Analysis of factors affecting the dairy cattle holding in drought prone areas: A study of Raichur district of Karnataka

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Abstract The dairy farming system enhances sustainable livelihood of farmers in drought prone area as it has been known as one of the activities aimed at alleviating poverty, unemployment, and nutritional related problems especially in rural areas of drought prone area. Karnataka stands next only to Rajasthan in India in terms of total geographical area prone to drought and Raichur district comes under severely affected category. Therefore, it becomes imperative to study the factors influencing holding of dairy animals in a drought prone area like Raichur district. A total of 100 dairy farmers were selected and in that 40 from unirrigated and 60 from irrigated area in the study area. Data were analysed using descriptive statistics and multiple regression analysis. The study revealed that the relationship between cropped area and rearing of dairy animals was positive and significant in irrigated area which indicated that existence of strong crop - livestock interaction. The qualitative and quantitative improvement of crop residues assures further improvement of dairy farming. The government should lay special emphasis on supply of dry fodder particularly in unirrigated areas to ensure round the year availability at cheap rates. As off-farm income plays important role in inducing the farmers to hold dairy animals it signifies the importance of successful implementation of welfare schemes like MGNREGA which have spill-over effects like rearing of dairy animals.

Keywords: Dairy cattle holding, drought prone area, multiple linear regression

Introduction

In India, around 68 per cent of the land is prone to drought in varying degrees. 35 per cent of area which receives rainfall between 750 mm and 1125 mm is considered drought prone while 33 per cent receiving less than 750 mm is chronically drought prone. (Government of India, 2000). According to drought prone area programme (DPAP), in 2007, 185 districts and 16 states of the country have been identified as drought prone. In terms of the total geographical area which is drought prone, the state of Karnataka ranks 2nd (14% of the area) and is next only to Rajasthan (20%). Nearly 90 per cent of the population in this semi-arid region is dependent on agriculture for their livelihood. Among its 30 districts, 18 districts were affected by drought and probability of occurrence of drought in Karnataka is once in four years. Karnataka experienced a severe drought for three consecutive years (2001-02, 2002-03 and 2003-04) and 159 taluks/blocks were listed as drought affected. During these periods, the state received 23 per cent of less rainfall (Nagaratna & Sridhar, 2009). The agricultural production declined to 64 lakh tonnes against the target of 104.05 lakh tones and the availability of crop residues for livestock was substantially low (GoK, 2003). The intensive drought had put most of the farmers in the state to the precarious situation leading to the migration to the nearby towns and cities besides high rainfall areas to work labourer in coffee and tea estates. The share of agriculture in state GDP declined by 3.5 per cent since 2001-02 (Panchamukhi et al., 2008). The promotion of dairy farming in drought prone areas is often justified by the assumption that adopting households will consume more milk; generate employment and more cash income. Milk is a significant source of both energy and protein, including many essential amino acids lacking in carbohydrate-based diets (Huss-Ashmore, 1993). In addition, to the extent that dairy farming increases incomes, households with dairy cattle can afford to purchase more food and a wider variety of foods. This 'income effect' enhances the sustainable livelihood of the rural people in drought prone area.

Livestock plays an important role in drought prone area particularly dairying. About 65 per cent of the rural poor have...
livestock for income and drought insurance in semi-arid tropics of India (Walker and Rayan, 1990). According to Nagaratna and Sridhar (2006), there was severe reduction in the annual income of the respondents during drought year whereas the reduction in income from livestock was less as compared to crops i.e. livestock production is less prone to variation in rainfall and other climatic factors. Livestock sector particularly dairy farming holds a great promise providing income and employment especially in drought prone because it is labour intensive and employment generated is relatively high (Rangnekar, 2004). According to Karmakar and Banerjee (2006), DAIRYING has been considered as one of the activities aimed at alleviating the poverty and unemployment especially in the rural areas in the rain-fed and drought-prone regions as it is considered as a secondary occupation for about 69 per cent of India's farming community. It contributes close to a one third of the gross income of rural households and in the case of those without land, nearly half of their gross income. An estimated 70 million rural households have milch animals of which about 75 per cent are landless, marginal or small farmers. Most of the rural milch owning households own only one to three animals and it is estimated that only around 15 per cent households own more than 4 milch animals (Government of India, 2011). Dairy farming assumes greater relevance in providing drought-proofing and ensuring income and employment and also nutritional security for sustainable rural livelihood (Patel, 1993). Improvement in livestock production is an important for increasing the income of marginal and small farmers and landless labourers, given the uncertainties of crop production. A systemic study was carried out for analysing factors affecting holding of dairy animals in drought prone area of Karnataka as limited literature is available in this area. Despite the drought in the state, milk production has shown increasing trend. Hence this study sought to narrow the existing knowledge gap to this agriculture sub sector (dairy sector) that has potential to improve the sustainable livelihood of rural people in drought prone area.

Materials and Methods

Multi-stage and purposive sampling techniques were adopted for the selection of respondents. A total of 100 dairy farmers were selected and in that 60 from irrigated and 40 unirrigated area were drawn from two randomly selected villages of two randomly selected taluks of Raichur district. The information was obtained through personal interview method on several aspects important for the study such as farming experience; dairy herd size; family members; consumption of milk; quantity of fodder given to dairy animal; access to irrigation; off farm income and cropped area.

Data collected were analysed using descriptive statistics and multiple regression analysis. Studies conducted by Kumar et al. (2007), Mariara (2004), Suresh et al. (2007), Nega et al. (2012) etc. demonstrated the effect of farming experience, cropped area, access to irrigation, access to off farm income, and family size on holding of dairy animals by using multiple regression models. This formed the basis of inclusion of the explanatory variables and also some of based on the general working hypothesis in this study. Herd size was used as a dependent variable (Y) while number of family members, age of household head, consumption of milk, farming experience, cropped area, availability of dry fodder, availability of green fodder, concentrates, access to irrigation and off-farm income were used as explanatory variables. It has been estimated for irrigated and unirrigated area and drought prone area using the same explanatory variables and dependent variable.

The implicit model of the regression was as indicated in the equation below:

\[
Y = \beta_1 F_m + \beta_2 A_h + \beta_3 F_e + \beta_4 D_f + \beta_5 G_f + \beta_6 c_o + \beta_7 A_i r + \beta_8 O_f f _i n c + \beta_9 c_o n _m i l k
\]

Where,

- Y ---- Herd Size (in number)
- Fm ---- Family members (in number)
- A_h ---- Age of the household head (in Years)
- F_e ---- Farming Experience (in years)
- D_f ---- Dry fodder (Kg/day/animal)
- G_f ---- Green fodder (Kg/day/animal)
- c_o ---- Concentrate (Kg/day/animal)
- A_i r ---- Access to irrigation (If =1, otherwise=0)
- O_f f _i n c ---- Off farm income (in Rupees)
- c_o n _m i l k ---- Consumption of milk (in litres)

Three production functions namely linear, Cobb-Douglas and semi-log (linlog and loglin) were tried which are depicted as follows:

**Linear**

\[
Y = a + \sum b_i X_i + \mu
\]

**Cobb Douglas**

\[
Y = a X_i^{b_i}
\]

**Semi log (lin log)**

\[
Y = \ln a + \sum b_i \ln X_i + \mu
\]

**Semi log (log lin)**

\[
\ln Y = a + \sum b_i X_i + \mu
\]

Where,

- Y = Herd size
- X_i = value of ith input used
- a = constant term
- b_i = partial regression coefficient of the ith input to be estimated
- \(\mu\) = Random error distributed normally with zero mean and constant variance.
- e = base of natural log.

The best function was selected on the following economic
and statistical and econometric criteria i.e. the value of coefficient of multiple determinations ($R^2$), significance level of individual regression coefficients, and the ability of the function to provide economically meaningful results. The Cobb-Douglas production function was found best fit for irrigated and unirrigated area and also for drought prone area keeping in the view of the significance, sign of explanatory variable and value of $R^2$.

Before running a multiple regression analysis, the following preliminary tests were carried out on the data;

1. Linearity - the relationships between the predictors and the outcome variables were linear,

2. Normality - the errors were normally distributed,

3. Homogeneity of variance (heteroskedasticity) - the error variance was found to be constant,

4. Independence - the errors associated with one observation were not correlated with the errors of any other observation and,

5. Multicollinearity - predictors were not highly collinear, i.e. linearly related, can cause problem in estimating the regression coefficients.

**Results and Discussion**

The mean of different variables used in the study have been presented in table 1. The table 1 revealed that the average family size was 6.32, 7.23, and 6.77 in irrigated area, unirrigated area, and drought prone area, respectively. The cropped area was maximum in irrigated (16.29 acres) which may be due to better access of water as compare to unirrigated area (9.51 acres) and drought prone area (12.9 acres). The consumption of milk was found maximum in irrigated area (2.20 litres) as compared to unirrigated area (2.04 litres) and drought prone area (2.12 litres). The quantity of green fodder was maximum in irrigated area (12.9 kg/day/animal) as compared to unirrigated area (3.41 kg/day/animal) and drought prone area (4.93 kg/day/animal) which may be due to better access to irrigation facility. The quantity of dry fodder was maximum in unirrigated area (12.9 kg/day/animal) which may be due to the fact that they feed more of same to meet the dry matter requirement as the green fodder was scarcely available. The quantity of concentrates was maximum in irrigated area (12.9 kg/day/animal) as compared to unirrigated area (0.97 kg/day/animal) and drought prone area (1.15 kg/day/animal). The percentage of dairy farmers having access to irrigation was 85 in irrigated area which was expected followed by drought prone area 61.25 and unirrigated area 37.5 and the average off farm income was maximum (`21500) in unirrigated area as farm income is less, unstable, and not available round the year. The term unstable is very much relevant here as study area is drought prone and recurrence of drought causes the crop production to fall drastically leading to decline in employment and income which forces people of these areas towards unskilled work in nearby cities thereby leading to higher off-farm income as compared to irrigated areas (`16150).

The results of selected regression model are presented in the table 2. The family members have been taken as a proxy for availability of labour for rearing of dairying animals by the household. The coefficient of labour is positive and significant for unirrigated area and in case of drought prone area coefficient of family members was positive and significant which indicated that availability of family labour facilitated rearing of dairy animals to meet the requirement of milk in a large family whereas for irrigated area coefficient is positive but insignificant.

The regression coefficient of age of head is positive and significant in unirrigated area which showed that elder head of households were aware of keeping dairy animals whereas

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Irrigated area</th>
<th>Unirrigated area</th>
<th>Drought prone area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family size (in number)</td>
<td>6.32</td>
<td>7.23</td>
<td>6.77</td>
</tr>
<tr>
<td>Age of household head (in years )</td>
<td>45.5</td>
<td>47.2</td>
<td>46.35</td>
</tr>
<tr>
<td>Cropped area (in acre)</td>
<td>16.29</td>
<td>9.51</td>
<td>12.9</td>
</tr>
<tr>
<td>Consumption milk (in litres)</td>
<td>2.20</td>
<td>2.04</td>
<td>2.12</td>
</tr>
<tr>
<td>Quantity Green fodder (kg/day/animal)</td>
<td>6.46</td>
<td>3.41</td>
<td>4.93</td>
</tr>
<tr>
<td>Quantity Dry fodder (kg/day/animal)</td>
<td>4.41</td>
<td>4.76</td>
<td>4.58</td>
</tr>
<tr>
<td>Quantity concentrate (kg/day/animal)</td>
<td>1.25</td>
<td>0.97</td>
<td>1.15</td>
</tr>
<tr>
<td>Farming Experience (in years)</td>
<td>12.5</td>
<td>13.6</td>
<td>13.05</td>
</tr>
<tr>
<td>Access to irrigation (in per centage )</td>
<td>85</td>
<td>37.5</td>
<td>61.25</td>
</tr>
<tr>
<td>Off farm income (in `)</td>
<td>16150</td>
<td>21500</td>
<td>18825</td>
</tr>
</tbody>
</table>
for irrigated area and drought area regression coefficient is positive but not significant. The regression coefficient of farming experience is also found to be positive but significant in unirrigated area while irrigated area positive coefficient and not significant. But in case of drought area coefficient was negative and non-significant. The result clearly demonstrates that once the farmer starts keeping dairy animals, he does not stop the dairy animal enterprise as he may have found it profitable or dairy animal holdings have acted as insurance against drought.

The relationship between cropped area and rearing of dairy animals has been found positive coefficient and significant in irrigated area and drought area which indicates that existence of strong crop - livestock interaction. The size of cropped area influences number of animals at least in two ways. First, by increasing household income it increases saving levels which in turn increases investment in livestock. Second, it affects the number of animals by affecting animal feed. Therefore, this is an expected result as with increase in cropped area the availability of feed and fodder is expected to increase which is crucial for rearing dairy animals while for unirrigated area coefficient was positive but not significant. The coefficient of consumption of milk was found to be positive and significant for both irrigated and unirrigated area as well as for drought area which implies that higher the milk consumption of the households, higher is the dairy animal holding to meet the family requirement. The regression coefficient of dry fodder was positive and significant for both areas and also for drought area which indicated the importance of dry fodder in whole of drought prone area for rearing dairy animals. The dry fodder was readily available because of vast cultivation of paddy in irrigated area whereas for unirrigated area it was easily accessible with cheap rate and sometimes free of cost from the relatives from the adjacent irrigated area. As noted previously, the consumption of dry fodder by dairy animals is higher, particularly in unirrigated areas, it points out the importance of dry fodder in rearing dairy animals. The regression coefficient of green fodder is positive and significant in irrigated area which means assured irrigation ensures availability of fodder particularly green fodder which induces farmer to rear dairy animals whereas for unirrigated positive

<p>| Table 2: Regression coefficient of factors affecting farmers to hold dairy animals in Raichur |</p>
<table>
<thead>
<tr>
<th>Explanatory variables</th>
<th>Irrigated area</th>
<th>Un irrigated area</th>
<th>Pooled data (DPA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family members (in no.)</td>
<td>0.031 (0.06)</td>
<td>0.081* (0.020)</td>
<td>0.290** (1.23)</td>
</tr>
<tr>
<td>Age of head of household (in years)</td>
<td>0.008 (0.02)</td>
<td>0.023** (0.009)</td>
<td>0.250 (0.108)</td>
</tr>
<tr>
<td>Farming experience (in years)</td>
<td>0.018 (0.02)</td>
<td>0.025* (0.008)</td>
<td>-0.080 (0.25)</td>
</tr>
<tr>
<td>Cropped Area (in acre)</td>
<td>0.039* (0.01)</td>
<td>0.009 (0.005)</td>
<td>0.100* (0.11)</td>
</tr>
<tr>
<td>Consumption of Milk (in litres)</td>
<td>0.342* (0.15)</td>
<td>0.148** (0.062)</td>
<td>0.280* (0.046)</td>
</tr>
<tr>
<td>Dry fodder (in kg/animal/day)</td>
<td>0.033* (0.006)</td>
<td>0.044* (0.011)</td>
<td>0.700** (0.13)</td>
</tr>
<tr>
<td>Green fodder (in kg/animal/day)</td>
<td>0.027* (0.004)</td>
<td>0.020 (0.019)</td>
<td>0.320 (0.09)</td>
</tr>
<tr>
<td>Concentration (in kg/animal/day)</td>
<td>0.014 (0.007)</td>
<td>0.075 (0.066)</td>
<td>0.010 (0.07)</td>
</tr>
<tr>
<td>Access to irrigation (if =1, otherwise=0)</td>
<td>0.012 (0.26)</td>
<td>0.148 (0.084)</td>
<td>0.040 (0.05)</td>
</tr>
<tr>
<td>Off farm income (in )</td>
<td>-0.00003 (0.00002)</td>
<td>0.0003** (0.00001)</td>
<td>0.07 (0.05)</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.71012 (1.113)</td>
<td>0.08332 (0.340)</td>
<td>-0.64 (0.09)</td>
</tr>
<tr>
<td>Model</td>
<td>Log linear model</td>
<td>Log linear model</td>
<td>Log linear model</td>
</tr>
<tr>
<td>Number of observation</td>
<td>60</td>
<td>40</td>
<td>100</td>
</tr>
<tr>
<td>R²</td>
<td>0.76</td>
<td>0.79</td>
<td>0.71</td>
</tr>
</tbody>
</table>

Figures in parentheses are corresponding standard error, * and ** indicate significant at 1% and 5%, respectively
coefficient and not significant and same for drought prone area. The regression coefficient of concentrate is positive but not significant for both irrigated and unirrigated area and also for drought area. The regression coefficient of access to irrigation is positive and not significant in unirrigated area, irrigated area and drought-prone area. The coefficient of off-farm income is negative and significant which may mean that off-farm income may induce the dairy farmers to shift to other lucrative enterprise whereas in unirrigated area, the off-farm income has positive and significant effect on dairy animal holding which means that the off-farm income induces farmers to hold dairy animals to minimise the risks posed by droughts. But in case of drought prone area the coefficient is positive but not significant. The findings of the study are in agreement with those reported by Nega et. al., (2012).

Conclusions

Several factors have been found influence on household decision to dairy animals. The expansion of area under irrigation and fodder cultivation particular in drought prone area is important for rearing of dairy animals, especially for green fodder. The potential for increasing percentage of operational land under fodder crops were limited in view of primary food security concerns and the dependence of dairy animals mainly on crop residues. Thus qualitative and quantitative improvement of crop residues assures the further improvement of dairy farming. The government should lay special emphasis on supply of dry fodder particularly in unirrigated areas to ensure round the year availability at cheap rates. As off-farm income plays important role in inducing the farmers to hold dairy animals it signifies the importance of successful implementation of welfare schemes like MGNREGA which have spill-over effects like rearing of dairy animals.

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