An Aid to Decision-Making by Smallholder Livestock Keepers in the Developing World

Use of FRAME, an interactive simulation model, can assist in making feed resource management decisions in situations where livestock feed is in short supply, such as mixed-species farms of resource-poor farmers in tropical countries.

Tethered Zebu cow consuming maize stover: seasonally limited feed supplies have both immediate and longer term effects on future productivity.

Background

In developing countries, seasonal variations and shortage in the supply of feeds are major constraints to livestock production on the mixed-species farms of resource-poor farmers. These constraints force farmers to make decisions regarding priorities for the allocation of feeds to the different classes of livestock on their holdings. They must ensure that essential functions (maintenance, provision of manure and draught power) are fulfilled while at the same time optimising animal productivity.

Animal performance in smallholder mixed-species livestock holdings is determined by complex, dynamic interactions of farmer, animal and feed management factors. However, current advice to farmers on feed resource management strategies is usually based on evaluations of short-term responses to nutritional and other interventions and is less than appropriate to their needs.

Integrating considerations of the dynamic nature of feed availability and allocation into the planning and implementation of research on feeding systems has been difficult and expensive or, more frequently, avoided altogether.

Research highlights

An interactive simulation model (FRAME), developed by the project, was constructed from standard, quantitative treatments of energy and protein transactions in ruminant livestock. The model uses a simplified input data-set, which describes feed quality and availability, to predict the effects of different feed allocation strategies across animal types in mixed-species livestock holdings.

FRAME was able to replicate the data collected by a Nepalese farmer on his mixed-species smallholding over a five-month period, from March to July, when availability of feed resources is at its most restricted. Liveweight changes predicted by the model closely reflected data collected on the loss in live weight of his draught oxen during their working period and their recovery in response to the monsoon season forage flush.

Observed and predicted pre- and post-partum liveweight changes in two cows on the same farm differed by 5.4% (15 kg) and 3.4% (5 kg) at the end of the five-month simulation period. Such weight changes would be expected to have implications for future breeding, as illustrated in the FRAME sub-component model (see overleaf). Weight changes predicted by the 'manure-compost' component of FRAME were consistent with observed data from a nitrogen balance experiment conducted with indigenous Malawi goats.

Uptake

The project highlighted the shortcomings of feed evaluation and rationing systems, derived for use in temperate production systems, when applied to tropical conditions. The model provides a useful framework for incorporating future improvements in the evaluation of tropical feeds. The approach taken allows the consequences of feeding decisions to be simulated in a dynamic way that is consistent with the farmers' feed availability, production objectives and feeding practices.

Initial indications from these studies are that reasonable predictions of liveweight changes over a short period, such as the critical five-month dry season in Nepal, can be made by

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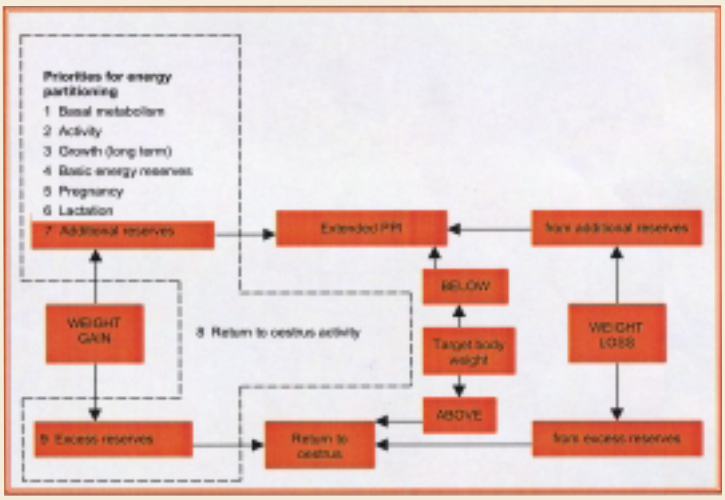
Project completed in 1995



Conceptual model of the possible relationships between energy partitioning and liveweight changes in the post-partum cow. (PPI = past-partum interval)

FRAME. However, the inclusion of a metabolism component in the model is required before predictions for lactating animals are reliable.

Linkages

Full testing of FRAME was undertaken using data from a related Livestock Production Programme project, R5690: Allocation of local feed resources for ruminants by crop/livestock farmers in Nepal. A future improved version will incorporate a predictive system for rationing dairy cattle in the tropics, developed in Project R6282: A practical feed rationing system for smallholder milk producers in the tropics. The refinement of FRAME's manure-compost component has been undertaken in Project R6283: Sustainable nutrient cycling in crop/livestock systems, investigating the implications of livestock feeding management for long-term soil fertility in smallholder mixed farming systems. Under a proposed follow-up project, the new improved version of FRAME will be tested on its suitability for use in practical situations in research and extension work.

Relevance to sustainable livelihoods

Sustainable livelihoods of resource-poor smallholder farmers can be improved by using FRAME as a tool in making feed resource management decisions to overcome the constraints to livestock production caused by the limited availability of feed. Practical feeding strategies can be implemented, based on prediction of results, such as the alternative allocation of feeds across species and the optimum timing of the use of feed supplements. Results will be seen in the improved utilisation of resources along with the increase in animal productivity and household incomes.

Selected project publications

- Thorne, P.J. (1994) Modelling livestock feed availability and allocation to improve seasonal feed supplies and feeding systems. Natural Resources Institute, Chatham, Kent. 82 pp. (unpublished)

- Thorne, P.J. (1995) Modelling the effects of livestock on nutrient flows in mixed crop-livestock systems. pp. 493–508. In: *Livestock and Sustainable Nutrient Cycling in Mixed Farming Systems of Sub-Saharan Africa.* Powell, J.M., Fernandez-Rivera, S., Williams, T.O. and Renard, C. (Eds.). Proceedings of an International Conference, Addis Ababa, Ethiopia, 22–26 November 1993. International Livestock Centre for Africa, Addis Ababa, Ethiopia.

- Thorne, P.J. (1995) FRAME: A simulation of the consequences of farmers' decisions on the allocation of limited feed resources in mixed species livestock holdings. Paper presented at Fourth International Symposium on Herbivore Nutrition, 11–15 September 1995, Clermont Ferrand, France.

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