Introductory paper

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Background

The first FAO electronic conference on Tropical Feeds and Feeding Systems was held in 1995 (Speedy, Dalibard and Sansoucy, 1996). About 200 participants took part from over 50 countries with more than three-quarters being from developing countries.

In this first conference, the evaluation of the nutritive value of tropical feeds for ruminants was reviewed by Leng (1996) and extensively discussed by the participants. To summarize, there are many data on the chemical analysis and calculated nutritive value of animal feeds but the emphasis has been on grains and supplements used in temperate systems. Far fewer data exist on the less conventional feeds and forages, especially those found in the tropics. Yet, for example, Tanzanian farmers use some 200 species of fodder trees for their livestock (Komwihanilo *et al.*, 1995). But even given sample data on alternative feeds, caution must be applied to their use in developing rations and feeding systems.

Firstly, samples of heterogenous materials like forages and fodders are subject to enormous variation. Plant age, component, location and season are among the many factors which may influence the composition. Even if the actual material were analysed, if the animal is given choice, it may select a part of the material which differs from the remainder which it refuses. Secondly, nutrients are NOT additive, especially in ruminant diets. Thus rice straw may have a very low feeding value on its own but when combined with a protein or simple nitrogen source such as urea, can give markedly improved animal performance. Urea treatment of straw can actually improve the availability of energy, which is not reflected in the chemical analysis. Thirdly, many plant materials contain compounds other than nutrients which influence digestion and metabolism

of the feed. Non-nutritional factors, such as phenolic compounds, are of principal concern in the case of many tropical plants. They form complexes with proteins and carbohydrates, and in the former case, this includes enzymes. This may be, but is not always, detrimental to the digestion of nutrients.

In short, it was concluded that animal feeding trials are the only sure test of the value of a feed, within a defined system. And the whole ration must be considered, as there are optimal and sub-optimal mixtures of available plant materials, in terms of digestion, metabolism and animal performance.

These basic yet fundamental concepts have been stated by Leng (loc. cit.) but are not yet widely accepted among nutrition chemists who continue to rely on 'feed analysis'. For this reason, a more descriptive approach has been adopted in the FAO Tropical Feeds database (Gohl, 1981; revised Speedy, 1994), together with considerable reference to animal trials and published results.

Other papers in the first conference included those on the strategy for use of renewable natural resources, roughage intake, the treatment of poor quality roughages, use of molasses-urea blocks, forage trees, the African Palm, aqualculture feeds, and examples of feed information on a variety of plant materials. It was decided to extend the scope of the second conference by considering livestock feed resources in the context of integrated farming systems.

Integration vs. Specialization: Historical Context

In colonial times, traditional farming systems which combined crops and livestock production were replaced in many tropical countries by large scale plantations of export crops (cotton, sugar, groundnut, palm oil, rubber, etc.). They relied heavily on imported technologies and inputs, increasing the dependency on the countries which supplied them. Multinationals have now taken over control of the system, and many developing countries are caught in the vicious circle of requiring commercial production to generate the hard currency needed to pay for the inputs.

Agricultural education and training in both the developed and

developing world put much more emphasis on specialization than on integration. Institutions separate crop and animal production at all levels (extensionists, researchers and decision makers), and the two groups ignore each other and struggle separately for power and budgets. They develop separate projects instead of cooperating with each other and exploiting the benefits of integration.

As the demographic pressure is increasing rapidly in the developing world, new priorities are emerging: food security, sustainable management of resources, slowing down the drift from the land and improving welfare of the rural poor. The commodity-oriented production system is now being called into question. Much more emphasis is put on integration within production systems and this is reflected in the new FAO Food Security Special Programme. Recently, World Bank projects aimed at strengthening the extension services in developing countries have begun to train general extensionists able to intervene in the different components of the farming systems: crops, livestock and forestry. Furthermore, participatory approach methodology is now adopted by most developers and greater emphasis is placed on indigenous knowledge and the needs of the rural population. New educational programmes have focused on integrated systems (e.g., the SAREC MSc Programme on Sustainable Systems of Livestock Production in Vietnam), and many NGOs are following the same line as CIPAV (Centro para la Investigación en Sistemas Sostenibles) in Colombia which has developed expertise in many components of integrated farming systems (from crop production, to animal production, energy, forestry and wild fauna).

Farming Systems

The emphasis in this conference is therefore on feeds as components of systems. It is essential to define 'the system' when reporting results and conclusions. Furthermore, it is concerned not just with the 'feeding system' but also with the feed plants as components of the 'farming system' which includes soil, water, crops, livestock and their interactions. The system may rely on external inputs (fertilizer, chemicals, etc.) or be self-sufficient (with minimal external inputs). The concept of 'sustainability' adds the dimension of time: whether the system can

continue indefinitely without soil or environmental degradation. It is important to judge the system not only in terms of is self-sufficiency but also in terms of its long-term viability.

Caution must be applied to the definition of the system. For one thing, 'systems' may be defined within a wide range of boundaries. In this context, it refers to the whole farming system, and the land, labour and economics of that system. The boundaries of the system may be further extended to include the environment, market, economic and social factors. Such considerations are vital when considered in the context of 'sustainable development'.

There are many instances where 'improvements' are reported in terms of yield, performance or financial margins, resulting from genetic, dietary or management changes. But such 'improvements' must be questioned in the context of environmental, market and social effects (indicators of sustainability'). The classic case is the 'Green Revolution' in which high-yielding varieties of rice and maize were introduced, with major effects on production and food supply. But these varieties required high inputs of chemicals and fertilizers. And the additional supply had serious market implications so that the poor farmers, who did not have access to land, capital and chemicals needed to use the new crops, suffered reduced prices and incomes (Greenland, 1990).

Such effects also occur in livestock production. Many developed countries have achieved big increases in milk production from dairy cows by genetic and technical improvement, with high usage of grain and a high level of subsidy. The result is a reduction in the number of cows and dairy farmers and the need to apply production quotas to limit supply.

Also, the high performance systems now operating in Europe are causing serious pollution problems as a result of high concentrations of animals in small geographic areas, e.g. Belgium, Brittany, the Netherlands, etc. In these systems, the feed base is often completely dissociated from animal production, with imports of cereals, cassava and soya from other regions or countries. The expansion of production based on non-local feed resources has proved to be environmentally unsustainable.

Brazil has increased production and exports of pig and poultry meat

by applying modern production methods and meat technology. This is in direct competition on the world market with supplies from France, USA, etc. Pig meat prices are currently (July 1996) low and small-scale production is uneconomic. Production is also based on corn and soya. The 'feed conversion efficiency' is good but corn prices have gone up and profits disappeared. The majority of producers are small and the risk is that more will abandon the rural areas and move to the cities. Furthermore, pollution from pig and poultry units is becoming a serious problem, as in many countries. Although this does not affect the economics of the pig enterprise, it has wide implications for human health and the environment. It represents an 'externality' which economists now take as a type of cost.

Much attention has also been paid by scientists to increasing beef production from extensive systems (by pasture improvement and improved management), especially in Latin America. Higher stocking rates mean higher profits per hectare. Economically, it benefits only the large cattle ranchers. And the world beef market is already saturated so increased supplies mean lower prices. It is also claimed to increase meat supplies to the cities. But the rich already consume protein in excess of requirement and the poor remain unable to buy beef.

So the consideration of 'livestock systems' which are environmentally, economically and socially stable must take account of factors beyond the farm level.They are likely to be environmentally non-destructive, not to contribute to saturated markets (although they may provide other products which are currently required) and to account for family labour and satisfaction within the small-farm sector.

System Definition

The question arises of what constitutes an environmentally sustainable system. Such a system is likely to be as near to, and therefore a modification of, the natural ecosystem of the area. This is proposed as a fundamental principle of environmental sustainability and should be borne in mind throughout the discussion. In the various agro-ecological zones, the following systems would apply:

- pasture-tree systems in arid or semi-arid savannah
- multi-layer perennial (tree) systems in humid forest environments
- pasture-palm systems in wet savannah
- multi-layer pond systems in wetland areas

These systems are polycultures rather than monocultures and involve trees and/or nitrogen fixing species. Food crops and animal feed resources can be chosen which replace the natural species but fulfill a similar role in the ecosystem. However, annual crops like maize and beans are unlikely to constitute sustainable options on tropical soils with a low cation exchange capacity (CEC) and where nutrients are mainly held in the organic matter (Weischet and Caviedes, 1994).

In such areas, the maintenance of soil organic matter and fertility are primary concerns. The integration of livestock itself may help the cropping system to become sustainable through the use of residues, animal power and recycling of nutrients. But if the cropping system is based on inputs of fertilizer and chemicals from outside the system and subject to long-term reduction in soil fertility, then the whole system, including the livestock element, should be regarded as unsustainable. Much attention has been paid in the past to crop byproducts, treatments (e.g. urea) and supplementation. Materials such as straw, husks, cakes, etc., are available and may be used for animal production but the integration of livestock per se does not guarantee the principle of long-term sustainability. More emphasis is likely to be placed on alternative perennial crops and multi-strata systems which conserve and replace the soil organic matter.

Even on fertile soils, there should be more attention paid to mixed farming systems (where byproducts are used), including integrated systems with legumes (especially multi-purpose trees), mixed livestock and return of nutrients through nitrogen fixation and use of manure.

Descriptions of feed use within systems must therefore be justified in terms of the environmental, as well as the economic and social sustainability of the system, together with the feeding value and animal performance.

The Programme

Papers were requested within the following subject categories:

1. Integration in small-scale farming systems.
2. The poultry component in integrated farming systems.
3. Integrated farming systems with a major fodder crop component.
4. Integrated farming systems with a major tree/shrub component.
5. Feed resources from cereal production.
6. Feed resources from large scale plantations.
7. Alternatives to industrial exploitation of plantations.
8. Fertilizer and energy components in integrated farming systems.
9. Networking for circulating information on integrated farming systems and promotion of these systems.

In addition, a number of short communications were requested and it was expected that participants would contribute to the discussion with data, experience and further contributions. Following from experience of the last electronic conference, a number of changes were made. The conference was fully moderated and all contributions and discussions wereconsidered by the moderators before release.

It was hoped that contributors would add information on feed and feeding systems that are not currently included in FAO Tropical Feeds. Such information should include full description, as well as brief exemplary chemical analysis and, where possible, animal performance results. Details of farming systems are particularly important and contributions should take account, as far as possible, of indicators of sustainability: environmental, social and economic.

Additional Information

FAO Tropical Feeds may be obtained on diskette by application to R. Sansoucy, FAO-AGA, 00100 Rome, Italy (Tel: +39 6 52253559 Fax: +39 6 52255749 E-mail: rene.sansoucy@fao.org) or from the world-wide-web.

The Proceedings of the First FAO Electronic Conference on Tropical Feeds and Feeding Systems can be obtained on diskette at the above address or from the www.

There are many articles on sustainable livestock systems and feed resources available from the electronic journal Livestock Research for Rural Development. A full list of papers will be sent to participants on request. The journal can be obtained in the same way as the above.

A special www site was set up where these can be obtained.

References

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