairy farms (Rs.6.25 per liter) followed by size class-II (Rs.6.75 per liter) and size class-III (Rs.6.55 per liter). In the existing market price the size class-I, size class-II and size class-III category of dairy farmers get profit over cost B Rs.4.10 per liter, Rs.4.05 per liter and Rs.4.20 per liter respectively. However the return per liter of milk over total cost is highest in size class-I category of dairy farm owners i.e.. Rs.2.85 followed by size class-II, (Rs.2.80 per liter) and size class-II (Rs.2.70 per liter).

In a similar study made by Naik D. in Bhubaneswar Block of Khurda district which indicates that the return per liter of milk over various costs at market price in different size class of dairy farms in Khurda district is more than the return per liter of milk which was received by the dairy farmers of Bhubaneswar block. It may be due to the fact that Bhubaneswar is the state capital of Orissa where demand for milk is more as compared to Dhenkanal district. Majority of farm owners in Dhenkanal district, have maintained the dairy farm as their main business. All the family members work in the farm and their dependence on hired labor is less than the dairy farmers of Bhubaneswar block of Khurda district. As the labour charge, cost of green feed and dry feed are less, it reduces the cost of production of milk and farmers of Dhenkanal district get more return over the dairy farm owners of Bhubaneswar block of Khurda district.

C. Impact Of Price Change On Production Of Milk

The effect of lagged price and lagged production of milk in a particular period have been studied with the help of the Nerlovian's price expectation model.

The modified Nerlovian's price expectation model used in this research is as follows:

$$Mp_t = \pi_0 + \pi_1 Mp_{t-1} + \pi_2 Mp_{t-1} + Ut$$

Where

Mp_t = production of milk in 't' th year

F_1 = Lagged price of milk in (t-1) th year

Mp_1 = Lagged production of milk in (t-1) th year

Ut = Random Component

π_0 = is a constant π_1 and π_2 are the regression coefficient.

Apart from this an attempt has been made to study the short run and long run elasticities of production of milk with the change of price as follows.

$$\text{Short run elasticity} = \pi_1 \frac{X1}{Y}$$

$$\text{And long run elasticity} = b \frac{X1}{Y}$$

Where

$$b = \frac{\pi 1}{1 - \pi 2}$$

X_1 is the average of lagged price of milk during the period and Y is the average of milk produced during the study period. The regression equation as well as elasticity substituting corresponding figures of production and productivity in the above stated equations.

D. Short Run And Long Run Elasticity Of Production Of Cow Milk In 13 Undivided Districts Of Orissa

The price elasticity of production of cow milk at the state level both in the short run and in the long run are found to be 0.552 and 0.551 respectively. It implies that one per cent increase in price of milk will tend to increase the production by 0.552 per cent in the short run and 0.551 per cent in the long run. This elasticity in the districts like Dhenkanal, Kalahandi, Koraput, Phulbani and Sundargarh is found to be negative both in the short run and in the long run. It implies that the increase in price will not be able to increase production in these districts. However other factors like feeding, infrastructural facilities and timely market support may be crucial for raising the level of production in these districts. In Bolangir district elasticity is found to be negative in the short run while Mayurbhanj district shows a negative elasticity in the long run. The price elasticity in Puri district is found to be higher both in the short run and in long run recording 0.974 respectively. It implies that 1 per cent rise in the price in Puri district will raise production and induce dairy farmers to produce up to a level of 0.974 per cent in the short run and 0.955 per cent in the long run. In the six district price elasticity of production varies in the range 0.71 (Mayurbhanj) to 0.774 (Balasore) in the short run and from 0.185 (Ganjam to 0.766 (Balasore) in the long run. (Table 3).

IV. CONCLUSION

The average cost of production of milk in Dhenkanal district (Cost A_1) is Rs.10.80, Rs.10.90 and Rs.10.70 respectively in size class-I, size class-II and size class-III. The variable cost per liter of milk is lowest in size class-I categories of dairy farms. However the variable cost per liter of milk is highest in size class-II categories of dairy farms due to more number of heifers and less number of cows which become uneconomic to maintain. Further the size of cow shed of both size class-II and size class-III are similar. The actual cost of the production of milk (Cost C) is Rs.16.15, Rs.16.10 and Rs.16.10 respectively in size class-I, size class-II and size class-III.

The return per liter of milk over variable cost is highest in the size class-I category of dairy farm (Rs. 6.75 per liter) followed by the size class-II (Rs.6.70 per liter) and size

class-III (Rs.6.55 per liter). In the existing market price, the size class-I, size class-II and size class-III category of dairy farmers get profit over cost B recording Rs.4.10, Rs.4.05 and Rs.4.00 per liter respectively. However the return per liter of milk over actual cost (cost 'C') is highest in the size class-I categories of dairy farm owners recording Rs.2.85 as profit followed by size class-II with Rs.2.80 per liter) and size class-III with Rs.2.70 per liter)

Price changes also influence the dairy farmers in decision making relating to allocation of resources. Price plays an important role in increasing production. The price elasticity of production of cow milk at the state level both in the short run and long run are found to be 0.552 and 0.551 respectively. It implies that one per cent increase in price of milk will tend to increase the production by 0.552 per cent in the short run and 0.551 per cent in the long run. This elasticity in the district like Dhenkanal, Kalahandi, Koraput, Sundargarh is found to be negative both in the short run as well as in the long run. It implies that the increase in price will not be able to increase production in these districts. However other factors like feeding, infrastructural facilities and timely market support may be crucial for raising the level of production in these districts. In Bolangir district elasticity is found to be negative in the short run while Mayurbhanj district shows a negative elasticity in the long run. The price elasticity in Puri district is found to be highest both in the short run and in long run recording 0.974 respectively. It implies that one per cent rise in the price in Pure district will raise production and induce dairy farmers to produce up to a level of 0.974 per cent in the short run and 0.955 per cent in the long run. In the other six districts price elasticity of production varies in the range 0.71 (Mayurbhanj) to 0.774 (Balasore) in the short run and from 0.185 (Ganjam) to 0.766 (Balasore) in the long run.

V. POLICY OPTION

The return per litre of milk over variable costs are highest in size class-I (Rs.6.75 per liter) followed by size class-II (Rs.6.70 per liter) and size class-III (Rs.6.55 per liter). However, all the categories of dairy farmers able to recover cost B and C at the prevailing farm gate price. This suggests the need for improving the market structure. A network of milk collection centers linked to decentralized storage facilities and processing plants and supported by efficient transport is essential. This will encourage dairy farmers to enhance their size of operation and will reduce milk spoilage and result in higher turnover.

The productivity of milk in Orissa at 0.45 kg per animal per day is abysmal. High levels of productivity achieved in some states like Punjab, Gujarat and West Bengal within India indicate the untapped potential in Orissa. The production curve can be shifted upwards with improved production and market management practices. An important related issue in reducing the proportion of none descries mulch animals which drain the resources without contributing to production satisfactorily.

Table 1: Cost of Production of Milk Per Liter in Dhenkanal District

Items	**Size Class I**	**Size Class II**	**Size Class III**	**Average**
Cost A1	10.50	10.90	10.70	10.85
Cost A2	10.80	10.90	10.70	10.85
Cost B	13.35	13.80	14.10	14.10
Cost C	16.15	16.10	16.10	18.15
Cost D	15.60	15.65	15.70	15.80

Table 2: Return Per Liter of Milk Over Various Costs at Market Price During 2010-11 in Different Size Class of Dairy Farms Dhenkanal District

Items	**Size Class I**	**Size Class II**	**Size Class III**
Cost A1	6.75	6.70	6.55
Cost A2	6.75	6.70	6.55
Cost B	4.10	4.05	4.20
Cost C	2.85	2.80	2.70
Cost D	3.45	3.30	3.35

Table – 3.Short Run and Long Run Elasticity of Production Of Cow Milk In 13 Undivided Districts Of Orissa

Sl. No.	**District**	**Short run elasticity**	**Long run elasticity**
1	Balasore	0.7736	0.7658
2	Bolangir	-0.5458	0.5475
3	Cuttack	0.5892	0.5591
4	Dhenkanal	-0.0618	-0.2123
5	Ganjam	0.2024	0.1856
6	Kalahandi	-1.238	0.3625
7	Keonjhar	0.4547	-0.6802
8	Koraput	-0.6180	-0.0452
9	Mayurbhanj	0.0714	-0.6981
10	Phulbani	-0.5793	0.9552
11	Puri	0.9754	03595
12	Sambalpur	0.5372	-0.1953
13	Sundargarh	-0.0432	1.44
ORISSA		**0.5517**	**0.5507**

Significant at 1 percent level of probability

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