Grazing options to intensify land use

Farmers' practices in managing livestock and crops vary greatly. Matthew Turner stresses the importance of analysing this variability to see what opportunities these practices provide for maintaining soil fertility and intensifying land use.

Matthew Turner

There is a long history of interaction between mobile herders and settled agropastoralists in the West African Sahel. Livestock managers provide manure and draft power to farmers through a number of different economic arrangements. Many observers feel that a fuller integration of crop and livestock husbandry would be a viable low-input strategy for sustainable agricultural development in the semiarid tropics. There are obvious limitations to the much promoted strategies like manure harvesting and mixed farming on privately owned and managed farms. But what other options do farmers have where chemical fertilisers are not available?

Limits of manure harvesting

Traditionally, farmers pursue mixed strategies to maintain the fertility of their croplands. Important components of their strategies are fallowing and "harvesting" manure. With fallowing alone, a minimum fallow/cropland ratio of about 5:1 (20% cropland) is needed to maintain productivity. Under increasing land pressure, harvesting manure from grazed rangeland is often promoted as the way to intensify land use. But analysts have found that, in many parts of semiarid West Africa, there is not enough rangeland to maintain the fertility of continuously-cropped areas through manuring alone.

Such conclusions are based on comparing regional noncropped/cropped ratios to sustainable Rangeland Cropland Ratios (RCR). These are calculated by multiplying the estimated annual nutrient deficit of cropland (kg/ha/yr) by the ratio of the carrying capacity of the range (ha/Tropical Livestock Unit [TLU]) and the annual nutrient excretion by livestock on cropped areas (kg/TLU/yr). Estimated values range from 10-240 ha of range to sustainably support 1 ha of cropland through manuring (Schlecht et al. 1993; Swift et al. 1989, van Keulen & Breman 1990). It is thought that a combination of reductions in livestock productivity, manure quality, crop productivity and pasture productivity will occur with lower RCRs. After some time, this will lead to reduction in continuously-cropped area and local presence of livestock. These calculations place a ceiling on manure-supported cropping fractions (4-9%) well below that of total cultivation fractions currently in many areas of the Sudanian zone.

There are many uncertainties in the parameters for calculating RCRs, and other strategies of managing soil fertility are not included. Nevertheless, although the sustainable RCRs will be considerably lower than normally calculated, such estimations support arguments that the potential to increase the area of continuous cropping or to increase productivity levels without additional soil fertility management strategies is limited in semiarid West Africa (van Keulen & Breman 1990). However, such calculations have provided surprisingly little insight into appropriate policies and technologies to maintain or increase productivity under existing and growing population densities and income levels.

Other options needed

Inorganic fertilisers or feed supplements and settled mixed farming are often seen as the most promising options to intensify cropping. However, inorganic fertilisers have been adopted only to grow cash crops such as cotton and groundnuts. Application on food crops is economically not attractive, among other reasons, because of unfavourable pricing.

Many observers have felt that, induced by population growth, a fuller, more reliable and less volatile integration would occur if livestock and cropland were jointly owned and managed by family units on mixed farms (McIntire et al. 1992). The settled mixed farming model has become the dominant model of agropastoral organisation promoted by development practitioners. However, its record of adoption has been limited on account of labour shortages, fluctuating livestock ownership and inadequate animal-keeping or cropping skills in the individual households (Niamir 1990).

What other options for intensification do farmers have?

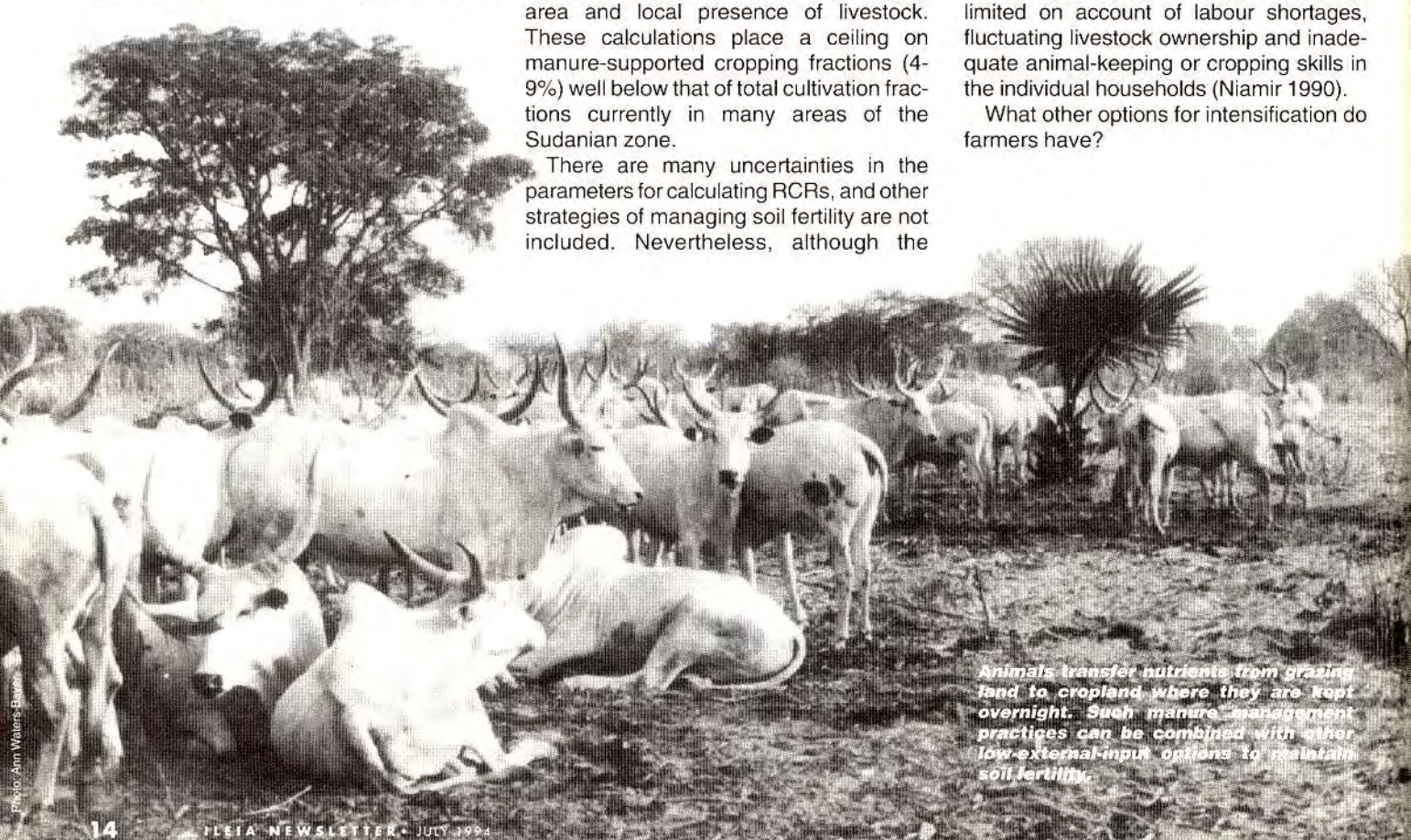

Photo: Ann Waters-Bayer

Animals transfer nutrients from grazing land to cropland where they are kept overnight. Such manure management practices can be combined with other low-external-input options to maintain soil fertility.

Analysis at village level?

A major reason behind the large variation in sustainable RCR estimates is the great difference in assumptions made about agronomic and livestock management practices. These differing assumptions do not result from inaccurate information about the "farming system" but rather reflect the high local variation in management characteristics that affect fertility maintenance.

Each of the three major components of sustainable RCR calculations are sensitive to agronomic and livestock management. Cropland nutrient deficits are affected by agronomic practices such as the extent of weeding, interannual regimes of applying manure/urine, ways of working manure/urine and crop residues into the soil, removal of crop residues, and ploughing. The amount of excretion-bound nutrients deposited on cropland per animal unit is affected by management decisions concerning herd composition, crop-residue grazing, transhumance and where the livestock stay overnight. Rangeland carrying capacities, while often treated as biophysically-determined, depend greatly on herd composition and the temporal and spatial patterns of grazing pressure, all of which are affected by livestock management decisions.

Therefore, while much of the debate on sustainability of farming in West Africa has revolved around regional land use, very little attention has been given to the variability of those management practices that significantly affect the efficiency of nutrient cycling. The importance and variability of management practices become very clear when analysis is made not at the regional level but rather at the village level where landuse decisions are made.

Opportunities in management

To illustrate this point, let us consider the importance of grazing management by analysing different options practised by two neighbouring villages in southeast Niger. These two options can be explained by using a simple model of village land use.

Around the village, circular zones indicate the three main types of land use: manure-supported continuously-cropped land near the village, surrounded by a ring of unmanured fields and fallows, and rangeland at the outside. For simplicity, assume that all land outside the continuously-cropped zone is open for grazing and the village can regulate its livestock population to maximise manuring potential. This ignores differences in management between unmanured fields and rangeland and assumes no externally-imposed boundary.

The grazing perimeter for the village's livestock is determined by the nocturnal location and effective grazing radius (GR) of its herds. The effective grazing radius is influenced by livestock species and herding practice. The area with continuously-cropped land is determined by dividing the grazed area by the assumed sustainable RCR. Figure 1, based on the data from the two villages, shows how two different cases of grazing radii (5 and 7 km, which is about the maximum GR) and nocturnal locations (in the village and at the perimeter of the continuously-cropped zone) can affect the amount of continuously-cropped land which can be supported by the manure.

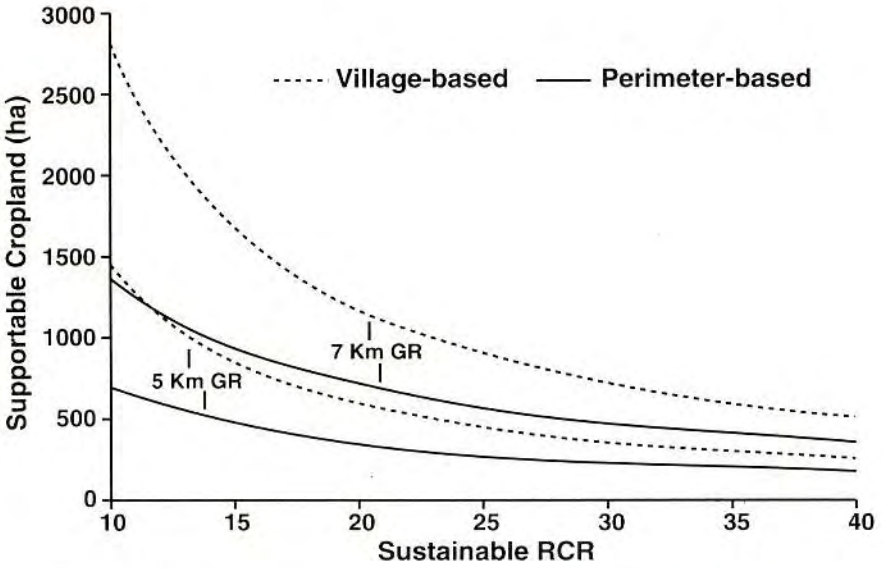

Figure 1. The relationship between supportable continuously-cropped area to assumed sustainable rangeland-to-cropland ratio (RCR) as predicted bya simple landscape model. Different types of grazing management are reflected in two different grazing radii (5 and 7 km) and whether animals spend the night at the edge of the continuously-cultivated perimeter (dotted lines) or in the village (solid lines).

The interesting feature of this simple model is that it shows that, over a wide range of sustainable RCR (eg. 20-40), the supportable continuously-cropped area is determined more by the livestock management options taken by village households than by the sustainable RCR itself.

Conclusions

Estimations of sustainable RCRs have demonstrated the limits of manure harvesting as a strategy for improving soil fertility management. As long as inorganic fertilisers and/or feed supplements are not affordable in West Africa, farmers have to maintain soil fertility with local resources. The false promise of privatised settled mixed farming has indirectly reduced the management options available to livestock owners. It provided justification for government indifference towards protecting transhumance corridors from encroachment by settled farmers, despite the fact that greater herd mobility has become more necessary in heavily cultivated areas because less pasture is available there.

An over-reliance on regional-level analysis has obscured the potential for improved fertility maintenance through changes in livestock or cropland management. Among villages and households, there is large variation in those management practices that are so important for fertility maintenance. This variation results from differences in production goals, knowledge and access to resources, eg. land and labour. Better analyses of these management practices is needed to gain a better understanding of which management practices are applicable when and where. Also other options for managing soil fertility, such as harvesting sediment and improving fallow vegetation with leguminous fodder crops, need further attention. More efficient nutrient management with existing resources can be promoted by participatory research to better define production goals and constraints, followed by an interactive network of small-scale development projects. ■

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