

Changing Land-use Systems and Socio-economic Roles of Vegetation in Semi-arid Africa: The Case of the Afar and Tigray of Ethiopia

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ABSTRACT In recent years, increased populations and the accompanying human demands have led to changes in land-use in the drylands of sub-Saharan Africa, in turn resulting in the reduction of vegetation and other natural resources. These changes have had a negative impact on natural resources and how these resources are being exploited. The affected uses include those related to livestock production, farm and off-farm linkages, ethno-veterinary and human medicines and marketing. This study used socio-economic surveys to obtain information on these changes and how, especially, they may be influencing the use of vegetation by the local communities – the Afar and Tigray – in north-eastern Ethiopia. The study revealed that large proportions of the plains are severely denuded due to the introduction of flood recession cultivation (in the early 1960s) with the aim of improving people's livelihoods. The findings further show that woody vegetation provides a range of products for direct use by the local communities. The results suggest that efforts should be made to protect and reproduce important vegetation species by integrating indigenous technical knowledge with modern technology.

INTRODUCTION

Arid and semi-arid lands (ASALs) cover about 60 per cent of Ethiopia's land surface and are home to 12 per cent of the human population and 26 per cent of the livestock population (Coppock, 1994). Various forms of pastoralism in these areas dominate land-use. The uncertainties of rainfall and primary production in the Ethiopian rangelands have promoted animal-based life-style that enable people to be mobile and opportunistic. Over the years, however, patterns of land-use have significantly changed and have threatened the productive capacity of vast areas in the ASALs of the country. As a result, large areas of natural grasslands have been converted into ar-

able lands and settlements.

Even though pastoralism is a successful adaptation to the ASALs ecosystems since it has evolved over several centuries, recent interventions and trends have threatened its viability. As elsewhere in Africa, pastoralists in Ethiopia are under pressure by internal as well as external factors that render their systems unsustainable. Of the major pastoral groups of Ethiopia, the Afars are thought to have suffered most due to population pressure, recurrent drought, ill-conceived development policies, encroachment of cultivation and the subsequent disruption of their traditional institutions (Helland, 1980; ILCA, 1981; G/Mariam, 1991; Ali, 1995).

North-eastern Ethiopia has been isolated from main stream national development for a long time due to civil conflict and therefore personal insecurity. As a result, little or no research has been conducted in many fields, including ecology and socio-economics. It is, thus, believed that this study will have a significant importance for policy makers working in the field of natural resource management. It is for these reasons that this study was conceived and conducted. The objective of this study was therefore to find out people's perceptions about changes in their land-based resources and catalogue indigenous knowledge on the socio-economic functions of woody vegetation in the face of such changes.

STUDY AREA

This study was carried out in Abala District, in the northern part of the Afar Regional State, north-eastern Ethiopia. The study area is located approximately 50 kms. east of Mekelle Town, at an average elevation of 1500 m above sea level.

The soils here are generally sandy and silty, and their texture is fairly coarse, with both sands and gravel present (Hunting and MacDonald, 1976). A semi-arid climate, receiving bimodal rainfall, characterises the area.

Based on the Ethiopian Meteorological Agency, the Shiket Station records for the period 1972–1979 indicate that the area received an average annual rainfall of 422 mm. It experiences high diurnal temperatures and severe heat, locally known as *hagai*, during the dry periods – in May and June. The existing vegetation consists of wooded bushland dominated by *Acacia etbaica*, with many associated trees and shrubs (Hunting and MacDonald, 1976).

According to the Central Statistics Authority (CSA, 1996), the Afar Region's total population is 1,106,383, of whom 27,259 people are found in Abala. About 16,163 people, in 3,454 households, live in the study area. The area is economically an important one where both livestock production and flood-based agricultural systems are practised. An extensive part of the plains is cultivated, the uncultivated area being occupied mainly by pastoral nomads (Hunting and MacDonald, 1976). The introduction of flood recession cultivation in the plains has resulted in the loss of prime grazing lands for the Afars.

METHODS

In this study, stratified systematic sampling (Weisberg and Bowen, 1977) was used to collect data. Sampling involved stratifying households into two homogeneous groups according to their origin (i.e. the indigenous Afars and settled Tigrians). A total of 60 households were interviewed, 30 from each group. Lists of *Bito* (the smallest administrative unit) were used as sampling frames. The initial household was selected at random to start the sampling. From this, and moving down the list, the 6th household was picked, then the 12th, 18th and so on, until the desired sample size was attained for each household group. Data were collected using a semi-structured questionnaire. They were then summarized, ranked and analyzed using descriptive statistics.

RESULTS AND DISCUSSIONS

Socio-Economic Characteristics of Local Communities

The population in Abala District consists of the indigenous Afar and the settled Tigray communities. The Tigrians, who number about 3,462 (CSA, 1996), have been settled in the area since the early 1960s. Agropastoralism was the predominant land-use in this area. Three components of this production system – crops, livestock and trees – contribute in a major way to household food security and income.

From the survey results, 55 per cent of the Tigrians are agropastoralists and 45 per cent are involved in crop production alone. Their primary income is derived from crop production, which accounts for 88 per cent of total income. The rest comes from livestock keeping and off-farm sources. The Tigrians mainly practise flood-recession agriculture along the Shugala, Abala, Murga and Liema flood plains. A few households practise irrigation during the dry season using the Abala river. The Afars who number about 12,536 (CSA, 1996) practise both livestock keeping and cultivation: 90 per cent of the Afars are agropastoralists, while the rest (10%) are pastoralists. The proportion of income from their primary activity – livestock production – was found to be about 65 per cent.

Factors Influencing Settlement and Cultivation

The factors influencing the settlement of the Tigrians and the process of sedentarization of the Afars were investigated. The Tigrians were originally cultivators. The Afars, on the other hand, are descendants of pastoralists. The settlers were asked why and how long they had been settled in the area. As shown in Table 1, the majority (45%) settled 21–30 years ago. The reasons as to why they settled in the area included seeking employment as labourers in road construction and charcoal making, escaping drought, and the need to find cultivable land. The Afars, on the other hand, started involving in agriculture 15–20 years ago. The driving forces towards their sedentarization included loss of grazing land and subsequent reduction of livestock production, loss of livestock following severe droughts,

Table 1: Percentage of settled households by duration and factors influencing settlement in Abala

	Settled households (%)
<i>Duration of settlement</i>	
0-10	—
1-20	30
21-30	45
31-40	25
<i>Factors influencing settlement</i>	
Need for agricultural land	45
Drought problem	10
Labour requirement for Mengesha	30
Labour requirement for road construction, charcoal making	25

land proclamation (in 1975), the need for better income with minimized risk related to settlement, and additional earnings through land-renting.

Increased settlement and subsequent cultivation in semi-arid lands is evident elsewhere in Ethiopia. For example, Ali (1995) reported that the Oromo highlanders settled in western Afar semi-arid lands, pushing the Afars from their dry season grazing areas. The findings in the current study, however, indicate that settlement did not result in pushing the indigenous people to the drier areas, but forced them to sedentarize and change their life-style. It was confirmed that pastoralists start cultivation not because they want to do so, but because only the rights of cultivators to land are recognized by the government and protected by law in Ethiopia (see also Sanford, 1983). Many research results in dryland Africa indicate that the expansion of settlement and dryland agriculture has resulted in transforming the pastoral way of life into agropastoral or sedentary agriculture. This has been reported in Ethiopia, Sudan, Kenya, Niger, Mali and other countries of the Sahel among others (e.g. Helland, 1980; ILCA, 1981; Sandford, 1983; G/Mariam, 1991; Keya, 1991; Kariuki, 1996).

Cultivation of Crops

Based on the socio-economic survey, the predominant source of livelihood in Abala District is agropastoralism. Crop production is mainly based on floods coming from the highlands of Tigray through the Abala, Shugala, Murga and Liena Rivers. Sorghum is the major crop cultivated in the alluvial flood plains. Other crops

include maize, tef, barley, chick-pea and vetch. Both groups of people have on average 2.8 ha of land under crops. However, only a few Afar households are involved in farming; the majority rent out their land to the Tigrians in return for an equal share of harvest. This has helped the two communities to coexist peacefully, benefiting from each other for at least three decades. It has also been reported that the relationship between the two communities is an important part of the mechanism used to cope with the harsh environment (Simonsen, 1996). Flood-based farming in the area is also characterized by the presence of trees dispersed in the farmland. After harvest animals wander freely on the farm during the dry season to feed on the crop residues. Such land-use practices are widely adopted elsewhere in Africa, especially in the transition zones where rainfall is insufficient for rain-fed agriculture.

Major constraints to crop production were cited as being shortage of flood water due to drought, small land sizes, poor flood diversion works, and erosion. Farmers spent more than three months every year to construct diversion spurs, using trees and shrubs, before floods came. Currently, the formation of big gullies and scarcity of trees and shrubs are rated as critical constraints to diverting floods to the cropping fields. As a result, many of the fields have been abandoned. Elders from both communities expressed the fear that the unavailability of cropping land would soon be a critical problem in the face of increased demand for cultivated land and the abandonment of cultivated fields.

Livestock Production and Feed Resources

The average numbers of livestock kept by the Afars and Tigrians are shown in Table 2. Tigrians favour cattle more than other animals since cattle are used for drought purposes besides providing milk. They rear sheep and goats mainly for the market. Donkeys are used for transporting crops, fetching water and collecting as well as selling firewood. Afar households raise, in order of importance, goats, cattle, camels, sheep and donkeys. They favour mainly goats and camels. The reasons given for this were that (i) camel and goat milk is their favourite diet, (ii) in a situation where grass cover is scarce the two species can survive better by browsing the

available trees and shrubs, and (iii) they can resist drought better than others. Goats have an advantage over camels because they give two births a year (mostly twins) and they can browse on steep hills, where camels and cattle cannot. The Afars sell or slaughter day- or week-old male kids and lambs (traditionally called *bekef*). Male

Table 2: Change in average livestock holdings per household in a period of 20 years, 1977–1997, among the Afar and Tigrai

Livestock type	Afar (II)		Tigrai (II)	
	1977	1997	1977	1997
Cattle	38	13	14	7
Sheep	37	17	9	6
Goats	125	53	22	10
Camels	27	9	—	—
Donkeys	1	1	1	2

kids or lambs are only allowed to grow if they are needed for breeding. This system is widely practised by the Afars throughout the region as a means of avoiding competition for feed (during dry seasons) and milk for human consumption (G/Mariam, 1991).

It was found that livestock holdings are declining due to shortage of grazing land, drought, animal diseases, and insecurity. Goat husbandry is a major effort currently due to a decrease in the amount of grass cover and an increase in the woody species composition in the hills and ridges. Camel numbers are, however, on the decline due to their inability to browse in steep hills. The Afars reported that the cultivation of flooded plains have resulted in a decrease in cattle, sheep and camel numbers.

Communal grazing lands in the hills and ridges form the major feed source for livestock followed by crop residues. During the rainy sea-

son animals graze or browse on ridges, hills, uncultivated fields and around homesteads. At the beginning of the dry season, locally known as *gillal* (Table 3), animals are allowed to graze in cropping fields. When the stubble and feed sources in the area are exhausted before the short rains (end of *gillal*) and during the hottest season (*hagai*), the Afars move to the surrounding extensive rangelands of Kala, Dergha and Bahri. Movement may extend up to Teru (about 150 kms. from Abala) during the dry years. The settled Tigrains, however, depend mainly on collected crop residues, usually of tef and barley, during the dry season. They normally do not move except in times of severe drought.

Lopping browse trees is practised, especially by the Afars, during the dry season when grass and herbaceous cover, and crop residues are depleted. Trees and shrubs are recognized as good sources of feed for all types of livestock during the dry season. They are particularly important as goat and camel feed. As livestock feed, *Acacia mellifera*, *A. nubica*, *A. tortilis Indigofera articulata*, *Grewia* species, *Balanites aegyptiaca* and *Salvadora persica* are the most common and preferred species.

Recent settlements and cultivation in the area have considerably increased the pressure on the indigenous people's life-style by reducing flooded grazing areas. As a result, sedentary life is the only choice for the Afars. Further, shortage of grazing land has led to overgrazing, consequently changing the physiognomy of natural vegetation. This finding is in agreement with those of Lamprey and Yussuf (1981), Ayoub (1988), Keya (1991) and Darkoh (1992), who reported that the reduction of dry season grazing land and the resulting overgrazing of marginal areas are caused by flood recession agriculture, irrigation schemes, and

Table 3: Seasons of the year described by the Afar and Tigrai

Season	Period	Description	
Afar	<i>Karma</i>	July-September	Main rainy season
	<i>Gillal</i>	October-December	Cool dry season
	<i>Deda/debaba</i>	January-February	Dry season with some clouds
	<i>Sugom</i>	April-March	Short rainy season
	<i>Hagai</i>	May-June	Hottest season
Tigrai	<i>Kremti</i>	July-September	Main rainy season
	<i>Mekera</i>	October-December	Harvesting time/beginning of dry season
	<i>Azmarā</i>	January-April	Dry season with some rains
	<i>Dirki</i>	May-June	Hot dry season

overstocking. Although the grasses in the plains and hills are depleted, herding is still the main activity among the Afars. In such a situation, trees and shrubs play a central role in animal husbandry as well as in the material, social and religious culture of the Afars.

Marketing of Livestock, Crops and other Products

The main market centre for both Afar and Tigray communities is Abala Town, where merchants from Mekelle Town, sellers and consumers meet. Mature and young animals, mainly males, are sold in the market. Butter, mainly from goats, is sold too, along with crops produced in the area, including fruits of *Ziziphus spina-christi* and *Balanites aegyptiaca*.

Market days are very important, especially for the Afars, for information exchange regarding the well-being of their families, animals, and knowledge about the physical environment. The system of information exchange (locally referred to as *dagu*) is a very well developed communication system of the Afars. *Dagu* is not only limited to local conditions but is also a means of acquiring information about political matters both in the region and at the country level. This system of knowledge is being practised and transmitted from one generation to the next, and lays the foundation for an adaptive continuity. In addition, according to Simonsen (1996), the knowledge held by the Afar elders plays a significant role in their technical management practices.

Local Knowledge on Woody Vegetation Use

Woody species of different genera provide a range of products and services to the Afar and Tigray communities. Nine major uses of trees and shrubs were identified and ranked on the basis of their highest priority uses (Table 4). Among these, fodder, construction and fuelwood were the most valued by both communities. The Tigray, however, ranked fodder third. This is an indication of the different social backgrounds of the two groups. It means that the Afar pastoralists consider livestock fodder as the best use of trees and shrubs, whereas the Tigray who were originally cultivators consider construction as the best use.

The use of trees and shrubs as perennial

Table 4: Priority uses of trees and shrubs ranked by type of use

Use	Rank	
	Afar	Tigray
Fodder for livestock	1	3
Construction	2	1
Fuelwood	3	2
Shade and shelter	4	4
Human food	5	7
Fence	6	6
Medicine	7	8
Farm implements	8	5
Household utensils	9	9

sources of browse for livestock, particularly goats and camels, was recognized. Some of the most important browse species include *Acacia tortilis*, *A. nubica*, *A. mellifera*, *A. senegal*, *A. nilotica*, *A. etbaica*, *Balanites aegyptiaca*, *Ziziphus spina-christi*, *Salvadora persica*, *Rhus natalensis*, *Indigofera articulata*, *Grewia erythrea*, *G. ferruginea*, *G. villosa*, and *Cordia gharaf*. *A. tortilis*, *Ziziphus spina-christi* and *A. nilotica* are usually lopped during the dry season to provide fodder for camels and goats. Camels had a wide range of feeding habits, beyond the above named woody species. The species of *Acacia* (especially *A. nubica*, *A. tortilis* and *A. mellifera*), *Balanites aegyptiaca*, *Salvadora persica* and *Indigofera articulata* are most preferred by camels. This is because they are most available, have high moisture content and are salty. Species such as *A. nilotica*, *A. tortilis*, *Ficus sycomorous*, *B. aegyptiaca* and *Ziziphus spina-christi* are also important for their use as shelter. These species are left in the cultivated fields and near homesteads for their multipurpose use. The species used as food by the communities include *Ziziphus spina-christi*, *Cordia gharaf*, *C. ferruginea*, *G. villosa*, and *Dobera glabra*. Fruits of *Ziziphus spina-christi* and *Balanites aegyptiaca* are occasionally sold in Abala market. The fruit of *Dobera glabra* is boiled before eating. The fruits and flowers of *Salvadora persica* are mainly used to prepare traditional Afar soup or juice.

Many woody species are used as firewood or fuelwood, but *Acacia etbaica* is the most dominant and most utilized tree for both charcoal and firewood. *A. etbaica* firewood is sold in Quha and Mekelle Towns to provide off-farm income. One donkey load of firewood costs six Ethiopian Birr (about 0.5 US \$) in Abala. The

same load costs 25-30 Birr in Quha and Mekelle Towns, which are located 45 and 55 kms. from Abala respectively. Such high prices of firewood seem to intensify the exploitation of woody species for sale in towns.

As shown in Table 5, trees and shrubs are commonly used as traditional human and livestock medicines. The Afar and Tigray have immense knowledge about medicinal plants and the procedures used in the herbal treatment, as also supported by Zekele (1997). In this study, medicinal uses of 19 plants were recorded from informants. The findings showed that the people rely primarily on traditional medicines, mainly because the provision of pharmaceutical medicine is unreliable and expensive. It is also believed that some medicinal plants are superior to modern drugs. A substantial body of knowledge of medicinal plants is known to have already been lost because most of it is transmitted orally from generation to generation (Abebe and Hagos, 1991). Ethno-medicinal information that has been built around numerous plants is on the verge of collapse, therefore, in Ethiopia. Herbalists here do not share their knowledge with outsiders but only with their eldest sons orally when they are old.

The pods and seeds of *Acacia nilotica*; and young twigs of *A. etbaica* are a source of tan-

ning material. *Salvadora persica* is traditionally used as toothbrush mainly by the Afars. It is rare to find an Afar without a toothbrush of *Salvadora persica* while herding, on the way to the market or at meetings. *Balanites aegyptiaca* is cherished by the people and is used as a writing board for Quran teaching. It is also believed that the plant can protect people from thunder, and therefore it is grown and protected around homesteads.

In general, people listed preferred species for each use as fodder (25 species), house construction (12 species), fuelwood (10 species), shade and shelter (8 species), food (13 species), fencing (9 species), household utensils (5 species), tanning (2 species), fumigation (3 species), and spiritual purposes (3 species). *Grewia bicolor* (locally, *Dewaito*) is the most preferred species for the Afar mat house construction, while *Acacia nilotica* (*Gessalto*) and *A. etbaica* (*Seraw*) are used in constructing the Tigray mud house. Although the study area has many indigenous plants of economic value to the people, the perception is that the abundance of the most important trees and shrubs is declining and some are on the verge of extinction (e.g., *Ziziphus spinachristi*, *Balanites aegyptiaca*, *B. rotundifolia*, *Cordia gharaf*, and *A. nilotica*). This has mainly been attributed to the clearing of vegetation for

Table 5: List of woody species used as traditional medicines by the Afar and Tigray

Species	Parts used	Diseases/conditions treated	Form of application
<i>Acacia etbaica</i>	Leaf	Goats and camels eye diseases	Extracts of leaf juice
<i>A. mellifera</i>	Bark, stem	Stops bleeding, heals wounds in animals and humans	Burned and tied
<i>A. nilotica</i>	Bark	Removes after-birth for cows	Extracts inserted into uterus
<i>A. nubica</i>	Leaf, root, bark	Headache, common cold, cough and wounds	Extracts taken, smelled
<i>A. senegal</i>	Leaf	Eye diseases	Extracts
<i>A. tortilis</i>	Root	Stomach and tooth aches	Extracts smoked
<i>Balanites aegyptiaca</i>	Root, bark	Malaria and wounds	Root extracts taken for malaria and barks tied for wound
<i>B. rotundifolia</i>	Root, leaf	Headache and malaria	Extracts, leaves chewed
<i>Boscia coriacea</i>	Root, leaf	Common cold and cough	Extracts
<i>Dobera glabra</i>	Seed	Malaria	Boiled extracts taken
<i>Calotropis procera</i>	Leaf or latex	Snake bites, cancer, anthrax	Latex applied or burned and tied
<i>Cadaba rotundifolia</i>	Leaf	Internal parasite	Extracts taken
<i>Capparis tomentosa</i>	Fruit	Cold and stomach pains	Extracts taken
<i>Grewia erythraea</i>	Root	Wounds	Extracts taken
<i>G. vilosa</i>	Root	Wounds	Extracts taken
<i>Nicotiana glauca</i>	Leaf/twig	External parasites in animals	Washed with water
<i>Solanum incanum</i>	Seed/root	Cough and common cold	Extracts smelled or taken
<i>Ziziphus spina-christi</i>	Leaf	External parasites	Washed with extracts
* <i>Hayokito</i>	Leaf	Heart problems	Extracts taken

*Species not identified by scientific name.

cultivation and cutting of trees for house construction, flood-diversion works, firewood and charcoal making.

Local Perceptions on Vegetation Change and Environmental Degradation

Based on interviews and discussions with the local elders, land-use changes in the area since the early 1960s have resulted in a reduction of natural vegetation cover and consequent environmental degradation. Clearing land for cultivation, settlements, road construction, firewood collection, charcoal making, and felling trees and shrubs for flood-diversion works are the most important contributing factors to the reduction of woody species. Also, recurrent drought, overgrazing, and erosion have had an impact on vegetation cover in the flood plains, ridges and hills. The most affected woody and grass species are *A. nilotica*, *A. tortilis*, *A. senegal*, *Ziziphus spina-christi*, *Balanites aegyptiaca*, *B. rotundifolia*, *Cordia gharaf*, *C. ovalis*, and *Cenchrus* and *Cynodon* spp. On the other hand, *Tarchonanthus camphoratus*, *Aloe* and *Euphorbia* spp., which are unwanted, have replaced the most palatable herbaceous species for livestock feed. The declining vegetation cover is also said to have contributed to the disappearance of wildlife: many wild animals including elephant, cheetah and lion were available in the area in the early 1960s but currently only monkeys and foxes are found here.

Declining vegetation cover, formation of gullies and abandonment of cropping fields, declining water availability and reduction of wildlife numbers and species diversity are perceived as the outcomes of recent settlements and cultivation in the area. The cumulative effect of cultivation, erosion and bush encroachment has reduced access to grazing lands, thus increasing pressure on the ecosystem.

CONCLUSION

The present study was conducted to gain insights into two important communities in Ethiopia regarding their understanding of changes in their natural resource base and how this had impacted their socio-economic situation. Large parts of the plains have been severely degraded due

to overgrazing. Both the Afar and Tigray are currently involved in flood recession cultivation for their food production. However, the question is, how long can the flood plain sustain continuous cropping? Changes in land-use, such as flood recession and irrigated agriculture, will continue, and so will the range resource. Consequently, there is a likelihood of negative impacts on the existing bio-diversity. This will negatively affect pastoral strategies involving mobility and other coping mechanisms. The future survival of pastoral production will be in jeopardy, therefore, considering the increasing human population that will seek to increase food production to attain and maintain its food security.

Grazing lands, which have not yet been cultivated, still have the potential to be managed on a sustainable basis. In this context, the concept of multiple land-use can be applied for proper resource planning and management. Where herbaceous cover is poor, the browse resource plays a key role in livestock feed supply, especially in the dry season. It also provides many other services. This resource can be managed on a sustained basis through traditional practices that have been developed over the ages in the ASALs.

Agropastoral communities in Abala acknowledged the vital role of trees and shrubs in providing a range of products and services. In addition, these plants determine site capability and can be used in rehabilitating gullied areas and abandoned cropping fields. There is a need, therefore, to use suitable trees and shrubs to assist in the rehabilitation of degraded areas. Future research should therefore look into ways that would ensure the protection and regeneration of preferred multipurpose trees and shrubs. To this end, indigenous technical know-how of the local communities is crucial in the rational use and protection of woody species.

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