REPORT 7

Strategies for improved fodder production in the dry season in the mid-hills of Nepal, using participatory research techniques.
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Interim report: Seasonal patterns of collection and allocation of fodders to livestock by households in selected mid-hills locations

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1 Introduction and Background

The work described in this interim report is a part of the research project 'Strategies for improved fodder production in the dry season in the mid-hills of Nepal, using participatory research techniques'. The project is funded by the UK Department for International Development (DFID) Renewable Natural Resources Research Strategy (RNRRS) Livestock Production Programme (LPP). The objective of the project is to develop increased and improved supplies of fodders for livestock on small-scale mixed farms in the mid-hills zones of Nepal. The projects' approach to this has been to work with local NGOs and farmers to develop a joint understanding of fodder requirements and options for fodder production on farm.

Livestock are a crucial component of the hill farming system in Nepal. They contribute to household subsistence and incomes, draught power and the recycling of nutrients essential for the fertilisation of cultivated land. Traditionally, communal grazing areas and off-farm fodder resources have been important for the nutrition of ruminant livestock. Increasing pressures on land, together with changing access rights to some communal resources, have led to a decrease in the availability of off-farm fodder resources and the loss or closing of grazing. Households have to rely increasingly on farm-produced fodders, including poorer quality crop residues. Seasonal feed shortages are becoming more severe, particularly for higher quality feeds, and farmers report this as limiting livestock holdings and productivity in many areas. Poorer community members are especially affected by these constraints because of their limited land holdings and lower capacity to produce or purchase supplementary feeds and chemical fertilisers.

A preliminary aim of the project is to identify the major factors affecting the availability and demand for fodders, and to describe fodder utilisation in order to identify feeding constraints and requirements. Initial discussions with the NGOs and farmers in target communities aimed at identifying the major factors contributing to differences between households in fodder availability and demand. Subsequent survey work was structured by these factors, to collect information on seasonal fodder collection and use over a full year. This information was also discussed with farmers. At the same time, farmers selected fodder planting materials from a range of available options. These materials were then established in nurseries and subsequently on farms, with farmers making the choices of what to plant, how much and where.

The project is implemented in conjunction with two principal collaborating institutions in Nepal, the Nepal Agroforestry Foundation (NAF) and the Forest Research and Survey Centre (FORESC) of the Ministry of Forests and Soil Conservation. NAF is a national NGO undertaking research and development projects to introduce fodder and other trees on farms. FORESC is the government research organisation for forestry and agroforestry research and resource survey. In addition, several local community-based NGOs linked to NAF participated in the field operations of the project. A secondary objective of the project is to develop with the NGOs a more critical and sensitive approach to determining fodder requirements and introducing new planting materials onto farms.

This interim report describes the first part of the project work to investigate fodder availability, utilisation and demand.

2 Surveys of fodder collection and allocation

Surveys of fodder collection and use were designed in three stages. First, 11 communities in the mid-hills target area were identified which were already working with established local NGOs interested in fodder development. A sub-sample of five of these communities was then selected to represent a range of circumstances relevant to fodder supply and demand and in which research activities would be concentrated. Secondly, the problems of fodder supply and demand were discussed in community meetings and village walks, to identify key factors to be considered in subsequent survey work. Thirdly, a sample of 10 households representing different circumstances was selected with the community to participate in more detailed survey work. The latter included single visit surveys of household circumstances (household sizes, land holdings, cropping patterns, labour availability), and bi-monthly surveys of livestock holdings, livestock production, fodder collection and feed allocation to different species of livestock over a twelve month period.

Bi-monthly surveys were conducted by means of a questionnaire-based discussion with every selected household at two month intervals. Eight surveys were conducted over 16 months from March 1998 to July 1999, allowing for learning of procedures in the early surveys and potentially providing repeat surveys through the critical late dry season (March to May). The survey was designed to be simple to operate, to avoid costly employment of enumerators and weighing of all feeds collected and allocated, but to provide sufficiently accurate information for describing the relative importance of major factors affecting feed supplies and demand, and for interpreting the requirements for additional feeds. It is hoped that by quantifying these circumstances and responses, lessons may be learned which can support fodder development in a more targeted and successful way. Also, development of a simple but sensitive method of survey would provide NGOs working in the field with a more critical tool for assessing seasonal fodder needs with farmers than current methods (often none).

The following sections describe the design and conduct of the site and household selection, and survey work.

2.1 Site and household selection

The target area for project activities was in the mid-hills zones of Kavre, Dhading and Sindhupalchok Districts of central Nepal accessible to the collaborating local research organisations and coordinators based in Kathmandu (NAF and FORESC). Within these three districts, potential collaborating village sites were identified through NAF partner-NGOs to represent (1) two main physical criteria, altitude and access to markets, and (2) various community criteria. The latter criteria included: involvment in community forestry management; concern about livestock feed supplies and fodder

development; sufficiently large to contain a range of household circumstances and enough households for sample surveys; and willingness to participate. In addition, communities to be selected had no previous formal involvement in fodder development activities since these might bias the demands for and selection of fodders.

A total of 11 villages were identified as meeting the above criteria. Five villages were selected from these for combined research and extension activities, while existing extension approaches alone were implemented in the remaining sites. Project Report No 2 (Kiff, Hendy, Neupane and Basukala, 1998a) details the selection process and the characteristics of 11 selected village locations. The locations and characteristics of the five villages selected for fodder research are listed in Table 1

Table 1 Locations and characteristics of villages selected for fodder research work

Village name	**District**	**Altitude**	**Access to markets**
Gajuri Chhap (GC)	Dhading	Low <1000m	Close (<1hr walk)
Gauthale (GA)	Dhading	Low <1000m	Distant (>1 hr walk)
Chankhubesi (CH)	Kavre	Mid 1000-1500m	Close
Ange (AN)	Sindhupalchok	Mid 1000-1500m	Distant
Tawari (TA)	Kavre	High >1500m	Distant

Within selected villages, households participating in the survey and research activities were selected to represent the range of circumstances thought to affect fodder availability and requirements. These circumstances were first tentatively identified in group discussions with farmers, and on the basis of previous research in other parts of Nepal. Key factors were identified as (1) livestock holdings and ratios to land holdings, (2) the mix of irrigated and dryland land holdings (khet and bari land respectively), and (3) the production objectives of livestock keepers (in particular whether milk production from cows or buffaloes was practised). Other factors peculiar to specific communities and locations were also identified, including the ethnic group of farmers, access to grazing resources, access to forest or other common property sources of fodders, and the general wealth of households. These factors are correlated in some cases, so that, for example, certain ethnic groups may have poorer access to resources, lower land holdings, and generally lower economic status. In a few cases, these factors are also correlated with greater dependence on larger livestock holdings, with consequently greater demands for fodders.

Selection of households was undertaken jointly by the communities, local NGOs and research partners in a participatory process. Following community discussion of the various factors affecting availability and demand for fodders (as above), classifications of the levels of the relevant key factors were made for the particular location. All households were then allocated to the various sub-classes identified. Households to participate in the research were then selected by the community out of the sub-class groups. The selection of households was done roughly in proportion to the numbers of households in the sub-class, though with the limitations that a total of only 10 households could be selected and at least 1 household should be selected from

each identified sub-class. In addition, where particular local factors were identified as being important, such as ethnic group, these factors were also included in the classifications and a sample of households selected. This selection procedure provided a representative sample of the households from each community as well as the opportunity to study the effects of differences between households, within the capacity of the project for field survey work. Details of the selection process and classifications of households for all the communities are provided in Project Report No 2 (Kiff, Hendy, Neupane and Basukala, 1998a) and Project Report No 3 (Kiff, Hendy, Vickers, Chhetri and Basukala 1998b).

2.2 Land holdings and household characterisation

Collection of information on land holdings and other household characteristics was undertaken by single visit surveys during the first year of the project. Information on land holdings was collected at the initial household selection process. This information was revised and corrected after six months, once better understanding and trust had developed between farmers and NGO staff.

Information on land holdings distinguished the main types of private cropland as:

Khet:	bunded land receiving supplementary watering (from rainfed run-on or stream irrigation)
Bari:	rainfed cropland, terraced or lowland
Pakho bari:	Sloping rainfed cropland
Kharbari:	Rainfed land less suited to cropping, cropped in some seasons or used to grow thatching grass

In addition, surveys specified the areas of holdings of each type of land from which different numbers of crops were taken in the year (generally one or two from bari land and one, two or three from khet land).

Household information collected included family size and structure and family labour availability and allocation to different activities in fodder collection and feeding. Labour surveys also attempted to identify the extent and seasonal patterns of labour use and constraints in fodder work. Surveys were conducted at one time towards the end of the survey year and collected information by recall over the survey year.

2.3 Livestock holdings and production objectives

Information on livestock holdings, production objectives and outputs was collected in the bi-monthly surveys of households. The forms used for these surveys are included in Annex 1. All information was provided by recall from farmers, or from the persons in the household carrying out the livestock work. Some follow-up checks of accuracy of the data were made at periodic visits, and further checks were carried out if anomalies appeared when collected data were entered in databases alongside previous survey data.

Information on holdings of fodder-consuming livestock were classified by age (suckling, immature, mature) and sex for cattle, oxen, buffaloes and small ruminants (almost all goats), in order to be able to estimate total fodder requirements and check data on reported fodder allocations. Holdings of local indigenous or crossbred milking cows and buffaloes were distinguished. (Holdings of poultry were not included in the survey). Records of milk outputs included daily milk production (total extracted milk) and monthly ghee production and sales per livestock species (cows and buffaloes). Meat production was recorded as total monthly consumption and purchase of meat, and sales of animals in the two months prior to survey. The purpose of recording livestock production was to provide a simple measure of productivity and farm outputs to compare with feed use, diet quality and requirements.

In addition to simple recording of livestock production, an attempt was made to determine the ranking of objectives of livestock feeding in each season. This was done in order to see if feeding objectives changed seasonally, or differed between households, or influenced the demand for different feeds. Following discussions with farmers, the main distinguishable feeding objectives were identified as:

For milking cattle and buffaloes:
- Milk production
- Calf survival
- Manure production
- Ghee production
- Cow condition/survival

For draught oxen:
- Condition/power
- Manure production

Households were asked to rank the importance of these objectives in each survey, and to describe how they affected feeding choices at that time.

2.4 Fodder collection and allocation

2.4.1 Fodder collection

Information on the collection and allocation of feeds was obtained in the bi-monthly survey, according to the survey forms shown in Annex 1. Discussions with farmers and household members suggested that they could easily recall and estimate (according to well known local measures) the amounts of fodders collected and fed to animals daily. Surveys were therefore designed to collect such information in the simplest way possible.

Accordingly, households were asked at each two-monthly visit to report on their current daily collection and use of fodders. Total household collection and use of fodders was reported in broad categories of:

Type of fodder	Measure	Source
crop residues, crop thinnings and weeds,	bhari	(on-farm, purchase)

fresh cut grass,	bhari	(on-farm, off-farm)
tree and shrub fodders,	bhari	(on-farm, off-farm)
grazing and	bhari	(on-farm, off-farm)
concentrates	kg	

'Crop residues' included straws and stovers of cereal and legume crops. Some of these were stored for later dry season use, in which case the amounts reported as 'collected' were the amounts taken from storage per day. 'Crop thinnings and weeds' referred to the green fodders derived from crop thinning and weeding. This applied mainly to bari crops in the early to mid rainy season (July-September). 'Cut grass' included green fodders cut from communal land, forests, roadsides, stream banks, field bunds and many other locations almost throughout the year and included a variety of mixed grasses, other herbs and weeds. This material was more or less green and growing when cut but also included some poorer quality older grasses and herbs at times such as later in the dry seasons. 'Tree and shrub fodders' included a wide range of lopped tree leaves and cut shrubs. It may be noted that the species composition, condition and feeding quality of these categories of fodders were variable through the year and to some extent between locations. The practice of cutting, drying and storing of grass for later dry season use was not reported in the project sites so was not included in the surveys.

Where appropriate, the main different sources of fodders were distinguished. Crop residues were available either from own farm sources (immediately after harvest or from store) or from purchase. Cut grass, tree and shrub fodders, and grazing sources were noted as on- or off-farm, the latter referring to sources in communal lands and forests (where allowed). Grazing 'on-farm' was reported as from crop aftermaths and weeds.

A constant problem in recording fodder use and requirements in mixed stall-feeding and grazing systems, is the measurement of grazing fodder contributions. In this survey, farmers were asked to report the daily duration of grazing of each type of livestock (in hours) and an estimate of the amounts of cut-grass fodder that would have had to be collected if animals had not been grazing. Given that most households practise systems of mixed grazing and stall-feeding at different times of year there seemed to be little difficulty in interpreting and reporting this information.

Concentrate use was reported either in dry weights (kg), or dry weights converted from local volume measures (eg tins, mana). Different types of concentrates were distinguished in recording, as follows:

Dutto	rice bran (4 mana/kg)
Pittoo	maize bran (with wheat and/or barley brans) (2 mana/kg)
Pinna	oilseed cakes (2 mana/kg)

These concentrates are actually commonly fed in wet form mixed with water. Pittu may be cooked with water, then called 'Kundo'.

The collection of specific fodders was identified within categories by reporting the percentage of each category made up by particular fodder species at each survey

(crops, tree species on-farms, tree and shrub species off-farms). This procedure allowed the preparation of lists of fodder species available and the seasonal patterns of their use in each location. It also potentially provided more specific information on the quality of feeds actually collected.

2.4.2 Fodder deficits

At the same time as asking about fodder collections, households were asked to report the amount of deficit of each fodder category they estimated for current requirements. The deficit was estimated as the amounts of additional fodder (in local measures) that would be required to satisfy normally expected full production or condition for the current livestock holdings and production objectives.

The concept of these measures of fodder deficits was first discussed with farmers and appeared to be relatively easily recognised. During the survey work, uncertainty was evident in some households about the definition of 'normally expected full production'. This was generally clarified with further discussion but some problems with definition may have remained in some cases, depending on the clarity of household objectives. Deficits were reported in terms of the types of fodders commonly available at the survey time (ie farmers did not specify particular fodders not currently grown or available in the village). Deficits of grazing were not reported as this was regarded as too difficult to estimate. The definition of deficits is thus probably somewhat limited, though may indicate the priority types of fodders needed and provide a guide to the selection of suitable introductions.

2.4.3 Fodder allocation

Finally, households were asked to report the daily allocation of collected fodders to different livestock types so that the amounts and composition of offered feeds could be estimated. These allocations were reported in percentages (or proportions) of the total amount of each fodder category given to the total holding of each type of livestock (cattle, buffaloes, oxen and goats), regardless of age and sex. Thus, for example, it might be reported that 20%, 40%, 30% and 10% of crop residues were allocated to cattle, buffaloes, oxen and goats respectively. In practice, animals are most often group-fed by livestock type, with similar fodder diets offered to immature and mature animals within types (though concentrates are more discriminatingly offered to breeding and milking animals). This facilitates reporting of proportional allocations with which respondents appeared quite confident. It is recognised that this procedure may be subject to errors in simplification and rounding of allocation proportions but was simpler to operate (in survey work and data handling) than attempting to record for each animal or group of animals the amounts of different feeds offered. The method appears sensitive enough to detect differences in diet compositions between livestock types and seasons, as described in the results sections below.

Although fodder allocations were reported by fodder category (crop residues, thinnings, cut grass, tree fodders), the specific composition of feeds offered could be estimated, if required, from the species composition of collections as recorded in section 2.4.1 above. Some differences in the allocations of specific constituent

fodders between livestock types were also expected and these were investigated in follow-up discussions with farmers.

For grazing, the allocation of fodder amounts to different types of livestock (cattle, buffaloes, oxen and goats) was estimated from the numbers of hours of grazing reported for each type.

Some minor additional problems with this reporting process emerged during the survey. One common practice, especially in the rainy seasons, is to collect some feeds on one day to last for two or several days. In such cases, strict daily reporting might miss or overestimate average daily collections and allocations. This may be avoided by careful questioning and discussion of all the fodders used in the particular season. Other potential sources of error concern the proportions of collected fodders that are eventually offered as feeds or actually consumed by livestock. Approaches to dealing with these problems are discussed with the feed allocation results below.

3 Summarisation and analysis of fodder data

Survey data was entered into computer spreadsheet databases for preliminary checking and summarisation. Data were entered separately in NAF and FORESC computers, cross-checked between spreadsheets, and back-checked with original survey forms. Data were then summarised for further checking within each season by estimating the amounts of feeds collected per livestock unit held by each household, and the amounts of feeds offered per adult equivalent of each livestock species. These summarisations were sufficient to detect outlying observations which could then be checked with households at subsequent visits.

Following data corrections, data on fodder collection were summarised by household and by season to illustrate sources of fodders (on- and off-farm), amounts collected, deficits and seasonal patterns of availability. These summarisations were undertaken in Excel spreadsheets. Data on fodder allocations were summarised by livestock species, households and seasons to illustrate the seasonal patterns of the amounts of feeds offered and the composition of diets. Some of these results are presented and discussed in following results sections. Preliminary findings from these summarisations were discussed with households and communities in group-meetings in order to check and explain the implications.

Key indicators and measures of fodder collections, deficits, allocations and diet compositions were then identified for further analysis to determine the major factors affecting feed supply and requirements. These analyses are still underway, conducted in SPSS procedures. Future discussion of results with households will further explore these results in relation to household choices of the types and amounts of additional fodders planted on farms.

3.1 Livestock holdings data

The survey distinguished types of livestock as cattle (including cows, immatures and suckling calves), oxen (working animals), buffaloes (including cows, immatures and calves) and goats (adult males and females, and kids). Generally fodder data were related to these particular types of livestock. However, in order to check and examine fodder collections and allocations in relation to overall livestock holdings, the latter were summarised into total livestock unit holdings (LU) and adult equivalent (AE) holdings of each species. These were estimated according to the conversion factors shown in Table 2 adopted from local practise in Nepal (see Pradhan 1987) and regarded as relevant to the relative liveweights of livestock types in the project area. (It may be noted that a variety of livestock unit conversion factors are reported in literature sources in Nepal so that comparisons across studies must take account of these differences).

Table 2 Livestock unit and adult equivalent conversion factors (1)

Livestock species/ Type	Adult/mature LU	Immature LU	Suckling young LU
Cows (2)	1.0	0.66	0.4
Oxen	1.2		
Buffalo	1.5	1.0	0.6
Goats	0.1	0.1	0.05

1. After Pradhan (1987)
   Livestock unit (LU) assumed to be equivalent to 1 adult indigenous cow of 250kg
   Adult liveweights of other species assumed to be 350kg, 300kg and 25 kg for buffaloes, oxen and goats respectively
2. Crossbred cattle and buffaloes conversion factors assumed to be 1.2 times indigenous animal factors

Adult livestock equivalents were used to compare with the fodder allocations to each type of livestock, since allocations were reported by type of livestock including all ages and sexes. Livestock were not weighed or measured in these studies so the option of estimating metabolic liveweights was not appropriate. It may be noted that the use of livestock units and adult equivalents to summarise livestock holdings provides only an approximate estimate of livestock stocking densities and feed demands.

3.2 Fodder collection data

Table 2.1 in Annex 2 illustrates the form of data on fodder collection derived from the first survey in March 1998 (cattle data only). The full data set includes observations from all 10 households in each of the five villages, from eight surveys over 16 months. Fodder collection and deficit data were converted to bhari equivalents (if recorded in other local measures) in the original survey forms.

The amounts of fodder provided by grazing were recorded directly from the reported amounts (bhari) of substitute cut grass that would be needed if animals had not been

grazed. The extent to which reported data appeared sensible across households was tested by relating the amounts of fodder collected by grazing with the numbers of hours of grazing reported. The latter was calculated as the sum of the numbers of livestock-unit-hours of grazing by all classes of livestock reported by the grazing households. Annex 3 shows these relationships and resulting linear regression equations found for each survey. There were significant linear relationships in each survey season (R^2 ranging from 0.52 to 0.87), giving some confidence that estimated fodder collections were at least consistent with reported grazing durations.

3.3 Fodder allocation data

Data on fodder allocations were summarised as illustrated in Tables 2.2 and 2.3 in Annex 2. The reported percentages of each fodder allocated to livestock types were converted to bhari based on the reported total bhari collections of each fodder type (Table 2.2). The diet composition for each livestock type could then be estimated. Fodder collection and deficit data were analysed and are discussed below in bhari terms rather than converting to estimated weights of fodders, given the uncertainties of these weight conversions.

3.4 Diet composition data

Diet composition data were initially estimated in bhari terms as noted above. However, in order to check that the survey procedure was providing reasonable estimates of fodder supplies and requirements, bhari measures had to be converted to fodder weights. Table 2.3 in Annex 2 illustrates the resulting data for cattle in the first survey in March 1998. Similar data were derived for each livestock type in each household in each survey season.

Conversions of bhari measures to fodder offer-weights took account of (1) the average weights of bhari of different fodder types, (2) the proportions of each bhari load that constituted fodder, and (3) the dry matter content of the fodder type. Conversion factors are shown in Table 3. Bhari weights were derived from sample weighings carried out by the project and from literature estimates. Fodder proportions in average bharis of different fodder types were estimated from field observations. Tree and shrub fodders, especially, include twigs and branches which are used for fire wood rather than fodder, and crop residues include coarse stems (eg of maize and millet) which are also not fed to livestock. Dry matter contents were derived from the many literature reports available (see Kiff, Thorne, Pandit, Thomas and Amatya, 1999).

Table 3 Conversion factors for estimating the dry matter weights of fodders in bhari of different fodder types

Fodder type	Fresh weight kg	Feed proportion %	Dry matter proportion %	Dry weight kg

Crop residue	30	70	80	16.8
Crop thinnings	35	90	30	9.5
Cut grass	35	90	25	7.9
Tree fodders	35	65	35	8.0

Bhari saved by grazing were converted by the same factors as for cut grass.

It is recognised that these conversion factors, applied as they are over many different specific fodders within each fodder type, represent only crude averages of dry matter yields. In addition, the same conversion factors were used for data from each survey season, when there may be some systematic differences in specific compositions of fodder types between seasons. Thus estimates of the amounts of dry matter of feeds offered to livestock must be interpreted with care. Nevertheless, the conversion factors represent the best available simple estimates, so that proportional diet compositions, diet differences between livestock types, and broad seasonal patterns of diet compositions should be sufficiently accurate to detect the effects of major influencing factors. Should further more detailed analysis prove necessary, then a more precise definition of specific collected fodder compositions and bhari conversion factors would be required. Data on specific fodder compositions are available for each household in the original survey data; additional information on bhari conversion factors would need to be collected from additional field samples.

In order to check the implied levels of feed allocations to livestock, the dry matter weights of fodders allocated were related to the numbers of adult equivalents of each livestock type in each household (as shown for cattle in Annex Table 2.3). Adult equivalents for each livestock type were estimated from the numbers of adult and immature animals, as shown in Table 2, assuming that these would be the main consumers of fodders (and suckling young would not).

4 Preliminary results

Preliminary results are presented in following sections to illustrate the types of findings that will be elaborated in final analyses. The results included so far cover livestock holdings, fodder collection, sources and deficits, and fodder allocations and diet compositions. Data on land holdings, labour availability, livestock production and production objectives remain to be summarised and will then be used in analyses of the factors affecting fodder supply and requirements.

4.1 Livestock holdings

Tables 4 and 5 summarise the numbers of households holding each type of livestock and the average herd and flock sizes for those households, as of the last survey in May 1999. At that time all households but one held some livestock. The one household without had lost its holdings of goats in March 1999 (a severe dry season). Otherwise all households held at least some livestock throughout the survey.

Most households in Gajuri Chhap and Gauthale held most types of livestock and with generally relatively higher herd sizes than in other villages. Total livestock unit holdings in these villages were nearly double the holdings in other villages (Table 5). Importantly, these villages retained most access to grazing land. Most households across all villages held goats. Holdings of other livestock types were variable between villages. Only in Gajuri Chhap did households keep both cattle and buffaloes; in other villages, households tended to hold either one or the other (cattle in Chankhubesi and buffaloes in Gauthale, Tawari and Ange). Relatively few households in Chankhubesi and Tawari kept oxen.

Holding sizes for each livestock type did not differ markedly between villages, commonly being in the range of 2-4 for all cattle, 1-3 for cows, 2-3 for oxen, 1-3 for all buffaloes and 3-10 for goats.

Combinations of livestock types in different holdings are illustrated in Figure 1. All households held a combination of at least two types of livestock. The most commonly held combinations were for all four livestock types (COBG) (15 households, especially in Gajuri Chhap), OBG (12 households, especially in Gauthale) and CBG.

Changes in livestock holdings throughout the year are illustrated in Annex 4. Patterns and sizes of holdings remained relatively stable through the year. The most significant changes appeared to occur in Ange where the numbers of households with cattle fluctuated (increasing in the rainy season and declining thereafter), while the numbers of households with oxen and buffaloes increased through the year. Average holding sizes for each livestock type were also generally relatively stable. Notable changes occurred in Gajuri Chhap and Ange where cattle herds declined slightly (from 3 to 2 and 2 to 1 respectively). Goat flock sizes increased in Gauthale and Tawari (from about 6 to 8).

Differences in livestock holdings between households within villages were clearly noted as this was a household selection criterion. A notable feature of these differences was the extent to which they were related to ethnic origin of households and access to resources. Thus, only four households in the Noya Gaun 'new village' section of Chankhubesi have access to off-farm resources for fodder collection and some grazing; the Magar community in Tawari has generally higher land and livestock holdings while the Tamang community has traditionally kept buffaloes and had limited access to grazing land; and access to grazing land in Ange has been denied since the closure of the communal forest in 1996. The effects of these differences will be examined in more detail in the next stage analyses.

Another important feature of livestock holdings concerns the distribution of crossbred milking animals. Presently crossbred cattle occur in Chankhubesi, where all cattle are some grade of crossbred and access to AI and milk markets is good and long established. Crossbred buffalo occur in very few households and have to purchased into the area (there are no local AI services). Currently, crossbred buffaloes are held by four households in Tawari and two in Ange. All goats are of the local breed.

Table 4 Numbers of households keeping each type of livestock in May 1999

Village	Number of households with each species (1)					
	All cattle	Cows	Oxen	Buffaloes	Goats	LU
Gajuri Chhap	10	9	9	9	10	10
Gauthale	10	3	10	10	10	10
Chankhubesi	8	8	2	4	9	9
Tawari	6	5	4	9	10	10
Ange	7	2	6	10	8	10
Overall	41	27	31	42	47	49

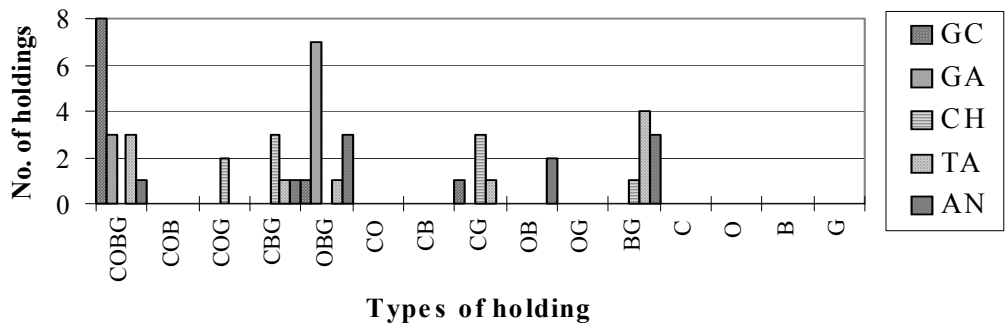
1. All cattle = cows plus immatures and young stock;
cows = adults
buffaloes and goats include all ages

Table 5 Average herd and flock sizes for households with the livestock type in May 1999

Village	Average holding sizes for households with each species					
	All cattle	Cows	Oxen	Buffaloes	Goats	LU
Gajuri Chhap	2.0	1.4	2.6	2.4	5.3	7.5
Gauthale	1.7	3.0	2.1	2.7	8.4	7.7
Chankhubesi	2.5	1.4	2.0	1.3	4.4	3.3
Tawari	2.4	1.4	2.0	1.7	7.5	4.3
Ange	1.0	1.0	1.8	2.0	3.9	4.6
Overall	1.8	1.6	2.2	2.1	6.0	5.5

1. All cattle = cows plus immatures and young stock;
cows = adults
buffaloes and goats include all ages

Figure 1



4.2 Fodder collection

Data on fodder collection and deficits were first summarised by households, villages and seasons. For each fodder type, the survey also provided information on the sources of fodder (whether on- or off-farm). Summarisation of these data in graphical form provided a basis for detecting important features and trends in the data, and discussion with farmers, before more detailed analysis of the factors affecting fodder supply and demand.

4.2.1 Seasonal patterns of fodder collection and deficits

Figure 2 illustrates the form of data summarised at household levels in Gajuri Chhap in May 1998 and July 1998. Similar data were summarised for all households, villages and survey seasons. The figures illustrate the differences between households in both the levels and composition of feed resources collected, and similarly for reported fodder deficits. Differences between households are clearly mainly due to differences in livestock holdings (both numbers and composition). Other differences are notable in the occurrence and impact of grazing. Grazing in May 1998 appeared to be practised by only those households with larger total fodder needs, and contributed a high proportion of fodder collected. Generally, deficits were proportionally larger for households not grazing than for those grazing. Deficits in May 1998 were reported to be mainly of cut grass, particularly for households not grazing. Deficits were much reduced in July 1998, after the start of the rains.

Fodder collection and deficit data were also summarised to illustrate village and seasonal effects for discussion with farmers. Annex 5 illustrates the numbers of households reporting the collection of each type of fodder, and the average amounts collected. Annex 6 presents a similar summary of deficit data. Graphical summaries in Annex 7 show the village differences in household average fodder collections and deficits, while Annex 8 shows the seasonal averages within villages.

Annex 5 shows the seasonal patterns of collection of fodders. Almost all households collect or use similar amounts of crop residues throughout the year. Collection of crop residues was generally highest in Tawari village. Crop thinnings and weeds were mainly collected in the July to September rainy cropping season. Cut grass and tree fodders were available throughout the year but the former was most collected over the July to November period and the latter over the January to May period. Tree fodders appeared to be most collected in Gajuri Chhap, Gauthale and Tawari villages. Grazing was also most important in these villages, particularly in Gajuri Chhap and Gauthale where generally more than 7/10 households reported grazing some livestock. Patterns of fodder deficits tended to show the converse of supply. Most households reported the greatest deficits in the late dry season surveys (March to May), particularly for tree fodders and cut grass. Anomalously, relatively large deficits continued to be reported in Ange village in the July survey, and reported deficits were lower in the 1999 dry season than in 1998 (despite farmers reporting that the 1999 season was one of the most severe in recent memory and that reported fodder collection was notably low). These apparent anomalies were discussed with farmers, so far without clear resolution.

Figure 2 Household data on fodder collection and deficits in different survey seasons

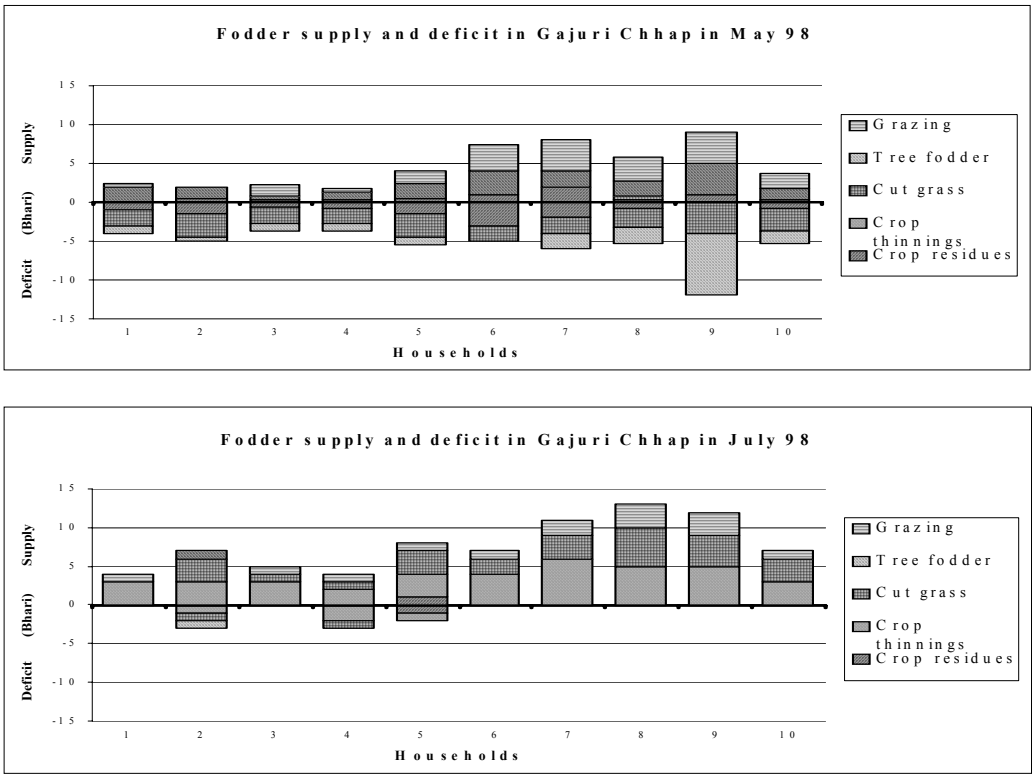
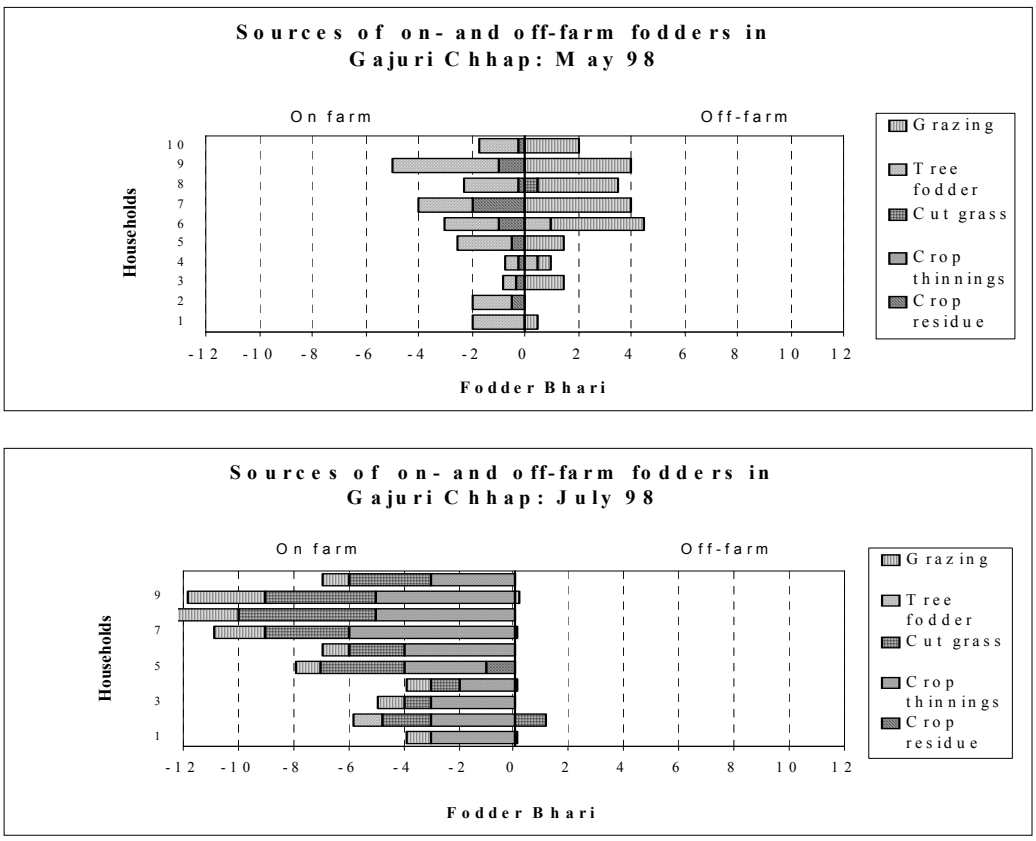


Figure 3 Household data on sources of fodders in different survey seasons



Annexes 7 and 8 illustrate village and seasonal averages of fodder collection and deficits. Gajuri Chhap and Gauthale generally showed the largest average collections and deficits of fodders, in line with relative livestock holdings. Deficits appeared proportionally greatest in these villages and in Ange. Chankhubesi, Tawari and Ange villages continued to report deficits in the early rainy season (July) but deficits were largest at that time in Ange, despite larger fodder collections than in the preceding dry season surveys.

Seasonal patterns of fodder collection and deficits (Annex 8) were broadly similar in all villages, with larger collections and smaller deficits through the rainy season and the converse in the dry season. Deficits were generally largest in the March and May 1998 surveys but also appeared in the fifth (November 1998) survey in all villages except Ange. Discussions with farmers suggested that this may be due to seasonal patterns of livestock production and feed demand, as well as to labour difficulties at harvest times (though collections in November were similar to the previous survey in September). These issues will be discussed further with farmers.

Data on the specific composition of collected fodder types remain to be summarised. These should reveal the proportional importance and seasonal patterns of utilisation of specific fodders, especially for tree fodders. Combined with deficit reports, these data should allow some interpretation of the types of additional fodders that may be required in different seasons.

4.2.2 Sources of fodders

Apart from distinguishing the types and specific composition of fodders, the survey identified the sources of fodders as either on- or off-farm. These data were first summarised for each fodder, household and survey season into graphical presentations which could be discussed with farmers. Figure 3 illustrates the household data for Gajuri Chhap in May and July 1998. These summaries highlighted various features of the sources of fodders, including differences between households, villages and seasons.

Differences in sources of fodders between households are principally due to factors such as the amount and type of land-holdings and differential access to off-farm resources (by rights or by proximity). The need for fodders from off-farm sources is also related to livestock holdings, while the ability to collect them may depend on labour availability. The influence of all these factors will be explored in future analyses.

Village and seasonal averages of amounts of fodders collected from different sources are shown in figures in Annex 9. Households in Tawari collected a higher proportion of overall fodders on-farm than in other villages. Gauthale households collected least on-farm and most off-farm. Seasonally, on-farm collection contributed less, and off-farm fodders more, in the dry season surveys. Cut grass fodder was collected largely on-farm in the rainy season surveys (July to November), in all villages, but mainly off-farm in the dry seasons in Gajuri Chhap and Gauthale. Overall seasons and villages, more than 60% of tree fodders was collected on-farm. In Tawari and Ange, almost all tree fodder in all seasons was collected on-farm. Only in Gauthale was a

substantial proportion of tree fodder collected off-farm, amounting generally to 40-60% of the total tree fodder. Lower proportion of tree fodder came from on-farm sources during the dry seasons in Gauthale and Chankhubesi but this seasonality was not marked in other locations. Grazing tended to be off-farm except in the July survey. In Ange, only one or two households grazed any livestock, and only on-farm except for during the rainy season. Crop residue and crop thinnings came predominantly from on-farm sources. Crop residue was purchased from off-farm sources by 3-6 households in Chankhubesi during the dry season months, but otherwise by only 1 household in Ange.

Charts in Annex 10 illustrate the numbers of households collecting different fodders on- or off-farm. These support the data on the proportional sources of fodders (Annex 9). While virtually all households in all villages collect some fodder on-farm, fewer than half the households in Tawari and Ange villages collect any fodder off-farm. In other villages, generally more than 6/10 households use some off-farm fodder sources. Surprisingly, generally less than half all households collect cut grass or tree fodders off-farm. Only in Gauthale do a majority of households consistently use off-farm tree fodders. Collection of cut grass on-farm is highly seasonal, with all households doing so in the main rainy season. Only in Chankhubesi and Ange do a majority of households also collect cut grass on-farm in the dry seasons, possibly because of the greater presence of irrigated land. Relatively few households graze animals on-farm. In Gajuri Chhap, Gauthale and Tawari generally more than half of households graze some animals off-farm. In contrast, only one or two households in Chankhubesi and Ange graze livestock at all.

4.2.3 Factors affecting the availability and collection of fodders

The above summaries of the fodder collection data, and resulting discussions with farmers, have identified several major factors likely to be affecting the availability of and demand for fodders. On the supply side, these include the amount and type of land holdings (especially the proportions of irrigated land, altitude and crop productivity), access to off-farm resources including grazing, the amounts of forest accessible off-farm, the existence and numbers of trees on farms, and labour availability for herding and fodder collection. The major factors affecting demand for fodders are the livestock holdings and production objectives of households. These in turn depend on factors such as access to markets, the availability of draft power sources (hired animals and tractors), and the demand for manure for crop fertilisation (determined by land holdings and soil types). Households differ within villages in respect of many of these factors, as well as village locations differing in certain respects. Seasonal factors are also obviously important determinants of supply and, to some extent, demand for fodders.

The effects of these factors will be explored in further multi-factorial analyses. These analyses will determine:

(1) which factors are most important in determining the supply and deficit of fodders, and the direction and magnitude of their effects

(2) the levels of fodder supply that are currently available under different circumstances, and

(3) the amounts, seasonality and types of fodder deficits under different circumstances (leading to definition of needs for additional fodders)

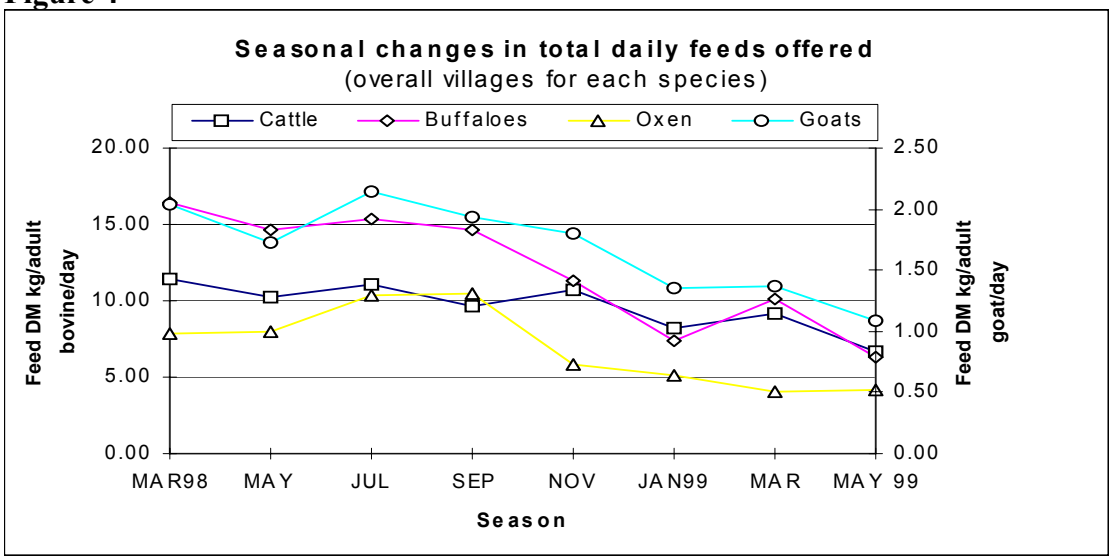
4.3 Fodder allocation

Information on the allocation of fodders to livestock was first summarised as illustrated in Annex 2 (described in section 3.3). These data were further summarised to explore the factors that may affect allocation rates to different livestock types, and eventually to identify fodder needs to supplement existing diets in different circumstances.

Total feed offer rates to different types of livestock are illustrated in Figure 4, expressed as amounts of dry matter (DM) of feeds per adult of each livestock type per day. Overall households and villages, the expected seasonal pattern of feed offer rates rising in the rainy seasons from July to November and falling in the dry seasons is evident, more marked for buffaloes, oxen and goats and less so for cattle. Offer rates appear reasonable in relation to the different bovine livestock types, generally ranked as expected from buffaloes to oxen and cattle.

However, total offer rates like these need to be interpreted with care, recognising the limits of the methods of data collection and analysis. Offer rates in this dataset are derived from the total feed allocations to all animals of a type (cattle, buffaloes, oxen or goats, as defined in section 3.1). Adult animal equivalent numbers are derived simplistically from holding numbers of adult and immature animals (not including suckling young which will not consume much fodder). Adult equivalent liveweights and conversion factors of each species are estimates from local experience and literature. Finally, the amounts of feeds offered are not all consumed by livestock; the portion not consumed is usually left as bedding and incorporated in compost. The proportion of fodder not consumed varies between fodder types, being greatest for coarse crop residues such as maize and millet stover and least for green cut grasses and crop thinnings.

Figure 4



Daily offer amounts are expressed as percentages of adult liveweights in Table 6. These provide a rough check that feed offer rates derived from reported fodder allocations are realistic. Average daily DM offer rates of between 1.38 to 4.59% of liveweight for cattle, buffaloes and oxen are within expected rates, bearing in mind the variable composition of total feeds. Cattle may generally be expected to consume feed DM amounting to between 1.5 to 3.0% of their liveweight per day. Goats usually consume proportionally more, between 2 to 6% of liveweight. Feed offer rates to goats appear somewhat higher than might be expected, though much of their feeds are tree and shrub fodders from which there may be relatively high refusal (non-consumption) rates. Farmers and survey staff also noted that the accuracy of estimating relatively small proportional allocations of fodders to the small holdings of goats may be less than for larger bovine holdings. In general, though, the demonstration of roughly expected feed offer rates, livestock species differences and seasonal patterns give some confidence that other trends and features in the data may be reliable.

Table 6 Total fodder dry matter offered per day to each livestock type

	Total daily fodder offered at different seasons Percent of adult liveweight per day (1)							
Species	Mar 98	May 98	Jul 98	Sep 98	Nov 98	Jan 99	Mar 99	May 99
Cattle	4.59	4.12	4.42	3.85	4.27	3.30	3.67	2.66
Buffalo	4.39	3.91	4.10	3.92	3.02	1.97	2.68	1.67
Oxen	2.63	2.67	3.45	3.49	1.94	1.72	1.36	1.38
Goats	8.14	6.88	8.60	7.75	7.19	5.43	5.47	4.37

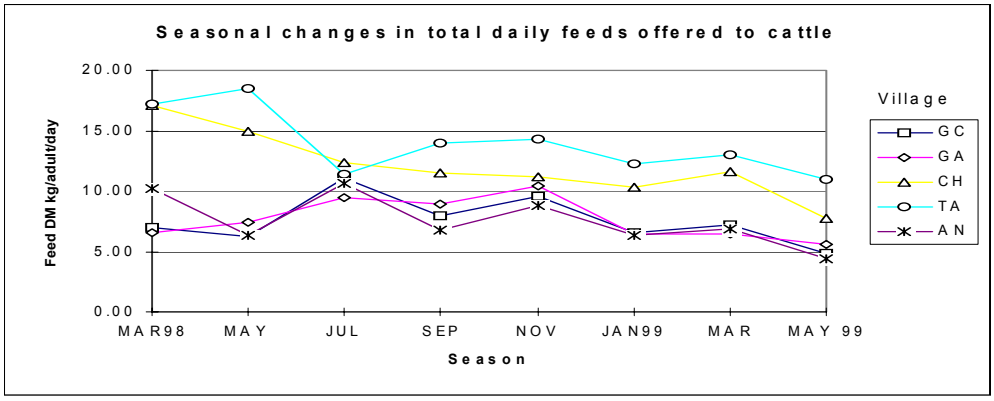
1. Adult average liveweights estimated as: cattle 250kg; buffalo 350kg; oxen 300kg; goats 25kg

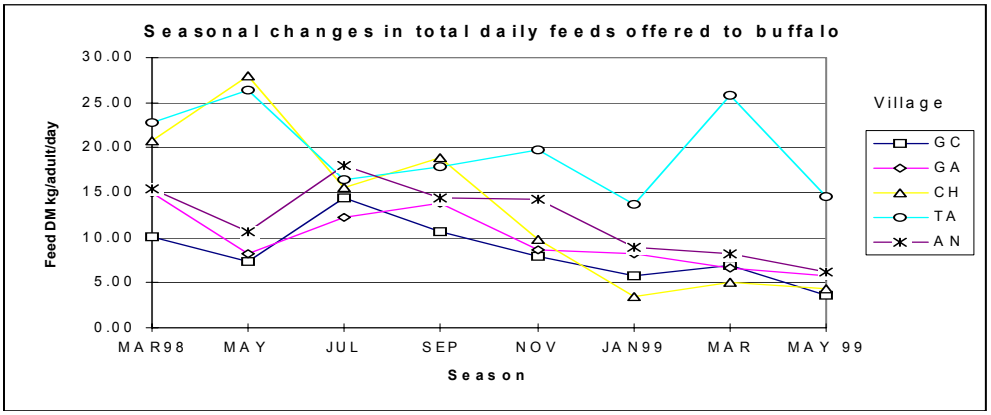
4.3.1 Fodder allocation to different species of livestock

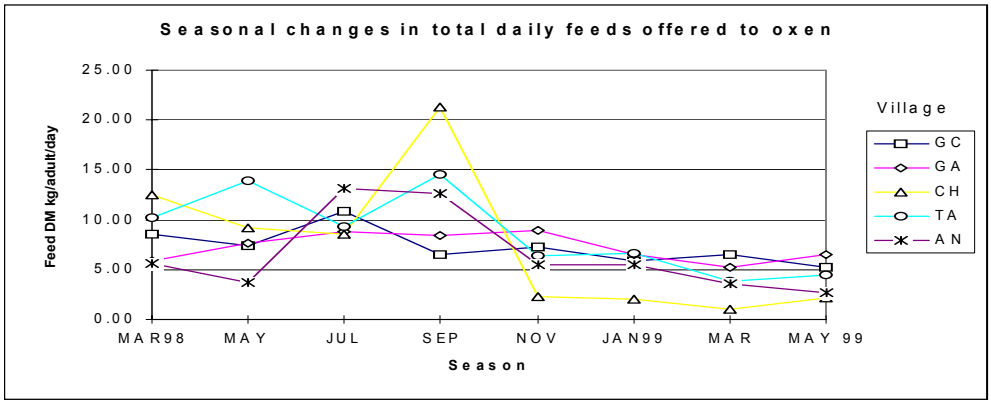
Figure 5 presents chart summarises of the amounts of fodders offered seasonally to each livestock type in the different villages. For cattle, offer rates were generally higher in Tawari and Chankhubesi than in other villages. These villages also showed a less pronounced seasonal pattern than in other villages. In Chankhubesi, this observation is probably due to the presence of crossbred cattle in all households. In Tawari, the reason is not so clear but may be related to the diet compositions, with a relatively high proportion of higher quality cut grass in the feeds offered. Similar high offer rates were noted also for buffaloes in Tawari.

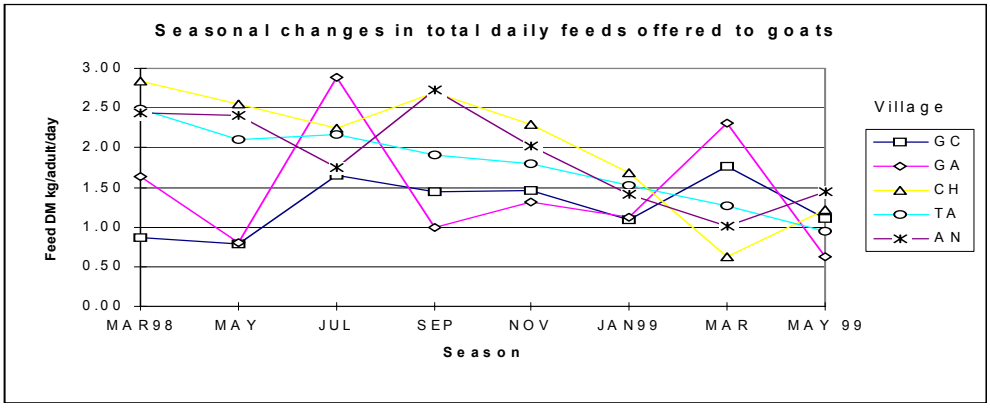
A second feature of these offer rate summaries is the relatively lower offer rates for all livestock in the 1999 dry season than in 1998, particularly noticeable for buffaloes and oxen. This pattern is consistent with farmer reports of the severity of the 1999 dry season. Fodder offer rates to buffaloes and oxen appeared particularly low in Chankhubesi.

Figure 5 Seasonal amounts of total feeds offered to different livestock types









A third feature in the summaries for buffaloes, oxen and goats is some variability in the averages between seasons within villages. In part this is due to low numbers of observations (households with the particular livestock in the particular season) in some villages, particularly for oxen. It may also be due to changes in feeding practices for oxen through the year depending on working and non-working periods. This has been discussed further with farmers. It is recognised that short term changes in feeding practices in relation to livestock production objectives may either be missed or may distort survey data collected at relatively infrequent intervals. These data thus need to be interpreted together with detailed discussions with farmers about feeding practices and changes.

It is also recognised that fodder allocation rates to particular livestock types are determined by multiple factors, including the total livestock holding and periodic changes in priorities between livestock types in households, the composition of diets (especially the use of concentrates), as well as seasonal and locational factors affecting the availability of fodders. Further analyses will explore the effects of these factors.

4.3.2 Composition of diets

Information on the composition of diets is illustrated in Annex 12. Charts in Annex 12 show the proportions of fodders allocated to each type of livestock in each season and village. Notable differences in the fodder allocations between livestock types included the important contributions of grazing for cattle and oxen. In Gajuri Chhap and Gauthale grazing contributed 10-30% of fodder to cattle and oxen. Buffaloes were generally not grazed, while goats grazed for less than 5% of their fodder. For buffaloes, grazing was replaced with higher proportions of cut grass and crop residues. Where tree fodders were available, their contribution to diets tended to be greater for buffaloes than for cattle and oxen. Tree fodders made a particularly important contribution to goat diets, at generally over 30% and up to over 80% in Gajuri Chhap and Gauthale. Crop residues were least important in goat diets. Many of these observations are as expected in the light of previous research and experience in the area (see for example van der Grinten 1997), and are supported by farmer observations.

The seasonal patterns of fodder allocation appeared fairly consistent across sites and livestock types. Crop residues were larger proportions of diets in the dry seasons, though used throughout the year to some extent. Crop residues were most important and least seasonal (ie used equally across all seasons) in diets in Ange where they contributed generally more than 50% of diets of cattle, buffaloes and oxen. Crop thinnings were significant components of diets only in July. They were least significant in Chankhubesi and Tawari, perhaps because of the greater availability of cut grass in these sites. Cut grass contributed most to diets in the rainy season period July to November, at 40-80% in September. However, while availability of cut grass was largely restricted to this period in Gajuri Chhap and Gauthale, it was included in diets throughout the year in Chankhubesi, Tawari and Ange. Tree fodders made their largest contributions to bovine diets in the dry seasons, though they were used in all survey seasons except September to November. Some tree and shrub fodder was allocated to goats in every season. Tree fodders were relatively small proportions of

diets of bovines in Chankhubesi and Ange. Concentrates were included in the diets of all classes of livestock throughout the year. Concentrate proportions of diets were highest in Chankhubesi, where milk production for sale was an important objective, and least Gajuri Chhap and Gauthale.

As noted above, several differences in diet compositions between sites were evident. Overall diet qualities appeared to be highest in Chankhubesi, with high proportions and extended availability of cut grass, and lowest in Ange, with high proportions of crop residues. Diets for cattle and oxen in Gajuri Chhap and Gauthale depend heavily on grazing and may also be relatively high quality, depending on the quality of grazing.

Overall, several important effects of sites, seasons and livestock production objectives are evident in the preliminary summaries of diet compositions and quality. In addition, household differences are also apparent. The data available thus provide a useful range of circumstances for further analysis to identify the major factors contributing to diet differences, and priority requirements for additional fodders. The fact that some expected trends and differences are evident in preliminary summaries gives some confidence that despite the simple survey method employed, the data may be sufficiently detailed to allow such analyses.

4.3.3 Nutrient composition of diets

The most important features of nutritive values of fodders and diets include dry matter (DM) content, DM digestibility and crude protein (CP) contents. Tannin content may be an important feature of tree fodders. High tannin contents may inhibit protein digestion so that CP may not be a valid measure of digestible protein availability. No direct observations or sampling of fodders has been undertaken in the studies reported in the current project. Information on nutritive values is available from the literature for many fodders, though values vary considerably between seasons and to some extent between sites, making average book values less useful in some cases. Data on tannins is not available for many tree fodders.

No detailed analysis of the nutrient composition of diets has yet been undertaken. Such analysis could be useful to identify nutrient deficits in diets and thereby priorities for supplementation. A potential problem with making such estimates is that the specific compositions of the broad categories of fodder types (crop residues, cut grass, tree fodders, etc) vary between seasons, locations and livestock types. The range of average nutritive values of the fodder type categories may thus be quite wide (as found by Thorne, see Kiff, Thorne, Pandit, Thomas and Amatya 1999). Also, not all the specific fodders collected have fodder value information available from the literature. Most importantly, tannin contents of many indigenous tree fodders are not known.

In these circumstances it may be sufficient to rank the quality of diets on the basis of the proportions of green fodders (grazing, cut grass and tree fodders), or crop residues, in order to identify supplementary fodder requirements. However, once the data on the specific composition of fodder types have been summarised it should be possible to estimate nutritive values of the main components so that a crude

comparison of average diets from households, livestock types, seasons and sites may be made.

4.3.4 Factors affecting fodder allocations

The above preliminary analyses have identified several factors that may have important influences on fodder allocations and diet compositions. The effects of these factors will be investigated in further analyses. The main factors to be investigated will include:

Season
Location/village
Livestock type
Overall livestock holdings and composition of holdings
Livestock production objectives, and
Grazing

The purpose of these analyses will be to identify the circumstances under which fodder allocations and diet compositions are poorest and most in need of supplementation. Other analyses will investigate fodder allocation and diet differences in relation to reported fodder deficits, in order to test whether reported deficits provide a sensitive and useful indication of fodder needs.

These analyses will be undertaken by multi-factorial analysis of variance methods using SPSS procedures.

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Annex 1 Survey forms for bi-monthly collection of household information on fodder collection and use, livestock holdings and livestock production

Village name:_____ **Date:**_____

Household Name:_____ **Researcher's name:** _____

Names of members of household involved in discussions: _____
_____
_____

1. Allocation of feeds to different classes of livestock

Feed type	**Allocation of feeds to different livestock (1)** **% of total daily collected feeds given (and enter main components of each fodder type)**				**Total daily collection/use of feed**	
	Cows	Buffaloes	Oxen	Goats	(%)	Bahri
Crop residue (cereal straws and dry residues)						
Crop thinnings and leaves (green fodders)						
Cut grass						
Fresh						
Dry						
Tree fodder						
Concentrates (kg/day)(2)						
Grazing (hours/day)						
On-farm Forest						
Off-farm Forest						
Aftermath						

1. Enter % of total daily feeds of each type allocated to the total holdings of different types of livestock
2. Enter total concentrates fed to total holding of each type of livestock per day, and name of concentrate type

2. Record the average daily collection of fodder from different sources for the household livestock. (Include fodder from storage e.g. straws)

Types of Fodder	**Source**	**Daily total fed (Bhari)**	**Estimated deficit (Bhari)**
Crop residue (dry residues)			
Crop thinnings and leaves (green fodders)			
Tree and shrub fodder	Forest		
	Private land		
Cut grasses	Forest		
	Private land		
Total			

How much fodder/grasses (in Bhari) is being saved daily by grazing livestock in this season?.....Bhari.
(ie how much less fodder required because of grazing)

3. Proportional Contribution of specific fodders in different types of fodder collected for livestock (In Percentage).

Fodder Types and specific fodders	**Contribution to amount fed daily to all animals (%)**	**Estimated deficit from full requirement (as % of what is already fed)**
Crop residues (straws and dry residues)		
Crop thinnings and leaves (green fodders)		
Grasses		
Fresh:		
Dry:		
Tree and Shrubs		
Kutmiro		
Gayo		
Tanki		
Khanyu		
Dabdabe		
Gideri		
Bakhri		
Pati		
Badahar		
Lapsi		
Others		

4. **Production Objectives**

At this season do you:

	Yes	No	Market type/ location Specify whether in village, market (distance), milk co-op etc.	Quantity	Price	Total production
Sell milk						
Sell ghee						
Sell animals						

5. Production objectives and effects on feed allocations in each season

Class of livestock	**Production objective priorities at this season**		**Effects on feeds allocated (note special feeds used)**
		Tick if relevant and rank	(enter only if production objective ticked for this season)
Cattle (cows)	Milk production		
	Ghee production		
	Calf survival		
	Cow condition/survival		
	Manure production		
Buffalo (cows)	Milk production		
	Ghee production		
	Calf survival		
	Cow condition/survival		
	Manure production		
Oxen	Condition/power		
	Manure production		

6. Feed allocations to different classes of livestock (typical daily allocations at season of visit)

	Cattle		Buffaloes		Draft Oxen	Goats
	Cows	Immatures	Cows	Immatures		
Fodder types						
Crop residues and by-products						
Rice straw						
Maize stover						
Maize thinnings						
Maize leaves and tops						
Maize cob sheaths						
Wheat straw						
Millet straw						
Other cereal straw						
Legume straw						
Vegetable by-product						
Farm-grown fodders						
Cut grass fodder						
Farmland fresh						
Farmland dry						
Forest fresh						
Forest dry						
Grazing						
Forest						
Grasslands						
Crop aftermaths						
Trees on farms						
Badahar						
Khanyu						
Koiralo						
Kutmiro						
Pati						
Tanki						
Trees in forests						
Chieuri						
Kangiyo						
Khanyu						
Khimbu						
Muhni						
Saj						
Sal						

Annex 2 Sample data from summarisation of household surveys on fodder collections, deficits and utilisation

Table 2.1 Fodder collection and deficit data

			Season 1 March 98								
			Fodder collected (bhari)					Fodder deficit (bhari)			
ID No	Village	H'hold	Crop residues	Crop thinnings	Cut grass	Tree fodder	Grazing	Crop residues	Crop thinnings	Cut grass	Tree fodder
GC1	1	1	0	0	0.25	0.75	0.25	0	0	0.75	3
GC2	1	2	0.5	0	1	2	0	0.5	0	2	1
GC3	1	3	1	0	0.75	1	0.5	1	0	1.5	2
GC4	1	4	0.25	0	0	1.5	1	0.75	0	0	0.5
GC5	1	5	0.5	0	0	4	1	1	0	0	4
GC6	1	6	0.5	0	0	3	3	1.5	0	0	5
GC7	1	7	0.5	0	1	2	2	0.5	0	1	2
GC8	1	8	0.5	0	0	2	2	1.5	0	0	2
GC9	1	9	1	0	1	6	4	1	0	3	7
GC10	1	10	0.5	0	0	1	0.5	1.5	0	0	3
GA1	2	1	2	0	0	5	0	2	0	0	10
GA2	2	2	0.33	0	0.125	1	0	0.75	0	1.875	2
GA3	2	3	0.5	0	0	2	1	0.5	0	0	4
GA4	2	4	0.5	0	0	2	1	1.5	0	0	2.5
GA5	2	5	1	0	0.5	3.5	0	1	0	1.5	4
GA6	2	6	1	0	0	3	2	4	0	0	3
GA7	2	7	0.5	0	0.25	1	0	0	0	0.75	1.5
GA8	2	8	0.5	0	0	2	0.75	1.5	0	0	4
GA9	2	9	0.5	0	0	1	1	0.5	0	0	3
GA10	2	10	1	0	0.25	3	3	2	0	1	5
CH1	3	1	0.5	0	0	0.33	0	0	0	0	0
CH2	3	2	0.5	0	0	0.16	0	0.5	0	0	0.84
CH3	3	3	1	0	1	1	1	2	0	2	2
CH4	3	4	1	0	0.5	1	0	0	0	0	0
CH5	3	5	1	0	1	1	0	1	0	0	1.5
CH6	3	6	0.5	0	1.5	0.25	0	0	0	0	0
CH7	3	7	1	0	2	1.5	0	0	0	0	0.5
CH8	3	8	2	0	0.5	0.5	0	0	0	0	0
CH9	3	9	1.5	0	1	1	1	3	0	0	0
CH10	3	10	1.5	0	1	1	0.5	0	0	2	3
TA1	4	1	1	0	0	1	0	0	0	0	0
TA2	4	2	1	0	0	1	0	0	0	0	0
TA3	4	3	2	0	1	1	0	0	0	1	1
TA4	4	4	1	0	0.25	1	1	1	0	0.75	1
TA5	4	5	1	0	1	1	0	2	0	2	2
TA6	4	6	1	0	1	1	0	0	0	1	1
TA7	4	7	2	0	0	3	2	2	0	0	2
TA8	4	8	1	0	1	2	1	0.5	0	0	1
TA9	4	9	2	0	0.5	4	1	2	0	1	4
TA10	4	10	1	0	1	1	1	1	0	1	1
AN1	5	1	0.5	0	1	1	0	0.5	0	3	1
AN2	5	2	0.16	0	0.4	1	0	0	0	0	0
AN3	5	3	0.5	0	1	0.5	0	0.5	0	1	1.5
AN4	5	4	0.5	0	0.5	0.5	0	0.5	0	0.5	0.5
AN5	5	5	0.33	0	1	1	0	0	0	0	1
AN6	5	6	1	0	1	1	0	1	0	1	1
AN7	5	7	1	0	1	1	0	0	0	0	0
AN8	5	8	0.5	0	0.5	1	0	0	0	0	0
AN9	5	9	1	0	2	1	1.5	0	0	3	1
AN10	5	10	0.66	0	0.5	1	0.5	0	0	3	0.5

Table 2.2 Fodder allocation data (1)

Village/ H'hold	Season 1 March 98 Cattle (% of each feed collected alocated to cattle) CR	CT	CG	TF	Gr	Conc	Season 1 March 98 Cattle (bhari of fodder allocated to cattle) CR	CT	CG	TF	Gr	Conc (kg)	Totfod
GC1	0	0	66	66	85	0	0	0	0.165	0.495	0.21	0	0.87
GC2	0	0	0	0	0	0	0	0	0	0	0.00	0	0.00
GC3	50	0	25	45	37	40	0.5	0	0.1875	0.45	0.19	7.2	1.32
GC4	20	0	0	25	45	0	0.05	0	0	0.375	0.45	0	0.88
GC5	30	0	0	20	14	0	0.15	0	0	0.8	0.14	0	1.09
GC6	30	0	0	20	37	0	0.15	0	0	0.6	1.10	0	1.85
GC7	33	0	25	20	45	0	0.165	0	0.25	0.4	0.91	0	1.72
GC8	20	0	0	20	45	10	0.1	0	0	0.4	0.91	1.2	1.41
GC9	30	0	10	20	25	0	0.3	0	0.1	1.2	0.98	0	2.58
GC10	20	0	0	15	42	0	0.1	0	0	0.15	0.21	0	0.46
GA1	0	0	0	0	0	0	0	0	0	0	0.00	0	0.00
GA2	0	0	0	0	0	0	0	0	0	0	0.00	0	0.00
GA3	0	0	0	0	0	0	0	0	0	0	0.00	0	0.00
GA4	20	0	0	20	0	20	0.1	0	0	0.4	0.00	0.8	0.50
GA5	30	0	20	20	0	0	0.3	0	0.1	0.7	0.00	0	1.10
GA6	20	0	0	20	16	20	0.2	0	0	0.6	0.33	2	1.13
GA7	0	0	0	0	0	0	0	0	0	0	0.00	0	0.00
GA8	15	0	0	12	100	0	0.075	0	0	0.24	0.75	0	1.07
GA9	15	0	0	12	36	5	0.075	0	0	0.12	0.36	0.1	0.55
GA10	20	0	0	30	34	0	0.2	0	0	0.9	1.01	0	2.11
CH1	0	0	0	0	0	0	0	0	0	0	0.00	0	0.00
CH2	40	0	0	33	0	33	0.2	0	0	0.0528	0.00	3.96	0.25
CH3	60	0	50	30	0	60	0.6	0	0.5	0.3	0.00	4.8	1.40
CH4	100	0	50	40	0	50	1	0	0.25	0.4	0.00	3	1.65
CH5	50	0	50	30	0	50	0.5	0	0.5	0.3	0.00	6	1.30
CH6	90	0	70	40	0	60	0.45	0	1.05	0.1	0.00	1.8	1.60
CH7	60	0	30	25	0	33	0.6	0	0.6	0.375	0.00	1.98	1.58
CH8	40	0	40	30	0	50	0.8	0	0.2	0.15	0.00	1.5	1.15
CH9	40	0	50	25	33	45	0.6	0	0.5	0.25	0.33	1.35	1.68
CH10	25	0	100	0	0	30	0.375	0	1	0	0.00	6	1.38
TA1	0	0	0	0	0	0	0	0	0	0	0.00	0	0.00
TA2	0	0	0	0	0	0	0	0	0	0	0.00	0	0.00
TA3	0	0	0	0	0	0	0	0	0	0	0.00	0	0.00
TA4	70	0	50	70	87	70	0.7	0	0.125	0.7	0.87	2.8	2.39
TA5	0	0	0	0	0	0	0	0	0	0	0.00	0	0.00
TA6	40	0	30	40	0	50	0.4	0	0.3	0.4	0.00	4	1.10
TA7	30	0	0	20	0	40	0.6	0	0	0.6	0.00	8	1.20
TA8	0	0	0	0	0	0	0	0	0	0	0.00	0	0.00
TA9	33	0	45	35	22	30	0.66	0	0.225	1.4	0.22	0.9	2.51
TA10	45	0	35	35	51	35	0.45	0	0.35	0.35	0.51	1.4	1.66
AN1	40	0	40	30	0	33	0.2	0	0.4	0.3	0.00	3.96	0.90
AN2	0	0	0	0	0	0	0	0	0	0	0.00	0	0.00
AN3	40	0	30	35	0	25	0.2	0	0.3	0.175	0.00	3.5	0.68
AN4	100	0	60	60	0	75	0.5	0	0.3	0.3	0.00	3	1.10
AN5	25	0	30	30	0	40	0.083	0	0.3	0.3	0.00	2	0.68
AN6	25	0	25	30	0	25	0.25	0	0.25	0.3	0.00	2	0.80
AN7	45	0	45	45	0	50	0.45	0	0.45	0.45	0.00	1.25	1.35
AN8	0	0	0	0	0	0	0	0	0	0	0.00	0	0.00
AN9	25	0	25	25	37	40	0.25	0	0.5	0.25	0.56	7.2	1.56
AN10	15	0	0	10	0	0	0.099	0	0	0.1	0.00	0	0.20

1. See below Table 2.3 for definitions

Table 2.3 Feed allocation and diet composition (1)

		Season 1 March 98 Cattle (% of fodder in diet)						Season 1 March 98 Cattle (kg of fodder dry matter allocated /hd of adult equivalents)						
Village	H'hold	CR	CT	CG	TF	Gr	Totfod	CR	CT	CG	TF	Gr	Conc	Totfeed
GC	1	0	0	19	57	24	100	0.00	0.00	0.65	1.97	0.67	0.00	3.29
GC	2	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GC	3	38	0	14	34	14	100	8.40	0.00	1.48	3.58	1.17	7.20	14.63
GC	4	6	0	0	43	52	100	0.84	0.00	0.00	2.99	2.86	0.00	6.69
GC	5	14	0	0	73	13	100	2.52	0.00	0.00	6.37	0.88	0.00	9.77
GC	6	8	0	0	32	59	100	0.69	0.00	0.00	1.31	1.89	0.00	3.88
GC	7	10	0	15	23	53	100	1.39	0.00	0.98	1.59	2.86	0.00	6.83
GC	8	7	0	0	28	65	100	0.28	0.00	0.00	0.53	0.95	0.20	1.77
GC	9	12	0	4	46	38	100	1.68	0.00	0.26	3.19	2.07	0.00	7.19
GC	10	22	0	0	32	46	100	0.63	0.00	0.00	0.45	0.50	0.00	1.58
GA	1	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GA	2	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GA	3	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GA	4	20	0	0	80	0	100	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GA	5	27	0	9	64	0	100	3.04	0.00	0.47	3.36	0.00	0.00	6.87
GA	6	18	0	0	53	29	100	3.36	0.00	0.00	4.78	2.05	2.00	10.19
GA	7	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GA	8	7	0	0	23	70	100	1.26	0.00	0.00	1.91	4.73	0.00	7.90
GA	9	14	0	0	22	65	100	0.63	0.00	0.00	0.48	1.13	0.05	2.23
GA	10	9	0	0	43	48	100	0.67	0.00	0.00	1.43	1.27	0.00	3.37
CH	1	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CH	2	79	0	0	21	0	100	2.55	0.00	0.00	0.32	0.00	3.00	2.86
CH	3	43	0	36	21	0	100	10.08	0.00	3.94	2.39	0.00	4.80	16.41
CH	4	61	0	15	24	0	100	25.45	0.00	2.98	4.83	0.00	4.55	33.26
CH	5	38	0	38	23	0	100	4.20	0.00	1.97	1.19	0.00	3.00	7.36
CH	6	28	0	66	6	0	100	3.78	0.00	4.13	0.40	0.00	0.90	8.31
CH	7	38	0	38	24	0	100	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CH	8	70	0	17	13	0	100	13.44	0.00	1.58	1.19	0.00	1.50	16.21
CH	9	36	0	30	15	20	100	7.64	0.00	2.98	1.51	1.58	1.02	13.70
CH	10	27	0	73	0	0	100	6.30	0.00	7.88	0.00	0.00	6.00	14.18
TA	1	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TA	2	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TA	3	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TA	4	29	0	5	29	36	100	5.88	0.00	0.49	2.79	2.74	1.40	11.90
TA	5	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TA	6	36	0	27	36	0	100	6.72	0.00	2.36	3.19	0.00	4.00	12.27
TA	7	50	0	0	50	0	100	10.08	0.00	0.00	4.78	0.00	8.00	14.86
TA	8	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TA	9	26	0	9	56	9	100	6.68	0.00	1.07	6.72	0.84	0.54	15.30
TA	10	27	0	21	21	31	100	7.56	0.00	2.76	2.79	3.20	1.40	16.31
AN	1	22	0	44	33	0	100	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AN	2	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AN	3	30	0	44	26	0	100	3.36	0.00	2.36	1.39	0.00	3.50	7.12
AN	4	45	0	27	27	0	100	5.06	0.00	1.42	1.44	0.00	1.81	7.92
AN	5	12	0	44	44	0	100	1.39	0.00	2.36	2.39	0.00	2.00	6.14
AN	6	31	0	31	38	0	100	4.20	0.00	1.97	2.39	0.00	2.00	8.56
AN	7	33	0	33	33	0	100	7.56	0.00	3.54	3.58	0.00	1.25	14.69
AN	8	0	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AN	9	16	0	32	16	36	100	2.53	0.00	2.37	1.20	2.12	4.34	8.22
AN	10	50	0	0	50	0	100	2.52	0.00	0.00	1.21	0.00	0.00	3.73

1. See below Table 2.3 for definitions

Notes to Tables 2.1, 2.2 and 2.3

Village names:

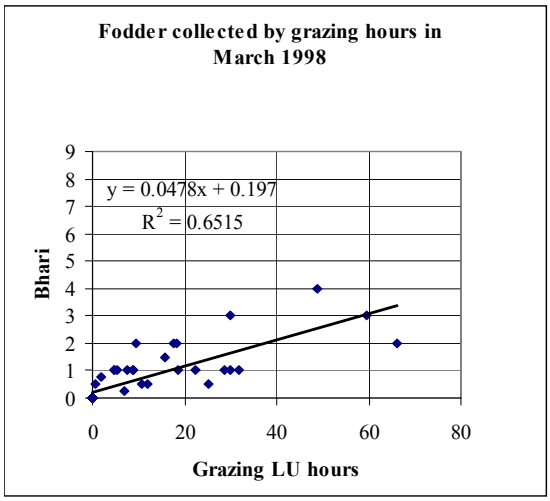
GC	Gajuri Chhap
GA	Gauthale
CH	Chunkhubesi
TA	Tawari
AN	Ange

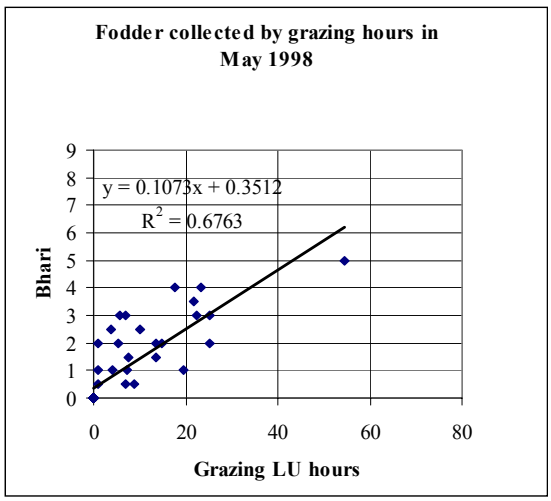
Fodder types:

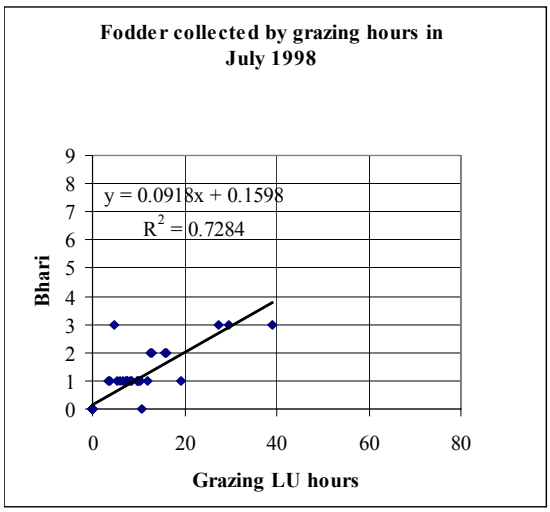
CR	Crop residues
CT	Crop thinnings
CG	Cut grass
TF	Tree fodders
Gr	Grazing
Conc	Concentrates
Totfod	Total fodders
Totfeed	Total feeds (fodders and concentrates offered to livestock)

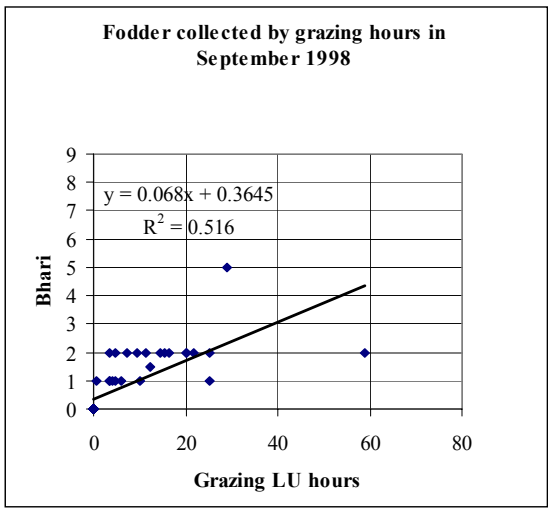
Annex 3 Relationships between reported grazed fodder amounts and daily livestock grazing durations.

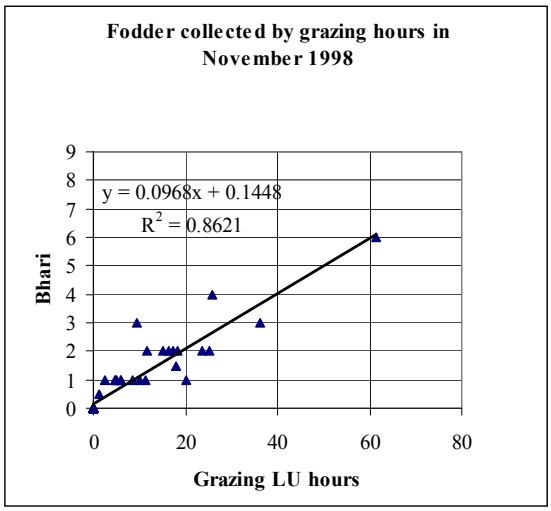
Linear regressions of relationship between amounts of fodder not collected because livestock were grazing and the numbers of Livestock-Unit-hours of grazing per day

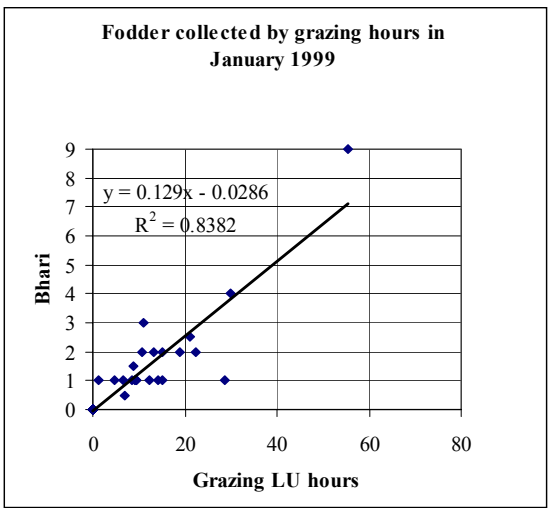


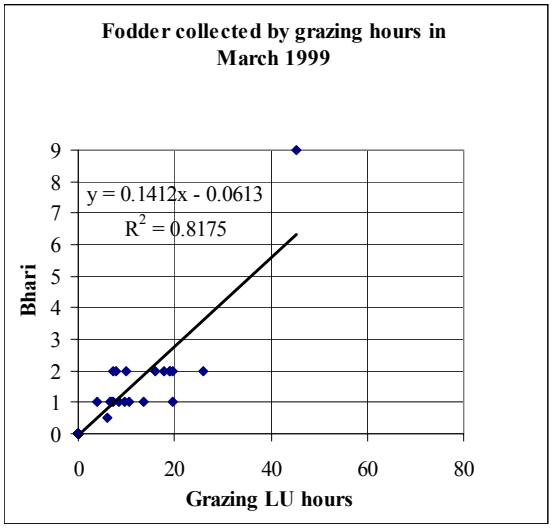


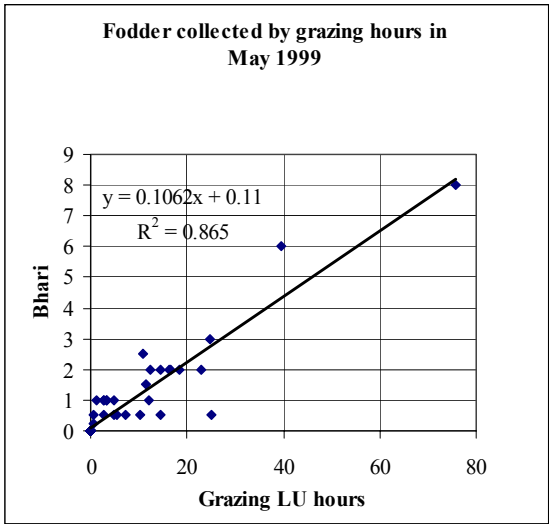






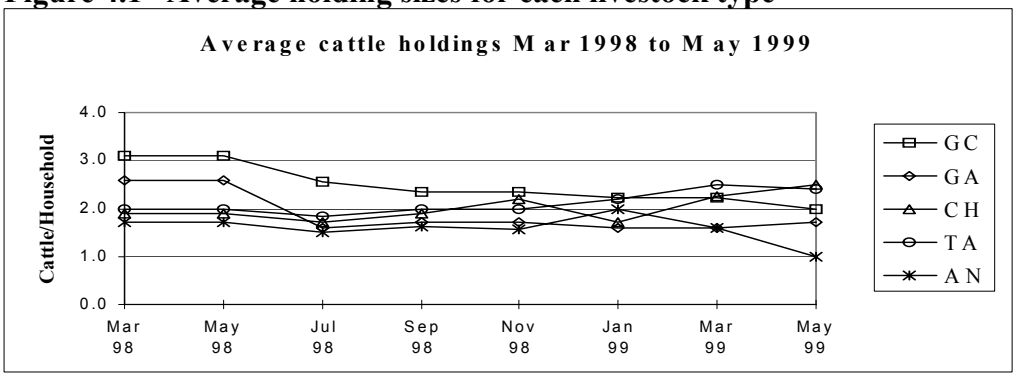


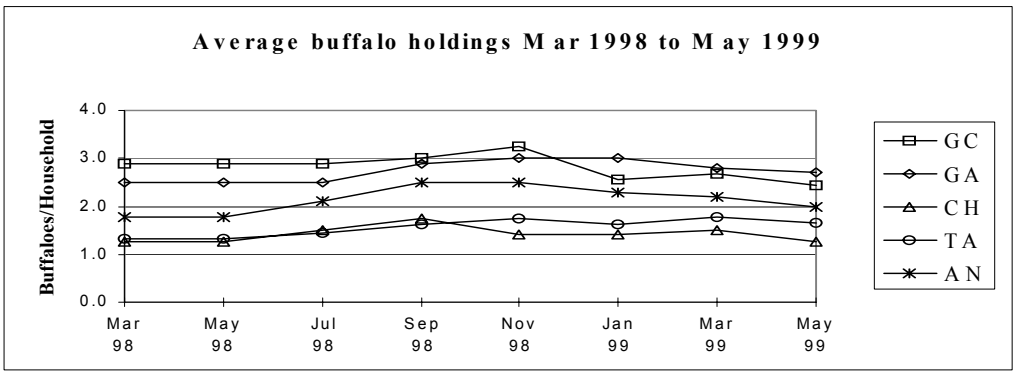

Fodder collected by grazing hours in March 1999
y = 0.1412x - 0.0613
R2 = 0.8175
Bhari
Grazing LU hours
0
1
2
3
4
5
6
7
8
9
0
20
40
60
80

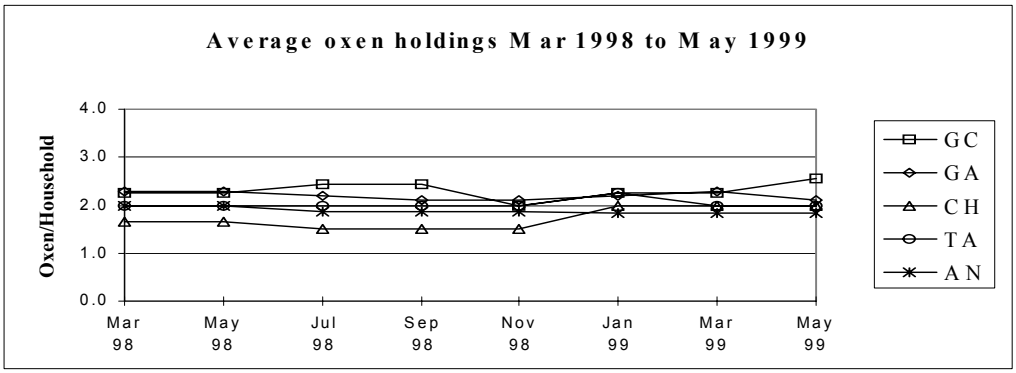

Fodder collected by grazing hours in May 1999
y = 0.1062x + 0.11
R2 = 0.865
Bhari
Grazing LU hours
0
1
2
3
4
5
6
7
8
9
0
20
40
60
80

Annex 4 Livestock holdings in survey households from March 1998 to May 1999

Figure 4.1 Average holding sizes for each livestock type







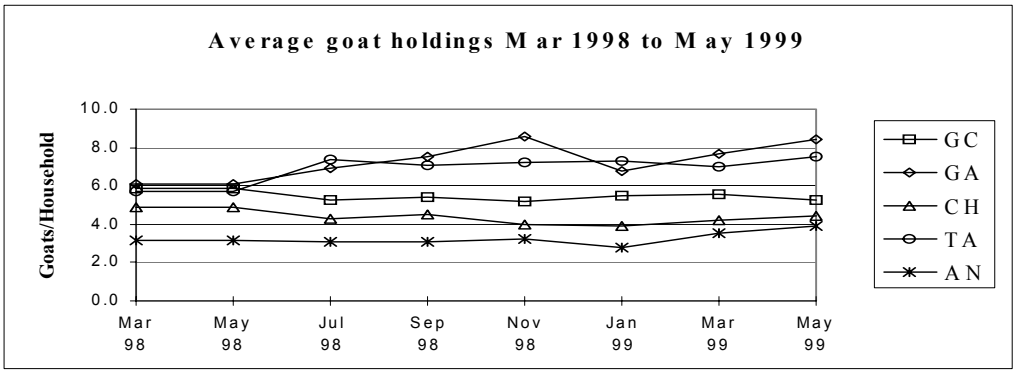
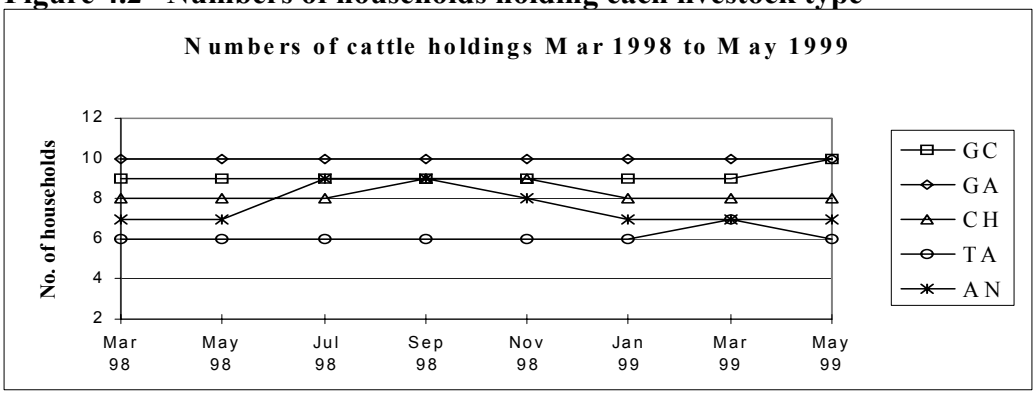
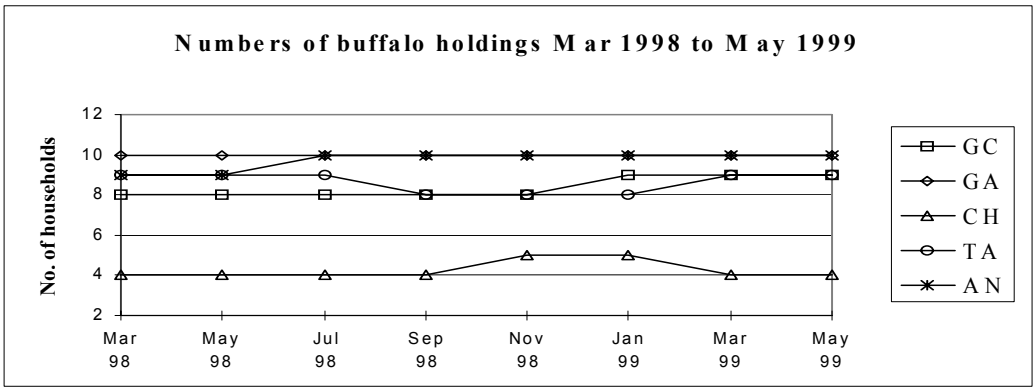
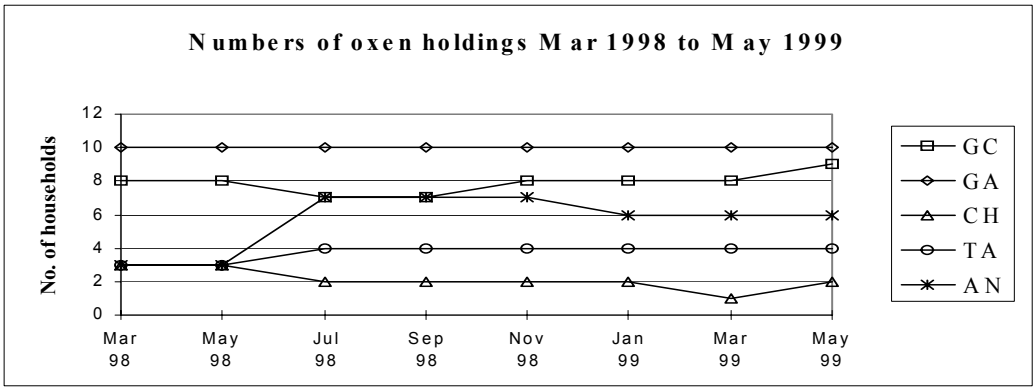
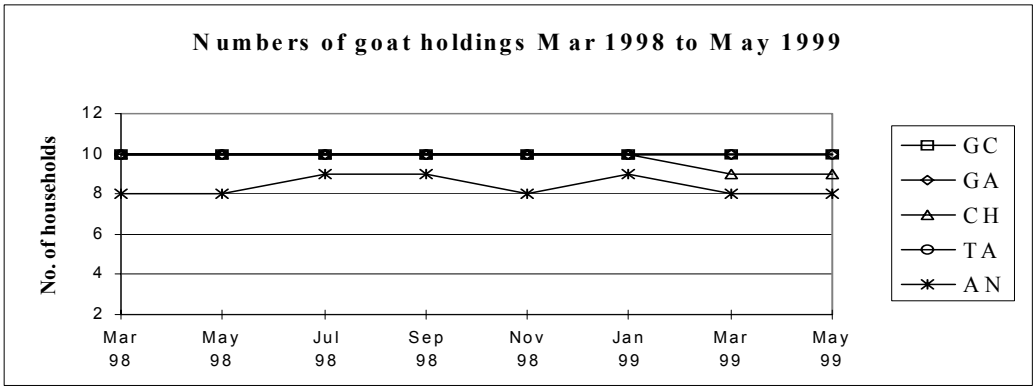


Figure 4.2 Numbers of households holding each livestock type

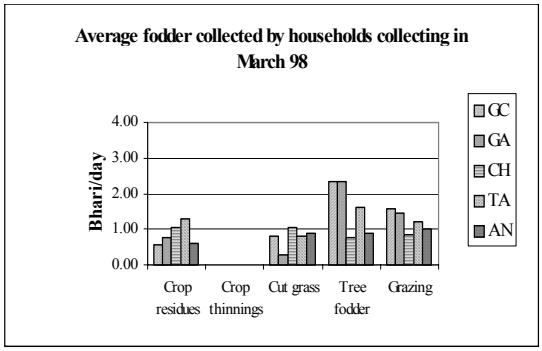


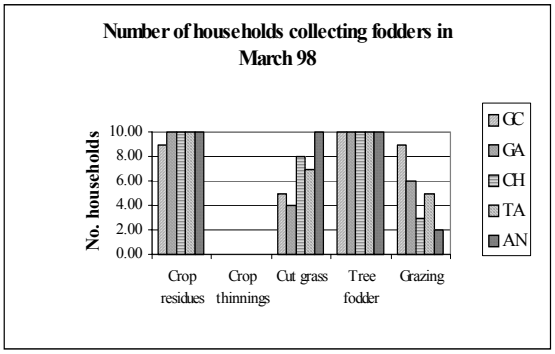


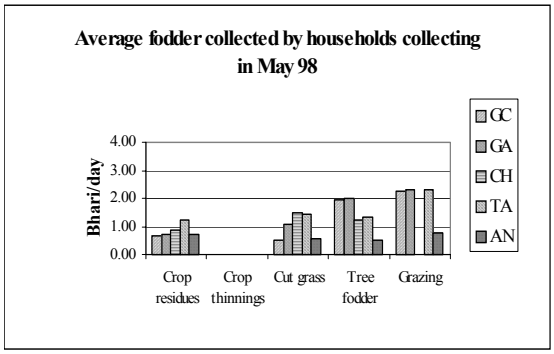


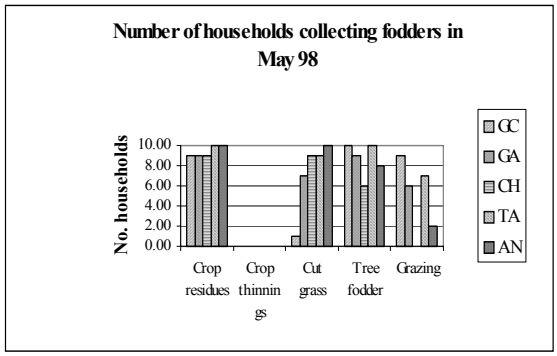


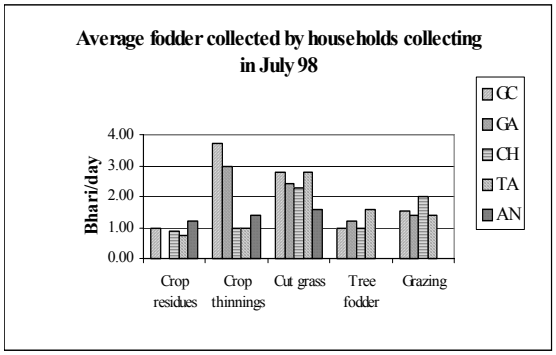
Annex 5 Average fodder collections and numbers of households reporting collecting each fodder type, March 1998 to May 1999

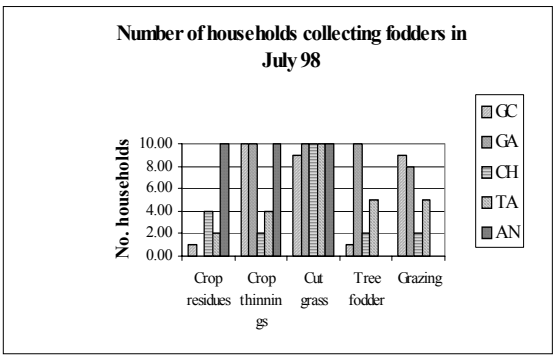


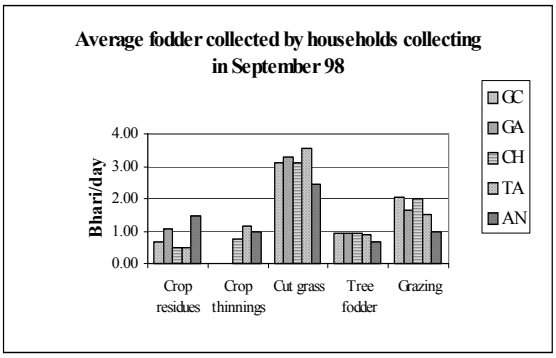


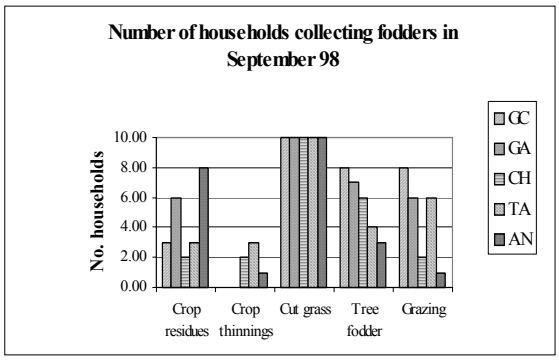


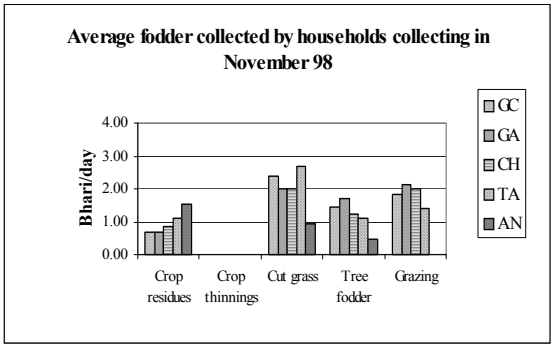


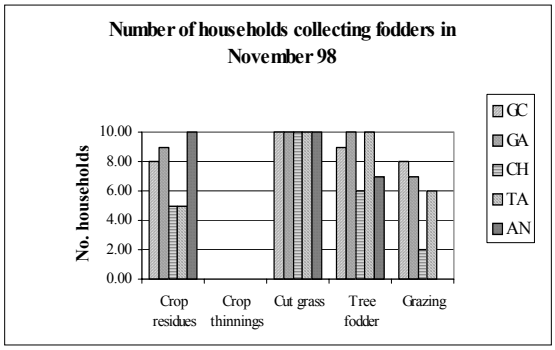


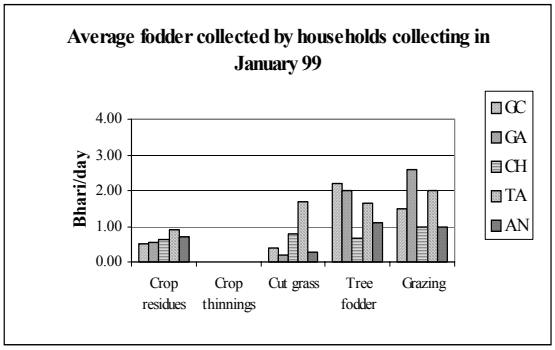


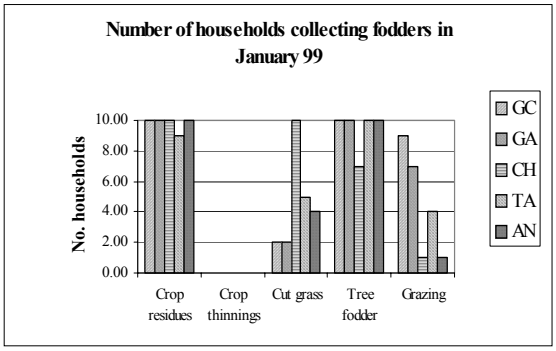


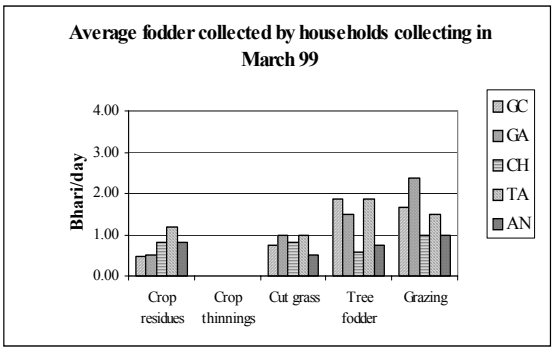


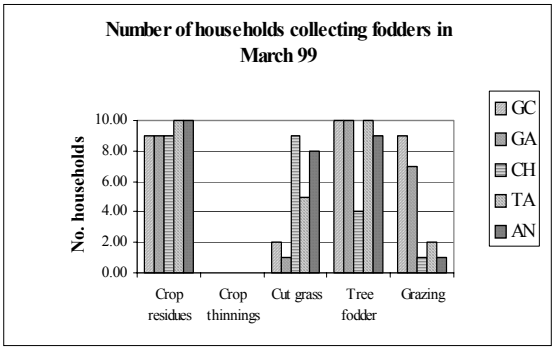

Average fodder collected by households collecting in November 98
Bhari/day
4.00
3.00
2.00
1.00
0.00
Crop residues
Crop thinnings
Cut grass
Tree fodder
Grazing
GC
GA
CH
TA
AN

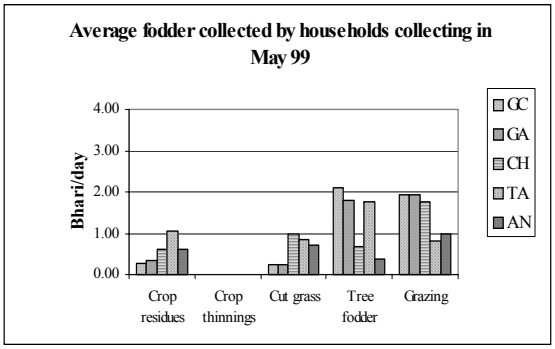

Number of households collecting fodders in November 98
No. households
10.00
8.00
6.00
4.00
2.00
0.00
Crop residues
Crop thinnings
Cut grass
Tree fodder
Grazing
GC
GA
CH
TA
AN

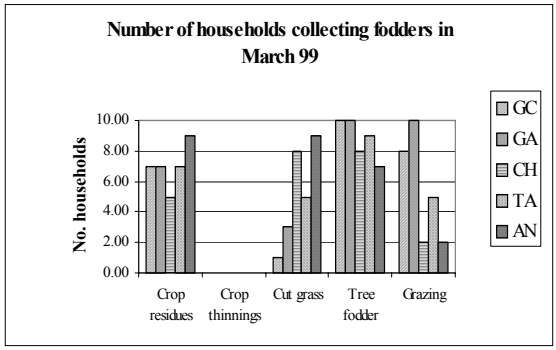

Average fodder collected by households collecting in January 99
Bhari/day
4.00
3.00
2.00
1.00
0.00
Crop residues
Crop thinnings
Cut grass
Tree fodder
Grazing
GC
GA
CH
TA
AN


Number of households collecting fodders in January 99
No. households
10.00
8.00
6.00
4.00
2.00
0.00
Crop residues
Crop thinnings
Cut grass
Tree fodder
Grazing
GC
GA
CH
TA
AN

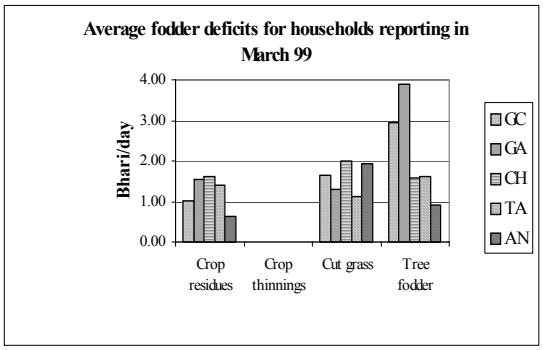

Average fodder collected by households collecting in March 99
Bhari/day
4.00
3.00
2.00
1.00
0.00
Crop residues
Crop thinnings
Cut grass
Tree fodder
Grazing
GC
GA
CH
TA
AN

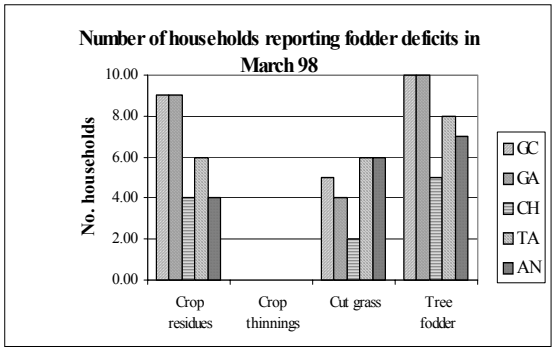

Number of households collecting fodders in March 99
No. households
10.00
8.00
6.00
4.00
2.00
0.00
Crop residues
Crop thinnings
Cut grass
Tree fodder
Grazing
GC
GA
CH
TA
AN

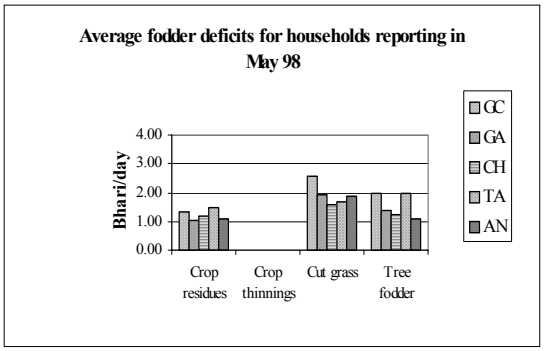

Average fodder collected by households collecting in May 99
Bhari/day
4.00
3.00
2.00
1.00
0.00
Crop residues
Crop thinnings
Cut grass
Tree fodder
Grazing
GC
GA
CH
TA
AN

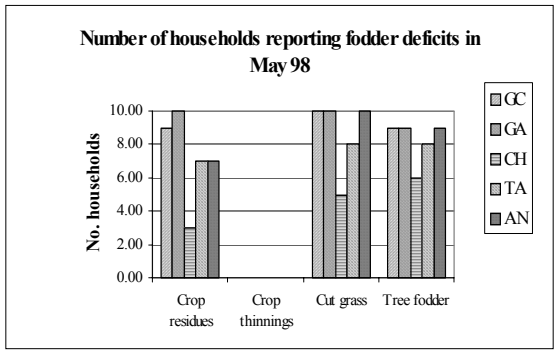

Number of households collecting fodders in March 99
No. households
10.00
8.00
6.00
4.00
2.00
0.00
Crop residues
Crop thinnings
Cut grass
Tree fodder
Grazing
GC
GA
CH
TA
AN

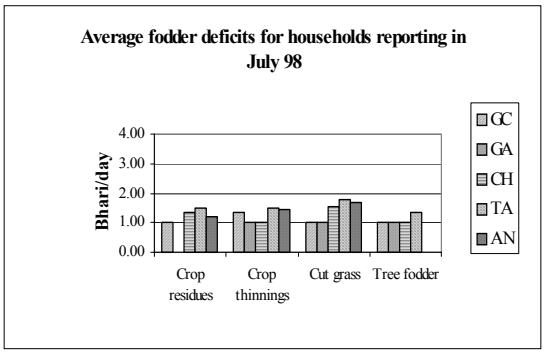
Annex 6 Average fodder deficits and numbers of households reporting deficits for each fodder type, March 1998 to May 1999

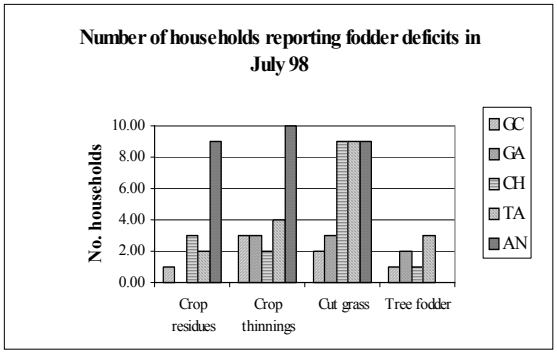


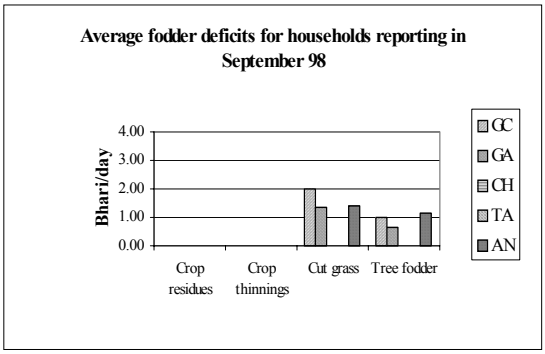


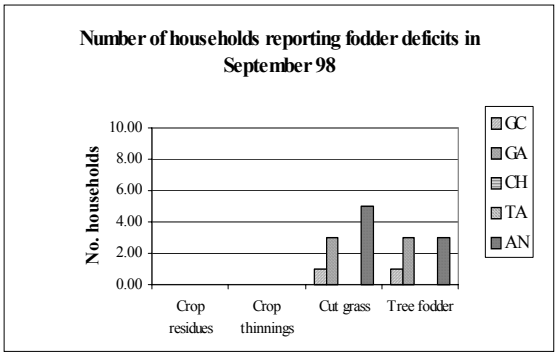


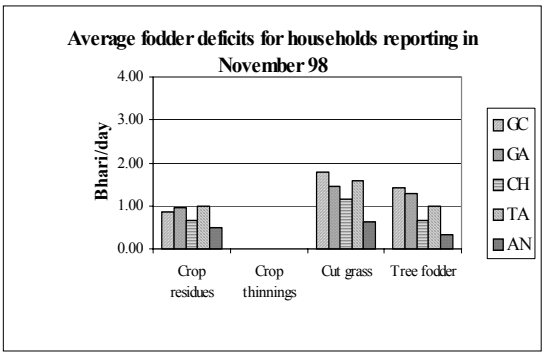


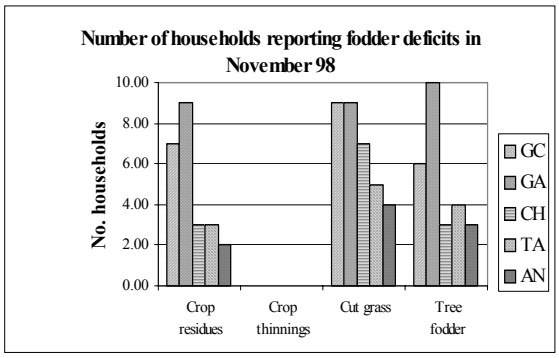


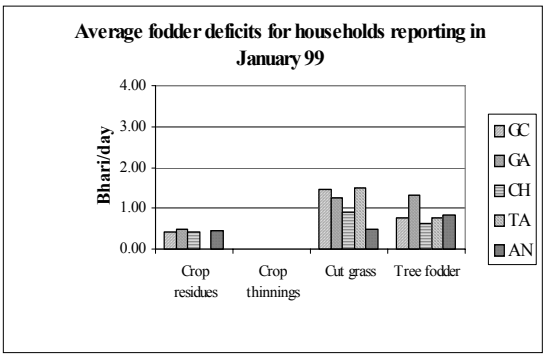


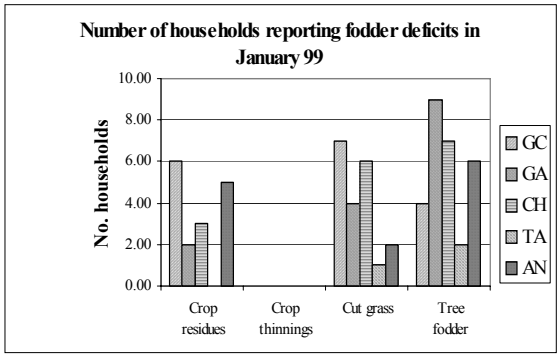


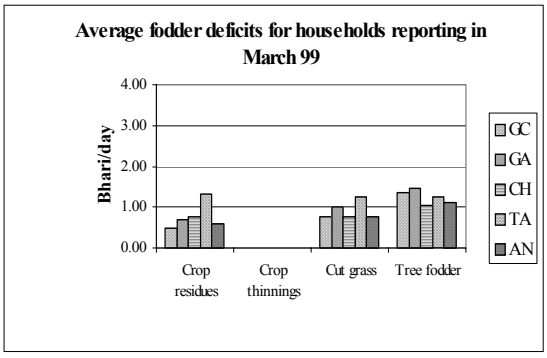


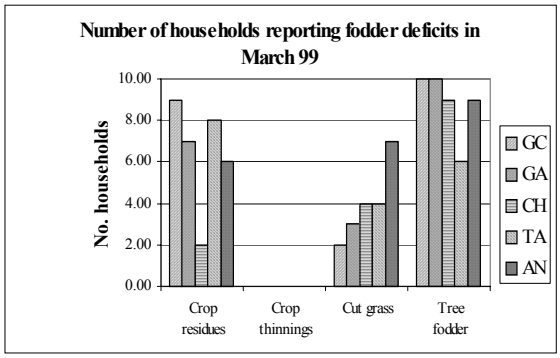

Average fodder deficits for households reporting in November 98
Bhari/day
4.00
3.00
2.00
1.00
0.00
Crop residues
Crop thinnings
Cut grass
Tree fodder
GC
GA
CH
TA
AN

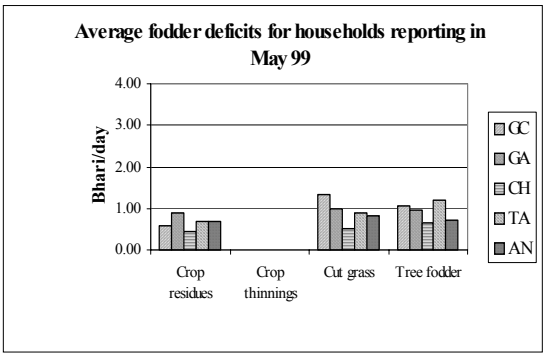

Number of households reporting fodder deficits in November 98
No. households
10.00
8.00
6.00
4.00
2.00
0.00
Crop residues
Crop thinnings
Cut grass
Tree fodder
GC
GA
CH
TA
AN

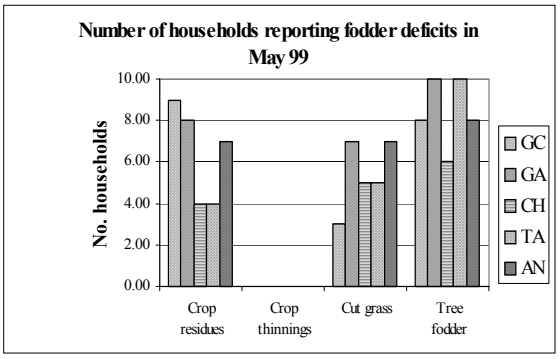

Average fodder deficits for households reporting in January 99
Bhari/day
4.00
3.00
2.00
1.00
0.00
Crop residues
Crop thinnings
Cut grass
Tree fodder
GC
GA
CH
TA
AN


Number of households reporting fodder deficits in January 99
No. households
10.00
8.00
6.00
4.00
2.00
0.00
Crop residues
Crop thinnings
Cut grass
Tree fodder
GC
GA
CH
TA
AN

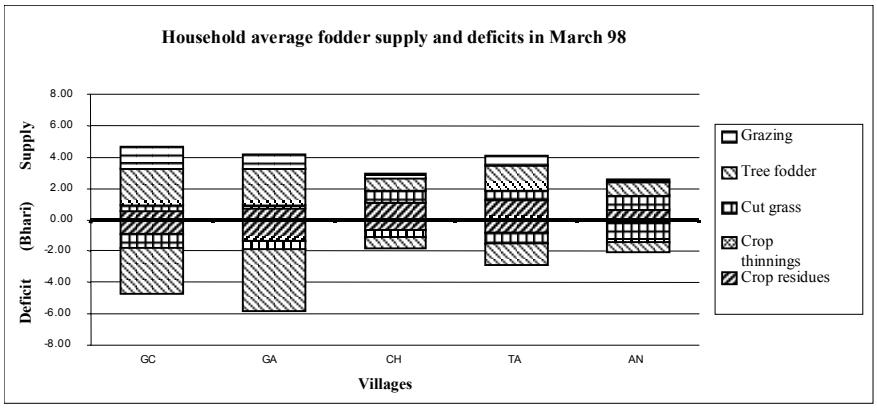

Average fodder deficits for households reporting in March 99
Bhari/day
4.00
3.00
2.00
1.00
0.00
Crop residues
Crop thinnings
Cut grass
Tree fodder
GC
GA
CH
TA
AN

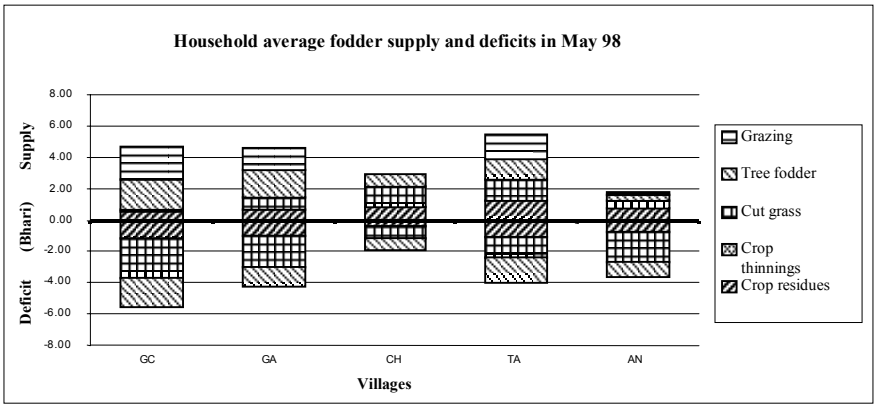

Number of households reporting fodder deficits in March 99
No. households
10.00
8.00
6.00
4.00
2.00
0.00
Crop residues
Crop thinnings
Cut grass
Tree fodder
GC
GA
CH
TA
AN

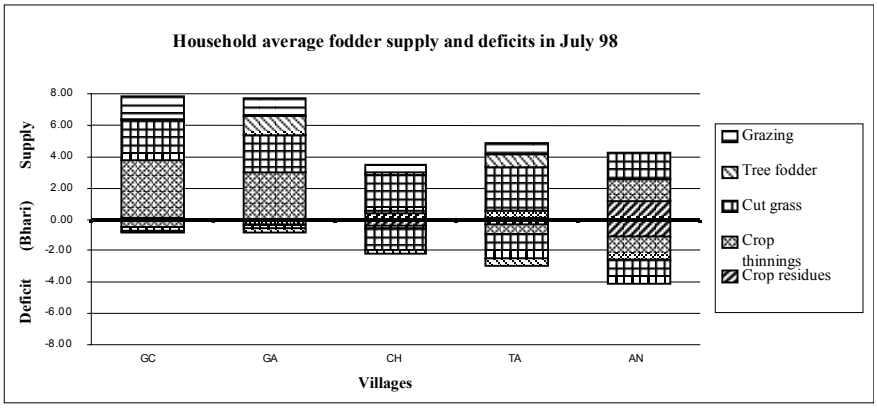

Average fodder deficits for households reporting in May 99
Bhari/day
4.00
3.00
2.00
1.00
0.00
Crop residues
Crop thinnings
Cut grass
Tree fodder
GC
GA
CH
TA
AN

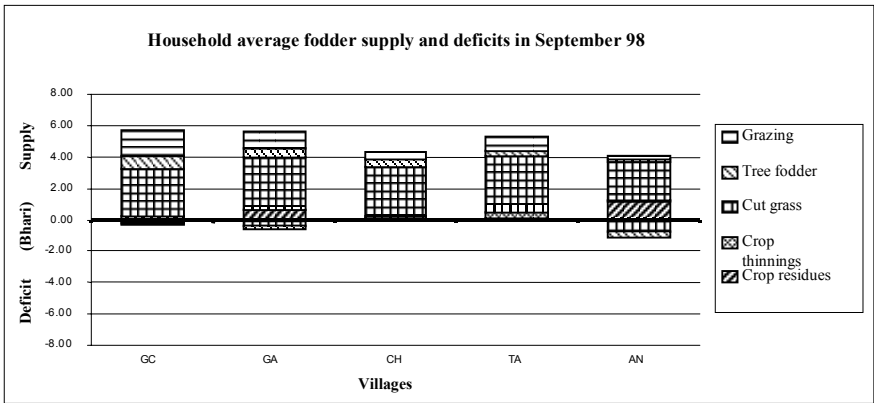

Number of households reporting fodder deficits in May 99
No. households
10.00
8.00
6.00
4.00
2.00
0.00
Crop residues
Crop thinnings
Cut grass
Tree fodder
GC
GA
CH
TA
AN

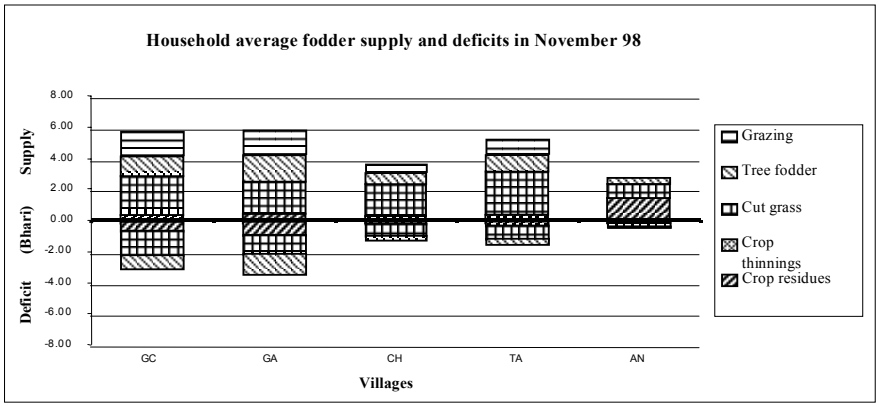
Annex 7 Average household fodder collection and deficits in survey villages March 1998 to May 1999

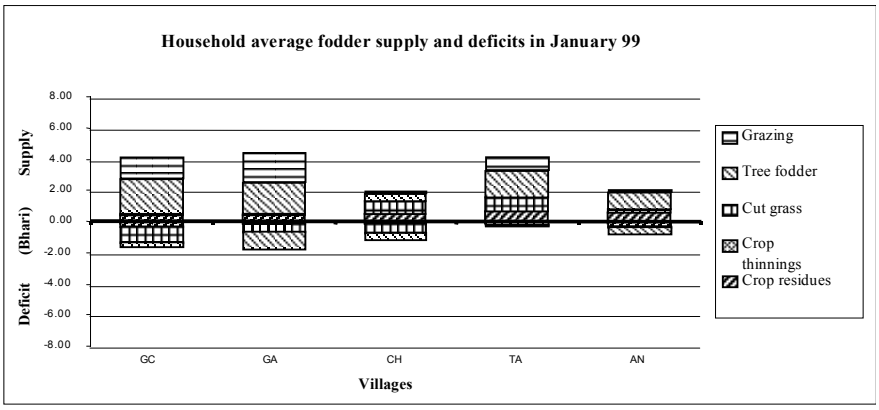


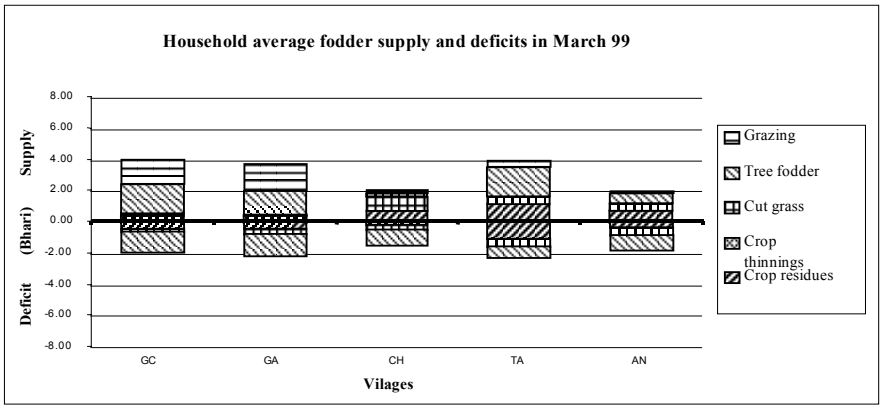


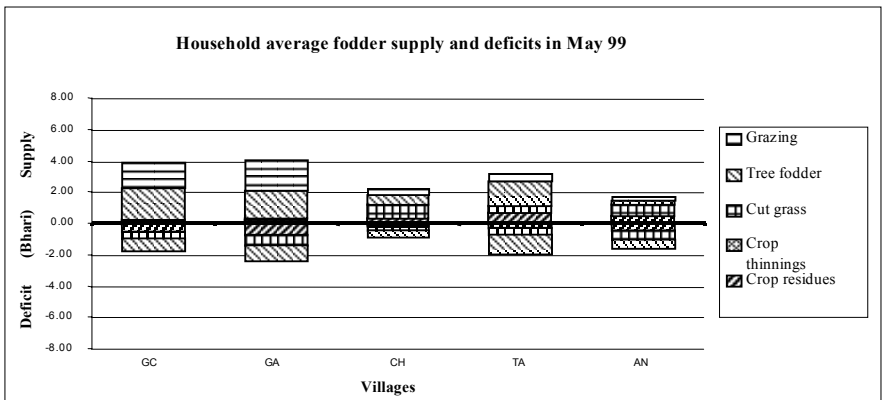





Household average fodder supply and deficits in November 98
Supply (Bhari) Deficit
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
-6.00
-8.00
GC
GA
CH
TA
AN
Villages
Grazing
Tree fodder
Cut grass
Crop thinnings
Crop residues

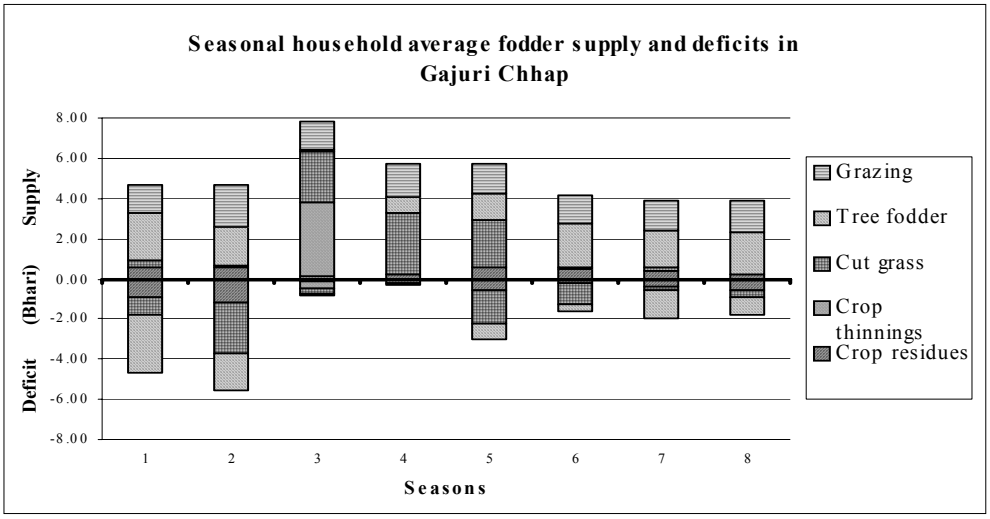

Household average fodder supply and deficits in January 99
Supply (Bhari) Deficit
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
-6.00
-8.00
GC
GA
CH
TA
AN
Villages
Grazing
Tree fodder
Cut grass
Crop thinnings
Crop residues

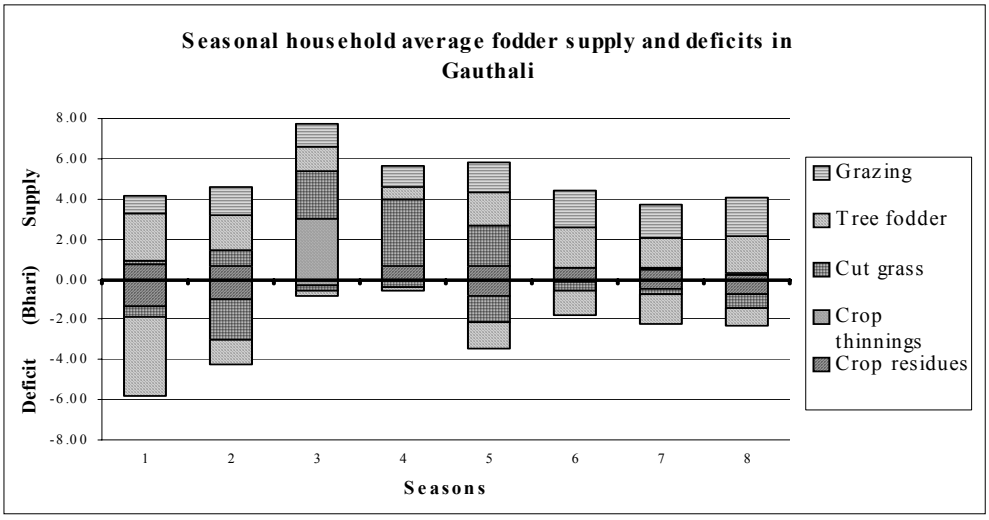

Household average fodder supply and deficits in March 99
Supply (Bhari) Deficit
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
-6.00
-8.00
GC
GA
CH
TA
AN
Vilages
Grazing
Tree fodder
Cut grass
Crop thinnings
Crop residues

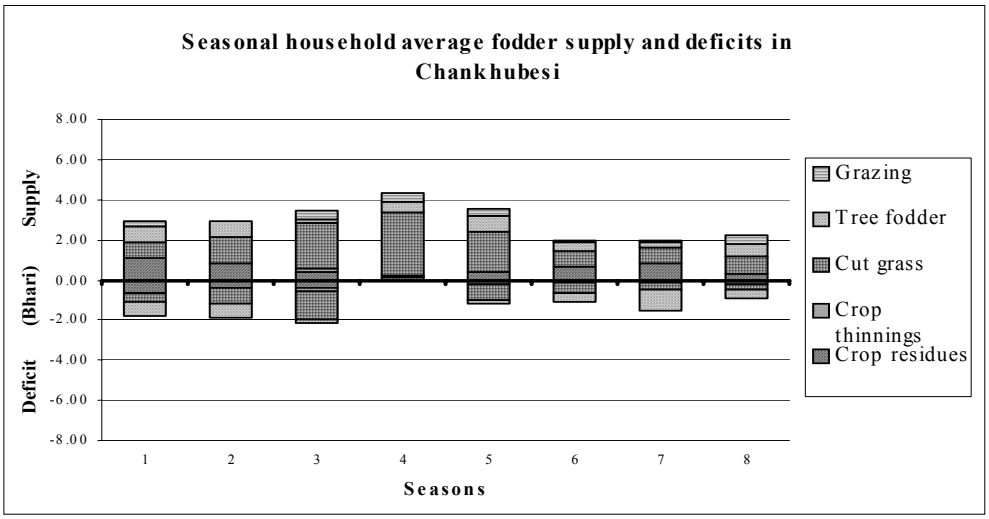

Household average fodder supply and deficits in May 99
Supply (Bhari) Deficit
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
-6.00
-8.00
GC
GA
CH
TA
AN
Villages
Grazing
Tree fodder
Cut grass
Crop thinnings
Crop residues

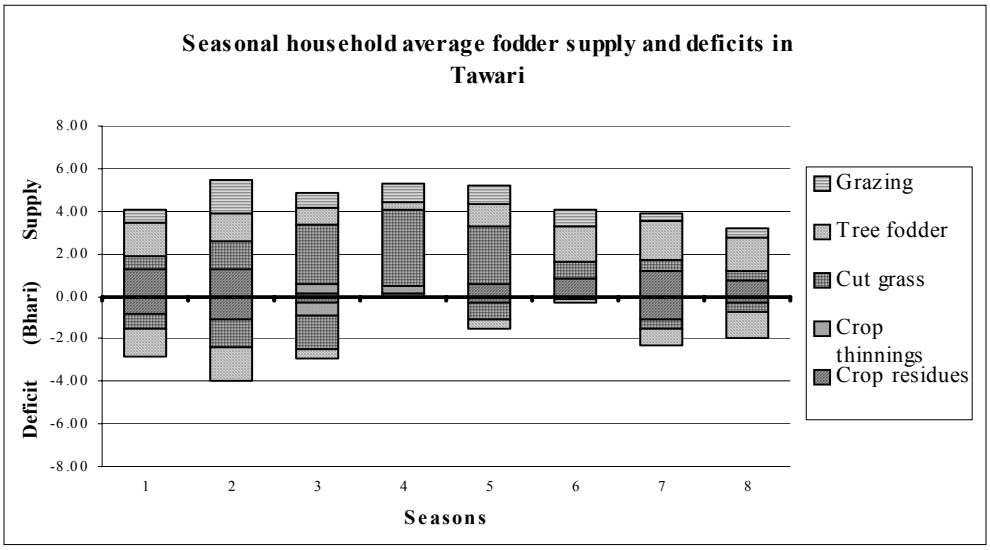
Annex 8 Seasonal average household fodder collection and deficits in survey villages March 1998 to May 1999

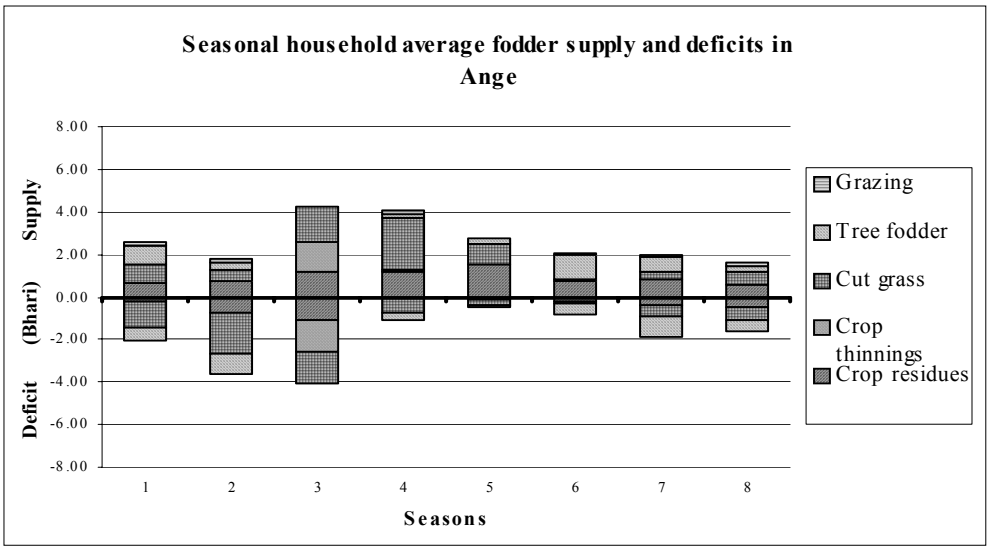
(for seasons 1 to 8, March 1998 to May 1999)



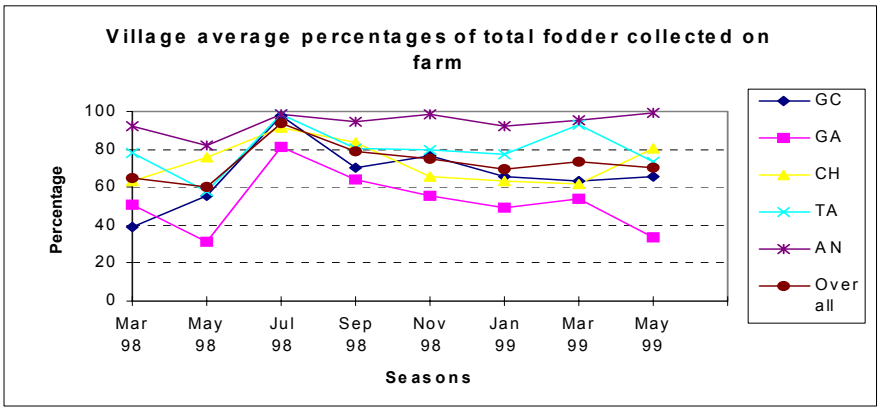


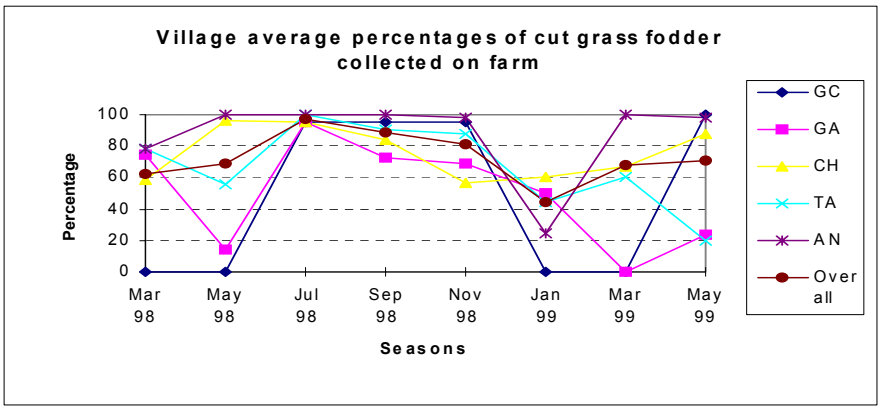


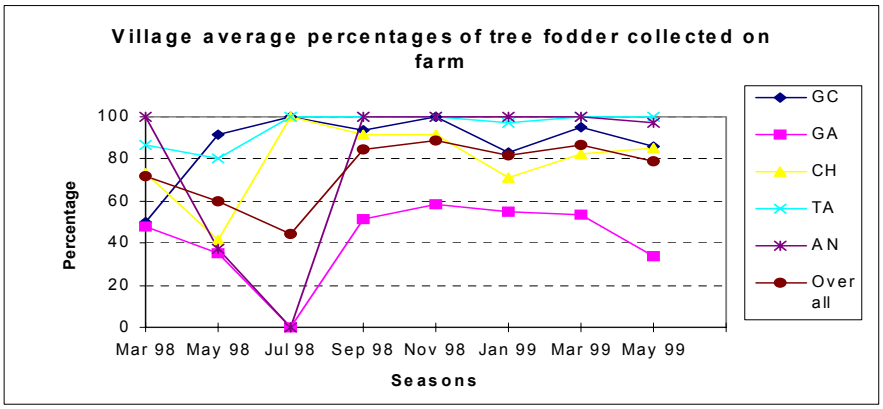

Seasonal household average fodder supply and deficits in Tawari
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
-6.00
-8.00
Deficit (Bhari) Supply
1
2
3
4
5
6
7
8
Seasons
Grazing
Tree fodder
Cut grass
Crop thinnings
Crop residues

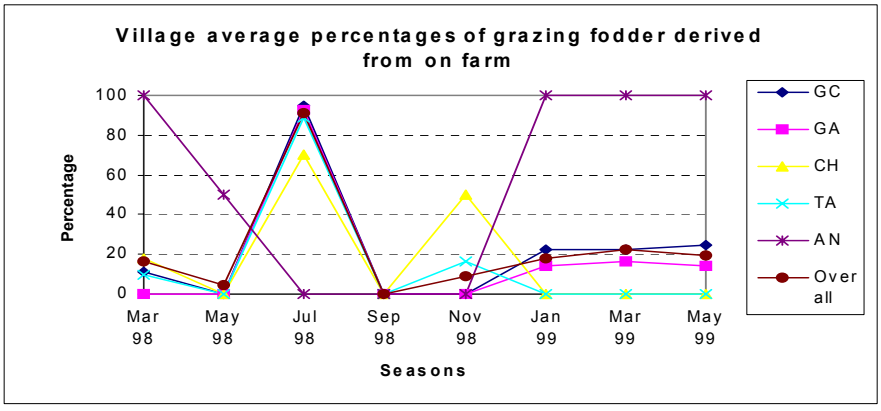

Seasonal household average fodder supply and deficits in Ange
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
-6.00
-8.00
Deficit (Bhari) Supply
1
2
3
4
5
6
7
8
Seasons
Grazing
Tree fodder
Cut grass
Crop thinnings
Crop residues

Annex 9 Village average percentages of total fodders, cut grass, tree fodders and grazing collected on-farm

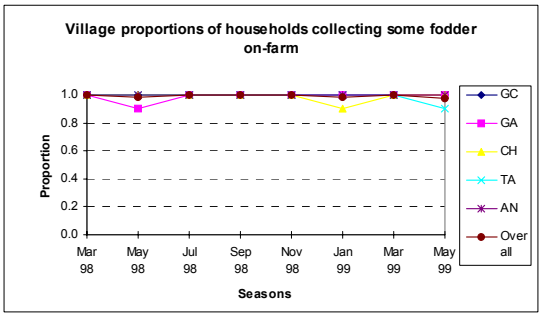


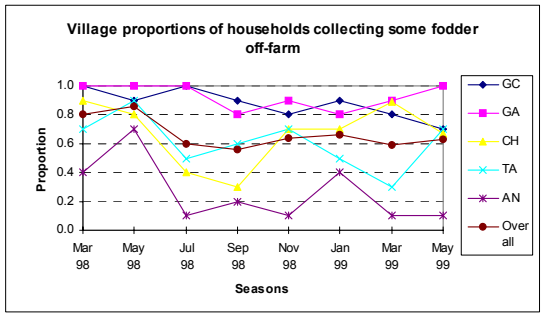


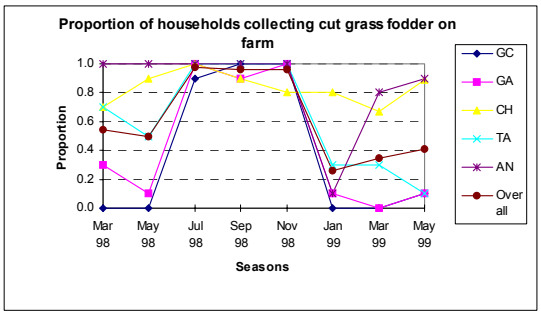


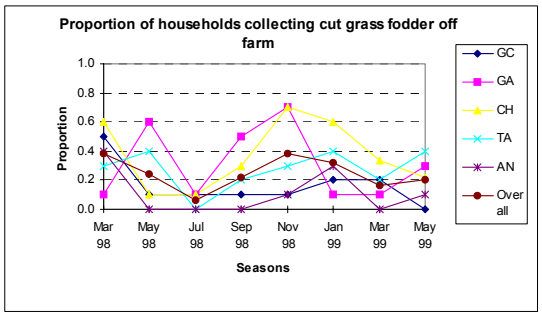


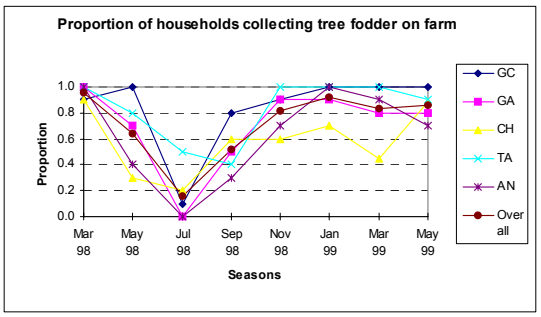
Annex 10 Proportions of households collecting different fodders on- and off-farm

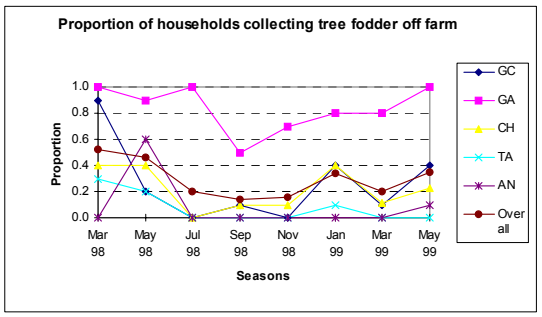


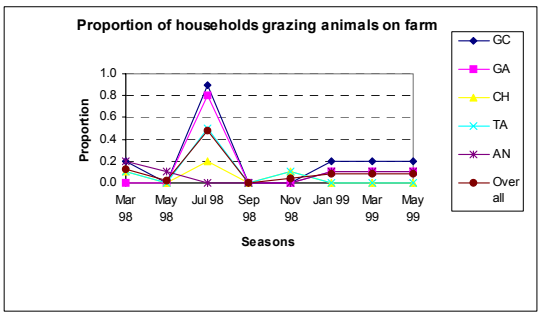


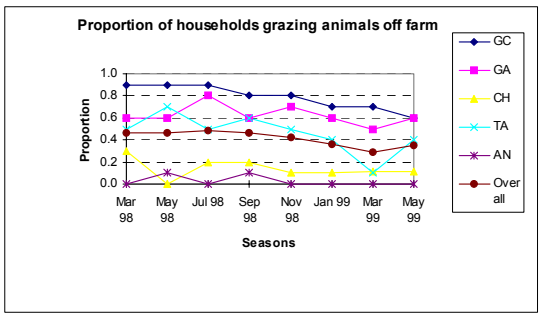




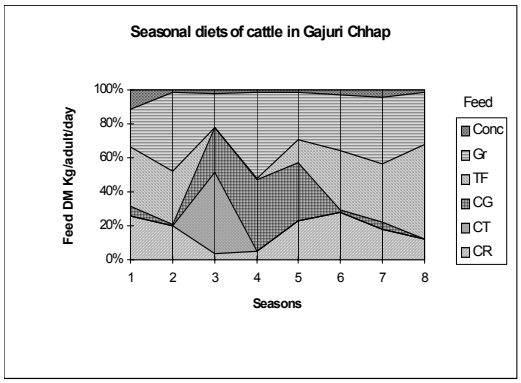


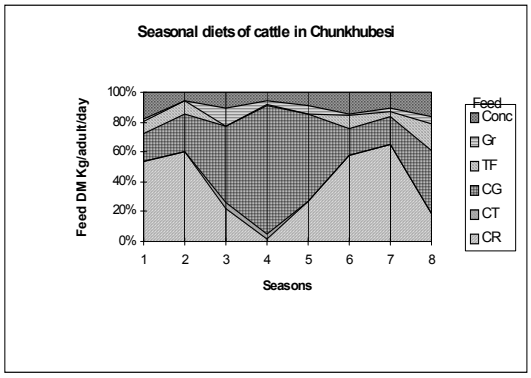


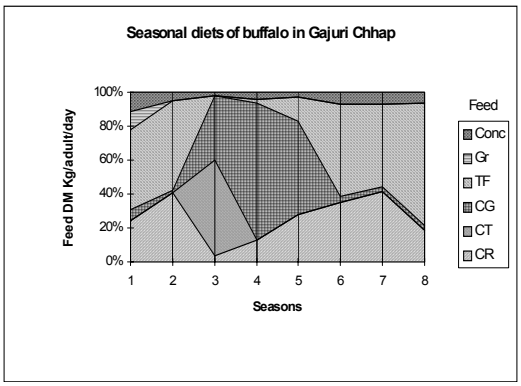


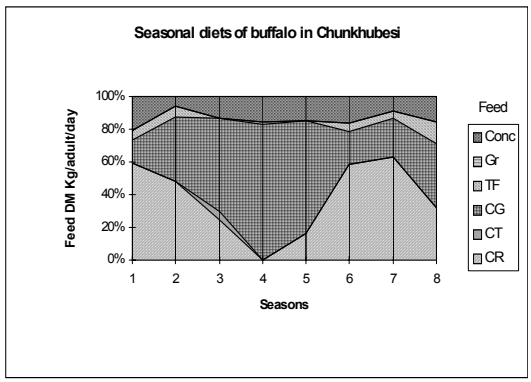


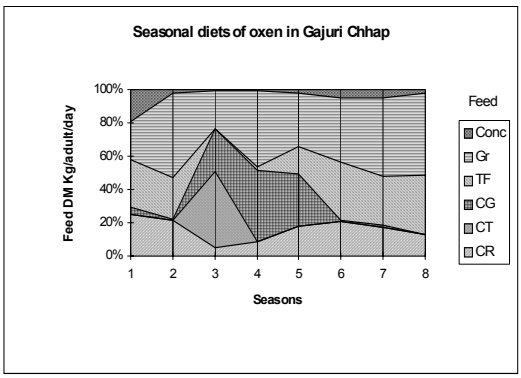
Annex 12 Seasonal compositions of diets offered to different types of livestock

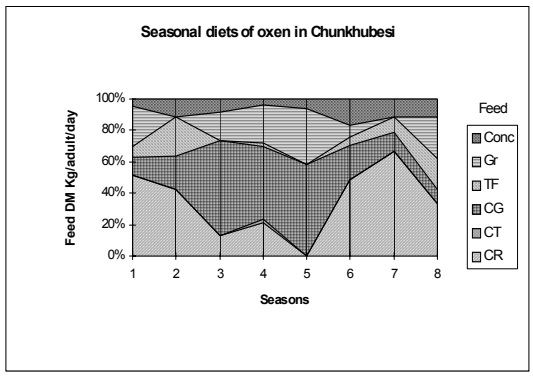


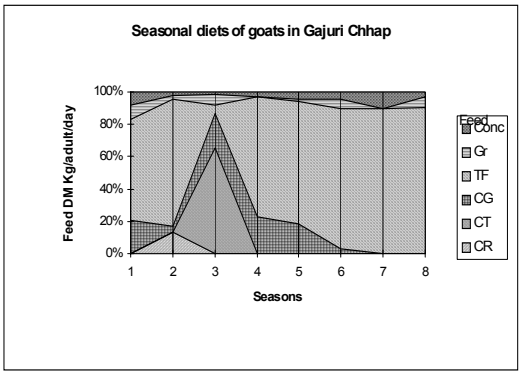


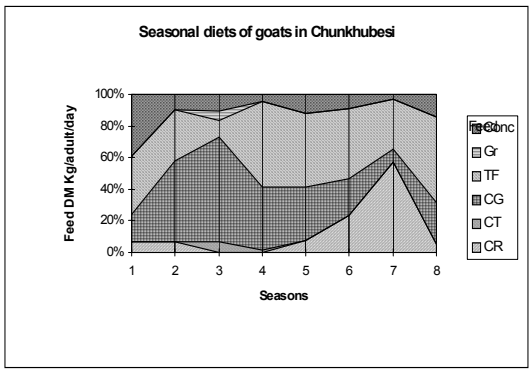


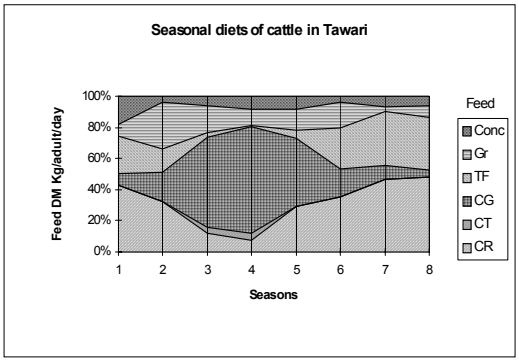


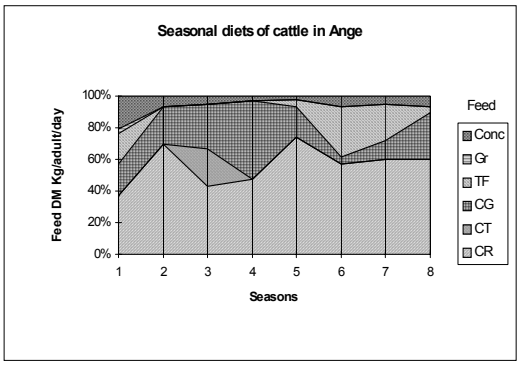


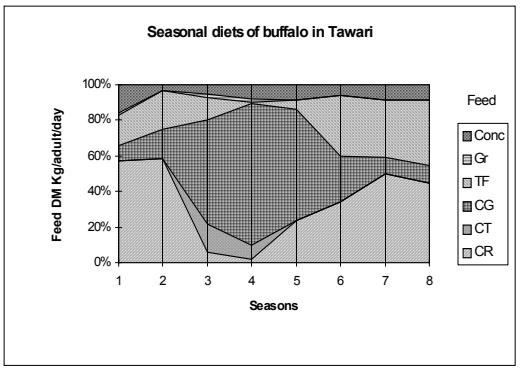


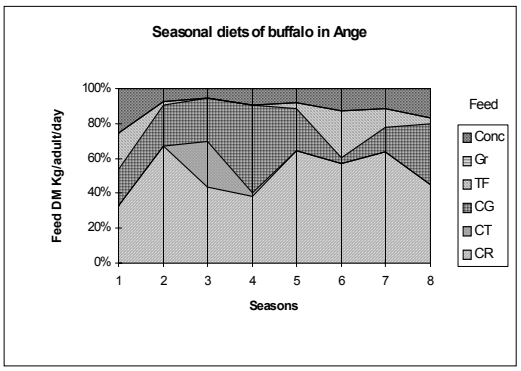


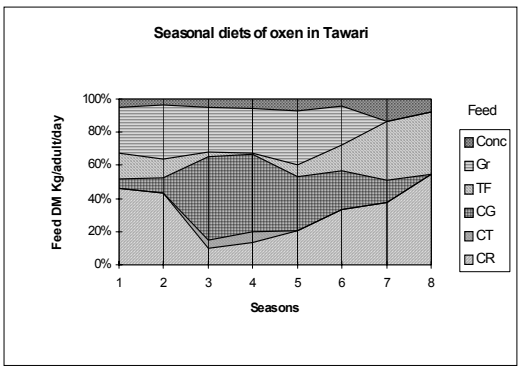


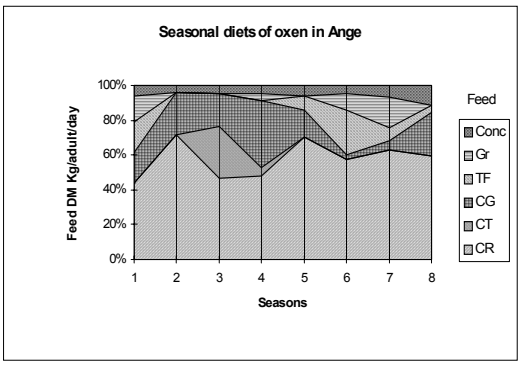

Seasonal diets of cattle in Tawari
Feed DM Kg/adult/day
100%
80%
60%
40%
20%
0%
1 2 3 4 5 6 7 8
Seasons
Feed
Conc
Gr
TF
CG
CT
CR

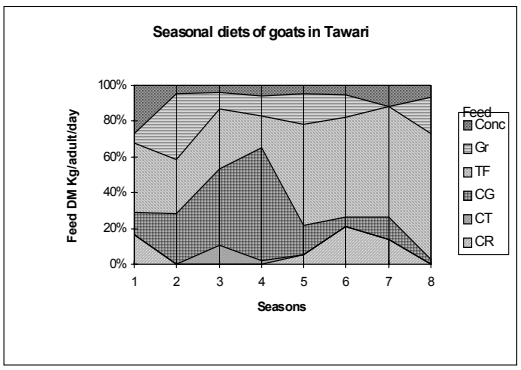

Seasonal diets of cattle in Ange
Feed DM Kg/adult/day
100%
80%
60%
40%
20%
0%
1 2 3 4 5 6 7 8
Seasons
Feed
Conc
Gr
TF
CG
CT
CR

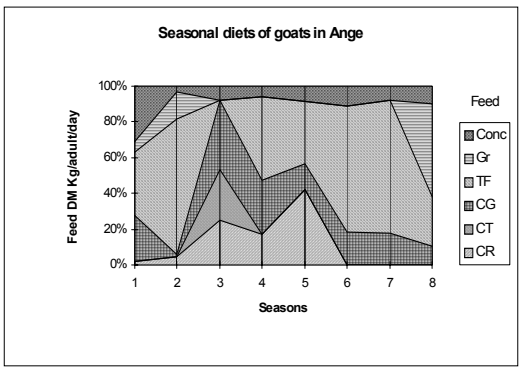

Seasonal diets of buffalo in Tawari
Feed DM Kg/adult/day
100%
80%
60%
40%
20%
0%
1 2 3 4 5 6 7 8
Seasons
Feed
Conc
Gr
TF
CG
CT
CR

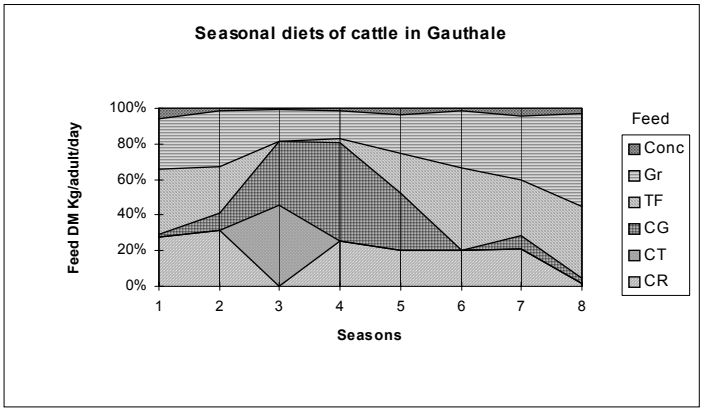

Seasonal diets of buffalo in Ange
Feed DM Kg/adult/day
100%
80%
60%
40%
20%
0%
1 2 3 4 5 6 7 8
Seasons
Feed
Conc
Gr
TF
CG
CT
CR

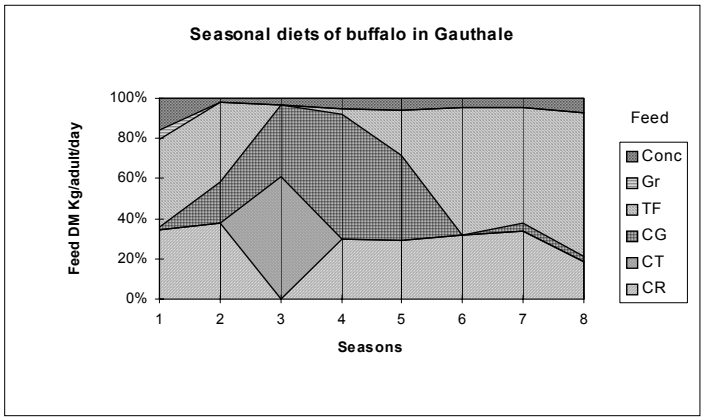

Seasonal diets of oxen in Tawari
Feed DM Kg/adult/day
100%
80%
60%
40%
20%
0%
1 2 3 4 5 6 7 8
Seasons
Feed
Conc
Gr
TF
CG
CT
CR

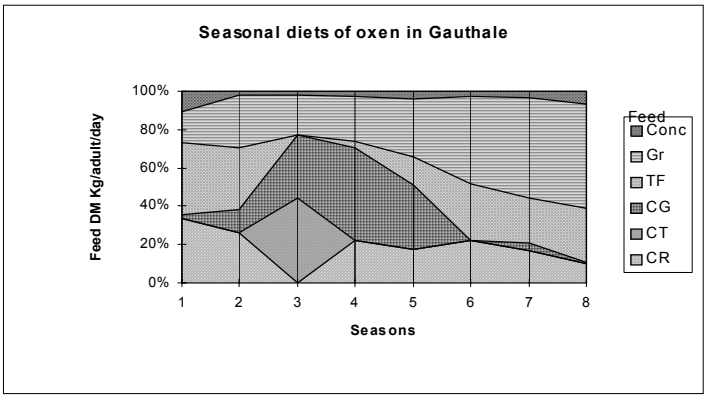

Seasonal diets of oxen in Ange
Feed DM Kg/adult/day
100%
80%
60%
40%
20%
0%
1 2 3 4 5 6 7 8
Seasons
Feed
Conc
Gr
TF
CG
CT
CR

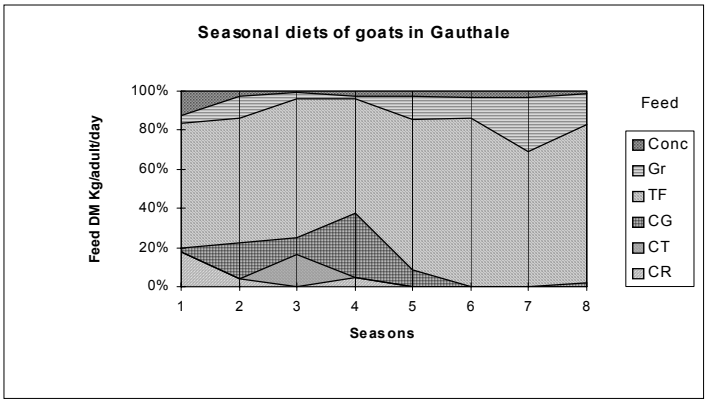

Seasonal diets of goats in Tawari
Feed DM Kg/adult/day
100%
80%
60%
40%
20%
0%
1 2 3 4 5 6 7 8
Seasons
Feed
Conc
Gr
TF
CG
CT
CR


Seasonal diets of goats in Ange
Feed DM Kg/adult/day
100%
80%
60%
40%
20%
0%
1 2 3 4 5 6 7 8
Seasons
Feed
Conc
Gr
TF
CG
CT
CR


Seasonal diets of cattle in Gauthale
Feed DM Kg/adult/day
100%
80%
60%
40%
20%
0%
1
2
3
4
5
6
7
8
Seasons
Feed
Conc
Gr
TF
CG
CT
CR


Seasonal diets of buffalo in Gauthale
Feed DM Kg/adult/day
100%
80%
60%
40%
20%
0%
1
2
3
4
5
6
7
8
Seasons
Feed
Conc
Gr
TF
CG
CT
CR


Seasonal diets of oxen in Gauthale
Feed DM Kg/adult/day
100%
80%
60%
40%
20%
0%
1
2
3
4
5
6
7
8
Seasons
Feed
Conc
Gr
TF
CG
CT
CR


Seasonal diets of goats in Gauthale
Feed DM Kg/adult/day
100%
80%
60%
40%
20%
0%
1
2
3
4
5
6
7
8
Seasons
Feed
Conc
Gr
TF
CG
CT
CR