Valuing Tropical Grasslands: The Case of Overstocking in Northeastern Uganda

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VALUING TROPICAL GRASSLANDS: THE CASE OF OVERSTOCKING IN NORTHEASTERN UGANDA

Abstract: One of the major concerns of the world community today is the loss of large areas of tropical grasslands and forests. Although there are various causes of grassland degradation, an important cause seems to be an under-valuation of grasslands by markets and governments. This under-valuation could be because many products from these grasslands (such as animal products) are consumed indirectly, or many of the products are traded in informal markets for which there is very little data. The other important reason is that some of the services provided by tropical grasslands such as animal grazing lands, hunting areas, bio-diversity protection, recreation and to some extent watershed protection, are not traded in markets; hence, their economic values are often ignored. Even in cases where the environmental values are recognized, they may not be measured or used to promote efficient resource management. This study seeks to examine some of the causes of grassland degradation and to explore grassland valuation issues in the context of Northeastern Uganda (Karamoja).

Household production and consumption model based on Gronau's model of 1977 has been used. The contingent valuation method has also been used in the analysis to establish the welfare loss to the households due to overstocking. The findings revealed that there is serious environmental degradation in Northeastern Uganda mainly due to overstocking and overgrazing. It was further found out that the willingness to pay for environmental maintenance depends on social and economic variables such as income and level of education. The economic importance of the grasslands suggests that the benefits the grasslands have provided cannot be excluded as an opportunity cost of any activity that degrades them. Policy makers should be aware of this problem when designing grassland management systems.

1. Introduction

The loss of large areas of tropical grasslands and forests has become a major concern of the world community today. Over the past century, a big percentage of grasslands and woodlands in Uganda has been affected by human activities such as livestock grazing, farming, logging and swamp reclamation. Across much of Northeastern Uganda, extensive and semi-extensive livestock systems rely on the use of these grasslands (rangelands) for the essential input of forage into livestock production. According to the State of Environment Report (Government of Uganda 1998), about 21 per cent of the total land in Uganda is covered with grassland and the annual loss is estimated to be 9 per cent. This destruction has continued unabated and, by many estimates, seems to be increasing in Uganda particularly in the Northeastern region. Whereas much research and attention has been concentrated more on forest depletion, grassland areas are threatened and this may have a major impact on the ecological systems of Uganda.

Grasslands comprise open savannah where the soil and average rainfall (300-700 mm) are not conducive to arable farming. The vegetation cover ranges from grasses interspersed with trees to forest savannah mosaics and woodland. These are, with some exceptions, sub-climax in ecological status: the action of man, grazing and fire having controlled their progressive change to thicket woodland or forest. The low rainfall characteristics of grasslands imply that this environment is largely semi-arid. The semi-arid grasslands occupy almost 2/3 of the total land area of Africa (World Resource Institute 1989) and they are a home for a large and rapidly growing population. In some countries, grasslands are used for settling excess population from arable regions. It is clear that semi-arid grasslands play an important role in economic development, and it is equally clear that new solutions must be found for the economic use of this land. Uganda's grasslands are found largely in the corridor extending from Moroto and Kotido Districts in the north-east through Lake Kyoga's flat lands to Masaka, Rakai and Mbarara Districts in the south-west, with smaller parts scattered throughout the country. This area is often referred to as the "cattle corridor", for most cattle are found in this zone. Keeping cattle is the main source of livelihood of the people staying in this area.

The ever-increasing scale of human activity in Northeastern Uganda is now prompting the search for more sustainable approaches to development. As Uganda experiences economic and population growth, it also experiences a greater strain on the finite national environmental systems. Tropical grasslands constitute important natural systems that help provide services that support life. They are a source of food for humans and their animals - a means of maintaining essential life support functions. There is therefore an urgent need for conserving these ecosystems.

In terms of general support functions, the services and products we derive from tropical grasslands are diverse and they benefit people at the local, national and global levels. Indigenous people and communities that live on the fringes of these grasslands rely on them to graze their animals that in turn provide them with food. They also rely on them for shelter. The well being of these communities therefore extensively depends on these grasslands.

Although there are many causes of grassland degradation, an important cause appears to be the activities of the pastoralists in search of the diverse benefits from the grasslands, such as food for humans and pasture for their animals, and other support functions such as shelter and fuel wood. However, these pastoralists manage their resources in many different ways. This can be through either cooperation or non-cooperation. Both types of management may result in overgrazing and overstocking. Overstocking occurs when the stock levels exceed the rangelands' carrying capacity, implying reduction of forage below the biological minimum when considered in terms of some unit of time. The effects of overstocking on the value of grasslands form the core of the study.

1.1 The Nature of the Problem

The effects of overstocking on sustainable development can be extremely detrimental. Bare plain slopes lose the ability to retain water, resulting in extensive erosion on the plains. The devastation from widespread erosion includes low crop yields, poor animal health and yields, loss of livestock and other animals, damage to human sources of survival, infrastructure and

equipment, the spread of disease and migration of the families affected. In regions such as Northeastern Uganda, these situations are frequently experienced. Overgrazing may also cause a decrease in soil retention capacity, greatly allowing the erosion of fertile topsoil and thus reducing the productivity of the land. This poses a threat to the lives of the people in these regions. Although it is difficult to place a monetary value on economic losses due to the depletion of grasslands, it is clear that the magnitude is quite high especially in pastures of Northeastern Uganda. The study was set out to look at whether and how overstocking and overgrazing lead to environmental degradation and to determine the value of such grasslands and the subsequent losses due to their depletion.

1.2 Objectives of the Study

The overall objectives of the study are to assess the value of tropical grasslands and to examine the effects of overstocking and overgrazing, particularly in Northeastern Uganda. The study examines pastoral areas where the effects of overstocking on grassland availability, agricultural production and the environment are strong. Several environmental valuation tools are to assess the benefits and costs of overgrazing and overstocking. The study looks at the possible consequences of overgrazing, resulting from competing demands by cattle keepers, on animal productivity.

1.3 Justification

Available evidence suggests that there is an increasing incidence of overstocking and overgrazing in pastoral areas of Northeastern Uganda. Overstocking, burning of grasslands and overgrazing, traditionally common practices in these areas, can cause rapid deterioration of the environment. There is lack of serious concern among policy makers over the issue of grassland deterioration. There is no clear policy to this effect, suggesting that either the government is not aware of the extent of grassland deterioration or there is no policy provision over these issues. The results of such a study will have implications for future economic analysis of grasslands and other environmental projects. A study of this nature is thus warranted to provide policy makers with the required tool and to assist them in re-directing future policies on grassland conservation and overall environmental management.

2.General Characteristics Of The Study Area

In this chapter, we present the general characteristics of Karamoja (Kotido and Moroto Districts), which is our study area. This section discusses among others the social, environmental, political and economic ways of life of the people of Karamoja.

2.1 District Characteristics

Kotido and Moroto Districts are located in the extreme Northeastern corner of Uganda and are generally characterized by semi-aridity. The area is also characterized by wide plains standing at about 1,500 meters above sea level. The area is not entirely featureless. It has several mountain masses of up to 4,000 meters in height and isolated inselbergs of 2,400 to 3,500 meters above sea level. The area contains a band of plains to the south and high mountains/rocks to the north- and north-west. Karamoja is drained by numerous seasonal streams and rivers originating from mountain ranges. These rivers join to form three main systems. There are no permanent water sources. The rivers and stream channels are seasonal which makes the districts dependent on underground water reserves.

The climate of Karamoja is semi-arid with distinct wet and dry seasons being a prominent feature. The area has one wet season, which alternates with a prolonged dry season of five to seven months. This dry season occurs from September to March. Available data and experiences show that unreliable rainfall with inadequate amounts and uneven distribution has significantly influenced the economy and life of the area. The mean annual rainfall of Karamoja ranges from 500 to 700 mm. Recently, rainfall has become so unreliable and erratic that predictability is quite difficult. From meetings held with local leaders and elders, it was realized that there has been a change in the pattern of rainfall distribution over the past two decades.

The vegetation of Karamoja is typically semi-arid with dry tree savannah species dominating grass species. There are also some forests with riparian vegetation doting most of the mountain ranges and seasonal river valleys. There are wide ranges of woodland savannah and tree savannah. These savannahs are usually interspersed with perennial grasses. The grass provides the best rangeland according to some livestock owners. The soils in these savannahs are said to have low to medium productivity rates.

Karamoja region is made up of two districts (Kotido and Moroto), each of which is made up of several counties. Kotido District, which formed our major survey area, is made up of three counties, namely Jie, Dodoth and Labwor. Each county is divided into sub-counties (9 in Dodoth, 6 in Jie and 5 in Labwor) and these are in turn divided into parishes. The governance structure of the districts consists of two almost parallel systems of authority: the traditional and formal administrative systems. The relationship between Jie, Dodoth and Labwor and the neighbouring districts is mainly determined by the availability of water and the direction and intensity of cattle raids. Unlike other Ugandans, the Karamojong are officially armed and they have exploited this unique position to protect and enhance the culture of raiding. Within Kotido District, the intensity of raiding is between the Jie and the Dodoth with the former said to be richer and more aggressive.

According to the population and housing census of 1991, the population of Karamoja was 369,823. About 53% of this population live in Kotido District. The total population of Uganda was estimated at 17 million at the time and now, i.e., in 2000, it is estimated at 22 million. Karamoja is one of the few areas in Uganda whose population has grown at a decreasing rate over the last two decades. The area is sparsely populated with an overall land density of 14.8 persons per square kilometre (1991 population and housing census). The majority of the people (95%) live in the rural areas. Kotido District alone covers an estimated area of 13,208 square kilometres.

Land in Karamoja is communally owned. Only a few individuals found in towns hold land titles. Virtually there is no buying of land in rural areas and in effect, every member of the community has access to land for purposes of cultivation, grazing and others, as long as the land is not already occupied. There is lack of proper planning and use of the land for sustainable purposes.

2.2 Economy

The economy of Karamoja is predominantly agricultural. Livestock husbandry is the main source of livelihood supplemented by arable farming, especially in areas that have been deprived of their cattle. Cultivation is extensively practised around the towns of Kotido in the central part of the district; Kaabong and Karenga in the north; Abim and Morulem in the west and south-west respectively. The communities in Labwor County were said to have lost most and in some cases all of their animals during raids by the Jie, Dodoth, Matheniko and Bokora. This has made them resort to cultivation and keeping a few livestock for their livelihood. Ownership of livestock and commercial transactions differs by county. For instance, according to the Kotido District Baseline Survey (National Environment Management Authority 1994), in Labwor County, the average number of heads of cattle owned by a household is 7.2 compared to 22.6 in Jie and 31.8 in Dodoth. The reason for low averages for Labwor as already mentioned is due to the raids.

The major animals kept are cattle, sheep, goats and donkeys. Cattle are the most treasured of all the livestock. Cattle are an index of socio-economic status and an investment for the unknown future. For this and other reasons, there is a tendency to increase livestock numbers rather than decrease them if there is an opportunity. Goats and sheep bring the main household income used for solving the day-to-day financial problems. Animals are used in different ways mainly as savings of wealth, items of prestige, items for marriage in the form of bride wealth, sources of food - milk and meat - for the community, and sources of skins and hides for dressing and bedding.

The area is typically pastoral with very little farming. Livestock rearing is an essential component of agricultural production in Karamoja. With increasing intensification of livestock rearing, the absolute requirement for pastures increases, and the timely availability of pastures for livestock becomes more important in maintaining animal stocks. There is a wide variation in the distribution of livestock populations in Karamoja. Though the figures for the region as a whole are not available, it is believed that more livestock are owned in this region than in any other region. Livestock and livestock products contribute to more than 85% of the household income in the study area. At the same time, livestock contribute to essential labour and products for agriculture; its upkeep entails the use of grassland resources for the provision of leaf fodder, grass and other feed inputs. Animals are grazed throughout the year, with migration to the more wet areas during the dry season.

2.3 Raids

Raiding is an age-old form of wealth redistribution among the Karamojong. It is a traditional and central form of restocking. Young warriors are compelled to accumulate cows for status mainly through raiding. A man without cows will not get respect from his fellow men and women. A man without cows risks remaining single. To some degree, one's respect depends on the number

of successful raids one has performed. Cattle raids can be both inter- and intra-ethnic, which also has regional and international dimensions such as when the Turkana of Kenya raid communities in Karamoja and vice versa.

2.4 Farming

Farming is a seasonal activity, which mainly occurs during the rainy season between March and October. As in many parts of Uganda, farming is a predominantly female occupation. The major crop grown is sorghum (red and white varieties) though millet, cassava and maize have a fair share of the cropped land. In addition to these crops, small amounts of groundnuts, cowpeas and soya beans are grown. Fruits and some vegetables mainly grow in the wilderness and contribute very small proportions to household incomes. Farming is a source of livelihood for both rural and urban communities, with the urban women farming on the outskirts of towns.

2.5 Seasonality, Climatic Conditions and Pastoral Behaviour

Seasonality pervades all aspects of life in the communities of Karamoja region. The region is semi-arid and enjoys only one rainy season a year (March to October), which can vary by starting later or ending in September. At times, the rains are very unpredictable. Under such harsh and unpredictable climatic conditions, agriculture and animal husbandry become very challenging. In this case, transhumance is inevitable in this region during the dry season.

While Karamoja is classified as a semi-arid zone, several microclimates exist, dividing the region into a number of ecological zones. Rainfall is the major determinant of these zones, which can be categorised as:

a) Semi-arid, low-lying expansive plains of central and eastern Karamoja. The plain is driest at its eastern end with a low rainfall regime of 300 - 500 mm. The central part receives an annual average rainfall of 500 - 750 mm.

b) Mountain areas where relief rainfall ensures thick vegetation cover, in contrast to the surrounding semi-arid plain. Average annual rainfall can reach up to 1000 mm.

c) Middle range zone (altitude 1370 - 1980 metres) between the Turkana escarpment and the mountains; it receives average annual rainfall of 500 - 800 mm. Rainfall is relief-influenced and supports thick vegetation cover (for example, Timu forest).

d) The moist agricultural savannah areas of western and southern Karamoja where average annual rainfall is over 1000 mm.

Environmental degradation has been most severe on the semi-arid plains of central and eastern Karamoja, which form the major part of the region. The rainfall regime is mono-modal. The repeated removal of the fertile topsoil and the exposure of the more compact, less porous, sterile lower soil results in more degeneration of plant growth. This is mainly through overgrazing,

cultivation, or bush clearing. The deterioration of the environment is also widely believed to be associated with pastoral habits. The following two views are usually advanced to back this belief.

a) Cultural behaviour: The pastoral Karamojong practise a ritual attachment to cattle, sometimes referred to as a "cattle complex". To a Karamojong, cattle are not just a kind of capital commodity from which he can obtain a living, but something far more important and sacred. In fact, it is said that outsiders find it difficult to understand why a Karamojong could commit suicide over the death of his ox (Mamdani, Kasoma and Katende 1992).

This strong man-cattle attachment seems to account for an ardent adherence to the conservative culture of pastoralism in favour of change to other modes of living. Cattle are also an index of socio-economic status. The tendency is normally to increase the livestock number rather than decrease it. It is therefore assumed that this zealous desire to maximise cattle number ends up in overstocking pastures and therefore in overgrazing.

b) Land ownership: As already mentioned, grazing land in Karamoja is communally owned. Normally, communally owned resources tend to be overused and misused by society. No individual value and protectionism is attached to the resources. Therefore, the tendency is for individuals to stock more to maximise benefits from the available communal pastures. This view seems to exclude the regulatory aspects inherent in an organised society, where the level of stock accumulation by an individual would be checked.

2.6 Organizational Hierarchy

The pastoral Karamojong have a traditional hierarchy of governance with two major groups: the elders and the warriors. The elders hold decisive powers with a kind of spiritual reverence. The warriors belong to the young generation, who follow the decisions agreed upon by the elders in assemblies, including cattle rustling. There is an orderly manner of ascendancy from the warrior group to the elder group based on age.

The working group consists of women and children. They perform most of the chores necessary for supporting their families, including cultivation, building *manyattas*[1] and collecting firewood. In the transhumance practice, this group is reasonably sedentary, staying in particular settlements for long periods, even when the men move to look for pasture.

In Karamoja, there is the "gun paradox". This is the most politically sensitive issue in Karamoja today. The brutalisation and demoralisation of the Karamojong by the state "opened" the eyes of the Karamojong to the gun as their only saviour. They sought to reply state militarism by the same method. This is evidenced by the fact that the increase of state brutality in Karamoja seems to correlate with the acquisition of more sophisticated rifles. Today, guns are in abundance in Karamoja. It is very common to see well-armed Karamojongs, some of them with machine guns, going about their daily activities, even in the presence of the state police and the army.

2.7 Energy Requirements

The Karamoja energy requirements are overwhelmingly based on fuel wood. Firewood is the sole cooking fuel in the rural areas. Among the urban centres, only Moroto has the benefit of supplementing fuel wood with electricity from diesel generators. NGOs and some missions also operate their own diesel engines. There is glaring evidence of large tracts of land that have been rendered bare of trees and bushes around settlements. Apart from the fuel wood requirements, trees are cut for *manyatta* and security fence construction. Charcoal demand in urban centres has also resulted in the depletion of trees in the surrounding areas. Areas around the towns of Kotido and Moroto offer a classic example of tree/bush cover depletion. Complaints about long distances to be covered in search of fuel wood can be heard from all lifestyles in Karamoja. The brewing and distilling industries are flourishing unhindered. This activity consumes a large amount of firewood, resulting in environmental degradation.

Due to lack of electric power supply, NGOs and some missions have resorted to the use of alternative sources of energy. Twelve wind-driven pumps were installed in the 1980s to provide water mainly to missionary centres and institutions. About half of them were working at the time the data was collected. Solar photovoltaic (PV) is used widely at all NGO operation centres, for lighting and communication and at hospitals for vaccine refrigeration. Solar water heating is used in several NGO residences. Karamoja offers a good demonstration case for the potency of solar and wind energy in Uganda.

In an attempt to provide alternative fuel to wood in schools, Karamoja Development Agency (KDA) embarked on the construction of small demonstration biogas plants in four schools (two in each district - Kotido and Moroto). However, the schools do not own cattle. This together with the migratory nature of the cattle in the surrounding areas has rendered the digesters inoperative.

3. Literature Review

There is scanty literature on the valuation of tropical grasslands in Uganda and the East African region in general. As noted above, most of the research on valuation on environmental effects has concentrated on wetlands because of the value of the resource and its rate of reclamation. However, despite this, the management of grassland resources for sustainable development remains one of the critical issues to be addressed by policy analysts and development agencies in Uganda. It is evident that there are many problems such as a decline in grazing land, overstocking, persistent degradation of resources, low agricultural productivity and low levels of welfare in the pastoral areas (Kisamba-Mugerwa 1991). This kind of set up has been existent although the indigenous people have tried to use their traditional conservation mechanisms. However, several interventions aimed at economic development seem to distort the original systems and they probably have fanned the situation.

3.1 The Concept of Land Degradation

The term land has different meanings. Land may be defined as the surface of the earth and all its natural resources. It may also be defined as the natural environment and its attributes within which production takes place. For the purpose of the study, the latter definition will be used, and in this case, land is a factor of production. In economics, land is understood to include land under water, rivers and lakes. The term land degradation in this study will include soil degradation and land cover (vegetation) depletion.

Grasslands (rangelands) comprise open savannah where soil and average rainfall (300 - 700 mm) are not conducive to arable farming. A clear understanding of the structure and function of the grasslands and its production systems is necessary for evaluating alternative strategies for use. Increased population growth, traditional nomadic pastoral sentiments of overstocking and invasion by agricultural settlers have led to over-utilization and consequently to an irreversible damage to the grasslands, especially in the districts of Kotido, Moroto, Luwero, Mbarara and Rakai (National Environment Management Authority 1993).

3.2 Types of Grassland Management Regimes

Property is not an object such as land, but is rather a right or benefit that is only as secure as the duty of all others to respect the conditions that protect the stream. When one has the right, one has the expectation in both the law and practice that one's claims will be respected by those with corresponding responsibility. Bromeley (1989) and Swallow (1987) show that there are about four types of grassland (rangeland) regimes. These are state property, private property, common property and open access property. A new form of property ownership called the "co-ordinated access" has also recently been developed in the literature. Each of these forms of tenure depends on how society recognises the rights of individuals or group of individuals over resources. Private property refers to situations where an individual or a group has exclusive rights to manage the resource. State property refers to situations where the state has control of the property while common property is that in which individuals who have access to the property manage it in consultation and pursue an agreed code of conduct among themselves. On the other hand, open access property reflects the complete lack of ownership; that is, it is open to anybody who gains access by physical presence.

There still remains confusion in the literature as to what exactly common pool resources and common property connote. In the study, common pool resources will be taken to mean any resource to which multiple users have joint access (Sethi and Somanathan 1996). Property, according to Bromley (1992), is a claim to a benefit (or income) stream; and a property right is a claim to a benefit stream that some higher body - usually the state - will agree to protect. Rights to a common property in the study, then, will be defined as a claim to a benefit stream flowing from a common pool resource (i.e., where there are multiple users with joint access). A common property management regime is defined to be the rules and regulations made, monitored and enforced by the group of users of the common pool resource. Furthermore, we will abstract from political power problems if the group will maximise over the sum of individuals' utility - all members' utility will be given equal weighting.

In our definition of common property, then, it is possible for the group to choose not to make or enforce any use-rules. Many authors have defined the distinction between common property and

open access by assuming that common property, by definition, implies that there are rules over the management of the resources and/or there are duties and responsibilities that members abide by (Berkes 1989; Bromley and Cernea 1989; Runge 1984; Sethi and Somanathan 1996). By defining common property as necessarily characterised by management and membership duties, one does away with the possibility of an "un-regulated" common property. As clearly shown by Dasgupta and Heal (1979), as long as membership itself is fixed and well-defined, rents accruing to the resource will not be driven to zero (the open access situation); however, these rents can still be less than the socially optimal rents if resource use is not regulated within the group. Thus, even if the group chooses no regulation, we still consider the resource to be common-pool and to be under a common property regime - as long as "outsiders", or non-members, are excluded.

Relating each of these systems to pastoralism, in the open access system, the livestock owners who achieve access of grasslands ignore the consequences of their behaviour for other grassland users. They achieve access to water or forage available in an area by their physical presence. There are no restrictions on the use of the grassland, and resources are considered free. This kind of situation encourages the pastoralists to maximise their private use of the available grassland areas. Windstrad (1975) asserts that the individual livestock owner cannot decrease pressure (by using less grassland) on the grazing land by reducing the size of his or her own herd as one would have no guarantee that other livestock owners having the same land would do the same.

Under the coordinated access, each livestock owner depends on the strategies of all other livestock owners sharing the same grassland. This system is common in some parts of Uganda and in other parts of Africa. The private property rights involve individual herders or groups of herders under a corporate body and they have exclusive rights to specifically defined areas of grazing land. The common property arrangement uses the grassland collectively but regulations that establish the qualifications for gaining access exist. These qualifications may be based on tribal, clan or sub-clan ties. According to Bannet, Lawry and Riddle (1986), pastoralists move with herds in varying patterns and combinations of semi-permanent residence or encampments, maximizing the use of available pasture in a climate that is seasonally variable or prone to drought.

3.3 Grassland Management and Carrying Capacity

The carrying capacity of grassland depends on the number of livestock it can sustain while maintaining biologically optimal levels of forage production (Kisamba-Mugerwa 1991). In order to have a sustained and long-term maintenance, livestock numbers must be kept at carrying capacity or below. However, in Northeastern Uganda stock levels usually exceed capacity, which is known as overstocking. The consequence of overstocking is that forage is reduced below biological optimum levels especially when considered in terms of some unit of time. Jarvis (1982) argues that degradation will result when natural forage productivity is reduced more or less permanently because of long lasting damage to the productivity of the resource base due to soil erosion caused by chronic overgrazing or change of vegetation composition toward less desirable forage species. It is therefore imperative that the stock levels are controlled if forage production is to be sustained.

The issue of carrying capacity, as argued by Scoones (1989), involves both economic and ecological factors. The economic carrying capacity is the stocking rate that offers maximum economic returns and it is determined by the economic objectives of the pastoralists. On the other hand, the ecological carrying capacity is determined by the environmental factors. Therefore, the dimension taken determines the environmental policies, and sometimes these may not be in line with the economic objectives of the people.

When the type of grassland management is related to the system of conservation, the most destructive system seems the "open access" system. Hardin (1968) basing himself on the theory of the "tragedy of commons" explains that over-exploitation of common resources will occur because each herdsman, as a rational decision-maker, seeks to maximise his private gain. The individual herdsman after weighing the costs and benefits from a personal perspective, finds gain in adding another animal to his herd. It is beneficial to the individual to add one more animal, but it is costly to the society as a whole due to the resulting over-exploitation of resources in the form of overgrazing. According to Hardin (1968, 20):

> As a rational being, each herdsman seeks to maximise his gain. Explicitly or implicitly, more or less adding one more to my herd? This utility has one negative and positive component. 1- the positive component is a function of the increment of one animal. Since the herdsman receives all the proceeds from the sale of the additional animal, the positive utility is nearly +1. The negative component is a function of the increment of one animal. However, since the effects of overgrazing are shared by all herdsmen, the negative utility for any particular decision-making herdsman is only a fraction of -1. Adding together the components of partial utilities, the rational herdsman concludes that the only sensible course for him to pursue is to add another animal to his herd

A lot of debate has been generated by Hardin's discussion of the tragedy of the commons. It may be argued that the tragedy of commons is of limited relevance and open to question. This is because the commons are not equivalent to open access situations, and the notion of commons implies a community that controls access to it, though the extent and effectiveness of the control may vary greatly across cases.

3.4 Causes of Grassland Degradation

Poor grassland resource management cuts across all types of grassland management regimes in the country. Bojo and Cassles (1995) distinguish two main causes of grassland degradation: direct and indirect. Direct causes comprise: forest clearance, crop cultivation practices, burning of dung, removal of crop residues and overgrazing. The indirect causes include poverty, insecure tenure, economic policies and population growth.

In the case of Northeastern Uganda, both causes apply although in different proportions. The study is not set out to investigate and discuss each of the causes separately, but we shall dwell more on overgrazing and its subsequent impact on the grasslands. According to Dixon, James and Sherman (1989), land degradation due to overgrazing occurs when livestock population per unit area of the ecosystem exceeds the safe stocking rate at that time (i.e., overstocking).

The process of grassland degradation due to overgrazing and overstocking occurs as follows: In the early stages of stress, the more palatable plant species, both annual and perennial, are reduced or eliminated and are replaced by less palatable species or by invaders from other ecosystems. In dryland areas, because they bear most of the grazing pressures in low rainfall years, palatable perennial grasses tend to be replaced by annual grasses. Initially, in good rainfall years, these annuals may produce more forage than the original ecosystems, but in poor rainfall years, they produce little or nothing. The original situation where forage production fluctuated with good or bad years has changed to a feast or famine situation. In low rainfall years (and in the initial period of the following normal or high rainfall year), the soil surface, once protected with perennial grasses, is exposed to wind and water erosion. The process of degradation continues with less plant growth, increasing grazing pressure (unless animal populations are greatly decreased) and increasing erosion (as a result of reduced plant cover) until the surface is reduced to gullies, base rock or sand dunes.

Furthermore, in many areas on the wetter margins of the arid rangelands, unpalatable woody shrubs and small trees, originally suppressed by competitive perennial grasses and attendant periodic grass fires, increase as the more palatable plants are reduced. Once established and with the overstepping of the ground vegetation, they become highly competitive and they further reduce ground cover and yield. They may protect soil surface from wind erosion, but they are not very effective against water erosion and have little value for grazing. Finally, concentrations of livestock near watering points, supplementary feeding places and campsites also destroy vegetation cover and cause further soil degradation by severe trampling (Dixon, James and Sherman 1989).

Bojo and Cassles (1995) suggest that low livestock productivity is a major limitation, and many animals need to be kept to satisfy the requirements of rural households. Since livestock are important and because livestock rearing is a risky undertaking, herders try to gain some insurance by holding a large number of animals. In the process, this affects both the grazing and agro-forestry systems. These problems are further worsened by other factors such as fire and deforestation. According to Gillis et al. (1992), the indirect causes of environmental degradation may be grouped into three broad categories. These categories are ignorance, institutional failure[2] and poverty. Other closely linked factors are population growth and poor technology, but these seem to have some linkage to poverty. In Uganda, for instance, poverty is in many respects believed to be a cause and effect of land degradation. Hence, poor people are both agents and victims of land degradation.

A high degree of ignorance regarding the effects of human encroachment on the natural resources has greatly enhanced the rates of grassland degradation. Information on the economy as well as the environmental impact of resource utilisation is incomplete or non-existent. Societies are ignorant or know little about the vital ecological issues involved in natural resource cycles. Many times, even the decisions from the central authorities have been biased against environmental (grassland) conservation, and this kind of situation sets precedence for high rates of degradation.

In addition, imperfect or poorly functioning markets for environmental services such as water, soil conservation and clean air clearly explain the market failure argument as a cause of

grassland degradation in Uganda. Many of the environmental resources are considered common property and therefore no price is usually tagged to them. However, in situations of serious deficiency, some of these resources are openly marketed although the prices vary depending on the cause of the shortage.

In the study "open access" means grazing practices in which there is no control in determining where, when and what number of animals to graze. "Common property" will refer to grazing practices in which there is some degree of internal control of grazing, including rules governing where, when and what number of animals to graze and the time limit. In Karamoja, communal grazing by ethnic groups is the typical practice. The code of conduct on the pattern of grazing is assumed known by individuals in a specific locality. Each livestock owner attains access to water and forage available by physical presence on that grassland and follows a strategy that is contingent upon others' expected reactions to that strategy.

3.5 Valuation of Environmental Impacts

The viability in estimating economic values of effects on the environment such as the real cost of soil erosion, the economic value of a swamp, the value of clean water and now the effects of overstocking on the environment has lately been claimed possible. A number of analytical techniques are potentially applicable to the evaluation of land degradation and its related problems. These techniques include assessment of risk and uncertainty, economic analysis and physical assessment. According to Dixon, James and Sherman (1989), economic analysis can be used to identify and analyse benefits and costs of present patterns of resource use and to help formulate policies that can promote better and more sustainable resource use. The need for economic valuation is based on the ground that it is essential in resolving disputes and in awarding compensation for environmental damage. It gives a truer measure of economic performance and improves selection of projects (Winpenny 1993). The economic valuation of environmental effects can be grouped into six categories: the effect on production, preventive expenditure and replacement cost, human capital approach, travel cost method, hedonic method and contingent valuation. These techniques provide different values and while some are relatively simple, others are sophisticated. However, the technique chosen depends on the nature of the problem being addressed and in the study; it is the contingent valuation method. The reason for adopting this method is discussed in the next section of theoretical framework.

On the other hand, assessment of risk and uncertainty in studying land degradation is very important because complete knowledge and absolute uncertainty is rare in the real world. For most activities, man can only roughly predict some outcomes. For this reason, evaluations of land use alternatives as well as of programmes and projects designed to combat land degradation must allow for risk and uncertainty. Risk can be defined when the probability distribution of a stochastic (random) variable is known, while uncertainty is associated with incomplete knowledge and may take several forms. Uncertainty may prevail also on the probability distributions of stochastic variables. Physical assessment is similar to risk and uncertainty in almost all ways; only that in the latter, no probability distributions are considered at all. Physical assessment is applied where there is completely no data and where resources (temporal and financial) cannot allow for primary data collection but where a decision has to be made. In such

cases, the research team may consult local farmers, independent experts or individuals with extensive field experience.

The choice of the most appropriate technique for a certain type of land degradation depends on several factors including available information and data that can feasibly be gathered; the time and resources available and the type of result required. In the study, we adopted the economic valuation approach for its ease and realism in analysis.

The issue of grassland degradation requires urgent attention regarding proper grassland management. Most of the techniques discussed above can be used to estimate the value of natural resources such as grasslands. Grassland resources pose several difficulties regarding the estimation of total economic value. Examples are the absence of markets for many grassland products and services, the difficulty of placing a monetary value on some of the resources, the lack of knowledge regarding the value and utility of some grassland functions and the difficulty in isolating the benefits of interrelated functions. In spite of such limitations, economic valuation methods can be useful to estimate values that are accurate at least within an order of magnitude.

The environmental functions that cannot be valued can be examined using other techniques such as multi-criteria analysis. The objective is to integrate environmental concerns into conventional economic decision-making process by providing policy analysts with better information upon which to base decisions involving alternative land uses. Traditional economic analysis often only accounts for the commercial value of environmental resources such as forest and game parks. To disregard the non-market value of grassland resources (including the amenity value) may cause certain alternative land uses to appear more desirable. Internalising the cost of overgrazing can be undertaken to some extent by identifying the benefits derived by local and national communities.

So far, most studies on valuation of natural resources have concentrated on the valuation of wetlands and they use the contingent valuation method. Studies on rangelands have mainly used risk and uncertainty analysis. Farber and Costanza (1987) value the wetland ecosystems in monetary terms using conventional economic methods and biophysical methods of energy analysis. In these studies, indirect methods were used to estimate the value of commercial fishing and trapping, recreation and storm protection. The total value of the wetlands was estimated as a sum of all these separate values. According to the results, the annual value amounts to US $155/ha and the value of commercial fishing and trapping accounts for 85 per cent of the total value. In these studies, the contingency valuation (CV) questions resulted in a mean willingness to pay (WTP) for preservation per household per year of US $147 or US $17/ha/year. Farber and Costanza (1987) also computed WTP figures from an estimated demand function for recreation. They followed the procedure of Smith, Desvouges and McGivney (1983) and regressed annual visits per household on the price of a visit, household income, age of household head and household size. This kind of approach, although it has limitations, has been used in our study. Interestingly, most studies that have used the CV method have been done in the United States and Europe, with very few in Africa. The study aims to provide an innovative input and fill the gap in the literature on the use of CV studies in developing countries and more specifically in Uganda.

4. Conceptual framework

As far as the early 1980s, there was mounting evidence that environmental degradation had a direct and negative impact on economic development. Several ecologists pointed out that the open dynamic socio-economic subsystem within which all human activity occurs is engulfed within a larger eco-sphere (Folke and Janssen 1992; Odum 1973). As human activity increases due to population growth and economic development, so does the scale of socio-economic subsystem relative to the finite extent of the eco-sphere, thereby endangering the capacity of the eco-system to provide essential environmental services that support the subsystem. The aim of sustainable development is to keep the scale of the socio-economic subsystem within these reasonable limits. While the overall objective is to improve the quality of life, this objective is constrained by the need to diminish the intensity of resource use, in order to maintain or even enhance environmental assets and services for the future.

It would be unreasonable to expect all tropical grasslands to be intact, especially given the projections for population and animal growth in developing countries. If alternative uses of grasslands yield higher returns than intact grasslands, then conservation is warranted. It is imperative, however, that such decisions first take into consideration the totality of goods and services provided by grasslands, all affected communities, and the impact of environmental support systems on sustainability.

Three main dimensions are essential to achieving sustainable development practices: economic, ecological and socio-cultural (Munasinghe 1993). The economic approach to sustainable development is based on the Hicks-Lindahl concept of maximising the flow of net benefits from a stock of resources. In this case, valuation of resources, particularly non-commercial resources, poses a great challenge. Maintaining the stability of natural (bio-physical) systems is a key objective of ecological development. On the other hand, the socio-cultural approach to sustainable development focuses on protecting all social and cultural systems, particularly those of indigenous peoples.

Tropical grasslands account for 21 per cent of Uganda's total land area. Common to these types of grasslands are their production of several types of environmental services and their strategic location in the landscape. This implies that they interact with the adjacent ecosystems and with the human society by imports and exports of different environmental services. An appropriate valuation of grasslands should then include these linkages.

Tropical grasslands play a vital role in maintaining natural environmental systems, thus they contribute to ecologically sustainable development in many different ways. Their linkages to adjacent ecosystems make them also highly productive since species from various ecosystems can make use of the grasslands. Grasslands are regarded as open systems with linkages to other ecosystems and to human society as shown in Fig. 1.

Fig. 1. Flows between grasslands, human society and other ecosystems

Sun Human society

(households and firms)

SOURCE: Adapted from Ing-Marie and Soderquist 1994

Grasslands receive inputs from other ecosystems and from the sun. The outputs or environmental services of the grasslands can be exported to human society and/or to other ecosystems. Several effects such as man's inputs and climatic conditions are taking place within the grasslands, which affect the productivity of the environmental services. The grasslands also export services to other ecosystems, for example, to water catchments from the swamps, which are also beneficial to other animals.

Human society receives products directly from the grasslands, for example, building materials and animal products as well as indirectly through other ecosystems. Other important services are recreational opportunities. When grassland resources come under extreme pressure of human activity, the result may be eventual desertification of the land. Loss of grassland cover affects the capacity of the land to retain water and may cause changes in rainfall patterns. This results in changing patterns of vegetation. Less dense shrubs and bushes may replace the rich biomass that required more moisture. If the pressure on the land due to human activity continues unchecked, the surviving vegetation may gradually disappear until the surface is virtually bare. Beyond a certain stage, the process of desertification may be difficult to reverse.

Land degradation normally occurs in a series of steps that results in a land with changed properties, i.e., it as one of less suitable use. Lal, Hall and Miller (1989) identified the processes that lead to land/soil degradation to include: accelerated erosion, increased wetness and poor drainage, laterization, reduction in activity and species diversity of soil fauna and flora. Based on this reasoning, the causes, effects and processes of soil/land degradation in relation to possible restorative measures could be conceptually modelled in Fig. 2.

These environmental impacts of human activity can be traced using techniques of environmental assessment. For instance, grassland deterioration may be caused among others by overstocking, overgrazing, land clearing, slash and burn farming. The task of environmental assessment is to distinguish and prioritise among these multiple causes and their impacts. These procedures are often carried out by biologists, social scientists and other experts to the best extent possible. Once the impact of human activities has been identified by an environmental assessment, environmental economic tools help to map these results into conventional decision-making. These methods include economic valuation of environmental impacts at the local/project level, sector/regional level, economy-wide or multi-sectoral level and international level. However, there is considerable overlap in the techniques used at different levels.

Fig. 2. Conceptual model for causes, effects, processes and restorative measures of soil and grassland degradation

Management Causes

SOURCE: Lal, Hall and Miller 1989.

In the study, the theoretical method of economic valuation has been adopted from Kramer, Sharma and Munasinghe (1995). In traditional economics, the value of environmental services is divided into two categories: use and non-use values (Krutilla 1967). In other words, the **total economic value** (**TEV**) of an environmental resource is made up of the **use value** (**UV**) and the **non-use value** (**NUV**).

This can be generalised as:

TEV = UV+NUV

Where **TEV** is the total economic value of the resource,

UV is the use value,

NUV is the non-use value.

However, **UV=DUV+IUV+OV**

Where **DUV** is the **direct use value**, which is determined by the contribution that environmental asset makes to current production and consumption;

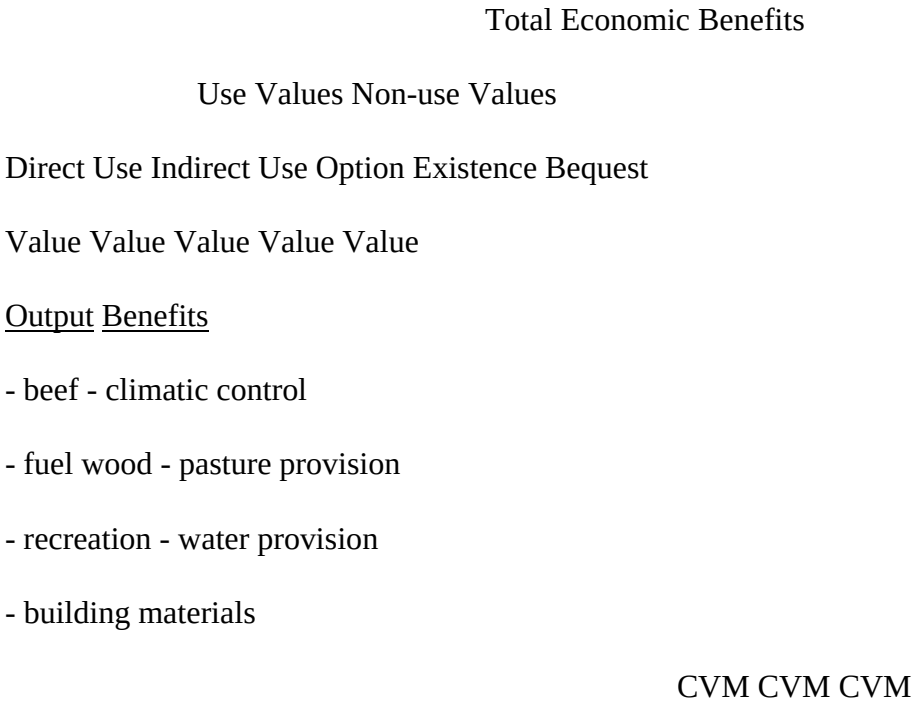
IUV is the **indirect use value** and includes the benefits derived from functional services that the environment provides to support current production and consumption for example grazing land, water and fuel wood.

OV is the **option value** that the consumers are willing to pay an unutilised asset, simply to avoid the risk of not having it available in the future.

Existence value arises from the satisfaction of merely knowing that the asset exists, although the valuer does not intend to use it; and **bequest value** reflects the desire to conserve environmental assets for the benefit of future generations.

Care must be taken to avoid the possibility of double counting. This may occur if the value of indirect supporting functions and the resulting direct uses are counted. These assessment values often overlap and they are usually difficult to measure. Emphasis will therefore be generally on TEV. Although TEV is a well-defined concept, the breakdown by components often introduces ambiguity and potential for overlap. Particularly elusive to measurement are the categories of OV and NUV. Since the primary objective is to measure TEV, the distinction between individual components of value is not strongly emphasised. The individual components are considered primarily as an indicative guide.

Fig. 3. Valuing grassland benefits



SOURCE: Barbier 1989.

Note: CVM = contingent valuation method.

Fig. 3 indicates the various techniques appropriate for measuring each type of grassland benefit. Valuing the benefits derived from tropical grasslands - as indicated in the figure - is relatively straightforward, usually involving the value of the production gained from directly exploiting these resources. One such example for the Hedija-Jama floodplain indicates that the total value of the annual production was Naira (N) 250-280 million for agriculture, N45 million for fishing and N14 million for fuel wood. However, measuring the indirect benefits of grassland environmental functions, such as pasture depletion, is more problematic. More sophisticated techniques of contingent valuation, travel cost method and hedonic pricing need to be used.

The value of grasslands as resources into production is calculated as the changes in producer profits and consumer welfare (Freeman 1993). If the change in supply of the resource has no impact on the final consumer price of the good, the value of the change in the supply of the resource is calculated as the corresponding change in producers' cost for producing the output in

question. A decrease in the supply of, say, forest products will then increase the cost for producing paper or furniture. The value of a change in forest products is then the sum of increases in costs for all sectors using the input in question. To estimate such a value, information on the producer cost functions is required. If the change in the supply of the ecosystem input is large enough to change the prices of consumer goods, we must add this effect to the change in the producers' profit. When the supply of pasture to the livestock of the pastoralists decreases, the whole sector may respond by adjusting the supply of livestock products such as milk. The associated increase in the output price can be large or small depending on the shape of the demand function for milk. An increase in the price of outputs implies a decrease in consumer welfare.

Several empirical techniques have been developed to measure the monetary value of environmental assets and impacts. Some grassland values such as recreational and other use values can be estimated by methods that yield monetary values of the environmental change in question. The results from implementing some of these techniques have been controversial even in developed market economies and they must be interpreted with caution and sound judgement. Since there seldom is explicit market for environmental services, these methods usually involve construction of a hypothetical market. The most frequently used direct method is the contingent valuation method (see Mitchell and Carson 1989). The basic concept underlying this valuation technique is the willingness to pay (WTP) of individuals for an environmental service or resource. This corresponds to the area under a demand curve derived from the consumption of the particular environmental service or resource. Questions are posed to the individuals about their willingness to pay an amount of money for an accomplishment of the change described. Real monetary transactions do not take place, however. Another measure of economic value is what people are willing to accept (WTA) in the way of compensation for environmental degradation. Empirical evidence shows that WTA compensation for being deprived of an environmental amenity yields higher values than corresponding WTP estimates to retain the same amenity. While there is no explanation for such a discrepancy based on economic theory, several behavioural and psychological explanations have been proposed. Other direct approaches include asking for people's ranking of certain alternatives (the contingent ranking method).

The CV method has been applied extensively in the last decade. Its widespread use, its legal significance in the United States and its general scepticism towards the use of interviews/questionnaires within economics are likely to be the three important reasons a gradually more intensive methodological debate has appeared, particularly in the US (see Arrow et al. 1993; Hausman 1993). One of the main issues being discussed is the consequence of the hypothetical nature of the method.

In contrast to the indirect estimation methods, direct methods such as the CV method have the potential to take also non-use values into account. It is important to recognise, however, that the monetary values that people report in a CV survey may nonetheless reflect only a part of the total economic value of the environmental resource. The problem here is that people might have preferences which lead them to certain WTP without having complete information on all functions of an environmental resource, for example, all environmental services provided by a grassland.

There are two major aspects related to this problem. Firstly, from a practical perspective, it might not be feasible to describe all functions in a CV survey. That is, even if complete information on the functions is available, communicating all this information to the respondents in a CV survey can be an impracticable task. Of course, it cannot be claimed that in this case a CV survey would give information on the total economic value. A complication is that some people might base the WTP on considerations other than the information communicated to them. Secondly, there might not be a complete scientific knowledge of all functions of a complex ecosystem like grasslands. However, to explore these issues is beyond the scope of the study.

Overall, many methods have been proposed for empirically measuring changes in the economic value of grassland resources. These methods rely on actual behaviour in conventional markets and constructed markets. The study has the objective of adapting some of these valuation methods for use in economic analysis of grasslands.

5.Methodology and Analysis

5.1 Data Collection

To determine the value of grasslands and the consequent impact of overstocking (overgrazing) on the environment, data was obtained from various sources. The main technique of collection data was a survey conducted on 200 households in 10 villages in Kotido and Moroto Districts. The pre-test questionnaire covered 25 households. These villages lie within the grassland areas, they comprised both cattle keepers and mixed farmers. Only one county in Moroto District was visited for security reasons. Local members of the community (high school teachers) and undergraduate students at Makerere University assisted in administering the survey. The enumerators were trained in both English and local language versions of the questionnaire. In the training, the enumerators were asked to translate the English version into the local language version and back into the English version to check consistency of information flow. The survey was undertaken following reconnaissance visits to the villages, focus groups, village leaders and households and after conversations with various people who are well versed with the localities.

The questionnaires focused on such areas as determining the extent of dependence of the villagers on the grasslands (environment) for obtaining products such as pasture for their animals, water, fuel wood and better sanitation. They also involved determining the extent to which villagers use the environmental facility for survival and assessing their attitudes towards the causes of degradation. Other questions focused on land use, time allocation, household production activities, and household socio-economic variables. Regarding the income generated by the household from harvesting grassland (environmental) products, information was obtained from their expenditures and valuation of the products they consume. The most important data was on the quality and quantity of products derived directly or indirectly from the grasslands. Price data on grassland products were obtained from a number of sources including interviews

with villagers, shop owners, household and village leaders. Livestock (agricultural) income was estimated from farm gate prices of products such as milk, beef and skins, and it was based on the yields.

A separate questionnaire was administered to the local village leaders. It focused on issues pertaining to general agricultural patterns, markets and prices of goods sold, village history and migration patterns, grassland-related cultural issues and details concerning their nomadic practices.

5.2 Household Sampling

The basic objective of the sample design was to obtain a representative cross section of households on which to base inferences about environmental changes. Two hundred households were sampled from the survey area (Kotido and Moroto Districts). The personal interviews were administered throughout 1999 to capture the effects of seasonality. The data were collected from the field interviewers by area supervisors and were returned to Makerere University for entry and analysis.

Two stage sampling design was used. From each county, two sub-counties were randomly chosen; from the sub-counties, two parishes were selected and ten households were randomly chosen from each parish. The survey covered the entire district of Kotido and one county in Moroto, to cater for different socio-economic and physical conditions. The survey was statistically representative after considering the enumeration areas used in the 1991 population census. Guidance was sought from the Statistics Department on the sampling procedures for the locations. Random selection of households within each village was done. Field supervisors in each county worked closely with interviewers and monitored their work.

Two hundred interviews were conducted, although Kotido District had a bigger sample size. As noted earlier, some parts of Moroto District were not accessible for security reasons. Sixteen of these interviews had to be removed from the sample. The reasons for removal were infinite bids (respondents who said they would pay any amount), random bidders whose bids bore no logical relationship to each other, protesters and those with incomplete and inconsistent information.

Similar to other personal interviewer surveys employed in the past, a few incomplete and inconsistent responses were a problem in the analysis. It was occasionally necessary to extrapolate existing information to fill the gaps left by respondents who were unwilling or unable to provide consistent or thorough information. In the present survey, two areas required particular attention: willingness to pay bids and values of household income.

The bids are crucial to the contingent valuation framework, and it was necessary to assure their validity. "Protestors"- respondents who refused to give any bids - were removed from the sample. The protestors were determined from the lack of any contingent valuation bids or from an interviewer's comment and they were distinguished from those who wished to bid zero. Zero bidders were left in the sample because the bids were felt to be legitimate by the interviewer and by the consistency of other information provided.

Equally important to the respondent's willingness to participate in the experiment (i.e., not being a protestor) is the respondent's understanding of the nature of the exercise. A lack of understanding of the willingness to pay concept led to the exclusion or the editing of other respondents. The final determination of household income also needed additional work. To gather this figure, the survey used a direct question on monthly income. This was later reconciled with other household indicators to check for consistency.

5.3 Model Approach

Household production models have been used by several economists to study a number of issues pertaining to farm households. The model used here is based on the household production and consumption model (Gronau 1977).

The goods that a household produces/demands are given by

$$X= (x_1, x_2, x_3, x_4,) \text{ ..... } 1$$

Where x_1 is the vector of purchases from the market, x_2 is the vector of consumption from home production (subsistence goods), x_3 is a vector of environmental resources such as grazing land, fuel wood and water. Two of these goods x_2 and x_3 are both produced and consumed by the household. Furthermore, households can obtain utility from the consumption of leisure x_4.

If the corresponding price vectors are:

$$P= (p_1, p_2, p_3) \text{ ..... } 2$$

Then the household's objective is to:

Maximise utility:

$$U(x) = u \{x_1, x_2,x_3,x_4)\} \text{ ..... } 3$$

Subject to an income constraint:

$$p_1x_1 \_ p_2(q_2-x_2) +p_3(r-x_3)-wY_a-p_kK + A- C..... 4$$

Where

A = other income assumed autonomous

C = is the cost of collecting the environmental resource

P_k = vector of prices of capital goods

K = vector of capital goods used in agricultural production.

w = is the market wage

Y_a = is hired labour in production of agricultural goods

r = is vector of grassland products harvested by the household.

X_3 = vector of environmental products used by the household.

P_3 = vector of prices for environmental products.

P_2 = vector of prices for agricultural products

q_2 = Vector of production of agricultural products

x_2 = vector of consumption of agricultural products

P_1 = vector of prices for the market goods

x_1 = a vector of marketed goods purchased by households

The above function gives a household's net surplus, and this income is used to purchase market goods at a market price. This net income is the income available to the household after consuming a portion of its produce and purchasing the inputs used in home production. Note that the households are faced with land and labour constraints as well as agricultural and grassland resource constraints.

The approach of household production function is often applied when estimating use values for consumption, especially recreational values. The monetary value of a change in the area of grasslands can be inferred if it is possible to identify and model a relationship between changes in area of the grasslands and the demand for the marketed compliment or substituted good. For instance, an increase in the stock of animals will result in a change in the total area per animal to which the households have access for grazing and for agricultural purposes. That is, with "optimal" animal stocks, the household is assumed to have access to a certain proportion of grassland resources. With the increase in animal stocks, an occurrence of overstocking will make the household increase its exploitation of the available grassland resources.

5.4 Valuation Methods Used in the Study and Analysis

To compliment the approach of household production function, use values of grasslands were estimated by methods that yield monetary values to the environmental change in question. The method of valuation used in this case is the contingent valuation method (CV). When this approach is used, a change in the provision of the environmental service in question is described to a sample of individuals in a questionnaire or interview setting. This method can be used to establish the welfare loss to the households and it has such advantages as its ability to value non-priced environmental goods and services such as water and better sanitation.

Because the ultimate aim of all economic activity is to satisfy individuals' needs and wants, the objective of valuing the direct use, indirect use and non-use benefits is to measure society's response. In a competitive society, one can assume that market prices reflect the WTP for goods and services. However, some complications arise in conjunction with grassland uses in Uganda. First, as in many other developing countries, market prices may be distorted by deliberate interventions or imperfect competition such as the existence of price ceilings or supports, subsidies or taxes, and monopoly conditions. In such instances, the use of shadow prices is often advocated. These are actual prices "adjusted" to eliminate any distortions caused by policies or market imperfections to reflect true WTP.

The second problem is that many grassland values are not directly reflected in market prices. This is true for all environmental functions, for resources harvested for own use by households, for most recreation and water transport services and for all non-use values. In our study, questions were posed to individuals about their willingness to pay (WTP) an amount of money for an accomplishment of the change described, or about what monetary compensation they require to accept change. Real monetary transactions did not take place. The respondents were asked whether they were willing to pay a certain amount of money for the non-marketed goods and services. They simply respond either "YES" or "NO" to the question. A hypothetical value was attached to some of the environmental resources. More willingness to pay for the environmental service implies environmental degradation. The responses in this approach were analysed using a logistic econometric model.

The welfare loss was also estimated by asking respondents to compare the present environmental condition with that of the past ten years. Problems of recall and bias in response are likely to be experienced here but they should not be significant enough to affect the results. The opportunity cost approach (OCA) was considered to analyse the time the households allocate to moving to grazing lands. Opportunity costs were defined as the benefit foregone by using a scarce resource for one purpose instead of using it for its next best alternative use (Gittinger 1982). As long as the household was using optimal and positive quantities of land in its grazing activities, a decline in grassland availability results in a decline in household benefits because of a decrease in household profits. The cost the household bears equals the change in profits because of the change in access of grazing land. This is based on the premise that the members of the households spend more time moving to the grazing areas and therefore cost to their welfare.

In the study, the value of grassland degradation was determined from indicators such as access to grazing land, water and associated products. These indicators were categorised into use and non use-values. The use values include the values to individuals in the form of pasture, fuel wood, food, water, clean air and timber for building while the non-use value would be in terms of the satisfaction people derive from knowing that the asset exists or from their desire to conserve the environment for future generations.

6.Findings

This chapter presents detailed empirical results of the contingent valuation and other surveys in the value of grasslands. As described in the previous chapter, an assessment of the benefits provided and costs of some activities related to pastoralism is attempted. There are two approaches. One is the use of the production function to estimate the values while the other focuses on the willingness to pay for environmental degradation/conservation. Data limitations prevent a comprehensive analysis of value of grasslands to direct use of key resources only - agriculture, pastoralism and products such as fuel wood and building materials. To the extent that overstocking threatens the grasslands, the net economic benefits of the grasslands indicate the opportunity costs of diverting grassland uses to other activities.

Two types of empirical results are reported below. The first type includes descriptive statistics on both the characteristics of the survey respondents and their answers about the value they place on changes in the environment. The average values placed on environmental problems are particularly useful for policy. The second type of empirical findings includes the results of multiple regression analyses. Multiple regression analyses were used to investigate the relationship between contingent valuation bids for improved environment and various socio-economic and environmental indicators. The goal was to determine how much of the variation in individuals' bids could be explained by differences in observed characteristics. The results are relevant to economic models of contingent valuation methodology.

The next sub-sections present the main summary of the statistics and results of the regression analyses. The regression techniques are also discussed in detail. The chapter concludes with a summary of the results of the analyses and a discussion of the implications for valuing the grasslands.

6.1 Descriptive Statistics

Table 1. Characteristics of the sample

Variable	Number	Mean	Std Dev	Min	Max
Age	184	45.00	14.00	16	98
Household size	184	14.40	11.30	2	64
Number of children	184	7.60	7.00	0	48
Income (dry season)	184	63125.00	105468.00	0	1000000
Income (wet season)	184	72511.00	150948.00	0	1500000
Income (monthly)	184	67818.00	128208.00	0	1250000
Willingness to pay	184	77247.67	150896.00	0	1400000

SOURCE: Authors' computation from the survey data.

The survey covered 10 villages in Kotido and Moroto Districts. The total population covered by the household survey is 2082 and the average household size in this region is 14.4 persons (table

1), of which about 7.6% are below the age of 18. This figure is very high compared to other regions in the country. According to the Population and Housing Census of 1991, the average household size for Uganda was 4.8 persons. The high figure is attributed to the nature of households in this region. The family usually live in groups that include all the lineage of one or two persons. That is, a household would include the grandparent, the grandchildren and even when these get married, they tend to remain in the same settlement. Thus, what is regarded as a family in this area can be broken down to several families in other parts of the country. However, the large family size should not be interpreted to mean the area is densely populated. Since the area is mainly semi-arid, it is sparsely populated with a few pockets of dense population in the urban areas and where there tend to be water and pasture.

Still with reference to table 1, the mean monthly household income is Shillings 67,818 before adjusting for regional prices and Shillings 20,931 after adjusting prices. The national mean monthly income for Uganda is about Shillings 33,750[3]. This indicates the mean income of our sample is far below the national average. This is not surprising given the area is one of the poorest and most backward in Uganda. It is evident that all the characteristics of the poor such as malnutrition, poor shelter, poor health and low income are observed in this area. Despite continued government efforts to provide special development programmes, economic progress has still eluded the area. The major reasons are the very high levels of illiteracy and strong cultural attachment.

Table 2. Distance from household to general infrastructure

Infrastructure	Mean	St dev	Min	Max
Dry- season-only feeder roads	1.8	2.8	0	30
Murram roads	2.9	3.5	0	29
Private transport (Taxis)	5.4	6.9	0	28
Market for agricultural goods	13.7	33.0	0	250
Market for other goods	57.3	92.4	0	250

As depicted in table 2, general access to infrastructure is limited. Most households sampled are located some distance from the access roads and it is notable that the markets are so distant from the households. A greater distance from the markets has several implications on the welfare of the people in the area and on the value of the benefits they derive from the grasslands. The mean distance to the market for agricultural goods is about 14 kilometres, implying that one has to walk 28 kilometres (to and fro) to access the markets for his/her goods. The situation is made even more pathetic by the fact that the markets for other goods, for instance essential households, are farther away. This clearly explains the general backwardness of the area.

The results of the survey also show that most of the villages do not have access to any medical facilities, running tap water or electricity. The village children in general do not have easy access to education facilities such as primary and secondary schools. Generally, most of the villages surveyed either had been or were within 3 to 10 kilometres of primary school facilities while the

average distance to the nearest hospital was 9 kilometres. This situation could explain the low education levels as shown in table 3.

Table 3. Educational levels of respondents

Level	Percentage
None	43.65
Never completed primary school	17.68
Completed primary school	9.94
Post-primary	16.02
Post-secondary	2.21
Tertiary level	8.84
University or higher	1.66

With close to half the population having not attended school at all, the chances of increasing the benefits from the grasslands are greatly hindered. The survey indicated that about 44% of the respondents have never been to school. Most of the respondents were male except for 23% who were female. This relatively small figure of the female respondents was attributed to several factors. In Karamoja, widowed women are taken over by their relatives and so they never consider themselves household heads. The other reason was that even in cases where the female person could respond, she feared the response of the household caretakers and therefore preferred not to talk to the enumerators.

As shown in table 4, the major occupations of the respondents are farming and cattle keeping. These activities are typical of these areas and most of the activities are done on a subsistence level. With the poor climatic conditions (semi-arid), one expects the levels of output likely to be low. This is so especially because there is no modernized agriculture in the area. Again, as already mentioned, efforts by both the government and non-governmental organizations have been hampered by illiteracy, insecurity and culture.

Table 4. Main occupation of household head

Activity	Percentage
Farming	46.93
Trade	0.56
Casual labourer	3.91
Fishing	13.97
Civil servant	3.91
Cattle keeper	30.73

Typical cattle keepers constituted about 31 per cent of our sample while another 47% did both cattle keeping and farming. Pastoralism is the primary economic activity in the area. Although it was problematic to find information on the exact number of livestock, the average household has

about 36 heads of cattle compared to 174 ten years ago. This figure may be misleading because the respondents were never willing to give the exact number of their cattle for fear of cattle raids or cultural beliefs that if counted, the livestock would die. It should be noted that, hitherto, no correct estimate of the number of cattle in this region has been obtained. Most households interviewed said that they would add to their existing stocks of animals. Animals reared are cattle, goats, sheep and donkeys. Table 5 and 6 show the estimated stocks of animals.

Table 5. Estimated number of livestock per household, 1999

Variable	Number	Mean	Std Dev	Min	Max
Cattle	184	36.0	70.0	0	576
Goats	184	41.0	246.0	0	3060
Donkeys	184	3.4	9.5	0	90
Sheep	184	59	155	0	1503

SOURCE: Authors' computation from survey data.

Table 6. Estimates of livestock per county, 1999

Type of Livestock	Dodoth	Jie	Labwor
Cattle	130,000	200,000	30,000
Sheep	80,000	50,000	15,000
Goats	70,000	40,000	20,000
Donkeys	5,000	5,000	n/a
Pigs	500	500	4000

SOURCE: The Karamoja GIS pilot operation.

According to the Veterinary Authority in this region, the total livestock population in 1999 was roughly estimated at 500,000 to 600,000 cattle and 400,000 goats and sheep. This size, compared to the total land area of the region of about 24,000 square kilometres minus gazetted area, farmland and rather useless land, gives a carrying capacity that is not environmentally sound. Moreover, the livestock distribution in the region is very uneven.

The counties with the highest numbers of livestock are Bokora, Matheniko, Pian and Jie. Other counties with low livestock figures are used as grazing areas for the powerful well-armed Matheniko, Bokora and Jie tribesmen

As the herds are concentrated mainly in the more arid central and eastern parts of the region, the result has been serious degradation of vegetation and land. These areas are now threatened with desertification. The impact of overgrazing in this belt is evidenced by the presence of gullies in the region. Overgrazing and overstocking have in one way or another, led to three significant and developmental consequences in both the region and the neighbourhood. The problems include:

first, facilitating the spread of communicable cattle diseases such as contagious bovine pleuro pneumonia, trypanosomiasis and tick borne diseases. Second, usually after cattle raids, the defeated groups have been deprived of a livelihood and have been generally marginalized. Third, many Karamojong who lost their cattle to rustlers have turned to settled agriculture. These problems therefore make management rather difficult. That is why it is assumed that Karamoja region is over-utilized, whereas that may not be the case. Other activities include farming, and the main crops grown are: sorghum, millet, cassava, cowpeas and maize. Pasture is the most economically important grassland product obtained by the household. Other products include fuel wood, fencing/building materials and water.

Turning to the environment related issues, 94 % of the respondents stated they were aware of environmental problems in the area and they thought that these problems posed a threat to their lives. Regarding the state of their environment, 44 % thought it was poor while only 13% thought it was good. None of the respondents claimed it was excellent reflecting the fact that the area is experiencing some problems. One critical issue worth noting was that about 60% felt the problem was beyond their control, reflecting the need for education on the likely causes of environmental degradation.

As shown in table 7, some 72% of the respondents thought that environmental problems were very important, and 21% thought they were important. Slightly fewer respondents were of the opinion that environmental problems mainly caused by overstocking were less important compared to other problems. On average, 22% of the respondents claimed that the environmental problems experienced were largely because of poor stocking systems in the area while 35% believed they were due to increasing population. About 67% thought the environmental problems were worse today compared to ten years ago.

Table 7. Description of environmental condition

Condition	Percentage
Excellent	0
Good	12.7
Fair	43.1
Poor	44.2
Importance of environmental conservation issues	
Very important	72.0
Important	21.0
Not important	7.0

Table 8 clearly shows that overstocking and overgrazing are the major causes of environmental degradation. This is consistent with the theory on pastoralism and nomadism in Sub-Saharan Africa, and confirms the hypothesis that they are a major cause of loss of value of the grasslands.

The major reason for overstocking which the majority of the respondents gave was that culturally, one is seen to be wealthier the more cattle (livestock) he/she has and therefore everybody is willing to add one more animal/ livestock to his/her stock. This has led to the rise in livestock numbers hence the extra pressure on the grasslands that already have poor conservation systems. Changes in weather are also believed to be among the main causes of grassland deterioration.

Table 8. Major causes of environmental problems

Causes	Percentage
Overgrazing	18.56
Overstocking	21.56
Lack of property rights	8.98
Poor monitoring system	16.17
Increasing population	34.73

The results for self-reported problems might be biased in the sense that the respondents may for instance want to give the impression that they are behaving in tune with certain social norms. The respondents generally perceived the practical problems of overstocking as rather enormous. In the case of water, for both household and livestock use, the problem is more severe during the dry season.

6.2 Ranking of Environmental Problems

The ranking of problems from most bothersome to least bothersome is presented in table 9. From the table, it is clear that water and pasture ranked the highest or worst. This response suggests that there is much pressure on available pasture, which directly points to overstocking. These problems are closely associated with environmental degradation. Imperatively, shortage of pasture, for instance, may be caused by overgrazing and/or overstocking, just as inadequate water for both households and livestock could be caused by effects on the ecosystem. The water retention capacity of the swamps and grasslands is severely affected by problems of erosion and silting, which directly or indirectly may be linked to overstocking.

Table 9. Ranking of environmental problems

Problem	Rank	Percentage
Shortage of water (for households)	1	34.90
Shortage of water (for livestock)	2	31.95
Shortage of pasture	3	22.89
Shortage of building materials	4	8.14
Shortage of firewood	5	5.92

Shortage of herbs and other fruits	6	2.53

SOURCE: Authors' computation from the survey data

As indicated in table 10, these environmental problems are responsible for the seasonal migrations usually practised by the livestock herdsmen. These migrants are mainly men and the youth. The movements mainly occur during dry seasons when people move from the northeast of the district (Dodoth) to the western and central parts, which have pastures that are more reliable. At times, herdsmen can move as far as Sudan, Kenya and other neighbouring districts like Soroti, Kumi, Kitgum and Lira. This also occurs during frequent droughts that are experienced in the district whereby whole communities/families migrate to neighbouring districts and countries in search of foodstuffs and other items.

Table 10. Causes of migration weighted by percentage

Factor	Percentage
Insecurity	28
Search for pasture and water	26
Natural calamities	17
Employment	11
Marriage	11
Other	7
Total	100

SOURCE: Authors' computation from the survey data.

The migration pattern of each county is affected more by some factors than by others. For instance, for people in Labwor and Dodoth, insecurity is a greater cause for migration (by levels of 49% and 38%, respectively). Employment scored the highest in the case of the Jie (46%), possibly due to the presence of the town of Kotido, NGOs and government departments, which have avenues for employment. While discussing with various groups, it was observed that in times of drought/famine, a large number of the population migrate to various places. This, in most cases, affects food production levels as people who would have cultivated go away. It is therefore not surprising that the area is faced with these enormous problems; yet, no serious effort has been made to improve the situation. Further analysis on the impacts of degradation is presented using the CVM survey results.

6.3 Hypotheses about the Determinants of the Valuation Bids

The dependent variables in the multiple regressions are contingent valuation bids reflecting the respondents' willingness to pay for the changes in the grassland indicators specified in the

survey. Before reporting the results, this section reviews the hypothesized relationships between these bids and the explanatory variables used in the analysis.

The socio-economic measures used as explanatory variables in the regressions are income, number of cattle, education, age, sex, awareness of environmental problems and location. If environmental products are assumed as normal goods, it is expected that higher income (also expressed by number of cattle) respondents would bid larger amounts. Since wealth or permanent income may be more relevant to the individual's willingness to pay than his or her current income, a variable indicating whether the respondent owns cattle was included in an earlier set of regressions as a proxy for wealth. Therefore, more wealth would most likely reflect a higher willingness to pay.

The remaining socio-economic variables used as explanatory variables are motivated by the literature on environmental conservation systems. For instance, more educated individuals are expected to bid for more improvements in the grassland management systems. Older people are expected to bid less than the young ones, because the younger people have a longer time to face the environmental problems unlike the older ones, and the females may bid less than the males. A set of grassland status measures was included in the regressions as explanatory variables for the willingness to pay bids. In the survey, the measure of general environment status was included - including whether the respondent judged his own environment to be excellent, good, fair, or poor. The individual's previous experiences with the problems were included. Individuals in bad environmental situations, as indicated by these measures, are expected to bid higher amounts for improvements in their health, reflecting increasing marginal disutility for bad grasslands.

The concept of increasing marginal disutility for bad grasslands can be the converse of the more familiar idea of decreasing marginal utility. It is assumed that what people care about - that is provides utility- is the amount of good pastures available. The standard assumption of diminishing marginal utility of good grasslands means that the more grassland products one has, the less he is willing to pay to obtain an improvement in grasslands. The case at hand does not deal directly with areas of good grasslands but, rather, with the change in symptoms experienced. As symptoms worsen, grasslands deteriorate, so the marginal utility of grasslands increases. Thus the hypothesis that people are willing to pay more for improvement of the grasslands, the more symptoms of environmental degradation they have already experienced is consistent with standard economic theory.

6.4 Willingness to Pay for Environmental Conservation

The purpose of the questions was to ascertain how much people would be willing to pay in cash/livestock for an environmentally sound grassland management, without any effort or work on their behalf. The respondents were asked:

> If the environmental problems in this village in the next year is the same as those in the last year, would it be worth Uganda shillings 100,000 (or one cow[4]) to you to completely get rid of these environmental problems?

The respondents were offered several higher/lower bids that they could afford depending on the first bid. The idea here was that there may be some people who were willing to offer more or less than what was stated, depending on their ability. Obviously, there is a considerable risk of misunderstanding associated with a question such as this one. The people who are concerned with grassland deterioration will generally realize that the most sensible solution to grassland degradation is reducing animal stocks and that it necessarily involves individual consideration. Some respondents offered a willingness to pay of zero. Perhaps one could say that not enough information about the hypothetical market for grassland maintenance was given. Therefore, it can be suggested that the reason for lack of answers on this question was that the respondents did not understand the question, or that they rejected it as unreasonable that they should pay for environmental problems caused by other people.

The answer to this question was most probably biased because some respondents gave a willingness to pay zero not because they do not want to pay anything for grassland conservation but because they felt that grassland problems concern pastoralists more than they concern typical farmers. Since there were some zero bids, we used the logistic function because the ordinary least squares would be an incorrect specification giving biased estimates. The contingent valuation responses were analysed with an econometric model. The discrete choice responses were used to estimate a bid function of a logistic regression framework. We considered the following model:

$$Y^*_i = a + b_i X_i + e^*_i \quad \text{..... (6.1)}$$

Where:

Y_i = measures the bid of the i^{th} person for controlling the grassland use;

X_i = independent variables of the i^{th} respondent; household income, age, sex, education, number of cattle, ownership of land, problems of environmental status, etc.;

a = intercept;

e^*_i = is the disturbance term assumed to satisfy all the usual properties of the disturbance term in the classical linear regression.

If the respondent indicated a positive willingness to pay, we assigned a value to Y^*_i equivalent to the amount specified. If the respondent gives a willingness to pay zero, then Y^*_i is unobservable and Y_i is given a value of zero. The model now becomes:

$$Y_i = a + b X_i + e_i \quad \text{..... (6.2)}$$

$$Y_I = Y^*_I \text{ if } Y^*_I > 0 \quad \text{..... (6.3)}$$

$$= 0 \text{ otherwise.}$$

Where Y_I is truncated at zero and e_I is truncated at $-(Y- b X_i)$

The results of the logistic regression are presented in table 11. The estimated bid model correctly predicted 80 percent of the responses, clearly indicating that the elicited bid responses were non-random. The mean WTP for environmental management per month is Uganda shillings 77,248. This is equivalent to US $52 per household[5] per month. Aggregating this mean willingness to pay over the total number of households in the region gives a total willingness to pay for environmental management of Uganda shillings 20.6 million or US $1,373,652. This figure is high, especially given that the income of the people in this area is low. This generally would reflect a high rate of environmental degradation and strong need for environmental conservation in the region.

Table 11. Regression results for WTP bids

Variable	Parameter estimate	T-Ratio
Intercept	-182.000	-2.84
Income	0.182	7.60
Age	0.128	6.32
In ages	-0.002	-5.80
Sex of head	0.172	1.12
Dependency ratio	0.869	3.91
In adult equivalents	0.003	0.18
EDUC1	0.860	3.91
Heads activity farming	-0.407	-0.12
Own Land	-0.377	-1.27
Distance to primary school	0.159	1.26
Distance to hospital	0.172	1.06
Environmental awareness	2.017	7.72
Seriousness of envir. problems	0.130	5.58
R2	0.435	
N	184.00	

SOURCE: Authors' computation from survey data

The willingness to pay question was administered in two forms. One was where the respondent was willing to pay cash, and the other applied if the respondent was willing to pay in kind (heads of livestock). The second part of the question was meant to cater for those respondents who were not willing or unable to part with some cash but preferred to pay in kind. These were then converted to cash terms using a conversion factor derived from the market rates for livestock.

Table 12. Reasons for willingness to pay

Reasons	Percentage
Cost affordable and reasonable	6.15
Will increase available pasture/water	32.31
Concerned about protecting his environment	42.31
Might help other rural people	13.85
Other	5.38

SOURCE: Authors' computation from the survey data.

The major reasons for the respondents' willingness to pay (table 12) were related to environmental factors. About 42% were interested in protecting the environment, and 32% were willing to pay to increase availability of pasture and water. These are definitely justified reasons, especially after considering the state of the environment in the region. On the other hand, most of those who were not willing to pay (66%) were constrained because they did not have the resources. Others were willing but could not afford, while about 17% did not have enough information (table 13).

Table 13. Reasons for NOT accepting to pay for the plan

Reasons	Percentage
Can't afford it	66.19
Can afford but not interested	7.19
Prefers another alternative	5.04
Not enough information	17.27
Cannot decide	4.32

SOURCE: Authors' computation from the survey data.

The full model was subjected to misspecification tests and it satisfied all the underlying assumptions. Versions of the model that were more restricted were also tested.

In general, the results revealed that a number of socio-economic variables were systematically related to willingness to pay. The effects of income on bids tended to be big and positive, as would be expected, indicating that people with higher income are willing to pay more for environmental conservation. The likely explanation for this could be that households with large

incomes could be deriving most of these incomes from grassland related activities. Therefore, such households would be more willing to pay to have this facility conserved. In a similar regression, we used number of livestock instead of income since there could probably be multi-colinearity between the two variables. The results were not significantly different from those on income. An interpretation of this result is that respondents with large numbers of cattle are likely to realize the effects of overstocking more and are thus more willing to pay for environmental damages caused by overstocking. Respondents who accepted limiting livestock numbers were more likely to agree to the offered bids. Most of the respondents who were willing to pay were interested in paying cash rather than foregoing their livestock, reflecting the strong attachment these people have with their livestock. This kind of attitude may likely be the cause of overstocking and grassland degradation.

As expected, the more educated did tend to bid more. The coefficient on education is positive and significant. No systematic relationship between the sex of the respondent and the amount of the bid was found. Although males tended to bid more, the coefficients are not significant in the statistical sense. In addition, the older people tended to bid more than the younger people did. The coefficient on age is positive and significant. This may be caused by various factors; perhaps the older people own more cattle and are more concerned on the likely effects of degradation on their livestock numbers.

More support was found for the expected positive relationship between awareness of environmental problems and willingness to pay, implying that respondents who are more aware of environmental problems are willing to pay more. This reflects an increasing marginal disutility of grassland degradation. Seriousness of the grassland degradation had a positive effect on the amount of bids offered. The estimated coefficient was significant at 95% confidence level. Surprisingly, the variable interest in environmental problems had a negative value, but was insignificant. Dependency ratio was found to be positive and significant, meaning that the higher the dependency problems, the more concern the household has about the welfare of its dependants. This finding could be consistent with economic theory that individuals always prefer to have some bequest value left for future generations. Several of the dummy variables for village groups have insignificant coefficients. The variables likely to reflect village level differences were not captured in the analysis.

6.5 Economic Valuation of Grassland Benefits

Data limitations may currently prevent a comprehensive analysis of the relative benefits of grasslands. Constraints on data limit our coverage to agriculture, livestock grazing/rearing, and fuel wood. The main source of data for calculating these direct use benefits was our survey. Where appropriate, actual prices are adjusted to economic values using shadow prices. Views on sustainability of resource use, especially grazing land, are also discussed, and the implications incorporated.

The grasslands are used for several purposes such as for agriculture, fuel wood, pasture and herbs. However, some of these benefits, much as they are extremely important, are less easy to value. Tables 14 and 15 show the crop production area and monthly values of grassland benefits and agricultural crops.

Table 14. Crop production area (Ha) of inter-planted crops

Inter-planted crops	Area (Ha)
Maize	2,410.25
Sesame	3,228.00
Beans	107.25
Cassava	78.00
Cowpeas	950.51
Total	6,794.00

SOURCE: Agriculture Department, Kotido

Agricultural production contributes to a sizeable proportion of the wealth in Karamoja region. According to the agricultural department in Kotido, the average yield per acre is 300 kg of sorghum; 350 kg of maize; 180 kg of groundnuts; 180-200 kg of sunflower; 150-200 kg of bulrush millet and 80-120 kg of cowpeas. Although the area has a better potential, Tables 14 and 15 clearly show that the values per household are still quite low. This probably explains the persistent famine in the area. According to the discussions held with community leaders, there are series of problems constraining agricultural production in the area.

Table 15. Value of agricultural and grassland activities

Activity	No. of observations	Total monthly value for all villages (`000) Shs.	Mean monthly value per household (`000) Shs.
Fuel wood	184	44,892.00	8.36
Sorghum	143	13,892.00	38.00
Millet	145	232.00	12.00
Cowpeas	124	54.00	5.20
Milk	132	43,456.00	128.00
Cassava	145	402.00	3.70
Live cattle	132	56423.00	98.00
Goats	134	54.00	6.00
Sheep	134	28.00	3.00
Skins	132	42.00	2.00

SOURCE: Authors' computations from the survey data.

One of the major constraints affecting agricultural production in the district is soil degradation. Ironically, farming activities are some of the major contributors to soil erosion and loss of

nutrients. This is particularly true for Labwor County where agriculture is a major occupation. Other factors that have contributed to land degradation include deforestation and overgrazing. Uncontrolled communal grazing and deforestation have exposed the soil to wind and water erosion. Rainfall is also of great significance to agricultural production. Unfortunately, according to the respondents, lately it has become so unreliable and erratic that predictability is quite difficult. Poor technology could also explain the low agricultural output in the area. The population relies on such traditional inputs as the hoe. It is unfortunate that usage of animal traction for cultivation is still minimal.

The low productivity is also explained by inadequate extension services (both staff and logistics), pests, diseases and traditional beliefs that lead to delayed sowing of crops. Due to these problems, nutritional levels in Karamoja are reported to be low. It has already been mentioned that child malnutrition is very common and the general health standards of the people are indeed poor. There is a high prevalence of diseases due to the weakened immunity of the population. Consequently, labour productivity has also declined. Once the productivity of land and labour reduces, there follows a loss of value in the resources.

6.5.1 Livestock and Grazing

The Karamoja grasslands provide important grazing resources both for sedentary farmers (with livestock settled within the grassland area) and for the nomads who use the grasslands during the wet season and migrate to other parts during the dry season. Although it is clear that livestock production in the area is both high and increasing, there is currently little data available on cattle numbers, herd composition, in- and out-migration of herds, herd off-take or carcasses and livestock products (for example, milk, yoghurt, hides) delivered to the market. Problems in obtaining these data are due to fear of continuous raids, cultural superstition where there is a belief that counting of animals may lead to their death, and illiteracy (some cattle keepers do not know how to count so prefer not to give the number of herds they own). This was a serious problem during the survey; at the time the data was collected, cattle raids were rampant in both Kotido and Moroto Districts. Scanty data was obtained on cattle numbers and this is what was used to derive estimates of livestock products in the area. The results of the analysis in this section should therefore be treated with caution.

In Labwor and Jie, medium to heavy grazing is practised. The Labwor communities keep only a few oxen for digging and therefore tend to have "free" pastures which neighbouring communities graze all year round. From the discussions, the value from milk and live cattle was considered highest. Although there were no accurate figures for the value of livestock, the figure from live cattle could probably be high. This result could be indirectly attached as a value for the grasslands since the cattle obtain their survival directly from the grasslands. Although the exact value of the grasslands is difficult to derive, some insights can be obtained from these figures. Added to the value for cattle are those for sheep, goats and skins. These items are indirectly derived from the grasslands and therefore they provide an indication of the value of the grasslands. Summing up the values from the livestock products gives a value of more than Uganda shillings 100,000,000 per month, according to the Departments of Agriculture and Veterinary Services.

6.5.2 Livestock Marketing and Production

Generally, the marketing infrastructure in Kotido is poorly developed and there is no standard for livestock marketing. The mean distance from most households to all types of markets is high - approximately 27 km. In addition, most markets are not typical market establishments such as those that may be found in other parts of the country. These are merely sites well known to the communities for disposing items. They operate regularly and they cannot be taxed, especially since bartering is practised in some instances. About 700 heads of cattle are sold out per month; and generally, the off-take is on the increase.

Relating to productivity, additional data must be acquired on the productivity of different grassland grazing resources (for example, pasture land, scrub land, marshes and forests). During rainy seasons, the plains are commonly infested with ticks and the grasses are very high. The clay soils found in the area become very sticky and marshy. Such conditions increase the incidence of foot rot, and are generally hazardous to both humans and livestock. Common diseases include contagious bovine pleura pneumonia (CBPP), *nagaana*, rinderpest, east coast fever (ECF), foot and mouth disease (FMD), mastitis and anthrax. However, with the little data available, it is difficult to calculate the value of the average monthly animal production attributable to grassland grazing.

Pasture management is poor due to indiscriminate burning and overgrazing. This has led to a succession of less palatable pasture plants and bare ground. Such a situation is highly susceptible to soil erosion by wind and water. Inadequate veterinary extension services and scarcity of animal drugs have hampered livestock improvement efforts by individuals. Removal of government subsidies in veterinary services has left cattle keepers at the mercy of traders some of whom sell bogus drugs. There is sale of unsuitable and expired drugs. In addition, inadequate marketing infrastructure has prevented the growth of commercial rearing, while scarcity of water is another major problem facing the industry. Moreover, due to cultural values, most farmers hold more cattle than the grazing pastures can accommodate.

6.5.3 Fuel Wood and Other Non-Timber Products

Net benefits from fuel wood production in Karamoja were calculated by distinguishing rural subsistence use from urban consumption. We later aggregated them to obtain a gross value. With an estimated 23,000 rural households in the region and an average monthly fuel wood consumption of 40 Kg, total rural fuel wood use is around 92,000 tonnes monthly. Fuel wood collected from the grasslands is also consumed in local towns, notably Kotido and Moroto. Applying the same monthly rate of 40 Kg of fuel wood used per household to 320 urban households yields a total urban consumption of 12840 tonnes. Note that estimating total area for fuel wood production is extremely difficult. The figure presented here is rather an approximation

Deforestation is one of the worst forms of environmental degradation. The problem is widespread over the entire region. The whole of Jie County is affected while in Dodoth County it is mainly in the areas of Kathile, Kaabong, Loyoro and Kalapata. For Labwor County, it is rampant in Alerek, Nyakwae and part of Abim. The causes of deforestation include firewood extraction, charcoal burning, browsing, dry wood fencing, bush clearing for agriculture, building materials and crafts. Although some form of agro-forestry is being introduced, the general trend is still consistent loss of vegetation with consequent deleterious effect to rainfall pattern, watershed and soil protection.

In addition to producing fuel wood, the grasslands yield important non-timber products that are significant to the livelihoods and subsistence of local communities. Some are important marketed commodities that generate substantial income such as honey, while others are very difficult to value such as building and fencing materials and herbs. Most of these products are used locally. The collecting of honey is done in the extreme North and yet very little of it is marketed or exported to other regions. A substantial amount is used in the village ceremonies such as marriage. Honey collected by local hunters is a highly valued commodity. Local prices range from Uganda shillings 500 to 1000 per litre. As for the fencing and building materials, they are obtained from the grasslands typically for the construction of corrals for their animals or their temporary shelter locally known as *manyattas.*

6.5.4 Wildlife Habitat - Tourism and Scientific Benefits

Recent information shows that the Karamoja grasslands are an important habitat for wildlife - with a game park (Kidepo) having several species of animals and birds. The game park has been a tourist attraction, earning the people some income. The rich and highly concentrated animal populations in the grasslands suggest they have a potential value in terms of scientific, educational and tourism benefits. Current uses of the grasslands for these purposes are still small. Poor tourist infrastructure, insecurity and transportation in Northern Uganda are the major constraints to the development of the tourist potential. Nevertheless, the Karamoja Development Agency (KDA) has tried to provide infrastructure and attract investment to the area. Efforts by the government to improve security have been stepped up to attract more tourists.

The people of Kotido District carry out hunting as a major form of livelihood. They also tap resources for making handicraft (such as the famous Karamojong stool), which are sold to tourists and other visitors. Therefore, conservation of grasslands as an important wildlife habitat has important option values for future tourism, educational and scientific uses. The grasslands may also have an important non-use existence value, in that individuals who do not intend to visit the parks and grasslands may value the fact that it exists as an important wildlife habitat. Accounting for these values is extremely difficult, however; and it may require sophisticated techniques of contingent valuation and travel cost methods.

Nevertheless, whatever traditional/cultural/customary or socio-economic role wildlife (bio-diversity) may be contributing to the communities in Karamoja region, present levels of utilization are not sustainable in the long term. Any future use must be based on protection of the species used or exploited. This is based on the following issues: firstly, there is apparent uncontrolled hunting and rampant poaching, particularly on the advent of popular use of the gun

trade with smugglers from across the borders. Secondly, there is poor management of wildlife resources in protected areas due to insecurity, poor remuneration and low staff morale, and lack of up-to-date inventory. Thirdly, the management policy in general excludes human beings; the user rights for the people are not clear-cut. Lastly, there is habitat fragmentation; that is, human settlements and agriculture are increasingly isolating animal habitat.

7. Conclusions and Policy Implications

The economic analysis of the agricultural, fuel wood, pastoral and other benefits provided by the Karamoja grasslands in Northeastern Uganda indicates that these benefits are substantial on all fronts. Not only are these grassland benefits currently important, but also they can be expected to yield significant economic returns for some time - if the grassland is properly managed and sustained. Even when taking into account the future non-sustainability of much of the grassland management/ stocking systems, the current analysis shows the benefits of the grasslands to be worth more than Uganda shs. 200,000,000 per month.

However, there are other significant economic benefits provided by the grassland system than the ones estimated in the analysis. Livestock grazing is particularly important, although honey collection and recreational and educational benefits may also prove to be substantial. The sum total of these additional benefits may actually exceed the estimated returns to direct grassland uses. The fact that there is a high willingness to pay among the respondents also shows that the rates of grassland deterioration could be high - hence the more people are willing to pay.

Then, economic importance of the grasslands suggests that the benefits they have provided cannot be excluded as an opportunity cost of any activity that degrades the grasslands. Policy makers should be aware of this problem when designing grassland management systems. Further analysis is required of the other grassland benefits and the proper estimation of the livestock numbers. Investigation on the sustainability of production within the grassland should be more thoroughly done.

It is clear that most people living in the grasslands are willing to spend a considerable amount of money or reduce their livestock by some marginal units to have the deterioration of grasslands abated. Economic factors such as income and number of livestock are important determinants in encouraging this willingness to pay. There is an increasing interest across the grasslands in having a management system installed - but it does obviously help if the government could help initiate the process of reducing animal numbers and controlling grazing.

The analysis indicates that CVM, if rigorously and carefully applied, can be effectively used in a developing country context. The econometric analysis undertaken indicates a systematic association between various socio-economic variables of interest and the expressed willingness

to pay for grassland management. The results show that responses to the CVM questions were decidedly non-random.

The Karamoja grasslands are useful in supporting livestock and other animals. While the benefits of conserving these grasslands are large, some very significant opportunity costs must be considered as a necessary condition to avoid open access problems that will threaten the existence of the grasslands in the end. Approximately 2 million people in this region and its neighbourhood will be negatively affected by overstocking and overgrazing. Annual compensation would be required but this would better be in the form of education, alternative income earning enterprise in overgrazed areas or other developments.

Notes

. These are temporary shelters used by the Karamojong.

2. This includes both government failure and market failure.

3. Exchange rate at the time is 1US$= Uganda shillings 1500.

4. A conversion factor of 1 cow to shillings 100,000 was used.

5. 1US$ = shillings 1500.

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