

Full Length Research Paper

The role of indigenous knowledge and perceptions of pastoral communities on traditional grazing management in north-western Tanzania

Ismail Saidi Selemani^{1,2}, Lars Olav Eik³, Øystein Holand¹, Tormod Ådnøy¹, Ephraim Mtengeti² and Daniel Mushi²

¹Department of Animal and Aquacultural Sciences, Norwegian University of Life Sciences, P. O. Box 5003, N-1432, Ås, Norway.

²Department of Animal Science and Production, Sokoine University of Agriculture, P. O. Box 3004, Morogoro, Tanzania.

³Department of International Environment and Development Studies (Noragric), Norwegian University of Life Sciences, P. O. Box 5003, N-1432, Ås, Norway.

Accepted 26 September, 2012

Traditional forage conservation, locally known as “ngitili”, which involves retaining an area of standing vegetation from the beginning of rainy season and opening it up for grazing at the peak of dry season, has become an important strategy for rangeland rehabilitation in the north-western semi-arid part of Tanzania. The present study assessed the current rangeland management practices, the role of indigenous knowledge on *ngitili* conservation and perceptions of agropastoralists on communal resources management. Data were collected from a total of 10 villages of Shinyanga rural and Meatu district. Over 90% of villagers were agropastoralists, where the mean numbers of specific livestock per interviewed household were 51 cattle, 40 goats, 20 sheep and 7 horses. The two most important traditional rangeland management strategies practiced by agropastoralists in this region were *ngitili* conservation and seasonal movement of livestock herds. Management of common resources was perceived to be problematic and most agro-pastoralists shifted from communal rangelands toward individual private *ngitili*. Interviewed agro-pastoralists claimed that, unequal sharing of benefits accrued from communal resources and poor management of communal *ngitili* lead to the preference of private *ngitili* to communal ones. The contribution of indigenous knowledge of Sukuma people lead to the success of *ngitili* conservation. However, the sustainability of this vital local knowledge is questionable. This paper recommends participatory management that allows integration of existing local knowledge in rangeland improvement.

Key words: Local knowledge, *ngitili*, rangeland degradation.

INTRODUCTION

Most of the pastoral communities that occupy the arid part of north-western Tanzania employ traditional fodder conservation practices and seasonal mobility. The pressure on grazing land in this region is quite intense,

and the magnitude of land degradation seems to have overwhelmed the indigenous people who previously used to live harmoniously with available natural resources. Kamwenda (2002) pointed out that extensive grazing and haphazard exploitation of rangeland resources in Shinyanga region caused serious environmental degradation. According to Wiskerke (2008), the pressure on this rangeland is attributed to, among other factors, an increase in number of livestock and crop production

*Corresponding author. E-mail: suma02seleman@yahoo.co.uk.
Tel: +255787251720.

leading to severe land degradation

Historically, the degradation of rangeland in Shinyanga is dated back to colonial era and has been associated with vegetation clearing programme aimed at eradicating high population of tsetseflies and typanosomia. In connection to clearing programme, villagilazation programme in 1970's lead to the abandonment of previous tradition *ngitili* practices and thus accelerated rangeland deterioration. *Ngitili* practice involves retaining an area of standing vegetation from the beginning of rainy season and opening it up for grazing at the peak of dry season. Human population increased rapidly and lead to high demand for fuel wood and cropland (Pye-Smith, 2010). Increase in number of livestock in Shinyanga and erratic rainfall has had influence on rangeland degradation.

Rangeland degradation due to extensive grazing in Shinyanga, threatens livelihood in this region, in terms of shortage of forage during dry seasons, deforestation, wood fuel scarcity, food insecurity and severe soil erosion (Kamwenda, 2002). Rubanza et al. (2007) described that livestock production in the north-western Tanzania especially during dry season is limited by low biomass productivity. According to Pye-Smith (2010), previous attempts which were led by the World Bank and other agencies to restore degraded rangeland in Shinyanga, largely failed partly due to exclusion of local people from decision making process.

Fisher et al. (2008) mentioned that, one way in which restoration programmes have been detrimental to local communities is by not involving local people in intervention programmes. However, Agrawal (2000) pointed out that since 1980s' most of conservation strategies related to management of protected land have shown a movement from local peoples' exclusion toward participation. Recognizing the role of indigenous knowledge in rangeland conservation, Ur-Rehman (2007), insists on incorporating local knowledge in ecosystem restoration projects.

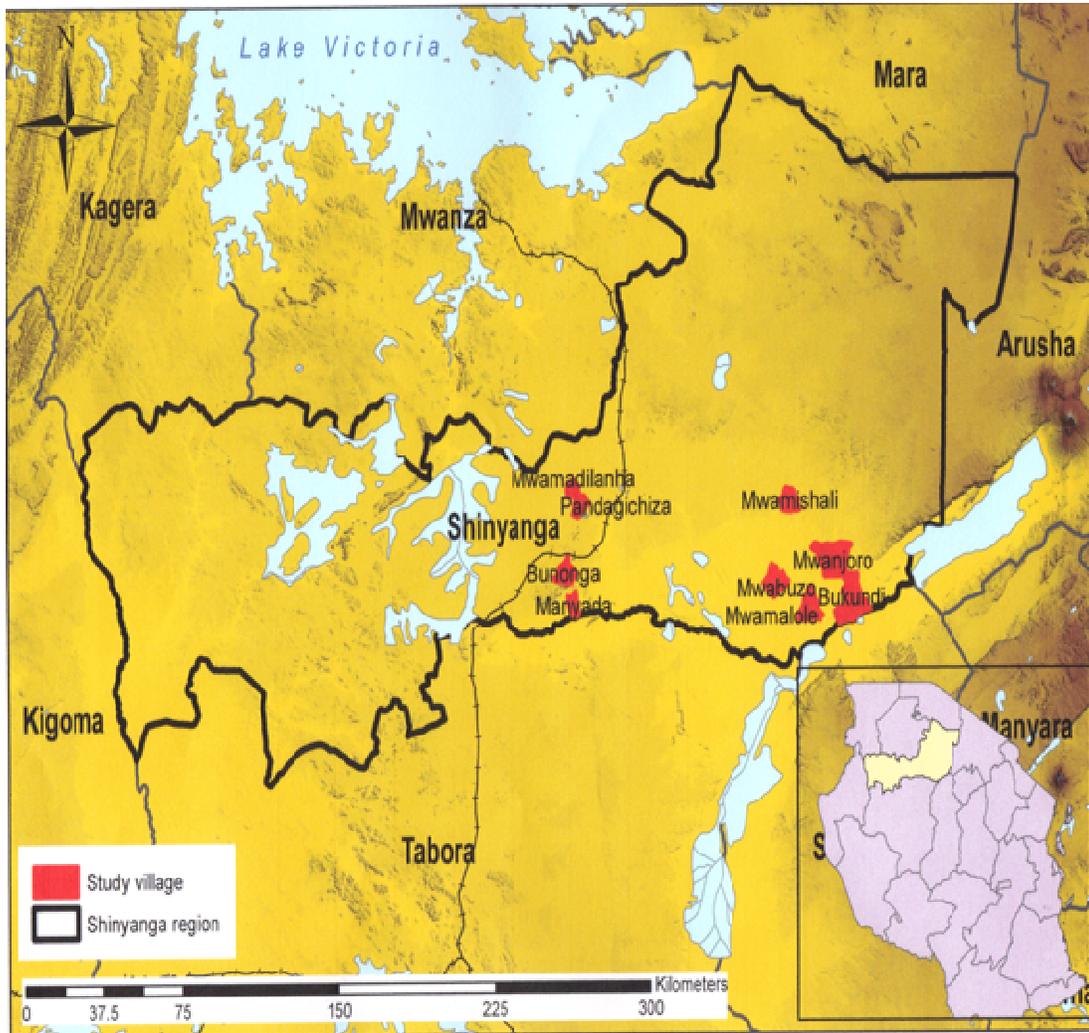
Seasonal mobility is one of the best strategy enabled Shinyanga pastoralists to utilize variety of rangeland resources with different seasonal characteristics. In most semi-arid regions of Tanzania, regular movements between wet and dry season have been practiced (Benjaminsen et al., 2009) to make best use of available resources and opportunities. The availability of pasture, water and minerals usually dictate the seasonal movement of livestock herds. However, most of rangelands in Tanzania have been heavily cultivated, leaving a mosaic of crop lands, fallow lands and natural reserves that may limit option for livestock migration. Little information is known in the study area about other challenges that limit seasonal migration of livestock.

Tanzanian pastoralists have adapted several other copying strategies to overcome feed shortage, which include reserving standing hay (Kamwenda, 2002), use of high nitrogen multipurpose tree legumes (Ndemanisho et al., 1998), treatment of crop residues with chemicals and

concentrate supplements (Mushi et al., 2009). The Sukuma agro-pastoralist communities in Shinyanga use their indigenous silvopasture technology to conserve fodder during the rainy season and feed their livestock during the dry season when forages are limited (Mwilawa et al., 2008). However, the efforts for integrating indigenous knowledge in the development of *ngitili* conservation system have not been sufficiently evaluated, documented and disseminated to other pastoralist communities in Tanzania. Oba and Kaitira (2006) emphasized that integration of indigenous knowledge into rangeland management may provide a quick way of understanding the prevailing land use impacts. Little effort to evaluate, integrate, document and disseminate local knowledge is attributed to the scientific bias that views pastoralists as exploiter of resources and thus makes difficult for herders and range ecologists to collaborate. According to Roba and Gufu (2009) most of the rangeland management practices in Africa have excluded local pastoralists' knowledge and considered scientific methods exclusively.

The insights on the role of indigenous knowledge could make important contributions for understanding changes in grazing patterns and rangeland improvement. The process of rangeland restoration would be made considerably more fruitful if local knowledge and perceptions are taken into consideration (Roba and Gufu, 2009). Solomon et al. (2006) proposed that any attempt to improve grazing conditions of pastoralists, first requires thorough understanding of indigenous knowledge, traditional practices, goals and strategies. The pastoralists' profound knowledge on key forage species and grazing behavior of livestock can form the basis for designing appropriate grazing management practices. Most interventions or development actions for improving livestock in Tanzania have proved unsuccessful, partly due to failure to obtain pastoralists' participation in providing necessary local knowledge.

Restoration of degraded rangeland in other part of East Africa through use of enclosures has shown positive effects on biodiversity (Verdoodt et al., 2009). Yet management options of particular enclosure may play major role in determining rangeland productivity. Agro-pastoralist communities occupying semi-arid region of Tanzania make use of both private and communal *ngitili* conservation management. Yet, no through study has been done in this region to evaluate the effect of *ngitili* management, being private or communal on rangeland productivity. In the north-western Tanzania, particularly in Shinyanga region, most agropastoralists communities tend to shift from previously practiced communal traditional forage conservation to private *ngitili*. The reason for this shift was previously not well known. This study assessed the motive behind changes in this paradigm, the roles of indigenous knowledge in traditional forage conservation, the perceptions of agropastoralists on common resource pools and factors limiting seasonal



SOURCE: TAWIRI

WGS 1984, UTM ZONE 36 S

Figure 1. Map showing study villages in Shinyanga, Tanzania.

mobility.

MATERIALS AND METHODS

Study area

This study was carried out in Shinyanga region, Tanzania, between January and February 2011. Shinyanga region is located at 2-3°S; and 31-31.5°E (south of Lake Victoria) and its altitude above sea level is 1000-1500 m (Kamwenda, 2002). The region is comprised of eight districts (Maswa, Kahama, Bukombe, Kishapu, Miatu, Bariadi, Shinyanga rural and Shinyanga urban) inhabited mostly by Sukuma people.

The area has semi-arid climate and receives low rainfall ranging from 600 mm to 800 mm per year (Rubanza et al., 2007). Drought, which occurs from June to November, is a common characteristic of the area. The minimum and maximum temperatures vary from 16.7 to 28.9°C (Rubanza et al., 2005). The vegetation consists of predominantly Acacia woodland with some areas covered by short

grasses and scattered shrubs (Rubanza et al., 2003).

Sampling procedures

The study was done in Shinyanga rural and Meatu. The selection of Shinyanga rural and Meatu was based on their effort in rangeland rehabilitation through *ngitili* conservation, the practice facilitated by The Shinyanga Region and Soil Conservation Programme, known as “Hifadhi Ardhi Shinyanga” (HASHI) in Swahili (Kamwenda, 2002; Pye-Smith, 2010). Ten villages, five from each district, were selected purposively based on experience of villagers on grazing management and forage conservation. The surveyed villages were Manyada, Bugogo, Bunango, Pandagichiza and Mwamadhaha from Shinyanga rural and Bukundi, Mwanjoro, Mwamishale, Mwamalole and Mwabuzo from Meatu district (Figure 1). Twenty households per village were randomly selected, for interview; so a total of 100 households per district were interviewed making a total of 200 respondents in the two districts.

Both quantitative and qualitative data were collected through combination of methods including interview with household heads

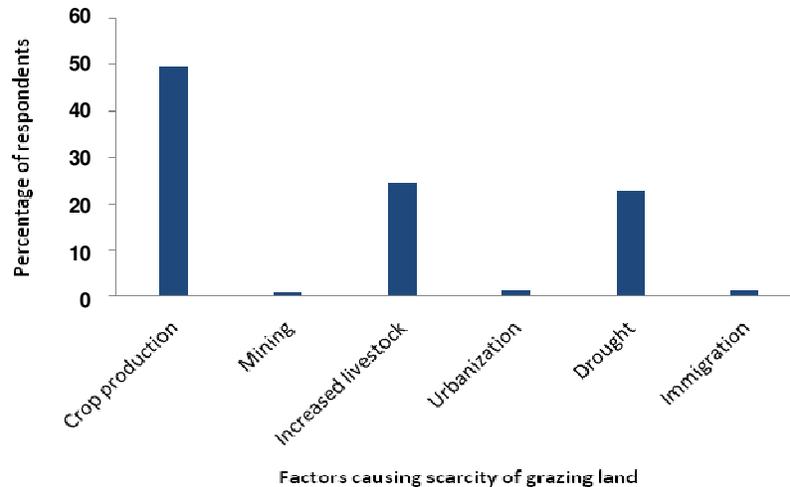


Figure 2. Perceived factors causing scarcity of grazing land in Shinyanga region.

using prepared questionnaire, focus group discussion with selected villagers, leaders and elders using checklist, and observation method during field survey with community experts. The questionnaire and checklists included information such as land use system and ownership, indigenous knowledge on grazing management, community perception on current grazing practice, sustainability of the practice as well as strengths and weaknesses of the current grazing system.

The prepared questionnaire was tested during one week of pilot study on 20 village members, prior to its administration to the household members in the main study. Two assistant researchers were trained and equipped with appropriate techniques of data collection. Twenty technical persons (ten in each district) including staff members from district councils, Natural Resources and Agroforestry Centre (NAFRAC) and Tanzania Traditional Energy Development and Environmental Organization (TaTEDO), with relevant knowledge in range science and extension officers were interviewed using a special questionnaire prepared for them. In focus group discussion, at least five experienced people in each village were involved in discussion using prepared checklist as a guidelines. The village government leaders were involved in selecting members of focus group discussion. Focus group discussion was conducted in open ended manner to gather sufficient information. The observation techniques using transect walk in the field were used to gather information related to experiences and knowledge of community on grazing practice and history of *ngitili* conservation.

Data analysis

Data collected from structured questionnaire were subjected to analysis using Statistical Packages for Social Sciences (SPSS). Both quantitative and qualitative data from closed end questionnaire, focus group discussion, and discussion during transect walk in the field were coded, summarized and variables such as frequency and means were analyzed using SPSS.

RESULTS

Household background

The Sukuma household usually includes man, as a head

of family, his wife, their children and other dependants. In this study, 86.5% of interviewed respondents were male-headed families and only 13.5% were female-headed families. The age class distribution of respondents was as follows: Less than 21 years (0%); between 21-40 years (30.8%); 41-60 years (52%); 61-80 years (16.7%) and more than 80 years (0.5%). In terms of education status, 20.5% of respondents had informal education, 77% attended primary schools, 2% secondary school and 0.5% had attained post secondary education.

Livestock production

The Sukuma people rely on both crop and livestock production. Out of 200 respondents, 93% were agropastoralists, 6% relied on crop alone and only 1% relied solely on livestock keeping. The mean numbers of cattle, goats, sheep and horses per interviewed household possessed livestock were 50.83, 40.45, 20.47 and 7.37, respectively. However, livestock production in Shinyanga has been limited by scarcity of grazing land. Interviewed respondents claimed that; the scarcity of grazing land is caused by increased crop production followed by increased number of livestock and unpredictable rainfall in Shinyanga region (Figure 2). Other factors mentioned under Figure 2 are urbanization mining and immigration.

Rangeland management practices

Agropastoralist communities in north-western Tanzania have adopted the two most important traditional rangeland management strategies, namely *ngitili* conservation and mobility. With regard to traditional forage conservation, two main types of *ngitili* differing in size and management are practiced in Shinyanga region;

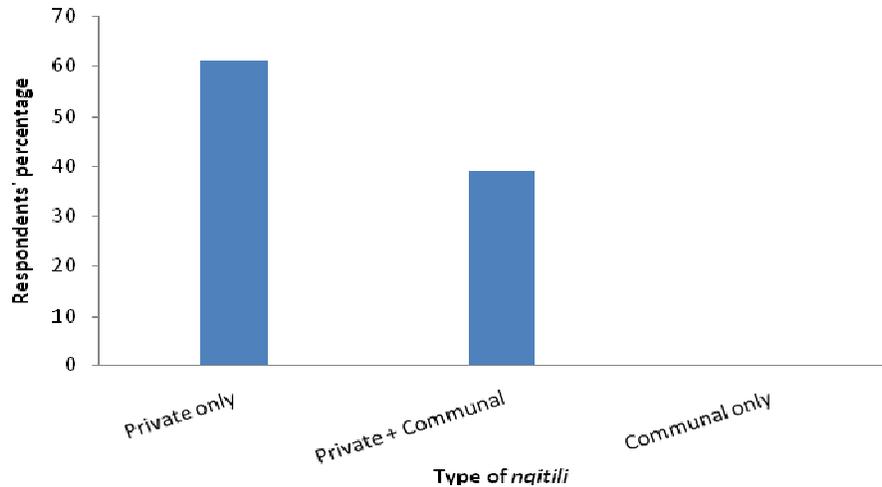


Figure 3. Types of ngitili practiced by Sukuma people in Shinyanga region

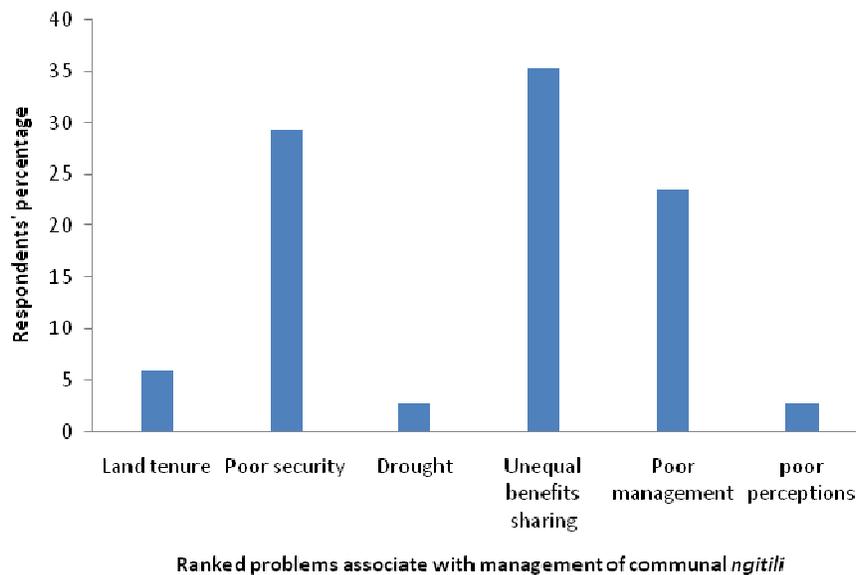


Figure 4. The constraints related to management of communal ngitili in Shinyanga .

private and communal ngitili. The average sizes of private and communal ngitili were 54.89 and 178.89 ha, respectively. However, selective percent of interviewed agro-pastoralists were found to practice private ngitili conservation and less percentage of them were engaged in both private and communal ngitili conservation (Figure 3). Respondents argued that;-communal ngitili provide low economic return mainly because of unequal sharing of benefits, poor land security and poor grazing management (Figure 4).

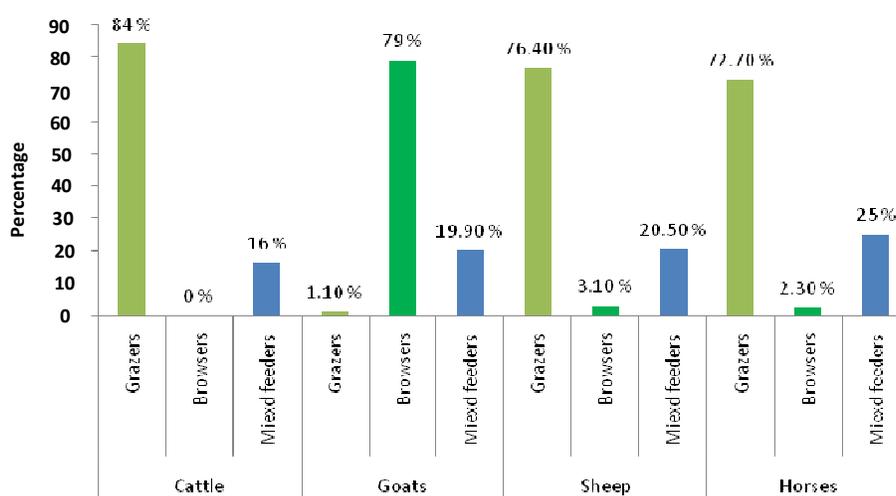
Traditional forage conservation and role of indigenous knowledge

Out of 200 people interviewed, 42% of them practiced

traditional forage conservation (ngitili) for the purpose of grazing during dry season. Others (24%) practice ngitili for firewood collection, while the rest conserved ngitili in order to obtain building materials (12%), timber (3%), to conserve environment (4%) and other (7%) for charcoal making. Moreover, about 8% of respondents indicated to conserve ngitili for purpose of selling standing hay to livestock keepers during dry season when feed is scarce. The Sukuma people have locally acquired knowledge which is very useful in grazing management especially destocking and traditional conservation of forage (Table 1). Most of respondents claimed to have knowledge of their rangeland condition and thus reduce the number of their livestock well below ecological carrying capacity by destocking their animals. More than 10% of these interviewed households mentioned under Table 1 have

Table 1. The Sukuma local strategies used in grazing management practices.

Local strategies	Traditional by-laws	Provision of fine	Rotation grazing	Tree planting	Sustainable harvesting	Conservation forage	Use Village guards	Collective management	good leadership	Installation of fence	Seasonal mobility	Destocking	Obedience/respect	Free ranging	Traditional dance	Set aside grazing areas	Prescribe burning	Total
Respondents' %	6.5	4	4	7.2	1	13	2	1	1	10	9	25	6	5	2	2	1	100

**Figure 5.** Classification of livestock into different feeding groups

knowledge of forage conservation and thus selection of *ngitili* sites based on availability of highly nutritive forage species. Seasonal movement of livestock rotational grazing, tree planting, installation of fence, prescribed burning and use of traditional ceremonies were also mentioned as examples of locally inherited strategies used in grazing management.

Agropastoralist communities in Shinyanga have local knowledge on grazing behavior of their livestock. More than 80% of respondents acknowledged that each livestock species has unique feeding strategy that separates them from others. Interviewed pastoralists categorized livestock into feeding groups ranging from pure grazers, intermediate or mixed feeders and pure browsers (Figure 5).

Classification of feed resources

In Table 2 out of 200 interviewed villagers, more than 40% of them mentioned *Eragrostis tenuffolia* as dominant grasses followed by *Cynodon nlemfuensis* and

Hyperrhenia rufa. *Eragrostis tenuffolia* species and *C. nlemfuensis* were listed as most palatable grass species in the study area. However, more than 50% of interviewed people were not familiar with unpalatable grass species, only very little respondents mentioned *Bothriochloa insculpta* and *Hyperrhenia rufa* as unpalatable grass species. In terms of woody species, out of 200 interviewed people, more than 60% of them mentioned *Acacia tortilis* as dominant followed by *Acacia nilotica* (Table 2). Under the same table, most of interviewed villagers indicated *A. tortilis* and *A. nilotica* as palatable browses. Likewise, most of interviewed villagers had little knowledge of unpalatable browse species, only few respondents mentioned *Diospyrus fischeri* *Terminalia sericea*, *Albizia amara* as unpalatable browses (Table 2).

Indicators of range condition and sustainability of local knowledge

The Sukuma people have local knowledge used to

Table 2. Key herbaceous and woody species typical in Shinyanga region.

		Key herbaceous plant species					
Local name	Scientific name	Dominant		Palatable		Unpalatable	
		F	P	F	P	F	P
Iugobi	<i>Cynodon nlemfuensis</i>	57	28.5	75	37.5	1	0.5
Nhelengu	<i>Hyperrhenia rufa</i>	33	16.5	11	5.5	25	12.5
Funya	<i>Gloris gayana</i>	3	1.5	6	3	9	4.5
Huruda	<i>Bothriochloa radicans</i>	4	2	0	0	32	16
Legi	<i>Pennisetum mezianum</i>	3	1.5	0	0	0	0
Tiza	<i>Commelina benghalensis</i>	1	0.5	0	0	0	0
Gurunya	<i>Eragrostis spp</i>	89	44.5	90	45	0	0
malambolambo	<i>Echinochloa haploclada</i>	1	0.5	1	0.5	3	1.5
ugimbi	<i>Dactyloctenium aegyptium</i>	0	0	1	0.5	0	0
Feya	<i>Aristida spp</i>	0	0	1	0.5	1	0.5
Shogoro	<i>Tridax spp</i>	0	0	1	0.5	5	2.5
Manumba	<i>Ocimum bacilium</i>	0	0	0	0	4	2
Kihandabasweji	<i>Acanthospermum hispidum</i>	0	0	0	0	1	0.5
Mapuungu	<i>Sorghum alnum</i>	0	0	0	0	3	1.5
Lugomela	<i>Bothriochloa insculpta</i>	0	0	0	0	2	1
Matindang'ombe	<i>Eleusine indica</i>	0	0	0	0	1	0.5
No idea		9	4.5	14	7	113	56.5
Total		200	100	200	100	200	100
		Key browses					
Migunga	<i>Acacia tortilis</i>	124	62	104	52	0	0
Mhale	<i>Acacia nilotica</i>	25	12.5	31	15.5	1	0.5
Migu	<i>Acacia polyacantha</i>	3	1.5	1	0.5	0	0
Lusina	<i>Leucaena lucocephala</i>	0	0	5	2.5	0	0
mitunduru	<i>Dichrostachys cinerea</i>	10	5	9	4.5	0	0
mipogoro	<i>Albizia amara</i>	5	2.5	2	1	1	0.5
Mmale	<i>Lanchoarpus capesa</i>	1	0.5	0	0	0	0
Malulambuli	<i>Ormocarpium ulata</i>	0	0	10	5	0	0
Masubata	<i>Diospyrus fischeri</i>	1	0.5	0	0	3	1.5
Midibilo	<i>Acacia bethamii</i>	1	0.5	0	0	0	0
Midabi	<i>Grewia similis</i>	3	1.5	0	0	0	0
Minyaa	<i>Euphobia tricali</i>	1	0.5	0	0	0	0
Mhunjaminzi	<i>Combretum fraxgrans</i>	2	1	3	1.5	0	0
Mikoma	<i>Grewia bicola</i>	1	0.5	0	0	0	0
Malula	<i>Acacia dropanolabium</i>	1	0.5	2	1	0	0
Mzima	<i>Terminalia sericea</i>	1	0.5	0	0	1	0.5
Mnene	<i>Sterculia quinqueloba</i>	1	0.5	0	0	0	0
Busari	<i>Harrisonia abyssinica</i>	0	0	2	1	0	0
Mvinje	<i>Lannea humilis</i>	0	0	1	0.5	0	0
Mgwata	<i>Acacia senegal</i>	0	0	1	0.5	0	0
No idea		20	10	29	14.5	194	97
Total		200	100	200	100	200	100

*F = Frequency of respondents; P = percentage composition.

determine the range condition and its trend. Sixty five (65%) percent of respondents use plant growth condition as an indicator of quality of *ngitili*, whereas 12.8% used colour of vegetation as indicator of range quality. Plant

species diversity (6.1%), animal plant species preference (4.7%), quality of soil (4.7%), rainfall (4.1%), accumulation of plant litter (1.3%) and animal body condition score (1.3%) were also stated as indicators of range

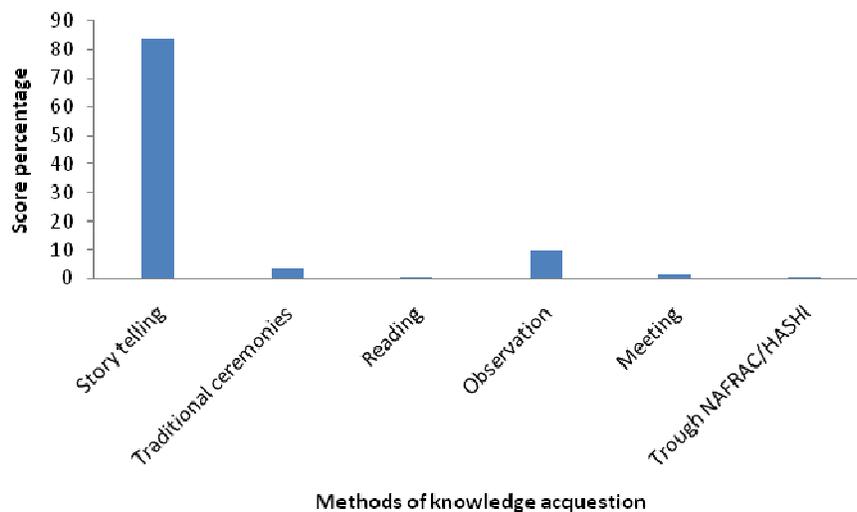


Figure 6. Methods used by Sukuma agropastoralists for acquiring and transfer local knowledge.

condition in respective order.

The main method for acquiring local knowledge in Sukuma communities is mainly through story telling methods from experienced people and elders. More than 50% of all respondents mentioned story telling method as the main source of indigenous knowledge (Figure 6). Likewise, more than 50% of interviewed people ranked the same method as useful tool for transferring local knowledge from one generation to another. However, other methods like village meeting, traditional ceremonies and seminars have also been mentioned as very useful methods for local knowledge transfer.

DISCUSSION

Agropastoralists perceptions on current grazing management strategies

This study revealed two important management strategies adapted by Sukuma agropastoralists, namely traditional forage conservation (*ngitili*) and seasonal movement of livestock-searching for feeds and water. Traditional forage conservation among Sukuma communities has proved to be instrumental in rangeland restoration. Interviewed households acknowledged that *ngitili* has improved their lives through grazing, firewood collection, environmental conservation and controlled soil erosion. These findings are similar to those reported by Barrow and Shah (2011), which assert that *ngitili* practice relied on indigenous knowledge has successfully enabled protection of environment and improved livelihood of communities in Shinyanga region.

Ngitili evolved in response to acute shortage of forage due to drought and diminishing of grazing land as a result of increased number of livestock, cropping and shortage

of herding labour. Increased acreage under cropping, number of livestock and frequency of drought have been repeatedly cited as the main causes of scarcity of grazing land in this study. The *ngitili* conservation system has partly solved the problem of forage scarcity in Shinyanga region.

Two types of *ngitili* practiced in Shinyanga are communal *ngitili* and private *ngitili*, which differs in terms of size and management systems. In the present study, it has been found that private *ngitili* are relative smaller in size, ranging from 1 to 400 ha while communal *ngitili* range from 1 to 500 ha. However these findings are contrary to those of Kamwenda (2002), who reported that private *ngitili* in Meatu district range from 0.2 to 20 ha and communal *ngitili* of an average size of 50 ha. This contradiction may be associated with the size of study areas; the previous study centered only in one village of Meatu district while present study involves ten villages from two districts with many (200) respondents. In terms of management, communal *ngitili* seemed to be poorly managed compared to private ones. These findings are supported by Tefera et al. (2007) who concluded that communal rangeland are generally in poor condition compared to private rangeland.

Most Sukuma agropastoralists currently are shifting from communal *ngitili* conservation to individual ones. The important lesson that can be drawn from this paradigm shift is the perceived problem associated with management of common resources pool. Pye-Smith (2010) described that communal *ngitili* are mainly managed by communities through village government, or institutions such as school, community based organization, mosques and churches. The quality of communal *ngitili* depends mainly on quality of managing institution. In this study, interviewed households coupled with focus group discussion participants mentioned factors; unequal

sharing of benefits accrued from communal *ngitili*, poor management and conflicts as main challenges associated with management of communal *ngitili*.

Adams et al. (2003), described that in management of common resources, conflicts are unavoidable. The characteristics of common property based on physical nature of the resources in such a way that controlling of common resources to potential users is costly and virtually impossible. Thus, conflicts are viewed as inseparable aspect in common resource pool management. Agrawal (2000) proposed participatory management as new innovation that could resolve conflicts by involving local communities. The big challenge in management of communal *ngitili* in Shinyanga is that management decisions are made by village government leaders and/or institution leaders on behalf of community members. We encouraged participatory rangeland management which aims to share existing local knowledge through community dialogue process. Pastoralist communities have collectively accumulated vast amount of experience in their local environments.

The second grazing strategy adopted by Sukuma agropastoralists to combat shortage of forage is seasonal movement of herds to various places. More agropastoralists were found to practice mobility and the few of them were sedentary. Homewood (2008), indicated that mobility is far better in terms of livestock production compared to sedentary livestock management. Mobility reduces grazing pressure and thus improve heterogeneity on rangeland ecosystem (Samuel and Engle, 2001). The importance of heterogeneity in rangeland is evident from ecological variability and feeding separation of different grazing animal groups in the study area. In focus group discussion participants argued that pastoralists are forced to migrate to *rubaga* (new grazing areas) due to scarcity of forages and water especially during dry seasons. This practice, apart from reducing grazing pressure, allows resting land for regeneration of new and palatable native pastures.

Despite its importance, livestock mobility in Tanzania has been characterized by numerous constraints, including; land use conflicts, exposing livestock to various diseases, blockage of stock routes and causing soil compaction and erosion. Livestock mobility has been perceived as an unorganized and environmentally destructive practice and thus sedentarization has been proposed as a solution by confining pastoralists to a certain defined areas (Benjaminsen et al., 2009). Vetter (2005) pointed out that, pastoral systems are commonly viewed as an unproductive and thus contributing less to national economies. In the study area, exposure of livestock to various diseases which leads to high mortality rate, soil erosion, and conflicts between pastoralists and farmers were frequently mentioned as problems associated with seasonal mobility. Experiences from local conflicts in Kilosa District that tragically ended in the killing of 38 people (Benjaminsen et al., 2009) and eviction of large number of herders from Usungu plain in

Mbarali District in 2006, which resulted in huge economic loss due to high mortality of transported livestock are few examples of challenges facing mobility as a grazing strategy for pastoralists in Tanzania.

Role of indigenous knowledge in grazing management

The traditional fodder conservation is based on inherited Sukuma indigenous knowledge. The use of traditional ceremonies and village guards (*sungusungu*) has successfully facilitated management of both communal and individual *ngitili* in the study area. Findings from this study are similar to those of Kamwenda (2002) who described that Sukuma norms for protecting *ngitili* was based on *sungusungu* and community assemblies (*dagashida*). These two institutions function in ordered manner, whereby through *sungusungu*, men aged 16 and above years conduct regular patrol, but when disputes arise the case can be referred to *dagashida* (Pye-Smith, 2010). The role these two customary institutions are recommended as best practice to be adapted to other pastoralist communities in Tanzania.

The Sukuma people, especially men, have a well developed local knowledge of animal-plant species interaction. Ability to classify their livestock into different feeding groups such as grazers, browsers and intermediate feeders is a result of long experiences acquired by livestock keepers. Although, most of pastoralists lack knowledge related to physiological functions and anatomical characteristics of livestock, yet feeding habits of livestock enabled them to classify livestock into above mentioned groups. Feed selection by each of the feeding groups is primarily influenced by two factors: palatability, the characteristic of plant, and preference, the behavior of animal (Bothma, 2010). In the present study *Eragrostis tenuifolia* and *C. nlemfuensis* have frequently cited as palatable grasses where *A. tortilis*, *A. nilotica*, *O. ulata* and *D. cinerea* were mentioned as palatable browses. In terms of preference, goats have been mentioned as highly selective animal and thus prefer high quality browses of *Acacia* species. Indigenous knowledge on feeding behavior of livestock may play important role in designing appropriate grazing management strategies. Selection of *ngitili* sites and allocation of particular animal groups may be based on habitat characteristics and feeding behavior of particular species of animal respectively.

Acceptability of particular feed is determined by number of factors, including feed composition and physical properties of such feed. Acceptability has been found to be negatively correlated with fibre and lignin contents (Tainton, 1999). For example, in this study, *H. rufa* was frequently cited by respondents as palatable when young but unpalatable when matured. The reasons behind lies on the decline in nutritive values of grass as a result of accumulation of cell wall contents as grass become

matured. These findings are supported by those of Meissner et al. (1999), who reported that acceptability of *H. rufa* declines rapidly as it become increasingly stemmy over the growing season. Most of natural pastures in Tanzania are characterized by fast growth and early maturity followed by rapid decline in nutritive value during dry season (Goromela et al., 1997).

The use of browse species as fodder to ruminants is increasingly become important in African semi-arid environments (Abdulrazak et al., 2000). In the north-west semi arid region of Tanzania especially Shinyanga region Acacia trees are dominants and are important sources of feed to livestock. The interviewed households in Shinyanga reported that two species of Acacia; *A. tortilis* and *A. nilotica* are highly palatable and provide important browses to goats. Meissner et al. (1999) reported that palatability of feed is positively correlated with concentration of protein contents. In his nutritive evaluation of Acacia trees, Abdulrazak et al. (2000), reported that leaf crude protein content of *A. tortilis* and *A. nilotica* were significantly higher than that of *Acacia seyal*. During transect walk in the field some participants mentioned local feeding facilitation technique that facilitate browsers especially goats to access high nutritive pods of acacia species. This involves use of long and hooked wooden stick to pull down branches of acacia trees especially *A. nilotica* in the level that can be accessed by goats. Despite their potential as feed resources to livestock, most woody species contain high level of anti-nutritional factors such as tannins (Assefa et al., 2008). These chemicals are defensive mechanisms in plants and thus are determining factors for palatability and range plant utilization (Bothma, 2010). However, local people in Shinyanga lack knowledge of anti-nutrition factors and hence were unable to explain why some woody species are avoided by browsers.

In the context of rangeland grazing, two indicators are used to assess rangeland improvement namely: plant based ecological indicators and livestock based indicators as those described by Roba and Oba (2009). The Sukuma people have appropriate local knowledge for assessing rangeland condition by using soil quality, plant based and livestock based indicators. When asked the criteria used to assess the change in quality of rangeland resources, respondents mentioned plant growth condition, colour of vegetation, species diversity, soil quality, animal habitat preference and livestock health in respective order. This implies that, the Sukuma pastoralists have relevant local knowledge related to rangeland management which involves the interaction of three factors; vegetation, soil and animals that are very important in monitoring range health.

Conclusion

Ngitili conservation and seasonal mobility are two

important strategies copying adopted by Sukuma people to overcome shortage of forages. The study revealed that, the Sukuma agropastoralists have accumulated locally inherited knowledge about grazing management. The use of customary institutions such as *sungusungu* and *dagashida* in the management of *ngitili* has successfully facilitated rangeland rehabilitation in this region. Indigenous knowledge on feeding behavior and rangeland assessment may be used as important tools in designing the appropriate range management practices. Unfortunately, this vital local knowledge has not yet realized as best strategies to be adapted and disseminated to other pastoralist communities in the country. Moreover, the sustainability of indigenous knowledge is questionable, since its acquisition and methods of transferring this local knowledge from one generation to another solely relies on experienced elders through story telling. It is thus imperative to design special mechanisms for documenting and disseminating the existing vital local knowledge.

The present study also revealed the perceived problem related to the management of common resource pool. Most of Sukuma people are currently shifting from traditionally communal *ngitili* to individual ones. Agropastoralists perceived that, in management of common resource pools, conflicts are unavoidable and thus the only solution is to practice private *ngitili*. Communal rangeland play major roles in productivity of livestock and thus we propose alternative management such as participatory management where integration of local knowledge is emphasized. This paper therefore, recommends participatory management that allows integration of existing local knowledge in rangeland improvement.

ACKNOWLEDGEMENT

The authors thank the Natural Resources and Agroforestry Centre (NAFRAC) and Tanzania Traditional Energy Development and Environmental Organization (TaTEDO) in Shinyanga for providing transport support and research assistants during data collection. We thank the staff members of NAFRAC and the Meatu District Council for their help with identification of plant specimens. Fund for the field work was provided by the Department of Animal and Aquaculture Science (IHA) at Norwegian University of Life Science (UMB) in Norway.

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