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# Optimum Herd Size, Income and Employment Potential of Common Buffalo Breeds in Ranga Reddy District of Andhra Pradesh

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## INTRODUCTION

Optimum herd size (OHS) emphasises the need to maintain the right number of animals and the right breed keeping in consonance with the resource endowments of the farmer. The poor economic status of the farmer acts as a formidable constraint on acquiring and managing milch animals. Hence the farmer must be extremely careful and cautious in deciding the number of milch animals. High milch yielding breeds of buffaloes would be preferred in the place of local breeds which are less productive.

In this direction the study was conducted with the specific objectives to: (i) determine optimum herd size (OHS) for different size-groups of the selected farmers and (ii) assess the income and employment potential of buffaloes in the existing and alternate farm situations.

## METHODOLOGY

Ranga Reddy district located in the semi-arid tropical zone of Andhra Pradesh was identified and selected for the study purposively. Secondary data was collected from Livestock Census, mandal and village revenue records for assessing the buffalo population. Primary data was collected by conducting personal interview with the farmers of Ranga Reddy district. Stratified random sampling technique was used for the selection of mandals, villages, dairy farmers, inhabiting the Ranga Reddy district. Four mandals namely, Uppal, Rajendranagar, Maheshwaram and Hayathnagar were selected at the rate of four villages per each mandal at random. Thus sixteen villages namely viz., Boduppal, Peergadiguda, Medipally and Mallikarjunagar from Uppal, Monkhol, Habsiguda, Srinagar and Imamguda from Maheshwaram, Sivarampally, Budwel, Narsingi and Mylardevpally from Rajendrangar and Kutubullahpur, Kuntlur, Torrur and Koheda from Hayathnagar were selected randomly for the study. The size groups were classified into five categories, landless, marginal (less than 1 ha.), small (1-2 ha.), medium (2-10 ha.) and large (10 ha. and above) according to the Agricultural Census 1976-77 based on size of the holding.

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During the course of the study there arose a difficulty in getting sufficient number of dairy farmers in the semi-medium (2 to 4 ha.) and medium groups (4 to 10 ha.). Hence the two groups were combined to form medium size group namely 2 to 10 ha. The total number of farmers accounted for 240 belonging to five different size groups drawn from four mandals i.e. 60 farmers per mandal, or 15 farmers per village were selected from 16 villages making a total of 240 farmers.

*Analytical Framework*

*Linear Programming: Optimum Herd Size*

Further, in order to derive the optimum dairy herd size and the pattern of income and employment the linear programming technique was employed as adopted by Kahlon *et al.* (1975), Sardana and Panghal (1984) and Kirke and Moss (1987).

LP technique was employed as the analytical tool to specify the optimum herd size in each category of dairy farmers. It was formulated as given below.

*Objective Function*: The maximisation of income is the objective function. The model has 13 activities and 9 constraints. The LP model specifying the optimum herd size is as follows:

$$\text{Max } Z = \sum_{j=1}^{n} C_j X_j$$

$$\sum_{j=1}^{n} \text{lij } X_j \leq L_i \text{ (land constraint),}$$

$$\sum_{j=1}^{n} \text{rij } X_j \leq R_i \text{ (Irrigated area constraint),}$$

$$\sum_{j=1}^{n} \text{sij } X_j \leq F_i \text{ (Fodder area restriction),}$$

$$\sum_{j=1}^{n} \text{sij } X_j \geq A_i \text{ (Minimum area restriction for green fodder),}$$

$$\sum_{j=1}^{n} \text{kij } X_j \leq K_i \text{ (Working capital constraint),}$$

$$\sum_{j=1}^{n} \text{mij } X_j \leq M_i \text{ (Labour constraint),}$$

$$\sum_{j=1}^{n} \text{gij } X_j \leq G_i \text{ (Green fodder constraint),}$$

$$\sum_{j=1}^{n} \text{dij } X_j \leq D_i \quad \text{(Dry fodder constraint)},$$

$$\sum_{j=1}^{n} \text{qij } X_j \leq Q_i \quad \text{(Concentrates constraint)},$$

$X_j \geq 0$ (non-negative constraint),
for J=1 to n activities,
i = 1 to m resources.

where,

$c_j$ = Net profit per unit of activity j.
$x_j$ = j-th activity level. These values will be generated by solving the LP model,
$l_{ij}$ = Area required to produce one kg of fodder grass in j-th activity,
$L_i$ = Area available for growing fodder grass,
$r_{ij}$ = Area required for producing one unit of paddy (straw) in j-th activity,
$R_i$ = Irrigated area available for growing paddy (straw),
$s_{ij}$ = Area required for producing one unit of Napier grass in j-th activity,
$F_i$ = Area available for growing Napier grass,
$k_{ij}$ = Working capital required for maintaining one buffalo in j-th activity,
$K_i$ = Available working capital,
$m_{ij}$ = The number of i-th family labour days required for maintaining one buffalo in j-th activity,
$M_i$ = The number of family labour days available with the farmers,
$g_{ij}$ = Green fodder required in kgs for maintaining one milch buffalo in j-th activity,
$G_i$ = Green fodder available with the farmer,
$d_{ij}$ = The quantity of dry fodder required to maintain one milch animal in j-th activity,
$D_i$ = Total quantity of dry fodder available with the farmer,
$q_{ij}$ = The quantity of concentrates required for maintaining one milch buffalo in j-th activity,
$Q_i$ = The total quantity of concentrate available with the farmer.

*Land constraint ($L_i$)*: This constraint relates to the land available for raising green fodders like para grass, Napier grass and grain crops like paddy and jowar. This is incorporated in the programming as per the procedure described hereunder.

Firstly, the average area under the cultivation of paddy and jowar during the period of study 1990-91 was calculated. Based on the proportion of by-product and main product in the total income, the area available exclusively for raising fodder grass is calculated. The area thus apportioned for by-product is treated as the available area for raising fodder. This procedure is applied for both paddy and jowar and their sum is treated as the total land available for raising fodders. It may be

mentioned here that paddy and jowar are the only fodders raised by the dairy farmers of the study region.

*Irrigated area restriction ($R_i$):* Since paddy is grown under irrigated conditions, the total area under paddy is apportioned separately for fodder and grain purposes as per the procedure stated earlier and the area allocation for fodder is treated as the irrigated area restriction.

*Seasonal restriction for fodder ($F_i$)*: Since paddy is grown in both the seasons and jowar is grown in *kharif* season only in the study region, the total available area in each season is first calculated and their sum is treated as the seasonal restriction for fodder.

*Minimum area restriction for green fodder ($A_i$)*: A minimum of 0.25 acres is treated as the minimum area requirement for raising green fodder like paragrass for maintaining one milch buffalo.

*Working capital constraint ($K_i$)*: The costs required to maintain one milch buffalo per annum is treated as the working capital constraint.

*Labour constraint ($M_i$)*: The number of family labour days required to maintain one milch animal is treated as labour constraint.

*Green fodder constraint ($G_i$):* Based on the Morrisson standards, the intake of 8 kg, 12 kg and 15 kg is treated as the requirement of green fodder per animal per day respectively for local, graded and murrah buffaloes.

*Dry fodder constraint ($D_i$):* A minimum dose of 3 kgs per day per milch buffalo irrespective of the breed is treated as the requirement of dry fodder for maintenance.

*Concentrate constraint ($Q_i$):* A minimum quantity of 2 kg of concentrates per day per milch buffalo irrespective of the breed is treated as the standard requirement of concentrates for maintenance.

In the absence of reliable data, information and standards, averages were considered for the study area based on the local practices, i.e., 3 kg dry fodder and 2 kg concentrate per animal per day.

for i = 1, 2 ……n activities, j = 1, 2 …….m activity levels.

The model is applied separately to different size-groups of dairy farmers namely landless, marginal, small, medium and large to determine the optimum herd size.

## RESULTS AND DISCUSSION

### *Determination of Optimum Herd Size, Income and Employment*

As stated earlier the determination of optimum herd size, income and employment from dairy farming for different size-groups of dairy farmers was attempted through the linear programming technique. The objective of linear programming is maximisation of net income subject to certain constraints on feeds, maintenance costs, labour utilisation, etc.

Table 1 presents the comparison of existing and optimal situations of dairy farming for the various sizes of operational holdings with reference to optimum herd size, income and employment.

*Optimum Herd Size*

The number of milch buffaloes for maintenance under both existing and optimal situations are presented breedwise and for each size-group in Table 1. While the existing situation reveals that at least one local buffalo is maintained on an average by the dairy farmers of each size-group, the optimal situation does not suggest any local buffalo to be included in the herd size. In the case of the graded milch buffaloes, the existing situation reveals at least one milch animal for size-groups landless, medium and large and 3 and 4 milch animals respectively in marginal and small size-groups. The optimal situation suggests no graded milch buffaloes in the size-groups (landless, marginal and large) but 2 graded milch buffaloes are suggested for maintenance in each of the size-groups small and medium. In the case of murrah buffalo, the existing situation reveals maintenance of at least one murrah buffalo in each of the size groups. But the optimal situation suggested that it was economical to maintain at least one murrah buffalo in size-groups small and medium and at least two milch buffaloes of murrah breed in the landless, marginal and large size-groups. But the overall situation revealed that the optimum herd size inclusive of all these breeds was 2, 2, 3, 3, 2 animals and milch as against 4, 5, 6, 4 and 4 in the existing situation for landless, marginal, small, medium and large size-groups respectively. It may be mentioned here that the studies of this type conducted earlier by the research workers such as Sardhana and Panghal (1984) in Bhiwani district of Haryana and Rao (1988) reported that two buffaloes would be the optimum herd size. The results are also in agreement with the earlier works in respect of the determination of optimum herd size.

An examination into the existing and optimum situations of herd size reveals some interesting facts. In the existing situation, the number of local buffaloes were found to be 2, 1, 1, 2 and 1 in the landless, marginal, small, medium and large size-groups whereas the optimum situation has totally dropped the maintenance of local buffaloes in all the five size-groups. This goes to prove the fact that local buffaloes are uneconomical due to their low productivity and heavy consumption of feeds and fodders.

With regard to the graded buffalo, the existing situation indicated that 1, 3, 4, 1 and 1 were maintained by the landless, marginal, small, medium and large farmers, whereas the optimum solution recommended graded buffaloes only to the small and medium size-groups at the rate of 2 each and negatived them to the landless, marginal and large groups. This reveals that the small and medium farmers were paying more attention in terms of management to the graded buffaloes maintained on their farms.

In the case of murrah buffaloes the existing situation has shown that one buffalo was being maintained by the landless, marginal, small, medium and large groups.

TABLE 1. COMPARISON OF EXISTING AND OPTIMUM SITUATIONS OF DAIRY FARMING FOR VARIOUS SIZES OF OPERATIONAL HOLDINGS

| | Existing situation | | | | | Optimum situation | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Particulars/sizes | Landless | Marginal | Small | Medium | Large | Landless | Marginal | Small | Medium | Large |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| 1. Herdsize (Number of milch buffaloes) | | | | | | | | | | |
| Local | 1.50 | 1.00 | 1.24 | 1.60 | 1.31 | - | - | - | - | - |
| Graded | 1.00 | 2.50 | 3.70 | 1.00 | 1.00 | - | - | 2.23 | 2.30 | - |
| Murrah | 1.00 | 1.30 | 1.21 | 1.00 | 1.19 | 2.14 | 2.15 | 0.54 | 0.55 | 2.17 |
| Overall | 3.50 | 4.80 | 6.15 | 3.60 | 3.50 | 2.14 | 2.15 | 2.79 | 2.85 | 2.17 |
| 2. (i) Income per day (Rs.) | 14.50 | 33.82 | 47.46 | 12.28 | 11.09 | 49.43 | 72.77 | 63.83 | 19.37 | 28.68 |
| (ii) Income per lactation (Rs.) | 4,350 | 10,146 | 14,238 | 3,684 | 3,327 | 14,829 | 21,831 | 19,149 | 5,811 | 8,604 |
| (iii) Percentage increase over existing situation | - | - | - | - | - | 240.89 | 115.17 | 34.49 | 57.74 | 158.61 |
| 3. (i) Labour employment per day per animal (Number of man-days) | 0.28 | 0.38 | 0.29 | 0.31 | 0.30 | 0.59 | 0.51 | 0.46 | 0.41 | 0.49 |
| (ii) Percentage increase over existing situation | - | - | - | - | - | 110.71 | 34.21 | 170.58 | 32.26 | 63.33 |

But the optimum situation recommended 2, 2, 1, 1 and 2 animals with respect to the landless, marginal, small, medium and large size-groups. A careful study of the above figures suggests that the landless and marginal farmers are dependent on dairy enterprise as the main source of income compared to other groups. They should pay more attention to the management of these high-yielding and productive animals compared to the local and graded breeds of buffaloes. The other three groups namely small, medium and large farmers have to pay equal attention to farming as well as dairying as their business propositions. The recommendation was one murrah buffalo for the small and medium farmers and 2 for the large farmers. The large farmers were in a position to hire labour to look after the maintenance of the heavy milch yielder, the murrah buffalo.

The overall situation in the optimum plan irrespective of breed suggests 2, 2, 3, 3 and 2 buffaloes to the landless, marginal, small, medium and large farmers. This signifies the importance of dairy enterprise on all size-groups, more so in the context of the study area which represents a typical mixed farming situation.

*Income and Employment*

*Income:* The incomes realised from dairy faming under the existing situation (Table 1) were Rs. 14.50, 33.82, 47.46, 12.28 and 11.09 per day for the landless, marginal, small, medium and large size-groups respectively under the existing situation, while it was Rs. 49.43, 72.77, 63.83, 19.37 and 28.68 under the optimal situation for the corresponding size-groups of farms in the same order as indicated above. When the income per lactation was considered, it was Rs. 4,350, Rs. 10,146, Rs. 14,238, Rs. 3,684 and Rs. 3,327 under the existing situation, while it was Rs. 14,829, Rs. 21,831, Rs. 19,149, Rs. 5,811 and Rs. 8,604 under the optimal situation. These results imply that the income under the optimal situation was more than three times for the landless size-group, more than double for the marginal size-group, nearly one and half times more for the small and medium groups and more than two and half times for the large size-group.

But when the income under the optimal situation was considered in terms of percentage increase over the existing situation, it was found that the increase in incomes was 240.89 per cent, 115.17 per cent, 34.49 per cent, 57.74 per cent and 158.61 per cent for the landless, marginal, small, medium and large size-groups respectively. Thus, when a comparison is made among different size-groups, the optimal situation shows maximum gains to the landless size-group and the minimum gain to the small size-group, while the large, marginal and medium size-groups occupy the second, third and fourth places respectively, in terms of the per cent of income gains through optimisation.

*Employment:* The existing and optimal situations with reference to employment using linear programming are presented in Table 1. The existing situation reveals that the employment per day per animal in terms of the number of man-days was 0.28, 0.38, 0.29, 0.31 and 0.30 for the landless, marginal, small, medium and large size-

groups respectively, while the optimum situation shows that they are 0.59, 0.51, 0.46, 0.41 and 0.49 in the order indicated. It could be observed that the employment was more than double in the landless size-group, nearly one and half times in the other size-groups compared to the existing situation. The percentage increase over the existing situation was found to be 110.71 per cent, 34.21 per cent, 170.58 per cent, 32.26 per cent and 63.33 per cent respectively for the landless, marginal, small, medium and large size-groups. These results suggest that the employment potential in the dairy economy under consideration was maximum in the small size-group and minimum in the medium size-group, while the landless, large and marginal size-groups occupy the second, third and fourth positions respectively.

The results revealed that the optimum herd size inclusive of all the three breeds was 2, 2, 3, 3 and 2 as against the 4, 5, 6, 4 and 4 in the existing situation for the size-groups landless (I), marginal (II), small (III), medium (IV) and large (V) farms respectively. The income realised from dairy farming under the existing situation was Rs. 14.50, Rs. 33.82, Rs. 47.46, Rs. 12.28 and Rs. 11.09 per day for the landless, marginal, small, medium and large size-groups respectively, while it was Rs. 49.43, Rs. 72.77, Rs. 63.83, Rs. 19.37 and Rs. 28.68 under optimal situation for the above groups. The employment per day per animal in terms of number of man-days under the existing situation was 0.28, 0.38, 0.29, 0.31 and 0.30, while it was 0.59, 0.51, 0.46, 0.41 and 0.49 in the optimum situation for the landless, marginal, small, medium and large size-groups respectively.

## POLICY IMPLICATIONS

To arrive at sensible policy decisions in a more meaningful way an opinion survey was conducted including all the 240 milk producers and their views and needs were ascertained and these are presented below:

Deciding on the optimum herd size is really an intriguing question. The present study has arrived at some possible solutions and clues in deciding the number of animals to be kept by the landless, marginal, small, medium and large groups of farmers. The present study revealed that feed costs are very high and are beyond the reach of the poor dairy farmers, though enterprising. The government along with the private sector undertakings which are involved in the production of animal feeds should gear up the production of feeds to meet the additional demand.

During the course of the study it was found out that buffaloes were preferred to cows. Graded buffaloes outnumbered the local and murrah buffaloes in the composition of a dairy farm. The cost of graded and murrah buffaloes was observed to be prohibitive in the study area and good milch animals were not within the reach of the landless, marginal and small farmers cost-wise. The income of the dairy farmers was found to be highest on small dairy farms, followed by marginal, landless, medium and large farmers. This reflects that dairying is more remunerative and profitable on small and marginal dairy units. It is felt that Amul type dairy co-

operatives should be tried in Andhra Pradesh for promoting the dairy sector. And finally this study will be of great help to policy makers at the macro level in deciding the optimum herd size to the above groups in poverty alleviation programmes like Integrated Rural Development Programme (IRDP), Small Farmers' Development Agency (SFDA), Marginal Farmers and Agricultural Labourers Development Agency (MFALA), etc. Since dairying was found to be a capital intensive enterprise, institutional financial assistance may be stepped up. Dairying may be made as one of the most important activities under IRDP programmes. Landless labourers, marginal and small farmers may be given priority in extending the financial assistance not only to purchase the milch animals but also in maintaining them.

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REFERENCES

Kahlon, A.S.; K.C. Dhawan and G.S. Gill (1975), "Relative Profitability of Dairy Enterprise Vis-à-Vis Crop Cultivation in the Punjab", *Indian Journal of Agricultural Economics*, Vol. 30, No. 3, July-September, pp. 120-128.

Kirke, A.W. and J.E. Moss (1987), "A Linear Programming Study of Family Run Dairy Farms in Northern Ireland", *Journal of Agricultural Economics*, Vol. 38, pp. 97-105.

Rao (1988), "Scope of Institutional Financing in Promoting Dairy Farming with Buffaloes", *Indian Journal of Animal Production and Management*, Vol. 4, Nos. 3 and 4, pp. 139-143.

Sardhana, P.K. and B.S. Panghal (1984), "Prospects of Increasing the Income and Employment on Small Farms through Dairying", *Indian Journal of Dairy Science*, Vol. 37, No. 3, pp. 187-192.