

## Methods of planning livestock feed requirements for smallholder farmers

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### 1. Introduction

Planning feed requirements of a given livestock farm is the main and essential activity for successful and profitable husbandry. The scope of the planning could stretch from a traditional system to well organized commercial farms. Planning feed requirements for commercial livestock farms are simpler and follows established principles and guidelines. On the other hand, in traditional livestock systems, such as pastoral, agropastoral and mixed crop–livestock systems, planning feed requirements is usually a challenging task. It is generally considered as routine practice and done in a traditional way, which lacks precision and effectiveness. For example, pastoralists plan to have feed and water through moving from place to place in an annual basis. Under such circumstances, the best way of planning is through experiences, which is an established good practice through trial and error.

Planning feed requirements of animals is important because, it ensures animals are fed properly, so we can reach the set production targets. It ensures minimizing feed wastage. It helps to predict feed surpluses and deficits to act accordingly in time. It helps to design strategies of acquiring required feeds including roughages in time and supplement feed requirements can be foreseen a long way in advance and therefore purchased at the lowest possible price.

Photo 1. Traditional livestock production systems in Ethiopia.



Animals require feed for different functions. They require feed for body maintenance (a condition in which the body is maintained without an increase or decrease in body weight, and with no production or work being done). Animals also require feed to produce (for growth, fattening, milk and egg production) and others such as wool production and traction. They require feed for reproduction (gamete production, foetus development). Feed requirements could be expressed in many ways depending on the prevailing production system including in terms of total dry matter, or in terms of roughages, concentrate supplements, total mixed rations (TMR), all details of nutrients (protein, energy, vitamins, minerals and water). Or in terms of digestible nutrients, gross and net energies. The objective of this short brief is to give highlights on the benefits of feed planning in each farm, village or district level. It will also give the principles and the information required and the procedures to follow in planning feed requirements for a given period.

## 2. Information required for planning livestock feed requirements

**The animals and their management**—In planning feed requirement, the first thing to know is the details of animals in the farm. Which type and number of animals are in the farm (cattle, goats, sheep or others)? What is the main purpose of the animals (milk, meat, power)? What is the level of productivity? How many are there in the different categories (milking cows, growing animals, heifers, steers, bulls, calves )? Good if one has individual live weights periodically. The management of the animals has the main determinant factor for proper planning of feed requirements of the animals. These include: One can broadly categorize the management of animals as pastoral, agropastoral and sedentary (mixed crop–livestock systems in Ethiopia) production systems. Extensive, semi-intensive and intensive systems, traditional and

commercial production systems. In dairy it could also be categorized as rural, peri-urban and urban systems. These classifications are normally based on the level of feed availability and feeding systems. It also implies the level of information/data availability.

**Quantifying and qualifying available feed resources**—In planning feed requirements for animals, one must identify the feeds which will be available in the area or to be potentially purchased. Some feed sources are normally difficult to estimate, such as feed from communal grazing land and aftermath grazing. On the other hand, feeds from natural or cultivated pasture hay and crop residues could be roughly estimated in terms of total dry matter produced. Crop residues yields are usually estimated from the grain yield using an established multiplying factor for the different crops as indicated in Table 1. Cultivated forage crops used as a cut and carry or conserved in any other form could be estimated through normal sample procedures. Availability of concentrate feeds in the form of compound feeds or agro-industrial products should be described. Any other feed sources which are quantifiable need also to be quantified. The other important parameters to be known in formulating or planning feeds for livestock are the price of every type of feed used and the major quality parameters in terms of nutrient content including protein, energy and digestibility. The price of seeds may also be seen across the different months or seasons of the year.

Table 1. Multipliers used to estimate crop residue yields from grain yields of different crops

No.	Crop type	Multiplier
1	Teff	1.5
2	Wheat	1.5
3	Barley	1.5

No.	Crop type	Multiplier
4	Oats	1.7
5	Rice	1.3
6	Maize	2
7	Sorghum	2.5
8	Millet	2.2
9	Faba bean	1.2
10	Field pea	1.2
11	Chickpea	1

### Describing the details of animals—

Feed requirements are based on the type, condition, and production level of the animals. Hence, information on the status of the animals is required. The basic information includes the weight of the animals, the production level (growth rate, milk yield/day) and physiological levels such as pregnancy need to be known. However, under smallholder farmers conditions, information like live weight of animals is usually difficult to obtain, even in most cases production levels are not well known and described. In such cases use of different methods of estimating live weight such as extrapolating weight from heart girth or converting animal types to tropical livestock units (TLUs) which is the equivalent to 250 kg using conversion factors indicated in Table 2.

Table 2. Conversion factors of different livestock groups into tropical livestock units (TLUs)

No.	Description of animals	Conversion factor to TLU	No.	Description of animals	Conversion factor to TLU
1	Calf	0.2–0.25	10	Sheep young	0.06
2	Crossbred calf	0.4	11	Goat young	0.06
3	Weaned calf	0.34	12	Sheep mature	0.1–0.13
4	Heifer	0.5– 0.75	13	Goat mature	0.1–0.13
5	Local cow	0.8–1	14	Donkey young	0.35
6	Local ox	1–1.1	15	Donkey mature	0.5–0.7
7	Crossbred cow	1.8	16	Camel	1.25
8	Crossbred ox/bull	1.9	17	Chicken	0.013
9	Crossbred heifer	0.7	18	Horse	0.8–1.1

### 3. Estimating feed requirements of animals

Feed requirements could be estimated for an individual animal, group of animals, a herd of animals in a given farm, for animals in a village, or at district, zone, region and country level. However, depending on the production system, as the size of the herd and area coverage increases variabilities increased and estimation of feed requirements are usually less precise.

#### a) Estimating feed requirements of animals for commercial farms

Normally commercial livestock farms are well organized and have recording schemes of basic information as a routine activity. They periodically record information including live weight, production levels, amount of feed used and details of financial transactions. The quantity and quality of feed types produced or purchased in a certain period of time and the prices of the feeds are also available. When farms have such information planning feed requirements of animals for a given period is usually easier and more precise. Feed requirements for individual animals and the total herd will be prepared using established procedures of ration formulation either manually or with the help of developed software to formulate

rations for different types of animals.

## b) Estimating feed requirements of animals for traditional feeding practices

Under the traditional livestock production systems, the basic information required such as live weight and production levels are not readily available or inadequate. This is because data recording systems are not in place and basic facilities such as weighing balances are not easily accessible or do not exist. When information such as live weight is required, it is usually estimated or extrapolated from established figures like for example using TLUs and heart girth measurements. When information on production levels such as milk yield and weight gain are not available planning feed requirements will be made usually through estimating the maintenance requirements. However, it is also possible to make crude estimates of feed requirements for the different production levels. Regardless of the quality of feed, feed intake of animals per day on dry matter basis normally ranges between 2.5–3% of the animal's live body weight. It is usually observed that animals consume higher proportions when the quality of feed or roughage is very good and lower when the quality is poor. For estimating feed requirements based on the level of production (milk yield, growth) it is possible to use standard feed requirement tables or practical recommendations. For example, there are recommendations to feed 0.5 kg of concentrate for 1 litre of milk low producing crossbred cows. It is advisable to be inquisitive about standard feed requirement tables, which are mostly established for highly productive temperate animal breeds.

### Example to plan feed requirement of a farmer owning mixed species of livestock

Table 3 shows an example of a farmer's livestock holdings expressed as to TLUs in

which the total live weights are estimated. The 10.43 TLU animals is equivalent to 2,606 kg live weight ( $10.43 \text{ TLU} \times 250 \text{ kg} = 2,606 \text{ kg}$ ). Accordingly, the daily feed requirements of these animals will be  $2,606 \text{ kg live weight} \times 3\% = 78.2 \text{ kg}$  (assume the animals consume 3% of the animal's live weight in DM basis). This annual feed requirement is multiplying the daily feed requirement by 365 days ( $78.2 \times 365 = 28,543 \text{ kg} = 28.5 \text{ t}$  of total dry matter (TDM)). It is normally advisable to add about 20% allowance for feeds that may be wasted as refusal and others. These brings the annual feed requirement to be 34,200 kg (34.2 t) ( $28.5 \text{ t} + (28.5 \times 20\%) = 34.2 \text{ t TDM}$ ). This feed is basically a maintenance requirement. However, the quality of the feed we provide determines the productivity. Therefore, knowing the quality of the feed and the production level helps to refine the planning to be more practical. When estimating the total available feed you need to critically look into the availability of the feed in the area, its nutritional value in relation to the nutrient requirement and target product, the price of the feed (if purchased) and ease of production and its productivity and quality (if it is to be produced).

Table 3. Example on how to convert the different type and number of animals a farmer has to TLU

No.	Animal description	Number of animals	Conversion factor to TLU	Total TLU
1	Crossbred cows	2	1.8	3.6
2	Local oxen	3	1	3
3	Crossbred calves	2	0.4	0.8
4	Crossbred heifer	1	0.7	0.7
5	Mature donkey	1	0.5–0.7	0.6
6	Sheep	15	0.1–0.13	1.73
	Total			10.43

Once the quantity of feed required for the animals on the farm is estimated, the next step is to quantify the available feeds including grazing, crop residues, hay, cultivated forage crops, agro-industrial by products, formulated concentrate feeds and others. Then the sum of these feeds available in dry matter basis will be compared to see the balance with the requirements. If the available feed is in a negative balance, then we have to design how to fulfil the deficit either through purchase, production or other means. If the balance shows extra feed, it could be conserved for later use or sold at the market.

In planning the feed requirements of the traditional production systems in the mixed crop–livestock production systems in Ethiopia, it is very essential to properly understand the farming system and livestock feeding practice. In the mixed crop–livestock systems there are 3 broadly categorized feeding practices:

1. Livestock fully under grazing systems, which is very extensive, traditional, and not market oriented,
2. Semi-intensive in which animals are partly grazing but provided with supplement feeds and
3. Indoor feeding/tethering.

For these systems, planning feed requirements for animals are described as follows:

- i. **Livestock feeding entirely based on grazing in mixed crop–livestock system area**—this is based on grazing on pasture and crop aftermaths, browsing bushes and trees, and feed on crop residues on threshing grounds. In these feeding practices the major issues for planning feed requirements are challenges to estimating available feeds from grazing and browsing, whether the animals consume adequately or not and variabilities on feed

availability over seasons. Therefore, such system requires experience to the production system. To improve productivity and efficient use of feed resources appropriate interventions are required.

- ii. **Livestock grazing and supplemented with additional feeds**—Most farmers in the mixed crop–livestock systems keep their livestock to graze and browse during the daytime and supplement crop residues and other feed sources in the mornings and evenings. The grazing lands are usually poor and during the dry season it is highly degraded and extremely poor. Estimating feed intake from grazing lands especially from communal grazing lands is difficult. However, the annual production of hay from grazing lands could be estimated based on the condition of the grazing lands. Poor grazing lands produce about 1 t/ha DM, relatively good grazing lands produces 1–2 t/ha DM, and protected grazing lands produce 3–4 t/ha DM. If applicable yield estimation by field sampling is more accurate. The estimated yield from grazing lands (pasture lands) could be used as grazing, cut and carry or conserved hay. In planning the feed requirements in such system there is a need to critically determine how much proportion of the feed requirement is fulfilled from the grazing and browsing. A good estimation is made from experience. Based on the estimation the remaining feed which is used as supplement will come from crop residues, hay, cultivated forages, concentrate feeds and others. Quantify these feeds and sum up. The next question is the sum of these feeds fulfilled the estimated feed requirement of the animals in addition to the grazing and browsing. Make a balance if the available feed is low then quantify the deficit

and plan how the feed shortage is managed or fulfilled from different feed sources through purchase, production of cultivated forages or other management options like culling of animals.

- iii. **Estimating feeds requirements to intensive (confined) feeding systems**—There are significant number of livestock farms in which animals feed intensively and productivity is also remarkably high. However, the data recording systems even for the financial systems is not in place. To make the farm more efficient and profitable, record keeping is crucial. Livestock identification, performance, financial and many other related information should be recorded and updated regularly. For planning feed requirements, measurements like live weights of individual animals, group of the animals (such as milking cows, dry cows, heifers, calves), record the production levels and physiological condition of individual animal (milk yield, growth rate and pregnancy) and calculate the feed requirements in terms of DM and nutrients (usually using nutrient requirement tables like NRC). Once you know the feed requirements of the different groups of animals then calculate the feed requirements for a given period of time. Feed requirements could be calculated in 2 ways: a) For individual animal's—Small-scale production systems, b) For a group of animals'—Large-scale production systems. The required feed should be produced or purchased in time. When feed ingredients are purchased, it should consider quality, price and timing. Properly formulate to produce the required mixed concentrate. Feed purchased in bulk should be stored properly in a dry, ventilated and cold place. Poor storage results in depreciation of quality and loss.

### c) Planning feed requirements at village, district or zonal levels

Planning feed requirements for animals at the village, district or at zonal level follows the same principle as that of planning for an individual livestock farm. The major deviation comes from the precision of data collected for such a large area and huge livestock population and the dynamic nature of the different factors considered. For planning three steps are required:

1. Enumerate the existing livestock population in the given kebele, district or zone. The data need to be detailed and should have the different categories (calves, heifers, oxen, cows etc.) in the different species (sheep, goats, cattle etc.). The livestock population should be converted to TLU so that their annual feed requirement for maintenance in terms of total DM is estimated. If production and productivity levels at kebele or district level is roughly estimated this could be considered in the feed requirement.
2. Taking stock of all the feed sources and estimating the total feed available per year at kebele, district or zonal level. All the grazing lands, crop areas cultivated and estimated grain and crop residues yields (by species level, maize, wheat, chickpea, lentil, enset etc.), hay made from natural pasture, cultivated forage crops, concentrate supplements and other feeds available. Sum up the total feed estimated in terms of dry matter.
3. By balancing the feed requirements of the livestock in the kebele, district or zone with the total available feed we can roughly estimate whether the feed is enough or deficit. Based on this prediction one can do the required action ahead of time.

## Summary

- Proper planning is the means for leading a successful livestock production. The major input/expense in livestock production is feed and effective feed planning helps to keep the farm more productive and profitable.
- Livestock numbers and conditions are dynamic—births, deaths, culling.
- The minerals have crucial roles in the health, proper physiological functions and efficient use of feeds. Mineral nutrition of ruminant livestock animals needs attention.
- Targeting to feed animals based on their requirements to make the farm more profitable.
- Cultivating forage crops is sustainable, environmentally attractive, economical and produce quality products and hence should be encouraged.
- The productivity of animals is remarkably affected if they do not have access to clean and adequate water. Water should always be considered in planning livestock feeds.
- Experiencing improved management of livestock production helps practically sound in planning livestock feed requirements.

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## Resources

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