Chapter 10

# Animal feeding trials

*This chapter relates to the design of feeding trials which aim to adapt technologies for use under smallholder farming conditions. In general, such trials will be done on the farms themselves with close participation of the farmers in the planning, execution and evaluation of the interventions. Certain interventions will have finite objectives concerned with responses of a certain species or element of the farming practice to variations in inputs. In all cases the activity should be planned to take account of the overall farming system and the impact that the intervention will have on that system.*

## INTRODUCTION

As far as possible, animal feeding trials should be done on farms since the objectives usually are to test interventions in a situation where conditions of management and resource availability are typical of the real-life farmer situation. The farm and the farmers serve as a forum for discussions of practical problems and provide the appropriate setting for participatory adaptation of technologies. By contrast, experiments at the station will have as their aim the study of new feed resources (e.g., with the nylon bag method of assessing rumen degradation potential; the chick biological test to rate protein- rich leaves for monogastric animals) and under-exploited animal species (e.g., the small non-ruminant herbivores).

## EXPERIMENTS ON FARMS

There are four main activities that on-farm work facilitates:

- Economic evaluation of an intervention (e.g., use of molasses-urea blocks for cattle or of urea treatment of straw).
- Biological (and economic) assessment of a nutritional manipulation (e.g., defining a response curve for a given nutritional input as in Figure 5.11).

- Demonstration of appropriate technologies (e.g., biodigesters, recycling manure with earth worms and water plants, agroforestry systems).
- Establishing a forum for discussion, for planning joint participatory activities and as an interface between farmers and scientists

Validation of technologies can be done on any farm scale. The individual farm is the replicate and it is usually relatively easy to have from 8 to 12 farms in such a trial. In Chapter 11, there is an example taken from Vietnam of this kind of economic assessment.

#### Experiments on smallholder farms

On smallholder farms it is rarely convenient to have more than one treatment. Moreover, the objective is nearly always to assess the economic and social impact of a particular intervention. Smallholder farmers are more concerned with risk and the overall impact of the intervention on their activities in the farming system than in a simple biological response. The experiences in Vietnam with introduction of low-cost plastic biodigesters is a good illustration of this type of reaction (Bui Xuan An *et al.*, 1994). The comments of the farmers (almost invariably the women) were:

- the work is easier because I do not have to look for firewood or spend time tending the fire,
- my kitchen is cleaner and so are the pots and pans, and
- it is very easy to boil water for the tea in the early morning.

For these farmers, the biological efficiency of the biodigester was not an issue. Later, they would come to appreciate that the by-product of the biodigester (the effluent) would be better than the fresh manure for growing crops and fish. But their first concern was the impact of the biodigester on their everyday activities.

#### The role of the larger farm

It is often argued that the larger farm should be ignored as being unrepresentative of the target group - the poorest farmers. Yet the large farm with a helpful owner or manager can be an asset and a means of

helping the poorer ones. Such farms are particularly appropriate for carrying out the second type of experiment (i.e., response function). It is also not too difficult to identify farmers in this category. Often they will be commercial farms employing managers who are themselves agricultural graduates and therefore with the training that facilitates the more precise execution of the intervention and the daily recording that may be necessary. In the CIPAV programme in Colombia, there are several such farms that perform a most valuable function by participating in joint research activities. They are part of an informal organization of producers that meet frequently as a group with CIPAV researchers to discuss joint problems and new possibilities. Several of the advances in the use of tropical feed resources, reported in this manual, have been developed in these collaborative activities.

Certain types of experiments are very suitable for carrying out on these larger farms. Thus the evaluation of the effects of supplements on milk production (e.g., molasses-urea blocks, tree foliages) can be done relatively easily with good statistical control, using analysis of covariance to correct for animal differences (see Chapter 8 and Table 6.3). In this case adequate replication can be obtained on the farm if the herd is of over 30 cows. The use of covariance and blocking of animals by calving date makes it possible to incorporate cows in varying stages of lactation in the trial.

## ON-STATION EXPERIMENTS

### The general approach

If investment is to be made in experimental facilities then, in general, it is best these are in the form of individual pens. For a given investment in capital, labour and operational costs, more data can be generated from animals in individual pens than in groups. Groups of animals more closely represent the situation on farms. But this should not be attempted in on-station work, which can never reproduce conditions on farms, nor should this be the objective. On-farm activities are proposed for this very purpose.

**Facilities that are renewable**

In the tropics, protection is needed mainly against the sun and rain. Wind speeds are only excessive in the vicinity of a cyclone, and it is pointless to build structures capable of withstanding events that may never occur. Better to aim for structures that can be recycled and rebuilt using local materials. Bamboo produces renewable materials that can be used to make almost all the structural components needed in a building for all classes of applied animal experiments. Roofs should be made of palm leaves as this produces a structure with excellent thermal insulation characteristics. Only in the case of pigs will concrete be required for the floor. For all animal, pen divisions are easily and conveniently made from bamboo.

The important issue is that the construction material, as much as possible, should be recyclable either for fuel or as compost.

**Grow what is needed and recycle the excreta**

Provided it is understood from the outset that on-station research is mainly a response to, and occasionally a prelude to on-farm work, then decisions can be taken which will reduce considerably the cost of the experimental facilities. At the outset, the station must possess sufficient land to be able to grow the crops that will produce the feed resources most likely to be investigated, i.e., those being recommended for use by farmers. All too often we see heavy investment in laboratories and animal houses but with no land either to grow the feed or to recycle the animal excreta. There are many examples of such reductionist and inappropriate planning at the level of both international and national research centres.

Research stations, in some instances, can perform a valuable role in creating interest and demonstrating confidence in technologies, which may have little application in an era of cheap fossil fuel, but which almost certainly will play an increasing role as the pressure increases to adopt more sustainable ways of using resources.

For instance, it will mostly be appropriate for smallholder farmers to use animal traction rather than mechanical power. The role of draft animals will be enhanced if they are multi-purpose - producing milk and meat as well as power. In this case it is very important that this strategy is demonstrated on the research station. There are too many examples at

research stations in developing countries of mechanical "graveyards" littered with broken tractors and implements.

Research on biodigesters and gasification technology is another area where the research station can set an example for the future.

### Animal species

It is not necessary to have facilities on the station to do research with all the target animals. The farming system will be developed on the smallholder farms -- not at the station. Thus it is rarely justified to have milking cows. It is much easier, and more can be done with a given level of funding, when goats are the experimental animals. For example, slatted floors for goats can be made from strips of bamboo. For cattle concrete slabs would be needed. Similarly, sheep are more appropriate than cattle for feed intake and growth studies.

The issue is not whether research findings with sheep or goats can be applied to cattle or buffaloes. The work with the sheep and goats should be directed towards establishing the principles of digestion and metabolism and likely trends in animal response to inputs. The final joint biological and economic evaluation must always be done on farms.

Thus, goats can be used to establish likely responses in milk yield to a range of tree foliages. But the final description of the response curve to one particular tree foliage will be done on a farm where the ecosystem favours growth of that particular tree. The station can grow small plots of a range of trees; the farm will want to concentrate on what is most suitable for the area in which it is situated.

Research stations can play a useful role in introducing under-exploited livestock species (e.g., earthworms, snails and insects), studying their biology and ecology and thus creating interest in their commercial use (Cardozo, 1993).

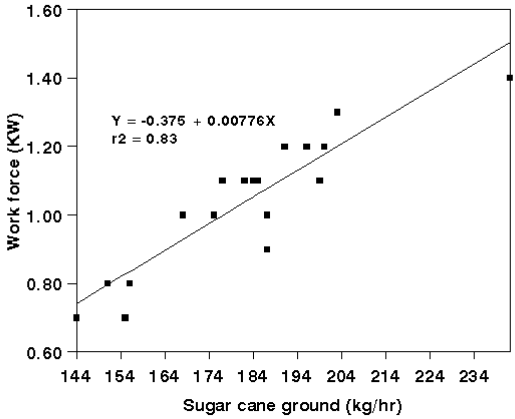
### Facilities for research with draft animals

Most on-station research in tropical developing should be done with two aims always in mind: of doing relevant research at lowest cost. Research on draft animals can be very expensive because of the difficulties of measuring work output. The approach to this issue tends to emphasize sophisticated means of measurement of work output, rather than identify

work activities which might be both useful and easy to measure.

A frequent form of draft animal work in developing countries is the grinding of sugar cane to make 'panela' or 'gur'. Earlier work in Bangladesh (Miah and Sarkar, 1990), subsequently confirmed in Colombia (Thu *et al.*, 1994), showed that the rate of grinding the sugar cane was highly correlated with the work output of the animal (Figure 10.1). Setting up the facilities for a sugar cane crusher and employing it for research on draft animals has many advantages. The work force is easily measured; the output of the work is useful (the cane juice can be used in experiments with pigs); it is easy to train the animals; and the work is done in relative comfort (as the crusher is easily situated under some form of roof or shade).

**Figure 10.1. Relationship between rate of crushing of sugar cane and work force exerted by the animal (Pairs of buffaloes and cattle) (Source: Miah and Sarkar, 1990).**



### Design of individual pens

The first requirement is for pens usually for individual animals, or for small groups in the case of pigs and poultry. The pens can be simple, but, they must facilitate adequate care of the animals, especially feeding and cleaning. Floors which are partially slatted, allowing faeces and urine to fall through into a pit below, are more expensive but the investment is justified in the improved environment for the animals (they are always dry and clean) and elimination of unpleasant tasks for the attendants. The feed hoppers should be designed to avoid spillage and to facilitate the collection of residues. Clean water should always be available.

Pens should be in multiples of four and the minimum needed is 16 units. This gives flexibility for feeding trials with up to four treatments in factorial and latin square arrangements. Animals with rumen fistulae must be held individually; the walls of their pens may need to be solid to prevent them damaging the fistula.

Pen construction in tropical regions can be much simpler and cheaper than in temperate countries where avoidance of stress from cold and wind requires more permanent structures equipped with insulation and often heating.

Feed troughs should be constructed carefully, especially for ruminants that will be fed bulky forages. The aim is to minimize spillage and make it difficult for the animal to pull the feed out into the pen.

Appropriate designs of pens and feed troughs are shown in Figures 10.2 to 10.9.

### Other facilities

Accurate balances are essential both for weighing animals and feeds. Spring balances should generally be avoided and simple scales which use weights hung from an arm are to be preferred. For cattle it is desirable to be able to weigh by intervals of 500 g and for sheep 200 g. Feed scales should weigh to 100 g.

**Figure 10.2. Plans of experimental pens for carrying out feeding trials with cattle. The building is 19.0 m x 7.0 m for 16 pens.**

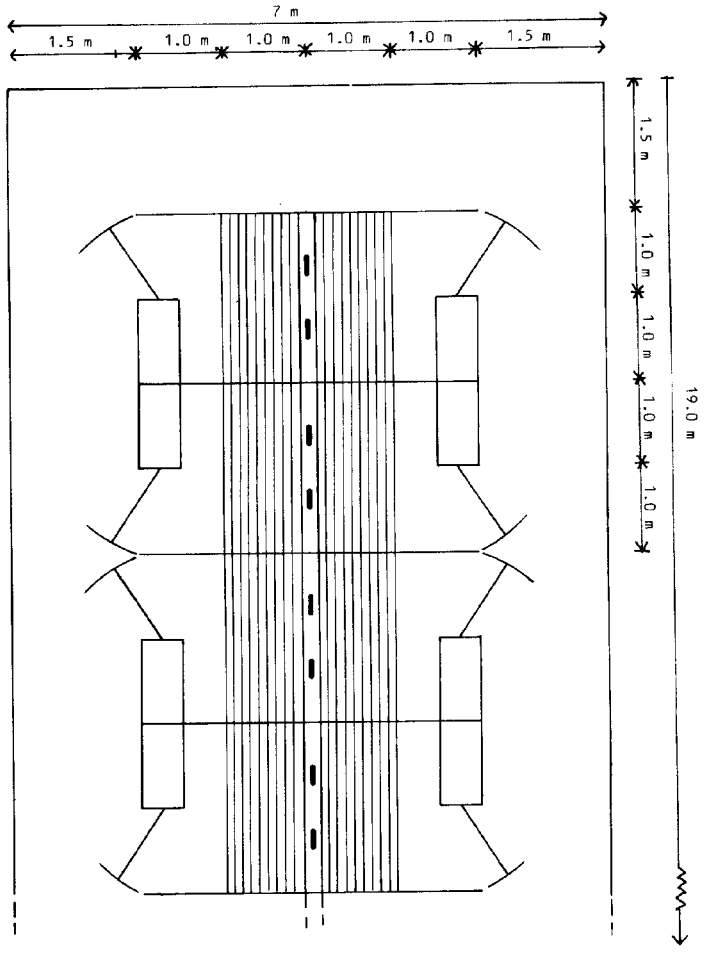


**Figure 10.3. Dimensions of cattle slats (in mm).**

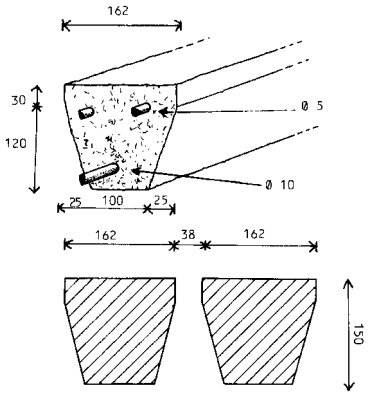



**Figure 10.4. Cross-section of cattle pens (in cm).**

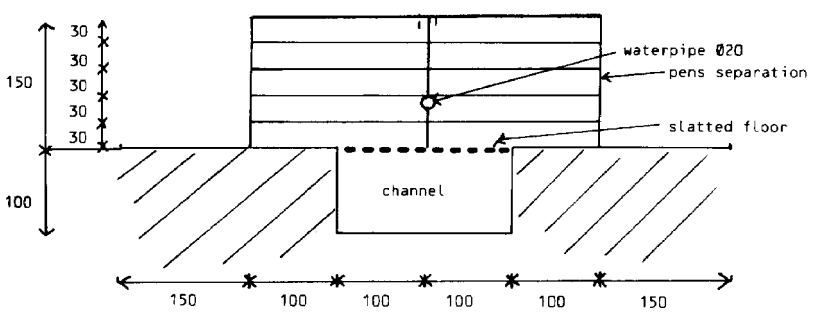


**Figure 10.5. Dimensions of feed trough for cattle (in cm).**

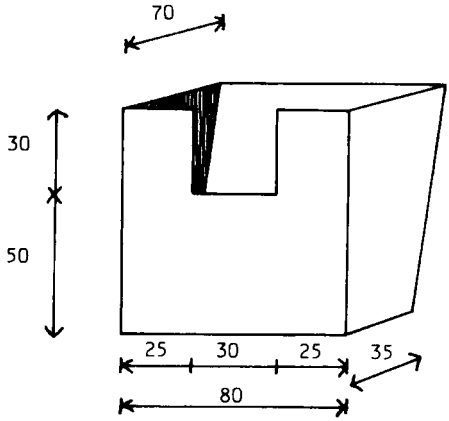



**Figure 10.6. Plans of experimental pens for carrying out feeding trials with sheep and goats (in cm).**

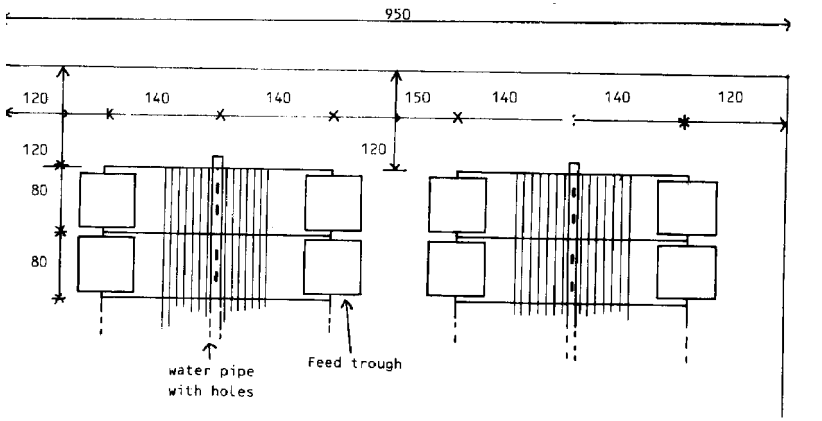


**Figure 10.7. Cross-section of experimental pens for sheep and goats (in cm). An elevated floor with the slats made from wood may be a better arrangement.**

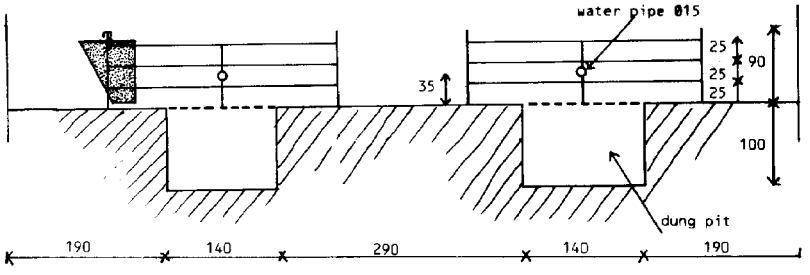



**Figure 10.8. Dimensions for slats for sheep and goat pens (in cm).**

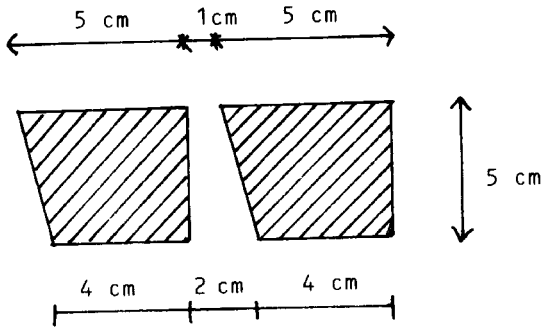
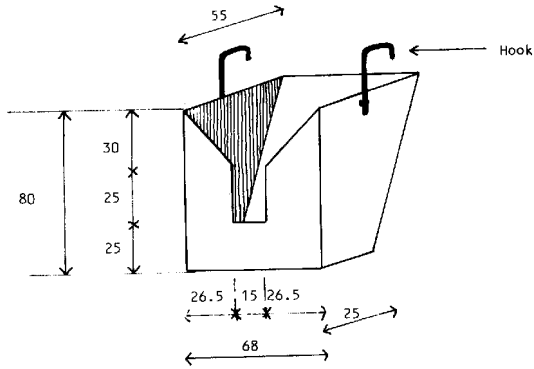


**Figure 10.9. Dimensions of feed troughs for sheep (in cm).**




## RECORDING

The first item of essential equipment is a notebook computer. These are now relatively inexpensive and available locally in most developing countries. Portability is necessary in order to work on farms. Adapters that permit power to be drawn from the battery of a vehicle, or from a solar panel, provide security for continuous working under most circumstances. Data should be entered in a spreadsheet in a form that will facilitate subsequent analysis and presentation (Chapter 8).

An important ancillary role of the portable computer is that it enables the researcher to demonstrate to the farmer the results obtained on that day on her/his farm. In this way, the farmer feels intimately involved in the research and will be much more likely to collaborate in future activities.