

Ngitili agrosilvipastoral systems in the United Republic of Tanzania

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Indigenous knowledge helps restore forest and mitigate dry season fodder shortages.

Environmental degradation resulting from extensive grazing and haphazard exploitation of rangeland forestry resources is a severe problem for the agropastoralists of Shinyanga, a northeastern region of the United Republic of Tanzania. Threats to livelihoods and the environment in this region include, among others, shortage of dry season fodder, deforestation, woodfuel scarcity, food insecurity and severe soil erosion. However, a traditional management system locally termed “*ngitili*” (dry-season fodder reserves) among the Wasukuma agropastoralists of Shinyanga has proved to be instrumental in range management and forest restoration. The system at the same time alleviates dry season fodder shortages, prevents environmental degradation such as soil erosion, and helps conserve biodiversity. It is estimated that between 350 000 and 500 000 ha of woodland were restored in the period from 1986 to 2001 (Kaale, Mlenge and Barrow, 2002).

Ngitili are farmer-led initiatives evolved from traditional strategies for grazing and food security (Kamwenda, 1999). The system involves retaining an area of standing vegetation (grasses, trees, shrubs and forbs) from the onset to the end of the rainy season. The *ngitili* area remains closed to livestock at the beginning of the wet season and is opened up for grazing at the peak of dry season.

The Wasukuma rules for protecting individual and communal *ngitili* are based on traditional village guards (*sungusungu*) and community assemblies (*dagashida*). These customary institutions are still important in contemporary natural resource management and have contributed to the successful management of *ngitili*, and particularly in adapting to the increase in herd size, which has grown above subsistence level.

Unfortunately, the validity of *ngitili* as a silvipastoral system has remained unknown as a best practice for broader adoption or adaptation. To facilitate its exten-

sion, an iterative diagnostic and design (D&D) survey (a World Agroforestry Centre [ICRAF] methodology) was conducted in the Meatu district to identify the components, structure, management and technological specifications of the system. This survey was combined with qualitative land evaluation to establish the potential suitability of land for *ngitili* in comparison with extensive grazing.

THE STUDY AREA

The study was conducted in the Meatu district of Shinyanga region, Tanzania. The district covers 8871 km² (United Republic of Tanzania, 1996). Altitude varies between 1000 and 1500m above sea level, with detached hills and grassy savannah woodlands (*mbugas*).

Between October and May the district has high, erratic, unpredictable rainfall, with two minor seasonal peaks in December and March to April (United Republic of Tanzania, 1996; Otysina and Asenga, 1993). Precipitation, which occurs in brief storms, is lost through quick surface runoff and high evapotranspiration rates. Dry-season precipitation, May to November, is under 50mm per year. The monthly evaporation rate exceeds the monthly rainfall almost every month (Ministry of Tourism, Natural Resources and Environment, 1995).

The native vegetation of Shinyanga is composed of shrubs (4 to 6 m high), often thorny and usually deciduous, and trees reaching up to 10 to 15m. The herbaceous layer that occupies the open spaces suffers severe livestock grazing pressure.

The miombo woodlands of Shinyanga are currently dominated by *Brachystegia*, *Julbernardia* and *Isoberlinia* species. Other important species are *Combretum collinum*, *Baikea* spp., *Lonchocarpus capasa*, *Azanza garkeana*, *Albizia* spp. and *Dalbergia melanoxylo*. Acacia woodlands consist mostly of *Acacia tortilis*, *A. nilotica* and *A. polyacantha*, while other important species in this agropastoral land

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include *Adansonia digitata* and *Tamarindus indica* (Kamwenda, 1999).

The population of Meatu is dominated by the Wasukuma, who are traditionally agropastoralists. Economic activities in the area include cultivation of food and cash crops, cattle rearing and mining (Maro, 1995). Cattle ownership indicates social status and financial capital. Livestock keeping is the second largest activity in Shinyanga, after agriculture (URT, 1996). The animals provide milk and manure and are of increasing importance for draught power (Mugasha, Isinika and O'Kting'ati, 1996; Kamwenda, 1999).

In Meatu there are two dominant land-use systems, the cotton-cereal system with cattle and the traditional Wasukuma agropastoral system. Under the former system farmers emphasize subsistence food production more than cash crops. Food crops are maize, cassava, sorghum, beans, rice, chickpeas, groundnuts and sweet potatoes. Farmers own cattle, but herds are smaller than under the traditional agropastoral system. The main constraints for farmers are soil erosion and declining soil fertility (Mugasha, Isinika and O'Kting'ati, 1996; Kessy *et al.*, 1988).

The local agropastoral system involves individually farmed arable plots and communally or privately owned grazing lands. The cropping units are generally small. Food crops grown in the system are maize, sorghum, bulrush, millet, cassava, rice and chickpeas. Livestock plays a major role next to the agricultural component. Herd size in this system is above subsistence level, and cattle require extensive use of land resources. Cattle not only provide milk for home consumption and draught power, but also fulfil social functions (prestige and bride price). A gradual increase in the human and livestock populations has led to a number of constraints such as land shortage for grazing, soil exhaustion, deforestation, fuelwood shortage and lack of fodder for livestock (Mugasha, Isinika and O'Kting'ati, 1996; Kessy *et al.* 1988).

The most important constraint limiting livestock production and food security in the area is the shortage of dry-season fodder, especially in years with insufficient rainfall (Maro, 1995; Kamwenda, 1999).

Extensive grazing scenario

Meatu district was evaluated for its suitability for extensive grazing under silvipastoral land use based on land and environmental conditions (Table 1).

Because the humid period when precipitation is greater than evapotranspiration is very short (78 to 142 days for the past ten years), the growing period is not suitable for pasture growth. Most of the year vegetation survives on stored soil moisture, and the growing period ceases as soon as the rainfall falls below evapotranspiration.

The sufficiency of water for pasture in Meatu was rated moderately suitable, based on the effective soil depth (50 to 90cm) and rainfall ranges (600 to 1000mm per annum).

The district temperature regime of maximum temperature 27.6°C to 30.2°C and minimum temperature of 15°C to 18.3°C, with mean temperature of 22.6°C to 24.6°C, is moderately suitable for pasture.

The soils are mainly red to yellowish, freely drained tropical soils (latisols), judged suitable for pasture. The greater part of the soils of Meatu are still regenerating and with time can develop reasonable nutrient

sufficiency status, particularly under natural regeneration of vegetative cover (District Rural Development Programme, personal communication, 1997).

Thus, based on land qualities, Meatu would be moderately suitable for extensive grazing, if it were not for the erosion hazard, which is severe in all places. The *ngitili* system appears to be a viable alternative.

NGITILI SYSTEM

Establishment and management

Ngitili areas are traditionally established on degraded land and around homesteads. They vary in size from 0.2 to 20ha for private ones to 50ha for communal *ngitili* (Maro, 1995). The boundaries are usually not rigidly marked, and physical barriers are not established, but ownership rights are well respected. The *ngitili* are protected by by-laws enforced by the local guards (*sungusungu*), and offenders must pay penalties.

The site selection for *ngitili* establishment is influenced by land availability, proximity to homesteads and ease of protection. Initial siting of the area is the responsibility of the household head. In the case of private or communal *ngitili*, a group of elders becomes responsible (Kilahama, 1994a). The potential sites are demarcated at the beginning of the wet season. Once the *ngitili* are demarcated and closed for protection, very little or no management is required during the rainy season.

TABLE 1. Suitability of conditions for extensive grazing in Meatu district, United Republic of Tanzania

Criterion	Suitability for extensive grazing
Soil sodicity	Suitable
Sufficiency of soil nutrients	Suitable
Temperature regime	Moderately suitable
Sufficiency of water for pasture	Moderately suitable
Drinking-water for animals	Moderately suitable
Growing period	Not suitable
Soil erosion and other hazards	Not suitable

Grazing starts from July or August, after the crop residues and fallow vegetation have been depleted. The most common system involves temporary demarcation of paddocks for specific periods. Upon the completion of fodder on a particular paddock, animals are moved to a fresh paddock. The demarcation of paddocks and the movement of animals between them is controlled by experienced elders, who make management decisions on the basis of specific indicators such as the utilization level and the availability of fodder.

The Wasukuma over the years have developed systematic management practices for *ngitili*. Management is aimed at optimizing fodder and thatch grass production and growth of other vegetation

species, hence improving biodiversity. Large trees which would possibly deter grass growth are deliberately removed, while fodder trees are protected. Most of the trees that now exist in *ngitili* are believed to influence grass production and the general fodder situation (Kilahama, 1994b).

***Ngitili* components, structure and composition**

Ngitili have two major components: vegetation and animals. The animal component encompasses mostly goats, cattle, sheep and donkeys. The interaction of livestock with vegetation has a significant role in the management and sustainability of the system.

Two distinct vegetation strata are identifiable, an upper stratum dominated by *Acacia tortilis*, *A. nilotica*, *A. polyacantha* and *A. seyal*, and a lower stratum of grasses, herbs and forbs. The structure and composition of *ngitili* are highly influenced by location, age, management practices and intensity of use.

The study identified 17 commonly grazed fodder grasses, 25 commonly browsed herbs and forbs and 25 browsed tree species used in *ngitili* (Table 2).

DISCUSSION AND CONCLUSIONS

The potential of *ngitili* as a silvopastoral practice was evaluated based on criteria for evaluating agroforestry set forth by FAO (1977, 1979, 1993a, 1993b) and Raintree (1987) (Table 3). It was found suitable by virtue of meeting required levels of sustainable production of dry-season fodder supplies, food for security and mitigation of land degradation such as severe soil erosion and deforestation.

Moreover, *ngitili* as a traditional practice has a great potential of improving the ecology of the soils and biodiversity of the sites, where trees, grasses, herbs and forbs grow together. Trees stabilize the soils because they are usually rooted deeply, and they enrich the surface soil with their litter (leaves, flowers, twigs and branches). The extensive ground cover reduces runoff, helps prevent soil erosion and facilitates water infiltration, percolation and storage in soil.

Two important lessons can be drawn from the Shinyanga example. First, *ngitili* is a traditional development and conservation mechanism, as opposed to an externally imposed cure for perceived (and sometimes real) land degradation problems. The people have developed and applied detailed knowledge about natural resource management through the *ngitili* practice. Second, customary institutions provide a strong social structure for implementing improvements and changes. Since the introduction of participatory extension in 1986, replacing the previously top-down extension ap-



A typical *ngitili*, Shinyanga region, United Republic of Tanzania

Cattle about to enter a typical *ngitili* for grazing



TABLE 2. Common tree species found in *ngitili* of Meatu and their environmental and fodder roles

Species	Environmental role	Parts foraged
<i>Acacia albida</i>	Nitrogen fixation, shade, soil conservation, dune fixation, soil improvement	Pods
<i>Acacia mellifera</i>	Nitrogen fixation, soil conservation, dune fixation	Pods
<i>Acacia nilotica</i>	Soil improvement, windbreak, nitrogen fixation, soil conservation	Leaves
<i>Acacia polyacantha</i>	Nitrogen fixation, ornamental, soil improvement	Leaves, pods, seeds
<i>Acacia saligna</i>	Mulch, shade, soil improvement, nitrogen fixation, soil conservation	
<i>Acacia senegal</i>	Nitrogen fixation, shade, soil conservation, soil improvement	Leaves
<i>Acacia seyal</i>	Nitrogen fixation, soil conservation, soil improvement, windbreak	Leaves
<i>Acacia tortilis</i>	Nitrogen fixation, shade, soil conservation, soil improvement, windbreak	Leaves, pods, seeds
<i>Acacia xanthophloea</i>	Nitrogen fixation, soil improvement, ornamental	
<i>Adansonia digitata</i>		
<i>Albizia gummifera</i>	Nitrogen fixation, shade, mulch, soil conservation, dune fixation, soil improvement	Leaves, fruits
<i>Albizia lebbek</i>	Mulch, nitrogen fixation, shade, soil conservation, ornamental, soil improvement	
<i>Azadirachta indica</i>	Windbreak, nitrogen fixation	
<i>Bauhinia variegata</i>	Nitrogen fixation, shade, soil conservation, ornamental, dune fixation, soil improvement	
<i>Borassus aethiopicum</i>		Fruits, leaves
<i>Brachystegia</i> spp.		Seeds
<i>Dalbergia melanoxylon</i>	Mulch, nitrogen fixation	Leaves
<i>Dichrostachys cinerea</i>		Leaves
<i>Erythrina abyssinica</i>	Ornamental, mulch, nitrogen fixation	Leaves
<i>Grewia bicolor</i>		Leaves, fruits
<i>Kigelia africana</i>		Leaves, flowers
<i>Parinari curatellifolia</i>	Shade, ornamental	
<i>Salvadora persica</i>	Mulch, nitrogen fixation, shade, soil conservation, dune fixation, soil improvement	
<i>Sclerocarya birrea</i>		Leaves, fruits
<i>Tamarindus indica</i>	Shade, ornamental, mulch	Leaves, fruits
<i>Trema orientalis</i>	Mulch, shade, soil conservation, ornamental, dune fixation	Leaves, fruits, pods
<i>Trichilia emetica</i>		Leaves
<i>Ximenia americana</i>		Leaves
<i>Ziziphus mauritania</i>	Soil conservation, windbreak	Leaves
<i>Ziziphus mucronata</i>		Leaves, flowers

proach, a remarkable change in attitudes towards woodlands and grasslands and their restoration has been realized.

Forest and woodland restoration is not just the responsibility of government. The *ngitili* case study demonstrates that rural farmers and villages can restore significant areas provided the incentives are right. In this case the two main drivers for adopting the resto-

ration practice were the need for dry-season forage for livestock and increasing needs for timber and non-wood forest products. The individual areas restored may not be large, but the number of people who either individually or jointly own them is great, and they are spread widely over the region.

Legal instruments for protecting *ngitili* are based on traditional rules and village

by-laws and are not externally imposed. Traditional rules are informal and neither documented nor enacted by a defined legal body. The main advantage of using them is that most people strictly adhere to them. Village-level by-laws are formal legal instruments. Experience has shown that villagers do not always adhere to by-laws unless they are linked to, or formal-

TABLE 3. Specifications for the *ngitili* system in Meatu district, United Republic of Tanzania

Subsystem	Functions and output	Management
Undergrowth vegetation, herbs and forbs	Browsing fodder production, soil conservation, microclimatic amelioration	Rotational browsing, paddocks, cut and carry, periodic opening and closing of enclosures
Undergrowth vegetation, grasses	Grazing fodder production, soil conservation, microhabitat, microclimatic amelioration	Rotational grazing, paddocks, cut and carry, periodic closing and opening
Intermediate to upper storey, tree species (predominantly <i>Acacia</i> spp.)	Browsing fodder production, soil conservation, microhabitat, microclimatic amelioration	Rotational grazing, paddocks, cut and carry, lopping, periodic closing and opening
Boundary planting (<i>Euphorbia tirucalli</i> , <i>Agave sisalana</i> , <i>Acacia</i> spp., <i>Eucalyptus</i> spp.)	Protection of enclosures, control of trespassing and encroachment; provision of browsing fodder, fuelwood and poles, microclimatic amelioration,	Enrichment planting, lopping, thinning and pruning
Animal component	Production of milk, meat and hides, income generation, interaction with vegetation	Rotational grazing/ browsing, paddocks, herding and zero grazing

ize, customary rules and regulations, or unless the villagers have a strong sense of ownership of the by-laws. In the Shinyanga region, customary rules and village by-laws are complementary. The choice of whether to use customary or statutory regulations depends on the problem or issue that needs to be addressed, the village leadership and the social set-up of the village.

The external validity of these findings remains a challenge to researchers, while their local validity could invite interesting possibilities for extension. ♦



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