Advantages of Cross-breed Buffalo Milk Production: A Case Study of Andhra Pradesh

GUDIPATI VIJAYUDU

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 advantages of cross-breed buffalo milk production in two villages of different levels of agricultural development in Andhra Pradesh. The districts covered from the two regions are: Guntur and Kurnool. Analysis presented is in respect of three breeds of buffaloes – murrah breed, murrah graded/graded murrah/cross-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.

Keywords: Type of Households, Buffalo Milk, and Inputs & Outputs

1. Introduction

Dairying in India, over the years, has 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 Pattern of Co-operative Dairying, with a three-tier system on co-operative lines at state, district and village levels. The institutional infrastructure developed at different levels has progressively

[1]Dr. Gudipati Vijayudu is an Assistant Professor, Department of Management Studies, NRI Institute of Technology, Visadala Road, Medikondur Mandal, Guntur District, PIN Code: 522 438 (Andhra Pradesh). Address for Correspondence: C/o. Madeboina Gopaiah, Uppalapadu Post, Veldurthy Mandal, Guntur District (Andhra Pradesh), PIN Code: 522 613. Mobile Nos. 99638 36159, 94405 22007, e-mail: vijaygudipati607@gmail.com

eliminated middlemen, enabling interface of producers with processors. Co-operatives 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 co-operative societies at the village level; these village level co-operatives are organised into a district level union; the district level unions federate into a state level co-operative organisation. At the national level, the National Co-operative Dairy Federation of India (NCDFI) coordinates the efforts of all state level co-operative 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 co-operative 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 deals with advantages of Graded Murrah/ Murrah Graded/Cross-breed Buffalo milk production: A Case Study of Andhra Pradesh. The results of the case study on advantages of Graded Murrah buffalo milk production in two districts of Andhra Pradesh - Guntur from the Coastal Andhra region and Kurnool from Rayalaseema region are presented in the paper. Coastal Andhra and Rayalaseema regions covering 13 districts constitute the present Andhra Pradesh State, after the state bifurcation on June 2nd, 2014, and the entire Telangana region covering 10 districts is now called Telangana State. Hyderabad is the joint capital for a period not exceeding ten years. Government of Andhra Pradesh plans to build a new capital, known as Amaravati, as a river front city on the banks of rives krishna. This city falls in Guntur district. The area identified as capital region governed by Capital Region Development Authority (CRDA) cuts across Krishna and Guntur districts. Vijayawada and Guntur are the major cities close to Amaravati.

2. Status of Milk Production in the Country

India has the distinction of being the largest producer of milk in the world with 132.4 million tonnes (MT), 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 production is 17.4 per cent in 2013, as compared to USA of 11.7 per cent, and China of 6.1 per cent. 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 289.3 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 (Table 1). 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. 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 graded murrah/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. 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 289.3 gms/day. Andhra Pradesh ranks sixth (391 gms/day), with annual growth rate of 7.8% during 2007-12, the highest among States in the growth rate, as against the all India average of 3.6%. 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% of milk, and 4% is contributed by others (Balamuniswamy *et al.*, 2013).

Graded Murrah/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-breed 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. And these 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 (Rajesh Kumar *et al*, 2011). 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. Year-wise milk production, annual growth rate, and CAGR for 2000 - 13 are given in Table 1.

Table 1. **Milk Production in India**

(Quantity in million tonnes)

Year	Production	Annual Growth (%)
2000-01	80.6	4.0
2005-06	97.1	5.0
2007-08	107.9	5.2
2009-10	116.4	3.7
2010-11	121.8	4.6
2011-12	127.9	5.0
2012-13	132.4	3.5
Period	**CAGR (%)**	
2000-01 to 2007-08	4.3	
2007-08 to 2012-13	4.2	

Source: www.nddb.org

3. Statement of the Problem

Dairying in India has emerged as a dynamic instrument of socio-economic change which not only provides milk and milk products but also helps in augmenting farm family income, narrowing down the protein gap, providing draught power, meat, hides and skin, horns, bones; manure for crop production, and in earning foreign exchange. In addition to this, there are values related to social and cultural aspects. In dairying, the major cost of milk production or the major component of costs of dairy production is the feed and fodder, which accounts for 35 to 60 per cent of the total cost.

4. Need for the Study

There is a strong need to concentrate on enterprises like animal husbandry, which is considered, to be quite compatible with the prevalent farming systems to form an economically viable mode of production system. Efforts by milk producers to bring down the cost of milk production; particularly by judicious use of concentrates and rearing of high milk potential milch cross-breeds are most desired for improving the profitability in milk production.

Though the economic advantage of dairy farming is well recognised by the farmers in the country, studies on economics of cross-breed buffalo rearing are lacking at present. These kinds of studies will be helpful not only to the dairy farmers in taking rational economic decisions by selecting the economic size and type of herd, and allocating their scarce resources but also serve as useful information for formulation of effective policies for boosting milk production.

5. Objectives and Focus of the Study

The results of the current study presented in the paper focus on the following objectives:

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

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

6. Hypotheses

(i) The dairy sector growth is not significant, and

(ii) Economic efficiency of the dairy farm is associated with cross-breed buffaloes.

7. Review of Studies on Milk Production

The findings of five research studies focusing on various aspects of milk production of buffaloes, cows, and camels are presented in this section. All the studies mentioned here and also references cited in the rest of the paper are included in the references given at the end of the paper.

Chaudhari, P.N *et al.* (2015), in their study of "A Comparison of different methods of sire evaluation for production and reproduction traits of Murrah graded buffaloes", covered 2,522 Graded murrah buffaloes scattered over 50 different villages of AMUL, Anand district of Gujarat State. The data were grouped into different classes based on village clusters (herds), periods (years) of birth and calving, seasons and age at first calving. The objective of the study was to estimate the sire breeding value, and to compare various methods of sire evaluation. The total of 47 villages were clustered into six groups based on village average milk yield with an assumption that the variation in the village milk production average is due to the management practices and resources available within the village receiving random sires. Moreover, on the basis of the prevailing climatic condition, a year was divided into three seasons, viz., winter (November – February), summer (March – June), and Monsoon (July – October) to account for environmental effects at various periods of the year. Buffaloes were assigned to 1 of 4 subclasses based on Age at First Calving (AFC) in months (Age $\leq$ 45, 45 > age $\leq$ 60, 60 > age $\leq$ 75, and age > 75 months).

The Graded murrah/cross-breeding sire breeding values through different methods were worked out. Heritability estimates by Least Square – Analysis of Variance (LS – ANOVA) method were 0.252 ± 0.044, 0.065 ± 0.032 and 0.073 ± 0.035, respectively for AFC, First Lactation Milk Yield305 (FMY305) and fat%. The genetic correlation of AFC with First Lactation Predicted Milk

Yield305 (FLY305) and fat% were – 0.782 ± 0.192 and – 0.451, respectively while the same between FLY305 and fat percent was 1.044 ± 0.39.

The phenotypic correlations of FLY305 with fat% and AFC were -0.042 and 0.109, respectively while the same between fat% and AFC was -0.099. For AFC, the AIREML (Average Information Restricted Maximum Likelihood) had the lowest error variance than LS (Least Squares), BLUP (Best Linear Unbiased Prediction), thus was the most efficient method. The relative accuracies in terms of rank correlations of D (Daughter's average), CC (Contemporary Comparison), LS, and BLUP method with most efficient AIREML method were 0.35, 0.90, 0.37 and 0.97, respectively for AFC. For FLY305, the value of rank correlations of D, CC, LS and AIREML with the most efficient BLUP method were 0.71, 0.71, 0.72 and 0.98, respectively. The values of rank correlations of D, CC, LS and AIREML with the most efficient BLUP method were 0.89, 0.89, 0.95 and 0.99, respectively. Generally the maximum number of sires is common for BLUP and AIREML methods for AFC, fat% and FLY305 indicating both BLUP and AIREML methods are the most competent methods for sire evaluation for field progeny testing programme.

Jaydeep Yoganandi *et al.* (2015), in their study of "Comparison of fat and SNF contents of camel milk with cow and buffalo milk", analysed 144 samples of milk of camel, cow and buffalo for fat and solid-not-fat (SNF) contents. Camel milk is an important source of food for people living in arid areas. Camel milk is also known for its medicinal properties. Camel population in Gujarat was reported to be 38,454 in 2007. Movement has been initiated to adopt camel milk on a commercial scale by the organised diary sector, especially in Kutch district of Gujarat. In this study, characteristics of camel milk are compared with those of cow milk and buffalo milk. Samples of camel milk were collected from Anand and Kheda districts, and Kutch district of Gujarat. Cow and buffalo milk samples were collected from the local herd maintained in villages near Anand.

Among camel milks from the two regions, milk collected from Anand and Kheda had more fat (4.35 ± 0.11) than that of Kutch sample (2.92 ± 0.16). The difference in fat content of camel milk (Anand and Kheda) and that of cow milk (4.65 ± 0.08)was statistically non-significant, whereas fat content of camel milk (Kutch) and that of cow milk was statistically significant ($P < 0.05$). The difference in fat content of both the camel milks, i.e., Anand and Kheda and that of the Kutch was also statistically significant. The fat content of both camel milks was statistically significant ($P < 0.05$) when compared to that of buffalo milk (6.57 ± 0.20).

Among camel milks, milk collected from Anand and Kheda had more SNF (7.53 ± 0.09) than that of Kutch (7.03 ± 0.14) which was statistically

significant ($P < 0.05$). The difference in SNF content of camel milk (Anand and Kheda) and that of the cow milk (8.39 ± 0.06) was statistically significant. Moreover, the SNF content of camel milk (Kutch) and that of the cow milk was also statistically significant ($P < 0.05$). The difference in SNF content of both the camel milks, i.e., Anand and Kheda, and that of the Kutch was statistically significant ($P < 0.05$). The SNF content of both camel milks was statistically significant ($P < 0.05$) when compared to that of buffalo milk (8.97 ± 0.08). The camel milk (both from Anand and Kheda, and Kutch districts) had lower fat and SNF contents compared to that of cow and buffalo milk. However, fat percent of camel milk (from Anand and Kheda) was non-significant compared to that of cow milk. Among camel milks, milk collected from Kutch district had lower fat and SNF content than that of Anand and Kheda districts. The analysis attempted in this study will be useful in formulating and developing various standards on milk especially of milk fat and milk solid-not-fat for camel, cow and buffalo milk by the policy makers. This will also be useful in product formulation.

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. Co-operative 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 a 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 Rs.19.6 and Rs.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 co-operative members and non-members, while low price of liquid milk was the major marketing constraint for co-operative members, and delay in payment by unorganised sector was the major constraint for non-members. Steps may be taken to strengthen the co-operative 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 Rs.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 Rs.12.5, Rs.12.6 and Rs.11.5, respectively. The net return over cost per litre of cow milk produced was Rs.2.2. All farms were financially viable earning a net profit of Rs.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.

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% beneficiaries and 50% 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.

8. Methodology

For the study of advantages of graded murra-breed/cross-breed buffalo milk production, a sample of 275 dairy households from two districts of Andhra Pradesh was covered through a multi-stage random and purposive selection process. Initially, two districts having the maximum number of three categories of milch buffaloes, namely, murrah breed, cross-breed, and non-descriptive adult buffaloes in each of the two regions of Coastal Andhra and Rayalaseema of the State were identified. After that one mandal each, with the largest milch buffalo population in those districts, and subsequently one village each with the largest milch buffalo population in the mandals were specified. The criterion for selection of the study area is, thus, the area having the largest population of three categories of milch buffaloes. The villages selected are Peteru in Repalle mandal of Guntur district (Coastal Andhra region), and Chapirevula in Nandyal mandal of Kurnool district (Rayalaseema region).

The 275 dairy households are classified into five categories: Along with the number and percentage, these are: Agriculture Labour (AL) 60 (21.8%), Marginal Farmer (MF-1) 60 (21.8%), Small Farmer (SF) 57 (20.8%), Semi-medium Farmer (SMF) 51 (18.5%), and Medium Farmer (MF-2) 47 (17.1%) (Large farmers are not available in the study region). 275 respondents owned 358 milch buffaloes of three categories: murrah breed 39 (10.9%), graded murrah/cross-breed 103 (28.8%), and non-descriptive/desi buffaloes 216 (60.3%). Among the statistical techniques applied, mention many be made of the following: Cobb-Douglas Production Function (CDPF), Chi-square ($\div^2$) test goodness-of-fit, and test of significance. Other techniques used are input - output analysis and cost-benefit ratio. Compound annual growth rate (CAGR) and annual growth rate have also been worked out. These were carried out for a number of features utilising the SPSS (Statistical Package for Social Sciences) 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.

9. Results and Discussion

9.1 Application of Chi-square Test and Test of significance

Chi-square ($\div^2$) 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 $\div^2$ 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.

10. Cobb-Douglas (CD) Production Function

To ascertain the input - output relationship in milk production, in two villages and two 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.

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

$$Y= \log b_1 x_1 + \log b_2 x_2 +\log b_3x_3 + \log b_4x_4+\log b_5x_5+\log b_6x_6+\ldots.. \log b_nx_n$$

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, X6= 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 man days, 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.

10.1 **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 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. 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 two districts is quite good as dairy households have been rearing this buffalo over the years. In Guntur district, green fodder cost is 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 both the districts.

11. **Input - Output Analysis**

Table 2. **Input - Output Relation, Category of Buffaloes and Households in two districts**
(Quantity in quintals per buffalo per annum)

HouseHolds	Input & Output	Murrah Breed		Graded Murrah		Non-Descriptive	
		Guntur	Kurnool	Guntur	Kurnool	Guntur	Kurnool
1	2	3	4	5	6	7	8
AL	DF	13	18	18	13	18	15
	GF	24	34	38	32	27	51
	CT	1.4	4.5	2.0	2.2	2.0	2.0
	MR	28	33	30	29	29	37
	MY(Ltr)	1,492	1,680	1,352	1,772	957	1,090
	Calf	1	1	1	1	1	1
	MP (B-kgs)	-	-	-	-	-	5.0
MF-1	DF	27	21	19	17	17	14
	GF	80	36	48	34	40	32

	CT	3.0	5.0	2.0	6.0	2.2	3.5
	MR	34	30	30	31	24	28
	MY(Ltr)	1,756	1,820	1,313	1,879	1,025	1,163
	Calf	1	1	1	1	1	1
	MP (B-kgs)	-	-	-	-	-	-
SF	DF	25	-	17	19	16	12
	GF	75	-	60	27	49	34
	CT	3.8	-	4.0	2.1	3.0	2.3
	MR	44	-	38	32	32	40
	MY(Ltr)	1,924	-	1,440	1,491	969	993
	Calf	1	-	1	1	1	1
	MP (B-kgs)	-	-	-	-	-	-
SMF	DF	35	15	19	20	30	21
	GF	34	-	27	41	45	54
	CT	4.3	-	4.8	2.3	3.6	2.4
	MR	47	20	35	53	40	58
	MY(Ltr)	2,145	640	1,614	1,267	1,045	996
	Calf	1	1	1	1	1	1
	MP (B-kgs)	-	-	-	-	-	-
MF-2	DF	21	-	21	20	25	22
	GF	23	-	39	18	38	30
	CT	4.0	-	3.0	2.0	3.0	2.1
	MR	41	-	40	23	34	31
	MY(Ltr)	1,818	-	1,410	1,202	988	856
	Calf	1	-	1	1	1	1
	MP (B-kgs)	-	-	-	-	-	-

Note: Inputs in quintals are - DF: Dry Fodder, GF: Green Fodder, CT: Concentrates (rice bran, groundnut oil cake, horse gram bran etc..); and outputs are -MR: Manure in quintals, MY: Milk Yield in litres (Ltr), MP: Milk Product, B: butter (kgs), and Calf.

Source: Computed from Primary data.

Table 2 presents the results of input-output analysis of milk production in respect of three types of buffaloes, district-wise and households category-wise. Results in respect of category of households are as follows: In Guntur in case of Murrah breed 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 per annum per buffalo (Tables 3&4). 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 man days is the highest in case of AL.

Table 3. **Overall Input – Output Relation, & Buffalo Category-wise in two Districts**

(Quantity in quintals per buffalo per annum)

District	Input & Output	Murrah Breed buffalo		Graded Murrah buffalo		Non-Descriptive buffalo	
		Overall	Range	Overall	Range	Overall	Range
1	2	3	4	5	6	7	8
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
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 3 reveal that the milk yield per animal per annum is the highest in Murrah breed buffaloes in 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 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 both the districts.

Table 4. **CBR for Milk Production in two Districts by Category of Buffaloes**

(Value in Rs. per buffalo per annum)

HouseHolds	CBR	Murrah Breed		Graded Murrah		Non-Descriptive	
		Guntur	Kurnool	Guntur	Kurnool	Guntur	Kurnool
1	2	3	4	5	6	7	8
AL	TC	10,865	13,340	15,273	13,931	14,459	19,301
	GI	27,848	25,875	28,780	33,254	20,890	22,883
	NP	16,983	12,535	13,507	19,323	6,431	3,582
	CBR	2.6:1	1.9:1	1.9:1	2.4:1	1.4:1	1.2:1
MF-1	TC	19,600	13,736	16,283	18,305	12,489	13,739
	GI	29,697	34,127	28,780	31,076	21,332	21,167
	NP	10,097	20,391	13,507	12,771	8,843	7,428
	CBR	1.5:1	2.5:1	1.8:1	1.7:1	1.7:1	1.5:1
SF	TC	22,409	-	17,168	12,646	15,865	16,445
	GI	33,938	-	29,676	25,539	18,282	18,631

	NP	11,529	-	12,508	12,893	2,417	2,186
	CBR	1.5:1	-	1.7:1	2.0:1	1.2:1	1.1:1
SMF	TC	22,400	8,383	17,343	13,450	21,383	15,644
	GI	32,732	11,100	30,753	23,842	21,340	19,691
	NP	10,332	2,717	13,410	10,392	-43	4,047
	CBR	1.5:1	1.3:1	1.8:1	1.8:1	1.0:1	1.3:1
MF-2	TC	20,878	-	15,561	11,096	18,654	12,964
	GI	35,434	-	38,086	25,108	21,244	16,662
	NP	14,556	-	22,525	14,012	2,590	3,698
	CBR	1.7:1	-	2.4:1	2.3:1	1.1:1	1.3:1

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

Source: Computed from primary data

Analysis of Table 4 indicating Gross Income (GI), Total Cost (TC), Net Profit (NP) and Cost benefit Ratio (CBR) 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. 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 CBR in all the two districts shows better performance (1.9 and 2.0 in Guntur and Kurnool districts, respectively). In Guntur, for AL, the ratio is 1.9 and for MF-2 2.4. 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 CBR 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. 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, and 29 to 36 per cent in case of Kurnool. Labour cost and medical expenditure also account for a very low percentage of TC in both the districts.

The overall analysis of the picture of both the districts reveals that graded murrah yields better results, in view of the higher fat content and better price per litre. Green fodder expenditure is substantial. It occupies the first place among the feed costs, followed by concentrates and dry fodder in Guntur district. In another district, concentrates occupies the first place, followed by green fodder and dry fodder. Expenditure on labour and medicine is very low. However, green fodder and concentrates have shown positive and significant effect on milk production in case of cross-bred buffalo. There is scope to increase milk production by feeding more green fodders and concentrate to the cross-breed (A similar type of result by Sunil Kumar Singh *et al*, 2011).

The overall results of Cost – Benefit Ratio (CBR) for the two 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 5.

Table 5. **Overall Picture of CBR for two Districts, Buffalo Category–wise**

District	Murrah Breed buffalo		Graded Murrah buffalo		Non-Descriptive buffalo	
	Overall	Range	Overall	Range	Overall	Range
1	2	3	4	5	6	7
Guntur	1.66	1.46 – 2.56	1.86	1.73 – 2.44	1.24	0.99 – 1.71
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 5 presenting CBR reveals that graded murrah has 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 one district, and close to it in case of another district. District-wise CBR analysis household category–wise (Table 4) reveals as follows: in Guntur for murrah breed, AL has received a better result compared to the other categories; for graded murrah, MF-2 has received a better result; and for non-descriptive, MF-1 has received a better result. In case of Kurnool, for murrah breed which has received the best CB ratio among the two districts, the result of MF-1 is better; for graded murrah AL followed by MF-2 and SF have received a better result; and in case of non-descriptive MF-1 has 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. 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 both the districts shows better performance (1.9 and 2.0 in Guntur and Kurnool districts, respectively). In Guntur, for AL the ratio is 1.9 and for MF-2 2.4. 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. 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 37 to 46 per cent in case of Guntur, 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 two 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 both the districts. Expenditure on labour and healthcare is very low.

12. 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.

12.1 Balance feed and fodder

Research should be encouraged on high yield fodder seeds for supply to rural areas. Waste lands 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 co-operative 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).*

12.2 Popularising improved breeds of buffaloes and adoption of scientific management practices

The study has 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 Guntur district. 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 has 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 co-operative network can facilitate these measures in respect of member 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).*

12.3 **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.*

12.4 **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.

12.5 **Milk Procurement Infrastructure and Minimum Support Price for Milk**

Milk procurement infrastructure developed by co-operative 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 *(Satynarayana Kanakala, 2013).*

13. 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 Andhra Pradesh study as explained earlier.

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