Livestock Interactions

Introduction

Farming systems that successfully integrate crop and livestock enterprises stand to gain many benefits that can have a direct impact on whole farm production. Ruminant animals are especially desirable due to their ability to convert forages, browse and crop residues high in cellulose to useful food and fibre products. Such animals provide for: system diversification; recycling of nutrients; soil enhancing rotation crops; power and transportation; and act as biological "savings accounts" for farmers during periods of stress. Nevertheless, even with the potential for synergies, if the system is managed to favour excessively either crops or livestock, synergies are lost and detrimental effects may result.

PLATE 1
Free roaming cattle may cause conflicts over resource use (FAO).

Failure to consider the livestock component as part of the agricultural system creates an immediate conflict because system resources must be used to support the animal enterprise. For example, a 410 kg cow will have a daily dry matter maintenance intake of roughly 1.5-2% of body weight. The daily requirement amounts to 8.2 kg or about 3.0 tons annually. This gives some idea of the magnitude of the annual biomass requirement but does not address the specific animal nutrient needs or a strategy for utilisation. Nutrient demand to carry out productive functions such as work, reproduction and growth will require more from the system. Not only do intake requirements increase to 2.5-3% of body weight but also the nutritive requirements of the ration are considerably higher than for maintenance. Animals that are maintained in poor body condition or are incapable of reproduction are of little or no value to the enterprise or the system in general.

There are, however, situations where conflicts between crop residues and cover crops required for CA and the demand from the livestock sector, are difficult to withstand. The exact nature of the conflict between crop and livestock production depends on the production system involved. It may be due to:

- Excessive residue consumption by livestock kept by farmers. Livestock may or may not have access to communal grazing land. If tenure is secure and livestock do not depend on communal land, it may be possible to solve conflict through technical changes in production system.
- Excessive residue consumption by livestock owned by pastoralists (and sometimes by farmers). This situation is more complex because crop producers/mixed farmers face different problems from those of pastoralists.

Competition for crop residues

Conservation agriculture practices require a critical level of crop residues and cover crops to maintain or enhance soil chemical, physical and biological properties and prevent land degradation. In many areas of the world, crops and livestock compete for the same resources, and require proper management to meet conservation agriculture objectives. Synergistic integration of crops and livestock offers numerous advantages.

Farming systems that successfully integrate crop and livestock enterprises stand to gain synergies that directly impact production and agro-ecological efficiencies. Sánchez (1995) has reviewed the case for the integration of livestock (mainly ruminants) with perennial crops. Some advantages listed include: diversification of income through animal products (milk, meat, fibre, hides, and manure), weed control, soil erosion control, increased yield of main crop, and income during the "start-up" period for tree crops.

Competition for crop residues and cover crops between livestock and in situ recycling represents a widespread and serious threat to realising the benefits of conservation agriculture.

PLATE 2
Traditionally, crop residues are removed from the field to serve multiple purposes in the household.
(FAO).

Traditionally, crop residues have been used for multiple purposes, i.e. fuel, building materials, mulch, feed and bedding (Smil, 1999), most of which conflict with their use for soil improvement. Among these, livestock related use (feed and bedding) is probably the most widespread in developing countries.

The removal of crop residues for or by livestock, either through grazing or cut and carry, is a common practice in most crop-livestock systems. In many cases residue removal by animals is excessive, leaving insufficient vegetation for soil enhancement and conservation purposes, and compromising the sustainability of the systems. Furthermore, in some systems these residues may have a greater long-term value as soil amendments, because many crop residues have very low feed value, often not meeting animal maintenance requirements. On the other hand, livestock are an important part of production in mixed farming systems and in the absence of alternative feed sources; farmers are usually unwilling to abandon this critically important one.

It is necessary to understand the root cause for such practices, as they usually involve socio-economic or cultural issues. Examples of the successful integration of livestock with cropping systems exist and these case

cultural issues. Examples of the successful integration of livestock with cropping systems exist and these case studies can serve as the basis for a concentrated effort to search for possible solutions to this important problem.

Complementary feeding strategies

In traditional mixed farming areas the use of the crop residues can be a strong initial deterrent for the smooth change towards conservation agriculture. If livestock is accustomed to feed on crop residues, a conflict of interest can be created when crop residues need to be kept for soil protection or for organic matter accumulation.

In this case, there are various alternative solutions whose viability would depend on the particular conditions of each location. The following are some of these options:

- Estimation of the amount of crop residues needed for soil protection and enrichment and the balance can then be used for animal feeding (direct controlled grazing or cut-and-carry).
- Establishment of double purpose cover crops (soil protection and forage) within the crop rotation cycle.
- Establishment of plots of permanent forages for direct grazing or for cut-and-carry.
- Reduction of herd size by culling out animals no longer needed for animal traction.
- Temporary displacement of animals to other areas.

Establishment of alternative and complementary forage sources (legumes, grasses and tree fodder), strategic application of inorganic fertilizers and manure, conservation of surplus forage, supplementation, treatment of crop residues, controlled grazing, zero, or combinations of these, must be flexible enough to adjust to the needs of each farming situation.

On steep land, the use of living contour erosion barriers consisting of grasses and/or leguminous trees that can serve as livestock feed is an efficient strategy if the species selected are palatable feeds as well as effective erosion barriers (Barber, 1999).

PLATE 3
A small area planted with *Arachis pintoi* serves as a protein bank. All animals are allowed to graze the area for 15 minutes a day. (A.J. Bot).

Legumes are particularly important in mixed farming systems because of their role in nitrogen cycling and as sources of protein for human and animal nutrition (Devendra, *et al.*, 2001). Nevertheless, when land is limited, farmers are reluctant to take land out of crop production to establish forages.

The ability to conserve and transfer forage from periods of surplus to periods of deficit appears to be a logical approach to efficient production. Nevertheless, the humid tropics bring special challenges to the practice of forage conservation (hay & silage) due to frequent rains and high humidity during the season(s) when surplus forages are available for conservation. This technology is rarely adopted by small farmers who see it as a costly process requiring machinery and infrastructure that is unavailable to them (Quiroz, *et al.*, 1997). However, simple methods have been developed which are suitable for small scale farmers in the semi-arid tropics (IIRR & ACT, 2005).

PLATE 4
Conservation of residues in Ethiopia.
(J. Ashburner).

In combination with other strategies, it would seem worthwhile to develop forage conservation methods appropriate for small and medium-sized farms. Cereal residues contain high concentrations of cell wall material and associated lignin. These constituents reduce the value of residues as livestock feeds. Possibilities exist through treatment to modify these constituents rendering them more nutritious. For example, ammonification of cereal residues with urea treatment (Pezo *et al.*, 2000) can significantly increase their crude protein concentrations, digestibility, intake and, consequently, animal performance. The adoption of these technologies by small farmers has been limited because some of these materials require access to specialised equipment, appropriate technical assistance, credit, or consistent supply of affordable inputs.

Where fodder is being cut and carried to confined livestock, the amount of residual field vegetation can be precisely controlled. If crop stubble is grazed, the herder must maintain control over the animals such that the needed residual is maintained. This can be done by controlling the grazing time permitted in a given area and by allowing animals to express selective defoliation of edible plant fractions. In cut and carry systems, non-edible parts can be returned either as such or as part of compost prepared by mixing with animal excreta. According to Sain and Barreto (1996) farmers in Guaymango, El Salvador who allow grazing of crop residue, restrict consumption to about 50 percent of the total amount available. As average residue yields of the maize/sorghum system are near 10 t/ha, the amount left (about 5 t/ha) is well above the 3.5 t/ha threshold reported by Barber (1996).

PLATE 5
Zero-grazing allows for precise amounts of feeds and nutrients, but it demands more labour.
(FAO).

The appropriate management of bovines is key for productivity improvements of grain production and even for livestock itself, by improving the sources and quality of feed, and indirectly, the soil. In order to achieve this, the following practices are emphasised:

1. **Not over-stocking**, but keeping a number of animals according to land availability and forage production capacity, balancing production and consumption of biomass during the year. This will avoid overgrazing and will maintain adequate soil coverage.
2. **Increase the intensity of land use** by the establishment of fenced areas, for the production of grasses and legumes for cutting, for grazing, for silage and for hay, and for corrals.
3. **To control grazing**, with rest periods which allow pasture recovery. The investment for pasture division and rotational grazing faces two major obstacles: the high fencing costs and current socio-economic situation of farmers, many of whom do not even have enough land to keep their own animals and graze them along road sides, empty lots or lands "borrowed" from neighbours.

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