CHAPTER III

MATERIALS AND METHODS

This chapter deals with the methodological framework adopted in order to attain the specific objective of the study.

3.1 Sampling Procedure

3.1.1 Selection of villages

Before the selection of sample villages and farmers for study a rough zonation of the region was done. This zonation was based on the initial hypothesis regarding agro-ecological conditions that determine where free grazing system and managed feeding system are likely to occur. District statistical data published annually by the district authorities and topographical maps and Atlas of Bundelkhand (Tyagi, 1997) was considered for the zonation of the region. Different agro-ecological locations of the regions were also visited during ground truthing for the selection of the sample villages. So that selected village closely represent the all agro-ecological parts of the region.

Ten representative villages of Bundelkhand Region (Fig. 2) were selected. Namely Rewan (Jhansi), Nandanwara (Lalitpur), Mahobkanth (Hamirpur), Chhani
Fig. 2: Location Map of Selected Villages in Bundelkhand Region

- Selected Sample Villages
1. Rewan
2. Nandanwara
3. Mahobkanth
4. Chhani
5. Barwara
6. Unao
7. Madhia
8. Bamitha
9. Mandala
10. Khemaria
(Jalaun), Barwara (S.M.Nagar) administratively in Uttar Pradesh and Unnao (Datia), Madhia (Tikamgarh), Bamitha (Chhatarpur), Mandla (Panna), and Khemaria (Sagar) in Madhya Pradesh. The sample data were recorded from these selected villages.

3.1.2 Selection of farmers

Farmers were categorized on the basis of their land holding, three categories of farmers were selected from each village i.e.; small (< 2 ha), medium (2-4 ha) and large (>4 ha). Five households were selected from each category, and total 15 farmers were selected from each village. A criterion in selection of farmers was that every selected household would have at least six animals to address the problems related to actual livestock holders. Thus, total 150 households and more than 900 livestock units were analyzed and detailed analysis of 485 livestock units were carried out during the present study.

3.2 Method of Inquiry and Collection of Data

During the course of investigation, a number of visits in different seasons to each selected village were made to collect the required information during the year 2002-2003.

3.2.1 Farmers interview on Schedule questionnaires

Primary data were collected by means of personal interview using well structured, modified schedule questionnaires (Spicer and Goonewardene, 1994) to meet the objectives of the present study.

Information about socio-economic status of the farmer and the feeding practices followed by farmers for their livestock was collected during three seasons
viz. monsoon (July – October), winter (November-February) and summer (March - June). The quantity of feeds and fodder offered to animals during twenty four hours was recorded thrice in each season and 500 gm sample of each feed was collected for the analysis.

3.2.2 Village walk

Grazing practices, seasonal availability of manpower, traditional feeding practices etc. were discussed with village pradhan / sarpanch, village level government officials and other key person to collect the required information. The information of common problems related to livestock, crops and soil degradation and possible suggestions on the issues were also recorded.

3.2.3 Local markets

Prevailing rates of input and output commodities were recorded from local markets of the region in different seasons.

3.2.4 Secondary data

The secondary data on livestock population for fodder production, grazing resources, and forest resources of Bundelkhand region have been obtained from different issues of the statistical magazine of concern districts. Other relevant secondary data were also collected from district, block headquarters and other published materials.
3.3 Weighing of the Animals

Body weight of cattle and buffaloes were calculated on the basis of their body measurements using modified shaffers formula (Thomas and shastry, 1991) as follows:

\[
\text{Live weight (in seers)} = \frac{\text{(Girth)} \times \text{(length)}}{Y}
\]

Where

\[Y = 9.0, \text{ if girth is less than 65 inches}
\]
\[= 8.5, \text{ if girth in between 65 – 80 inches}
\]
\[= 8.0, \text{ if girth is over 80 inches}
\]

and one seer = 0.93 kg.

Sample units of goat and sheep were weighed by hanging them on spring balance. Body weight of lactating cattle, buffaloes and small ruminants were recorded once in a season. But change in body weight of growing cattle and buffaloes were recorded at monthly interval for one year.

3.4 Plan of On-farm Experiment

As per the availability of livestock and feeding system as adopted by the farmers, animals were grouped for detail feeding analysis. The efforts were made to keep similar type and equal number of livestock in each group of farmers and feeding systems to minimize the variation in the field study. Two feeding systems F₁ and F₂ and three categories of landholders T₁, T₂ and T₃ were the variables and thus total six number of treatment blocks (F₁ T₁, F₁ T₂, F₁ T₃, F₂ T₁, F₂ T₂, F₂ T₃) were taken for comparative study of Free Range Grazing (FRG) versus Managed Feeding
(MF) system in lactating animals. Each livestock unit within the treatment group was considered as one replication. Following number of livestock were investigated in different season for a period of one year.

Table 1: Number of replications (livestock) under detailed study

<table>
<thead>
<tr>
<th>Type of livestock</th>
<th>Categories of farmers</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Small</td>
<td>Medium</td>
<td>Large</td>
<td>Total</td>
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<tr>
<td>A. Feeding system analysis</td>
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<tr>
<td>a. Lactating Cattle</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. cows in Free</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td>Range Grazing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Managed feeding system</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>42</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>28</td>
<td>28</td>
<td>28</td>
<td>84</td>
<td></td>
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<tr>
<td>b. lactating Buffaloes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FRG</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td>MF</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>32</td>
<td>32</td>
<td>32</td>
<td>96</td>
<td></td>
</tr>
<tr>
<td>B. Feeding pattern for round the year</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>3. Cattle heifers</td>
<td>21</td>
<td>21</td>
<td>21</td>
<td>63</td>
<td></td>
</tr>
<tr>
<td>4. Buffaloe heifers</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>72</td>
<td></td>
</tr>
<tr>
<td>5. Sheep</td>
<td>37</td>
<td>37</td>
<td>NA</td>
<td>74</td>
<td></td>
</tr>
<tr>
<td>6. Goat</td>
<td>32</td>
<td>32</td>
<td>32</td>
<td>96</td>
<td></td>
</tr>
<tr>
<td>Grand Total</td>
<td>174</td>
<td>174</td>
<td>137</td>
<td>485</td>
<td></td>
</tr>
</tbody>
</table>

The managed feeding system was adopted by the farmers for lactating animals only. Most of the growing cattle and buffaloes were reared under free range grazing system therefore, annual feeding pattern were recorded in three treatment categories of
landholders for growing cattle, buffaloes, sheep and goat. Large farmers were not rearing sheep in selected villages. Four buffaloes, seven sheep and twelve goats were replaced with similar animals in concerned categories due to Sale/death of the animals during the study.

3.5 Feeding and Management

Animals under free range grazing (FRG) system were mainly low producing cows, buffaloes, growing livestock, dry animals, goat and sheep. Resource poor farmers also adopted FRG system for their well producing livestock. From the start of summer to late monsoon season animals of FRG system were send for the grazing at early morning about 6:00 am in all the selected villages. They graze in community lands or crop harvested agricultural lands without any restriction. However one follower is taken care in case of buffaloes, sheep and goat and other costly livestock. The grazing hours were recorded for all the animals under experiment. In evening animals return to their home and they were offered dry fodder mainly crop residues and some home made concentrate. Lactating animals were fed with concentrate during milking time only. In winter season FRG system did not existed, and all the livestock were managed with limited grazing as in managed feeding system.

The managed feeding (MF) system of livestock included stall feeding, cut and carry system for rangeland grasses, rotational grazing and feeding fair amount of concentrates. Farmers adopted managed feeding system for the lactating animals specially for milking buffaloes. In this system animals were allowed to graze for a limited hours (3 to 4) on personnel lands, but major amount of feeds received were cut
and carry grasses, crop residues and concentrate mixture. Wheat straw mixed with water soaked concentrate mixture called “Sani” was the common feeding practice in the region. Drinking water were offered by the farmers to their livestock usually once in a day and twice in summer season. The quantity of green fodder, dry fodder and concentrate consumed by the livestock in 24 hour and left refusal were recorded in schedule proforma thrice in each season.

3.6 Calculation of Adult Cattle Unit (ACU)

To convert livestock population in to Adult Cattle Unit (ACU), the following conversion formula (Tyagi, 1997) has been applied.

\[
\text{One ACU} = \frac{\text{Weight of livestock x livestock nos.}}{350}
\]

Where:

- Weight of cow (over 3 years) = 350 kg
- Weight of cow (below 3 years) = 200 kg
- Weight of buffaloes (over 3 years) = 400 kg
- Weight o buffaloes (below 3 years) = 250 kg
- Goat/sheep equivalent to 0.2 cow unit each

3.7 Calculation of Feed Intake of Animals During Free Range Grazing

Feed intake of cattle and buffaloes during grazing was estimated by clipping random quadrates in grazing areas. The quadrate method was used earlier (Mahanta et al, 2002) for the estimation of biomass yield of rangelands utilized in grazing. The quadrates (1 m x 1m size) were randomly selected within the grazinglands at morning. The number of quadrates selected varied from 3 to 9 as per the size of grazing area.
The total fodder biomass of each quadrat was harvested and collected for weighing and then recorded the number of livestock grazing that area. The random quadrates were again selected and clipped on the next day morning within the same grazing land. Difference of the fodder biomass of that area was divided by the number of grazing livestock, and thus, estimated the fodder intake with the following assumptions:

1. All the livestock grazing the area have equal opportunity to graze and eating equal amount of fodder biomass.

2. Over night fodder growth in rangelands considered negligible.

Feed intake of goat and sheep during grazing hours could not be estimated due to their feeding habits of grazing, browsing and lopping. However, supplementary feed offered to these owines were recorded.

3.8.1 Preparation of samples for chemical analysis

The samples of individual feed collected from villages were oven dried at 70 °C till the constant weight. They were then grounds in Willy mill to pass 1 mm sieve and preserved in air tight polythene bags until subjected to proximate analysis, cell and cell wall composition and invitro digestibility.

3.8.2 Determination of Moisture

It was determined by drying a known weight of samples at 100 °C in the hot air oven till a constant weight was recorded.

3.8.3 Proximate analysis

All the determinates under proximate analysis were carried out in duplicate by method described by the Association of Official Agricultural

3.8.4 Cell wall composition

Neutral Detergent Fibre (NDF) and Acid Detergent Fibre (ADF) were estimated by the methods suggested by Goering and Vansoet (1970). Hemicellulose was calculated as difference of NDF and ADF. Lignin was estimated in ADF residue by treating the residue with 72% (w/w) sulphuric acid for 3 hours at 20 to 30°C. The cellulose was calculated as the difference between ADF and lignin. All determinations were carried out in duplicate.

3.8.5 Invitro dry matter digestibility

Invitro dry matter digestibility of forage samples was done as suggested by Vansoet et al (1966).

3.8.6 Determination of DCP and TDN

Digestible Crude Protein (DCP) and Total Digestible Nutrients (TDN) values for different feeds were computed using the digestibility values of Sen and Ray (1971) and NRC (1988).

3.9 Economics of Milk Production

In order to evaluate among treatment groups the economics of individual treatment was worked out in both feeding systems as well as for the categories of farmers at prevailing rates of inputs and output in the market.
3.10 Statistical Analysis

The data pertaining to the present investigation were subjected to statistical analysis by the method described by Snedecor and Cochran (1967).

1. The randomized block design (factorial) for comparison of free range grazing
   Versus managed feeding system.

2. Standard measures of central tendency and dispersion were used for working out means of treatment groups.

3.11 Limitations of the Study

The study is perceived to have the following limitations:

1. Since, the farmers in the study area do not maintain proper record, in spite of all the possible care in collecting data, the errors in primary data can not be ruled out.

2. Since the study is based on one-year cross-sectional data, the results may vary for other years with the agro-climatic changes in the region.