

**A STUDY ON SHEEP PRODUCTION SYSTEMS IN
IRRIGATED AND RAINFED AREAS IN KRISHNA
DISTRICT OF ANDHRA PRADESH**

By

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No part of the thesis has been submitted for any other degree or diploma. The published part has been fully acknowledged. All assistance and help received during the course of investigations have been duly acknowledged by the author of the thesis.

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DECLARATION

I, S.SAI SATISH RAJU hereby declare that the thesis entitled “A STUDY ON SHEEP PRODUCTION SYSTEMS IN IRRIGATED AND RAINFED AREAS IN KRISHNA DISTRICT OF ANDHRA PRADESH” submitted to Sri Venkateswara Veterinary University, Tirupati for the degree of “MASTER OF VETERINARY SCIENCE” is the result of original research work done by me. I also declare that the materials contained in this thesis have not been published earlier.

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ABSTRACT

A study was undertaken to study various sheep production practices followed by the shepherds in irrigated and rainfed areas of Krishna district. A total number of 250 sheep farmers and their flocks comprising 125 from each area of the district were interviewed by a questionnaire schedule and required information was collected.

Out of the total farmers, illiterate sheep farmers constituted about 81.6 and 88 per cent in irrigated and rainfed areas, respectively. Literate farmers recorded were 18.4 and 12 per cent, respectively, in irrigated and rainfed areas studied. Sheep farmers from Backward Communities constituted about 86.4 and 67.2 per cent, followed by Scheduled Castes community 8 per cent and 15.20 per cent, respectively, in irrigated and rainfed areas. Majority of the farmers in both the areas were landless (45.6 per cent in irrigated area and 72.8 per cent in rainfed area) followed by marginal land holders (36 per cent in irrigated area and 16.8 per cent in rainfed area). The average flock size in irrigated and rainfed areas of the district was 66.36 ± 2.32 and 73.62 ± 3.0 , respectively.

The average body weights in the male for 2 teeth, 4 teeth, 6 teeth and full mouthed animals in irrigated area were 42.0 ± 0.49 , 44.50 ± 0.34 , 44.33 ± 0.40 and 44.29 ± 0.28 ; while in rainfed area, the corresponding values were 39.92 ± 0.33 , 42.67 ± 0.33 , 43.11 ± 0.20 and 43.57 ± 0.20 Kg, respectively. The mean body weight (kg) for 2 teeth, 4 teeth, 6 teeth and full mouthed ewes observed were 31.99 ± 0.270 , 36.02 ± 0.240 , 37.27 ± 0.167 and 40.52 ± 0.269 kg, respectively, in irrigated area; while in

rainfed area, the corresponding values were 29.30 ± 0.40 , 34.84 ± 0.40 , 37.22 ± 0.35 and 42.01 ± 0.56 kg, respectively, in rainfed area.

The average body lengths in the male for 2 teeth, 4 teeth, 6 teeth and full mouthed animals in irrigated area were 76.08 ± 0.22 , 77.83 ± 0.37 , 78.11 ± 0.30 and 78.71 ± 0.28 cm, respectively. While in rainfed area the corresponding values were 74.75 ± 0.21 , 76.17 ± 0.30 , 76.89 ± 0.26 and 77.14 ± 0.50 cm, respectively. The mean body lengths for 2 teeth, 4 teeth, 6 teeth and full mouthed ewes were 66.48 ± 0.23 , 64.93 ± 0.44 , 67.94 ± 0.35 , 72.78 ± 0.50 cm, respectively, in irrigated area. While in rainfed area the corresponding values were 64.17 ± 0.46 , 64.27 ± 0.37 , 65.99 ± 0.32 and 67.43 ± 0.50 cm, respectively.

The mean height at withers for 2 teeth, 4 teeth, 6 teeth and full mouthed rams observed were 83.08 ± 0.28 , 84.83 ± 0.40 , 86.11 ± 0.26 and 84.57 ± 0.29 cm, respectively, in irrigated area. While in rainfed area the corresponding values were 81.33 ± 0.28 , 81.83 ± 0.30 , 84.78 ± 0.22 and 82.71 ± 0.28 cm, respectively. The average height at withers in ewes for 2 teeth, 4 teeth, 6 teeth and full mouthed animals in irrigated area were 74.62 ± 0.23 , 75.93 ± 0.17 , 76.75 ± 0.28 and 79.11 ± 0.30 cm, respectively. While in rainfed area the corresponding values were 72.51 ± 0.29 , 75.54 ± 0.27 , 76.12 ± 0.29 and 76.88 ± 0.31 cm, respectively.

The average chest girth for 2 teeth, 4 teeth, 6 teeth and full mouthed rams observed were 82.50 ± 0.19 , 85.50 ± 0.42 , 86.33 ± 0.33 and 85.00 ± 0.30 cm, respectively, in irrigated area. While in rainfed area the corresponding values were 81.25 ± 0.25 , 83.17 ± 0.30 , 84.22 ± 0.32 and 83.43 ± 0.20 cm, respectively. The mean values for chest girth in ewes for 2 teeth, 4 teeth, 6 teeth and full mouthed animals in irrigated area were 77.99 ± 0.31 , 79.83 ± 0.26 , 81.40 ± 0.25 and 82.16 ± 0.34 cm, respectively. While in rainfed area the corresponding values were 73.94 ± 0.31 , 78.94 ± 0.31 , 81.24 ± 0.52 , 86.66 ± 0.49 cm, respectively.

The mean punch girth for 2 teeth, 4 teeth, 6 teeth and full-mouthed rams observed were 83.25 ± 0.32 , 86.50 ± 0.42 , 85.22 ± 0.22 and 85.71 ± 0.28 cm, respectively, in irrigated area. While in rainfed area the corresponding values were 82.42 ± 0.22 , 84.83 ± 0.30 , 83.56 ± 0.24 and 84.43 ± 0.42 cm respectively. The average punch girth in ewes for 2 teeth, 4 teeth, 6 teeth and full mouthed animals in irrigated area were 80.09 ± 0.33 , 83.07 ± 0.40 , 84.21 ± 0.28 and 89.24 ± 0.44 cm, respectively. While in rainfed area the corresponding values were 76.09 ± 0.56 , 82.65 ± 0.30 , 84.84 ± 0.26 and 85.51 ± 0.30 cm, respectively.

The average age at first mating in ewes, age at first mating in rams, age at first lambing, lambing interval, age at weaning and weight at weaning in irrigated and rainfed area were 13.16 ± 0.06 and 14.52 ± 0.06 months; 19.89 ± 0.18 and 19.63 ± 0.20 months; 18.24 ± 0.05 and 19.52 ± 0.06 months; 306.68 ± 0.81 and 308.53 ± 1.15 days; 3.71 ± 0.40 and 4.09 ± 0.05 months; 12.57 ± 0.0 and 10.98 ± 0.05 kg, respectively.

It was observed that all the farmers in both the areas were rearing sheep extensively. Housing pattern comprising of an open pen along with a closed roof structure was seen in the majority of the sheep holdings in both the areas studied (56 and 57.6 per cent) and most of the shepherds were housing the sheep nearer to their houses (94.4 and 72 per cent).

Flock mating commonly followed and flushing was not at all practiced by the shepherds. June – August and January – March were found to be the breeding seasons for the sheep in the area. The mean grazing distance per day was 5.46 ± 0.13 km in irrigated area and 5.8 ± 0.14 km in rainfed area. The mean grazing duration per day was 8.88 ± 0.09 hrs in irrigated area and 9.38 ± 0.12 hrs in rainfed area. All the farmers in the study were following the deworming and vaccination regularly. Majority farmers in both areas were following burial method of carcass disposal (72.8 and 52 per cent). From the study it was observed that the marketing of meat was done mainly through middlemen (84 and 93.6 percent).

LIST OF SYMBOLS AND ABBREVIATIONS

&	And
a.m.	Ante meridiem
A.P.	Andhra Pradesh
BC	Backward castes
DAH	Department of Animal Husbandry, Dairying & Fisheries
df	Degrees of freedom
GOI	Government of India
hr	Hour(s)
Ha	Hectare(s)
i.e.	That is
Kg	Kilogram(s)
Km	Kilometer(s)
LRS	Livestock Research Station
OC	Other Castes
/	Per
p	probability
p.m.	Post meridiem
SC	Scheduled Castes
SE	Standard Error
ST	Scheduled Tribes

Chapter - I

Introduction

CHAPTER I

INTRODUCTION

Small ruminants play a complementary role to other livestock in the utilisation of available feed resources and provide one of the practical means of using vast areas of natural grassland in regions where crop production is impractical. Sheep with its multi-facet utility (for meat, wool, skin and manure) play an important role in the Indian agrarian economy. They are better adapted to arid and semi-arid tropics with marginal and sub-marginal lands, which are unfit for crops. They are perhaps the most suitable livestock species to utilise the sparse vegetation available in dry land areas. They have an excellent ability to survive over a prolonged period of drought and semi-starvation and are less prone to extreme weather conditions, ectoparasites as well as other diseases. In certain areas, the availability of drinking water is also a serious problem, causing flocks to migrate elsewhere. Because of their hardiness and adaptability to dry conditions, the north-western and the southern peninsular regions of the country have a large concentration of sheep.

Sheep in India are mostly maintained on natural vegetation on common grazing lands, waste lands, uncultivated lands, stubble of cultivated crops and top feeds. Rarely they kept on grain, cultivated fodder or crop residues.

In South India sheep are mainly reared for meat production. None of the religions stand in the way for slaughter of small ruminants. Even though the mutton is four times costlier than the chicken, the demand for it is increasing day by day. But the production and productivity of mutton from small ruminants is not improving. Large scale rearing of these small ruminants provide inputs to consumer industries such as leather, meat processing, blanket weaving and they also provide employment throughout the year.

India is a country with vast livestock resources and is rich both in numbers and also in variety. There are 42 recognised sheep breeds in India. The total Sheep contributes around 12.71 per cent of the total livestock population. The total sheep in the country is 65.06 million numbers in 2012, declined by about 9.07 per cent over census 2007 (19th Livestock Census-2012, GOI). Sheep population is generally found in the arid and semi-arid areas of Western India, Deccan Plateau and Western Himalayas. About 60% of sheep in the country are concentrated in seven states, namely Andhra Pradesh, Telangana, Rajasthan, Karnataka, Tamil Nadu, Jammu & Kashmir and Maharashtra. Sheep density is the highest in the arid ecosystem and least in the irrigated system.

According to estimates of the Central Statistics Office, the gross value added from livestock sector at current prices was about ₹ 5,004,05 crore during 2014-15 which is about 26.9% of the gross value added from total agriculture, forestry and fishing sector at current prices and 26.7% at constant prices (2014-15). The livestock sector is contributing about 4.4% of total gross value added to the country at current prices and about 4% at constant prices (Basic Animal Husbandry & Fisheries Statistics, GOI, 2016). The meat production from sheep and goat in India as estimated is 441 and 941 million kg, respectively, that contributes 7% and 16% contribution to 5900 million kg of total meat produced in country. In production of sheep meat; Andhra Pradesh ranks first with 45.07% contribution followed by Karnataka (7.95 per cent) and Rajasthan (7.91 per cent).

The sheep is backbone of rural economy in arid, semi-arid and hilly region of our country, because sheep plays an important role in the livelihood of a large proportion of small and marginal farmers and landless labourers engaged in sheep rearing. Mostly the people living below the poverty line and weaker section of society in our country are rearing sheep and goat by traditional system of farming constructing 40 per cent of total

population (Sharma and Sen, 2001) which cannot afford the proper management, feeding and health care of these animals for increasing production. Due to its socio-economic importance sheep and goat are assessed for economically backward farmer having small marginal land holding or even for landless laborers. It is a primary occupation of some categories of people and provides income and employment to their families. Encouraging rearing of these small ruminants particularly by weaker sections of the community in rural areas would go a long way for effecting social change by improving the income of these people, which will help them to uplift above the poverty line.

Andhra Pradesh stands 1st in the total sheep population in the country with 13.55 million sheep. Krishna district with a population of 5,08,061 ranked 9th in the state (Divided Andhra Pradesh). Though the state has enormous sheep population the productivity is very low compared to world averages. The average meat yield per sheep in Andhra Pradesh was 12 Kg against 10 Kg of the India's average (DAH, 2009). These values are very low compared to the world average of 18 Kg and Australia's average of 21 Kg. These figures indicate that there is a lot of potential for sheep development mainly in terms of breed development, management and rearing practices.

Therefore improvement programmes are necessary to increase and sustain the productivity of small ruminants to meet the demands of human population on them. This is only possible by understanding the different farming systems and when simultaneously addressing several constraints in feeding, health control, general management, as well as cost and availability of credit and marketing infrastructure etc. The knowledge on various aspects of sheep husbandry practices followed by the farmers is of great importance to fill the gap between existing practices and the recommended scientific practices.

Keeping the above facts in view, the present study was taken up with the following objectives.

1. To study the socio-economic characters of sheep farmers in irrigated and rainfed areas of Krishna district.
2. To find out the growth and reproduction characters of sheep in irrigated and rainfed areas of the district.
3. To study the breeding, feeding management and health care practices adopted by sheep farmers in irrigated and rainfed areas of the district.
4. To identify the problems faced by sheep farmers in irrigated and rainfed areas of the district.

Chapter - II

Review of Literature

CHAPTER II

REVIEW OF LITERATURE

2.1 Socio-economic status of farmers

Maheswaran and Subramanian (1998) reported that in Mecheri Taluk of Salem District 88 per cent of the sheep holders were illiterates and the age group of males were of above 45 years.

Geeta *et al.* (1999) in their observations while studying about sheep farmers of Karnataka found that 70.41 % of the Karnataka sheep farmers were illiterates. Out of total sheep farmers, more than half are blanket weavers (63.27 per cent). The sheep farmers belonged to the age group between 20-30 years (31.61 percent) followed by 40-50 years (25.51 per cent).

Kushwaha *et al.* (1999a) reported that 20-30 % of the Chokla sheep holders were illiterates.

Arunachalam *et al.* (2002) Farmers maintaining sheep alone without any other livestock species were largely landless (75 per cent). The largest number (17.02 per cent) of households in the study area maintaining sheep and poultry.

Chaturvedi *et al.* (2002) opined that sheep farmers in Malpura taluk of Rajasthan had the average land holding (acres) and proportion of holding (percent) marginal, small, medium and large farmers 0.37 and 0.21; 3.60 and 5.05; 6.80 and 19.06; 20.77 and 75.68, respectively.

Thiruvankadan *et al.* (2004) observed that the average household family size in Mecheri sheep farmers was 4.33 ± 0.02 with a literacy rate of 51.73 %. The percentage of farmers belonging to backward, most backward and other communities were 64.1, 29.5 and

6.40 %, respectively. The mean land holding was 5.28 ± 0.23 acre of which the irrigated and rainfed land constituted 32.95 and 67.05 per cent. The percentage of farmers having agriculture as the main occupation was 90.82. The distribution of farmers with marginal, small, medium and large land holding size was 19.70, 34.95, 35.41 and 0.73 %, respectively.

Sahana *et al.* (2004) in a survey in Jalauni sheep breeding tract, reported that the average family size of sheep farmers was 9.

Kumar *et al.* (2006) reported that the overall literacy percentage of sheep farmers was 40.50. The average family size was 7.75. Among the farmers surveyed 53, 56, 50, 5 and 14 per cent shepherds also maintained cattle, buffalo, goats, chicken and donkeys along with sheep, respectively. About 90 per cent of sheep farmers were landless and the average land holding was between 4 to 11 acres in Muzzaffarnagari sheep farmers.

Kandasamy *et al.* (2006) reported that the Coimbatore sheep are owned exclusively by the Kurumba / Kurumba grounders who are listed under most backward class and the average household size was 4.40 acres and the literacy rate was 54.34 per cent, respectively. The average land holding among sheep farmers was 5.29 acres and most of them (90 percent) were landless.

Kuldeep *et al.* (2006) in a study on socio-economic conditions of sheep farmers in western Rajasthan reported that out of the total respondents, 84.70% farmers had sheep farming as the main occupation and 81.18% were marginal farmers with the average land holding of 5.7 ha /family. The average livestock holding of sheep, goat, cattle, buffalo, camel and donkey per household were 93.70, 14.30, 2.30, 1.90, 1.20 and 1.70 heads, respectively.

Mishra *et al.* (2006) in a study about Garole sheep in Rajasthan, observed that 56 to 75 % of the sheep holders belonged to middle age group.

Arora *et al.* (2007) reported that in breeding tract of Jaisalmeri sheep, more than 80% farmer's family members were illiterates.

Suresh *et al.* (2008) studied the farmer's management practices of sheep flocks in eastern semi-arid region of Rajasthan and reported that the land holding size of marginal, small, semi-medium, medium and large farmers was 0.59, 1.38, 2.81, 6.13 and 16.29 ha, respectively, with the overall operational land holding size of 5.00 ha. Majority farmers were living in joint family system.

Tanwar *et al.* (2008) in a study conducted on socio-economic aspects of goat keepers and management practices prevailed in the tribal area of Udaipur district of Rajasthan observed that majority of the goat keepers were illiterate and belonged to schedule tribes. It was further observed that they were in the age group of 31-50 years with medium sized family and small land holding.

Virojirao *et al.* (2008) while studying the adoption of sheep husbandry practices in Chittoor district of Andhra Pradesh reported that majority (40.9 per cent) of the sheep farmers were illiterates and 52.3% of farmers were still in the joint family system. It was also reported that 54.5% of farmers had a family size of more than 6 members and remaining 45.5% of the respondents were having the family size with less than 5 members. The sheep farmers possessing cattle, buffaloes, goats and backyard poultry were 45.5, 4.6, 2.3, and 13.6 per cent, respectively.

Yadav *et al.* (2009) while studying the socio-economic status of shepherds rearing Marwari sheep found that they were socially backward and economically marginal. Further,

twenty-five of the 26 farmers/shepherds were landless while the remaining 1 farmer owned 1 acre of land. Average family size was observed to be 6.85.

Arora *et al.* (2010) reported that Ganjam sheep were mostly reared by economically weaker sections, especially the Gola community.

Deshpande *et al.* (2010) in a survey revealed that 36 % of farmers were in higher age group followed by middle age group. Majority of the farmers (64%) were literate having minimum primary education, 61% farmers were land less and majority of farmers have animal husbandry as main occupation.

Saha *et al.* (2010) in a study on sheep rearing Practices in Ganderbal District of Jammu & Kashmir reported that majority of the farmers (47.5 per cent) belonged to middle age group. Majority of the farmers maintaining small and nuclear families (57.50 per cent).

Singh *et al.* (2010) reported that Maximum goat rearing households belong to backward (74%) followed by schedule caste (22%) communities. Maximum goat keepers were marginal (59%), followed by landless (38) and small (3%) landholding category. Most of the (>55%) goat keepers were illiterates in Uttar Pradesh.

Patil *et al.* (2012) reported that 51% sheep farmers belonged to middle age group (37-54 yrs). The joint family system was found in 57% families. 47% had more than 8 members in their family. The majority of the respondents (60 per cent) were illiterate. The majority (54per cent) of farmers were marginal land holders.

Rajanna *et al.* (2012) reported that 70.31 per cent shepherds are middle-aged and 74.65 per cent are illiterates, 99.32 per cent of the farmers are Hindus, 0.52 per cent to Christians and 0.17 per cent to Muslims. Majority farmers were maintaining joint families with medium family size. About 97.40 per cent farmers belonged to the backward community, 1.22 per cent to Scheduled Tribes and 0.52 per cent to Scheduled Casts. 64.58

per cent farmers had medium experience (17-41.3 years) in sheep rearing. 77.26 per cent of the farmers had agriculture as the main occupation. Overall mean land holding was 2.47 ± 0.09 acres. 42.88 per cent farmers possessed 50 to 100 sheep. 71.53 per cent farmers had 4-8 members in their family.

Ramesh *et al.* (2012) reported that majority of the respondents in Karnataka were nuclear family type (75%), about 76.6% were having 3-7 family member, while 31.6 % of respondents were illiterate and about 45% respondents were marginal farmers who had less than 2.5 acres of land. Majority of the farmers 53.3% having low level of experience in small ruminant farming while majority 55% of responders having small size of flock (2-9 animals). In case of total annual income 55% of farmers belong to medium income group.

Rao *et al.* (2013) reported that agriculture was the main occupation for 69.06% farmers. About 60.10% of shepherds had less than 2.5 acres land. About 75.35 percent of the shepherds belonged to the backward community, followed by scheduled castes (8.96%) other castes (8.65%) and scheduled tribes (7.08%) in North Coastal Zone of Andhra Pradesh.

Choudary *et al.* (2013) reported that mean family size of the farmers was 4.34 with majority (80.77%) of famers belonged to medium size. About 57.7% of farmers had primary education. The overall mean land holding in the surveyed area was 1.94 ± 0.20 acres and 99.04% farmers chosen sheep husbandry as main occupation in Macherla Brown sheep breeding tract of Andhra Pradesh.

Arora *et al.* (2014) reported that in breeding tract of Malpura sheep, more than 80 percent farmer's family members were found illiterate. 72% of the farmers were earning less than Rs.30, 000 per year.

Singh M K *et al.* (2014) reported that majority of the respondents (54%) belonged to backward communities followed by schedule castes (37%) and general (9%). The average family size, land holding size was 5.60 ± 0.18 and 1.46 ± 0.24 ha, respectively, in Bundelkhand region.

Kumar *et al.* (2015) reported that majority of the respondents belonged to middle age group (66.2%), illiterate (44.6%) with medium level of experience in goat farming (68.8%) and medium family education status (73.7%). Landless farmers constituted about 25.8%, marginal farmers 54.2% and small/semi-medium 20.0%. Majority of the respondents belonged to joint family (52.9%) and Hindu religion (93.3%) followed by other backward class (48.7%). Agriculture and animal husbandry were the primary occupations of the respondents in Firozabad and Mainpuri districts of Uttar Pradesh.

In a survey on sheep production practices in Guntur district of Andhra Pradesh, Sireesha *et al.* (2015) reported that majority (92.5 per cent) shepherds were illiterates. Among the shepherds, 44.58% belonged to Backward Communities, 20% to Scheduled Castes, 15% to scheduled Tribes and 20.42% to Other Communities. Out of the total farmers studied, 52.5 % were landless, 37.92 % were marginal, 7.08 % were small and 2.50 % were large farmers. 90% of the respondents indicated that sheep farming was their main occupation.

Serma Saravana *et al.* (2016) reported that 51.67 per cent shepherds were of the middle age group, 60% of farmers had up to the primary level of education with 35.83 per cent marginal land holding in Northern Tamil Nadu.

Deepak *et al.* (2017) reported that about 75% of the respondents were illiterates. Majority of the farmers belonged to the age group of >30 yrs in Allahabad district of Uttar Pradesh.

2.2 Flock profile

Kushwaha *et al.* (1999b) reported that the flock size of Chokla sheep ranged between 57 and 64.

Arunachalam *et al.* (2002) analyzed the sheep and combinations of sheep farming along with other livestock in Tamil Nadu region and found that out of the 20 combinations studied, 8.51 % farmers maintained sheep as single species and 2.13 % maintained sheep and goat.

Sahana *et al.* (2004) reported that the average flock size was 34 and the flock size ranged from 3 to 150 in Jalauni sheep. Generally, one adult male is maintained in each flock for breeding purpose.

Dixit *et al.* (2005) observed that the flock size of Rampur bushair sheep varied from 3 to 150. Two to three breeding rams were kept per 100 ewes for breeding.

The average flock size of Mecheri sheep in its breeding tract was found to be 24 by Karunanithi *et al.* (2005). It was further reported that the flock on an average consisted of 1 ram, 17 ewes and 6 lambs.

The average flock size of migratory Coimbatore sheep was 503 ± 13 (range 100 to 900) and in stationary flocks was 60 ± 8 (range 40 to 120). The ram ewe ratio was 1:24. In migratory flocks on an average, there were 17.80 goats along with three to four mongerel dogs (Kandasamy *et al.*, 2006).

Kuldeep *et al.* (2006) reported that the average flock size in western Rajasthan was observed to be 93.7 of which 1.3 were rams, 62.0 ewes, 10.9 male lambs and 19.5 female lambs.

Thiruvankadan *et al.* (2007) in a study on Mecheri sheep observed that average flock size in its breeding tract was 23.82, of which there were 6.22 lambs, 16.60 ewes and 1.00 ram. They further observed that ram to ewe ratio in that particular area was 1: 16.60.

Virojirao *et al.* (2008) reported that the flock size maintained by sheep farmers in Chittoor district of Andhra Pradesh ranged from 10 to 183. The flock size in the majority (50 per cent) of sheep farmers was between 25 to 50 sheep, followed by flocks of less than 25 sheep (20.5 per cent), more than 100 sheep (11.4 per cent) and equal numbers (9.09 per cent) distributed into categories i.e. 51-75 and 76-100.

Kumar *et al.* (2008) observed that the average flock size in Malpura sheep varied from 20 to 150 and the bigger flocks were observed to have 2 –3 rams, whereas smaller flocks had none.

Chandran *et al.* (2009) reported that the average flock size of Vembur sheep in Tamil Nadu ranged from 20-68 sheep with a mean of 38.6. He also reported that an average flock consisted of 1 ram, 24.5 ewes, 2.8 ram lambs and 10.3 ewes.

Yadav *et al.* (2009) in a study on Marwari sheep reported that the average flock size was 113, comprising of 81 ewes, 1 ram and 31 lambs. Most of the farmers kept 1 or 2 rams for breeding.

Arora *et al.* (2010) in a study on Molecular characterisation of Ganjam sheep reported that average flock size in Ganjam sheep was 35 with 1 ram, 26 ewes and 8 lambs or hoggets

Devendran *et al.* (2010) reported that the average flock size in migratory flocks was 503 and 60 in stationary flocks in Coimbatore breeding tract.

Patil *et al.* (2012) in a study on Socio-Economic Profile of Sheep Reared Dhangar Pastoralists of Maharashtra reported that average sheep per family was 69.48. Among them 48.75 were ewes and 2.30 per cent were rams.

Rajanna *et al.* (2012) reported that overall flock size was 113.50 ± 2.7 . It was found that farmers maintaining 50-100, 100-105 flock was 42.88 and 28.65 per cent respectively in Telangana Region of Andhra Pradesh.

Ravimurugan *et al.* (2012) reported that the average flock size was 52 sheep, of these 68 per cent were adult ewes in Padukottai, Sivagangai, Ramanathapuram districts of Tamil Nadu.

Choudary *et al.* (2013) reported that the mean flock size was 120.64 ± 4.80 sheep and 41.34 % farmers had 50 to 100 sheep per flock in Macherla Brown sheep breeding tract of Andhra Pradesh.

Ravimurugan *et al.* (2013) reported that 72.33 per cent farmers were maintaining Chevaadu sheep as pure flocks and 27.67 per cent maintaining as mixed flocks. The average size of pure flocks was 76.08 sheep. The structure of an average flock was 1.74 rams, 57 ewes, 4.69 ram lambs and 12.65 ewe lambs. The average flock size of Chevaadu mixed with other breeds/population was 74.4. The percentage of farmers keeping Chevaadu with a flock size of up to 25 to 50, 51 to 75, 76 to 100 and >100 were 11.53, 16.50, 22.42, 24.70 and 24.85, respectively.

Akila (2014) reported that the average flock size in Karur district of Tamil Nadu was 48.0 ± 10.6 sheep.

Kailash and Kavitha (2015) reported that generally farmers rear small numbers of goats with sheep flock. Majority of farmers (85.56%) adopted mix grazing. Sheep and goat were taken for grazing in mixed flock in Rajasthan.

Singaravadivelan *et al.* (2015) reported that the overall mean flock size was 228.13 ± 11.46 . The sheep flock was comprised of 2.74% breeding rams, 66.19% breeding ewes, 0.56% young males, 14.79% young females, 5.70% male lambs and 8.02% female lambs in migratory sheep flocks of southern Tamil Nadu.

Sankhyan *et al.* (2016) reported that 50% of the farmers belonged to medium flocks, 40.2% belonged to small flocks while 9.8% were with larger size flock in Western – Himalayan region of India.

Deepak *et al.* (2017) reported that about 40.7% of sheep farmers in Allahabad district of Uttar Pradesh had a flock size >30 .

2.3 Production performance

2.3.1 Body measurements

Dixit *et al.* (2005) studied the biometry of Rampur Bushair breed and reported that average body length, height at withers and chest girth in males were 52.56 ± 0.58 cm, 58.68 ± 0.30 cm, and 79.63 ± 0.49 cm, respectively, and in females the same were 50.34 ± 0.71 cm, 53.93 ± 0.45 cm and 75.99 ± 0.38 cm, respectively.

Karunanithi *et al.* (2005) reported that the overall means for height at withers, chest girth and body length at about 24 months of age in Mecheri sheep were 67 ± 0.4 cm, 74 ± 0.4 cm and 66 ± 0.4 cm, respectively.

Kumar *et al.* (2006) reported that under field condition average body length, height at withers, chest girth and paunch girth in male and female were 80.30 and 73.50 cm, 80.70 and 73.60 cm, 84.30 and 78.50 cm, 84.50 and 79.30 cm, respectively, in Mazaffarnagari sheep.

Kumar *et al.* (2008) observed that averages for body measurements of Malpura breed such as body length, height at withers and chest girth in adult males were 72.12 ± 0.70 cm, 71.93 ± 0.68 cm and 83.62 ± 0.89 cm and in adult females the corresponding figures were 63.91 ± 0.14 cm, 64.04 ± 0.22 cm and 70.11 ± 0.21 cm, respectively.

Chandran *et al.* (2009) found the average body length, height at withers and chest girth in adults were 76.0 ± 0.9 cm, 82.2 ± 0.6 cm, and 88.0 ± 0.7 cm in males and 67.0 ± 0.1 cm, 75.1 ± 0.1 cm and 78.1 ± 0.2 cm in females.

Devendran *et al.* (2009) conducted a survey on the biometric parameters of Coimbatore sheep and found the average body length, height at withers, chest girth in adults to be 62.4 ± 0.4 cm, 60.9 ± 0.3 cm and 69.8 ± 0.4 cm, respectively.

Ravimurugan and Devendran (2009) reported that the least squares mean for height at withers, body length, heart girth and paunch girth were 74.22 ± 0.71 , 66.82 ± 0.87 cm, 81.65 ± 0.82 cm, 72.43 ± 1.15 cm, respectively in males and 69.88 ± 0.33 cm, 59.19 ± 0.41 cm, 73.44 ± 0.39 cm, 69.96 ± 0.54 cm, respectively in females of Ramnad White sheep in Tamil Nadu.

Arora *et al.* (2010) recorded average body length, height at withers and chest girth in Ganjam males as 60.7 ± 0.50 cm, 67.7 ± 0.48 cm and 72.7 ± 0.68 cm, respectively, and in females 58.7 ± 0.36 cm, 64.9 ± 0.45 cm, 64.9 ± 0.45 cm, respectively for the same.

Rani *et al.* (2014) reported that the overall least squares mean of height at withers at 2, 4, 6 and 8- teeth age were 76.91 ± 0.4 cm, 79.83 ± 0.17 cm, 81.13 ± 0.38 cm and 81.79 ± 0.4 cm, respectively. The average Paunch girth at 2, 4, 6 and 8-teeth age groups were 79.47 ± 0.47 cm, 82.68 ± 0.2 cm, 83.83 ± 0.54 cm and 84.34 ± 0.51 cm, respectively. The chest girth of 2, 4, 6 and 8-teeth age groups were 78.04 ± 0.49 cm, 80.62 ± 0.11 cm, 81.91 ± 0.49 cm and 82.92 ± 0.46 cm, respectively. The average body length at 2, 4, 6 and 8-teeth age groups were 71.14 ± 0.5 cm, 73.29 ± 0.18 cm, 74.55 ± 0.04 cm and 75.66 ± 0.48 cm, respectively in Nellore sheep.

2.3.2 Body weight

Kushwaha *et al.* (1999b) studied the performance of Munjal breed and reported that the body weights of adults ranged from 50 to 83 kg with an average of 65.93 ± 2.43 kg in males and in females the same ranged from 35 to 55 kg with an average of 45.37 ± 0.99 kg.

Sahana *et al.* (2004) found that the average adult body weights of male and female Jalauni sheep were 35.50 ± 2.10 kg and 27.20 ± 0.70 kg, respectively.

Kumar *et al.* (2008) recorded the average adult body weight in Malpura breed as 40 kg in males and 30 kg in females.

Devendran *et al.* (2009) reported that the average body weight in Coimbatore adult sheep were 35.5 ± 0.5 kg in males, 24.5 ± 0.4 kg in females.

Chandran *et al.* (2009) observed the overall least square means of body weights of Vembur lambs at 3, 6, 9, and 12 months of age as 11.9 ± 0.2 kg, 16.1 ± 0.2 kg, 18.7 ± 0.3 kg and 22.4 ± 0.5 kg, respectively, and the adult body weights as 29.9 ± 0.2 kg for females, and 43.1 ± 0.9 kg for males.

Yadav *et al.* (2009) reported that the average adult body weight in Marwari male and female sheep were 40.7 ± 1.13 kg and 30.1 ± 0.028 kg, respectively.

Arora *et al.* (2010) in a study on molecular characterisation of Ganjam sheep reported that the average body weight in Ganjam male and female sheep was 27.0 ± 0.96 kg and 23.9 ± 0.63 kg, respectively.

Pragati *et al.* (2012) reported that average adult body weight of sheep was 24.67 ± 0.07 kg. The overall least squares means of body weights at birth, 3, 6, 9 and 12 months of age were 1.93 ± 0.03 , 6.14 ± 0.05 , 10.28 ± 0.07 , 14.66 ± 0.08 and 18.57 ± 0.06 kg, respectively, in Edka sheep of Puri district of Odisha.

Ravimurugan *et al.* (2012) reported that average body weight in adult rams and ewes of Pattanam sheep of Tamil Nadu was 51.50 ± 1.20 kg and 36.95 ± 0.5 kg, respectively.

Rao *et al.* (2013) reported that the mean body weight (kg) at weaning, 6 months, one year and above one year age were 8.96 ± 0.14 kg, 16.05 ± 0.12 kg, 20.39 ± 0.16 kg and 26.31 ± 0.15 kg for ewe lambs and 10.10 ± 0.11 kg, 15.48 ± 0.09 kg, 26.01 ± 0.30 kg and 40.43 ± 0.26 kg, respectively for ram lambs. The age at weaning for lambs was 3.25 ± 0.04 months in North Coastal zone of Andhra Pradesh.

Mane P M *et al.* (2014) reported that the overall least squares means of body weights of Deccani sheep at birth, 3, 6, 9 and 12 months of age were 3.44 ± 0.01 , 15.66 ± 0.09 , 22.04 ± 0.13 , 23.06 ± 0.14 and 24.27 ± 0.16 kg, respectively, in an organised farm.

Rani *et al.* (2014) reported that the overall least squares mean for body weight at 2, 4, 6 and 8-teeth age were 35.26 ± 0.23 kg, 38.45 ± 0.13 kg, 39.53 ± 0.32 kg and 40.06 ± 0.33 kg, respectively, in Nellore sheep.

Gowane G R *et al.* (2015) reported that the least squares means for birth, 3 and 6 months weights in Malpura field flocks were 3.01 ± 0.05 , 15.08 ± 0.21 and 24.44 ± 0.50 kg and in Kheri they were 2.97 ± 0.05 , 14.76 ± 0.22 and 17.49 ± 0.29 kg, respectively.

Kumar *et al.* (2017) reported that the means body weights at birth, three, six, nine and 12 months of age were 3.10 ± 0.01 , 14.20 ± 0.10 , 19.33 ± 0.18 , 23.16 ± 0.36 and 27.41 ± 0.18 kg, respectively, in sheep maintained at Livestock Research Station, Palamaner, Andhra Pradesh.

2.4. Reproductive performance

Acharya (1982) recorded the average age at first lambing and lambing interval as 846 and 428 days, respectively in Nellore sheep.

Mehta *et al.* (1995b) reported that in Sonadi and Malpura breeds breeding of sheep throughout the year was not uncommon but the major breeding months are July and August and the major lambing months are November and December. Age at first mating was 19 months in female and 24 months in males.

Kushwaha *et al.* (1999) reported that age at first mating among Chokla sheep flock was 18 months in rams and for ewes was 10-15 months. Farmers harvested 2 lambs/ewe in 14 months when feed and fodder availability was satisfactory. When the situation is worst, one lamb in a year was harvested.

Kushwaha *et al.* (1999b) reported that age at first mating of Munjal breed was around 12 to 15 months in females, while males were generally used for breeding at around 18 months of age.

Dixit *et al.* (2002) reported that the least squares mean for age at first conception, age at first lambing, service period and lambing interval were 580 ± 13 days, 730 ± 13 days, 142 ± 26 days and 290 ± 26 days, respectively in Bharat Merino sheep.

Sushilkumar *et al.* (2003) observed that 95 per cent of ewes produced the first lamb at 16 to 20 months age (2 teeth stage) which indicated that most of the farmers breed their ewes at yearling stage. Most of the farmers used breeding rams for 4 – 5 years.

Dass *et al.* (2004) found that the overall least squares mean for age at first service, age at first lambing and first lambing interval were 579.27 ± 2.24 days, 730.50 ± 2.47 days and 358.09 ± 3.66 days, respectively in Marwari sheep.

Mishra *et al.* (2004) recorded that the average age at first conception and first lambing were 11.36 ± 0.11 months and 16.49 ± 0.12 months, respectively for Ganjam sheep breed of Orissa under field conditions.

In Jalauni sheep breed, the average age at sexual maturity was one year for both male and female, age at first lambing was 1.50 to 2 years with a lambing interval of one year. A ewe delivers 7-9 lambs in her lifetime. Twinning was rare (Sahana *et al.*, 2004).

Dey and Poonia (2005b) reported that the least squares mean for age at first service, age at first lambing and inter lambing interval as 775.83 ± 12.94 days, 925.08 ± 13.02 days and 351.79 ± 2.56 days, respectively in Nali ewes.

Dixit *et al.* (2005) observed that sexual maturity of both sexes of Rampur Bushair sheep breed was 12 months of age.

In Muzaffarnagri sheep, the age at first breeding in males was 10 to 14 months with a breeding life of 5-6 years. Average age at first lambing in ewes was 17 months. Lambing

rate was about 60 to 95 per cent with a lambing interval of 6-8 months. Litter size was mostly single, but some farmers also reported 4-25 per cent twining. A ewe produced 8-12 lambs in its lifetime (Kumar *et al.*, 2006).

The mean age at first mating in male and female Coimbatore sheep were 12.50 ± 0.10 months and 11.10 ± 0.10 months, respectively. The average age at first lambing and lambing interval was 16.60 ± 0.10 months and 7.70 ± 0.10 months, respectively. The lambing per cent on the basis of ewes available was 82.40 ± 0.40 and twining was 1.10 per cent (Kandasamy *et al.*, 2006).

Patro *et al.* (2006) analysed the data on indigenous meat-type sheep of coastal Orissa and reported that the least square means for age at first conception, age at first lambing, gestation period, service period and lambing interval were 368.81 ± 0.79 days, 518.67 ± 0.81 days, 149.90 ± 0.08 days, 63.13 ± 0.25 days and 214.01 ± 0.33 days, respectively.

The least squares mean for age at first lambing, gestation period, service period and lambing interval were 15.47 ± 0.7 months, 153.38 ± 38 days, 93.24 ± 0.88 days and 283.13 ± 0.95 days, respectively, in Pungal sheep (Gopal and Hari Prasad, 2007).

The average age at first service, age at first lambing and lambing interval were 650 days, 810 days and 370 days, respectively, in Malpura sheep (Kumar *et al.*, 2008).

Poonia (2008) reported that the mean age at first lambing, weight at first lambing and lambing interval were 530.53 ± 12.39 days, 35.44 ± 0.63 kg and 247.66 ± 4.88 days, respectively, in Munjal sheep.

Kumaravelu *et al.* (2012) reported that age at first mating in ewes (months), age at first mating in rams (months), age at first lambing (months), age at weaning (months) and

lambing interval (months) in Southern and North Eastern agro-climatic zones in Tamil Nadu were 12.90 and 13.41; 21.11 and 18.97; 18.19 and 18.97; 3.91 and 5.54; 10.98 and 11.88, respectively.

Pragati *et al.* (2012) reported that the least squares means of age at sexual maturity, gestation period, age at first lambing and lambing interval were 208.64 ± 2.29 , 149.54 ± 0.06 , 379.33 ± 1.28 and 210.66 ± 0.06 days, respectively, in Edka sheep of Puri district of Odisha .

Rajanna *et al.* (2012) reported that the least squares mean for age at first mating, age at first lambing and lambing interval were 610.00 ± 3.81 , 788.39 ± 3.94 and 420.93 ± 2.76 days, respectively in Nellore sheep in farmers flock of Telangana.

Ravimurugan *et al.* (2012) reported that the average age at first mating in rams and ewes ranged from 9 to 12 and 10 to 12 months, respectively. The age at first lambing ranged between 15 and 17 months in Pattanam sheep of Tamil Nadu.

Rao *et al.* (2013) reported that the percent lambing, twinning and weaning were 81.33 ± 0.26 , 0.48 ± 0.04 and 85.53 ± 0.16 , respectively. The mean age at first mating was 12.85 ± 0.10 and 21.17 ± 0.07 in ewes and rams, respectively.

The overall least squares mean for age at first conception, age at first lambing and lambing interval were 632.12 ± 16.93 days, 778.62 ± 6.92 days and 256.40 ± 4.63 days, respectively, in Deccani ewes maintained in an organized farm. (Mandakmale *et al.*, 2013).

Mane *et al.* (2014) reported that the overall least squares mean for age at first conception, age at first lambing and lambing interval were 489.21 ± 3.55 days, 638.91 ± 3.56 days and 307.90 ± 1.37 days, respectively, in Deccani sheep reared in an organized farm.

Rani *et al.* (2014) analysed the data on Nellore jodipi sheep maintained at Livestock Research Station, Palamaner and reported that the overall least squares mean for age at first service, age at first lambing, lambing interval and gestation period were 689.09 ± 1.23 days, 841.04 ± 1.21 days, 383.43 ± 0.48 days and 151.95 ± 0.08 days, respectively, in Nellore jodipi sheep.

Singaravadivelan *et al.* (2014) reported that the mean lambing percentage, twinning percentage, age at first mating (months) in ewes, age at first mating (months) in rams, age at first lambing (months) and weaning percentage in migratory and non-migratory flocks were 93.56 and 91.50; 1.87 and 1.52; 12.34 and 13.22; 19.64 and 21.44; 18.54 and 19.68; 85.98 and 87.15, respectively. The weaning period for ram and ewe lambs were 2.94 ± 0.96 and 5.03 ± 0.13 in migratory flocks and 4.82 ± 0.13 and 6.06 ± 0.17 in non-migratory flocks, respectively. The months of October, November and December were main lambing season and the months of April and May were second lambing season.

Malik *et al.* (2016) reported that the average age at first lambing (AFL), weight at lambing (WL) and average lambing interval (ALI) were 707.05 ± 2.07 days, 26.91 ± 0.10 kg and 402.85 ± 2.40 days, respectively, in Harnali sheep maintained at Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, Haryana.

2.5 Housing Management

2.5.1 Housing for stationary sheep

Padmanabhan (1994) observed that in Salem and Dharmapuri district of Tamil Nadu, sheep were allowed to remain in open fields in the night and are confined to a small place called 'Patti'. Only some farmers have sheep pens and they were cleaned daily and dung stored in heaps in the manure pit.

Sahana *et al.* (2004) in a study on Jalauni sheep documented that 30 per cent of the sheep farmers provided closed housing with complete walls on all four sides. A part of the farmer's house is also used to shelter sheep and other livestock. The walls are made up of stone, bricks or other local materials with a thatched roof. The roof of the sheds was low with poor sanitary conditions.

Thiruvankadan *et al.* (2004) observed that Mecheri sheep in their breeding tract were housed mostly in open pens made up of bamboo sticks and penned in the harvested fields. The feed and water troughs were mostly made up of mud and in some places with cement material.

The non-migratory Rampur Bushair sheep were kept in closed houses called "khud or Duar" in winter and in Open houses in summer as reported by Dixit *et al.* (2005).

Kumar *et al.* (2006) in a survey on Muzaffarnagri sheep observed that majority of the farmers provide housing, especially during the night. All types of housing were observed. The sheep housings were part of owner's house (44 percent) or adjacent to human dwelling (45 percent) or separate (11 percent), which were a close type having a complete wall on all four sides with thatched shed in it.

In a survey on Coimbatore sheep, Kandasamy *et al.* (2006) reported that in stationary flocks, housing was the open type with side protection made up of wooden reapers or bamboos. Even during rainy season, no protection is provided to the sheep.

Thiruvankadan *et al.* (2007) while recording data on Mecheri sheep reported that 61.8 per cent of the sheep farmers in Tamilnadu providing housing to sheep only during night time and 94.84 percent of farmers providing the open type of housing with kutcha flooring.

Nayak *et al.* (2008) reported that the floors of the Ganjam sheep houses in majority cases are of a kutcha type and in some cases, houses were made up of bamboo mats raised about four feet above the ground. The drainage system of the animal houses was found to be poor with a small gutter provided towards one side of the house that is connected to an outside drain.

It was reported that sheep housing in the Chittoor district of Andhra Pradesh was mostly (88 per cent) of the kutcha type which was a temporary house with mud walls and roof made up of tree leaves and other waste materials (Virojirao *et al.*, 2008).

Chandran *et al.* (2009) while studying the housing for Vembur sheep observed that housing was provided only during rainy season. He further observed that 32% of the houses were of an open type and the remaining was the semi-open type.

Arora *et al.* (2010) reported that Ganjam sheep were mostly reared on extensive management system with the help of family members.

In stationary flocks of Coimbatore sheep, the type of housing was the open type with side walls made up of bamboos (Devendran *et al.*, 2010).

Rajanna (2012) reported that 80.73 per cent farmers possessed kutcha house whereas 19.27 per cent had a pucca house in his study in Telangana region of Andhra Pradesh.

Rao *et al.* (2013) reported that about 88.75% farmers providing penning only during night time. Majority shepherds kept their sheep in kutcha houses with kutcha flooring and 88.02% farmers storing sheep manure in open heap method in North Coastal Zone of Andhra Pradesh.

Rajanna *et al.* (2013) reported that semi semi-open type of housing was adopted by 60.07% farmers. All the farmers (100 per cent) were providing kutcha floor and 64.41% farmers providing a thatched roof. 93.40% farmers were not replacing the soil. Night penning of sheep was done by 22.92% farmers. About 93.40% farmers stored manure in open heap method. Among the sheep farmers 51.56, 38.37, 10.07 per cent farmers used manure in own agricultural fields, sold to others and practicing both, respectively. 76.34 per cent farmers sold manure once in a year.

Sireesha *et al.* (2014) observed that about 52.90 % of the farmers keeping their sheep in closed houses, 42.10 % of the farmers providing open houses, whereas 5% of the farmers did not provide any housing. Out of the farmers providing housing majority (60.70 per cent) had their animal houses located near their houses and the remaining (39.30 percent) had their animal houses located away from their houses in Guntur district of Andhra Pradesh.

Deepak *et al.* (2017) reported that all the framers in Allahabad district of Uttar Pradesh were rearing sheep in extensive method.

2.5.2 Location of sheep pen

Chandran *et al.*, 2009 reported that location of house was near the residence of flock owner in Vembur breeding tract.

Arora *et al.* (2010) observed that the animals in Orissa region were usually housed in separate open sheds adjacent to or in part of the owner's house. In some cases, they were also kept in the open.

Sireesha *et al.* (2014) reported that 60.70% of the shepherds housed their sheep nearer to their houses.

2.5.3 Housing for migratory sheep

Dixit *et al.* (2005) observed that the migratory Rampur Bushair sheep took shelter in the forest area under trees or curved stones, etc.

Kandasamy *et al.* (2006) reported that the sheep are penned in the open in harvested fields during nights and fenced with nylon nets.

Devendran *et al.* (2010) reported that housing was not provided for migratory flocks of Coimbatore sheep. Even during rainy season, there was no extra protections provided to the flock and were penned in the open harvested fields during night time and penning site was changed almost every day.

2.6 Breeding management

Kushwaha *et al.* (1997) in a study on Chokla sheep revealed that the sheep were known to breed throughout the year although the majority of them breed during July-August.

Kushwaha *et al.* (1999b) reported that age at first mating of Munjal breed was around 12 to 15 months in females, while males were generally used for breeding at around 18 months of age.

Karunanithi *et al.* (2005) in a study on breed characteristics of Mecheri sheep reported that breeding of Mecheri sheep was random and unplanned and the majority of the ewes were mated in the months of June to November. The rams of Mecheri sheep were kept for mating up to four years of age.

Dixit *et al.* (2005) reported that the peak breeding seasons in Rampur Bushair sheep were in the months of April to May and October to November. Natural mating was common. Two to three rams per 100 ewes were kept for the breeding of sheep in the flock.

In a study on Coimbatore sheep, Kandasamy *et al.* (2006) reported that Rams, ewes and other age groups are grazed and penned together and hence uncontrolled natural mating takes place throughout the year. Pure breeding is generally practiced. No ram exchange is followed by shepherds. The males are selected based on growth, body size and health status from nine to twelve months. On an average, one breeding ram is kept for every 24 ewes.

Tilahun *et al.* (2006) in a study on assessment of small ruminant management practices in Ethiopia observed that there was uncontrolled breeding in study area and major

(82%) breeding season was wet season. Further it was observed that farmers in that area were maintaining one ram for 30- 50 breeding ewes.

Kumar *et al.* (2008) reported that major breeding season in Malpura breeding tract was July-August and the minor breeding season was February –March.

Virojirao *et al.* (2008) in a study on adoption of sheep husbandry practices in Chittoor district of Andhra Pradesh observed that the main breeding season for sheep was between June – August and off-season extended between January – March. The rams used in the flock for the breeding purpose are mainly home grown (56.8%). The rams are mixed with flock and all the flocks are going for the natural services. The sheep farmers keep the rams along with the flocks all through the year. Only one-fifth of the respondents were aware of the advantages of ram rotation.

Yadav *et al.* (2009) reported that the breeding life of a Marwari ram in Rajasthan region was 2–3 years and farmers in the area used rams for 2–3 seasons and thereafter exchanged them with other farmers in order to avoid inbreeding.

Chandran *et al.* (2009) in a study on Vembur sheep in its native tract reported that the major breeding season in that area was March-May, and the minor breeding season was July – September. It was further reported that only one ram was present in 85% of the flocks, 2 rams were present in 5% and 10% flocks were not having any rams.

Devendran *et al.* (2009) in a study on Coimbatore sheep rearing and management practices followed by the shepherds, observed that major breeding season was from mid-April to mid-June

Arora *et al.* (2010) in a study on the morphological and genetic characterization of Ganjam sheep reported that pure and selective breeding was followed in the farmer's flock and breeding took place from July to October.

Tailor *et al.* (2010) reported that in Sonadi sheep breeding tract, majority of the breeding stock was selected from their own flock.

Sireesha *et al.* (2014) reported that flock mating commonly followed in the study area. June – August and January – March were found to be the breeding seasons for the sheep in the area. The ram to ewe ratio maintained by the majority of the farmers was 1: 50. About 86.25 % farmers were following ram rotation in their flocks. 64.58 % farmers were changing ram once in 5 years and above in Guntur district of Andhra Pradesh.

Sankhyan *et al.* (2016) reported that farmer's own flock was the primary source of 68.4% breeding rams and they practice selection of male ram based on indigenous knowledge.

2.7 Grazing and feeding management

Padmanabhan (1994) observed that sheep were allowed to graze with no stall feeding in Salem and Dharmapuri district of Tamil Nadu. Some of the farmers feed the sheep with groundnut haulms, horse gram bhusa, etc., especially during the summer season.

Mehta *et al.* (1995a) in a study on characterization and conservation of Sonadi sheep revealed that the sheep were grazed from 9.00 a.m. to 7.00 p.m. The average grazing distance was 5 Km. 3% of farmers offered 250 to 500 g of Barley for 5 – 10 days post-

lambling for ewes. In addition to grazing, 29 % of the farmers had offered ground nut waste, babool pods and neem leaves to the sheep.

Sirohi and Rawat (2000) observed that in Rajasthan, concentrates were fed only to breeding ram in the majority of small as well as large farms. Groundnut cake and babool pods were fed as dry fodder mainly during the months of April to July when the availability of grazing land was low.

Chaturvedi *et al.* (2002) reported that sheep were reared exclusively on grazing with dry fodder supplementation even during critical stages of growth, advanced pregnancy and lactation in Malpura taluk of Rajasthan.

Dorji *et al.* (2003) observed that except salt, sheep are not receiving any supplementary feeding in addition to grazing in Bhutan.

Pattanayak *et al.* (2003) observed that Ganjam sheep of Orissa were maintained on extensive grazing with natural grasses like dub (*Cynoden doctylon*), Anjan (*Cenchrus ciliaris*) and stai (*Cynodon plectostachyas*). The common shrubs and leaves foraged by sheep in the grazing area were leaves of kantaikoli (*Ziziphus penoplia*), Acacia (*Acacia arabica*), Ber (*Ziziphus mauritiana*), Agathi (*Sesbania grandiflora*) and Tentuli (*Tamarindus indicus*).

Sushilkumar *et al.* (2003) reported that that the mean grazing time Kheri and Malpura sheep was 8-10 hours. In addition to grazing, rams were provided with Cereal grains @ 250-300 grams/day during the breeding season.

Jalauni sheep were maintained solely on grazing. The majority of farmers did not provide any supplementary feed to any category of animals i.e. pregnant ewes, lactating

ewes, breeding rams or lambs. The animals were taken for grazing at about 9-10 a.m. and returned at sunset as reported by Sahana *et al.* (2004).

Thiruvenkadan *et al.* (2004) observed that Mecheri sheep were grazed for 7-8 hours on roadsides, harvested fields, uncultivated areas and forest areas without any extra supplementation.

Dixit *et al.* (2005) reported that the migratory Rampur Bushair sheep were dependent solely on grazing while non-migratory sheep were supplemented with concentrate (barley plus wheat) @ 100-200 gms/animal/day in addition to grazing.

Kumar *et al.* (2006) reported that Muzzaffarnagari sheep were maintained on grazing for 8 hours a day and traveled for 4-20 km/day.

Kandasamy *et al.* (2006) reported that Coimbatore sheep depended solely on grazing and travelled a distance of 5-8 km for 7 to 8 hours in a day. No tree fodder is fed to the sheep, even during the period of scarcity. No concentrate supplementation is given to the lambs or adults. Watering is done two or three times a day based on the season and availability and the sources are generally canals, ponds or wells

Kuldeep *et al.* (2006) reported that the mean grazing time of sheep were 6.9, 7.8 and 8 hrs/day during rainy, winter, summer season, respectively in Rajasthan.

Thiruvenkadan *et al.* (2007) In a study conducted on Mecheri sheep and management practices followed by the farmers in Tamil Nadu, reported that sheep were sent for grazing for a period of 7 – 8 hrs. in uncultivated areas for a distance of 3-4 km. It was also reported that during scarcity, lactating ewes were fed with concentrate feed consisting

of rice bran, groundnut cake, soaked cotton seed and bajra in Mecheri sheep breeding tract in Tamil Nadu.

Suresh *et al.* (2008) reported that sheep managed in extensive and semi-intensive feeding system depends mostly on the common grazing land with very less supplementation of concentrate mixture in Eastern semi-arid region of Rajasthan.

Kumar *et al.* (2008) reported that the farmers were raising Malpura sheep under extensive grazing system and flocks were grazed for 8–10 hrs/day on natural grasses, crop stubble, roadside and fallow lands with seasonal tree lopping.

Nayak *et al.* (2008) reported that Ganjam sheep were reared under extensive grazing on natural pastures, shrubs, tree leaves, crop residues and they were never fed with concentrate mixture at any stage.

Chandran *et al.* (2009) reported that the vembur sheep in Tamil Nadu mainly depended on grazing in uncultivated and forest lands and harvested fields. It was further reported that grasses, herbs, stubbles and tree leaves were the major sources of feed. Rams were fed with *Sorgum vulgare*, *Phasiolus mungo* in addition to grazing. It was also mentioned that on an average the grazing distance was 2-6 km from the shed and the duration for which flocks were sent for grazing was 7-8 hrs/day. Sheep were allowed to watering 2 to 3 times per day depending up on availability.

Jain and Singh (2009) stated that the Nellore sheep were taken out for grazing from 8 a.m. to 6 p.m. and the flocks were reported to cover a distance of 10-20 km for grazing during the entire day while some of the farmers reported covering 3-5 km only. The adult sheep were maintained exclusively on grazing only without any extra supplementation.

Supplementary feeding to sheep and goat was not given by any of the farmers and grazing was the only source of feeding in Orissa as reported by Behura *et al.* (2009).

The Ganjam sheep were allowed to graze on natural grasses (*Cynodon doctylon*, *Cenchrus ciliaris*) and shrubs (*Acacia arabica*, *Ziziphus mauritiana*) from 9 or 10 a.m. in the morning to 6 p.m. in the evening for a distance of 5–20 Km. Tree loppings were also provided to the sheep but no supplementary feeding was given (Arora *et al.*, 2010).

Survey on Coimbatore sheep revealed that flock was allowed to graze extensively up to a distance of 5 to 8 Km for 7 to 8 hrs a day in harvested fields, barren and uncultivable lands, roadsides and in forest areas. Further, it was observed that even during scarcity, sheep were not fed with tree fodder or concentrate supplementation. Watering was done 2 or 3 times a day and sources of water were ponds, wells, or canals (Devendran *et al.*, 2010).

Rao *et al.* (2013) reported that the mean grazing time and grazing distance was 8.48 ± 0.06 hrs and 6.02 ± 0.17 km in summer and 6.08 ± 0.08 hrs and 3.78 ± 0.03 km in other seasons, respectively in North Coastal Zone of Andhra Pradesh.

Sireesha *et al.* (2014) reported that all the farmers were maintaining their sheep on extensive feeding system. About 91.70% of the farmers grazed their animals for the duration of 8-10 hr and the grazing distance ranged from 2-4 km (67.90 percent) to 4-6 km (32.10 per cent). None of the farmers were giving special feeding to pregnant and lactating ewes and only a small population (4.60 per cent) followed special feeding of rams. None of the farmers were feeding mineral mixture and only very few were given supplementary feeding in her study area.

Singaravadivelan *et al.* (2014) reported that the overall mean migratory distance of the sheep flock was 317.00 ± 6.21 and 148.40 ± 6.21 kms in major and minor migratory tracts, respectively, in southern Tamil Nadu. There is a large demand for night penning and folding of sheep in harvested agricultural fields.

Gowane *et al.* (2015) reported that the average grazing time for Malpura and Kheri sheep flock was 10 km. The average distance covered during grazing was 10 km, 30 km for Malpura and Kheri.

Hussain *et al.* (2015) reported that majority of the respondents (68.33%) followed sole grazing system for sheep. Concentrate mixture to sheep was offered by 35.00% of respondents. Flushing ration to the breeding ewes was provided by 35.00% of the respondents. Mineral mixture and vitamin supplementation to sheep was practiced by only 10% of the respondents. The feeding of cultivated green fodder to sheep was always practised by 31.67% of the respondents in sub-tropical zone of Jammu and Kashmir.

Kailash and Kavitha (2015) reported that 82.78% of farmers grazed their flocks on the community land resources. The majority of farmers adopted the mixed type of grazing. Sheep and goats were taken for grazing in mixed flocks. The total time spent for grazing was 9.45, 8.23, 7.41 hrs and total distance covered was 8.44, 7.41, 7.24 km in summer, rainy and winter seasons, respectively, in western Rajasthan.

Singaravadivelan *et al.* (2015) reported that the mean duration of penning in agricultural lands was 8.55 ± 0.07 months in a year. The mean grazing time and distance covered were 10.59 ± 0.05 h and 5.34 ± 0.12 km/day in summer and 9.05 ± 0.08 h and 3.70 ± 0.07 Km/day in other seasons, respectively, in migratory flocks of Southern Tamil Nadu.

Bagdi *et al.* (2016) reported that 50% of the farmers were providing concentrate mixture to ewe during pregnancy and lactation. About 5.56% of farmers growing grasses and planting fodder trees in Goda village of Rajasthan.

2.8 Lamb management

2.8.1 Housing for lambs

Padmanaban (1994) reported that in Mecheri block of Salem district lambs are taken care for 2 months. They were kept at home and afterward they were released into the flocks.

Kandasamy *et al.*, (2006) reported that the new-born lambs are housed in the lamb hut up to 15 days during daytime and are allowed with their dams during the night. Then the lambs are joined with the adults. Lamb hut is usually made up of palmyra fronds supported with bamboo or Nochi (*Vitex negundo*) sticks inside.

Lambs of Vembur sheep were kept in round houses known as *koodu* during the day time and were released into the flock at night time (Chandran *et al.*, 2009).

Arora *et al.* (2010) reported that Ganjam lambs were provided with basket-type enclosures up to 1 month of age.

It was reported by Devendran *et al.* (2010) that it is a practice for the farmers in Tamil Nadu to house newborn Coimbatore lambs in lamb hut up to 15 days during day time and to join them with the mother during night time.

Rajanna *et al.* (2013) reported that the majority (82.12 per cent) of farmers provided lamb enclosures during day time and released into the flocks in night times. These enclosures were made up of bamboo sticks, kept in inverted position and called as “Guduka” or “Podi” in local language

Kailash and Kavitha (2015) reported that the young lambs below 2 months of age were kept in their separate house during the night.

2.8.2 Lamb feeding

Padmanaban (1994) reported that in Mecheri block of Salem district some of the farmers fed the lambs with eggs, green leaves of neem and other trees and grass.

Sahana *et al.* (2004) reported that the lambs of Jalauni sheep were kept in the house for about 15 days after birth and thereafter join the flock for grazing.

Dixit *et al.* (2005) observed that lambs suckled their mother up to 2 months of age and then sent to graze along with the mother in Rampur Bushair sheep flocks of Jammu And Kashmir State.

Kandasamy *et al.* (2006) reported that no concentrate supplementation is given to the Coimbatore lambs. Young lambs are sent for grazing after 15 days of birth along with adults.

Thiruvenkadan *et al.* (2007) reported that 50% of farmers sent the lambs for grazing immediately after the 1st day of lambing and ram lambs were fed with concentrate mixture @ 100- 300 gms per day. Further, it was observed that lambs were maintained with ewe's milk, local weeds, grasses, tree leaves and harvested crops up to 3 months of age and then they were sent for grazing. A practice of feeding lambs with cow milk and ragi gruel as milk replacers was also observed to be commonly followed by the farmers. It was a common practice to tie tender grasses at the top of the lamb pen after one month of lambing. Lambs were allowed for suckling both in the morning and in evening.

Virojirao *et al.* (2008) in a study on adoption of sheep husbandry practices in Chittoor district of Andhra Pradesh observed that very few (4.55 per cent) shepherds were following the practice of lamb feeding.

It was observed by Behura *et al.* (2009) that 32% of farmers in Orissa state gave some bran, vegetable and kitchen waste to the male kids and lambs for fattening.

The Vembur lambs in Tamil Nadu were maintained on ewe's milk up to 1 month and thereafter they were fed with cooked grains. They were maintained on *Cyprus rotundus* grass for 1-3 months before they were allowed for grazing. (Chandran *et al.*, 2009)

Jain and Singh (2009) reported that the Nellore lambs were supplemented with tamarind leaves.

Hussain *et al.* (2015) reported that creep ration was provided to lambs by only 16.67% of the respondents. Majority (83.33%) of the respondents allowed lambs suckling on dam's milk for more than six weeks in sub-tropical zone of Jammu and Kashmir.

2.9 Health Management practices

Mehta *et al.* (1995b) reported that in Malpura sheep breeding tract drenching with deworming twice in a year was commonly practiced. Dipping was not practiced and only 7% of the sheep were vaccinated against Enterotoxaemia and sheep pox.

Pattanayak *et al.* (2003) observed that Ganjam sheep farmers of Orissa state are not followed the deworming and vaccination to their sheep.

The majority of the farmers in Jalauni sheep breeding tract area were not vaccinating their sheep against common diseases and no veterinary treatment was provided to diseased animals due to lack of accessibility of veterinary hospitals and poor financial status of the farmers, as well as the lack of awareness. (Sahana *et al.*, 2004).

Thiruvankadan *et al.* (2004) stated that in the breeding tract of Mecheri sheep, deworming was practiced at regular intervals and vaccination against FMD, sheep pox and enterotoxaemia was done only in the face of outbreaks.

Dixit *et al.* (2005) in a study on Rampur Bushair sheep reported that the main sheep diseases prevalent in that tract were Sheep Pox, Foot and Mouth Disease, Enterotoxaemia, Lung and Gastrointestinal Helminthic infestation and Mange. The majority of farmers (> 50 per cent) were aware of vaccination against viral diseases, drenching and dipping against parasitic infestation.

Kuldeep *et al.* (2006) in their study on sheep husbandry in Rajasthan observed that the sheep farmers spent on an average Rs.1.60, 4.68, 5.20 and 2.14/sheep/year for deworming, vaccination, treatment and other health coverage activities, respectively. The cost of health coverage ranged from Rs.12-15/sheep/year.

Dass (2007) studied the performance and management of Pugal sheep in the home tract and observed that sheep were routinely vaccinated and treated for the diseases.

Gopal and Hari (2007) reported dipping was carried out in ordinary water twice a year to Muzaffarnagari sheep.

Suresh *et al.* (2007) reported that the sheep farmers of Malpura and Toda Raisingh tehsils of Rajasthan mostly dependent on the Government Veterinary clinic (38 per cent) and private veterinary practitioners for the treatment of sheep. Ethnic treatment practices and treatment by the farmer himself is also followed widely.

Thiruvankadan *et al.* (2007) in their study on the health practices followed by sheep farmers in the Mecheri breeding tract observed that the sheep in the area were vaccinated against Foot and Mouth Disease, Enterotoxaemia and sheep pox during outbreaks and deworming was practiced at regular intervals.

Virojirao *et al.* (2008) in a study in Chittoor district revealed that only 43.2 and 54.6% farmers were following de-ticking and deworming, respectively, when government or non-government agencies take up mass de-ticking and deworming programmes. About 90% shepherds vaccinating their flock regularly.

Chandran *et al.* (2009) reported that the diseases prevalent in the breeding tract of Vembur sheep were Bluetongue, Foot and Mouth Disease, Peste des Petits Ruminants, Enterotoxemia, Sheep pox and Anthrax.

Only some farmers in Ganjam sheep breeding tract vaccinated their sheep against Foot and Mouth Disease, Enterotoxaemia and Peste des Petits Ruminants and used anthelmintics like Oxylozanide, Albendazole, Fenbendazole, Piperazine and so forth. Others neither vaccinated their sheep nor dewormed them. (Arora *et al.*, 2010).

Devendran *et al.* (2010) in a study reported that Coimbatore sheep were generally vaccinated against Anthrax, Enterotoxaemia, Peste des Petits Ruminants and Sheep pox and deworming was done once in 3 or 4 months.

Ravimurugan *et al.* (2012) reported that the sheep were drenched with anti-anthelmintics in the months of January and July (i.e. twice a year) and vaccinated against Anthrax and Foot and Mouth diseases. In the years, where there is adequate rainfall, vaccination against Enterotoxaemia is followed. It was learnt that Anthrax is the commonest contagious disease prevailing in Ramanathapuram district of Tamil Nadu.

Rao *et al.* (2013) reported that 47.39% farmers dewormed their sheep at every 6 months interval. About 87.60% sheep flocks were vaccinated against Enterotoxaemia and 71.87% against Foot and Mouth Disease.

Rajanna *et al.* (2013) reported that Deworming, vaccination was followed by 100 per cent farmers, spraying was followed by 8.16% farmers. The majority (88.54 per cent) of

sheep farmers were thrown dead animals into open fields and unused open wells. About 46.35 per cent farmers deworming their sheep four times in a year and 69.44 per cent farmers doing deworming on their own.

Sireesha *et al.* (2014) observed that all the farmers in the study were vaccinating their sheep and were following regular deworming.

Meena *et al.* (2015) reported that majority of the households (66.25 per cent) were initially providing self-medication using traditional practices and in cases of severity of disease/ailment, village quack was consulted. Vaccination of sheep was followed in only 48.75 per cent of farmers. In addition, in only 31.25% farmers the sick animals were isolated from the flock in Rajasthan.

Bagdi *et al.* (2016) in a survey in Goda village of Rajasthan reported that all farmers in the village were adopting vaccination against Enterotoxemia, Sheep Pox, PPR and Foot and Mouth disease.

2.10 Marketing

2.10.1 Marketing of lambs

Bose *et al.* (1999) in a study reported that 60 per cent of Bengal sheep farmers closer to township sells their sheep lambs/sheep directly to butchers and in villages through middlemen. A major factor affecting prices was farmers need.

Marketing of Mecheri sheep in its breeding tract was at weekly markets (57.25 per cent) or sold to middlemen (42.75 per cent), who visit the villages periodically. Animals were mostly transported by truck. Ram lambs were sold at 3 months of age. (Thiruvankadan *et al.*, 2004).

Karunanithi *et al.* (2005) in a study on Mecheri sheep reported that few ram lambs were selected for future breeding and others were disposed off at the age of 3 -12 months and almost all the ewe lambs were retained in the flocks for future breeding.

In a survey on Coimbatore sheep, Kandasamy *et al.* (2006) reported that selling surplus males lambs takes place around two months of age.

Nayak *et al.* (2008) observed that shepherds sold their surplus males of Ganjam sheep at about 6-12 months of age mostly during festive occasions or during urgent monetary requirement and the male lambs were generally castrated at 4 to 6 weeks of age.

Chandran *et al.* (2009) reported that sheep farmers in Vembur breeding tract obtained income through the sale of ram lambs, aged or culled ewes and through penning in the fields. It was further reported that ram lambs were sold at around 4 months of age by the farmers in that region.

Jain and Singh (2009) in a study on Vembur sheep reported that the surplus lambs were sold at 2 to 3 months age in its breeding tract.

Devendran *et al.* (2010) in a survey on Coimbatore sheep reported that surplus male lambs were sold at around 2 months of age.

Tailor *et al.* (2010) reported that in Sonadi sheep breeding tract, all the males were disposed off up to 10 months and some males were kept for breeding purpose.

Ravimurugan *et al.* (2012) reported that Ram lambs were sold from the flock after weaning, i.e. around 2–3 months of age. Few male lambs were kept in the flock for breeding purpose.

Senthilkumar *et al.* (2012) reported that majority of farmers preferred to sell animals in their own villages itself to reap the benefits of negotiation. The main reasons for selling the animal was urgent need of money (marked by 52.73 and 58.46%), fodder scarcity

(21.82%) and fear about sickness. It was observed that 50 to 60% of respondents sold male kids below 6 months of age in Tirunelveli district of Tamil Nadu.

Akila (2014) reported that marketing of sheep was done mainly through middlemen and weekly livestock markets in Karur district of Tamil Nadu.

Sireesha *et al.* (2014) reported that the age of selling the male lambs ranged from 6-12 months of age. It was observed that majority of the animals were slaughtered during festivals and various family and cultural events in her study area.

2.10.2 Basis of sheep marketing

Thiruvankadan *et al.* (2004) in a study on Macheri sheep marketing reported that the basis for selling of Mecheri sheep on muscle thickness at loin and thigh.

Karunanithi *et al.* (2005) in a study on Mecheri sheep reported that in most of the markets trading is based on muscle thickness at loin and thigh.

Virojirao *et al.* (2008) in a study on adoption of sheep husbandry practices in Chittoor district of Andhra Pradesh reported that 75% of the farmers sold their stock directly in the shandies or through the middle men and no farmer preferred selling on body weight basis.

Arora *et al.* (2010) in a study on Ganjam sheep reported that the selling price of the animals in the breeding tract was based on body size, body weight and arbitrary body score determined by butchers or middlemen.

Ramesh *et al.* (2012) reported that 85% of respondents sold their animal when they needed cash for home consumption. Important marketing channels were relatives and

friends, local markets and village collectors. The price of the animals was established based on the body confirmation of the animal in Karnataka.

Ravimurugan *et al.* (2012) reported that the sales of the ram lambs were made in the villages based on the weight and appearance of sheep.

Senthilkumar *et al.* (2012) reported that the most common criterion used by respondents for selling of animals was based on muscle thickness at loin and thigh region (70.91 and 81.54% in livestock market-I and market-II, respectively). In most of the cases trading was based on muscle thickness of animals at loin and thigh region in Tirunelveli district of Tamil Nadu.

Sireesha *et al.* (2014) reported that all the shepherds were selling the animals only on the live animal basis. About 73.75 % sheep farmers sold their animals for meat in the local market where as 17.08 % sold them in shandies. About 87.08 % animals were sold mostly through the hands of middlemen. The price was determined by the age and weight of the animals and also the demand in the market.

2.11. Constraints

Rauniyar *et al.* (2000) observed six major constraints to sheep farming in Nepal viz. poor performance of local sheep breeds, a serious seasonal deficit of pasture and other feed, lack of organized market for wool and meat, poor access to agricultural credit, primitive shearing equipment and inadequate supply of drinking water for sheep.

Selvam and Safiullah (2002) reported that shrinkage of traditional grazing lands and unorganized trading of the sheep were the major problems with small ruminant productivity.

Kumar (2003) reported that scarcity of grazing land, infestation of grazing area by *prosopis juliflora* bushers, non-availability of green fodder, disease prevalence and lack of infrastructure for marketing wool were the major problems for sheep rearers in Rajasthan.

Selvakumar (2003) reported the constraints of sheep rearing in Tamil Nadu were in the order of inadequate fodder supply, disease incidence, lack of own finance, non-availability of labour, costly veterinary treatment, middleman, delay in disbursement of the loan, unsuitable climatic conditions and inadequate knowledge about scientific practices.

Kumar *et al.* (2006) reported that non-availability of adequate grassland, paucity in the availability of pure breeding rams of the breed and lack of proper health care (vaccination and deworming) particularly in the flocks of landless and poor sheep breeders were the main constraints in Mazaffarnagari sheep breeding tract.

Yadav *et al.* (2006) in a study on Muzaffarnagri sheep breed observed that the non-availability of adequate grassland, paucity in the availability of pure breeding rams and lack of proper health care in the flocks of landless poor were the main constraints in sheep production.

Kuldeep *et al.* (2006) in a study on socio-economic survey of sheep farmers in western Rajasthan observed that the major problems faced by sheep farmers during migration were resistance by local farmer's restrictive rules and regulations and lack of veterinary health cover. It was further observed that lack of graded breeding rams and lack of proper marketing for animal produce was also a depressing factor.

Misra *et al.* (2007) in a study on strategies for livestock development in rainfed agro-ecosystem of India reported that inadequate availability and poor quality of feed and fodder, high incidence of diseases and inadequate knowledge on the appropriate management of livestock were identified as the major problems faced by small farmers in India.

Virojirao *et al.* (2008) carried out a study on the adoption of sheep husbandry practices in Andhra Pradesh and made some prominent observations which indicated that shepherds were exploited by middlemen or butchers in the study area and further observed that failure of co-operatives and backwardness of sheep farmers were the twin causes for exploitation.

In a survey conducted by Yadav *et al.* (2009) on Marwari sheep, it was indicated that shrinkage in the breeding tract, grazing land, inadequate health measures, and decrease in breed purity are the factors that were responsible for decreasing population trend.

Meganathan *et al.* (2010) undertook the constraint analysis of tribal livestock farming in Tamil Nadu and observed that factors like lack of sufficient pasture land, marketing facilities, adequate credit facilities, remunerative prices for the livestock products and scientific knowledge on livestock farming were the major constraints perceived by the tribal farmers.

Rao *et al.* (2013) reported that disease outbreaks (85.95 per cent) and lack of veterinary facilities (83.81 per cent) were major constraints during migration in North Coastal Zone of Andhra Pradesh.

Choudary *et al.* (2013) reported that the major constraints perceived by sheep farmers was the incidence of disease, followed by high lamb mortality, shrinkage of grazing land, drinking water scarcity, exploitation by middlemen, no compensation for deaths,

labour problem, lack of credit facility, non-availability of breeding rams, and lack of veterinary aid in Macherla Brown sheep breeding tract of Andhra Pradesh.

Meena and Singh (2013) reported that 46.50 and 40.00 per cent of the participant farmers were in the medium and high levels of adoption of recommended sheep husbandry practices, respectively, whereas 51.00 and 43.00 per cent of non-participant farmers were in the medium and low levels of adoption of sheep husbandry practices, respectively, in arid zone of Rajasthan.

Harilal *et al.* (2014) reported that majority of the sheep farmers (100 per cent) perceived a lack of knowledge on the preparation of balanced feed followed by inadequate knowledge on the right time of crossing (95.83 per cent) as the second major constraint in Srikakulam district of Andhra Pradesh.

Khalid *et al.* (2014) reported that inadequate credit facilities, lack of knowledge in scientific practices, poor services and facilities provided by the government, inadequate technical guidance, non-availability of training facilities, non-availability of roughage, lack of veterinary services at farmer's doorstep and non-availability of organized market for wool/mutton were the major constraints faced by the respondents in Jammu and Kashmir.

Sireeha (2015) reported that non-availability of concentrate feed at a reasonable cost, proper transport facilities, grazing lands and water facilities were found to be the major constraints hindering the sheep rearing in her study.

Bagdi *et al.* (2016) reported that lack of grazing land, local market, proper sheds and water troughs were the major problems faced by Shepherds of Soda village in Rajasthan.

Sankhyan *et al.* (2016) reported that Diseases, predators, environmental extreme, veterinary aid in high hills and marketing infrastructure were major constraints in sheep in Western – Himalayan region of India.

Chapter - III

Materials and Methods

CHAPTER III

MATERIALS AND METHODS

Materials and methods were presented in the following subheads viz., geographical profile of Krishna district, socio-economic profile, sheep population in the district, management conditions at farmer's level, data collection and statistical analysis of the collected information.

3.1 Geographical profile of Krishna district

3.1.1. Geographic location

Krishna district is located on the east coast of India between 15 °- 43'N. latitude and 17° 10'N. Latitude and between 80° E. longitude and 81°33'E. Longitude, covering an area of about 8,727 Sq.Km. It accounts for 5.35% of the total geographical area of the state. The district is naturally divided into delta and upland areas. Krishna district has 4 Revenue Divisions, these revenue divisions are divided into 50 mandals in the district. These 50 mandals consists of 49 mandal parishads, 973 panchayats, 1005 villages and 5 municipalities.

3.1.2. Boundaries

The district was surrounded by West Godavari district in the east, Bay of Bengal in the south, Guntur and Nalgonda districts in the west and Khammam district in the north directions. (Fig.1).

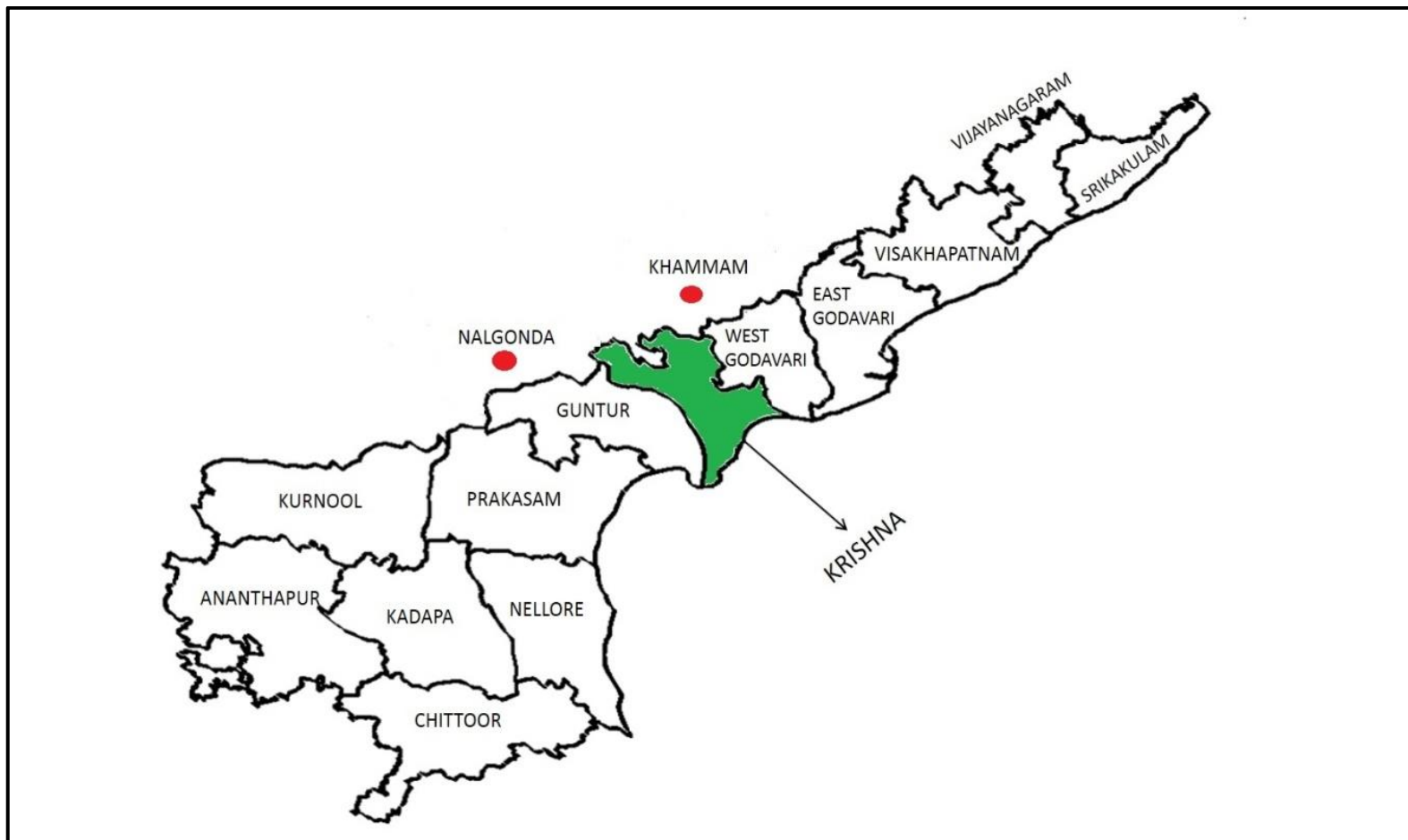


Fig.1 Map of Andhra Pradesh showing Krishna district.

3.1.3. Demographic Particulars

The total population of the district is 45,17,398 with a literacy per cent of 73.78. The density of the district was 518 residents per sq.km. Of the total population, males were 50.19% and females were 49.81%. Of the total population, the Scheduled Caste population share in the district is 16.57% and Scheduled Tribes is 2.48%. The percentage of urban population in the total population was 40.81.

3.1.4. Land Utilisation

The total geographical area of the district was 8,72,700 ha. During the year 2015 the area covered by forest was 76,186 ha. The net area sown was 4,85,637 ha. and the total cropped area in the district was 6,76,999 ha. The barren and uncultivated wasteland was 36,757 ha. Land put to non-agricultural use was 1,52,614 ha.

3.1.5. Climate

The district falls under tropical climatic zone and experiences extreme hot summer and severe winter. Summer temperatures raise even up to 50⁰C and while cold waves in the uplands of the district as low temperatures as 8⁰C. The period starting from April to June is the hottest.

The year may be divided into four seasons viz.,

- December- February: Dry and cool winter season
- March- May: Summer season
- June – September: South-West monsoon
- October – November: Post monsoon or retreating monsoon season.

3.1.6 Rainfall

Normal rainfall of the district was 1034 mm and 67% (686 mm) of this is received through South – West monsoon, 24% (250 mm) is contributed by North - East monsoon, while remaining 9% (98 mm) is shared by winter and summer showers.

Frequent cyclones of different intensities and tidal storms are natural calamities affecting the central tracts of Krishna, particularly causing deterioration of ground water quality in the coastal aquifers.

3.1.7. Rivers

The only major river in the district is 'Krishna'. Other riverlets include Muneru, Tammileru and Budameru. Besides there are some hill streams like Jayanthi, Kattaleru, Ippalavagu, Upputeru, Paleru, Ballaleru, Nidimiyeru etc. This district shares with the West Godavari district one of the large freshwater lakes on the east coast, namely 'Kolleru'.

3.1.8. Irrigation

Krishna is the major river irrigating the district and Muniyeru, Tammileru, Budameru and Paleru are the main riverlets. Muniyeru is the chief tributary to River Krishna and is the major sources of irrigation in the district.

Sir Arthur Cotton got constructed an anicut across Krishna river about 200 years ago at Vijayawada and the same was replaced with the present Prakasam Barrage 50 years ago. It caters the needs of agriculture in Krishna, Guntur and West Godavari districts. The district gets irrigation water through major canals on the left side of the river course. Krishna Delta is mainly divided into Krishna Central division and Krishna Eastern division.

Upland mandals in the district are irrigated by the waters of Nagarjuna Sagar Project; left canals, minor irrigation tanks, lift irrigation schemes, bore tube filter points, wells and small supply channels.

3.1.9. Soils

Agriculture is the main occupation in the district. The most common type of soils in Krishna district is Black Cotton Soils (57.6%) followed by Sandy Clay Loam (22.3%), Red loamy Soils (19.4%) and Sandy Soils (0.7 %).

3.1.10. Crops

Paddy (2,88,042 ha) is the main food crop of the district followed by Black gram (1,25,694 ha), Maize (25,632 ha), Green gram (17,719 ha), Sugarcane (16,719 ha) and Groundnut (1,844 ha).

3.2. Sheep population

India with a sheep population of 65.06 million, ranks 3rd in the world (GOI-2012), while Andhra Pradesh with a population of 1,35,59,822 sheep stands first in the country. The sheep population of A.P in different livestock census were given in the Table. 1&2 and Fig. 2.

Table.1 Sheep population of Andhra Pradesh in different years.

Year	1993	1999	2003	2007	2012
Population (Lakhs)	77.87	97.43	210.15	255.39	135.59

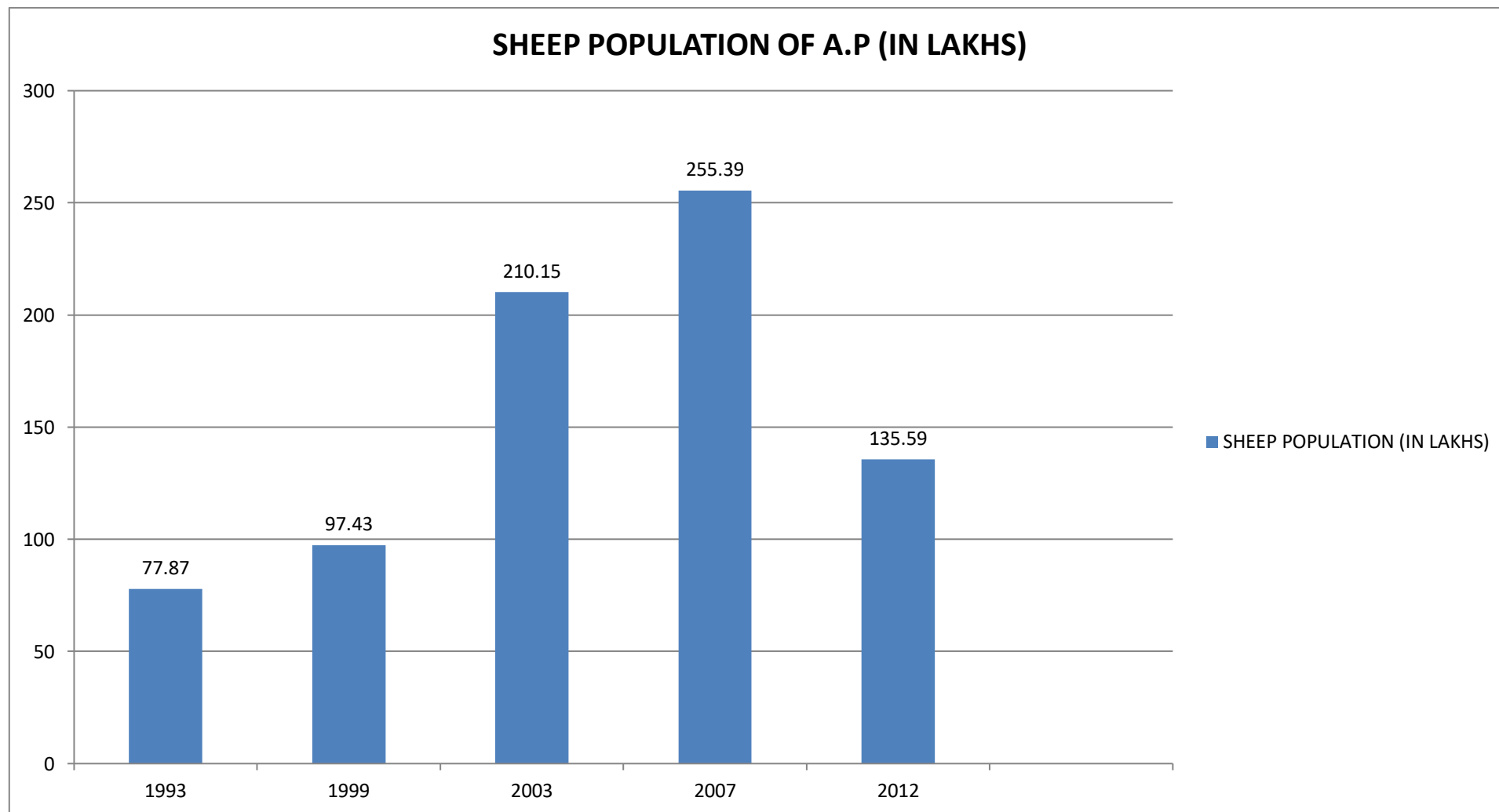


Fig.2 Graph showing sheep population trend in Andhra Pradesh.

Table.2 Detailed Sheep population (Heads) of Andhra Pradesh in various census years.

Category	Census Year				
	1993	1999	2003	2007	2012
1.sheep (cross bred)					
(i) Male					
(a) under 1 Year	4747	12396	79040	4365	9325
(b) 1 year and above	7194	15895	58550	2140	7953
Total crossbred male Sheep	11941	28291	137590	6505	17278
(ii) Females					
(a) under 1 Year	6861	15550	115236	4493	13262
(b) 1 year and above	25598	31470	247536	4911	22799
Total Crossbred Female Sheep	32459	47020	362772	9404	36061
Total Crossbred Sheep	44400	75311	500362	15909	53339
2.sheep (indigenous)					
(i) Male					
(a) under 1 Year	743698	1070561	1960255	2925952	3013781
(b) 1 year and above	925024	1298160	1889519	2579729	2207610
Total indigenous male sheep	1668722	2368721	3849774	5505681	5221391
(ii) Females					
(a) under 1 Year	1387845	2092176	3485362	5571465	5698607
(b) 1 year and above	4686277	5206981	13179176	14446397	15422246
Total indigenous female Sheep	6074122	7299157	16664538	20017862	21120853
Total indigenous Sheep	7742844	9667878	20514312	25523543	26342244
Total Sheep	7787244	9743189	21014674	25539452	26395583

(Source: GOI-2012)

3.2.1 Small ruminant population of Andhra Pradesh

The district wise small ruminant population of Andhra Pradesh was provided in the Table.3. Among the districts, Anantapur district ranked first in the sheep population with 38,79,840 sheep and East Godavari district ranked at the bottom with 2,46,722 sheep. Krishna district with a population of 5,08,06 ranked 9th in the state (Divided Andhra Pradesh).

Table.3 District wise small ruminant population of Andhra Pradesh as per 19th Livestock Census-2012.

Sl.No	District	Sheep	Goat	Total Small Ruminants
1	Srikakulalm	5,75,046	2,12,300	7,87,346
2	Vizianagaram	2,52,610	1,73,751	4,26,361
3	Visakhapatnam	4,23,123	3,24,024	7,47,147
4	East Godavari	2,46,722	2,92,201	5,38,923
5	West Godavari	4,36,810	1,93,218	6,30,028
6	Krishna	5,08,061	1,51,118	6,59,179
7	Guntur	6,21,122	2,13,249	8,34,371
8	Prakasam	14,06,578	4,06,239	18,12,817
9	S.P.S Nellore	10,51,938	3,51,426	14,03,364
10	Y.S.R Kadapa	14,03,224	4,57,896	18,61,120
11	Kurnool	5,06,173	15,04,671	20,10,844
12	Ananthapuram	38,79,840	7,85,210	46,65,050
13	Chittor	12,50,077	4,28,721	16,78,798
	Toal	1,35,59,822	44,95,526	1,80,55,348

(Source: Statistical abstract of Andhra Pradesh-2015)

3.3 Selection of respondents

Selection of respondents was made by multistage stratified random sampling technique. The district is divided into two areas i.e irrigated and rainfed areas. In the first stage from each area, five mandals were selected (Fig. 3). In the second stage from each mandal, five villages were selected at random. In the third stage from each selected villages, 5 sheep farmers were selected forming total respondents of 250 farmers. On the basis of above classification, the study involved a total number of 2 areas, 10 mandals, 50 villages and 250 farmers. List of sheep farmers from the selected villages was prepared separately with the help of Veterinary Assistant Surgeons of the nearest veterinary institutions. The details of the sampling plan were represented in Fig.4 and the list of mandals and the names of the villages were given in Table.4.

3.4 Data Collection

The selected farmers were interviewed by contacting them at their doorstep by utilising a pre-tested interview schedule developed for the purpose (Appendix). Data pertaining to the socio-economic profile of sheep farmers, productive, reproductive parameters, management practices at farmer's level, health care practices, sheep marketing details and constraints in sheep rearing and marketing was collected from the sheep farmers using a pre-tested interview schedule.

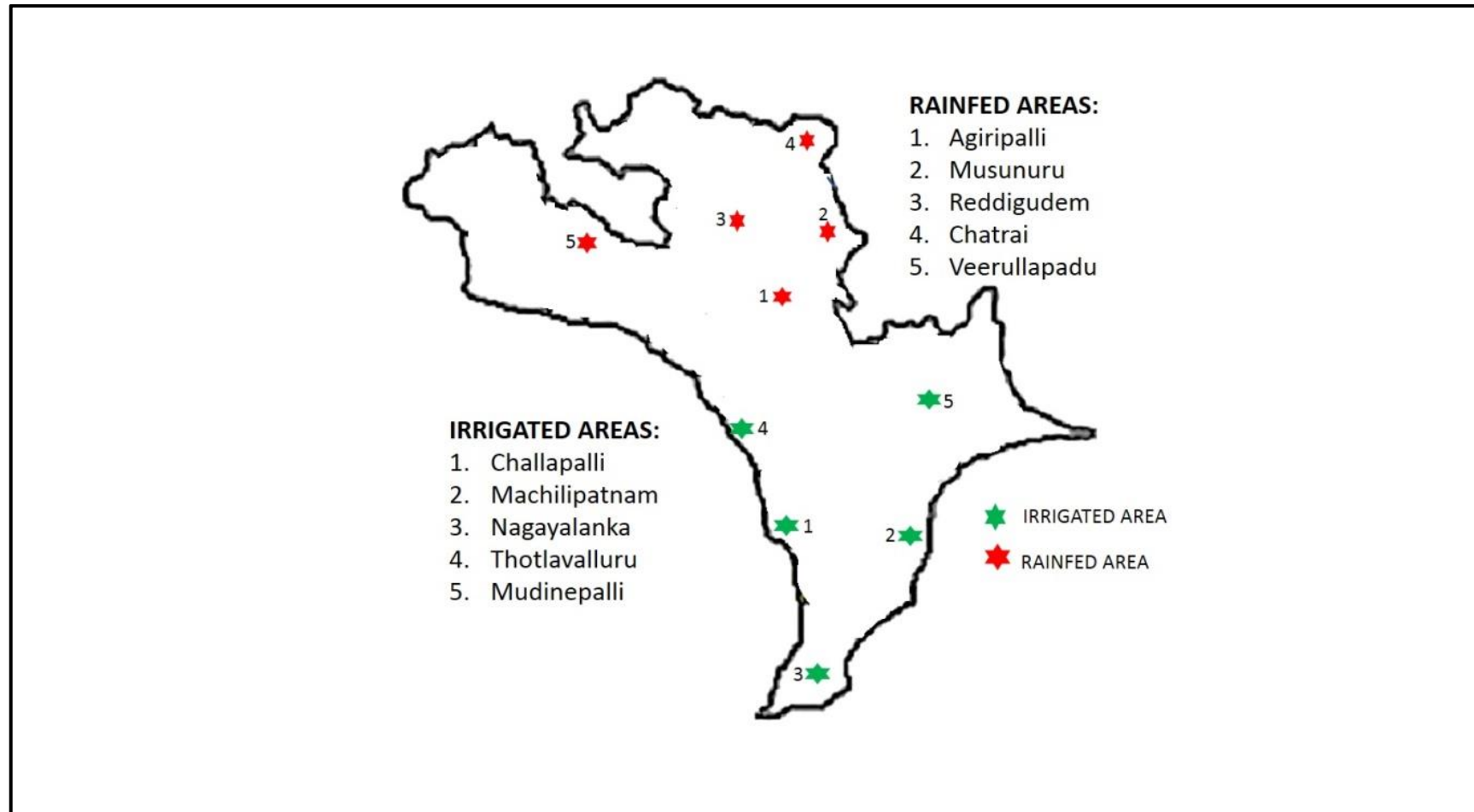


Fig.3 Map of Krishna district showing the study area.

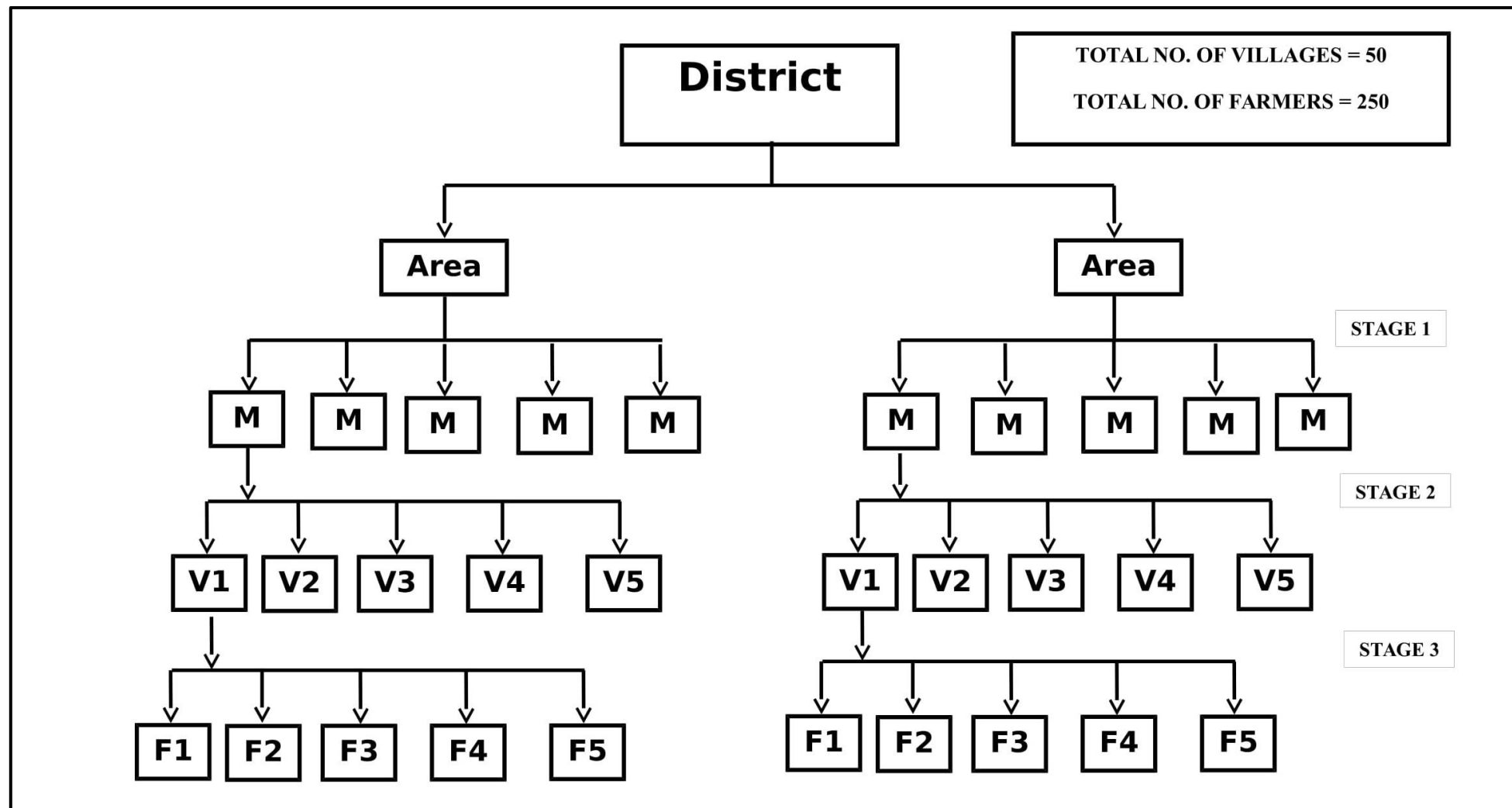


Fig4. Sampling plan for the present study.

Table.4 List of mandals and villages surveyed in irrigated and rainfed areas of Krishna district.

AREA	REVENUE DIVISION	MANDAL	VILLAGES
I R R I G A T E D A R E A	MACHILIPATNAM	1. CHALLAPALLI	1. CHALLAPALLI
			2. NADAKUDURU
			3. MANGALAPURAM
			4. PAGOLU
			5. LAKSHMIPURAM
	MACHILIPATNAM	2. MACHILIPATNAM	1. MANGINAPUDI
			2. GOPUVANIPALEM
			3. TALLAPALEM
			4. N.GOLLAPALEM
			5. MUDIRAJUKONA
	MACHILIPATNAM	3. NAGAYALANKA	1. PARRACHIVARA
			2. BHAVADEVARAPALLE
			3. PEDAPALEM
			4.CHINAKAMMAVARIPALEM
			5. SANGAMESWARAM
	VIJAYAWADA	4.THOTLAVALLURU	1. THOTLAVALLURU
			2. CHAGANTIPADU
			3. ROYYURU
			4. VALLURUPALEM
			5. BHADRIRAJUPALEM
	GUDIVADA	5. MUDINEPALLI	1. MUDINEPALLI
			2. VISHWANADRIPALEM.
			3. PEDAGONNURU
			4. VAIVAKA
			5. KORRAGUNTAPALEM

Table.4(contd.)

R A I N F E D A R E A	NUZVID	1.AGIRIPALLI	1. AGIRIPALLI
			2. VADLAMANU
			3. EDULAGUDEM
			4. SAGGURU
			5. EDARA
	NUZVID	2.MUSUNURU	1. MUSUNURU
			2. KATRENIPADU
			3. GOPAVARAM
			4.GOGULAMPADU
			5.SIMHADRI PURAM
	NUZVID	3.REDDIGUDEM	1. REDDIGUDEM
			2. NAGULURU
			3. KUDAPA
			4. MUTCHINAPALLE
			5. KUNAPARAJUPARVA
	NUZVID	4.CHATRAI	1. CHATRAI
			2. CHANUBANDA
			3. CHITTAPUR
			4. NARASIMHARAOPALEM
			5. PARVATAPURAM
	VIJAYAWADA	5.VEERULLAPADU	1. VEERULLAPADU
			2. VELLANKI
			3. JUJJURU
			4.CAVATAPALLI
			5. PONNAVARAM

3.4.1 Socio-economic profile of the farmers

The information pertaining to sheep farmers regarding the level of literacy like primary grade, secondary grade or above was collected. The information on the occupation of the farmer was elicited and classified as main and subsidiary occupation basing on their level of involvement in a particular occupation. Accordingly, the farmers were classified into Agricultural, Animal husbandry. The chronological age at the time of inquiry was taken as a measure and classified into three categories as young, middle and old.

Category	Young	Middle aged	Old aged
Age	Up to 30 years	31 to 50 years	Above 50 years

The respondents were classified into literate and illiterate on the basis of their ability to read and write. The respondents were categorized into five groups based on land holding, according to (Agricultural Debt Waiver and Debt Relief Scheme, 2008 http://www.nabard.org/pdf/debt_waiver_scheme.pdf).

Type of farmers	Land holding size
Landless farmers	0 acres
Marginal farmers	0.01 – 2.5 acres
Small farmers	2.6 – 5 acres
Medium farmers	5-10 acres
Large farmers	Above 10 acres

In the present study, flock size had been formulated taking into account the number of heads of sheep which included ram, ewe, replacement female and lambs possessed by the flock owners and the average flock size per household was calculated. Sheep farming experience was also calculated based on the observations in the

questionnaire. The knowledge level of farmers regarding sheep rearing was also collected in irrigated and rainfed areas.

3.4.2 Productive parameters of sheep

The information on the biometric parameters of sheep was collected through interaction with the farmers, personal observations and on the spot recording of the parameters such as body weight, body length, height at withers, chest girth and punch girth of sheep.

<u>Parameter</u>	<u>Measurement</u>
Body weight	The body weight was measured by using a 100 kg spring balance with an accuracy of 0.10 gm by using a spring balance.
Body length	Length of the body was measured from the shoulder point to pin bones in centimetres by using a flexible tape.
Height at withers	Height was measured from the ground to the level of withers in centimetres by using a flexible tape.
Chest girth	Body girth was measured as circumference around the chest just behind the withers in inches.
Punch girth	Body circumference in front of the sacrum.
Age	2 teeth (1-1.5 years), 4 teeth (1.5-2 years), 6 teeth (2.5-3 years) and 8 teeth (3.5 to 4 years).

3.4.3 Reproductive parameters of sheep

Reproductive performance of rams and ewes was studied through the questionnaire. The information on age at first mating in males, age at first mating in females, age at first lambing, lambing interval, age at weaning and weight at weaning were collected.

3.4.4 Management practices followed by shepherds at field level

3.4.4.1 Housing management practices

The information with regard to various management activities related to housing was collected. The information about the way the sheep were reared was also collected and categorized into extensive, semi-intensive, intensive systems. The type of housing provided and the materials used for housing and roofing was also gathered by visiting the shepherd's localities and by personal observation. The feeding and watering facilities provided in the sheds/houses by the shepherds were recorded by personal visit and interaction by the investigator. Information pertaining to the cleaning of shed and periodicity of cleaning was also collected with the help of a pre-tested questionnaire. The results obtained will be compared between irrigated and rainfed areas of the district.

3.4.4.2 Breeding management

The breeding practices followed by the shepherds in the irrigated and rainfed areas of Krishna district were collected in the present study. The information on knowledge of farmers on heat signs exhibited by sheep, mating practices, awareness on ram to ewe ratio, flushing and the major season for breeding were collected using the questionnaire. The information regarding the ram rotation like the practice of ram rotation, period of ram rotation and the method by which the ram was rotated was collected by interacting with the farmers and by use of a questionnaire. The flocks were also observed for the ram to ewe ratio, housing system of male and female animals (whether they kept together or separately) and mating practices followed by the shepherds etc.

3.4.4.3 Grazing and feeding practices

The information about the grazing practices followed by the shepherds was collected, with the help of a pre-tested questionnaire. The information pertaining to

various activities related to grazing, distance covered during grazing, duration and direction of grazing areas was collected by personal interaction with the shepherds.

In addition to the above information, the details of feeding practices followed by the shepherds were also gathered. The information included about the nature of supplementary feeding, concentrate feeding, lamb feeding, special feeding practices followed by shepherds was recorded.

The information about the migration, details of penning and penning management was also collected with the help of a questionnaire, personal observation and by interaction with the shepherds in both the areas.

3.4.4.4 Health Management

The information on health management practices followed by the shepherds in the study area was collected by interacting with the shepherds. Using the standard questionnaire, information pertaining to the health management practices like regular vaccination and deworming and the source from which the shepherds procured the vaccines, dewormers was also collected. In addition, the information regarding the ways in which the sick animals and dead animals were disposed of was also collected. The knowledge of farmers on the health and diseases was collected by questionnaire and also by observation during the course of personal interaction.

3.4.5 Marketing

The information regarding the marketing practices followed by the shepherds in the irrigated and rainfed areas of Krishna district was obtained by interacting with the farmers using the pre-tested questionnaire. The questionnaire included questions to obtain information pertaining to the mode of marketing, mode on which the selling was done, place of disposal, the basis of marketing, age at which the male lambs were marketed and marketing of other by-products by the farmers. The information thus obtained was analysed and tabulated.

3.5 Constraints in sheep rearing

The information on various constraints faced by the shepherds in sheep rearing was collected by using a questionnaire. Problems faced during grazing of sheep, marketing of meat was collected by interacting with interested farmers. The reasons for the low profitability of sheep enterprise were also observed, so as to provide some information to policy makers to make sheep rearing a profitable enterprise.

3.6 Statistical Analysis and Experimental Design

Data collected were tabulated and analysed as per standard statistical procedures (Snedecor & Cochran, 1994) using SPSS (version 15.0.1), software.

Chapter - IV

Results

CHAPTER IV

RESULTS

4.1 SOCIO ECONOMIC STATUS OF THE SHEEP FARMERS IN KRISHNA DISTRICT

Socio economic status of the farmers in irrigated and rainfed areas of Krishna district was presented in Table 5.

4.1.1 Age of the sheep farmers

The age of sheep farmers in the study area is presented in Table. 5 and depicted in Fig.5. It was seen from the table that the majority of the farmers studied in the irrigated and rainfed areas of the district were middle-aged (64 per cent and 60 per cent respectively). About 14.4 per cent farmers are of young age in both irrigated and rainfed areas. Whereas, 21.6% and 25.6% of the farmers were old age in irrigated and rainfed areas, respectively.

4.1.2 Literacy level of the sheep farmers

Illiterate sheep farmers constituted about 81.6 and 88 per cent in irrigated and rainfed areas of the study area, respectively. Literate farmers recorded were 18.4 and 12 per cent, respectively in irrigated and rainfed areas.

4.1.3 Family type and size of sheep farmers

As far as the family type of the sheep holders was concerned, nuclear family type dominated in both the areas (81.6 in irrigated and 84.8 per cent in rainfed area), followed by joint family type (18.4 and 15.2 per cent, respectively).

The family size of shepherds in the study area was depicted in Fig.6. The majority of the sheep farmers were having medium-sized families i.e 5-7 members (46.4 per cent in both the areas) followed by small-sized families i.e 2-4 members (45.6 per cent in irrigated area and 38.4 per cent in rainfed area). Large size families i.e >7

Table 5. Socio economic profile of shepherds in irrigated and rainfed areas of Krishna district.

S.NO	OBSERVATION		IRRIGATED AREA		RAINFED AREA		TOTAL	
			NO.OF FARMERS	%	NO.OF FARMERS	%	NO.OF FARMERS	%
1	AGE	YOUNG (<30 YEARS)	18	14.4	18	14.4	36	14.4
		MIDDLE (31-50 YEARS)	80	64	75	60	155	62
		OLD (>50YEARS)	27	21.6	32	25.6	59	23.6
2	EDUCATION	ILLITERATE	102	81.6	110	88	212	84.8
		LITERATE	23	18.4	15	12	38	15.2
3	FAMILY TYPE	JOINT	23	18.4	19	15.2	42	16.8
		NUCLEAR	102	81.6	106	84.8	208	83.2
4	FAMILY SIZE	SMALL (2-4 MEMBERS)	57	45.6	48	38.4	105	42
		MEDIUM (5-7 MEMBERS)	58	46.4	58	46.4	116	46.4
		LARGE (ABOVE 7 MEMBERS)	10	8	19	15.2	29	11.6

Table.5(contd.)

5	LAND HOLDING (ACRES)	LANDLESS (0 ACRES)	57	45.6	91	72.8	148	59.2
		MARGINAL (0.01-2.5 ACRES)	45	36	21	16.8	66	26.4
		SMALL (2.51-5 ACRES)	21	16.8	12	9.6	33	13.2
		MEDIUM (5-10 ACRES)	2	1.6	1	0.8	3	1.2
		LARGE (ABOVE 5 ACRES)	0	0	0	0	0	0
6	MAIN OCCUPATION	SHEEP REARING	64	51.2	93	74.4	157	62.8
		SHEEP REARING & AGRICULTURE	61	48.8	32	25.6	93	37.2
7	ANNUAL HOUSEHOLD INCOME	LOW (RS. <55000)	56	44.8	52	41.6	108	43.2
		MEDIUM (RS.55000- 90000)	64	51.2	65	52	129	51.6
		HIGH (RS.>90000)	5	4	8	6.4	13	5.2
8	TYPE OF FARMER'S RESIDENCE	KUTCHA	72	57.6	70	56	142	56.8
		PUCCA	53	42.4	55	44	108	43.2

Table.5(contd.)

9	FARMER'S RELIGION	HINDU	120	96	115	92	235	94
		CHRISTIAN	5	4	10	8	15	6
		MUSLIM	0	0	0	0	0	0
10	COMMUNITY	OC	4	3.2	5	4	9	3.6
		BC	108	86.4	84	67.2	192	76.8
		SC	10	8	19	15.2	29	11.6
		ST	3	2.4	17	13.6	20	8
12	SHEEP FARMING EXPERIENCE	< 5 YEARS	26	20.8	24	19.2	50	20
		5-15 YEARS	76	60.8	72	57.6	148	59.2
		>15 YEARS	23	18.4	29	23.2	52	20.8

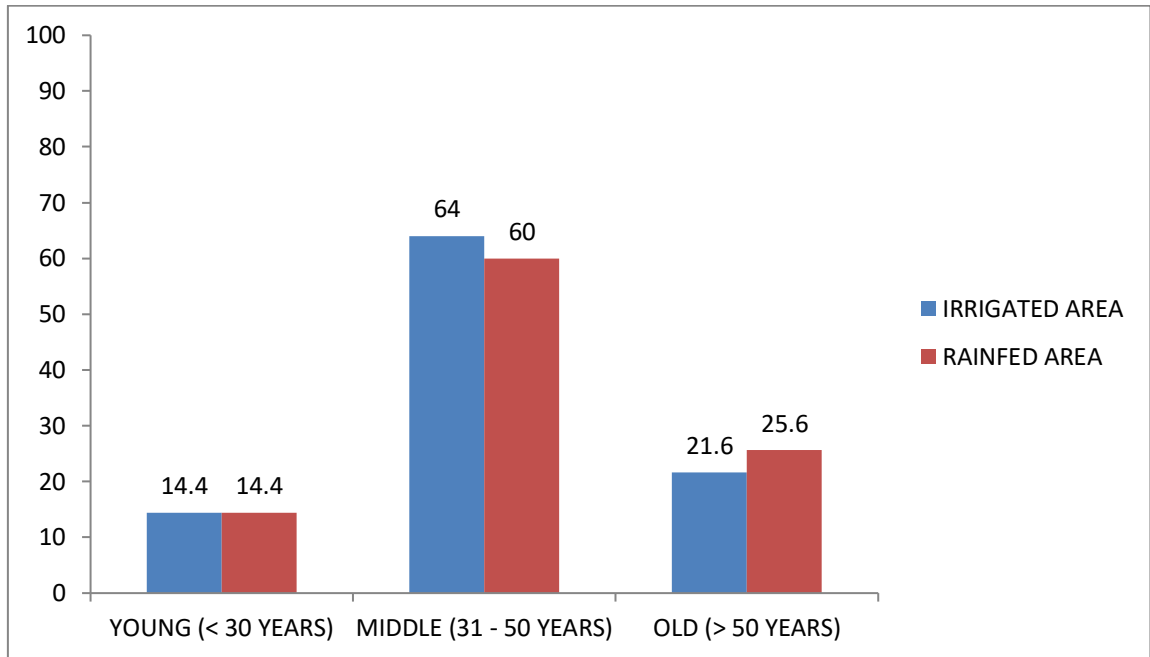


Fig.5 Age groups of shepherds in irrigated and rainfed areas of Krishna district.

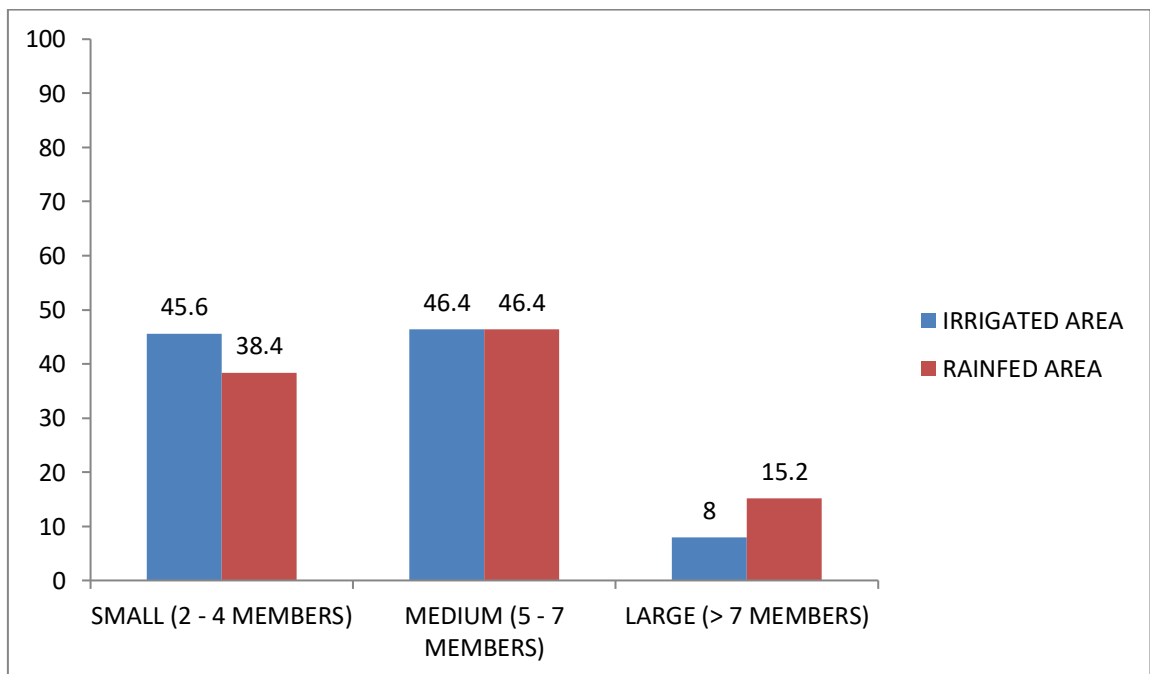


Fig.6 Family size of shepherds in irrigated and rainfed areas of Krishna district.

members, constituted the least (8 per cent in irrigated area and 15.2 per cent in rainfed area).

4.1.4 Land holding of sheep farmers

Classification of sheep farmers based on agricultural land holding and overall mean land holding of sheep farmers in the study area are presented in Table.5 and depicted in Fig.7.

From the table, it was observed that majority of the farmers in both the areas were landless (45.6 per cent in irrigated area and 72.8 per cent in rainfed area) followed by marginal land holders (36 per cent in irrigated area and 16.8 per cent in rainfed area). Small holders constituted about 16.8 per cent in irrigated area and 9.6 per cent in rainfed area. Very few medium farmers noticed in the study area (1.6 per cent in irrigated area and 0.8 per cent in rainfed area). The average land holding size in irrigated area was 1.2 ± 0.14 acres and in rain fed area it was 0.60 ± 0.10 acres.

4.1.5 Main occupation of sheep farmers

It was seen from the Table.5 that majority of the households studied in both areas, sheep rearing was the main occupation (51.2 per cent in irrigated area and 74.4 per cent in rainfed area). Whereas, remaining respondents were engaged in agriculture and agriculture labourers (48.8 per cent in irrigated area and 25.6 per cent in rainfed area).

4.1.6 Annual household income

From Table.5 it was evident that majority of the sheep farmers were having annual household income between Rs. 55,000 -90,000 (51.2 percent in irrigated area and 52 per cent in rainfed area), followed by the farmers having income below Rs. 55,000 (44.8 per cent in irrigated area and 41.6 per cent in rainfed area). Very few sheep farmers (4 percent in irrigated and 6.4 per cent in rainfed area) were getting income above Rs. 90,000 per year.

4.1.7 Type of farmer's residence

In both areas, most of the sheep farmers were living in kutcha houses (57.6 per cent in irrigated area and 56 per cent in rainfed area) and remaining sheep farmers were living in pucca houses (42.4 per cent in irrigated area and 44 per cent in rainfed area).

4.1.8 Farmer's religion and community

The social status of sheep farmers based on religion and community in the study area was presented in Table.5 and in Fig.8. In irrigated area, the majority of the sheep farmers were Hindus (96 per cent) followed by Christians (4 per cent). No Muslim respondent encountered in the present study in both areas. Similarly, the majority of the sheep farmers in rainfed area were Hindus (92 per cent) followed by Christians (8 per cent). Sheep farmers from Backward Communities constituted about 86.4 and 67.2 per cent, respectively, in irrigated and rainfed area of the study area. Sheep farmers from Scheduled Castes community constituted about 8 and 15.20 per cent respectively in the above areas. Sheep farmers from Schedule Tribes community constituted 2.4 and 13.6 per cent, respectively, in irrigated and rainfed areas. Very few sheep farmers from other than above said communities (OC) were encountered during the study (3.2 per cent in irrigated area and 4 per cent in rainfed area).

4.1.9 Sheep farming experience

The sheep farming experience of the shepherds was presented in Table.5 and depicted in the Fig.9. It was observed from the table that most of the sheep farmers in both areas had 5-15 years of experience in sheep farming (60.8 per cent in irrigated and 57.6 per cent in rainfed area). About 20.8 per cent of farmers in irrigated area and 19.2 per cent farmers in rainfed area had sheep farming experience of less than 5 years. Sheep farmers having the experience of more than 15 years were 18.4 per cent in

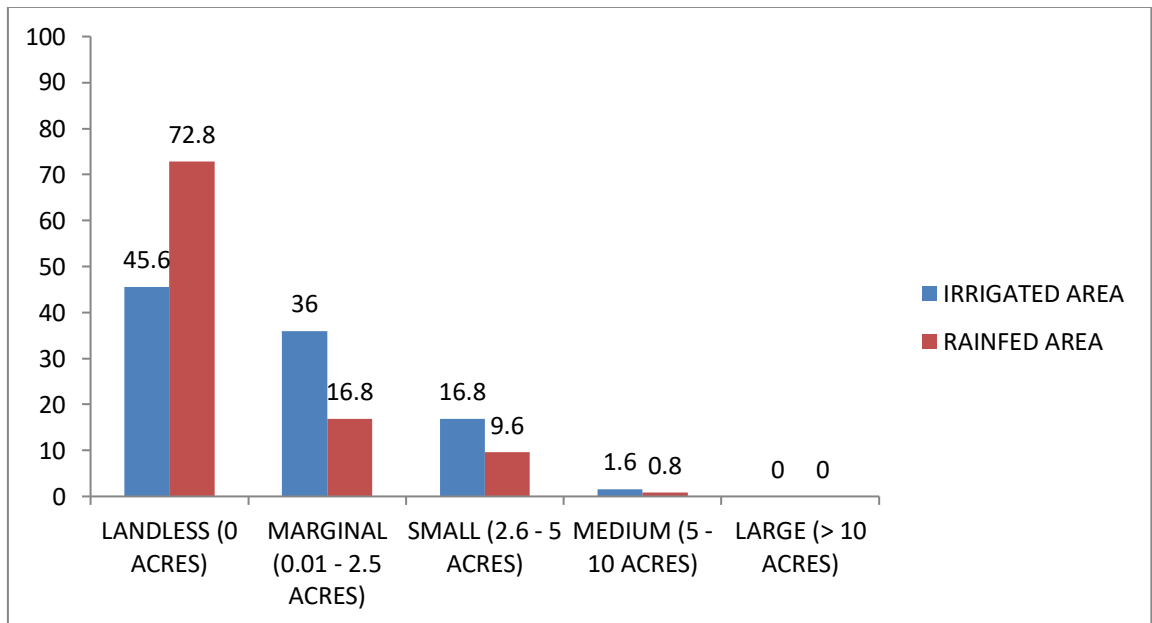


Fig.7 Land holding pattern of shepherds in irrigated and rainfed areas of Krishna district.

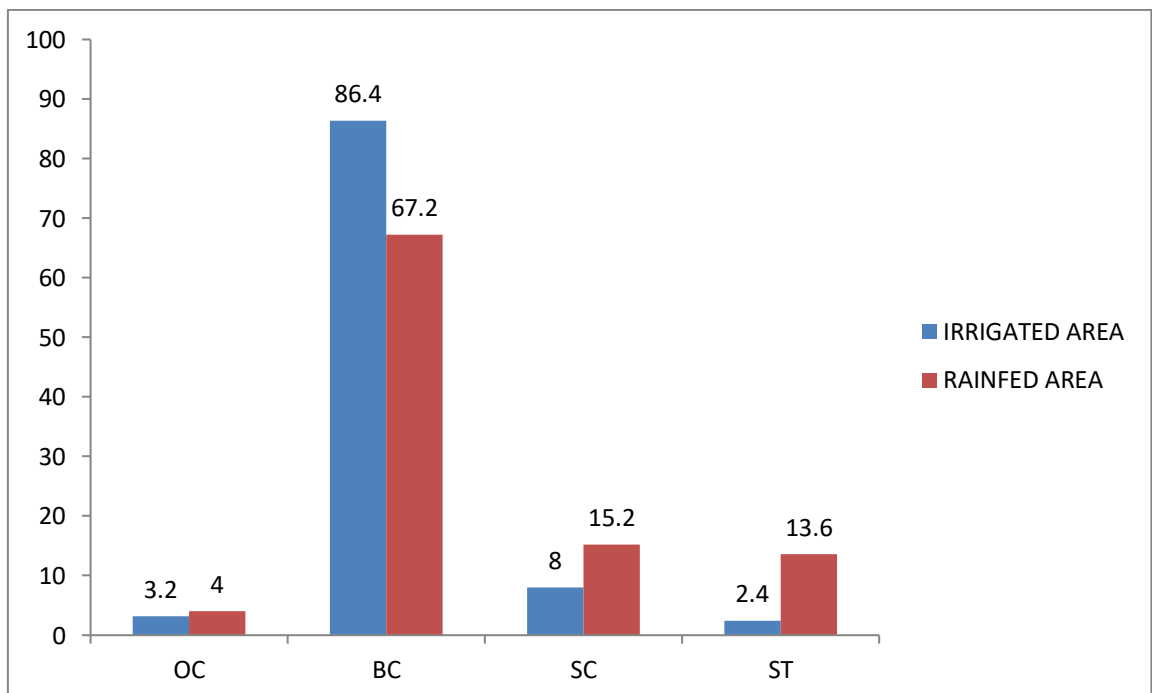


Fig.8 Community of shepherds in irrigated and rainfed areas of Krishna district.

irrigated area and 23.2 per cent in rainfed area. The average sheep farming experience in irrigated area was 9.77 ± 0.69 years and in rainfed area it was 12.05 ± 0.88 years.

4.2 FLOCK PROFILE OF SHEPHERDS IN KRISHNA DISTRICT

Flock profile of shepherds in irrigated and rainfed areas of Krishna district were presented in Table 6.

4.2.1 Livestock ownership of sheep farmers

Livestock ownership of sheep farmers of the study area was presented in Table 6. The majority of the farmers in irrigated area (54.4 per cent) and rainfed area (68 per cent) reared sheep along with goats. About 12.8 per cent of the farmers in irrigated area and 8 per cent of the farmers in rainfed area studied owned single species of sheep. Next to this, the major combination was sheep, goat and buffalo (28.8 per cent in irrigated area and 16 per cent in rainfed area) and sheep, buffalo and poultry (4 per cent in irrigated area and 8 per cent in rainfed area). The goats will lead the sheep herd and will control it. (Fig.11)

4.2.2 Flock size of sheep farmers

The flock profile of shepherds in irrigated and rainfed areas of Krishna district was presented in Table 6 and depicted in the Fig.10.

In the present study, it was observed that out of the total farmers studied majority were maintaining flocks whose size ranged between 51-75 (42.4 per cent in irrigated area and 32 per cent in rainfed area). About 28% of sheep farmers were maintaining flock with size 25-50, about 19.2% farmers were maintaining flock ranged in between 76-100, 5.6% were maintaining flocks above 100 and very few farmers were maintaining less than 25 sheep (4.8 per cent) in irrigated area. Whereas, 26.4% farmers had flocks with the range of 76-100, about 24% were maintaining flocks with the range 25-50, 14.4% had flocks above 100 and very few (3.2 per cent) shepherds maintaining

Table 6. Flock profile of shepherds in irrigated and rainfed areas of Krishna district.

S.NO	OBSERVATION		IRRIGATED AREA		RAINFED AREA		TOTAL	
			NO.OF FARMERS	%	NO.OF FARMERS	%	NO.OF FARMERS	%
1	LIVESTOCK OWNERSHIP	SHEEP ALONE	16	12.8	10	8	26	10.4
		SHEEP+GOAT	68	54.4	85	68	153	61.2
		SHEEP+GOAT+BUFFALO	36	28.8	20	16	56	22.4
		SHEEP+BUFFALO+POULTRY	5	4	10	8	15	6
2	FLOCK SIZE	<25	6	4.8	4	3.2	10	4
		25-50	35	28	30	24	65	26
		51-75	53	42.4	40	32	93	37.2
		76-100	24	19.2	33	26.4	57	22.8
		>100	7	5.6	18	14.4	25	10
3	SOURCE OF RAMS	HOMEGROWN	81	64.8	66	52.8	147	58.8
		PURCHASED	3	2.4	4	3.2	7	2.8
		EXCHANGED	41	32.8	55	44	96	38.4
		NO RAM	0	0	0	0	0	0
4	SOURCE OF EWES	HOMEGROWN	117	93.6	115	92	232	92.8
		PURCHASED	8	6.4	10	8	18	7.2

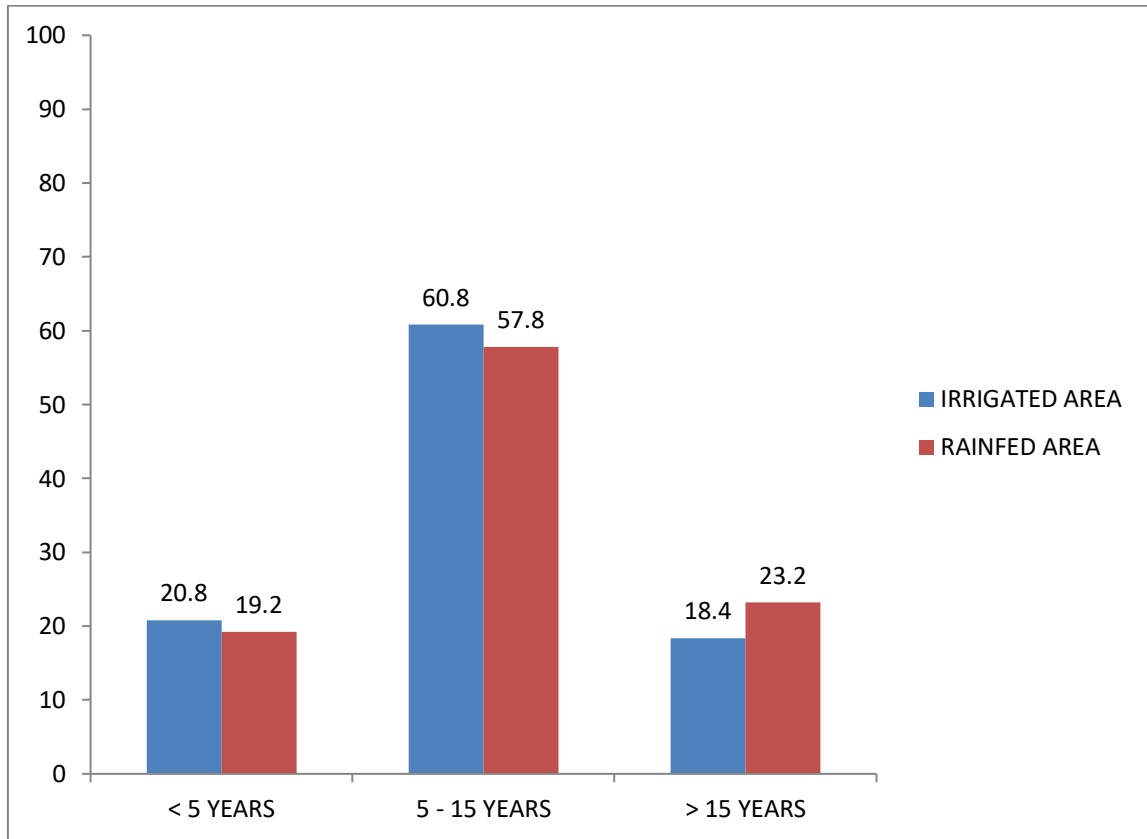


Fig.9 Sheep farming experience of shepherds in irrigated and rainfed areas of Krishna district.

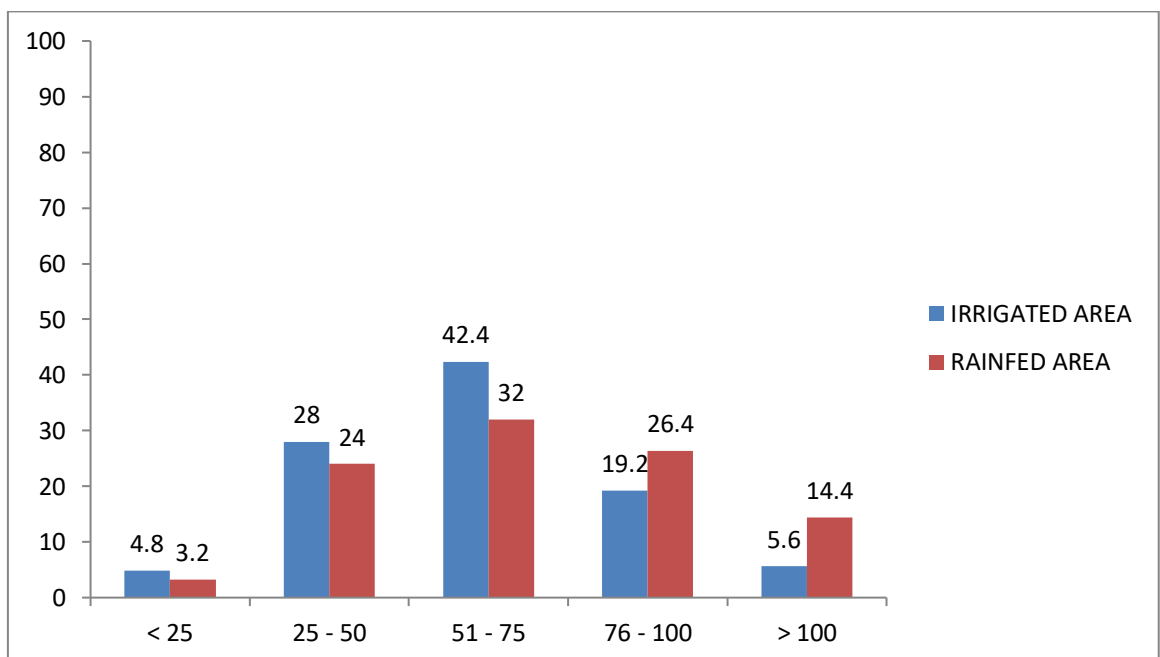


Fig.10 Flock profile of shepherds in irrigated and rainfed areas of Krishna district.



Fig.11 Goat leading the sheep flock.

flock less than 25 in rainfed area. It was seen that the average flock size in irrigated area of the district was 66.36 ± 2.32 and in rainfed area, it was 73.62 ± 3.0 .

4.2.3 Source of sheep additions in the flock

Data on source of sheep additions in the flocks of the study area are presented in Table 6. The ram, ewe in irrigated area of Krishna district were depicted in Fig.12&13, respectively. The ram, ewe in rainfed area were depicted in Fig.14&15.

Replacement stock from their own flock was the main source of addition to the sheep flocks of both the areas.

4.2.3.1 Source of rams

All the shepherds in the study area were maintaining rams in their flocks. Homegrown rams were found to be the major source of rams to the farmers (64.8 percent in irrigated area and 52.8 per cent in rainfed area) followed by procuring the rams by means of exchange with the neighbors (32.8 percent in irrigated area and 44 per cent in rainfed area). Whereas, very few farmers were purchasing rams from outside (2.4 percent in irrigated area and 3.2 per cent in rainfed area).

4.2.3.2 Source of ewes

Similarly, homegrown ewes were the source of ewes for the majority (93.6 per cent in irrigated area and 92 per cent in rainfed area) of the farmers selected in the study area. While very few (6.4 percent in irrigated area and 8 per cent in rainfed area) procured ewes for their flocks by means of purchase from others.



Fig.12 Ram in irrigated area of Krishna district.



Fig.13 Ewe in irrigated area of Krishna district.



Fig.14 Ram in rainfed area of Krishna district.



Fig.15 Ewe in rainfed area of Krishna district.

4.3 PRODUCTION PERFORMANCE OF SHEEP IN KRISHNA DISTRICT

4.3.1 Body weight

The mean body weight (kg) of sheep at different ages in the study area were measured and analysed and presented in Table 7 and standard error bars for body weight of sheep in irrigated and rainfed area of Krishna district was shown in the Fig.16.

The mean values for body weights in the male for 2 teeth, 4 teeth, 6 teeth and full-mouthed animals in irrigated area were 42.0 ± 0.49 , 44.50 ± 0.34 , 44.33 ± 0.40 and 44.29 ± 0.28 kg, respectively; while in rainfed area, the corresponding values were 39.92 ± 0.33 , 42.67 ± 0.33 , 43.11 ± 0.20 and 43.57 ± 0.20 kg, respectively.

The mean body weight for 2 teeth, 4 teeth, 6 teeth and full-mouthed ewes were 31.99 ± 0.270 , 36.02 ± 0.240 , 37.27 ± 0.167 and 40.52 ± 0.269 kg, respectively in irrigated area; while in rainfed area, the corresponding values were 29.30 ± 0.40 , 34.84 ± 0.40 , 37.22 ± 0.35 and 42.01 ± 0.56 kg, respectively.

The males in irrigated area differed significantly ($P < 0.05$) with those of in rainfed area in all age groups, except in 8 teeth. The body weight 4 teeth female sheep in irrigated area did not differ significantly ($P < 0.05$) compared to rainfed area, while the corresponding weights in other age groups differed significantly. The body weights of males in both areas at all ages were significantly higher than the females of the same age ($P < 0.01$). There is the effect of sex on body weights of sheep in both the areas. The effect of sex on body weight in both areas was presented in Table 8.

4.3.2 Body length

The mean body length (cm) of sheep at different ages in the study area was presented in Table 9 and standard error bars for body length of sheep in irrigated and rainfed area of Krishna district was shown in the Fig.17.

The mean values for body lengths in the male for 2 teeth, 4 teeth, 6 teeth and full-mouthed animals in irrigated area were 76.08 ± 0.22 , 77.83 ± 0.37 , 78.11 ± 0.30 and

Table 7. Mean (\pm SE) body weight (kg) of sheep for various age groups in irrigated and rainfed areas of Krishna district.

S.No	Age	Sex	Irrigated area	Rainfed area	t-value (df)	Overall
1	2-Teeth	Male	42.00 \pm 0.49 (12)	39.92 \pm 0.33 (12)	3.49**	40.95 \pm 0.36 (24)
		Female	31.99 \pm 0.27 (87)	29.30 \pm 0.40 (87)	5.55**	30.64 \pm 0.26 (174)
2	4-Teeth	Male	44.50 \pm 0.34 (6)	42.67 \pm 0.33 (6)	3.84**	43.58 \pm 0.35 (12)
		Female	36.02 \pm 0.24 (89)	34.84 \pm 0.40 (89)	2.49	35.43 \pm 0.24 (180)
3	6-Teeth	Male	44.33 \pm 0.40 (9)	43.11 \pm 0.40 (9)	2.68*	43.72 \pm 0.26 (18)
		Female	37.27 \pm 0.16 (89)	37.22 \pm 0.35 (89)	0.11**	37.24 \pm 0.19 (178)
4	8-Teeth	Male	44.29 \pm 0.28 (7)	43.57 \pm 0.20 (7)	2.04	43.92 \pm 0.19 (14)
		Female	40.52 \pm 0.26 (90)	42.01 \pm 0.56 (90)	-2.39**	41.26 \pm 0.31 (180)

Values in the parenthesis indicate number of observations.

** indicates the values in a row were more significantly differed ($P < 0.01$)

* indicates the values in a row were significantly differed ($P < 0.05$)

Table 8. Effect of sex on body weights (kg) of sheep for various age groups in irrigated and rainfed areas of Krishna district.

S.no	Age	Area	Male	Female	t-value (df)
1	2-Teeth	Irrigated area	42.0±0.49 (12)	31.99±0.27 (87)	13.30 ^{**}
		Rainfed area	39.92±0.33 (12)	29.30±0.40 (87)	20.25 ^{**}
2	4-Teeth	Irrigated area	44.50±0.34 (6)	36.02±0.24 (89)	20.30 ^{**}
		Rainfed area	42.67±0.33 (6)	34.84±0.40 (89)	14.84 ^{**}
3	6-Teeth	Irrigated area	44.33±0.40 (9)	37.27±0.16 (89)	13.06 ^{**}
		Rainfed area	43.11±0.20 (9)	37.22±0.35 (89)	14.47 ^{**}
4	8-Teeth	Irrigated area	44.29±0.28 (7)	40.52±0.26 (90)	3.87 ^{**}
		Rainfed area	43.57±0.20 (7)	42.01±0.56 (90)	2.61 ^{**}

Values in the parenthesis indicate number of observations.

^{**} indicates the values in a row were more significantly differed (P<0.01)

* indicates the values in a row were significantly differed (P<0.05)

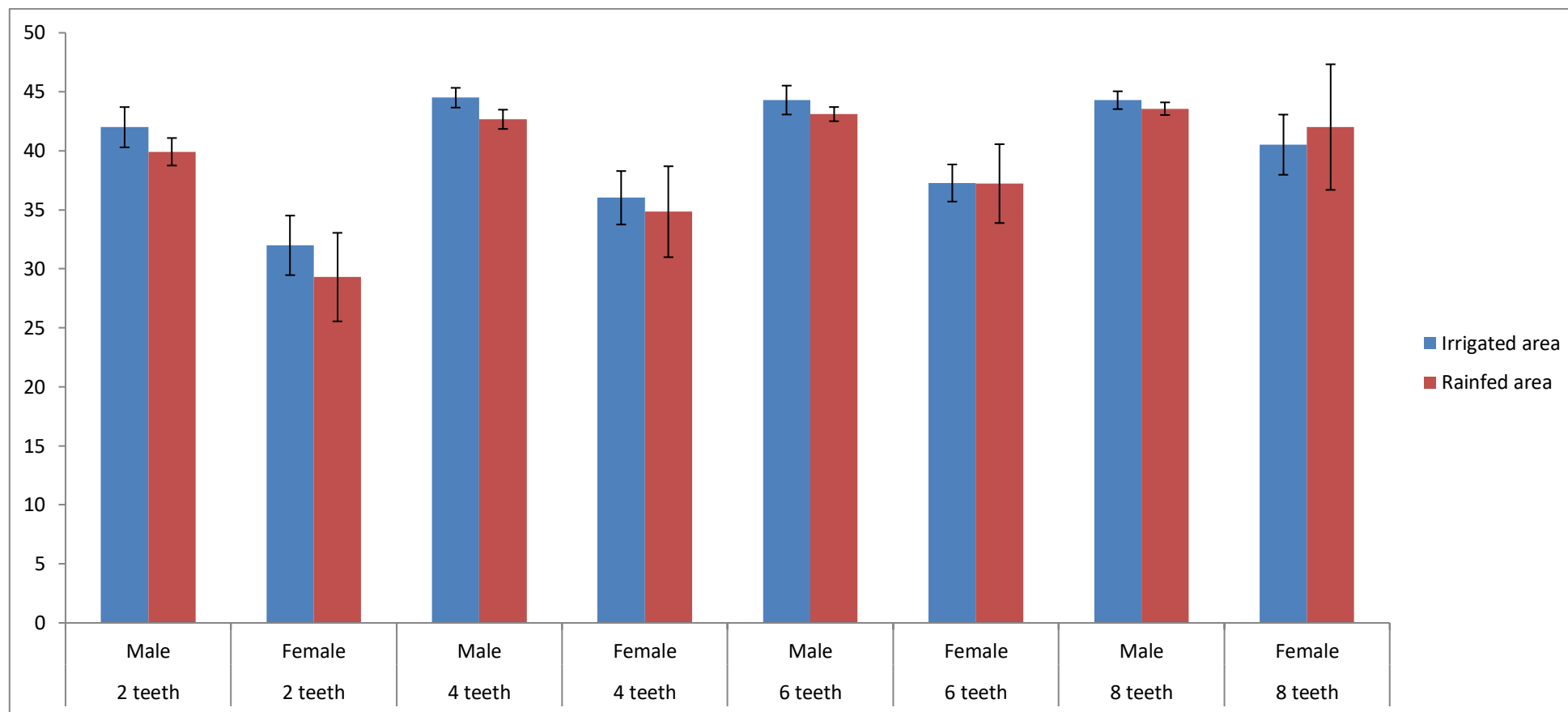


Fig.16 Standard error bars for body weight of sheep in irrigated and rainfed areas Krishna district.

78.17 \pm 0.28 cm, respectively. While in rainfed area the corresponding values were 74.75 \pm 0.21, 76.17 \pm 0.30, 76.89 \pm 0.26 and 77.14 \pm 0.50 cm, respectively.

The mean body lengths for 2 teeth, 4 teeth, 6 teeth and full-mouthed ewes observed were 66.48 \pm 0.23, 64.93 \pm 0.44, 67.94 \pm 0.35, 72.78 \pm 0.50 cm, respectively, in irrigated area. While in rainfed area the corresponding values were 64.17 \pm 0.46, 64.27 \pm 0.37, 65.99 \pm 0.32 and 67.43 \pm 0.50 cm, respectively.

From the study, it was evident that there was a significant difference between the two areas with respect to the body length of sheep at all age groups except between the females of 4 teeth age ($P < 0.05$). The body lengths of males in both areas at all ages were significantly higher than the females of the same age ($P < 0.01$). There is effect of sex on body lengths of sheep in both the areas. The effect of sex on body length in both areas was presented in Table 10.

4.3.3 Height at withers

The mean height at withers (cm) of sheep at different ages in the study area was presented in Table 11 and standard error bars for height at withers of sheep in irrigated and rainfed area of Krishna district was shown in the Fig.20.

The mean height at withers for 2 teeth, 4 teeth, 6 teeth and full-mouthed rams observed were 83.08 \pm 0.28, 84.83 \pm 0.40, 86.11 \pm 0.26 and 84.57 \pm 0.29 cm, respectively, in irrigated area. While in rainfed area the corresponding values were 81.33 \pm 0.28, 81.83 \pm 0.30, 84.78 \pm 0.22 and 82.71 \pm 0.28 cm, respectively.

The mean values for height at withers in ewes for 2 teeth, 4 teeth, 6 teeth and full-mouthed animals in irrigated area were 74.62 \pm 0.23, 75.93 \pm 0.17, 76.75 \pm 0.28 and 79.11 \pm 0.30 cm, respectively. While in rainfed area the corresponding values were 72.51 \pm 0.29, 75.54 \pm 0.27, 76.12 \pm 0.29 and 76.88 \pm 0.31 cm, respectively.

In the present study, it was observed that the mean height at withers of sheep in irrigated area was significantly higher compared to that of rainfed area in all ages,

Table 9. Mean (\pm SE) body lengths (cm) of sheep for various age groups in irrigated and rainfed areas of Krishna district.

S.No	Age	Sex	Irrigated area	Rainfed area	t-value (df)	Overall
1	2 teeth	Male	76.08 \pm 0.22 (12)	74.75 \pm 0.21 (12)	4.22**	75.41 \pm 0.20 (24)
		Female	66.48 \pm 0.23 (87)	64.17 \pm 0.46 (87)	4.39**	65.32 \pm 0.27 (174)
2	4 teeth	Male	77.83 \pm 0.30 (6)	76.17 \pm 0.26 (6)	3.83**	77.0 \pm 0.32 (12)
		Female	64.93 \pm 0.44 (89)	64.27 \pm 0.37 (89)	1.14	64.60 \pm 0.28 (178)
3	6 teeth	Male	78.11 \pm 0.30 (9)	76.89 \pm 0.26 (9)	3.02**	77.5 \pm 0.24 (18)
		Female	67.94 \pm 0.35 (89)	65.99 \pm 0.032 (89)	4.07**	66.96 \pm 0.25 (178)
4	8 teeth	Male	78.17 \pm 0.28 (7)	77.14 \pm 0.50 (7)	2.69*	77.92 \pm 0.19 (14)
		Female	72.78 \pm 0.50 (90)	67.43 \pm 0.50 (90)	7.49**	70.10 \pm 0.40 (180)

Values in the parenthesis indicate number of observations.

** indicates the values in a row were more significantly differed ($P < 0.01$)

* indicates the values in a row were significantly differed ($P < 0.05$)

Table 10. Effect of sex on body lengths (cm) of sheep for various age groups in irrigated and rainfed areas of Krishna district.

S.no	Age	Area	Male	Female	t-value (df)
1	2-Teeth	Irrigated area	76.08±0.22 (12)	66.48±0.23 (87)	29.04**
		Rainfed area	74.75±0.21 (12)	64.17±0.46 (87)	20.45**
2	4-Teeth	Irrigated area	77.83±0.30 (6)	64.93±0.44 (89)	24.02**
		Rainfed area	76.17±0.30 (6)	64.27±0.37 (89)	24.63**
3	6-Teeth	Irrigated area	78.11±0.30 (9)	67.94±0.35 (89)	21.58**
		Rainfed area	76.89±0.26 (9)	65.99±0.32 (89)	26.28**
4	8-Teeth	Irrigated area	78.71±0.28 (7)	72.78±0.50 (90)	10.20**
		Rainfed area	77.14±0.50 (7)	67.43±0.50 (90)	13.59**

Values in the parenthesis indicate number of observations.

** indicates the values in a row were more significantly differed (P<0.01)

* indicates the values in a row were significantly differed (P<0.05)

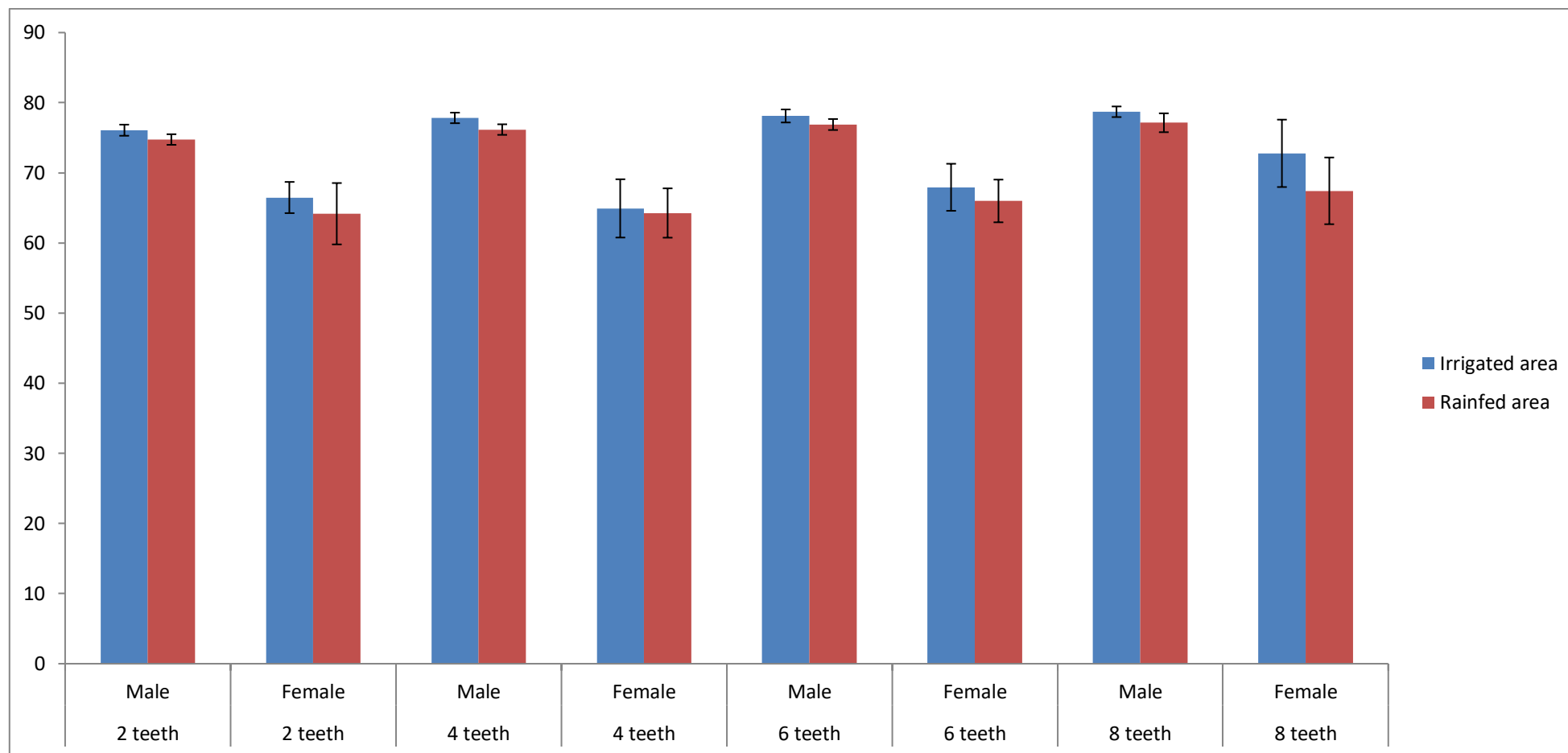


Fig.17 Standard error bars for body lengths of sheep in irrigated and rainfed areas of Krishna district.



Fig.18 Measuring body weight of sheep.



Fig.19 Measuring body length of sheep.

Table 11. Mean (\pm SE) height at withers (cm) of sheep for various age groups in irrigated and rainfed areas of Krishna district.

S.No	Age	Sex	Irrigated area	Rainfed area	t-value (df)	Overall
1	2-Teeth	Male	83.08 \pm 0.28 (12)	81.33 \pm 0.28 (12)	4.32**	82.20 \pm 0.26 (24)
		Female	74.62 \pm 0.23 (87)	72.51 \pm 0.29 (87)	5.69**	73.56 \pm 0.20 (174)
2	4-Teeth	Male	84.83 \pm 0.40 (6)	81.83 \pm 0.30 (6)	5.93**	83.3 \pm 0.51 (12)
		Female	75.93 \pm 0.17 (89)	75.54 \pm 0.27 (89)	1.21	75.73 \pm 0.16 (178)
3	6-Teeth	Male	86.11 \pm 0.26 (9)	84.78 \pm 0.22 (9)	3.89**	85.44 \pm 0.23 (18)
		Female	76.75 \pm 0.28 (89)	76.12 \pm 0.29 (89)	1.53	76.43 \pm 0.20 (178)
4	8-Teeth	Male	84.57 \pm 0.29 (7)	82.71 \pm 0.28 (7)	4.50**	83.64 \pm 0.32 (14)
		Female	79.11 \pm 0.30 (90)	76.88 \pm 0.31 (90)	5.03**	77.99 \pm 0.23 (180)

Values in the parenthesis indicate number of observations.

** indicates the values in a row were more significantly differed ($P < 0.01$)

* indicates the values in a row were significantly differed ($P < 0.05$)

Table 12. Effect of sex on height at withers (cm) of sheep for various age groups in irrigated and rainfed areas of Krishna district.

S.No	Age	Area	Male	Female	t-value (df)
1	2-Teeth	Irrigated area	83.08±0.28 (12)	74.62±0.23 (87)	22.92**
		Rainfed area	81.33±0.28 (12)	72.51±0.29 (87)	21.71**
2	4-Teeth	Irrigated area	84.53±0.40 (6)	75.93±0.17 (89)	12.91**
		Rainfed area	81.83±0.30 (6)	75.54±0.27 (89)	15.33**
3	6-Teeth	Irrigated area	86.11±0.26 (9)	76.75±0.28 (89)	24.10**
		Rainfed area	84.78±0.22 (9)	76.12±0.29 (89)	23.63**
4	8-Teeth	Irrigated area	84.57±0.29 (7)	79.11±0.30 (90)	12.75**
		Rainfed area	82.71±0.28 (7)	78.88±0.31 (90)	13.61**

Values in the parenthesis indicate number of observations.

** indicates the values in a row were more significantly differed (P<0.01)

* indicates the values in a row were significantly differed (P<0.05)

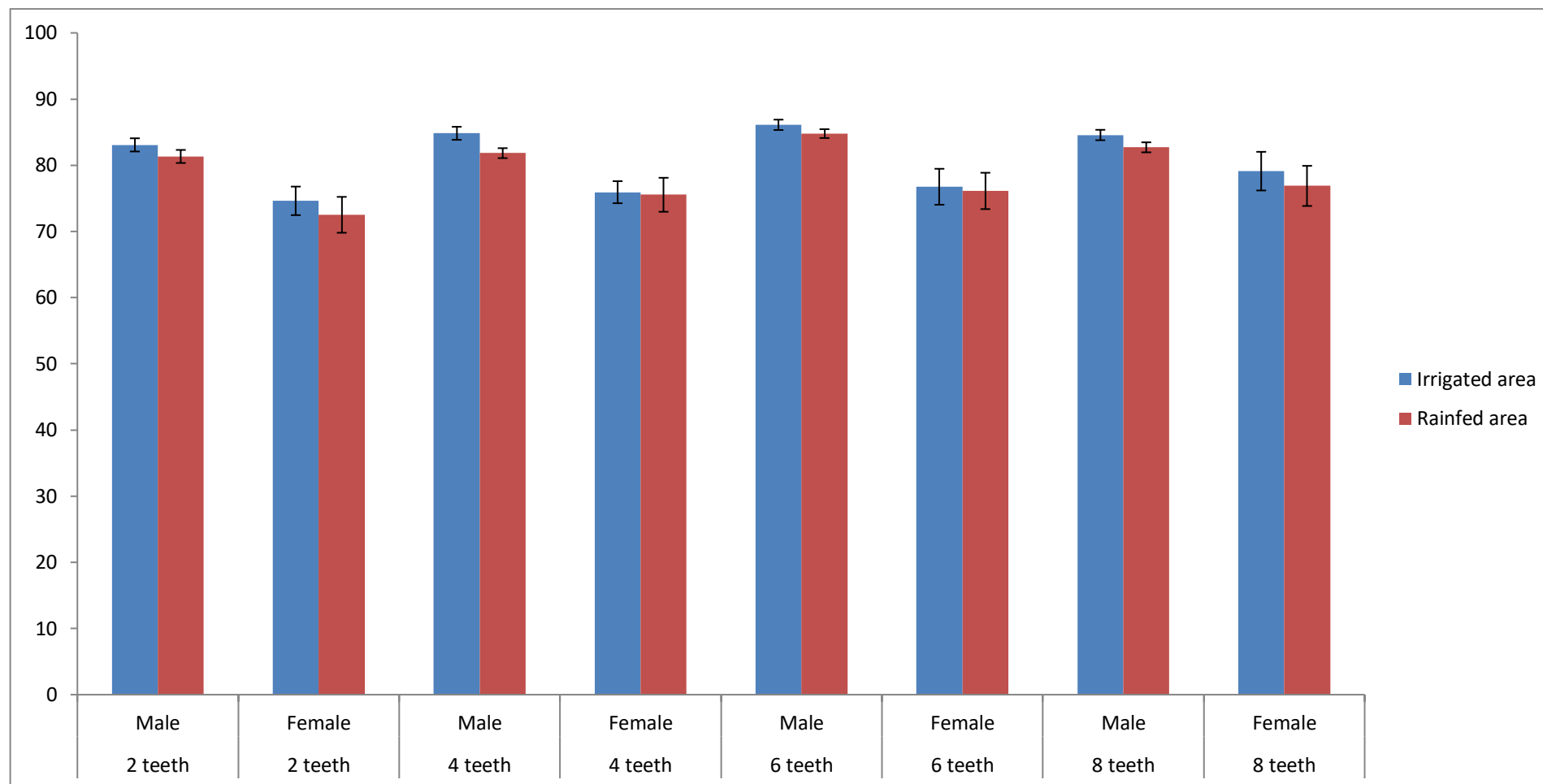


Fig.20 Standard error bars for height at withers of sheep in irrigated and rainfed areas of Krishna district.

except between the females of 4 teeth and 6 teeth age ($P<0.05$). The height at withers of males in both areas at all ages was significantly higher than the females of the same age ($P<0.01$). There is the effect of sex on height at withers of sheep in both the areas. The effect of sex on height at withers in both areas was presented in Table 12.

4.3.4 Chest girth

The mean chest girth (cm) of sheep at different ages in the study area was presented in Table 13 and Standard error bars for chest girth of sheep in irrigated and rainfed area of Krishna district was shown in the Fig.21.

The mean chest girth for 2 teeth, 4 teeth, 6 teeth and full-mouthed rams observed were 82.50 ± 0.19 , 85.50 ± 0.42 , 86.33 ± 0.33 and 85.00 ± 0.30 cm, respectively in irrigated area. While in rainfed area the corresponding values were 81.25 ± 0.25 , 83.17 ± 0.30 , 84.22 ± 0.32 and 83.43 ± 0.20 cm, respectively.

The mean values for chest girth in ewes for 2 teeth, 4 teeth, 6 teeth and full-mouthed animals in irrigated area were 77.99 ± 0.31 , 79.83 ± 0.26 , 81.40 ± 0.25 and 82.16 ± 0.34 cm, respectively. While in rainfed area the corresponding values were 73.94 ± 0.31 , 78.94 ± 0.31 , 81.24 ± 0.52 , 86.66 ± 0.49 cm, respectively.

In the present study, it was observed that the mean chest girth of sheep in irrigated area was significantly higher compared to that of rainfed area in all ages, except between the females of 6 teeth age ($P<0.05$). But in case of 8 teeth females, chest girth of rainfed area sheep was significantly higher than that of the female sheep in irrigated area of the same age. The chest girth of males in both areas at all ages was significantly higher than the females of the same age except 8 teeth stage ($P<0.05$). In 8 teeth age, chest girth of female sheep in rainfed area was significantly higher than that of the male sheep in irrigated area ($P<0.05$). There is the effect of sex on chest girth of sheep in both the areas except in 8 teeth stage in rainfed area. The effect of sex on chest girth in both areas was presented in Table 14.

Table 13. Mean (\pm SE) chest girth (cm) of sheep for various age groups in irrigated and rainfed areas of Krishna district.

S.no	Age	Sex	Irrigated area	Rainfed area	t-value (df)	Overall
1	2-Teeth	Male	82.50 \pm 0.19 (12)	81.25 \pm 0.25 (12)	3.94**	81.83 \pm 0.20 (24)
		Female	77.99 \pm 0.31 (87)	73.94 \pm 0.31 (87)	9.04**	75.96 \pm 0.27 (174)
2	4-Teeth	Male	85.50 \pm 0.42 (6)	83.17 \pm 0.30 (6)	4.42**	84.33 \pm 0.43 (12)
		Female	79.83 \pm 0.26 (89)	78.94 \pm 0.31 (89)	2.13*	79.38 \pm 0.20 (178)
3	6-Teeth	Male	86.33 \pm 0.33 (9)	84.22 \pm 0.32 (9)	4.54**	85.27 \pm 0.34 (18)
		Female	81.40 \pm 0.25 (89)	81.24 \pm 0.52 (89)	0.28	81.32 \pm 0.29 (178)
4	8-Teeth	Male	85.00 \pm 0.30 (7)	83.43 \pm 0.20 (7)	4.26**	84.21 \pm 0.28 (14)
		Female	82.16 \pm 0.34 (90)	86.66 \pm 0.49 (90)	-7.44**	84.40 \pm 0.34 (180)

Values in the parenthesis indicate number of observations.

** indicates the values in a row were more significantly differed ($P < 0.01$)

* indicates the values in a row were significantly differed ($P < 0.05$)

Table 14. Effect of sex on chest girth (cm) of sheep for various age groups in irrigated and rainfed areas of Krishna district.

S.No	Age	Area	Male	Female	t-value (df)
1	2-Teeth	Irrigated area	82.50±0.19 (12)	77.99±0.31 (87)	12.18**
		Rainfed area	81.25±0.25 (12)	73.94±0.31 (87)	18.07**
2	4-Teeth	Irrigated area	85.50±0.42 (6)	79.83±0.26 (89)	5.46**
		Rainfed area	83.17±0.30 (6)	78.94±0.31 (89)	9.54**
3	6-Teeth	Irrigated area	86.33±0.33 (9)	81.40±0.25 (89)	11.74**
		Rainfed area	84.22±0.32 (9)	81.24±0.52 (89)	4.84**
4	8-Teeth	Irrigated area	85.00±0.30 (7)	82.16±0.34 (90)	6.14**
		Rainfed area	83.43±0.20 (7)	86.66±0.49 (90)	-6.02**

Values in the parenthesis indicate number of observations.

** indicates the values in a row were more significantly differed (P<0.01)

* indicates the values in a row were significantly differed (P<0.05)

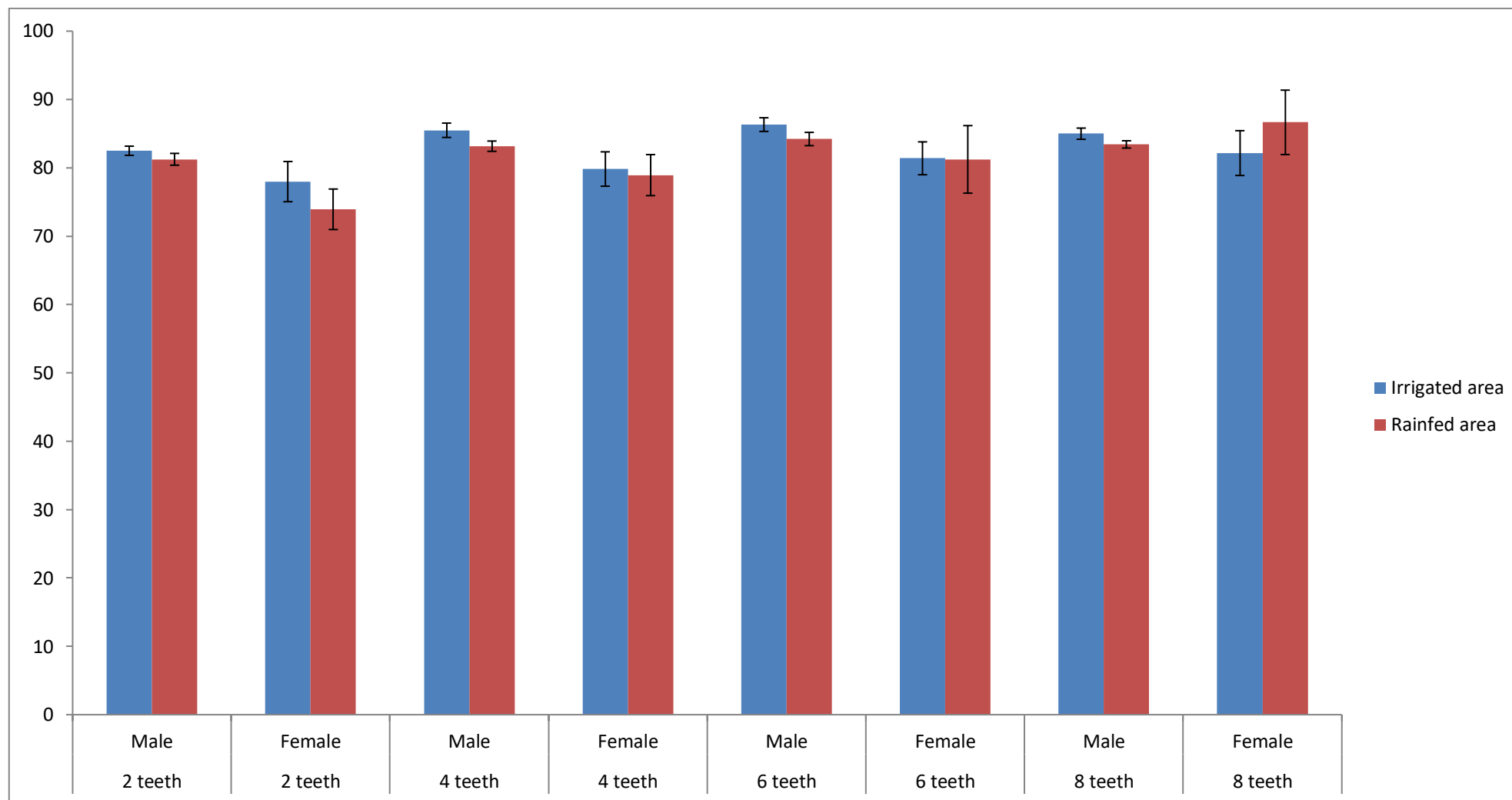


Fig.21 Standard error bars for chest girth of sheep in irrigated and rainfed areas of Krishna district.



Fig.22 Measuring height at withers of sheep.



Fig.23 Measuring chest girth of sheep.

4.3.5 Punch girth

The mean punch girth (cm) of sheep at different ages in the study area was presented in Table 15 and standard error bars for punch girth of sheep in irrigated and rainfed areas of Krishna district was shown in the Fig.24.

The mean punch girth for 2 teeth, 4 teeth, 6 teeth and full-mouthed rams observed were 83.25 ± 0.32 , 86.50 ± 0.42 , 85.22 ± 0.22 and 85.71 ± 0.28 cm, respectively, in irrigated area. While in rainfed area the corresponding values were 82.42 ± 0.22 , 84.83 ± 0.30 , 83.56 ± 0.24 and 84.43 ± 0.42 cm, respectively.

The mean values for punch girth in ewes for 2 teeth, 4 teeth, 6 teeth and full-mouthed animals in irrigated area were 80.09 ± 0.33 , 83.07 ± 0.40 , 84.21 ± 0.28 and 89.24 ± 0.44 cm, respectively. While in rainfed area the corresponding values were 76.09 ± 0.56 , 82.65 ± 0.30 , 84.84 ± 0.26 and 85.51 ± 0.30 cm, respectively.

In the present study, it was observed that the mean punch girth of sheep in irrigated area was significantly higher compared to that of rainfed area in all ages, except between the females of 4 teeth and 6 teeth age ($P < 0.05$). The chest girth of males in both areas at all ages was significantly higher than the females of the same age, except 6 teeth and 8 teeth age. In 6 teeth age, punch girth of female sheep in rainfed area was significantly higher than that of the male sheep in irrigated area ($P < 0.05$). Whereas, in case of 8 teeth stage punch girth of female sheep in irrigated area was significantly higher than that of the male sheep in rainfed area ($P < 0.05$). The effect of sex on punch girth in both areas was presented in Table 16.

Table 15. Mean (\pm SE) punch girth (cm) of sheep for various age groups in irrigated and rainfed areas of Krishna district.

S.no	Age	Sex	Irrigated area	Rainfed area	t-value (df)	Overall
1	2-Teeth	Male**	83.25 \pm 0.32 (12)	82.42 \pm 0.22 (12)	2.08**	82.83 \pm 0.21 (24)
		Female**	80.09 \pm 0.33 (87)	76.09 \pm 0.56 (87)	6.04**	78.09 \pm 0.36 (174)
2	4-Teeth	Male**	86.50 \pm 0.42 (6)	84.83 \pm 0.30 (6)	3.16**	85.66 \pm 0.35 (12)
		Female	83.07 \pm 0.40 (89)	82.65 \pm 0.30 (89)	0.81	82.85 \pm 0.25 (178)
3	6-Teeth	Male**	85.22 \pm 0.22 (9)	83.56 \pm 0.24 (9)	5.07**	84.38 \pm 0.0.25 (18)
		Female	84.21 \pm 0.28 (89)	84.84 \pm 0.26 (89)	-1.63	84.52 \pm 0.19 (178)
4	8-Teeth	Male*	85.71 \pm 0.28 (7)	84.43 \pm 0.42 (7)	2.49**	85.07 \pm 0.30 (14)
		Female*	89.24 \pm 0.44 (90)	82.51 \pm 0.30 (90)	12.43**	85.87 \pm 0.36 (180)

Values in the parenthesis indicate number of observations.

** indicates the values in a row were more significantly differed (P<0.01)

* indicates the values in a row were significantly differed (P<0.05)

Table 16. Effect of sex on punch girth (cm) of sheep for various age groups in irrigated and rainfed areas of Krishna district.

S.No	Age	Area	Male	Female	t-value (df)
1	2-Teeth	Irrigated area	83.25±0.32 (12)	80.09±0.33 (87)	6.69**
		Rainfed area	82.42±0.22 (12)	76.09±0.56 (87)	10.32**
2	4-Teeth	Irrigated area	86.50±0.42 (6)	84.83±0.30 (89)	5.81**
		Rainfed area	84.83±0.30 (6)	82.65±0.30 (89)	5.04**
3	6-Teeth	Irrigated area	85.22±0.22 (9)	84.21±0.28 (89)	2.80**
		Rainfed area	83.56±0.24 (9)	84.84±0.26 (89)	-3.59**
4	8-Teeth	Irrigated area	85.71±0.28 (7)	89.24±0.44 (90)	-6.66**
		Rainfed area	84.43±0.42 (7)	82.51±0.30 (90)	3.63**

Values in the parenthesis indicate number of observations.

** indicates the values in a row were more significantly differed (P<0.01)

* indicates the values in a row were significantly differed (P<0.05)

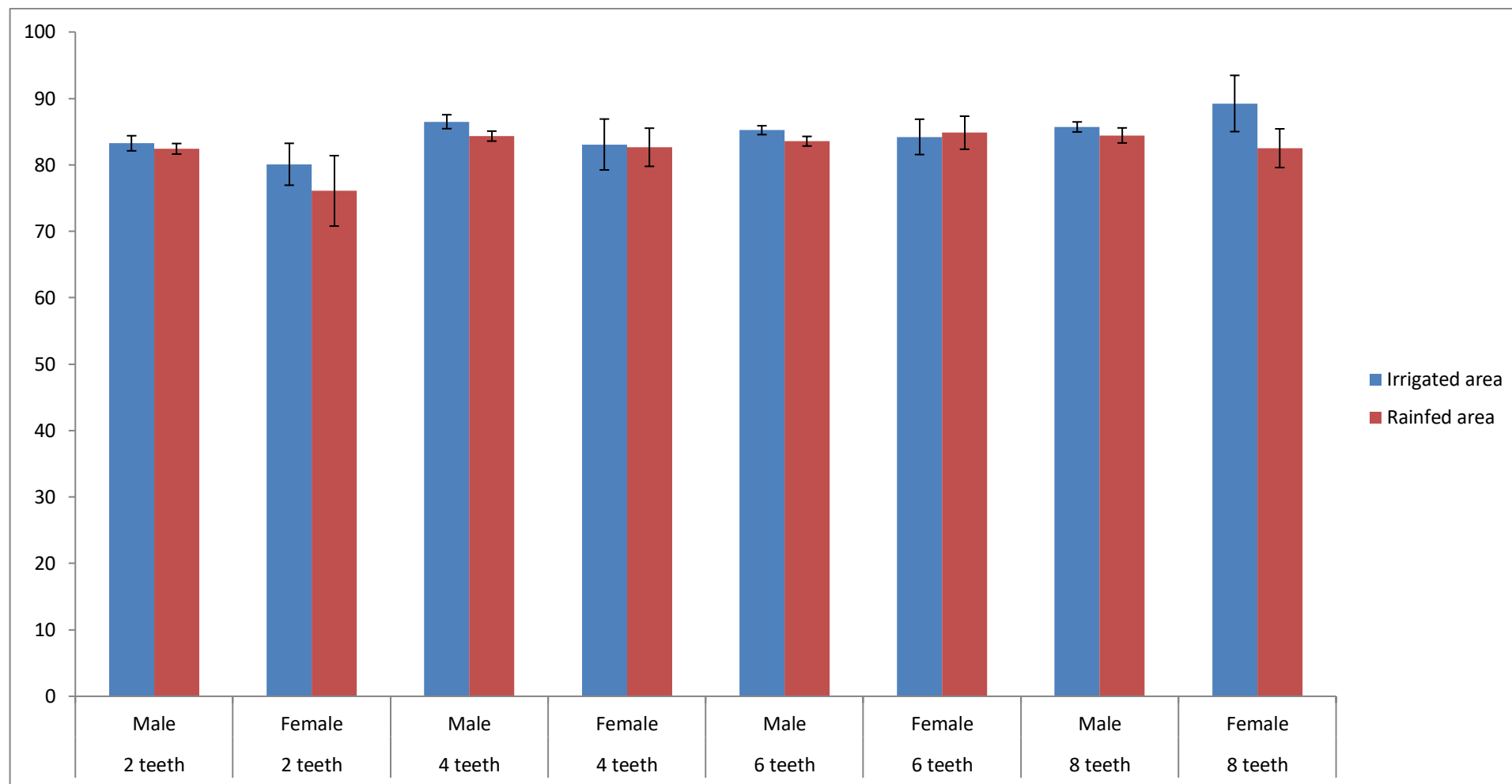


Fig.24 Standard error bars for punch girth of sheep in irrigated and rainfed areas of Krishna district.



Fig.25 Measuring punch girth of sheep.

4.4 REPRODUCTIVE PERFORMANCE OF SHEEP IN KRISHNA DISTRICT

The reproductive performance of sheep in irrigated and rainfed areas of Krishna district was presented in Table 17.

4.4.1 Age at first mating in females

The average age at first mating in ewes in irrigated and rainfed area was 13.16 ± 0.06 and 14.52 ± 0.06 months, respectively. There was a significant difference in age at first mating in females between irrigated and rainfed area ($P < 0.01$).

4.4.2 Age at first mating in males

The average age at first mating in rams in irrigated and rainfed area were 19.89 ± 0.18 and 19.63 ± 0.20 months, respectively. There was no significant difference in age at first mating in males between irrigated and rainfed areas ($P < 0.05$).

4.4.3 Age at first lambing

The average age at first lambing in irrigated and rainfed area was 18.24 ± 0.05 and 19.52 ± 0.06 months, respectively. There was a significant difference in age at first lambing of sheep between irrigated and rainfed area ($P < 0.01$).

4.4.4 Lambing interval

The mean lambing interval in irrigated and rainfed area was 306.68 ± 0.81 and 308.53 ± 1.15 days, respectively. There was no significant difference in lambing interval of sheep between irrigated and rainfed areas ($P < 0.05$).

4.4.5 Age at weaning

The mean age at weaning in irrigated and rainfed area was 3.71 ± 0.40 and 4.09 ± 0.05 months, respectively. There was a significant difference in age at weaning of lambs between irrigated and rainfed area ($P < 0.01$).

4.4.6 Weight at weaning

The mean weight at weaning in irrigated and rainfed area was 12.57 ± 0.0 and 10.98 ± 0.05 kg, respectively. There was a significant difference in weight at weaning of lambs between irrigated and rainfed area ($P < 0.01$).

Table 17. Reproductive performance of sheep in irrigated and rainfed areas of Krishna district

Parameter	Irrigated area	Rainfed area	t-value (df)	Overall
Age at first mating in female (Months)	13.16 ± 0.06 (125)	14.52 ± 0.06 (125)	14.929**	13.84 ± 0.06 (250)
Age at first mating in male (Months)	19.89 ± 0.18 (125)	19.63 ± 0.20 (125)	-0.958	19.76 ± 0.13 (250)
Age at first lambing (Months)	18.24 ± 0.05 (125)	19.52 ± 0.06 (125)	14.403**	18.88 ± 0.06 (250)
Lambing interval (Days)	306.68 ± 0.81 (125)	308.53 ± 1.15 (125)	1.313	307.60 ± 0.70 (250)
Age at weaning (Months)	3.71 ± 0.40 (125)	4.09 ± 0.05 (125)	5.397**	3.90 ± 0.03 (250)
Weight at weaning (Kg)	12.57 ± 0.07 (125)	10.98 ± 0.05 (125)	-17.219**	11.78 ± 0.06 (250)

Values in the parenthesis indicate number of observations.

** indicates the values in a row were more significantly differed ($P < 0.01$)

* indicates the values in a row were significantly differed ($P < 0.05$)

4.5 SHEEP PRODUCTION AND MANAGEMENT PRACTICES OF SHEPHERDS IN KRISHNA DISTRICT

4.5.1 HOUSING MANAGEMENT PRACTICES FOLLOWED BY SHEPHERDS

In the present study, an investigation has been made to study the housing management practices followed by the farmers in the irrigated and rainfed areas of Krishna district. Housing management practices followed by the farmers were analysed and are presented in Table 18.

4.5.1.1 Rearing of sheep

In the present study, it was observed that all farmers in the study area were following extensive system of sheep rearing. None of the farmers were following semi-intensive (or) intensive type of rearing in both the areas.

4.5.1.2 Type of housing

Majority of the farmers provided semi open type of housing (56 per cent in irrigated area and 57.6 per cent in rainfed area) to their sheep. Next to semi open houses, open housing without any shelter was predominant in in both areas (36 per cent in irrigated area and 42.4 per cent in rainfed area). Only 8% of the farmers were providing closed housing in irrigated area and none of the farmers were provided the closed type of housing in rainfed area.

4.5.1.3 Placing of animals

Majority of the sheep pens in the study area were nearer to the farmer's residence (94.4 per cent in irrigated area and 72 per cent in rainfed area). Very few farmers constructed the sheep pens away from their residence (5.6 per cent in irrigated area and 28 per cent in rainfed area).

4.5.1.4 Type of roof and floor

As shown in the Fig.26, majority farmers were providing a thatched roof to the sheep (61.6 per cent in irrigated area and 47.2 per cent in rainfed area). About 36 per cent farmers in irrigated area and 42.4 percent in rainfed area were not providing any

Table 18. Housing management practices followed by shepherds in irrigated and rainfed areas of Krishna district.

S.NO	HOUSING PRACTICES		IRRIGATED AREA		RAINFED AREA		TOTAL	
			NO.OF FARMERS	%	NO.OF FARMERS	%	NO.OF FARMERS	%
1	REARING	INTENSIVE	0	0	0	0	0	0
		SEMI-INTENSIVE	0	0	0	0	0	0
		EXTENSIVE	125	100	125	100	250	100
2	TYPE OF HOUSING	OPEN	45	36	53	42.4	98	39.2
		SEMI OPEN	70	56	72	57.6	142	56.8
		CLOSED	10	8	0	0	10	4
3	PLACING OF ANIMALS	NEAR OWNER'S HOUSE	118	94.4	90	72	208	83.2
		FAR AWAY	7	5.6	35	28	42	16.8
4	TYPE OF ROOF	NO ROOF	45	36	53	42.4	98	39.2
		PUCCA/ASBESTOS	3	2.4	13	10.4	16	6.4
		THATCHED	77	61.6	59	47.2	136	54.4
5	TYPE OF FLOOR	CONCRETE	0	0	0	0	0	0
		SLAB	0	0	0	0	0	0
		MUD	125	100	125	100	250	100

Table.18(contd.)

6	ENCLOUSERS	WALL	13	10.4	16	12.8	29	11.6
		FENCE	112	89.6	109	87.2	221	88.4
7	PROVISION OF FEED IN SHED	YES	0	0	0	0	0	0
		NO	125	100	125	100	250	100
8	PROVISION OF WATER IN SHED	YES	27	21.6	20	16	47	18.8
		NO	98	78.4	105	84	203	81.2
9	SEPARATE HOUSING FOR YOUNG AND ADULT	YES	0	0	0	0	0	0
		NO	125	100	125	100	250	100
10	SPECIAL HOUSING FOR PREGNANT ANIMALS	YES	0	0	0	0	0	0
		NO	125	100	125	100	250	100
11	MALE & FEMALE SEPERATED	YES	0	0	0	0	0	0
		NO	125	100	125	100	250	100
12	SOIL REPLACEMENT	FOLLOWED	107	85.6	91	72.8	198	79.2
		NOT FOLLOWED	18	14.4	34	27.2	52	20.8
13	MANURE STORAGE	OPEN	125	100	125	100	250	100
		PIT	0	0	0	0	0	0

Table.18(contd.)

14	MANURE DISPOSAL PATTERN	OWN FARM USE	68	54.4	31	24.8	99	39.6
		SALE ONCE IN A YEAR	52	41.6	94	75.2	146	58.4
		SALE TWICE A YEAR	5	4	0	0	5	2
15	CLEANING OF PREMISES	DAILY	125	100	125	100	250	100
		FOR EVERY 2-3DAYS	0	0	0	0	0	0

roof (open type) to their sheep. Very few were keeping their flock under the asbestos roof (2.4 per cent in irrigated area and 10.4 per cent in rainfed area).

All the shepherds were maintaining their sheep on mud floor (Kutcha floor) only. No farmer was maintaining their sheep on a concrete floor in the study area.

4.5.1.5 Enclosures

Majority farmers were providing fence made of thorny plants, locally available sticks, bamboo slits and nylon nets (89.6 per cent in irrigated area and 87.2 per cent in rainfed area). For very few flocks the enclosure was wall (10.4 per cent in irrigated area and 12.8 per cent in rainfed area).

4.5.1.6 Provision of feed and water in the pen

All the farmers in the study area were not providing any extra feed in the pen in both areas.

Similarly, the majority of the farmers were not offering water to the sheep in the pen (78.4 per cent in irrigated area and 84 per cent in rainfed area). Remaining farmers i.e 21.6% in irrigated area and 16% in rainfed area were providing water in the pen, especially in summer months, when all the outside water bodies were dried.

4.5.1.7 Separate housing for various categories of sheep

No provision was made to keep the males and females separately in both the areas.

4.5.1.8 Soil replacement in sheep enclosures

From the present study Table 18, it was observed that nearly 85.6 per cent farmers in irrigated area and 72.8 per cent farmers in rainfed area were following soil replacement in sheep enclosures (Fig.27). Majority of the farmers in both the areas were replacing the soil on yearly basis.



Fig.26 Sheep house with thatched roof and mud floor.



Fig.27 Soil replacement in the sheep pen.

4.5.1.9 Sheep manure storage and disposal pattern

In the present study Table 18, it was found that all farmers storing manure in an open place forming a heap in both areas. None of the farmers were following pit method of manure storage in the study area.

It was observed that 54.4% shepherds in irrigated area and 24.8% shepherds in rainfed area were using sheep manure in their own fields. About 41.6% shepherds in irrigated area and 75.2% shepherds in rainfed area were selling sheep manure once in a year. Remaining farmers selling sheep manure twice a year. All farmers in the study area were cleaning the pen daily in both areas.

4.5.2 BREEDING MANAGEMENT PRACTICES FOLLOWED BY SHEPHERDS IN KRISHNA DISTRICT

The results showing various breeding management practices followed in the study areas was presented in Table 19.

4.5.2.1 Knowledge on heat symptoms

In the present study, it was evident that majority of the sheep farmers in both areas had knowledge on heat signs in sheep (77.6 per cent in irrigated area and 88 per cent in rainfed area). Remaining shepherds lack knowledge on heat signs.

4.5.2.2 Mating practices

All the farmers in the study area were not adopting the separation of males and females. Flock mating was common in the study area. There was no restriction on mating.

Majority of the shepherds were having awareness on ram to ewe ratio (86.4 per cent in irrigated area and 92.8 per cent in rainfed area). Remaining farmers did not have awareness on ram to ewe ratio. The majority were keeping one ram for every 40-50 ewes.

Table 19. Breeding management practices followed by shepherds in irrigated and rainfed areas of Krishna district.

S.NO	BREEDING MANAGEMENT PRACTICES		IRRIGATED AREA		RAINFED AREA		TOTAL	
			NO.OF FARMERS	%	NO.OF FARMERS	%	NO.OF FARMERS	%
1	KNOWLEDGE ON HEAT SYMPTOMS	YES	97	77.6	110	88	207	82.8
		NO	28	22.4	15	12	43	17.2
2	MALE & FEMALE KEPT SEPERATLEY	YES	0	0	0	0	0	0
		NO	125	100	125	100	250	100
3	MATING PRACTICES	HAND MATING	0	0	0	0	0	0
		FLOCK MATING	125	100	125	100	250	100
4	RESTRICTION ON MATING	YES	0	0	0	0	0	0
		NO	125	100	125	100	250	100
5	AWARENESS ON RAM TO EWE RATIO	YES	108	86.4	116	92.8	224	89.6
		NO	17	13.6	9	7.2	26	10.4
6	RAM ROTATION	YES	125	100	125	100	250	100
		NO	00	00	00	00	00	00

Table.19(contd.)

7	PERIOD OF ROTATION	3 Yrs	31	24.8	64	51.2	95	38
		4 Yrs	70	56	48	38.4	118	47.2
		5 Yrs & ABOVE	24	19.2	13	10.4	37	14.8
8	RAM ROTATION METHOD	HOME GROWN	81	64.8	66	52.8	147	58.8
		BY EXCHANGE	3	2.4	4	3.2	7	2.8
		BY PURCHASE	41	32.8	55	44	96	38.4
9	BASIS FOR SELECTION OF BREEDING ANIMALS	AGE	0	0	0	0	0	0
		WEIGHT	0	0	0	0	0	0
		BOTH	125	100	125	100	250	100
10	FLUSHING	YES	0	0	0	0	0	0
		NO	125	100	125	100	250	100
11	BREEDING SEASON	JUNE-AUG	125	100	125	100	250	100
		JAN-MAR	125	100	125	100	250	100

Homegrown ram was the major source for future breeding ram in the study area (64.8 per cent in irrigated and 52.8 per cent in rainfed area). Majority of the farmers (56 per cent) in irrigated area were changing their rams for every 4 years, followed by 24.8% farmers for every 3 years and 19.2 % farmers changing the ram after 5 years. Whereas, majority of the farmers (51.2 per cent) in rainfed area were changing their rams for every 3 years, followed by 38.4% farmers for every 4 years and 10.4 % farmers changing the rams 5 years & above.

4.5.2.3 Basis for selection of breeding animals

All the farmers in the study area were selecting breeding animals based on both age and body weight.

None of the farmers were following flushing of breeding ewes in the study area.

From the present study, it was revealed that the major breeding season was from June to August and minor was from January to March.

4.5.3 GRAZING AND FEEDING MANAGEMENT PRACTICES FOLLOWED BY SHEPHERDS IN KRISHNA DISTRICT

Feeding and grazing management followed by shepherds in irrigated and rainfed areas of Krishna district were presented in Table 20.

4.5.3.1 Grazing management practices followed by shepherds in Krishna district

In the present study, it was evident that majority of the sheep in both areas were traveling a distance of 4-6 km. daily during grazing (45.6 per cent in irrigated area and 48.8 per cent in rainfed area), followed by 2-4 km. distance (32.8 per cent in irrigated area and 33.6per cent in rainfed area). Few sheep were taken more than 6 km daily for grazing (21.6 per cent in irrigated area and 17.6 per cent in rainfed area). The mean grazing distance per day was 5.46 ± 0.13 km in irrigated area and 5.8 ± 0.14 km in rainfed area.

Table 20. Grazing and feeding management practices followed by shepherds in irrigated and rainfed areas of Krishna district.

S.NO	GRAZING & FEEDING PRACTICES		IRRIGATED AREA		RAINFED AREA		TOTAL	
			NO.OF FARMERS	%	NO.OF FARMERS	%	NO.OF FARMERS	%
1	GRAZING DISTANCE	2-4 Kms	41	32.8	42	33.6	83	33.2
		4-6 Kms	57	45.6	61	48.8	118	47.2
		6-8 Kms	27	21.6	22	17.6	49	19.6
2	GRAZING DURATION	6-7 Hrs	7	5.6	8	6.4	15	6
		8-10 Hrs	108	86.4	90	72	198	79.2
		MORE THAN 10 Hrs	10	8	27	21.6	37	14.8
3	SOURCE OF WATER FOR GRAZING SHEEP	POND	125	100	125	100	250	100
		WELL	0	0	0	0	0	0
		HAND PUMP	0	0	0	0	0	0
		TAP	0	0	0	0	0	0
4	DIRECTION OF GRAZING	ONE SIDE	3	2.4	6	4.8	9	3.6
		CHANGED REGULARLY	122	97.6	119	95.2	241	96.4

Table.20(contd.)

5	ROUTINE GRAZING LANDS	PRIVATE LANDS	33	26.4	41	32.8	74	29.6
		COMMON LANDS	92	73.6	84	67.2	176	70.4
6	GRAZING ON CROP LEFTOVERS	YES	107	85.6	118	94.4	225	90
		NO	18	14.4	7	5.6	25	10
7	SPECIALL FEEDING OF PREGNANT	YES	0	0	0	0	0	0
		NO	125	100	125	100	250	100
8	SPECIAL FEEDING OF NURSING MOTHER	YES	0	0	0	0	0	0
		NO	125	100	125	100	250	100
9	SPECIAL FEEDING OF RAMS	YES	17	13.6	29	23.2	46	18.4
		NO	108	86.4	96	76.8	204	81.6
10	SUPPLEMENTARY FEEDING	YES	0	0	0	0	0	0
		NO	125	100	125	100	250	100
11	CULTIVATION OF FODDER CROPS	YES	17	13.6	0	0	17	6.8
		NO	108	86.4	125	100	233	93.2

Table.20(contd.)

12	SALT FEEDING	YES	61	48.8	97	77.6	158	63.2
		NO	64	51.2	28	22.4	92	36.8
13	MINERAL MIXTURE FEEDING	YES	0	0	0	0	0	0
		NO	125	100	125	100	250	100
14	MIGRATION OF FLOCK	YES	75	60	78	62.4	153	61.2
		NO	50	40	47	37.6	97	38.8
15	MIGRATION PERIOD	RAINY SEASON	75	60	0	0	75	30
		SUMMER	0	0	78	62.4	78	31.2
16	SHEEP PENNING	PRACTICED	109	87.2	116	92.8	225	90
		NOT PRACTICED	16	12.8	9	7.2	25	10
17	WATER DURING PENNING	YES	125	100	125	100	250	100
		NO	0	0	0	0	0	0
18	INTERVALS OF WATERING	ONCE	45	36	99	79.2	144	57.6
		TWICE	68	54.4	26	20.8	94	37.6
		THRICE	12	9.6	0	0	12	4.8

Most of the shepherds allowed their sheep to graze for 8-10 hrs per day (86.4 per cent in irrigated area and 72 per cent in rainfed area), followed by more than 10 hrs of grazing (8 per cent in irrigated area and 21.6 per cent in rainfed area) and 6-7 hours grazing (5.6 per cent in irrigated area and 6.4 per cent in rainfed area). The mean grazing duration per day was 8.88 ± 0.09 hrs in irrigated area and 9.38 ± 0.12 hrs in rainfed area. The village water ponds were serving as a major source of water for the sheep in both areas.

Majority of the sheep farmers regularly changed the direction of grazing (97.6 per cent in irrigated area and 95.2 per cent in rainfed area).

Community lands were the major sites of sheep grazing (73.6 per cent in irrigated area and 67.2 per cent in rainfed area) (Fig.28), followed by private lands (26.4 per cent in irrigated area and 32.8 per cent in rainfed area). About 85.6% sheep in irrigated area and 94.4% sheep in rainfed area were grazing on crop leftovers.

4.5.3.2 Feeding management practices followed by shepherds in Krishna district

No sheep was receiving any extra supplementary feeding in any stage of their life in both areas. Some farmers in the study area were feeding extra supplementary feed like jowar grains, broken rice and concentrate mixture to the breeding rams (13.6 per cent in irrigated area and 23.2 per cent in rainfed area).

Some farmers in irrigated area especially in Machilipatnam mandal were cultivating fodder crops like pillipesara (*Vigna trilobata*), Co-3 to feed the sheep (13.6 percent).

About 48.8% shepherds in irrigated area and 77.6% shepherds in rainfed area were feeding their sheep with salt. None of the farmers were providing the mineral mixture to sheep.



Fig.28 Sheep grazing on Common lands.

4.5.3.3 Migration details

Majority of the sheep farmers following migration in adverse condition like scarcity feed and water (60 per cent in irrigated area and 62.4 per cent in rainfed area). Remaining were stationary flocks. In these stationary flocks roadside grazing, canal bank grazing, crop harvest residues, top feeding, sown fodder crops etc. were the source of feed for sheep.

Majority of the sheep in irrigated area were migrated in rainy season as all the fields would be having crops and chances of grazing were less. Sheep in rainfed area were migrated between the months of summer (February to June) due to scarcity feed and water.

Sheep penning provides additional income to the shepherds. Because of that reason most of the sheep farmers were practicing the penning (87.2 per cent in irrigated area and 92.8 per cent in rainfed area). The penning was considered as one of the major reason for migration because agriculturalists hire the flock during night time to their fields for manuring to increase the soil fertility. The sheep are penned in the open in harvested fields during nights (Fig.29) and some shepherds fenced with nylon nets of about four to five feet height supported by iron rods (or) long poles (Fig.30). All the farmers were providing water during penning in both areas and the majority of the farmers in irrigated area were watering the sheep twice in a day (54.4 per cent), whereas, watering the sheep only once a day was practiced by the majority of the farmers in rainfed area (79.2 per cent) during penning.



Fig.29 Open penning in agricultural fields.



Fig.30 Nylon net penning in the agricultural fields.

4.5.4 LAMB MANAGEMENT PRACTICES FOLLOWED BY THE SHEPHERDS IN KRISHNA DISTRICT

Lamb management practices followed by the shepherds in irrigated and rainfed areas of Krishna district were presented in Table 21.

4.5.4.1 Confinement of dam after lambing

In the present study, it was observed that 86.4 per cent farmers in irrigated area and 81.6 per cent farmers in rainfed area were sending the dam for grazing on next day of lambing itself. Remaining farmers (13.6 per cent in irrigated area and 18.4 per cent in rainfed area) were sending the dam for grazing within 10-15 days of lambing.

4.5.4.2 Lambs sent for grazing

Majority of the farmers were sending the new born lambs for grazing within 15 days after their birth (96 per cent in irrigated area and 89.6 per cent in rainfed area). About 8% of the farmers in rainfed area were sending the lambs for grazing between 15-30 days after their birth. Remaining farmers were allowing the lambs to graze after 30 days after their birth. The lambs were kept in a special basket made of bamboo sticks called “Gampa” in the local language and kept in an inverted position to protect them from stray dogs and other predators (Fig.31)

4.5.4.3 Feeding of tender leaves

About 80% farmers in irrigated area and 92.8% farmers in rainfed area were feeding the lambs with the tender leaves of subabul (Fig.32) and other tree leaves for daily feeding

4.5.4.4 Weaning

In the present study, about 65.6% shepherds in irrigated area and 76% shepherds in rainfed area were practicing weaning. About 34.4% shepherds in irrigated area and 24% shepherds in rainfed area were not practicing weaning.

Table 21. Lamb management practices followed by shepherds in irrigated and rainfed areas of Krishna district.

S.NO	LAMB CARE & MANAGEMENT		IRRIGATED AREA		RAINFED AREA		TOTAL	
			NO.OF FARMERS	%	NO.OF FARMERS	%	NO.OF FARMERS	%
1	CLEANING AT THE TIME OF LAMBING	YES	92	73.6	70	56	162	64.8
		NO	33	26.4	55	44	88	35.2
2	CONFINEMENT OF DAM AFTER LAMBING	RETAINED	17	13.6	23	18.4	40	16
		SENT FOR GAZING	108	86.4	102	81.6	210	84
3	LAMBS SENT FOR GRAZING	WITHIN 15 DAYS	120	96	112	89.6	232	92.8
		WITHIN 30 DAYS	0	0	10	8	10	4
		ABOVE 30 DAYS	5	4	3	2.4	8	3.2
4	FEEDING OF TENDER LEAVES	PRACTICED	100	80	116	92.8	216	86.4
		NOT PRACTICED	25	20	9	7.2	34	13.6
5	WEANING	PRACTICED	82	65.6	95	76	177	70.8
		NOT PRACTICED	43	34.4	30	24	73	29.2

Table.21(contd.)

6	LAMB FEEDING	MOTHERS MILK ALONE	125	100	125	100	250	100
		SUPPLEMENTARY MILK FEEDING	0	0	0	0	0	0
7	CARE OF THE LAMB BY	WOMEN	16	12.8	5	4	21	8.4
		CHILDREN	7	5.6	2	1.6	9	3.6
		BOTH	102	81.6	118	94.4	220	88



Fig.31 Lamb enclosure made of bamboo sticks.



Fig.32 Subabul feeding to lambs.

4.5.5 HEALTH MANAGEMENT PRACTICES FOLLOWED BY SHEPHERDS IN KRISHNA DISTRICT

Health management practices followed by shepherds in irrigated and rainfed areas of Krishna district were presented in Table 22.

4.5.5.1 Knowledge on health and diseases

All the respondents in the study area had good knowledge about sheep health and diseases affecting the sheep.

4.5.5.2 Deworming details

All the shepherds in the study area were deworming their flock regularly. The majority (54.4 per cent) of the farmers in irrigated area were deworming four times in a year, followed by thrice a year (42.4 per cent). Very few farmers in irrigated area were deworming their sheep for every 6 months (3.2 per cent). Whereas, most of the farmers (69.6 per cent) in rainfed area were dewormed three times in a year. About 17.6 per cent farmers were deworming for every three months. Very few were deworming their sheep twice a year (12.8 per cent). No farmer was practicing dipping in the study area.

Some farmers were using government supplied deworming drugs, whereas some farmers were purchasing them from outside due to inadequate supply by the State Animal Husbandry Department.

4.5.5.3 Vaccination details

All the farmers in the study area were regularly vaccinating their flock. The farmers were vaccinating against FMD, Sheep pox, PPR, Blue Tongue, ET. Shepherds solely depend on vaccines supplied by State Animal Husbandry Department.

4.5.5.4 Disposal of sick animals

The majority of the selected farmers (96.8 per cent in irrigated area and 92.8 per cent in rainfed area) were giving treatment to the sick animals. Whereas, few were

Table 22. Health measures followed by shepherds in irrigated and rainfed areas of Krishna district.

S.NO	HEALTH CARE & MANAGEMENT		IRRIGATED AREA		RAINFED AREA		TOTAL	
			NO.OF FARMERS	%	NO.OF FARMERS	%	NO.OF FARMERS	%
1	KNOWLEDGE ON HEALTH & DISEASES	YES	125	100	125	100	250	100
		NO	0	0	0	0	0	0
2	DEWORMING	REGULAR	125	100	125	100	250	100
		NOT REGULAR	0	0	0	0	0	0
3	PERIODICITY OF DEWORMING	TWICE A YEAR	4	3.2	16	12.8	20	8
		THRICE A YEAR	53	42.4	87	69.6	140	56
		FOUR TIMES A YEAR	68	54.4	22	17.6	90	36
4	SUPPLY OF DEWORMER	GOVERNMENT	0	0	0	0	0	0
		PURCHASED	0	0	0	0	0	0
		BOTH	125	100	125	100	250	100
5	PRACTICE OF DIPPING	YES	0	0	0	0	0	0
		NO	125	100	125	100	250	100
6	VACCINATION	YES	125	100	125	100	250	100
		NO	0	0	0	0	0	0

Table.22(contd.)

7	VACCINATION DONE FOR	FMD	125	100	125	100	250	100
		SHEEP POX	125	100	125	100	250	100
		PPR	125	100	125	100	250	100
		BLUE TONGUE	125	100	125	100	250	100
		ET	125	100	125	100	250	100
8	SUPPLY OF VACCINE	GOVERNMENT	125	100	125	100	250	100
		PURCHASED	0	0	0	0	0	0
9	DISPOSAL OF SICK ANIMALS	TREATED	121	96.8	116	92.8	237	94.8
		EMERGENCY SALE	4	3.2	9	7.2	13	5.2
10	DISPOSAL OF DEAD ANIMALS	THROWN IN OPEN FIELDS	19	15.2	56	44.8	75	30
		BURIED	91	72.8	65	52	156	62.4
		CONSUMPTION	15	12	4	3.2	19	7.6
11	DISINFECTION OF HOUSE	YES	112	89.6	103	82.4	215	86
		NO	13	10.4	22	17.6	35	14

Table.22(contd.)

12	SPRAYING OF INSECTICIDES	YES	58	46.4	32	25.6	90	36
		NO	67	53.6	93	74.4	160	64
13	TREATMENT OF ANIMALS WITH	ALLOPATHY	116	92.8	97	77.6	213	85.2
		ITK	1	0.8	3	2.4	4	1.6
		BOTH	8	6.4	25	20	33	13.2

disposing the sick animals by emergency sale (3.2 per cent in irrigated area and 7.2 per cent in rainfed area).

4.5.5.5 Disposal of dead animals

Among the farmers surveyed, 72.8% in irrigated area and 52% in rainfed area were disposing of the dead animals by burial method. Whereas, 15.2% farmers in irrigated area and 44.8% farmers in rainfed area were throwing the dead animals in the open fields. Remaining people were opting to sell the carcass (12 per cent in irrigated area and 3.2 per cent in rainfed area) for consumption.

4.5.5.6 Disinfection of sheep pen

A study was made to understand the regularity of disinfection of sheep pen, spraying of insecticides, treatment of sick animals and found that 46.4% shepherds in irrigated area and 25.6% shepherds in rainfed area were following spraying of insecticides. Whereas, 53.61% shepherds in irrigated and 74.4% in rainfed area were not spraying insecticides.

About 89.6% farmers in irrigated area and 82.4% farmers in rainfed area were disinfecting the sheep pen, whereas rest of them were not disinfecting the pen.

Treating of sick animals with allopathy was followed by 92.8% farmers in irrigated area and 77.6% farmers in rainfed area.

4.5.6 MODES OF MARKETING FOLLOWED BY SHEPHERDS IN KRISHNA DISTRICT

Mode of sheep marketing followed by the shepherds of irrigated and rainfed areas of the district was presented in Table 23.

4.5.6.1 Mode of marketing of sheep

In the present study, it was observed that 84 % farmers in irrigated area and 93.6% farmers in rainfed area were selling the sheep through middlemen in the village,

Table 23. Modes of marketing followed by shepherds in irrigated and rainfed areas of Krishna district.

S.NO	PARAMETER		IRRIGATED AREA		RAINFED AREA		TOTAL	
			NO.OF FARMERS	%	NO.OF FARMERS	%	NO.OF FARMERS	%
1	MODE OF MEAT MARKETING	DIRECT	20	16	8	6.4	28	11.2
		MIDDLE MEN	105	84	117	93.6	222	88.8
2	MODE OF SELLING	LIVE ANIMALS BASIS	125	100	125	100	250	100
		WEIGHT BASIS	0	0	0	0	0	0
3	PLACE OF DISPOSAL	SHANDIES	19	15.2	6	4.8	25	10
		CITY MARKET	0	0	0	0	0	0
		LOCAL	106	84.8	119	95.2	225	90
4	BASIS OF MARKETING	AGE	0	0	0	0	0	0
		DEMAND	0	0	0	0	0	0
		BODY WEIGHT	0	0	0	0	0	0
		AGE & DEMAND	125	100	125	100	250	100

Table.23(contd.)

5	AGE OF MARKETING OF MALE LAMBS	2-4 MONTHS	27	21.6	43	34.4	70	28
		5-6 MONTHS	98	78.4	82	65.6	180	72
6	MARKETING OF OTHER BY- PRODUCTS	MANURE	57	45.6	91	72.8	148	59.2
		SKIN	0	0	0	0	0	0

while the rest sold it directly to the consumer. Irrespective of the area, all the farmers were selling meat on the live animal basis.

4.5.6.2 Place of disposal of animals

Place of disposal of animals for marketing was mostly local market (84.8 per cent in irrigated area and 95.2 per cent in rainfed area). Remaining farmers disposed of their animals in shandies.

4.5.6.3 Basis of marketing

In both the areas surveyed, it was observed that both age and demand were the basis for marketing of sheep. Along with above-said factors, some farmers were selling their sheep whenever they need money to supplement the family income.

4.5.6.4 Age of Marketing of male lambs

In this survey, it was observed that 78.4% farmers in irrigated area and 65.6% farmers in rainfed area were selling male lambs at the age of 5-6 months, while rest were selling them at 2-4 months age.

4.6 CONSTRAINTS FACED BY SHEPHERDS IN KRISHNA DISTRICT

In the present study, an attempt was made to understand the various constraints faced by the shepherds in irrigated and rainfed areas of Krishna district in sheep rearing and the results were presented in Table 24. It was observed that availability of veterinary services and regular vaccination was not a constraint to the shepherds in Krishna district. Lack of scientific knowledge of the farmers surveyed (92 per cent in irrigated 93.6 per cent in rainfed area) was found to be the major constraint in sheep rearing. While middlemen hindrance was the major constraint in sheep marketing (87.2 per cent in irrigated and 84 per cent in rainfed area).

Apart from the constraints listed in the Table 24, the other constraints faced by the shepherds of study area include inadequate extension services, disease attacks, lack

Table 24. Constraints faced by shepherds in irrigated and rainfed areas of Krishna district.

S.NO	OBSERVATION		IRRIGATED AREA		RAINFED AREA		TOTAL	
			NO.OF FARMERS	%	NO.OF FARMERS	%	NO.OF FARMERS	%
1	VETERINARY SERVICES	AVAILABLE	125	100	125	100	250	100
		NOT AVAILABLE	0	0	0	0	0	0
2	REGULAR VACCINATION	PRACTICED	125	100	125	100	250	100
		NOT PRACTICED	0	0	0	0	0	0
3	SCIENTIFIC KNOWLEDGE	PRESENT	10	8	8	6.4	18	7.2
		LACKING	115	92	117	93.6	232	92.8
4	MIDDLEMEN HINDRANCE	YES	109	87.2	105	84	214	85.6
		NO	16	12.8	20	16	36	14.4
5	ORGANISED MEAT MARKETS	AVAILABLE	0	0	0	0	0	0
		NOT AVAILABLE	125	100	125	100	250	100

Table.24(contd.)

6	CONCENTRATE FEED AT REASONABLE COST	AVAILABLE	29	23.2	18	14.4	47	18.8
		NOT AVAILABLE	96	76.8	107	85.6	203	81.2
7	TRANSPORT FACILITY	AVAILABLE	11	8.8	15	12	26	10.4
		NOT AVAILABLE	114	91.2	110	88	224	89.6
8	GRAZING LAND	AVAILABLE	8	6.4	14	11.2	22	8.8
		NOT AVAILABLE	117	93.6	111	88.8	228	91.2
9	WATER FACILITY	AVAILABLE	105	84	50	40	155	62
		NOT AVAILABLE	20	16	75	60	95	38

of quality ram, high cost of veterinary medicines, lack of credit & insurance facilities, lack of compensation for deaths, high lamb mortality, labor shortage, lack of government schemes etc. were found to be the major constraints hindering the sheep rearing in the study area.

Chapter - V

Discussion

CHAPTER V

DISCUSSION

5.1 SOCIO ECONOMIC STATUS OF SHEEP FARMERS IN KRISHNA DISTRICT

5.1.1 Age of the farmers

As per the results presented in Table 5, it was observed in the present investigation that out of the 250 farmers surveyed, the majority of the farmers in the irrigated and rainfed areas of the district were middle-aged (64 per cent and 60 per cent respectively), followed by old age. The percentage of young people involved in the sheep rearing was very low. It indicates that youth was not showing any interest towards sheep rearing. These results were similar to observations of Mishra *et al.* (2006), Tanwar *et al.* (2008), Saha *et al.* (2010) and Rajanna *et al.* (2012). These results were in contradictory to the findings of Deshpande *et al.* (2010) where more old age farmers were recorded in his study area.

The present study revealed that since the state of Andhra Pradesh is under the era of rapid industrialization, younger age group opts for waged jobs in factories which they think as improvement in social status. Most of the shepherds were educating their children as they know the importance of education.

5.1.2. Literacy level of the sheep farmers

In the present study, it was found that about 81.6 % of the respondents in irrigated area and 88% in rainfed area were illiterates. The literates were small in number. These findings coincided with the findings of Maheswaran and Subramanian (1998) in their study on Mecheri sheep holders, Geetha *et al.* (1999) in Karnataka, Kumar *et al.* (2006) in Muzzaffarnagari sheep farmers, Arora *et al.* (2007) and Sireesha *et al.* (2015).

These findings were nearer to the findings of Geeta *et al.* (1999) and Rajanna *et al.* (2012). But the results obtained in the present study were in contrary to the findings of Kushwaha *et al.* (1999a), Kandasamy *et al.* (2006), Thiruvankadan *et al.* (2004) and Virojirao *et al.* (2008) where only 20-30%, 45.66%, 48.27% and 41% of the respondents were illiterates, respectively.

The present study revealed that majority of the farmers in the study area were not having education and were not aware of the importance of education as they entered the sheep rearing by tradition. Therefore it became a major hindrance for the farmers to take up scientific methods of rearing and to accept new practices.

5.1.3 Family type and size of sheep farmers

Table 5 revealed that medium family size dominated in both the study areas (46.4 per cent in both areas). Saha *et al.* (2010), Rajanna *et al.* (2012) observed a similar trend in their study. But results obtained in the present study were in contrary to the findings of Sahana *et al.* (2004) and Patil *et al.* (2012), where large families were predominant.

Majority of the farmers were maintaining nuclear families in the study area (81.6 in irrigated and 84.8 per cent in rainfed area). These findings were similar to the observations of Suresh *et al.* (2008) and Saha *et al.* (2010) and in contrary to the findings of Virojirao *et al.* (2008), Sireesha *et al.* (2015) and Patil *et al.* (2012) where it was reported that majority of the farmers had joint families

5.1.4 Land holding of sheep farmers

Table 5 showed that majority of the farmers in irrigated area was landless (45.6 per cent). Similarly, 72.8% of sheep farmers in rainfed area were landless. A similar trend was observed by Geeta *et al.* (1999) Arunachalam *et al.* (2002), Kumar *et al.* (2006), Deshpande *et al.* (2010) where 82%, 75%, 90% and 61% of sheep farmers were landless in their study areas.

The results obtained in the present study with regard to land holding pattern was contrary to the finds of Kuldeep *et al.* (2006), Saha *et al.* (2010) and Patil *et al.* (2012) where the majority of the farmers were with marginal land holding.

5.1.5 Main occupation of sheep farmers

The majority of the households studied in both areas, sheep rearing was the main occupation (51.2 per cent in irrigated area and 74.4 per cent in rainfed area). Geeta *et al.* (1999) in Karnataka, Sahana *et al.* (2004) in Jaluni sheep breeding tract, Kandasamy *et al.* (2006) in Coimbatore sheep breeding tract, Kuldeep *et al.* (2006) in Western Rajasthan, Sireesha *et al.* (2015) in Andhra Pradesh reported that animal husbandry activities were the main occupation of the sheep owners in their study.

The present study was in contrary with the findings of Thiruvankadan *et al.* (2004), Chaturvedi *et al.* (2008), Suresh *et al.* (2008), Saha *et al.* (2010), Rao *et al.* (2013) and Rajanna *et al.* (2012), where it was reported that agriculture was the main occupation of the respondents.

5.1.6 Annual household income

It was evident from Table 5, that majority of the sheep farmers were having medium annual household income i.e between Rs.55,000 -90,000 (51.2 percent in irrigated area and 52 per cent in rainfed area). Rajanna *et al.* (2012) and Patil *et al.* (2012) reported similar observations in their study area, where the majority of the sheep farmers belonged to medium income group. These findings are in contrary to the findings of Thiruvankadan *et al.*, (2004), Rao *et al.* (2013) and Arora *et al.* (2014) where the majority of the sheep farmers were getting an annual income of below Rs.25000 (low-income group).

These figures suggest that the sheep husbandry was still in the hands of economically weaker section of the population.

5.1.7 Type of farmer's residence

In both areas, most of the sheep farmers were living in kutcha houses (57.6 per cent in irrigated area and 56 per cent in rainfed area). Similar findings were reported by Virojirao *et al.* (2008), Rajanna *et al.* (2012) where, the majority of the sheep farmers were living in kutcha houses in their study areas.

The above results indicate the economic backwardness of shepherds in the study area.

5.1.8 Farmer's religion and community

It was observed from the Table 5 that in both the study areas, Hindus were the major sheep keepers (96 per cent in irrigated and 92 per cent in rainfed area) followed by Christians. None of the sheep holders belonged to the Muslim religion. Similar findings reported by Rajanna *et al.* (2012) in Andhra Pradesh, Kumar V *et al.* (2015) Mainpuri districts of Uttar Pradesh.

Majority of the sheep rearers belonged to Backward Casts in both the areas (86.4 per cent in irrigated area and 67.2 per cent in rainfed area) followed by Scheduled Casts (8 per cent in irrigated area and 15.2 per cent in rainfed area). Other Casts farmers were very less in the present study. The results obtained in the present study were similar to the findings of Thiruvankadan *et al.* (2004), Singh *et al.* (2010), Sireesha *et al.* (2015) and Rajanna *et al.* (2012). These results were in contrary to the report of Tanwar *et al.* (2008) where, most of the shepherds belong to Scheduled Tribes category in Udaipur district of Rajasthan.

It may be concluded from the results in the present study that sheep farming in the study area was still practiced as a caste based occupation. The farmers having higher social status but economically poor keep few sheep and goats as a source of supplementary income.

5.1.9 Sheep farming experience

Most of the sheep farmers in both areas had 5-15 years of experience in sheep farming (60.8 per cent in irrigated and 57.6 per cent in rainfed area). These were in accordance with the findings of Ramesh *et al.* (2012), but contrary to the findings of Rajanna *et al.* (2012), where most of the respondents had 18-41 years of experience in sheep farming.

5.2 FLOCK PROFILE OF SHEPHERDS IN KRISHNA DISTRICT

5.2.1 Livestock ownership of sheep farmers

From Table 6 it was evident that majority of the farmers in irrigated area (54.4 per cent) and rainfed area (68 per cent) reared goats along with sheep. Similar findings observed by Misra *et al.* (2007), Patil *et al.* (2012) and Kailash and Kavitha (2015).

The results indicating that the farmers had knowledge about the advantage of keeping the mixed herd with goats like leading the herd and controlling the sheep herd with the help of goats.

5.2.2 Flock size of sheep farmers

In the present study, it was observed that out of the total farmers studied, majority were maintaining flocks whose size ranged between 51-75 (42.4 per cent in irrigated area and 32 per cent in rainfed area). However, the flock size of the farmers ranged from 20 to 150. The average flock size in irrigated area of the district was 66.36 ± 2.32 and in rainfed area, it was 73.62 ± 3 . These findings were similar to those made by Kushwaha *et al.* (1999b) and Patil *et al.* (2012), Whereas, the flock size was observed to be higher in comparison with the findings of Sahana *et al.* (2004) and Suresh *et al.* (2008) where, the average flock size was reported to be 34 and 54, respectively.

These results indicated that the flock size was not constant and varied from flock to flock and from farmer to farmer. It has a direct influence on the overall income of

sheep farming. Flock sizes are dynamic and their increase/decrease is controlled by factors such as disease, sales for urgent monetary requirements, grazing resources, labour etc.

5.2.3 Source of sheep additions in the flock

5.2.3.1 Source of rams

All the shepherds in the study area were maintaining rams in their flocks. Homegrown rams were found to be the major source of rams for the farmers (64.8 percent in irrigated area and 52.8 per cent in rainfed area).

It clearly showed that within the flock selection of rams, though an unscientific way which may eventually reduce the flock performance due to inbreeding. It was felt that imparting knowledge to the farmers regarding the importance of selection and exchange of the rams will help in obtaining better breeding efficiency and genetic improvement in the flock. However, the farmers were generally reluctant to share their breeding ram due to some socio-economic reasons and beliefs. A similar type of practice was observed by Suresh *et al.* (2008), Tailor *et al.* (2010), Misra *et al.* (2007) and Rajanna *et al.* (2013) in their studies.

5.2.3.2 Source of ewes

Similarly, homegrown ewes were the source of ewes for the majority (93.6 per cent in irrigated area and 92 per cent in rainfed area) of the farmers selected in the study area. Similar observations were made by Virojirao *et al.* (2008) and Sireesha *et al.* (2014). But in contrary to the results of the present study, Rajanna *et al.* (2013) reported that all the breeding ewes were purchased from outside in Telangana region of Andhra Pradesh.

5.3 PRODUCTION PERFORMANCE OF SHEEP IN KRISHNA DISTRICT

5.3.1 Body weight

From Table 7, the mean values for body weights in the male for 2 teeth, 4 teeth, 6 teeth and full-mouthed animals in irrigated area were 42.0 ± 0.49 , 44.50 ± 0.34 , 44.33 ± 0.40 and 44.29 ± 0.28 ; while in rainfed area, the corresponding values were 39.92 ± 0.33 , 42.67 ± 0.33 , 43.11 ± 0.20 and 43.57 ± 0.20 Kg, respectively. The body weights of male sheep reported by Rani *et al.* (2014) in Nellore brown were higher than the weights of male in rainfed area and lower when compared to the weights in irrigated area. The body weights reported by Rani *et al.* (2014) in male sheep were 40.59 ± 0.57 , 43.67 ± 0.23 , 43.95 ± 0.62 and 43.70 ± 0.65 kg, respectively at 2, 4, 6 and 8-teeth of age.

The pooled mean body weight (kg) for 2, 4, 6 and full mouthed ewes observed were 31.99 ± 0.270 , 36.02 ± 0.240 , 37.27 ± 0.167 and 40.52 ± 0.269 , respectively in irrigated area; while in rainfed area, the corresponding values were 29.30 ± 0.40 , 34.84 ± 0.40 , 37.22 ± 0.35 and 42.01 ± 0.56 kg, respectively in rainfed area. These values were lower to the values reported by Rani *et al.* (2014) in Nellore brown ewes, where the mean body weights were 29.92 ± 0.13 , 33.23 ± 0.14 , 35.11 ± 0.14 and 36.33 ± 0.13 kg, respectively at 2 teeth, 4 teeth, 6 teeth and 8-teeth of age and in females the body weights were 29.92 ± 0.13 , 33.23 ± 0.14 , 35.11 ± 0.14 and 36.33 ± 0.13 kg, at the corresponding ages and were lower compared to the body weights of female sheep in the present study.

Table 7 showed that, the males in irrigated area differed significantly ($P < 0.05$) with those of in rainfed area in all age groups, except in 8 teeth. The body weight 4 teeth female sheep in irrigated area did not differ significantly ($P < 0.05$) compared to rainfed area, while the corresponding weights in other age groups differed significantly. The body weights of males in both areas at all ages were significantly higher than the females

of the same age ($P < 0.01$). There is the effect of sex on body weights of sheep in both the areas.

The reason for higher body weights of sheep in irrigated area than rainfed area was due to more availability of water and grazing material.

5.3.2 Body length

From Table 9, the mean values for body lengths in the male for 2 teeth, 4 teeth, 6 teeth and full-mouthed animals in irrigated area were 76.08 ± 0.22 , 77.83 ± 0.37 , 78.11 ± 0.30 and 78.71 ± 0.28 cm respectively. While in rainfed area the corresponding values were 74.75 ± 0.21 , 76.17 ± 0.30 , 76.89 ± 0.26 and 77.14 ± 0.50 cm respectively.

The mean body lengths for 2 teeth, 4 teeth, 6 teeth and full-mouthed ewes observed were 66.48 ± 0.23 , 64.93 ± 0.44 , 67.94 ± 0.35 , 72.78 ± 0.50 cm respectively in irrigated area. While in rainfed area the corresponding values were 64.17 ± 0.46 , 64.27 ± 0.37 , 65.99 ± 0.32 and 67.43 ± 0.50 cm respectively.

These body lengths were lower than the values recorded by Rani *et al.* (2014) in Chittoor district of Andhra Pradesh, where the body lengths of male sheep were 76.37 ± 0.99 , 77.46 ± 0.31 , 78.22 ± 0.86 and 78.46 ± 0.94 cm at 2 teeth, 4teeth, 6 teeth and 8-teeth of age, respectively, while in females the corresponding means were 65.91 ± 0.22 , 69.12 ± 0.19 , 70.87 ± 0.20 and 72.85 ± 0.19 cm respectively.

From the study, it was evident that there was a significant difference between the two areas with respect to the body length of sheep at all age groups except between the females of 4 teeth age ($P < 0.05$). The body lengths of males in both areas at all ages were significantly higher than the females of the same age ($P < 0.01$). There is effect of sex on body lengths of sheep in both the areas.

5.3.3 Height at withers

From Table 11, the pooled mean height at withers for 2 teeth, 4 teeth, 6 teeth and full-mouthed rams observed were 83.08 ± 0.28 , 84.83 ± 0.40 , 86.11 ± 0.26 and 84.57 ± 0.29

cm respectively in irrigated area. While in rainfed area the corresponding values were 81.33 ± 0.28 , 81.83 ± 0.30 , 84.78 ± 0.22 and 82.71 ± 0.28 cm respectively.

The mean values for height at withers in ewes for 2 teeth, 4 teeth, 6 teeth and full-mouthed animals in irrigated area were 74.62 ± 0.23 , 75.93 ± 0.17 , 76.75 ± 0.28 and 79.11 ± 0.30 respectively. While in rainfed area the corresponding values were 72.51 ± 0.29 , 75.54 ± 0.27 , 76.12 ± 0.29 and 76.88 ± 0.31 respectively.

These values were Lower the values recorded by Rani *et al.* (2014) of all ages except in males of 6 teeth age and females of 2 teeth, 4 teeth age. The corresponding values of height at withers for male were 82.26 ± 0.8 , 84.34 ± 0.29 , 85.36 ± 0.74 and 84.65 ± 0.79 cm at 2, 4, 6 and 8- teeth age respectively, while in females the corresponding means were 71.55 ± 0.20 , 75.27 ± 0.9 , 76.91 ± 0.17 and 78.93 ± 0.16 cm respectively.

In the present study, it was observed that the mean height at withers of sheep in irrigated area was significantly higher compared to that of rainfed area in all ages, except between the females of 4 teeth and 6 teeth age ($P < 0.05$). The height at withers of males in both areas at all ages was significantly higher than the females of the same age ($P < 0.01$). There is the effect of sex on height at withers of sheep in both the areas.

5.3.4 Chest girth

From table 13, the mean chest girth for 2 teeth, 4 teeth, 6 teeth and full-mouthed rams observed were 82.50 ± 0.19 , 85.50 ± 0.42 , 86.33 ± 0.33 and 85.00 ± 0.30 cm respectively in irrigated area. While in rainfed area the corresponding values were 81.25 ± 0.25 , 83.17 ± 0.30 , 84.22 ± 0.32 and 83.43 ± 0.20 cm respectively.

The mean values for chest girth in ewes for 2 teeth, 4 teeth, 6 teeth and full-mouthed animals in irrigated area were 77.99 ± 0.31 , 79.83 ± 0.26 , 81.40 ± 0.25 and 82.16 ± 0.34 cm respectively. While in rainfed area the corresponding values were 73.94 ± 0.31 , 78.94 ± 0.31 , 81.24 ± 0.52 , 86.66 ± 0.49 cm respectively.

Rani *et al.* (2014) recorded higher values in males and lower values in females of corresponding ages of the present study, where means for chest girth recorded by Rani *et al.* (2014) in males were 82.95 ± 0.95 , 84.77 ± 0.34 , 85.12 ± 0.96 and 84.87 ± 0.97 cm at 2, 4, 6 and 8 teeth of age, respectively, while in females the least-squares means were 73.13 ± 0.22 , 76.48 ± 0.21 , 78.71 ± 0.22 and 79.97 ± 0.20 cm for the corresponding ages.

In the present study, it was observed that the mean chest girth of sheep in irrigated area was significantly higher compared to that of rainfed area in all ages, except between the females of 6 teeth age ($P < 0.05$). But in case of 8 teeth females, chest girth of rainfed area sheep was significantly higher than that of the female sheep in irrigated area of the same age. The chest girth of males in both areas at all ages was significantly higher than the females of the same age except 8 teeth stage ($P < 0.05$). In 8 teeth age, chest girth of female sheep in rainfed area was significantly higher than that of the male sheep in irrigated area ($P < 0.05$). There is the effect of sex on chest girth of sheep in both the areas except in 8 teeth stage in rainfed area.

5.3.5 Punch girth

From Table 15, the mean punch girth for 2 teeth, 4 teeth, 6 teeth and full-mouthed rams observed were 83.25 ± 0.32 , 86.50 ± 0.42 , 85.22 ± 0.22 and 85.71 ± 0.28 cm respectively in irrigated area. While in rainfed area the corresponding values were 82.42 ± 0.22 , 84.83 ± 0.30 , 83.56 ± 0.24 and 84.43 ± 0.42 cm respectively.

The mean values for punch girth in ewes for 2 teeth, 4 teeth, 6 teeth and full-mouthed animals in irrigated area were 80.09 ± 0.33 , 83.07 ± 0.40 , 84.21 ± 0.28 and 89.24 ± 0.44 cm respectively. While in rainfed area the corresponding values were 76.09 ± 0.56 , 82.65 ± 0.30 , 84.84 ± 0.26 and 85.51 ± 0.30 cm respectively.

These values were lower than the values recorded by Rani *et al.* (2014) in all ages except in the males of 6 teeth age. The mean values for paunch girth recorded by

Rani *et al.* (2014) in males were 82.55 ± 0.91 , 85.02 ± 0.35 , 84.96 ± 1.05 and 84.87 ± 1.01 cm at 2, 4, 6 and 8 teeth of age respectively, while in females the means were 76.37 ± 0.21 , 80.35 ± 0.22 , 82.69 ± 0.24 and 83.90 ± 0.21 cm at the corresponding ages.

In the present study, it was observed that the mean punch girth of sheep in irrigated area was significantly higher compared to that of rainfed area in all ages, except between the females of 4 teeth and 6 teeth age ($P < 0.05$). The chest girth of males in both areas at all ages was significantly higher than the females of the same age, except 6 teeth and 8 teeth age. In 6 teeth age, punch girth of female sheep in rainfed area was significantly higher than that of the male sheep in irrigated area ($P < 0.05$). Whereas, in case of 8 teeth stage punch girth of female sheep in irrigated area was significantly higher than that of the male sheep in rainfed area ($P < 0.05$).

5.4 REPRODUCTIVE PERFORMANCE OF SHEEP IN KRISHNA DISTRICT

5.4.1 Age at first mating in females

Table 17 revealed that, the age at first mating in females in irrigated and rainfed area were 13.16 ± 0.06 and 14.52 ± 0.06 months, respectively. The age at first mating in females reported by earlier workers in different breeds ranged from 10-24 months (Kushwaha *et al.*, 1999, Mehta *et al.*, 1995, Mishra *et al.*, 2004, Kumar *et al.*, 2006 and Kandasamy *et al.*, 2006). Breed and nutritional status of the animal might be the reason for the differences in age at first mating in ewes. There was a significant difference between irrigated and rainfed area ($P < 0.01$).

5.4.2 Age at first mating in males

Table 17 revealed that the age at first mating in males in irrigated and rainfed area was 19.89 ± 0.18 and 19.63 ± 0.20 months, respectively. The age at first mating in rams reported by earlier workers ranged from 10 to 24 months in different breeds. (Mehta *et al.* (1995a), Dixit *et al.* (2005), Kumar *et al.* (2006), Kandasamy *et al.* (2006)

and Kushwaha *et al.* (1999a)). There was no significant difference between irrigated and rainfed area ($P < 0.05$).

5.4.3 Age at first lambing

Table 17 revealed that the age at first lambing in irrigated and rainfed area was 18.24 ± 0.05 and 19.52 ± 0.06 months, respectively. These values were comparable to the findings of Kandasamy *et al.* (2006) in Coimbatore sheep (16.60 ± 0.10 months), Poonia (2008) in Munjal sheep (530.53 ± 12.39 days) and Mane *et al.* (2014) in Deccani sheep (638.91 ± 3.56 days). Higher AFL was reported by Acharya (1982) and Rani *et al.* (2014) in Nellore sheep (841.04 ± 1.21 days) and Dey and Poonia (2005b) in Nali sheep (925.08 ± 13.02 days). There was a significant difference between irrigated and rainfed areas ($P < 0.01$).

5.4.4 Lambing interval

Table 17 revealed that the lambing interval in irrigated and rainfed area was 306.68 ± 0.81 and 308.53 ± 1.15 days, respectively. The means recorded in the present study are in accordance with the findings of Dixit *et al.* (2002) in Bharat Merino sheep (290 ± 26 days) and Mane *et al.* (2014) in Deccani sheep (307.90 ± 1.37 days). However higher lambing interval was reported by Rajanna *et al.* (2012) in Nellore sheep (420.93 ± 2.76 days) and lower values reported by Patro *et al.* (2006) in indigenous meat-type sheep of coastal Orissa (214.01 ± 0.33 days). There was no significant difference between irrigated and rainfed area ($P > 0.05$).

5.4.5 Age at weaning

Table 17 revealed that the age at weaning in irrigated and rainfed area was 3.71 ± 0.40 and 4.09 ± 0.05 months, respectively. There was a significant difference in age at weaning between the two areas. Similar age at weaning was reported by Rao *et al.* (2013), where the age at weaning for lambs were 3.25 ± 0.04 months in North Coastal

zone of Andhra Pradesh. There was a significant difference between irrigated and rainfed areas ($P < 0.01$).

Weaning is influenced by the sex of the lamb and demand for sale. Ram lambs units are coming up in Andhra Pradesh. They are weaned and fed independently in order to attain early weight and maturity. Ewe lambs will remain in the same flock as replacement stock.

5.4.6 Weight at weaning

Table 17 revealed that the weight at weaning in irrigated and rainfed area was 12.57 ± 0.0 and 10.98 ± 0.05 kg, respectively. There was a significant difference in weight at weaning between the two areas. Singh and Kushwaha (1995) reported weight at weaning as 16.65 ± 0.21 kg in Bharat Merino sheep, Rao *et al.* (2004) recorded the weight at weaning as 11.67 kg and 12.24 kg in Nellore Jodipi and Palla sheep respectively. Dey and Poonia (2005b) reported that weight at weaning as 10.66 ± 0.10 kg in Nali lambs. Rathod and Sreedhar (2010) reported that weight at weaning as 14.51 ± 0.09 kg in Nellore lambs. Singh *et al.* (2013) reported that weight at weaning as 15.13 ± 0.14 kg in Marwari lambs. Rao *et al.* (2013) reported weight at weaning as 8.96 ± 0.14 kg in North coastal zone of Andhra Pradesh. There was a significant difference between irrigated and rainfed areas ($P < 0.01$).

5.5 SHEEP PRODUCTION AND MANAGEMENT PRACTICES OF SHEPHERDS IN KRISHNA DISTRICT

5.5.1 HOUSING MANAGEMENT FOLLOWED BY SHEPHERDS

5.5.1.1 Rearing of sheep

From Table 18 it was evident that all farmers in the study area were rearing the sheep in an extensive system. None of the farmers were following intensive (or) semi-intensive type of rearing in both the areas. These results were in accordance with the

findings of Chaturvedi *et al.* (2008), Dass *et al.* (2007), Kailash and Kavitha (2015), Misra *et al.* (2007), Sireesha *et al.* (2014) and Ravimurugan *et al.* (2012).

5.5.1.2 Type of housing

Majority of the farmers were providing semi-open type of housing (56 per cent in irrigated area and 57.6 per cent in rainfed area) to their sheep. A similar type of housing was observed by Suresh *et al.* (2008) in Rajasthan, Gopal *et al.* (2012) in Muzaffarnagari sheep breeding tract and Rajanna *et al.* (2013) in Andhra Pradesh. Whereas, Arora *et al.* (2007), Tiruvenkadan *et al.* (2007) and Devendran *et al.* (2010) observed open housing predominantly in their study areas.

5.5.1.3 Placing of animals

Majority of the sheep pens in the study area were nearer to the farmer's residence (94.4 per cent in irrigated area and 72 per cent in rainfed area). These results were comparable with the findings of Chandran *et al.* (2009), Arora *et al.* (2010), Sireesha *et al.* (2014) who reported that most of the sheep housed near to the farmer's residence.

5.5.1.4 Type of roof and floor

Majority of the farmers were providing a thatched roof to the sheep (61.6 per cent in irrigated area and 47.2 per cent in rainfed area). These coincides with the findings of Yadav *et al.* (2009), Kaliash and Kavitha (2015) in Rajasthan, Sireesha *et al.* (2014), Rao *et al.* (2013) and Rajanna *et al.* (2013) in Andhra Pradesh.

All the shepherds were maintaining their sheep on mud floor (Kutch floor) only. No farmer was maintaining their sheep on a concrete floor in the study area. Similar type of observations were recorded by Thiruvenkadan *et al.* (2007), Nayak *et al.* (2008), Suresh *et al.* (2008), Yadav *et al.* (2009), Gopal *et al.* (2012), Sireesha *et al.* (2014), Rao *et al.* (2013) and Rajanna *et al.* (2013). It might be concluded that most of the farmers were not having pucca structures for the houses and it could be due to the involvement of landless, small and marginal farmers.

5.5.1.5 Enclosures

Majority of the farmers were providing fence made of thorny plants, locally available sticks, bamboo slits and nylon nets (89.6 per cent in irrigated area and 87.2 per cent in rainfed area). A similar type of enclosures was observed by Tanwar *et al.* (2008), Gopal *et al.* (2012), Kaliash and Kavitha (2015), Suresh *et al.* (2008) and Rajanna *et al.* (2013). But Sahana *et al.* (2004) reported that majority of the sheep enclosures were made of stones (or) bricks in Jaluni sheep breeding tract.

5.5.1.6 Provision of feed and water in the pen

All the farmers in the study area were not providing any extra feed in the pen in both areas. Majority of the farmers were not offering water to the sheep in the pen (78.4 per cent in irrigated area and 84 per cent in rainfed area). Similar results were obtained by Sahana *et al.* (2004), Tanwar *et al.* (2008) and Sireesha *et al.* (2014).

5.5.1.7 Separate housing for various categories of sheep

None of the farmers in the study area were providing special houses for males & females, Lambs & adults, pregnant animals in both areas. These results were in agreement with the findings of Kandasamy *et al.* (2006), Sireesha *et al.* (2014), Dixit *et al.* (2005), Misra *et al.* (2007), Devendran *et al.* (2010) and Sabapara *et al.* (2010). It indicated that proper facilities were not present for keeping different categories of animals separately.

The lambs were kept in a special basket made of bamboo slits and kept in an inverted position called “Gampa” in the local language to protect them from stray dogs and other predators. A similar type of protection to the lambs was observed by Nayak *et al.* (2008), Tanwar *et al.* (2008), Chandran *et al.* (2009) and Kandasamy *et al.* (2006).

5.5.1.8 Soil replacement in sheep enclosures

The non-migratory sheep flock has to be sheltered in the same shed throughout the year. The peculiar behavior of pawing the earth with one of their forelimbs while

lying down in the sheep makes the floor uneven and pits will be formed on the ground. These pits have to be filled up with fresh mud on the floor of the sheep sheds. In the present study, it was observed that nearly 85.6 per cent farmers in irrigated area and 72.8 per cent farmers in rainfed area were following soil replacement in sheep enclosures. These results were contrary with the findings of Rajanna *et al.* (2013), Where majority of the farmers in his study area were not following soil replacement.

5.5.1.9 Sheep manure storage and disposal pattern

In the present study, it was evident that all farmers storing manure in an open place forming a heap in both areas. About 54.4% shepherds in irrigated area and 24.8% shepherds in rainfed area were using sheep manure in their own fields. About 41.6% shepherds in irrigated area and 75.2% shepherds in rainfed area were selling sheep manure once in a year. Padmanabhan (1994), Sireesha *et al.* (2014) and Rajanna *et al.* (2013) observed similar practices in their studies. In contrary to the findings of the present study, Thiruvankadan *et al.* (2004) observed that in the Mecheri tract, sheep manure was rarely collected and stored, but directly made to fall on harvested fields while penning. Sheep farmers need to be educated on proper methods of storage and disposal of manure, who maintain stationary flocks.

All farmers in the study area were cleaning the pen daily in both areas. Similar results were observed by Sireesha *et al.* (2014) in her study, where 93.3% farmers were cleaning the pen daily. Most of the farmers in the present study were keeping the premises of animals clean and hygienic which could be due to the womenfolk who were taking care of it.

5.5.2 BREEDING MANAGEMENT PRACTICES FOLLOWED BY SHEPHERDS IN KRISHNA DISTRICT

5.5.2.1 Knowledge on heat symptoms

Table 19 showed that majority of the sheep farmers in both study areas had knowledge on heat symptoms in sheep (77.6 per cent in irrigated area and 88 per cent in rainfed area). These results were comparable to the findings of Sireesha *et al.* (2014). These findings revealed the association shepherds had with their flocks and the traditional knowledge they possessed.

5.5.2.2 Mating practices

All the farmers in both areas were following flock mating. There was no restriction on mating. Similar findings were reported by Virojirao *et al.* (2008), Sireesha *et al.* (2014), Misra *et al.* (2007) in Andhra Pradesh, Dixit *et al.* (2005) in Rampur Bashire breeding tract, Kandasamy *et al.* (2006), Devendran *et al.* (2010) in Coimbatore sheep breeding tract, Karunanithi *et al.* (2005) in the Macheri sheep breeding tract, Sahana *et al.* (2004) in Jalauni sheep breeding tract and Tailor *et al.* (2010) in Sonadi sheep breeding tract. These observations clearly indicated that the farmers were not aware of the better breeding practices.

Majority of the shepherds were having awareness on ram to ewe ratio (86.4 per cent in irrigated area and 92.8 per cent in rainfed area). The majority were keeping one ram for every 40-50 ewes. Similar results were reported by Tilahun *et al.* (2006) in the Awassi city where one ram was maintained for every 30 to 50 breeding ewes. Dixit *et al.* (2005) observed ram to ewe ratio in the breeding tract of Rampur Bushair sheep as two to three rams per 100 ewes. Similarly, Sireesha *et al.* (2014) observed one ram was kept for every 50 ewes in Andhra Pradesh. This observation could be interpreted that the farmers were aware of the ram to ewe ratio.

Majority of the farmers (56 per cent) in irrigated area were changing their rams for every 4 years, followed by 24.8% farmers for every 3 years and 19.2 % farmers changing the ram after 5 years. Majority of the farmers (51.2 per cent) in rainfed area were changing their rams for every 3 years, followed by 38.4% farmers for every 4 years and 10.4 % farmers changing the rams 5 years & above. The results conclude that farmers of rainfed area had more knowledge on ram rotation than irrigated area farmers. These observations were similar to the findings of Karunanidhi *et al.* (2005) in Mecheri sheep breeding tract and Sireesha *et al.* (2014) in Andhra Pradesh. The results obtained in the study were higher than the reports given by Kushwaha *et al.* (1999a) in where the ram was changed for every 2 years in Chokla sheep, Suresh *et al.* (2008) in Rajasthan and Ravimurugan *et al.* (2012) in Pattanam sheep breeding tract where the ram was changed for every 2-3 years.

5.5.2.3 Basis for selection of breeding animals

All the farmers in both areas were selecting breeding animals based on both age and body weight. A similar type of observations reported by Ravimurugan *et al.* (2010) in Ramanand White sheep breeding tract, Kandasamy *et al.* (2006) in Coimbatore sheep breeding tract and Sireesha *et al.* (2014) in Andhra Pradesh.

None of the farmers were following flushing of breeding ewes in the study area. This observation clearly indicated that farmers in Krishna district were not following any scientific methods in breeding practices adopted for sheep rearing and the cause could be lack of education and guidance on this aspect.

From the present study, it was revealed that the major breeding season was from June to August and minor was from January to March. These findings were in conformity with those of Kushwaha *et al.* (1997), where it was found that majority of Chokla sheep bred during July-August though they were known to be bred throughout the year. Similar findings were also reported by Karunanithi *et al.* (2005), Kumar *et al.*

(2008) and Virojirao *et al.* (2008). However, Arora *et al.* (2010) reported that breeding season in Ganjam sheep was from July to October.

5.5.3 GRAZING AND FEEDING MANAGEMENT PRACTICES FOLLOWED BY SHEPHERDS IN KRISHNA DISTRICT

5.5.3.1 Grazing management practices followed by shepherds in Krishna district

The mean grazing distance was 5.46 ± 0.13 km in irrigated area and 5.8 ± 0.14 km in rainfed area in a day. From the present study, it was observed that the mean grazing duration was 8.88 ± 0.09 hrs in irrigated area and 9.38 ± 0.12 hrs in rainfed area in a day. The present findings on grazing time and distance in the study area were comparable with the earlier reports of Mehta *et al.* (1995), Sushilkumar *et al.* (2003), Thiruvankadan *et al.* (2004), Kumar *et al.* (2006) and Kandasamy *et al.* (2006). The distance to which the grazing restricted might indicate the habit of returning back to their places during the night and staying back with their families.

From Table 20, it was evident that regular change of the direction in which the animals were taken for grazing was observed to be followed by a large fraction of farmers interviewed (97.6 per cent in irrigated area and 95.2 per cent in rainfed area). While a small fraction let their animals to go for grazing in one direction. The practice of changing the direction of grazing indicated that the sheep farmers were avoiding overgrazing and also were aware of sources of grazing where, sufficient grazing materials were available.

Community lands were the main grazing areas for sheep in both the areas (73.6 per cent in irrigated area and 67.2 per cent in rainfed area) in addition to agricultural fields. Sheep obtain forage from a combination of herbage and crop stubbles from both community and private agricultural fields. Farmer's cultivated lands become common grazing lands after harvesting for livestock including sheep. The present finding agrees

well with that of Thiruvankadan *et al.* (2004), Kandasamy *et al.* (2006) and Kuldeep *et al.* (2006), Kailash and kavitha (2015). Shepherds often scolded by the land owners during grazing in private lands.

5.5.3.2 Feeding management practices followed by shepherds in Krishna district

It was observed from Tale 20 that no sheep was receiving any extra supplementary feeding in any stage of their life in both areas. Similar observations were reported by Sahana *et al.* (2004), Kandasamy *et al.* (2006), Nayak *et al.* (2008) and Sireesha *et al.* (2014). In contrary to the findings of the present study, Dixit *et al.* (2005) reported that non-migratory sheep supplemented with concentrates (Barley plus Wheat) @ 100-200 gms/animal/day and tree leaves. Only 50.67 per cent shepherds were feeding tree leaves to their young lambs. Chaturvedi *et al.* (2002) reported that dry fodder was supplemented during critical stages of growth, advanced pregnancy and lactation. Thiruvankadan *et al.* (2007) reported that the lactating ewes were fed with rice bran, groundnut cake, soaked cotton seed and bajra during summer. Kailash and Kavitha (2015) reported that dry fodder was provided to the pregnant sheep in Rajasthan.

Some farmers in the study area were feeding extra supplementary feeding like jowar grains, broken rice and concentrate mixture to the breeding rams (13.6 per cent in irrigated area and 23.2 per cent in rainfed area). The results of the present study were in agreement with the findings of Sirohi and Rawat (2000), Sushilkumar *et al.* (2003), Chandran *et al.* (2009), where some farmers in their study area were giving supplementary feed to the rams. On the contrary, Kushwaha *et al.* (1999b) observed that rams of Munjal breed were supplemented with concentrates throughout the year.

Some farmers (13.6 per cent) in irrigated area especially in Machilipatnam mandal were cultivating fodder crops like pillipesara (*Vigna trilobate*), Co-3 to feed the sheep (13.3 percent). Cultivation of fodder crops to the sheep was reported by

Padmanabhan (1994), Sirohi and Rawat (2000), Chaturvedi *et al.* (2002), Thiruvankadan *et al.* (2004), Mehta *et al.* (1995) and Sireesha *et al.* (2014).

About 48.8% shepherds in irrigated area and 77.6% shepherds in rainfed area were feeding their sheep with salt. The results were not in agreement with the findings of Dorji *et al.* (2003) in Bhutan, where very few farmers were providing salt to the sheep.

5.5.3.3 Migration details

Because of the non-availability of grazing land in their home tract, sheep owners practice migration over extensive areas. During migration, the shepherds depend mainly on common property resources like community grazing lands including permanent pastures, uncultivable & cultivable waste lands, fallow lands and village forests. Majority of the farmers in the study area were following migration in adverse condition like scarcity feed and water (60 per cent in irrigated area and 62.4 per cent in rainfed area). Remaining flocks were stationary flocks. Dixit *et al.* (2005) reported that the Gaddi tribes in Jammu and Kashmir owning Rampur bushair sheep followed migration during summer months, whereas Kuldeep *et al.* (2006) observed that in Rajasthan sheep flocks were on migration for seven months in a year.

The reasons for migration were lack of feed resources, income from penning, traditional practice, successive drought, lack of water resources and lack of sufficient grazing land. Similar findings were reported by Chandramouli *et al.* (1996) in Nellore district of Andhra Pradesh, Dorji *et al.* (2003) in Bhutan, respectively.

In the present study majority of the sheep in irrigated area were migrated in rainy season as all the fields would be having crops and chances of grazing were less. Similar results were observed by Sireesha *et al.* (2014) where, all the farmers practicing migration only during rainy season. Whereas, the sheep of rainfed area migrating in summer months (February to June). A similar type of migration was observed by Jain and Singh (2009) where migration was mainly during the summer season.

Sheep penning was found to be a common practice among the shepherds of Krishna district as it was noted that 87.2% in irrigated area and 92.8% farmers in rainfed area in the present study were practicing sheep penning. Sheep penning was observed by Thiruvankadan *et al.* (2004), Sireesha *et al.* (2014), Misra *et al.* (2007), Rao *et al.* (2013) and Kailash and Kavitha (2015) in their study areas. The change of penning site or duration of penning depended on the area of land on which they needed to pen and also as per the agreement made between the owner of the land and the sheep farmer. The findings in the present study were not in accordance with the findings of Kandasamy *et al.* (2006) and Devendran *et al.* (2010) where, it was reported that penning site was changed almost every day for Coimbatore sheep, irrespective of any other conditions.

5.5.4 LAMB MANAGEMENT PRACTICES FOLLOWED BY SHEPHERDS KRISHNA DISTRICT

5.5.4.1 Confinement of dam after lambing

It was observed from Table 21 that, About 86.4 per cent farmers in irrigated area and 81.6 per cent farmers in rainfed area were sending the dam for grazing on next day lambing of lambing itself. Sireesha *et al.* (2014) observed a similar trend in her study.

5.5.4.2 Lambs send for grazing

Majority of the farmers were sending the new born lambs for grazing within 15 days after their birth (96 per cent in irrigated area and 89.6 per cent in rainfed area). Similar findings were reported by Sahana *et al.* (2004) where, the lambs of Jalauni sheep were kept in the house for about 15 days after birth and later joined with the flock for grazing and Kandasamy *et al.* (2006) where, the lambs of Coimbatore sheep were sent for grazing after 15 days of birth. The findings of present study were in contrary to those of Thiruvankadan *et al.* (2007) where, it was reported that 50% of farmers in Tamil Nadu region sent their lambs for grazing immediately after 1 day of lambing,

Padmanaban (1994) reported that in Mecheri block of Salem district lambs were sent to grazing after 2 months, Gopal *et al.*, (2012) where, lambs were sent to grazing after 2 months of age in Muzaffarnagari sheep breeding tract, Kailash and Kavitha (2015) where, 52% lambs sent to grazing after 2 months of age in Rajasthan.

5.5.4.3 Feeding of tender leaves

About 80% farmers in irrigated area and 92.8% farmers in rainfed area were feeding the lambs with the tender leaves of subabul and other tree leaves for daily feeding. Similar findings were reported by Jain and Singh (2009) who reported that the Nellore lambs in Nellore district of Andhra Pradesh were supplemented with tamarind leaves and Sireesha *et al.* (2014) reported that about 80% farmers feeding subabul to young lambs in Guntur district of Andhra Pradesh.

5.5.4.4 Weaning

In the present study, about 65.6% shepherds in irrigated area and 76% shepherds in rainfed area were practicing weaning. About 34.4% shepherds in irrigated area and 24% shepherds in rainfed area were not practicing weaning. This indicated that majority of the shepherds were having sufficient knowledge about the advantages of weaning.

5.5.5 HEALTH MANAGEMENT PRACTICES FOLLOWED BY SHEPHERDS IN KRISHNA DISTRICT

5.5.5.1 Knowledge on health and diseases

Table 22 showed that all the respondents in the study area had knowledge about sheep health and diseases. Sireesha *et al.* (2014) also found a similar type of observations in their study, where the majority of the farmers had sufficient knowledge on sheep health and diseases.

5.5.5.2 Deworming details

All the shepherds in the study area were deworming their flock regularly. 100% deworming was reported in Rajasthan and Telangana region of Andhra Pradesh by Swarnkar and Singh (2010) and Rajanna *et al.* (2013), respectively. These finds were in contrary to the findings of Pattanayak *et al.* (2003), Nayak *et al.* (2008) where, the majority of the farmers were not following deworming in Orissa.

The majority (54.4 per cent) of the farmers in irrigated area were deworming four times in a year. Similar findings were observed by Sireesha *et al.* (2014) and Rajanna *et al.* (2013) in Andhra Pradesh where, 3-4 times drenchings per year was practiced. Whereas, most of the farmers (54.4 per cent) in rainfed area were deworming their flock three times in a year, which agrees well with the findings of Kuldeep *et al.* (2006), Kailash and Kavitha (2015) in Rajasthan, Where sheep were drenched 2-3 times in a year. It was observed that role of the veterinarian in the selection of anthelmintic was limited in the present study.

No farmer was practicing dipping in the study area. Similar reports were observed by Mehta *et al.* (1995b) in Malpura sheep breeding tract. But Gopal and Hari (2007) reported dipping was carried out in ordinary water twice a year to Muzaffarnagari sheep.

5.5.5.3 Vaccination details

All the farmers in the study area were regularly vaccinating their flock. The farmers were vaccinating against FMD, Sheep Pox, PPR, Blue Tongue, ET. Shepherds solely depend on vaccines supplied by State Animal Husbandry Department. It might be concluded that farmers were resorting to vaccination as and when it was supplied by the government agencies irrespective of their need basing on the supply and availability. However, it could be concluded that vaccination was being carried out on a regular basis. These findings were in conformity with the findings of Thiruvankadan *et al.*

(2007) and Dixit *et al.* (2005) in the breeding tracts of Mecheri and Rampur Bushair sheep, respectively. The reports of Devendran *et al.* (2010) and Arora *et al.* (2010) also support the present findings. But the findings of present study were not in conformity with those that of Sahana *et al.* (2004) wherein, a majority of the farmers in Jalauni sheep breeding tract area were not vaccinating their sheep against common diseases.

5.5.5.4 Disposal of sick animals

The majority of the selected farmers (96.8 per cent in irrigated area and 92.8 per cent in rainfed area) were giving treatment to the sick animals. Whereas, few farmers were disposing the sick animals by emergency sale (3.2 per cent in irrigated area and 7.2 per cent in rainfed area). These results were contradictory to the findings of Sahana *et al.* (2004), where no treatment was provided to the sick animals due to lack of accessibility of veterinary hospitals and poor financial status of the farmers, as well as lack of awareness. Further, the sick sheep were mostly treated by non-qualified quacks in the study area.

5.5.5.5 Disposal of dead animals

Among the farmers surveyed 72.8% in irrigated area and 52% in rainfed area was disposing of the dead animals by burial method. Whereas, 15.2% of the farmers in irrigated area and 44.8% of the farmers in rainfed area were throwing the dead animals in the open fields. Remaining farmers were opting to sell the carcasses (12 per cent in irrigated area and 3.2 per cent in rainfed area). Similar type of reports were observed by Sireesha *et al.* (2014). These results indicated that shepherds had sound knowledge about the importance of carcass disposal.

5.5.5.6 Disinfection of sheep pen

From the present study, it was concluded that about 46.4% shepherds in irrigated area and 25.6% shepherds in rainfed area were following spraying of insecticides, whereas 53.61% shepherds in irrigated and 74.4% in rainfed area were not spraying

insecticides. There is a need to educate the shepherds about the importance of disinfecting the sheep pen and the diseases to which the insects act as vectors.

5.5.6 MODES OF MARKETING FOLLOWED BY SHEPHERDS IN KRISHNA DISTRICT

5.5.6.1 Mode of marketing of sheep

In the present study, From Table 23, it was observed that 84 % farmers in irrigated area and 93.6% farmers in rainfed area were selling the sheep through middlemen in the village. Similar observations made by other workers like Bose *et al.* (1999), Karunanidhi *et al.* (2005), Srivastava and Saraswat (2005), Virojirao *et al.* (2008) and Sireesha *et al.* (2014).

This is possibly due to the fact that middlemen finance the sheep farmer to meet their urgent financial needs like medical and festival expenses for which farmers were obliged to sell their stock to middlemen as a gesture of goodwill, which results in reduced profit margin to the farmers. The establishment of micro credit facilities through sheep co-operative societies will largely help sheep farmer from the exploitation of middlemen. In the absence of any organized marketing, the middlemen exploitation will be more.

5.5.6.2 Place of disposal of animals

Place of sheep marketing was mostly local market (84.8 per cent in irrigated area and 95.2 per cent in rainfed area). Similar findings were reported by Karunanidhi *et al.* (2005) in Mecheri sheep breeding tract, Virojirao *et al.* (2008), Sireesha *et al.* (2014) in Andhra Pradesh.

5.5.6.3 Basis of marketing

In both the areas surveyed, it was observed that both age and demand were the basis for marketing sheep. Price for marketable stocks was fixed on the basis of physical

appearance alone in both the areas. In none of the reports including the present study, the price was fixed based on body weight of the animal. Farmer's need, age, sheep conformation in terms of muscle thickness at loin and thigh, sex of the animal, health, breed and skin will influence the selling price of animals as reported by the earlier workers like Bose *et al.* (1999), Thiruvankadan *et al.* (2004), Karunanithi *et al.* (2004), Srivastava and Saraswat (2005) and Sireesha *et al.* (2014).

The most important defect in the entire sheep marketing system was selling through approximate weight and visual observation. Accurate body weight was not considered in the sale of live sheep. There were no regulated markets for the sale of sheep in the district. Establishment of proper marketing channels was essential.

5.5.6.4 Age of Marketing of male lambs

In this survey, it was observed that 78.4% farmers in irrigated area and 65.6% farmers in rainfed area were selling male lambs at the age of 5-6 months, while rest were selling them at 2-4 months age. Similar findings reported by Sireesha *et al.* (2014) where the age of sale of lamb was 5-6 months, Senthilkumar *et al.* (2012) where the age of sale of lamb was below 6 month, Suresh *et al.* (2008) where the age of sale of lamb was 6-8 months, Swarnkar and Singh (2010) where the age of sale of lamb was 5 months.

In Krishna district, some farmers purchase ram lambs at 5-6 months of age for the purpose of fattening for a period of 4 to 5 months, feed them with grains, concentrates and sell for ready cash.

5.6 CONSTRAINTS FACED BY SHEPHERDS IN KRISHNA DISTRICT

Table 24 revealed that unavailability of concentrate feed at a reasonable cost, proper transport facilities, grazing lands and water facilities were found to be the major constraints hindering the sheep rearing in the present study. Almost similar findings were observed by Misra *et al.* (2007) who reported that inadequate availability and poor

quality of feed and fodder, high incidence of diseases and inadequate knowledge on the appropriate management of livestock were identified as the major problems faced by small farmers in India.

Lack of scientific knowledge of the farmers surveyed (92 per cent in irrigated 93.6 per cent in rainfed area) was found to be the major constraint in sheep rearing while middlemen hindrance to farmers (87.2 per cent in irrigated and 84 per cent in rainfed area) was the major constraint in marketing the sheep. These findings were in agreement with Virojirao *et al.* (2008) where, exploitation by middlemen (or) butchers was the major constraint and failure of cooperatives and backwardness of sheep farmers were the twin causes for exploitation.

Selvam and Safiullah (2002), Yadav *et al.* (2006), Rauniyar *et al.* (2000) and Yadav *et al.* (2009) reported that shrinkage of pasture lands and grazing lands were the major constraints faced by the shepherds in their respective areas which were in agreement with the findings of present study.

It was observed that availability of veterinary services and regular vaccination was not a constraint to the shepherds in Krishna district but lack of organized markets was a constraint faced by the farmers in the present study. Selvam and Safiullah (2002), Rauniyar *et al.* (2000) reported that lack of organised markets was also a constraint faced by the sheep farmers. While, lack of pure breeding rams and lack of proper health care were constraints faced according to Yadav *et al.* (2006) in Muzaffarnagari breeding tract and Yadav *et al.* (2009) in Marwari breeding tract.

Sheep farmers do not receive any financial support from government or other development agencies. Exploitation by quacks was another problem reported in the study area.

5.7 Policy measures

Based on the observations of the study, the following measures could be taken up to improve the status of sheep farmers so as to make it more profitable encouraging other small and marginal farmers taking up sheep rearing so as to diversify their source of income.

1. Sheep farmers may be educated about the modern management techniques such as providing supplementary concentrate feeding.
2. Majority of the sheep farmers in both the study areas replaced the breeding stock from their own existing stock results in inbreeding. In such a situation, the periodical introduction of fresh rams and rotation of breeding rams among contemporary flocks should be followed to avoid inbreeding depression. Sourcing replacement stocks from institutional farms and other organized farms periodically will be a good practice to adopt. Breedable rams may be supplied to farmers based on state sheep breeding policy to improve the productive efficiency in ewes.
3. Majority of the farmers consider twinning as a bad omen and cull the ewes that have twinned. The farmers must be educated to realize the advantage of twinning and retain such parent and their progenies for future breeding.
4. The practice of flushing with locally available feed ingredients must be popularized among the sheep farmers.
5. Price is fixed mostly on physical appearance. Lambs especially ram lambs with good meat conformation, which ought to be the future parents are sold for slaughter. Sheep farmers must be educated on the awareness of retaining superior ram lambs for breeding.

6. The price must be fixed based on body weight of the stock rather than physical appearance alone. Usage of a weighing scale in sheep weightment must be popularized for adoption to avoid loss.
7. As the existing sheep co-operative societies are defunct, sheep farmers may form sheep rearer's self-help groups. This will address their help at the time of crisis, joint purchase deworming drugs, joint vaccination programmes, approaching the government agencies, insurance, marketing of animals, etc.
8. Ecto-parasites causing big menace in the sheep flocks. Essential control measures like mass de-ticking programmes should be carried out in sheep flocks.
9. Suitable low-cost concentrate feeds may be made available on subsidy basis to the sheep farmers.
10. Village common lands have to be brought under improved pastures. The Panchayats may be given incentives to develop common grazing resources in the village commons through the convergence of NREGS (National Rural Employment Guarantee Scheme). The indigenous grasses which are sparsely available in the wastelands should be replaced by the improved type of grasses, pastures and forages. Fodder trees also like subabul, acacia, etc., may be planted.
11. Availability of water is one of the major problems to the sheep in the present study. Provision of drinking water to sheep at regular and frequent intervals is necessary. The ponds and tanks in the villages may be repaired if existed.
12. Lack of proper shelter or housing facilities has been responsible for the outbreak of diseases and low health status of sheep, which cause heavy loss and damage to the farmer. The shelter provided through enclosures of thorny bushes should be replaced by good sheds to protect the sheep from rain, cold and heat. Further, provision of flooring and drainage facilities will improve the health status of sheep.

13. Extension wing of the Department of Animal Husbandry may be strengthened to educate the farmers about the ram rotation and improved breeding management.
14. Since a large number of the farmers studied were illiterate, extension methods such as farm and home contacts by extension personnel, radio, TV, mobile phones etc., which do not require reading ability, should be used to promote scientific sheep farming among these farmers.
15. Majority of the sheep farmers were in need of financial support. Concerned Banks and A.H Departmental support may be helpful to solve this problem.
16. Knowledge about sheep insurance must be imparted to the flock owners to tide over the unforeseen risks.
17. Advance information may be provided about the areas where sufficient grazing material is available during migration. Assistance may also be provided to the sheep farmers during migration.
18. Veterinary services may be extended to the remote areas.
19. Farmers must be trained and retrained to develop their management skills for proper feeding including fodder development and conservation, proper breeding skills, disease control and prevention, basic on-farm processing methods of value addition their sheep farming, simple record-keeping and the exploitation of synergies between livestock and crops.
20. Quacks must be controlled as they are doing immense damage to the field of Veterinary practice as well as to the farmer.
21. The focus should be on the development of an integrated farming system with livestock and other most remunerative activities as its components.

Chapter - VI

Summary

CHAPTER VI

SUMMARY

A study was conducted to analyse the sheep production system under field conditions in irrigated and rainfed areas in Krishna district of Andhra Pradesh. A total number of 250 sheep farmers and their flocks comprising 125 from each area formed the study subject. In both areas sheep rearing was the main occupation of the respondents (51.2 and 74.4 per cent). Majority of the sheep farmers in both areas were Hindus and belonged to Backward Class followed by Scheduled Castes. Literacy rate in irrigated and rainfed areas were 18.4 and 12 per cent, respectively. Majority of the sheep owners in both areas were in the middle age group (64 and 60 per cent). Nuclear family type dominated in both the areas. The mean sheep farming experience of farmers in irrigated area and rainfed area was 9.77 ± 0.69 and 12.05 ± 0.88 years, respectively. Majority of the sheep farmers in both areas were landless (45.6 per cent and 72.8).

Among the total farmers, 12.8 per cent in irrigated area and 8 per cent in rainfed area owned single species of sheep alone. The average flock size in irrigated and rainfed areas of the district was 66.36 ± 2.32 and 73.62 ± 3.0 , respectively. The study indicated that the flock size was not constant and varied from flock to flock and from farmer to farmer and depended on many factors such as disease, sales for urgent monetary requirements, grazing resources, labour etc. Replacement stock from own farm was the main source of addition into flocks in both the areas.

The mean values for body weights in the male for 2 teeth, 4 teeth, 6 teeth and full-mouthed animals in irrigated area were 42.0 ± 0.49 , 44.50 ± 0.34 , 44.33 ± 0.40 and 44.29 ± 0.28 kg, respectively; while in rainfed area, the corresponding values were 39.92 ± 0.33 , 42.67 ± 0.33 , 43.11 ± 0.20 and 43.57 ± 0.20 kg, respectively. The mean body

weight (kg) for 2 teeth, 4 teeth, 6 teeth and full-mouthed ewes observed were 31.99 ± 0.270 , 36.02 ± 0.240 , 37.27 ± 0.167 and 40.52 ± 0.269 kg, respectively, in irrigated area; while in rainfed area, the corresponding values were 29.30 ± 0.40 , 34.84 ± 0.40 , 37.22 ± 0.35 and 42.01 ± 0.56 kg, respectively, in rainfed area. The body weights of males in irrigated area differed significantly with those of in rainfed area in all age groups, except in 8 teeth ($P < 0.01$). The values for 4 teeth female sheep in irrigated area did not differ significantly compared to rainfed area, while the corresponding weights in other age groups differed significantly ($P < 0.05$).

The mean values for body lengths in the male for 2 teeth, 4 teeth, 6 teeth and full-mouthed animals in irrigated area were 76.08 ± 0.22 , 77.83 ± 0.37 , 78.11 ± 0.30 and 78.71 ± 0.28 cm, respectively. While in rainfed area the corresponding values were 74.75 ± 0.21 , 76.17 ± 0.30 , 76.89 ± 0.26 and 77.14 ± 0.50 cm, respectively. The mean body lengths for 2 teeth, 4 teeth, 6 teeth and full-mouthed ewes observed were 66.48 ± 0.23 , 64.93 ± 0.44 , 67.94 ± 0.35 , 72.78 ± 0.50 cm, respectively, in irrigated area. While in rainfed area the corresponding values were 64.17 ± 0.46 , 64.27 ± 0.37 , 65.99 ± 0.32 and 67.43 ± 0.50 cm, respectively. There was a significant difference between the two areas with respect to the body length of sheep at all age groups except between the females of 4 teeth age ($P < 0.05$).

The mean height at withers for 2 teeth, 4 teeth, 6 teeth and full-mouthed rams observed were 83.08 ± 0.28 , 84.83 ± 0.40 , 86.11 ± 0.26 and 84.57 ± 0.29 cm, respectively, in irrigated area. While in rainfed area the corresponding values were 81.33 ± 0.28 , 81.83 ± 0.30 , 84.78 ± 0.22 and 82.71 ± 0.28 cm, respectively. The mean values for height at withers in ewes for 2 teeth, 4 teeth, 6 teeth and full-mouthed animals in irrigated area were 74.62 ± 0.23 , 75.93 ± 0.17 , 76.75 ± 0.28 and 79.11 ± 0.30 cm, respectively. While in rainfed area the corresponding values were 72.51 ± 0.29 , 75.54 ± 0.27 , 76.12 ± 0.29 and 76.88 ± 0.31 cm, respectively. The mean height at withers of sheep in irrigated area was

significantly higher compared to that of rainfed area in all ages, except between the females of 4 teeth and 6 teeth age ($P<0.05$).

The mean chest girth for 2 teeth, 4 teeth, 6 teeth and full-mouthed rams observed were 82.50 ± 0.19 , 85.50 ± 0.42 , 86.33 ± 0.33 and 85.00 ± 0.30 cm, respectively, in irrigated area. While in rainfed area the corresponding values were 81.25 ± 0.25 , 83.17 ± 0.30 , 84.22 ± 0.32 and 83.43 ± 0.20 cm, respectively. The mean values for chest girth in ewes for 2 teeth, 4 teeth, 6 teeth and full-mouthed animals in irrigated area were 77.99 ± 0.31 , 79.83 ± 0.26 , 81.40 ± 0.25 and 82.16 ± 0.34 cm, respectively. While in rainfed area the corresponding values were 73.94 ± 0.31 , 78.94 ± 0.31 , 81.24 ± 0.52 , 86.66 ± 0.49 cm, respectively. The mean chest girth of sheep in irrigated area was significantly higher compared to that of rainfed area in all ages, except between the females of 6 teeth age ($P<0.05$).

The mean punch girth for 2 teeth, 4 teeth, 6 teeth and full-mouthed rams observed were 83.25 ± 0.32 , 86.50 ± 0.42 , 85.22 ± 0.22 and 85.71 ± 0.28 cm, respectively, in irrigated area. While in rainfed area the corresponding values were 82.42 ± 0.22 , 84.83 ± 0.30 , 83.56 ± 0.24 and 84.43 ± 0.42 cm, respectively. The mean values for punch girth in ewes for 2 teeth, 4 teeth, 6 teeth and full-mouthed animals in irrigated area were 80.09 ± 0.33 , 83.07 ± 0.40 , 84.21 ± 0.28 and 89.24 ± 0.44 cm, respectively. While in rainfed area the corresponding values were 76.09 ± 0.56 , 82.65 ± 0.30 , 84.84 ± 0.26 and 85.51 ± 0.30 cm, respectively. In the present study, it was observed that the mean punch girth of sheep in irrigated area was significantly higher compared to that of rainfed area in all ages, except between the females of 4 teeth and 6 teeth age ($P<0.05$).

The average age at first mating in ewes, age at first mating in rams, age at first lambing, lambing interval, age at weaning and weight at weaning in irrigated and rainfed area were 13.16 ± 0.06 and 14.52 ± 0.06 months; 19.89 ± 0.18 and 19.63 ± 0.20 months; 18.24 ± 0.05 and 19.52 ± 0.06 months; 306.68 ± 0.81 and 308.53 ± 1.15 days; 3.71 ± 0.40 and

4.09±0.05 months; 12.57±0.0 and 10.98±0.05 kg, respectively. A significant difference noted in all reproductive parameters of sheep between irrigated and rainfed area except in age at first mating in male and lambing interval ($P<0.01$).

It was observed that all the farmers in the study area were rearing sheep extensively in extensive method. Housing pattern comprising of an open pen along with a closed roof structure was seen in the majority of the sheep holdings in both the areas studied (56 and 57.6 per cent) and most of the shepherds were housing the sheep nearer to their houses (94.4 and 72 per cent). All the farmers in the present study were keeping the premises of animals clean and hygienic which could be due to the women folk who were taking care of it. It was observed that 85.6 per cent of the farmers in irrigated area and 72.8 per cent farmers in rainfed area were following soil replacement. Storage of sheep manure in open place forming a heap was observed in both the areas.

However, the study also revealed that majority (77.6 and 88 per cent) of the farmers had sound knowledge about the signs of heat. These findings revealed the association shepherds had with their flocks and the traditional knowledge they possessed. It was observed that the breeding seasons of sheep were during June to August and January to March. The study clearly showed that 'within the flock' selection of both rams and ewes though an unscientific way, was prevalent among the farmers. It was felt that imparting knowledge to the farmers regarding the importance of selection and changing the rams will help in obtaining better breeding efficiency and genetic improvement of the flock

The study revealed that the farmers in the study area depended solely on grazing. The mean grazing distance per day was 5.46±0.13 km in irrigated area and 5.8±0.14 km in rainfed area. The distance indicates the habit of returning back to their place of living during the night and staying back with their families. The mean grazing duration per day was 8.88±0.09 hr in irrigated area and 9.38±0.12 hr in rainfed area. Village water ponds

were serving as a major water source for the sheep in both areas. The practice of changing the direction of grazing indicated that the sheep farmers were avoiding overgrazing and also were aware of sources for grazing. It was further observed that no additional care was exercised in feeding of breeding rams, pregnant and lactating ewes.

From the study it was revealed that about 86.4 per cent farmers in irrigated area and 81.6 per cent farmers in rainfed area were sending the dam for grazing on next day of lambing itself. Majority of the farmers were sending the new born lambs for grazing within 15 days after their birth (96 per cent in irrigated area and 89.6 per cent in rainfed area). The lambs were kept in a special basket made of bamboo sticks called “Gampa” in the local language.

All the shepherds in both the study areas were practicing deworming and vaccination regularly. About 54.4 per cent farmers in irrigated area were deworming their sheep for every 3 months, whereas in rainfed area 69.6 per cent farmers deworming for every 4 months. Vaccination was done against FMD, Sheep pox, PPR, Blue Tongue, ET in both the areas. Majority farmers in both areas were following burial method of carcass disposal (72.8 and 52 per cent). None of the farmers were practicing dipping in the study area.

Middlemen played a key role in marketing sheep in both the zones. Majority of the farmers reported that price for their stock was fixed on the basis of physical appearance alone. Local marketing of sheep (within the villages) was predominant in both the areas.

Lack of scientific knowledge of the farmers surveyed (92 per cent in irrigated 93.6 per cent in rainfed area) was found to be the major constraint in sheep rearing. While middlemen hindrance was the major constraint in sheep marketing (87.2 per cent in irrigated and 84 per cent in rainfed area).

It might be concluded from the results of the present study that, the majority of the shepherds were landless and were following traditional methods of sheep rearing without any scientific inputs with regard to housing, feeding and breeding. The farmers were aware of health and disease and were practicing preventive vaccinations and deworming. The major constraint observed was lack of sufficient grazing lands and organised meat markets.

Policy intervention in the form of providing some secured grazing areas, educating the shepherds with regard to scientific feeding and breeding and by creating proper channels of marketing would help the sheep rearers in this region improve their socio-economic status.

Chapter - VII

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Chapter - VIII

Appendices

Appendix

1. SOCIO ECONOMIC PROFILE OF SHEEP FARMERS

- a. Name of the farmer:
- b. Village :
- c. Mandal:
- d. Age:
- e. Education: literate/ illiterate
If literate: primary (1st-5th) / secondary (6th -10th) / above
- f. Family type: joint / nuclear
- g. Family size: small (2-4) / medium (5-7) / Large (>7)
- h. Land holding : Yes / No
If Yes, Land holding size (acres) :
- i. Main occupation : A.H./ A.H. & agriculture /labor
- j. Annual house hold income : Low(<55000/-) / Medium(55000-90000) / High (<90000)
- k. Type of farmers residence : Kutcha / pucca
- l. Religion : Hindu / Christian / Muslim
- m. Sheep farmer's caste : Other Castes / BC / SC /ST
- n. Sheep farming experience :

2. FLOCK PROFILE OF SHEPHERDS:

- a. Flock size:
- b. Livestock maintained:

	No.of males	No.of females	No.of young ones	Breed
Cattle	----	----	----	----
Buffalo	----	----	----	----
Sheep	----	----	----	----
Goat	----	----	----	----
Others	----	----	----	----

c. Sheep breed maintained : Nellore / Deccani / Local/ Other

If Nellore – Palla / Jodipi / Brown

d. Source of breeding ram : Home Grown / Purchased / Exchanged / No Ram

e. Source of ewe : Home Grown / Purchased

3. **HOUSING :**

a. Raring system : Extensive / Semi intensive / Intensive

b. Type of housing : Open / Semi open / Closed

c. Roof : No roof / Thatched / Asbestos / Cement

d. Floor : Mud / Concrete / Slab

e. Enclosure : Wall / Fence

f. Special housing for pregnant : Yes /No

g. Special housing for lambs : Yes / No

h. Separate housing for males and females : Yes / No

i. Duration of special housing :

j. Special protection during rainy / cold weather : Yes / No

k. Place of housing: Near/ Far from house/ Inside

l. Migration : Yes / No

If yes, Distance: km

Migration routes:

- m. Problems in migration :
- n. Season of migration : Summer / Rainy season
- o. Manger in the pen: Yes/ No
- p. Bedding material:
- q. Disinfection of house : Yes / No
- r. Spraying of insecticides in pen: Yes/ No
- s. Provision of water in the shed: Yes / No

If yes, mode of offering: Troughs / Utensils / Buckets / Any others

- t. Source of water: pond/ well/ tap / hand pump
- u. Intervals of provision of water: Throughout the day / At regular intervals
- v. Cleaning of house: Yes / No
- w. Provision of feed in the shed: Yes / No

If yes, how often: Daily / For 2-3 days

- x. Soil replacement : Followed / Not followed

If followed, how often: twice a year / yearly / for every 2 years

- y. Method of manure storage : Open / Pit
- z. Manure disposal pattern: Own farm use / Sale / Both

If sale, Frequency of manure sale: Once in a year / Twice in a year

4. BREEDING MANAGEMENT :

- a. Does he processes the knowledge about heat symptoms: Yes / No
- b. Type of mating : Natural / Artificial
 if natural : Pen / Flock / Hand
- c. Restriction on mating : Yes / No
- d. Maintaining breeding rams : Yes / No

If yes, number of breeding rams maintained:

Number of breeding ewes maintained:

- e. Awareness of Ram to ewe ratio: Yes / No
- f. Ratio of ram to ewe :
- g. Basis for selection of breeding animals : Age / Demand / Age + Demand
- h. Twinning: Common / Not common
- i. Breeding seasons followed : June –aug / Jan- march
- j. Number of lambing for life time :
- k. Awareness on Ram rotation : yes / no
- l. Flushing of breeding stock : yes / no

5. **FEEDING**

A. Nature of feeding : Grazing / Stall-fed

Grazing: Yes / No

- a. If yes, hours of grazing: 6-7 hrs / 8-10 hrs / >10hrs
- b. Grazing lands: Community lands/ Private lands
- c. Sheep penning during night: Yes / No

If yes, amount paid to the shepherd: Cash / Cash + Fodder / Only grains

- d. Cost / Acre/ Night:
- e. Provision of water during grazing: Yes / No
- If yes, intervals: once / twice / thrice
- f. Grazing distance : 2-4 kms / 4-6 kms / 6-8 kms / More
- g. Direction of grazing: One side / Changed regularly
- h. Source of grazing: Tree leaves/ Fodder/ Grasses
- i. Extra supplement feed in the shed: Provided / Not provided

If provided, offering feed: Concentrates / Green / Dry fodder

- j. Basis for feeding extra supplements: Age / Physiological Condition / Sex

If no, type of feeding: Hand fed/ Self

- a. Green fodder fed : As such / Chaffed
- b. Quantity offered:
- c. Frequency of offering:
- d. Varieties of green fodder: Roughages / Legumes / Grasses
- e. Varieties of roughages:
- f. Varieties of legumes:
- g. Varieties of grasses:
- h. Green fodder availability to animals: Night / Day time

B. Source of concentrates: Purchased / Homemade / Grains

If homemade, type of ingredients used:

If purchased, cost of concentrate:

C. Total quantity of feed offered:

	Roughage	Legume	Dry fodder	Concentrate
Adults:	----	----	----	----
Pregnant:	----	----	----	----
Breeding ram:	----	----	----	----
Lambs:	----	----	----	----

D. Extra mineral mixture feeding : Yes / No

E. Feeding extra salt: Yes / No

F. Antibiotics to feed: Yes / No

G. Type of feeding to rams: Grazing / Conc.mix

H. Creep feeding to lambs: Yes / No

If yes, composition:

I. Feeding of crop by-products: Yes / No

If yes, varieties:

J. Conc. Feeding during advance pregnancy: Yes / No

K. Feeding to nursing mother: Grazing / Fodder / Conc.

L. Cultivation of fodder : yes / no

If yes, which variety:

6. LAMB MANAGEMENT PRACTICES

a. Cleaning at the time of lambing: Yes / No

b. Dam after lambing : Retained/ Sent for grazing

If retained, how long: 1-3 days / 3-7 days / 7-10 days

c. Who will take care of lambs: Woman / Children / Both

d. Lambs send to grazing: Within 15days / 15-30 days / Above 30 days

e. Lambs feeding : Mother's milk / Supplementary milk feeding

if supplementary feeding: Buffalo milk / Any other

f. Weaning : Practiced / Not practiced

7. HEALTH MANAGEMENT :

a. Shepherd had the knowledge about diseases : Yes / No

b. Flock regularly dewormed : Yes / No

If dewormed, time interval: Twice a year / Thrice a year / Four times a day

c. Deworming agent: Self / Vet / Para vet / Gopala mitra

d. Deworming supplier: Govt / Purchased / Both

e. Vaccination of the flock : Yes / No

If yes, for what diseases:

f. Supply of vaccine: Govt / Purchased / Both

g. Name of the diseases he knows:

h. Common diseases in the flock : Pox / ET / FMD/ PPR

i. Season of disease outbreaks:

j. Spraying of insecticides : Yes / No

k. Disinfection of house : Yes / No

l. Practice of dipping : yes / no

m. Disposal of sick animals : Treated / Emergency sale

If treated, treatment with: allopathy / ITK / Both

n. Carcass disposal: Thrown in open fields / Buried / Consumption

8. **MARKETING**

a. Mode of sheep marketing: Direct / Middle men

b. Mode of sheep selling: Live animal basis / Weight basis

c. Place of disposal: Shandies / City market / Local (village)

d. Basis of marketing: Age / Body weight / Demand / Age and Demand

If demand: Seasonal / Festival (name)

e. Age of marketing of animal:

f. Cost of meat per Kg:

g. Marketing of other by products : Yes / No

h. Sale of surplus ram lambs: Yes / No

If yes, age of selling: 2-4 months / 5-6 months

9. CONSTRAINTS

1. Availability of RLU / Veterinary Dispensary / VH / VPC : Yes / No
2. Availability of veterinary services: Yes/ No
3. Availability of vaccination facilities regularly : Yes / No
4. Meat marketing facilities: Yes / No
5. Availability of concentrate feed: Yes/ No
6. Transport facilities:
7. Feed availability : Yes/ No
8. Water facility: yes/ no
9. Knowledge about rotation of breeding rams : Yes / No
10. Grazing land availability : Yes / No
11. Middle man hindrance in the market: Yes / No
12. Any other:

10. REPRODUCTION PERFORMANCE

- a. Age at first mating in females :
- b. Age at first mating in males :
- c. Age at first lambing :
- d. Lambing interval :
- e. Age of weaning :
- f. Weight at weaning :

10. PRODUCTIVE PERFORMANCE OF SHEEP

	<u>2 Teeth</u>					<u>4 Teeth</u>					<u>6 Teeth</u>					<u>8 Teeth</u>				
	<u>Body wt</u>	<u>Body length</u>	<u>Hight at withers</u>	<u>Chest girth</u>	<u>Punch girth</u>	<u>Body wt</u>	<u>Body length</u>	<u>Hight at withers</u>	<u>Chest girth</u>	<u>Punch girth</u>	<u>Body wt</u>	<u>Body length</u>	<u>Hight at withers</u>	<u>Chest girth</u>	<u>Punch girth</u>	<u>Body wt</u>	<u>Body length</u>	<u>Hight at withers</u>	<u>Chest girth</u>	<u>Punch girth</u>
<u>EWE</u>																				
<u>RAM</u>																				