

## **IMPACT OF DAIRY COOPERATIVES ON THE INCOME OF RURAL HOUSEHOLDS IN ANDHRA PRADESH**

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### **ABSTRACT**

The study has analysed the impact of membership of dairy cooperatives on the income and milk yield of milch animals of dairy farmers in the study area. The study has been conducted in the Guntur and Chittoor districts of Andhra Pradesh by collecting data from 80 member and 80 non-member milk producing households which were stratified into small (1-3 SAUs), medium (4-6 SAUs) and large (> 6 SAUs) herd size categories. Net income has been found to be more in dairy cooperative members than non-members. The impact of membership in dairy cooperatives on net income has also been found to be positive and significant, indicating higher net income in dairy cooperative members than in non-member households. The dairy cooperatives have significant impact on the productivity of milch animals in the study region as they are providing proper veterinary services to its members. The study clearly indicated that dairy cooperatives are the main instrumental tools for enhancing the milk yield and income of dairy farmers in the study area.

**Keywords:** Dairy cooperatives, Membership, income, milk yield, net income

### **INTRODUCTION**

In India, cooperatives are used as a potential tool for all round development of human society, especially of its rural sector. The institutional mechanism of dairy cooperatives are used as a potential tool in increasing the milk production, improving the nutritional standards of the people, generating employment opportunities, improving income levels as well as reducing income inequalities in rural areas, especially for landless labourers, small and marginal farmers. These dairy cooperatives provide organized network of milk marketing along with proper input services like provision of artificial insemination, health care services and quality feed and fodder

inputs and also output services like credit facilities, financial support and animal insurance services with subsidy etc.

This paper has attempted to find whether impact of membership of dairy cooperatives are instrumental in increasing net income and milk yield of a household. Generally, income of a household can be increased by either increasing milk production or reducing cost of milk production. Therefore, in the present study, the cost of milk production and returns from local cow, crossbred cow and buffalo among different herd-size categories for dairy cooperative member and non-member households was estimated. Earlier studies carried out by Kumar and Sharma (1999), Meena (2008), Shahnawaz (2013) and Binita Kumari (2015) have indicated that net income of member households is more than that of non-member households.

## **MATERIALS AND METHODS**

The multistage sampling procedure was used for selection of state, district, mandal and village dairy cooperative societies. Andhra Pradesh state was purposively selected as the state ranks fifth in the country in terms of milk production. In 2015-16, the milk production in the state was 108.17 lakh metric tonnes. Further, Guntur and Chittoor districts were purposively selected as they have the highest milk procurement per day. From each district two mandals constituting highest and lowest milk procurement were purposively selected and from each mandal, two village dairy cooperative societies were selected randomly. From each village cooperative, 10 member and 10 non-member dairy farmers were selected randomly.

The primary data was collected from 160 dairy farmers of Andhra Pradesh, comprising 80 each from Guntur and chittoor districts. Out of 80 farmers from each district, 40 were members and 40 were non-members of dairy cooperatives. The households were then post stratified into three categories on the basis of their herd size as per standard animal units (SAUs) by using cumulative square root frequency method. The three categories were i) small herd size category (1-3 SAUs), ii) medium herd size category (4-6 SAUs) and iii) large herd size category (> 6 SAUs). Then, households were categorized with respect to member and non-member dairy farmers. Based on the herd size categories in the present study, the member households were categorized into 19, 26 and 35 as small, medium and large farmers, respectively and non-members were categorized into 27, 33 and 20 as small, medium and large farmers, respectively. Heckman two stage model was used to access the impact of membership of dairy co-operatives on the milk yield of milch animals and net income from dairy farming.

### **Econometric model**

#### *Heckman two stage model*

A vital issue in estimating impact is self-selection bias. Selection bias results from estimation on a sub sample of individuals who have essentially selected themselves for participation in a particular program. Several techniques have been developed to correct for this bias, mostly a two-stage technique attributed to Heckman (Heckman, 1979). In the Heckman two-stage method, the binary membership variable is estimated on the total sample of members and non-members in the outcome equation. Logit analysis is the most commonly used method in the estimation. The predicted membership probabilities was used to calculate a correction term. The correction term also known as Inverse Mills Ratio (IMR) which was included in the outcome equation and the outcome model was estimated by using ordinary least squares on the total sample and used to suggest the net impact of the programme.

In the first stage, the membership in dairy cooperatives decision was estimated and in the second stage the effect of membership on household income and productivity of milch animals was studied.

**First stage:- Factors influencing membership (Binary logit model)**

In case of multinomial choices, the probit model has found to be limited use in evaluating multiple integrals of the normal distribution. In this contrast, the logit model has been widely used in many fields.

The decision to take membership in this study has been modelled as

$$\alpha_{ij} = \beta_j X_{ij} + \epsilon_{ij}$$

Where,

- $\alpha_{ij}$  = latent variable i.e., membership (j = 1 for membership in dairy cooperative societies) of the  $i^{th}$  farmer
- $\beta_j$  = vector of parameters to be estimated
- $\epsilon_{ij}$  = random-error of estimation
- $X_{ij}$  = vector of independent variables affecting membership and includes the following variables like

Age (AGE) of dairy farmer is the number of years of the head of household. It is hypothesized that age of household head will be negatively related to membership in dairy cooperative which means that the older household head is less likely to participate in the dairy cooperatives.

Younger farmers tend to be more enterprising, fast decision makers, and have capacity to adopt new technologies.

*Education* (EDU) refers to score obtained for the level of education (on a 10 point scale) of the household head. Education is expected to favour entry into the dairy cooperatives. Education and age is also an indicator of management capabilities.

*Social participation* (SOCIAL) is reflector of the respondent's character of being associated to various social groups like Panchayat, religious organizations, political parties etc. Higher the social participation of a given household more is his probability of being a member of dairy cooperative societies. This variable was captured on a 20 point scale giving score 1 if he is a member of a given organization and 2 if he is an office barrier.

*Herd size* represents overall herd strength of dairy animals. In this study herd strength was taken by two ways, one, as number of milch cows (HERD) and second, in terms of standard animal units (SAU) of the entire stock (including young animals and adult males). It can be considered a proxy for financial capability and production capacity of a farmer. A positive effect of this variable is expected on membership in the dairy cooperatives.

*Land ownership* (LAND) is the land in hectares as owned by the dairy farmer. Since, land is usually positively related to the herd size and availability of financial capital, it is postulated that larger farmers would select dairy cooperatives as compared to smaller ones.

*Distance to paved road* (DPR) is the distance from the household to metalled road measured in kilometers. It is expected to inversely related to the membership decision to dairy cooperatives. In general, the famers with lower transaction costs are more likely to become a member in the dairy cooperatives. Those living near roads would have easier access to dairy cooperatives thus, as the distance from paved road increases, the dairy farmers will refuse to take membership in the dairy cooperatives.

*Distance to market* (DM), the distance to a main market measured in kilometers is taken as a proxy for access to alternative markets. It is hypothesized that nearness to the market gives the dairy farmers more choice of selecting a dairy cooperative.

*Distance to milk collection centre* (DMCC) is the distance in kilometers to the collection centre of co-operative society in a given village. The more the farmer has to commute, the less he would opt for the cooperative agency.

*Provision of veterinary services* (INPUT) means provision of services like veterinary health services, breeding services, feed input support, credit and insurance facilities to be provided to a

dairy farmer by the dairy cooperatives. The variable has been taken as dummy,  $D=1$  if any service is provided by dairy cooperatives,  $D =0$ , otherwise. A positive relation is expected between veterinary services and membership to the dairy cooperatives.

*Price* is the main economic incentives for the membership in dairy cooperatives

Actual procurement price (PRICE) is the amount paid per litre of milk to a dairy farmer by the dairy cooperatives. Price offered is expected to be an important determinant to take membership in the dairy cooperatives. Higher the price paid by the dairy cooperative, higher will be the probability of the household to take membership in dairy cooperatives. Price has a significant effect on membership in the dairy cooperatives. Price appear to affect membership in dairy cooperative positively; i.e. as procurement price increases farmers tend to take membership in dairy cooperatives because of stable pricing policies adopted by dairy cooperatives.

The analysis was carried out in STATA 16.0.

### **Second stage:- Impact of dairy cooperatives on net income and milk yield**

In the second stage, impacts of farmers' membership,  $\alpha_{ij}$  and their impacts on farmers' income and yield was studied.

#### **Estimation of Outcome Variables**

**Productivity:** The information on milk drawn in pail during morning and evening was recorded for each animal. For animals that had calf at heel, the quantity of milk that the calf must be consuming was also noted. Thus, the daily milk yield of each lactating animal was recorded on the day of visit. The average productivity of animals (herd average) on each sample household was worked out as:

Productivity (lit./day) = Total milk production on the test day/ number of milch animals

From the estimates of daily productivity of each animal hence obtained, the average milk yield on each sample household was worked out.

**Net Income:** The net income was computed from the detail information on the cost and returns in milk production.

$$\text{Net Income (Rs./animal)} = \text{Gross Returns} - \text{Gross Cost}$$

The net income per animal was aggregated over number of animals in a household to arrive at dairy net income of the household from milk production.

The two impact equations are

$$YIELD_i = \beta_0 + \beta_1 M_i + \beta_2 NM_i + \beta_3 AGE_i + \beta_4 EDU_i + \beta_5 SOCIAL_i + \beta_6 DM_i + \beta_7 INPUT_i + \beta_8 SAU_i + \beta_9 IMR\_M_i + \beta_{10} IMR\_NM_i + u_i$$

$$NET\_INC_i = \gamma_0 + \gamma_1 M_i + \gamma_2 NM_i + \gamma_3 AGE_i + \gamma_4 EDU_i + \gamma_5 SOCIAL_i + \gamma_6 DM_i + \gamma_7 HERD_i + \gamma_8 PRICE_i + \gamma_9 IMR\_M_i + \gamma_{10} IMR\_NM_i + v_i$$

Where,

YIELD = average productivity of milch animals on the sample households (lit./day)

NET\_INC = Net income of households from milk production (₹/day)

$M_i$  = Dummy for member group (= 1 for members, 0 for otherwise)

$NM_i$  = Dummy for non- member group (=1 for member, 0 for otherwise)

AGE = Age of household head (in years)

EDU = Educational score of the head of household

SOCIAL = Social participation score of the dairy farmer

DM = Distance from market (kms.)

PROVISION OF VETERINARY SERVICES = Dummy for veterinary services provided by dairy cooperatives like feed input support and credit to their members (=1 if provided, =0 for otherwise)

SAU = Standard Animal Unit

HERD = Number of milch animals of a given household

PRICE = Procurement price of milk (₹/lit)

IMR\_M = Inverse Mills Ratio for cooperative members

IMR\_NM= Inverse Mills Ratio for cooperative non-members

AGE: We hypothesized that age of household head will be negatively related to productivity and net income which means that the younger farmers are expected to be more enterprising, fast

decision makers, and have capacity to adopt new technologies, leading to more productivity of dairy animals and hence net income.

*MEMBERSHIP*: It is expected to be positively related to net income and productivity of milch animals that means the dairy farmers who took membership in dairy cooperatives will have more productivity and hence net income.

*EDUCATION and SOCIAL PARTICIPATION*: Social characteristics of dairy farmers like education and social participation are hypothesized to be positively related to the impact variables. Both these social variables are expected to increase managing capabilities and facilitate adoption of new technologies of the dairy farmer leading to more productivity and net income.

*PROVISION OF VETERINARY SERVICES*: It expected to be positively related to productivity of milch animals, higher the services provided by dairy cooperatives more is the productivity of milch animals of the dairy farmers.

*DISTANCE TO MARKET*: Distance to market is hypothesized to be negatively related to impact variables, as more the distance to market means lesser accessibility to inputs and hence lower productivity and net income.

*SAU*: SAU is expected to be negatively related to productivity of milch animals, as it imposes under resource constraint due to less availability of feed and fodder in the study area.

*PRICE*: Price is hypothesized to be positively related to productivity and net income, higher the prices of milk more will be procurement of inputs like feed leading to more productivity and hence net income.

Both the impact equations were estimated in STATA 16.0. software.

## **RESULTS AND DISCUSSION**

Factors influencing membership in dairy cooperatives (Binary logit model)

Estimates of binary logit regression are presented in Table 1. The parameters of this model can be interpreted as the effects on the probability of taking membership in dairy cooperatives of an infinitesimal change in each independent continuous variable and the discrete change in the probability for dummy variables.

The results of binary logit analysis has shown in Table 1. The most important determinant of membership in co-operatives is the distance to milk collection centre (DMCC). The estimated

coefficient of the variable is negative which indicates that as the distance from the milk collection centre increases by 1 km., the probability of membership of household in dairy co-operative decreases by 1.04.

The co-efficient of dummy variable of the veterinary services, (D = 1 if provided, 0 otherwise) turned out to be positive and significant. The regression results indicate that when veterinary services are provided to the farmers, they are about 0.19 times more interested to take membership in dairy co-operatives.

The coefficient of current procurement price came out to be positive and significant clearly indicating that higher prices paid by DCS facilitates the membership of the farmers. The role of price factors has also been brought out by Sharma *et al.* (2009).

Another important factor of membership in dairy cooperative is the extent of social participation. Results indicate that the farmers that are socially more active by way of being member of any social organization like *panchayat*, religious group, political organization, are more likely to be member of the dairy cooperatives. For an increase in the social participation score by one unit, *ceteris paribus*, the likelihood of co-operative membership goes up by 0.67 times. Social capital has been captured by Sharma *et al.* (2009) in terms of a dummy variable.

The coefficient of herd size (no.) came out to be positive and significant clearly indicating that an increase in herd size by one unit, *ceteris paribus*, the likelihood of co-operative membership goes up by 0.7 times.

The coefficient of age of household head came out to be negative but its influence was non-significant on membership in dairy cooperatives.

Some of the variables (education of household head and land ownership) were not significantly associated with membership in dairy cooperatives in the study area.

**Table 1: Binary Logit Estimates of the membership in dairy cooperatives**

<b>Independent variables</b>	<b>coefficient estimates</b>	<b>Standard error</b>
Constant	0.7334	2.3696
Age (years)	-0.00375	0.02979
Social Participation	0.6752*	0.2363



Herd size (No.)	0.708**	0.1509
Veterinary services (yes=1; No=0)	0.1923**	0.0570
Price	0.0877*	0.0426
Distance to milk collection centre (km)	-1.0424**	0.4938
Number of observations	160	
log likelihood function	-84.7753	
Restricted log likelihood	-110.9035	
Chi <sup>2</sup>	52.26	

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

Note: The dependent variable is membership in dairy cooperatives (1 for members, 0 for non-members).

### **Impact of dairy cooperatives on net income and milk yield of milch animals**

The second stage model estimated the net income from dairy and milk yield by generating Inverse Mills Ratio (IMR) of this binary logit model and including it as an explanatory variable in the estimation of impact regressions. Following the standard Heckman model, the Mills ratio was included as an explanatory variable to control for self-selection bias in the second stage OLS model. The results for each of the two outcome variables are discussed below:

#### ***Milk Yield***

The regression results of dairy cooperatives on milk yield are presented in Table 2. The regression coefficient of the dummy variable for membership is positive and significant, this suggests that productivity of milch animals on households who took membership in dairy cooperatives is significantly higher.

The relation effect as captured through IMR, it came out to be positive and significant in case of member households implies that those who took membership in dairy cooperatives obtain a higher impact variable than a random drawing from the population of farmers with a comparable set of characteristics would get. Similarly, the regression coefficient of IMR for non-members came out to be positive but non-significant means those who are not a member of dairy

cooperatives get lower impact variable than the rest of the population of farmers with a comparable set of characteristics drawn randomly.

The regression coefficient of dummy variable for the provision of veterinary services came out to be positive and significant influence on the productivity of milch animals.

The regression coefficient of distance from market came out to be negative but not significant. As the distance from market (DM) increases, the access to inputs, like veterinary medicine, feed etc. becomes more difficult and hence yield is adversely affected. The role of provisioning of veterinary services becomes particularly important in such situation which has a favourable influence on productivity of milch animals.

The regression coefficients of herd size (SAUs) came out to be negative and significant implies that on the small holder production systems, where resource availability is a limiting factor, the productivity of milch animals tends to decrease with increase in the stock of animals.

The effect of three personal characteristics of household head included in the model was found to be positive though non-significant. Higher education and social participation enhances awareness and capability of household to adopt improved techniques of production, thus, positively affecting productivity. The coefficient of age variable came out be negative and non-significant implies that younger generation tends to be more receptive to improved techniques of dairy farming and hence age and productivity would be inversely related. The positive coefficient of age is perhaps suggestive of better milk yield on households who have more experience in dairying as reflected from their higher age.

### ***Net Income***

The net income of the farmers from milk production was significantly higher in case of cooperative members as compared to non-members. The regression results of dairy cooperatives on net income are presented in Table 2.

The regression coefficient of the dummy variable for membership is positive and significant, this suggests that net income of households who took membership in dairy cooperatives is significantly higher.

**Table 2: Impact of dairy cooperatives on net income and milk yield of milch animals**

Independent variables	Income		Yield	
	Regression coefficients	Standard error	Regression coefficients	Standard error
Constant	43.5990**	10.025	9.3679*	1.4814
Age	-0.2602*	0.1246	-0.0196	0.0182
Education score	0.9445	0.6319	0.0550	0.0934
Membership	1.8386*	0.6940	0.5095**	0.2500
Social Participation	0.6259	1.7256	0.1508	0.2585
Distance to main market	-0.0191	0.0274	-0.0016	0.0040
Herd size (SAUs)	2.6986*	1.1361	-0.5276**	0.1693
Veterinary services	5.7235*	2.4072	1.0533**	0.3545
Price	0.7390**	0.1726	0.0439	0.0255
IMR_ Member	32.3502*	13.5539	7.0953**	1.9112
IMR_ Non-Member	23.7984	13.2172	3.2165	2.0039
Number of observations	160		160	
R <sup>2</sup>	0.40		0.26	

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

The regression coefficients of herd size (SAUs) came out to be positive and significant implies that the net income tends to increase with increase in the stock of animals.

The regression coefficient of dummy variable for the provision of veterinary services came out to be positive and significant that means as provision of veterinary services by dairy cooperatives increase, then productivity of milch animals will be more and hence there is increase in the net income.

The regression coefficients of procurement prices offered by dairy cooperatives came out to be positive and significant for net income from milk production.

The control variables other than price, SAUs, membership and provision of veterinary services also have the expected relationship with net income. Enhancement in education and social participation status has a positive effect on net income while the distance from market (DM) constraints the input availability adversely affecting net income. The coefficient of age variable is negative but significant implies that young farmers have more influence on increasing net income.

### **CONCLUSIONS AND IMPLICATIONS**

The important determinants of membership in dairy cooperatives were the distance to milk collection centre (DMCC), provision of veterinary services, herd size (No.), procurement price of milk and social participation score of the dairy farmer. The estimated coefficient of the DMCC variable is negative which indicates that as the distance from the milk collection centre increases by 1 km., the probability of membership of household in dairy co-operative decreases by 1.04. The co-efficient of dummy variable of the veterinary services, ( $D = 1$  if provided,  $0 =$  otherwise) turned out to be positive and significant. The regression results indicate that when veterinary services are provided to the farmers, they are about 0.19 times more interested to take membership in dairy co-operatives.

The economic incentives reflected in prices of milk received by the producers also had an important bearing on the membership in dairy cooperatives. The coefficient of current procurement price came out to be positive and significant, clearly indicating that higher prices paid by DCS facilitates the membership of the farmers. Social characteristics of household head also played important role in taking membership in dairy cooperatives, it was found that for an increase in the social participation score by one unit, *ceteris paribus*, the likelihood of co-operative membership goes up by 0.67 times.

The regression coefficient of dummy variable for the provision of veterinary services came out to be positive and significant influence on the productivity of milch animals. This is due to the provision of proper veterinary services by the dairy cooperatives to the member farmers. The net income from milk production was positively influenced by the membership, herd size, provision of veterinary services and the procurement prices of milk. But on the small holder production systems, where resource availability was a limiting factor, the productivity tends to decrease with increase in the stock of animals.

Enhancement in education and social participation status has a positive effect on productivity and net income while the distance from market (DM) constraints the input availability adversely

affecting these two outcome variables. The study revealed that provision of veterinary services can condition the increase in membership, number and productivity of dairy animals, net dairy income of the milk producers and hence, milk procurement of the cooperatives.

The study revealed that there is a positive impact of dairy cooperatives on the productivity of dairy animals and net income of the member households. The reason behind this conclusion was that provision of veterinary services and higher remunerative prices of milk offered by the dairy cooperatives to its members. Thus, steps should be taken to bring greater number of milk producers in the cooperative network by making them aware about the benefits of the cooperative programme.

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