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ECONOMICS OF BUFFALO MILK PRODUCTION – A CASE STUDY OF COMPOSITE ANDHRA PRADESH

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ABSTRACT

Milk production is a complex process involving a number of genetic and non-genetic factors. Variation in genetic potential, feeding and management practices influence the yield of milk for cattle and buffaloes. Costs and Returns of dairying are important concerns of dairy farmers. The results of the study presented in the paper examine the economics of buffalo milk production and productivity in three villages of different levels of agricultural development in Composite Andhra Pradesh. The districts covered from the three regions are: Guntur, Nalgonda and Kurnool. Analysis presented is in respect of three breeds of buffaloes – murrah breed, graded murrah breed, and non-descriptive/desi, and five categories of dairy households - agricultural labour, marginal, small, semi-medium and medium farmers. The results flowing from the Input-Output Analysis, Cobb-Douglas Production Function, χ^2 test, and Cost-benefit Ratio are presented district-wise and buffalo category-wise. Emphasis is on intensification of the drive for cross breeding of species, as graded murrah is considered highly remunerative in terms of yield of milk and adoption of scientific management practices.

Introduction

Dairying in India, over the years, witnessed a sea change from a largely unorganised activity into a booming organised industry, with the implementation of the Operation Flood Programme from 1970 and other dairy development programmes. National Dairy Plan (NDP) is a composite programme launched in 2012 in select districts. The programme consists of three components: (i) village-based milk procurement system, (ii) ration balancing programme, and (iii) fodder development programme. These efforts will improve the quality of milk. NDP needs to be extended to more districts in the next few years. The white revolution owes much to the Anand

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Pattern of Cooperative Dairying, with a three-tier system on cooperative lines at State, district and village levels. The institutional infrastructure developed at different levels has progressively eliminated middlemen, enabling interface of producers with processors. Cooperatives form part of the National Milk Grid which links producers with consumers throughout the country bridging the gaps on account of seasonal and regional variations in the availability of milk. The Anand pattern is a three- tiered structure in which the farmers organise themselves into dairy cooperative societies at the village level; these village level cooperatives are organised into a district level union; the district level unions federate into a State level cooperative organisation. At the national level, the National Cooperative Dairy Federation of India (NCDFI) coordinates the efforts of all State level cooperative dairy federations.

In the light of the liberalised competitive environment, the milk producers are scaling up their production capacities and adopting dairy farming on commercial lines to tap market opportunities. As a result, many commercial dairy farms and private dairy processing enterprises have come up in the country, particularly in milk surplus States. Dairying in India continues to be a small holder's enterprise, particularly of landless labourers, and marginal and small farmers. Organisational efforts are being made to expand the cooperative network to enable farmers to get better earnings through increased milk production with the help of scientific breeding, feeding and adoption of scientific management practices. The paper dealing with economics of buffalo milk production is presented in two sections. Section I presents the status of milk production in the country and review of studies on milk production; section II covers the results of the case study on economics of buffalo milk production in three districts of Composite Andhra Pradesh - Guntur from the Coastal Andhra region, Kurnool from Rayalaseema region, and Nalgonda from Telangana region. Coastal Andhra and Rayalaseema regions constitute the present Andhra Pradesh State, after the State bifurcation on June 2, 2014, and the entire Telangana region covering 10 districts is now called Telangana State. Data presented for Andhra Pradesh State in the paper refer to Composite Andhra Pradesh.

Status of Milk Production in the Country

India has the distinction of being the largest producer of milk in the world with production level of 132.4 million tonnes (MT) in 2012-13. USA stands second with the production level of 91.6 MT, and China third with 47.6 MT in 2013. India's share in world milk production is 17.4 per cent in 2013, as compared to USA of 11.7 per cent, and China of 6.1 per cent (www.fao.org). Compound Annual Growth Rate (CAGR) for milk production during 2005-2013 works out to 5.1 per cent for China and 4.2 per cent for India. Per capita availability of milk in the country in 2011-12 is 290 gms per day compared to the world average in 2011 of 289 gms per day. Average annual growth rate of milk production for India in the recent years has been 4.2 per cent compared to the world production average of 2.3 per cent. Growth in recent years has been faster compared to the earlier decades in India. It has touched 5 per cent in 2011-12, and declined to 3.5 per cent in 2012-13. Average

annual growth rate in per capita availability of milk for India has been around 3 per cent in the recent years, faster than in earlier years (www.nddb.org/statistics). The average milk yield of indigenous cattle and buffalo is around 1.98 litres per day which is very low as compared to the yield of cross-breeds of 6.75 litres per day. This is due to the poor plan of nutrition, low genetic potential for milk production, and near absence of the genetic improvement programmes. Cross-breed cows and buffaloes are more income remunerative than local breed of animals, mainly on account of better milk yield, better productive traits, and considerable growth in income and employment due to increase in productive and reproductive performance of cross-breeds of animals (Ganesh Kumar, B. and Raj Vir Singh, 2008).

With all India milk production in 2012-13 as 132.4 MT, the contribution of leading States is as follows. Arranged in the descending order of milk production in 2012-13, the position of 13 major States with production in MT, and percentage share given in parentheses is as follows: Uttar Pradesh 23.3 (17.6 per cent), Rajasthan 13.9 (10.5 per cent), Composite Andhra Pradesh (Andhra Pradesh and Telangana States) 12.8 (9.6 per cent), Gujarat 10.3 (7.8 per cent), Punjab 9.7 (7.3 per cent), Madhya Pradesh 8.8 (6.7 per cent), Maharashtra 8.7 (6.6 per cent), Haryana 7.0 (5.3 per cent), Tamil Nadu 7.0 (5.3 per cent), Bihar 6.8 (5.2 per cent), Karnataka 5.7 (4.3 per cent), and West Bengal 4.9 (3.7 per cent). These 13 major States account for production of 119.11 MT (89.9 per cent). Seven other States with above 1.1 MT production level together account for 11.6 MT (8.8 per cent). These States arranged in the descending order with output in MT and percentage share given in parentheses are: Kerala 2.8 (2.1 per cent), Odisha 1.7 (1.3 per cent), Jharkhand 1.7 (1.3 per cent), Jammu and Kashmir 1.6 (1.2 per cent), Uttarakhand 1.5 (1.1 per cent), Chhattisgarh 1.2 (0.9 per cent), and Himachal Pradesh 1.1 (0.8 per cent). These 20 States together produced 130.7 MT, 98.7 per cent of all India milk production in 2012-13 (www.nddb.org/statistics).

Buffaloes are the largest genetic resource found in large numbers in a number of States, and form an important component of the livelihood of rural masses. Composite Andhra Pradesh stands second in the country in total buffalo population, and adult female as well as male buffaloes, with Uttar Pradesh (UP) as the number one State. In total milk production in 2012-13, out of the all India level of 132.4 MT, UP accounts for 17.6 per cent, Rajasthan second at 10.5 per cent, and Composite Andhra Pradesh stands third at 9.6 per cent. Compound Annual Growth Rate (CAGR) of milk production during 2007-13 for Composite Andhra Pradesh is 8.2 per cent (the highest), with Madhya Pradesh, Gujarat, and Rajasthan as second, third and fourth with the growth rate as 5.5, 5.4 and 5.2 per cent, respectively. All India average is 4.2 per cent. In per capita availability of milk in 2011-12, Punjab has the pre-eminent position of the number one State with 945 gms/day as against the all India average of 290 gms/day, and the world average of 289.31 gms/day. Composite Andhra Pradesh ranks sixth (391 gms/day), with annual growth rate of 7.8 per cent during 2007-12, the highest among States in the growth rate, as against the all India average of 3.6 per cent (www.nddb.org/

statistics). In India, buffaloes contribute 55 per cent of total milk production, though their population is less than that of cattle. Buffalo milk being rich in fat, there is greater demand for buffalo milk, compared to other categories of milk; and it commands a premium price in the market. Cattle contribute 41 per cent of milk, and 4 per cent is contributed by others (Balamuniswamy, D. and B. Parameswara Reddy, 2013).

Milk production is a complex process involving a number of genetic and non-genetic factors. Type of breed and ability for milk secretion by individual animals are the important factors. The important non-genetic factors influencing milk production include the quality of feed and fodder, labour, order of lactation, stage of lactation, etc. A number of research studies as presented later in the literature review have revealed that there is great variation in the relative economic efficiency of different breeds of milch animals reared by different categories of the herd size farmers due to variation in genetic potential, feeding and management practices. The problem is more acute as most of the milk producers are landless agricultural labourers, marginal and small farmers with very low herd size of one to two animals, and in some cases three to four, and lack scientific know-how to boost the animal productivity. This results in increased cost of milk production and lower returns. Besides the increasing cost of inputs, profitability of milk production also depends on the price received by the milk producer through the channel through which he/she sells milk. Analysis of costs and returns from dairying is an important issue affecting the livelihood of the vast majority of rural masses.

Review of Studies on Milk Production

The findings of a few research studies focusing on various aspects of milk production of buffaloes and cows are presented in this section.

Tanwar, P.S. et al. (2012), in their study of "Economics of Milk Production among Member and Non-member Families of Dairy Co-operatives in Jaipur District (Rajasthan)" covered 240 milk producers owning milch buffaloes (120 among members of 10 cooperatives and 120 non-members in the district). The results show that net return per buffalo per year was higher in member families than non-member families. This reflects that the members of dairy cooperatives kept not only superior breed of buffaloes but also followed better feeding and scientific management practices than their counterpart non-member families, which in turn enhances their profit by way of higher productivity of buffaloes. Further, the existence of dairy cooperatives, which offered higher price of milk to the members, resulted in increased income of the members. The study suggests that it would be beneficial for non-members to become members of cooperatives to take advantage of the facilities provided by the cooperatives to improve their earnings and status in dairy farming through well established linkages.

The overall gross maintenance cost per animal per year was higher in member families in comparison to non-member families. Maximum cost was on small farmers, and minimum was on landless farmers in both categories. The share of variable and fixed cost in total maintenance cost was almost the same for member and non-

member families. The cost of feed, fodder, and concentrate was the main component in gross maintenance cost. The overall cost per litre of milk was lower (₹ 10.47) in member families than non-member families (₹ 11.29). The size of landholding showed negative relationship with the cost of milk production. The overall net return per animal per year was higher in case of members in comparison to non-members. The overall net profit per litre of milk was ₹ 4.73 for members and ₹ 2.01 for non-members. The overall average income per rupee of investment was higher for members (₹ 1.45) than for non-members (₹ 1.18).

Michael Khovelo, L.L. et al. (2012) in their study of "Economics of Milk Production and its Constraints in two districts of Nagaland", namely, Kohima and Dimapur covered 120 milk producing households possessing cross-bred and local cows. Cooperative members and non-members were covered in the study for pinpointing the production and marketing constraints. Results of the study showed that the feed cost accounted for 78.3 per cent of the gross cost in cross-bred cows and 68.8 per cent in local cows where concentrate formed the major constituent of the feed cost. The share of labour was 12.8 and 21.1 per cent of the gross cost for cross-bred and local cows, respectively. The average daily milk yield of milch cross-bred and local cows was found to be 4.4 and 1.5 litres, respectively. The cost of milk production for milch cows per litre worked out to be ₹ 19.6 and ₹ 29.1 for cross-bred and local cows, respectively. The high per litre cost of milk could be due to the high feed cost associated with low milk yield in case of local cows. Therefore, efforts should be made to upgrade the germplasm of local zebu cattle in order to improve its productivity, thus, reducing the cost of milk production. The net return was found to be positive for cross-bred cows while it was negative for local cows across all categories of households. The study further observed low availability and high price of concentrate to be the major production constraint in milk production for both cooperative members and non-members, while low price of liquid milk was the major marketing constraint for cooperative members, and delay in payment by unorganised sector was the major constraint for non-members. Steps may be taken to strengthen the cooperative society infrastructure and payment of remunerative price of milk to the milk producers.

Avinash K. Ghule et al. (2012), in their study on "An Economic Analysis of Investment Pattern, Cost of Milk Production and Profitability of Commercial Dairy Farms in Ahmednagar district of Maharashtra" covered 40 commercial dairy farms of largely cows from 12 villages. Only three are mixed farms with cows and buffaloes. The dairy farms of varying herd sizes had average herd size for small, medium and large categories as 10.55, 14.11 and 34.66 milch animals, respectively. The average investment per farm was estimated to be ₹ 12.17 lakh; indicating that commercial dairy farming is a highly capital intensive business. The share of dairy animals in total investment ranged from 51.3 per cent (small farms), 55.2 per cent (medium farms) to 70.1 per cent (large farms). The average productivity of cross-bred cattle was 9.7, 9.6 and 9.5 litres of milk per day for small, medium and large category of commercial farms; while the cost of milk per

litre was ₹12.5, ₹12.6 and ₹ 11.5, respectively. The net return over cost per litre of cow milk produced was ₹ 2.2. All farms were financially viable earning a net profit of ₹ 1.9 lakh per farm per year. Commercialisation in dairy farming has contributed to increase in income levels of farmers through increased production. The productivity of cattle in terms of milk production per milch cattle per day as well as wet average was found to be higher in small commercial farms in comparison to medium and large farms in that order. Large farms have invested maximum share of fixed capital in the dairy animals whereas on the small farms relatively more investment was done on development of infrastructure. Commercial dairy farms had devoted a fairly large area of their operational holding for growing fodder crops to meet their fodder requirement with least dependence on purchased fodder. Feed represented one of the largest components of cost. The wet to dry animal ratio was better in case of cross-bred cattle farms as compared to buffalo farms. Poor wet to dry ratio led to increased cost and relatively low return on the large buffalo farms.

Aulakh, G.S and Rajbir Singh (2012), in their study on "Adoption of recommended management practices by buffalo owners conducted in three districts of Punjab", namely, Bathinda, Ferozepur and Sangrur on a sample of 180 buffalo owners from six villages examined the adoption of recommended management practices by buffalo owners. The study revealed that overall; the buffalo owners had medium level of adoption of recommended management practices. Adequate supply of water, and feed to buffalo, and udder cleaning before milking were the practices which were highly adopted, whereas separation of pregnant buffalo a few days before calving, wallowing in the ponds, and weaning of calves, practices were least adopted by the buffalo owners. The medium level of adoption was observed in case of practices like care of naval card of the calf, disinfection of the shed, dehorning of calves, and cleaning of animals before milking. The education level of the respondents was positively and significantly related with the adoption of management practices. The adoption of improved dairy practices becomes a prerequisite for sustained growth and development of dairy industry. The low productivity of buffalo is mainly due to lack of adoption of improved management practices.

Inderpreet, K. et al. (2010), in their paper "Pattern of Milk Production and Marketing in Ludhiana and Sangrur Districts of Punjab" present the findings of the study with focus on production and marketing aspects of milk in two districts, leading in milk production in the State. It is concluded that quantities of milk produced and milk retained for household consumption were positively correlated to the size of the herd. The large milch animal herd farmers dominated the supply side of the milk market. The sale of cow milk was more compared to buffalo milk in the study area. The most preferred mode of selling milk was the local vendor followed by cooperative societies, private milk plants, and direct sale to consumers. The large quantity of milk sold per household confirmed that the dairy farmers in the selected districts of Punjab were adopting dairy farming on a commercial scale, and the farmers'

experiences in selling milk revealed that organised milk marketing system is essential to enable the farmers to get remunerative prices, as the present system is inadequate.

Mallikarjuna Reddy, R. and S. Subramanyam (2002), analysed the gap between the potential and the realised yields of dairy animals maintained by the farmers. The decomposition of the yield gap into its contributory factors reveals that the sound management practices and increased input use (better feeding) are the factors responsible for the yield gap in cross-bred cows and Murrah buffaloes. The study examined feeding patterns of animals in both the situations. It is learnt that the deficiency of protein in the rations of the farmer-bred animals is the major factor responsible for the lower milk productivity of farmer-bred animals. Therefore, it is suggested that all the farmers should include protein rich feeds in the ration of their animals. Further, the addition of the micronutrients like mineral mixtures and vitamin supplements in small quantities improve the daily milk-yield and lactation length of farmer-bred animals.

Ganesh Kumar, B. et al. (2011), in their article "Economic Analysis of Buffalo Farming in Andaman & Nicobar Islands – A Micro level Study" studied the economics of buffalo farming, and estimated the average size of buffalo holdings of the farmers and economic traits of buffaloes such as the age at first calving, order of lactation, lactation period, dry period, inter-calving period, service period, lactation yield, and daily milk yield. It was found that with increase in herd size, the productivity and profitability increased, indicating economies of scale, and labour cost decreased, conveying optimal utilisation of family labour in buffalo farming. The major constraints identified include non-availability of fodder and land for the farming practices. It is concluded that buffalo farming in these islands is a highly profitable enterprise under the prevailing socio-economic conditions.

Rajesh Kumar et al. (2011), in their article, "Impact of Cross-breeding on Productive Performance of Cattle: A BAIF's Case", a study carried out in Bareilly district of Uttar Pradesh covered 120 cattle owning households of 12 villages comprising 50 per cent beneficiaries and 50 per cent non-beneficiaries of the Bharatiya Agro Industries Foundation (BAIF). The study focused on the Cattle Development Programme to assess the impact of cross-breeding interventions on the production performance and related variables of cattle and its relationship with income and employment generation. The cattle owning families availing the breeding services of BAIF and those not using the services of BAIF since the last five years were the respondents. The impact of cross-breeding was studied in terms of significant differences in the mean values of cattle production performance and related variables, degree of relationship of cattle production performance trait with income and employment generation, and the per cent change in cattle production performance, and related variables among beneficiaries and non-beneficiaries over the last five years. Cross-breeding interventions of BAIF's cattle development programme were found to be an effective tool for raising income and employment generation due to better productive and reproductive

performance of cross-bred cattle. The cross-breeding interventions could contribute to nutritional as well as livelihood security of rural families. Efforts should be focused not only on artificial insemination services but also to create awareness among the farmers to rear quality milch breeds.

Research Methodology

The cost of milk production from dairying is an important aspect for producers, consumers and policy makers to provide effective linkage between the milk producers and consumers, so that the producers get remunerative price for milk, and consumers get milk and milk products at reasonable rate. Estimation of costs and returns from milk production for different breeds of milch buffaloes maintained by different categories of sample dairy farmers is essential to understand the viability of the enterprise from various angles. This motivated the researcher to pursue the current study in three agro-climatic zones of Composite Andhra Pradesh.

Objectives pursued in the present study are two-fold:

(i) to examine the economics of buffalo milk production and productivity in the study region in Composite Andhra Pradesh, and

(ii) to suggest policy measures for improving productivity of the dairy sector.

In three selected villages of Composite Andhra Pradesh, representing different levels of agricultural development, the study examines the theme in respect of three breeds of buffaloes – murrah breed, graded murrah breed, and non-descriptive/desi, and five categories of dairy households - agricultural labour (AL), marginal farmer (MF-1), small farmer (SF), semi-medium farmer (SMF), and medium farmer (MF-2) who are engaged in dairying as the main or secondary occupation. As the coverage is in three districts of different economic regions, results are presented in respect of the individual districts, and category of farmers for each breed of buffaloes.

The three types of buffaloes covered in the study are:

(i) **Murrah Breed Buffalo:** Murra breed buffalo is black in colour, and horns are short and slightly curved in a spiral shape. It is a massive and stocky animal with heavy bones. Its height is 133 cm, and weight 650 kgs. It originated in Haryana State in November 1966.

(ii) **Graded Murrah Breed Buffalo:** Graded murrah or cross-breed buffalo emerges from systematic and frozen semen-based cross-breeding programme being practised in a number of States. This is yet to be adopted extensively in the country. A major advantage of cross-bred buffaloes is that they continue to produce milk in the summer season as well when the buffalo milk output drops by as much as 50 per cent.

(iii) **Non-descriptive Buffalo:** Non-descriptive buffalo rearing in India has a long history. It symbolises the long tradition of keeping buffaloes as part

of the household. This category of buffalo population is on the decline, giving place to cross-bred improved varieties. Greater popularity is for graded murrah breed buffalo.

For the study of economics of buffalo milk production, a sample of 275 dairy farmers from three villages of Composite Andhra Pradesh was covered through a multi-stage random and purposive selection process. Initially, three districts having the largest adult buffalo population in each of the three regions of the State were identified. After that, one mandal each, with the largest adult buffalo population in those districts, and subsequently one village each with the largest adult buffalo population in the mandals were specified. The criterion for selection of the study area is, thus, the area having the largest number of milch buffaloes of different categories of three years and above age group. The villages selected are Peteru in Repalle mandal of Guntur district (Coastal Andhra region), Ananthagiri in Kodad mandal of Nalgonda district (Telangana region), and Chapirevula in Nandyal mandal of Kurnool district (Rayalaseema region).

The 275 sample respondents of dairy households are classified into five categories: Along with the number and percentage, these are: AL 60 (21.8 per cent), MF-1 60 (21.8 per cent),SF 57 (20.8 per cent), SMF 51 (18.5 per cent), MF-2 47 (17.1 per cent). 275 respondents owned 358 adult buffaloes of three categories: murrah breed 39 (10.9 per cent), graded murrah 103 (28.8 per cent), and non-descriptive/desi buffaloes 216 (60.3 per cent). Care was taken to represent reservations in the sample of dairy farmers. Community-wise distribution of the respondents is as follows: backward classes (BC) 35.6 per cent, scheduled castes (SC) 11.3 per cent, scheduled tribes (ST) 2.6 per cent. The rest of 50.5 per cent are open categories (OC). The analysis attempted is in respect of the category of dairy households and type of buffaloes. Results presented of input-output, production function, and cost-benefit ratio analysis refer to these key aspects to pinpoint the distinguishing features of the three study areas. The districts covered in the study in order of level of development are: Guntur - agriculturally well developed, Nalgonda – next level of agricultural development, and Kurnool – lowest in terms of agricultural development, among the three districts covered in the study. The conclusions indicate the pre-conditions of success in regions of varying levels of development.

Among the statistical techniques adopted, mention many be made of the following: Input - Output analysis, Cobb-Douglas Production Function, and Cost-benefit analysis/cost-benefit ratio for three categories of buffaloes, five categories of dairy households, and overall picture district-wise. Chi-square (χ^2) test goodness-of-fit and test of significance were carried out for a number of features utilising the SPSS software. Using these tests, relationship or association was established between the socio-economic characteristics of the sample respondents and ten pairs of variables influencing buffalo milk production, and for identifying production and financial constraints affecting milk production.

Results and Discussion

Application of Chi-square Test and Test of Significance

Chi-square (χ^2) test and test of significance worked out for ten pairs of variables show that for four pairs, the result shows significance indicating that they exert considerable influence on improving milk production. The pairs are: gender and main occupation, literacy status and main occupation, educational qualification and main occupation, and main occupation and marital status. Six pairs where association is shown as insignificant are: religion and marital status, religion and main occupation, religion and secondary occupation, gender and secondary occupation, education qualification and experience in dairying, and various categories of dairy households and debt.

Production and financial constraints affecting milk production have been studied using χ^2 test. For six variables, the result showed significance. For one, the result showed insignificance. The milk yield and overall production of milk are linked in a significant way with variables such as quality of bulls, veterinary facilities, availability of land for fodder cultivation, availability of green fodder, proper shed facility, and availability of credit. Inadequate knowledge about balanced feeding has not been found to be significant.

Results of Input-Output Analysis

Table 1 presents the results of input-output analysis of milk production in respect of three types of buffaloes, district-wise and farmer category-wise. The overall picture given in Table 2 summarises the results of input-output analysis district-wise for three categories of buffaloes.

Table 1 : Input –Output Relation in Milk Production by Category of Buffaloes and Households

(Quantity in quintals per buffalo per annum)

Households	Input & Output	Murrah Breed			Graded Murrah			Non-Descriptive		
		Guntur	Nalgonda	Kurnool	Guntur	Nalgonda	Kurnool	Guntur	Nalgonda	Kurnool
AL	DF	13	10	18	18	19	13	18	19	15
	GF	24	70	34	38	29	32	27	24	51
	CT	1.4	2.3	4.5	2.0	1.7	2.2	2.0	2.3	2.0
	MR	28	40	33	30	29	29	29	56	37
	MY(Ltr)	1,492	2,040	1,680	1,352	1,470	1,772	957	916	1,090
	Calf	1	Died	1	1	1	1	1	1	1
	MP (B-kgs)	-	-	-	-	-	-	-	-	5.0
MF-1	DF	27	15	21	19	18	17	17	22	14
	GF	80	52	36	48	35	34	40	19	32
	CT	3.0	5.0	5.0	2.0	3.7	6.0	2.2	2.5	3.5
	MR	34	32	30	30	30	31	24	41	28
	MY(Ltr)	1,756	1,629	1,820	1,313	1,756	1,879	1,025	916	1,163
	Calf	1	1	1	1	1	1	1	1	1
	MP (B-kgs)	-	-	-	-	-	-	-	-	-
SF	DF	25	25	-	17	18	19	16	21	12
	GF	75	29	-	60	38	27	49	28	34
	CT	3.8	1.8	-	4.0	2.0	2.1	3.0	2.0	2.3
	MR	44	41	-	38	33	32	32	29	40
	MY(Ltr)	1,924	1,708	-	1,440	1,477	1,491	969	848	993
	Calf	1	1	-	1	1	1	1	1	1
	MP (B-kgs)	-	-	-	-	-	-	-	-	-

(Contd...)

Table 1 *(Contd...)*

Households	Input & Output	Murrah Breed			Graded Murrah			Non-Descriptive		
		Guntur	Nalgonda	Kurnool	Guntur	Nalgonda	Kurnool	Guntur	Nalgonda	Kurnool
	DF	35	31	15	19	27	20	30	20	21
	GF	34	16	-	27	24	41	45	20	54
	CT	4.3	4.3	-	4.8	3.5	2.3	3.6	2.0	2.4
SMF	MR	47	52	20	35	33	53	40	36	58
	MY(Ltr)	2,145	1,811	640	1,614	1,448	1,267	1,045	1,171	996
	Calf	1	1	1	1	1	1	1	1	1
	MP (B-kgs)	-	-	-	-	-	-	-	-	-
	DF	21	30	-	21	28	20	25	29	22
	GF	23	08	-	39	25	18	38	20	30
	CT	4.0	2.5	-	3.0	2.0	2.0	3.0	2.0	2.1
MF-2	MR	41	50	-	40	39	23	34	44	31
	MY(Ltr)	1,818	2,018	-	1,410	1,195	1,202	988	865	856
	Calf	1	1	-	1	1	1	1	1	1
	MP (B-kgs)	-	-	-	-	-	-	-	-	-
Inputs for all respondents (Qty)	DF	24	22	18	19	22	18	21	22	17
	GF	47	35	35	42	28	36	40	22	40
	CT	03	03	05	03	02	03	03	02	02

Note : Inputs in quintals are - DF: Dry Fodder, GF: Green Fodder, CT: Concentrates; and outputs are - MR: Manure in quintals, MY: Milk Yield in litres (Ltr), MP: Milk Product, B: butter (kgs), and Calf, Qty: quintals.

Source : Computed from primary data.

Table 2 : Overall Input – Output Relation in Milk Production, Buffalo Category-wise in Three Districts

(Quantity in quintals per buffalo per annum)

District	Input & Output	Murrah Breed		Graded Murrah		Non-Descriptive	
		Overall	Range	Overall	Range	Overall	Range
Guntur	DF	24	13 - 35	19	17 – 21	21	16 – 30
	GF	47	23 - 80	42	27 – 60	40	27 – 49
	CT	3	1.4 - 4.3	3	2.0 - 4.2	3	2.0 – 3.6
	MR	39	28 - 47	35	30 – 40	32	24 – 40
	MY (Ltr)	1,827	1,492 - 2,145	1,426	1,313 –1,614	997	957 – 1,045
Nalgonda	DF	22	10 - 31	22	18 – 28	22	19 -29
	GF	35	08 – 70	3	24 – 38	22	19 -28
	CT	3	1.8 – 5.0	2.6	1.8 – 3.8	2	2.0 – 2.5
	MR	43	32 – 52	33	29 – 39	41	29 – 56
	MY (Ltr)	1,841	1,629 – 2,040	1,469	1,195 – 1,756	943	848 – 1,171
Kurnool	DF	18	15 -21	18	13 – 20	17	12 – 22
	GF	35	34 – 36	36	18 – 41	40	30 – 54
	CT	5	4.5 – 5.0	3	2.0 – 6.0	2	2.0 – 3.5
	MR	28	20 – 33	34	23 – 53	39	28 – 58
	MY (Ltr)	1,380	640 – 1,820	1,522	1,202 – 1,879	1,020	856 – 1,163

Note: Inputs in quintals are - DF: Dry Fodder, GF: Green Fodder, CT: Concentrates; and outputs are - MR: Manure in quintals, and MY: Milk Yield in litres (Ltr).

Source: Computed from primary data.

The overall results given in Table 2 reveal that the milk yield per animal per annum is the highest in Murrah breed buffaloes in Nalgonda (1,841 litres), followed by Guntur (1,827 litres). Next comes the graded murrah buffalo from Kurnool (1,522 litres). For Kurnool, murrah buffalo's yield is only 1,380 litres, low compared to that of graded murrah of this district (1,522 litres). In Guntur and Nalgonda, graded murrah buffalo's milk yield falls in between that of murrah breed and non-descriptive categories. Non-descriptive buffalo's yield is the lowest in all the districts. Further analysis in the category of farmers and agricultural labour is as follows (Table 1): In Guntur in case of murrah buffalo, except in respect of AL, for all other categories the yield is quite high; the highest in respect of SMF (2,145 litres) compared to the overall figure of 1,827 litres. In respect of graded murrah buffalo, yield in case of SMF is the highest among the categories. In case of non-descriptive buffalo also, the yield for SMF is the highest. In case of inputs, heavy reliance is placed on green fodder, followed by dry fodder. Use of

concentrates is very low. For labour, the number of mandays is the highest in case of AL. In respect of Nalgonda, in case of murrah buffalo, as against the overall milk yield of 1841 litres, yield for AL, MF-2 and SMF is quite high, and low in others.

Sumit Mahajan and A.K. Chauhan (2011), in their article, "Resource Use Efficiency in Milk Production in Rural and Peri-urban Dairy Farms in Ludhiana District of Punjab", focus attention on analysis of input-output relationship and resource use efficiency in respect of the use of principal inputs that go into the production of milk. A number of genetic and non-genetic factors influence milk production. Important genetic factors are type of breed of the animal and ability for milk secretion by individual animals. The important non-genetic factors include quality of feed and fodder, labour, order of lactation, stage of lactation, etc. To realise maximum returns from milk production, all the scarce resources must be used optimally.

Milk production has been estimated by using Cobb-Douglas Production Function, for milking cross-bred cattle and buffaloes on rural dairy farms and milking cattle on peri-urban dairy farms using expenditure on feeds, and fodders, labour cost, and miscellaneous expenditure on dairying as explanatory variables. The study revealed that green fodder and concentrates have shown positive and significant effect on milk production in case of cross-bred cattle on rural dairy farms. Green fodder has turned out to be underutilised on rural dairy farms. There is scope to increase milk production by feeding more green fodder to the cross-bred cattle in rural dairy farms. Concentrates were optimally utilised on both the rural and peri-urban dairy farms. During the scarcity period of green fodder, the peri-urban dairy farmers were following the practice of making silage themselves; rural dairy farmers may also be encouraged to prepare silage during abundance of fodder. The findings of this review corroborate the findings of the present study of the researcher.

Analysis of Cost-Benefit Profile

Cost-Benefit analysis of dairy operations in value terms in the three districts covers three categories of buffaloes, five categories of respondents, and the overall picture. The cost is divided into fixed, variable, and total cost. Fixed cost covers depreciation on the cost of buffaloes and shed, and interest on fixed capital. Variable cost covers fodder cost, concentrates cost, labour cost, milk transport cost for milk from house to milk centre, and healthcare cost. Output values have been worked out for milk yield per animal per annum, calf, milk products, and manure. Difference between gross income (GI) and total cost (TC) gives net profit (NP). CB ratio has also been worked out from GI, and TC, using the formula GI ÷ TC. Table 3 presents the details in respect of three categories of buffaloes, and in each of them, three districts and five categories of respondents.

Table 3 : Cost-Profit Profile for Milk Production in Three Districts by Category of Buffaloes and Households

(Value in ₹ per buffalo per annum; CB is a ratio)

Households	CB Profile	Murrah Breed			Graded Murrah			Non-Descriptive		
		Guntur	Nalgonda	Kurnool	Guntur	Nalgonda	Kurnool	Guntur	Nalgonda	Kurnool
AL	TC	10,865	23,443	13,340	15,273	13,673	13,931	14,459	15,146	19,301
	GI	27,848	29,087	25,875	28,780	25,715	33,254	20,890	19,657	22,883
	NP	16,983	5,644	12,535	13,507	12,042	19,323	6,431	4,511	3,582
	CBR	2.6:1	1.2:1	1.9:1	1.9:1	1.9:1	2.4:1	1.4:1	1.2:1	1.2:1
MF-1	TC	19,600	16,556	13,736	16,283	13,246	18,305	12,489	13,328	13,739
	GI	29,697	30,487	34,127	28,780	36,143	31,076	21,332	19,235	21,167
	NP	10,097	13,931	20,391	13,507	22,897	12,771	8,843	5,907	7,428
	CBR	1.5:1	1.8:1	2.5:1	1.8:1	2.7:1	1.7:1	1.7:1	1.4:1	1.5:1
SF	TC	22,409	15,852	-	17,168	9,369	12,646	15,865	11,435	16,445
	GI	33,938	34,381	-	29,676	25,795	25,539	18,282	16,699	18,631
	NP	11,529	18,529	-	12,508	16,426	12,893	2,417	5,264	2,186
	CBR	1.5:1	2.2:1	-	1.7:1	2.8:1	2.0:1	1.2:1	1.5:1	1.1:1
SMF	TC	22,400	18,876	8,383	17,343	18,529	13,450	21,383	23,291	15,644
	GI	32,732	27,554	11,100	30,753	27,344	23,842	21,340	18,105	19,691
	NP	10,332	8,678	2,717	13,410	8,815	10,392	-43	-5,186	4,047
	CBR	1.5:1	1.5:1	1.3:1	1.8:1	1.5:1	1.8:1	1.0:1	0.8:1	1.3:1
MF-2	TC	20,878	18,301	-	15,561	13,006	11,096	18,654	21,245	12,964
	GI	35,434	27,720	-	38,086	22,240	25,108	21,244	17,219	16,662
	NP	14,556	9,419	-	22,525	9,234	14,012	2,590	-4,026	3,698
	CBR	1.7:1	1.5:1	-	2.4:1	1.7:1	2.3:1	1.1:1	0.8:1	1.3:1

Note: TC: Total Cost, GI: Gross Income, NP: Net Profit, CBR: Cost-Benefit Ratio

Source: Computed from primary data.

The overall Cost Benefit Ratio for the three districts in the three categories of buffaloes along with the range of ratios for various categories of respondents is presented in a summarised form in Table 4.

Table 4 : Overall Picture of CB Ratio for Three Districts, Buffalo Category–wise

District	Murrah Breed		Graded Murrah		Non-Descriptive	
	Overall	Range	Overall	Range	Overall	Range
Guntur	1.66	1.46 – 2.56	1.86	1.73 – 2.44	1.24	0.99 – 1.71
Nalgonda	1.60	1.24 – 2.16	2.02	1.47 – 2.75	1.07	0.77 – 1.46
Kurnool	2.00	1.32 – 2.48	1.99	1.69 – 2.38	1.26	1.13 – 1.54

Source: Computed from primary data.

Table 4 reveals that graded murrah benefited milk producers to a greater extent than the other two categories. Non-descriptive category gives the lowest ratio. Murrah breed has given the result lower than that of graded murrah in two districts and close to it in case of one district. Analysis category–wise (Table 3) reveals as follows: in Guntur for murrah breed, AL received a better result compared to the other categories; for graded murrah, MF-2 received a better result; and for non-descriptive, MF-1 received a better result. In case of Nalgonda, for all the three categories of buffaloes, the result of SF is better. The overall picture for all respondents reveals better performance for graded murrah. In case of Kurnool, for murrah breed which received the best CB ratio among the three districts, the result of MF-1 is better; for graded murrah AL followed by MF-2 received a better result; and in case of non-descriptive, MF-1 received a better result.

Analysis of GI, TC, NP and CB ratio district-wise, buffalo category-wise, and households category-wise reveals as follows: In Guntur, income and cost are the highest for murrah breed buffalo; next comes graded murrah buffalo; and the third is non-descriptive buffalo, which stands the lowest. The same pattern holds good for Nalgonda for all the three categories of buffaloes. However, in respect of Kurnool, income, cost and net profit for graded murrah are higher than those of murrah breed; and for non-descriptive buffaloes, the result is the lowest for all categories of respondents. For graded murrah buffalo, the overall CB ratio in all the three districts shows better performance (1.9, 2.0, and 2.0 in Guntur, Nalgonda and Kurnool districts, respectively). In Guntur, for AL the ratio is 1.9 and for MF-2 2.4. In Nalgonda, the ratio is 2.8 for SF, 2.7 for MF-1, and 1.9 for AL. In Kurnool, the ratio is 2.4 for AL, 2.3 for MF-2, and 2.0 for SF. In respect of murrah breed, the overall CB ratio for Kurnool is 2.0, and for MF 2.5. In case of Guntur, the overall ratio is 1.7, for AL 2.6, and for MF-2 1.7; and in case of Nalgonda, the overall ratio is 1.6, for SF 2.2, and for MF-1 1.8. Analysis of costs reveals as follows: the cost of green fodder has been high and that of dry fodder low. Depreciation on the cost of buffaloes and shed occupies bulk of the cost requiring from 37 to 46 per cent in case of Guntur, 35 to 42 per cent in case of Nalgonda, and 29 to

36 per cent in case of Kurnool. Concentrates account for the lowest cost. Labour cost and medical expenditure also account for a very low percentage of TC in all the districts.

The overall analysis of the picture of the three districts reveals that graded murrah yields better results, in view of the higher fat content and better price per litre. In the cost of inputs, green fodder expenditure is quite substantial, and cost of concentrates is quite low in all the districts. Expenditure on labour and healthcare is very low.

Cobb-Douglas (CD) Production Function

To ascertain the input - output relationship in milk production, in three villages and three districts selected for the study, multiple regression analysis was employed. The non-linear model, i.e., CD Production Function was found to be the best fit for the data of this type.

$Y= b_1x_1+b_2x_2+b_3x_3+b_4x_4+b_5x_5+b_6x_6 \ldots. + b_tx_t$

$Y= \log b_1x_1 + \log b_2x_2 + \log b_3x_3 + \log b_4x_4 + \log b_5x_5 + \log b_6x_6 + \ldots.. \log bnxn$

Where

Y= gross returns from milk yield per buffalo per annum in rupees

X_1= cost of green fodder, X_2= cost of dry fodder, X_3 = cost of concentrates, X_4= cost of labour, X_5 = cost of medical expenditure, X_6= transfer cost for milk from home to milk centre

b_1, b_2, b_3, b_4, b_5, b_6 ---- b_n are regression coefficients of the respective variables.

All the variables are tested at 5 per cent level of significance.

In order to draw a comparative picture of the economic aspects of milk production for different species of milch buffaloes based on per day milk production, cost of six inputs (dry fodder, green fodder, concentrates, labour mandays, transfer cost for milk from home to milk centre, and medical expenditure), and revenue from four outputs (milk yield, manure, milk product, and calf) were considered. Multiple regression analysis was constructed for the cost of inputs and value of output. The value of output is the dependent factor, and different input costs are the independent factors.

Results of C-D Production Function

(i) **Murrah Breed Buffaloes:** Input variables proved highly significant are costs of labour, green fodder, dry fodder and concentrates. Medical expense was not considered. For murrah breed buffalo, receptivity in Guntur district is quite good, as the district is agriculturally well advanced. It is less in Nalgonda, and very low in Kurnool district. This high yield and remunerative breed needs to be popularised in these two districts.

(ii) **Graded Murrah Buffaloes:** All the input variables, except expenses on medical proved highly significant. – These are dry fodder, green fodder, concentrates and labour costs. Receptivity for this cross-breed is quite good in Guntur district. Nalgonda comes next where receptivity is lower. In Kurnool, familiarity is very low. This cross-breed variety which is less expensive and yield is better compared to murrah breed needs to be popularised in all

districts of different levels of development, to replace the non-descriptive buffaloes in a phased manner.

(iii) **Non-descriptive Buffaloes:** Popularity of this category of conventional buffalo in the three districts is quite good as dairy households have been rearing this buffalo over the years. In Guntur district, green fodder cost is significant. In Nalgonda district, dry fodder, green fodder, concentrates and labour costs are significant. In Kurnool district, dry fodder, green fodder, and labour costs are significant. Concentrates and medical expenses are not found to be significant. Medical expenses are not significant in all the three districts.

Suggestions

In the light of the findings and conclusion of the study, suggestions regarding measures to be taken by the government and other organisations to make dairying a profitable enterprise are listed here.

1. **Balance Feed and Fodder:** Research should be encouraged on high yield fodder seeds for supply to rural areas. Wastelands are to be developed as fodder grounds through participation of village panchayats. Quality feed concentrates are also to be supplied to the dairy farmers. Institutional support, including cooperative network can be of great help to the dairy farmers in this direction. At present, consumption of concentrates is quite low, as greater emphasis is laid on green fodder. Greater use of concentrates is to be encouraged through easier availability of concentrates and adoption of scientific management practices. The study suggests that milk producers may be encouraged to include protein rich feeds in the ration of their animals. The addition of micro-nutrients like mineral mixture and vitamin supplements in small quantities will improve the milk yield and lactation length of household–bred buffaloes (Mallikarjuna Reddy, R. and S. Subramanyam, 2002).

2. **Popularising Improved Breeds of Buffaloes and Adoption of Scientific Management Practices:** The study revealed that improved breeds of buffaloes are gaining popularity, but the adoption rate is quite low at present. Artificial insemination plays a major role in this direction. Gopala mithra scheme for artificial insemination is being implemented only in one of the three districts covered in the study, namely, Guntur. It should be pursued extensively with the involvement of Bharatiya Agro-Industries Foundation (BAIF) of Pune, which is operating in a number of States, including Andhra Pradesh. Among the improved breeds of murrah breed and graded murrah buffaloes, experience revealed that graded murrah breed has greater advantages. Government has to create awareness among the dairy farmers and agricultural labourers regarding this practice to genetically improve

the quality of breeds of buffaloes. Extension activities, training programmes, awareness camps, and demonstration of improved practices should be given greater importance in dairy development. Adoption of improved breeds and use of scientific management practices may be covered through these services. For improved breeds of animals, application of scientific management practices needs to be substantially improved, as care needed for them is quite high. Liberal credit from institutional sources may be made available to farmers, and livestock insurance may be encouraged. The cooperative network can facilitate these measures in respect of members of dairy farmers. Non-members also may need to be supported with a suitable structure (Aulakh, G.S and Rajbir Singh, 2012 & Ganesh Kumar, B. and Raj Vir Singh, 2008).

3. **Increasing the Herd Size :** Milch stockholding size continues to be an average of one or two buffaloes per household, and in some cases three to four. Stockholdings are to be enlarged through commercial holdings of viable herd size, with credit facility and market access. An intermediate holding size of 5-10 milch buffaloes, handy for the family to manage with household labour is to be encouraged. In addition, commercial dairy farms of a larger size may also be encouraged, as is the practice in States such as Punjab, Gujarat and Maharashtra. Studies which have indicated higher profitability and economies of scale for larger herd size farms/households include Ganesh Kumar, B. et al. (2011), Inderpreet, K. et al. (2010), and NDDB Annual Report 2012-13.

4. **Healthcare :** Disease forecasting, control and eradication measures have to be taken up regularly to provide an efficient animal health care. Immunisation programme must be effectively implemented. For providing veterinary services to dairy farmers, animal health clinics are suggested at suitable locations to serve a cluster of villages.

5. **Milk Procurement Infrastructure and Minimum Support Price for Milk :** Milk procurement infrastructure developed by cooperative and private processors is considered inadequate by milk producers. Facilities such as milk bulk coolers, electronic milk testing facilities need to be created and strengthened; and capacity of milk chilling centres and processing plants may need to be augmented. It is suggested that minimum support price may be fixed for milk of different qualities, as is the practice for agricultural crops at present. Export of dairy products needs encouragement through various incentives as milk production steadily increases (Satyanarayana Kanakala, 2013).

Conclusion

In the light of the increasing demand driven by the growing population, higher income and greater health consciousness, the dairy industry has to record faster growth. Based on the estimates of the National Dairy Development Board (NDDB), demand for milk in the country is likely to

reach 150 million tonnes (MT) by 2017, and 180 MT by 2022 from the level of 132.4 MT in 2013. To cope up with the growing demand, an average increase of 5 MT per annum over the next 10 years is envisaged – doubling of the average incremental rate achieved over the past 15 years. The demand for milk will be propelled due to the increasing middle class population with high disposable income along with the fast changing socio-economic and cultural values and health consciousness.

Millions of agricultural labourers, small and marginal farmers engaged in dairying who own two to three animals, and produce an average of 5 litres of milk per day comprise the critical portion of India's dairy industry. Livestock development in general and dairy development activities in particular are the key components of pro-poor development strategy as livestock distribution is much more equitable than land distribution. Thus, changes in the dairying environment have important implications for the smallholder farmers and for poverty reduction.

The two hypotheses examined in the study are: (i) the dairy sector growth is not significant; & (ii) economic efficiency of the dairy farm is associated with high breed buffaloes. Both of them have been validated through the results of the Composite Andhra Pradesh study as explained earlier.

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