Comparison of labour requirements for cropping maize on land previously used for *Stylosanthes* fodder banks and on adjacent fallows in the subhumid zone of Nigeria

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Summary

THIS PAPER *examines the returns to labour from cropping fallowed land and land that has been used for* Stylosanthes *fodder banks in the subhumid zone of Nigeria. Contrary to the farmers' claims, the results of the study show that 'fodder bank soils' are easier to ridge than the adjacent natural fallows. However, due to the additional work needed to harvest the increased yield, cropping in fodder banks requires more labour. Although the technology has not yet been widely adopted, the trial with maize reported in this paper showed that incremental earnings of about 15% are possible, allowing for labour charges and assuming the extra yield was surplus to subsistence and had a lower marginal value.*

Introduction

ILCA has accumulated considerable evidence of the beneficial. effects of *Stylosanthes* pastures on soils in the subhumid zone of Nigeria. These effects have been expressed in terms of crop yield i.e. returns on land area. However, land is not a limiting factor for cropping in the study area; labour availability during the peak periods of a growing season is the critical constraint.

Labour is the major input in subsistence farming and also largely determines the amount of land a farmer cultivates each year (Powell, 1'986). In order to maximise the benefits from labour spent on a unit of land, the farmer usually adopts inter-cropping which exploits crops with different growing periods within the same season. With this technique, labour shortage is most critical at the time of land preparation, especially ridging which takes place during the peak period of labour demand (Ingawa, 1986). A delay in the onset of rains could aggravate this problem by shortening the period of land preparation before planting the first crop (Jones and Wild, 1975). The lack of labour needed to slash and burn land studded with bush after a natural fallow encourages farmers to continue cropping the same piece of land despite declining yields (Powell, 1986) and the need for rest periods between crop phases (Young and Wright, 1980). However, the reduction in grain yield caused by continuous cropping can in some instances be alleviated by the application of fertilizers.

In the subhumid zone of Nigeria, ILCA has been experimenting with fodder banks (concentrated fenced units of *Stylosanthes*, established and managed near the pastoralists' homesteads) to provide supplementary feeding for animals during the dry season. Mohamed-Saleem (1986) reported that maize grown in fodder banks of various ages produced higher grain yields than maize cultivated on previously cropped or natural fallow soils. This suggests that fodder banks could be used by agropastoralists for both fodder and grain production. The finding may also encourage arable farmers who have no livestock but are interested in the subsequent benefits of the technology to cropping to lease land to landless pastoralists for the establishment of fodder banks.

Farmers who are familiar with *Stylosanthes* experienced difficulties in tilling stylo soils, which implies the need for extra labour at the critical time of ridging. Informal interviews with the indigenes of Ganawuri (one of ILCA's case study areas in the subhumid zone of Nigeria) showed that this problem occurred with stylo that had been used for soil reclamation and allowed to become woody. In order to examine the extent of the problem, an experiment was undertaken to compare the labour inputs for cropping maize inside grazed fodder banks with those on adjacent natural fallows.

Methods

The study was conducted at Abet (9°30' N, 8°25' E; 1300 mm rainfall between April and October) during the 1985 growing season. Two fodder banks of *Stylosanthes hamata* cv. Verano, established 3 and 4 years previously and grazed during all subsequent dry seasons, were identified. Four 15 m x 10 m plots were laid out inside each fodder bank. The plots were on sites in which the legume component was representative of that (50 to 60% stylo) found in other fodder banks in the subhumid zone of Nigeria. Comparable plots were demarcated immediately outside the fodder banks on fields that had been under natural grass fallow for at least 4 years.

All agricultural operations were carried out by the same hired labourers, who were allocated randomly among the replicated plots inside and outside the fodder banks. The operations included ridging twice, two fertilizer applications and two weeding operations followed by harvesting, which comprised plucking, dehusking and shelling. The time taken to complete each task was recorded. Observations on labour input were also monitored by interviewing the workers.

In May 1985 the plots were ridged at 1-m intervals to a height of 30 cm. They were planted with the TZPB maize variety at a rate of 3 seeds per hole with a spacing of 0.25 m. After emergence, seedlings were thinned to one per hole. A uniform dose of 60 kg N/ha, 60 kg P/ha and 60 kg K/ha was applied as compound fertilizer (15:15:15) prior to planting and another dose of 60 kg N/ha was applied as urea 6 weeks later. Plots were weeded 5 and 8 weeks after sowing. At harvest, the cobs were plucked and then dehusked, dried and shelled to determine grain yield. The stalks were cut and dried at 60°C for 48 hours to determine the dry weight of crop residues. All data collected were analysed using analysis of variance.

Results

Figure 1 (average of 2 sites) gives a break-down of labour requirements by operation for cropping maize inside and outside the fodder banks. Cropping within fodder banks required 129 man-days/ha on average, compared with 110 days on natural fallow. Ridging ‘fodder bank soil’ required significantly less labour than did ridging soils under natural fallow, indicating that the latter was more difficult to till. This finding was supported by the workers taking part in the trial, who admitted that the `natural fallow soil' was more difficult to ridge. More time was needed, however, to harvest maize grown within the fodder barks. This was because grain and crop residue yields on stylo plots were higher by 2 and 3 t/ha on average than those on natural fallow soils (Tables 1 and 2).

Discussion

The study reported in this paper demonstrates that the labour requirement for ridging a ‘fodder bank soil’ was lower than that for ridging soils under natural fallow. The relative ease of tilling a soil previously under stylo was confirmed by the workers' perceptions of labour spent on ridging. Further evidence was provided by another study in the area in which Mohamed-Saleem et al (1986) found that soils that had been under stylo for 3 to 4 years had lower bulk densities (1.42 g/cm3) than both fallows with similar grass species (1.61 g/cm3) and repeatedly cropped soils (1.72 g/cm^3).

Table 1. *Average grain yields of maize grown on stylo and natural fallow soils, Abet, 1985.*

Location	Average grain yields (kg/ha)		Average of 2 sites
	Site 1	Site 2	
Inside fodder bank	4 785	4 533	4 659
Outside fodder bank	2 411	2 679	2 545
LSD (0.01)	452	335	

Figure 1. *Labour requirements for cropping maize on stylo and natural fallow soils.*

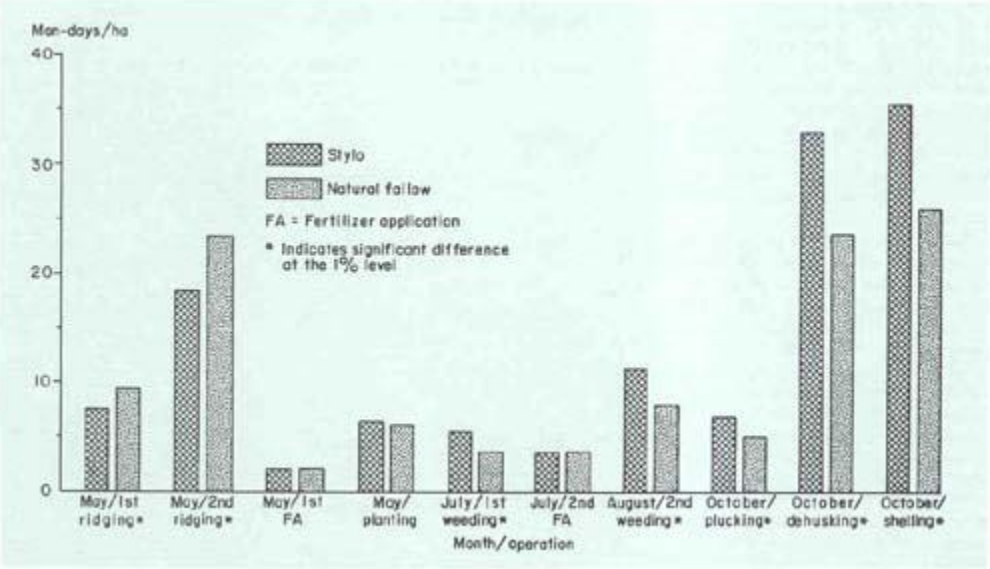

Table 2. *Average crop residue yields for maize grown on stylo and natural fallow soils, Abet, 1985.*

Location	Average crop residue yields (kg DM/ha)		Average of 2 sites
	Site 1	Site 2	
Inside fodder bank	7 212	7 586	7 399
Outside fodder bank	4 018	4 523	4 271
LSD (0.01)	2 331	592	

Cropping causes a soil to lose its structure rapidly and to undergo compaction (Kowal and Kassam, 1978), which implies that continuously cropped soil will require more time to till.

More time was spent on other operations in the fodder banks than on fallows. This increased the total labour input on stylo sites by 19 man-days/ha, amounting to 129 man-days/ha as compared with a total of 110 man-days spent on cropping outside the fodder banks. Previous studies in the zone reported 103 man-days/ha for cropping maize on similar soils under similar farming conditions (Poate, 1980).

The extra labour required for weeding the cropped areas within the fodder banks was due to a greater weed growth resulting partly from the repeated emergence of stylo from a large seed reserve built up over the years. However, since the plots were weeded between July and August, which is a relatively less intense labour period (Ingawa, 1986), the labour input for this operation was not critical. Owing to the increased grain yield, the labour requirement for harvesting maize in the fodder banks was higher by 19 man-days/ha than that on natural fallows (Figure 1). During harvest demand for labour is high but assistance is available from women and children, who are not normally involved in ridging.

The observed increase in crop yields on ‘fodder bank soils’ confirms earlier findings in two other case study areas in the zone (Mohamed-Saleem, 1986), although the maize yield on stylo soils in this study was on average 1 tonne more at similar fertilizer rates. This could be attributed to a 200 mm higher rainfall and its better distribution in 1985 as compared with that in the previous 4 years. The crop yield differences inside and outside fodder banks are related to variations in the physical properties of the soils, which could have favoured higher water infiltration and nutrient retention by the post-*Stylosanthes* soil (Mohamed-Saleem et al, 1986).

The budgetary implications of increased labour use and crop yield are summarised in Table 3.

Cropping maize inside the fodder bank increased income by 124% over growing maize on fallow land. The potential benefit to agropastoralists can be derived by comparison with a budget for a typical herd of 40 cattle. According to Waters-Bayer (1986), a herd owner in Abet derives the following income from:

Sales of cattle	₦ 2080
Sales of dairy products	940
Total	₦ 3020

Powell and Taylor-Powell (1985) reported that pastoralists in Abet cultivate an average of 0.87 ha/household of which 0.24 ha is under maize. Hence the income from growing maize alone in a fodder bank would be 170.00.

Pending research on the yield responses of the other major cereal crops, an estimate of the potential incremental revenue for agropastoralists may be derived from the assumption that the total area under cereal crops is under maize i.e. 0.722 ha (83% of the average area cultivated by pastoralists). The total annual grain income from cropping a fallow is estimated at 411.00 (569.5 x 0.722), and the gross cattle and crop income would be 3431. The incremental revenue resulting from cropping a fodder bank would then be 511.4 (708.32 x 0.722), which is equivalent to 15% of the present annual income.

Table 3. *Budgets for growing maize on fallow land and in fodder banks, Abet, 1985.*

	Unit/ha	Unit cost/ha ₦	Total cost/ha ₦
Outside fodder bank			
Expenditure			
Labour	110 man-days	5.00	550.00
NPK	240 kg	0.21	50.40
Urea	125 kg	0.21	26.25
Total expenditure			626.65
Income			
Grain yield	2 545 kg	0.47[a]	1 196.15
Balance			569.50
Inside fodder bank[b]			
Expenditure			
Labour	19 man-days	5.00	95.00
NPK	Nil		
Urea	Nil		
Income			
Incremental grain yield	2 114 kg	0.38[c]	803.32
Incremental balance			708.32

[a] Retail price of maize in the region.
[b] Excludes benefits of improved cattle productivity.
[c] Wholesale price used to value surplus crop.
Sources: Ingawa (personal communication) for grain prices; fertilizer prices were obtained from the Farmers' Supplies Company, Kaduna State, Nigeria.

Data available so far suggest that fodder banks of highly productive legumes such as *Stylosanthes* spp. could be an alternative land use to a natural fallow in situations where high-quality fodder and the preservation of soil conditions are vital for increasing agropastoral outputs. Since labour is a major constraint, any operation that would increase labour

requirement would not be readily acceptable to either farmers or pastoralists. Methods requiring low labour inputs for fodder bank establishment have already been demonstrated (Mohamed-Saleem et al, 1986). The results of the present study suggest that a cropping system with a forage legume interphase could greatly increase crop yields in addition to increasing livestock productivity which is the original objective of establishing fodder banks (Mani et al, 1986).

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