FORAGE BASED FALLOW MANAGEMENT STRATEGIES FOR INTENSIFIED LAND USE AND RESOURCE CONSERVATION IN SMALL HOLDER FARMS

M.A. Mohamed Saleem and Kahsay Berhe
International Livestock Research Institute (ILRI), P.O. Box 5689, Addis Ababa, Ethiopia

ABSTRACT
Intensification of land-use is inevitable for long term food security in the east African highlands, but technological options need to be environmentally safe. How forages can be used as a basis for intensified grain and fodder production from the same land unit, and serve as a profitable fallow during necessary crop-free rest period is the purpose of this study.

KEYWORDS
Forage, fallow, livestock, intensification, highlands

INTRODUCTION

Abject poverty, high population pressure, falling agricultural productivity, varying land capability and widespread resource degradation are reasons why the east African highland ecozone has become an international and regional priority for research and development. Pressure for cropland has forced people move into marginal lands, steep slopes and traditional grazing lands. Intensified use, particularly of prime lands, will become inevitable to increase productivity, and also as a strategy to curtail misuse and degradation of marginal lands by having to cultivate them to satisfy subsistence needs. Livestock are important in the highland farming systems, and different animal types serve varying human needs and compete for the same feed resources. Opportunities for environmentally safe intensification of land-use include improving crop/livestock productivity by using high potential cereals and forages, efficient farm and fallow feed management and soil nutrient and water management and use of the same livestock for multiple tasks such as milk production and work. Fallow or crop-free (rest) periods of one in 3-4 years for vertisols are considered necessary (Young and Wright, 1984) to break the life cycles of pathogen build up, but the level of farmer income during the rest periods will depend on the usefulness of the fallow-vegetation to livestock, and is the focus of this study.

MATERIALS AND METHODS

A long term trial, composed of nine crop/forage land-use types (LUTs), is being conducted since 1992 at ILRI Debre Zeit Station, Ethiopia. The same treatments (Table 1) were superimposed over the first three year experimental period, followed by a year of rest in 1995. Traditionally, unimproved durum wheat grown as a sole crop (LUT9) is one of the major LUTs in the vertisols of the Ethiopian highlands. Depending on the LUT, the grain, crop residue, weeds and sown herbaceous and tree forage yields/ha were recorded and appropriately converted to crude protein (CP) and metabolizable energy (ME) values per unit land for assessment of intensification benefits in comparison with the traditional land use (LUT9).

RESULTS

Annual grain production from unimproved sole wheat crop (LUT9) averaged 701 kg/ha. Replacing it with the improved wheat variety ET-13 (LUT4) significantly increased annual grain and fodder productivity, and combining it with other food and forage crops further increased the land productivity compared to sowing only local or improved wheat (Table 1). Annual total fodder (DM/ha) from a land unit (comprised of crop residues, weeds and foliage from tree and herbaceous forages) was highest from sole lablab plots followed by wheat ET-13/clover or wheat ET-13/grass pea sequence between the sesbania alley (LUTS 6&5). The sole wheat produced the lowest amounts of fodder DM per land unit in all three years, and in combination with legumes, fodder CP levels increased as opposed to 3 to 4% in sole wheat residue.

Replacing the local wheat with ET-13 increased grain energy output from 6.31GJ/ha to 13.18GJ/ha. The sole lablab (LUT2) or combined lablab/sesbania forage systems (LUT3) produced the highest ME output among the LUTs tested. However, as food grain is considered important in the subsistence production system, the annual ME output was found maximized in the system when wheat was followed by grass pea between sesbania alleys (LUT5) (Fig. 1).

Fallow vegetation is found to be influenced significantly by the type of previous land use (Table 2). Compared to plots that had sole wheat crops, vegetative quantity and quality on plots which combined legumous forages with crops were found more beneficial to livestock from the point of ME and protein.

DISCUSSION

From the traditional wheat system, crop residue after harvest is the principal feed for livestock besides the weeds collected and fed after each weeding. The CP content of the local wheat residue (3.9%) is even far below the recommended CP in a live weight maintenance diet (ARC, 1980). Replacing the local wheat with ET-13 does not improve the CP content in the tissues, although the CP quantity increased per unit land area. Feed productivity from the wheat ET-13 field can further be qualitatively and quantitatively increased by combining it with forages as in LUTs 5 and 6. However, subsistence farmers may not accept LUT6 with the reduced grain yields in spite of higher yields of good quality feed.

There is concerted effort in Ethiopia through the national extension services and NGOs to replace the local variety with the improved wheat variety. Although this can lead to increases in grain, ME and CP per unit area compared to the local wheat variety, the need for additional energy and protein to make up the shortfalls for livestock will continue at the smallholder level in the highlands. Introducing new crop varieties will not therefore be sufficient. Agricultural development should also cater for the growing demand for quality feed to improve livestock productivity. There are possibilities for varying the pattern of feed delivery during any given year without affecting the grain production, by selecting crop/forage and tree mixtures that can be harvested at different times of the year. As fallow periods between crop cycles are needed, combinations of forages with food crops are more beneficial than sole crops for improved quantity and quality in the regenerating fallow vegetation, making it more valuable for livestock. Smallholder farmers have more than one piece of land, scattered at different locations. How forage based fallow can be incorporated within spatial land management to maximize returns from the land holdings without risking land degradation is a major research interest to ILRI.

REFERENCES

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Table 1
Land use types and mean annual grain and total fodder yields.

Land use types (LUTs)	Mean yields: Wheat grain (t/ha)	Mean yields: Fodder[y] (t/ha)
1. Sole sesbania (*Sesbania sesban*) tree harvested Feb/March		8.25
2. Sole lablab (*Lablab purpureus*) sown mid June and harvested early Sept.		13.68
3. Sesbania in 4x4 m alley lablab mixture		11.42
4. Sole improved wheat (*Triticum aestivum*) ET-13 sown June & harvested early Sept.	1.57	4.44
5. ET-13 sown & harvested as in 4 followed after harvest by grass pea(*Lathyrus sativus*) sown Sept. & harvested Jan-Feb.between 4x4 m sesbania alleys	1.76 0.43[x]	10.19
6. ET-13/clover (*Trifolium steudneri*) sown & harvested with ET-13 as in 4 mixture between 4x4 m sesbania alleys	0.87	8.83
7. Oat (*Avena sativa*)/vetch (*Vicia dasycarpa*) mixture sown in June & harvested in Sept. between 4x4 m sesbania alleys		8.56
8. Oat/vetch mixture sown mid June followed after harvest early Sept. by grass pea sown & harvested as in 5	1.07[x]	8.58
9. Sole unimproved durum (*Triticum durum*) wheat sown mid/late Aug. and harvested in Nov/Dec.	0.70	2.07

[x] Yield of grass pea
[y] Crop residue + (harvested sown forage, if appropriate) + weeds

Table 2
Fallow herbage DM yield (t/ha) and quality as influenced by previous land-use.

	Dominant species						Treatment		
LUTs	1	2	3	4	5	Others	Total	ME (GJ/ha)	CP (kg/ha)
1	1.07	0.59	0.97	0.68	0.92	2.42	5.16	50.06	629
2	1.95	2.69	0.47	0.52	0.47	1.32	9.16	96.23	872
3	2.40	1.79	0.55	0.73	0.73	1.84	7.88	74.90	885
4	1.04	0.75	0.71	1.56	0.30	3.33	5.36	43.97	864
5	0.99	0.86	0.23	1.56	0.30	1.73	5.51	52.38	599
6	0.51	0.72	0.25	1.40	0.33	2.32	4.78	38.72	503
7	1.02	1.36	0.30	0.52	0.61	1.13	5.25	42.54	515
8	1.77	1.21	1.60	0.96	1.39	2.13	7.59	72.14	737
9	0.82	0.48	0.40	0.60	0.49	1.40	3.84	31.11	651

Species
1 = *Sorghum arundinaceum*
2 = *Commelina latifolia*
3 = *Brachiaria eruciformis*
4 = *Setaria pallide*

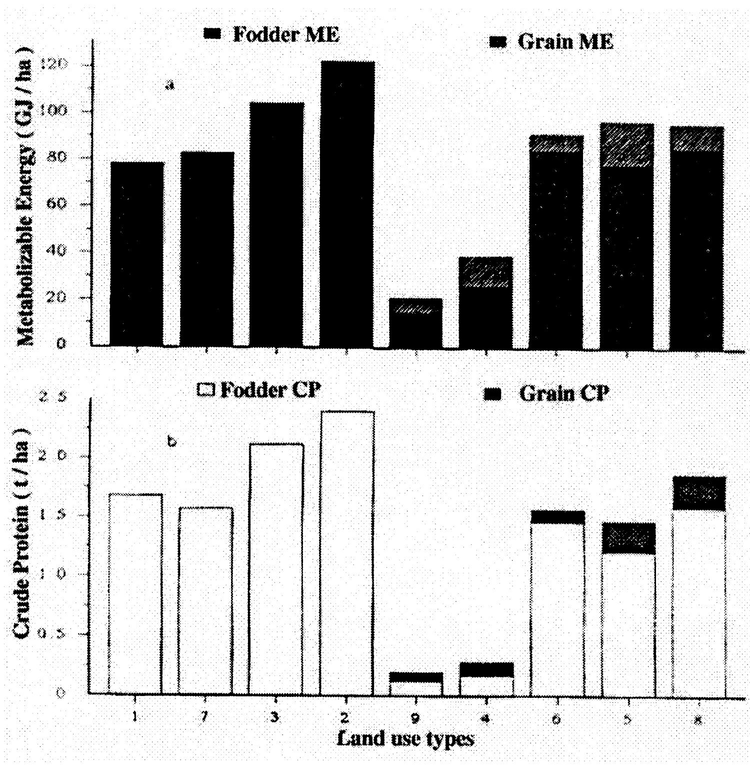

Figure 1
Attainable metabolizable energy and crude protein levels/ha from different types of land-use.