Challenges of sustainable land-use management on ecosystems around protected areas. A case of Bwindi Impenetrable National Park.

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Abstract

Increasing rates of human population growth and anthropogenic impacts on a global scale have left few populations of plants and animals undisturbed. Globally land use activities have had a profound impact on the ecosystems as well as their functioning activities. Many ecosystems are exposed to the effects of land use in different measures. Land-use change and related habitat loss and fragmentation have long been recognized as important drivers of past and present ecosystem change. High population density, high poverty and dependence on natural resources pose a major threat for the conservation of the protected areas, especially in the situation of Bwindi Impenetrable National Park, which is an isolated forest surrounded by a densely concentrated population. The study is to investigate the challenges of sustainable land-use management around protected areas. The main aim is to establish different land-use activities that impact on sustainability of ecosystems around the park. The problem is not clear whether land-use activities result in perturbations of ecosystems around Bwindi Impenetrable National Park. This is exacerbated in destruction of habitats, wet land degradation, migration of certain animals, and encroaching among others. The problem seems to be compounded by, intensive agriculture, forest fires, soil erosion and degradation of the ecosystems. These in turn impact on the ecosystem structure and resilience. The literature review mainly focused on ecosystem disturbance as a result of land-use.

The research design includes the use of qualitative data that will be in a descriptive form and quantitative data that will comprise of statistical or measurable aspects like land area and distances. Bwindi Impenetrable National Park is located in southwestern Uganda (0° 53’-1° 08’S, 29° 35’-29° 50’E) The park consists of 321 sq. km of rugged land with steep slopes. The study will use a sample of 30 respondents especially the community leaders, conservationists in the field, the staff from UWA, the porters and tour guides, the tourism association leaders, cultural leaders and agricultural officers. Purposive random sampling will be utilized in conjunction with interview guides and oral interviews. Analysis of data will be done by use of excel and frequencies plus percentages.

Key words: Land-use, ecosystems, disturbance, anthropogenic effects, sustainability.

1. Introduction

Increasing rates of human population growth and anthropogenic impacts on a global scale have left few populations of plants and animals undisturbed. Participation in non-consumptive wildlife activities, such as eco-tourism, that generally do not directly harm organisms or their habitats is projected to double over the next 50 years. Thus, human interactions with plants and animals may be among the most pressing issues in developing sustainable approaches to mitigating
anthropogenic impacts. Yet most research that monitors populations at risk of decline or extinction has focused on behavioral and demographic measures of viability, without integrating human activity patterns. Moreover, understanding the mechanisms by which human activities affect reproduction and development may suggest novel approaches to mitigate the deleterious effects of these activities on wild populations. Anthropogenic disturbance is a relevant and widespread facilitator of environmental change, with potentially significant implications for individuals and populations. There is increasing evidence that vertebrate populations are stressed when exposed to humans, which is manifested by changes in behavior and physiology (Williams et al.).

Ecosystems are sensitive not only to changes in climate and atmospheric trace gas concentrations but also to other anthropogenic changes such as land use, nitrogen deposition, pollution and invasive species (Vitousek et al., 1997; Mack et al., 2000; Sala et al., 2000; Hansen et al., 2001; Lelieveld et al., 2002; Korner, 2003b; Lambin et al., 2003; Reid et al., 2005). In the recent past, these pressures have significantly increased due to human activity (Gitay et al., 2001). Natural disturbance regimes (e.g., wildfire and insect outbreaks) are also important climate-sensitive drivers of ecosystem change. Projecting the impacts of the synergistic effects of these drivers presents a major challenge, due to the potential for non-linear, rapid, threshold-type responses in ecological systems (Burkett et al., 2005).

Land-use change represents the anthropogenic replacement of one land use type by another, e.g., forest to cultivated land (or the reverse), as well as subtle changes of management practices within a given land use type, e.g., intensification of agricultural practices, both of which are affecting 40% of the terrestrial surface (reviewed by Foley et al., 2005). Land-use change and related habitat loss and fragmentation have long been recognized as important drivers of past and present ecosystem change, particularly of biodiversity (Heywood and Watson, 1995; Fahrig, 2003). Fire influences community structure by favouring species that tolerate fire or even enhance fire spread, resulting in a relationship between the relative flammability of a species and its relative abundance in a particular community (Bond and Keeley, 2005). As a result, many vegetation types are far from the maximum biomass predicted by regional climate alone (Bond et al., 2005). Geographical shifts in key species or fire may therefore cause fundamental community shifts (Brooks et al., 2004; Schumacher and Bugmann, 2006). Fire-prone vegetation types cover a total of 40% of the world’s land surface (Chapin et al., 2002), and are common in tropical and subtropical regions (Bond et al., 2005), and the boreal region (Harden et al., 2000) in particular.

The relative importance of key drivers on ecosystem change varies across regions and biomes (Sala et al., 2000; Sala, 2005). Several global studies suggest that at least until 2050 land-use change will be the dominant driver of terrestrial biodiversity loss in human-dominated regions (Sala et al., 2000; UNEP, 2002; Gaston et al., 2003; Jenkins, 2003; Scharlemann et al., 2004; Sala, 2005). Conversely, climate change is likely to dominate where human interventions are limited, such as in the tundra, boreal, cool conifer forests, deserts and savanna biomes (Sala et al., 2000; Duralappah et al., 2005). Assessment of impacts on biodiversity differ if other drivers than climate change are taken into account (Thomas et al., 2004a; Sala, 2005; Malcolm et al., 2006).
Interactions among these drivers may mitigate or exacerbate the overall effects of climate change (Opdam and Wascher, 2004). The effects of land-use change on species through landscape fragmentation at the regional scale may further exacerbate impacts from climate change (Holman et al., 2005a; Del Barrio et al., 2006; Harrison et al., 2006; Rounsevell et al., 2006).

Notwithstanding the foregoing, the principal loss of habitats and some species from the 1960’s was mainly due to conversion of natural ecosystems into agricultural land. The underlying cause of habitat alteration is the high rate of growth of Uganda’s population which at 3.4% per annum is higher than the world average and even the one of Sub-Saharan Africa. During the 1970s and early 1980s, Uganda lost significant numbers of wildlife populations. Some species such as the white rhino and the black rhino became extinct. The wanton destruction of wildlife populations in the absence of law and order in the 1970s and early 1980s was the main reason why today, wildlife populations outside protected areas are drastically reduced. Although the situation has improved a lot, biodiversity loss is still there sustained by the high levels of poverty in rural areas. The majority of the poor in Uganda live in rural areas. The poor are both agents and victims of environmental degradation. Poverty is being addressed by the Government and its development partners. Headcount poverty has declined from 56% in 1992 to 38% by 2004 (UBOS 2004).

According to Pomeroy & Tushabe (2004) the overall rates of biodiversity loss have declined for such important groups as large mammals and primates, including apes, as well as birds such as pelicans and fish eagles. But woody biomass in all its forms continues to decline, together with all the biodiversity that depends upon trees, and biodiversity loss seems to be an almost inevitable consequence of agricultural intensification (Pomeroy & Tushabe 2004). Ecosystem changes caused by climatic changes can also affect the many ecosystem goods and services on which society depends. Likewise, climate change effects on ecosystem goods and services may elicit human actions that in turn affect climate, ecosystem disturbance, and/or ecosystem structure and functioning.

The fact that forested parks often are the last remaining source of fuel makes the combination of high population density, high poverty and dependence on natural resources a major threat for the conservation of the protected areas. Especially in the situation of Bwindi Impenetrable National Park, which is an isolated forest surrounded by a densely concentrated population, agricultural encroachment is the major threat to preservation of the forest (WCMC 2001). Approximately 10,000 families cultivate the land immediately surrounding Bwindi Impenetrable National Park. More than 20 years ago, according to Butynski (1984), about 84% of the forest compartments already displayed signs of human activity (WCMC 2001).

2. Literature review

At the global level, human activities have caused and will continue to cause a loss in biodiversity through, *inter alia*, land-use and land-cover change; soil and water pollution and degradation (including desertification), and air pollution; diversion of water to intensively managed ecosystems and urban systems; habitat fragmentation; selective exploitation of species; the introduction of non-native species; and stratospheric ozone depletion. The current rate of biodiversity loss is greater than the natural
background rate of extinction. Climate change directly affects the functions of individual organisms (e.g., growth and behavior), modifies populations (e.g., size and age structure), and affects ecosystem structure and function (e.g., decomposition, nutrient cycling, water flows, and species composition and species interactions) and the distribution of ecosystems within landscapes; and indirectly through, for example, changes in disturbance regimes (IUCN et al., 2004).

Natural communities are shriveling rapidly and shrinking on all sides because of the expansion of agriculture, urbanization, damming, forest fragmentation, contaminants into water tables, road building, and even more indirect human impacts such as the invasion by exotic species and the distribution of genetic crops. For instance in Nepal, eco-tourists flock to hike one of the remaining wilderness regions on the planet, but these hikers have stripped the landscape bare of sticks and twigs for fuel and left trash that spoils the experience for future visitors. In the Galapagos, the burgeoning number of visitors strains these sensitive and fragile islands. The impact of these visitors, manifested by disease, fire, and theft, has altered the natural balance of the island ecosystems (Deborah, 1998).

Ecosystems provide many goods and services that are crucial to human survival. Some indigenous and rural communities are particularly dependent on many of these goods and services for their livelihoods. These goods and services include food, fiber, fuel and energy, fodder, medicines, clean water, clean air, flood/ storm control, pollination, seed dispersal, pest and disease control, soil formation and maintenance, biodiversity, cultural, spiritual, and aesthetic and recreational values. Ecosystems also play a critical role in biogeochemical processes that underlie the functioning of the Earth’s systems (Malcolm et al., 2006).

NEMA (2001) says that realistic projection of the future state of Earth’s ecosystems can be made without taking into account human land- and water-use patterns—past, present, and future. Human use will endanger some terrestrial and aquatic ecosystems, enhance the survival of others, and greatly affect the ability of organisms to adapt to climate change via migration. The relative impact of climate change and other factors such as land use, biotic invasions, and pollution on endangered species are likely to vary regionally. Thus, in some ecosystems, climate change is likely to have less impact on endangered or threatened species than other factors. Concern over species becoming rare or extinct is warranted because of the goods and services provided by ecosystems and the species themselves. Most of the goods and services provided by species (e.g., pollination, natural pest control) are derived from their roles within systems. Other valuable services are provided by species contributing to ecosystem resilience and productivity. The recreational value (e.g., sport hunting, wildlife viewing) of species is large both in market and non-market terms. Species loss could also impact the cultural and religious practices of peoples around the world. Losses of species can lead to changes in the structure and function of the affected ecosystems, and loss of revenue and aesthetics. Understanding the role species, or groups of species, play in ecosystem services is necessary to understand the risks and possible surprises associated with species loss.

**Pressures on ecosystems from Human Activities**

The Earth is subjected to many human-induced and natural pressures, collectively referred to as
global change. These include pressures from increased demand for resources; selective exploitation or destruction of species; land-use and land-cover change; the accelerated rate of anthropogenic nitrogen deposition; soil, water, and air pollution; introduction of nonnative species; diversion of water to intensively managed ecosystems and urban systems; fragmentation or unification of landscapes; and urbanization and industrialization. Climate change constitutes an additional pressure on ecosystems, the biodiversity within them, and the goods and services they provide. Quantification of the impacts of climate change alone, given the multiple and interactive pressures acting on the Earth’s ecosystems, is difficult (IUCN et al., 2004).

The loss of biodiversity from diverse and extensive ecosystems does not necessarily imply a loss in productivity. The global distribution of biodiversity is correlated with global temperature and precipitation patterns, among other factors. Rapid climate change is expected to disrupt these patterns (usually with the loss of biodiversity) for periods of at least decades to centuries as ecosystems change and reform. Climate variability refers to variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate on all spatial and temporal scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external forcing (external variability).

According to Carpenter et al. 2006 and Millennium Ecosystem Assessment 2003, there are direct and indirect drivers, the underpinning assumption is that ecosystem change is brought about by a complex web of interactions between humans and their surroundings as humans seek to satisfy their basic needs and improve their well-being. To systematize the approach to understand these interactions, and describe the relationship in terms of “drivers” of ecosystem change. The MA definition of a driver is any natural or human-induced factor that directly or indirectly causes a change in an ecosystem (Carpenter et al. 2006). A direct driver unequivocally influences ecosystem processes. An indirect driver operates more diffusely by altering one or more direct drivers. The categories of global driving forces are demographic, economic, sociopolitical, cultural and religious, scientific and technological, and physical and biological. Drivers in all categories other than physical and biological are considered indirect. Important direct, i.e., physical and biological, drivers include changes in climate, plant nutrient use, land conversion, and diseases and invasive species.

Changes in ecosystem services are almost always caused by multiple interacting drivers. These drivers can work over time, e.g., population and income growth interacting with technological advances that lead to climate change, or over levels of organization, e.g., from local zoning laws to international environmental treaties; they can also happen intermittently, e.g., droughts, wars, and economic crises. For example, reviews of case studies of deforestation and desertification (Geist and Lambin 2002, 2004) reveal that synergistic factor combinations are the most common, i.e., the combined effects of multiple drivers that are amplified by reciprocal action and feedbacks. Drivers interact across spatial, temporal, and organizational scales. Global trends such as climate change or globalization can influence regional contexts of local ecosystem management. For example, a study in South Africa found that changes in the export prices of cash crops can
trigger land-use changes at the local level. The removal of national credits and subsidies causes some farmers to become more vulnerable to environmental changes, whereas others profit from easier access to markets and become less vulnerable to climate change (Leichenko and O'Brien 2002). Any specific ecosystem change is the result of a myriad of interactions among drivers. Although some drivers are global, the actual set of interactions that brings about an ecosystem change is more or less specific to a particular place. For example, a link between increasing producer prices and production growth can be found in many places throughout the world. The strength of this effect, however, is determined by a range of location-specific factors that include production conditions, the availability of resources and knowledge, and the economic situation of the farmer (Jones 2002). No single conceptual framework exists that captures the broad range of case study evidence (Lambin et al. 2001). Changes in ecosystem services feed back to the drivers of change. For example, altered ecosystems create new opportunities and constraints on land use, induce institutional changes in response to perceived and anticipated resource degradation and shortages, and give rise to social effects such as changes in income inequality because there are winners and losers in environmental change.

In general, biodiversity loss is caused by deforestation, wetland degradation due to population growth and encroaching human settlements, selective tree harvesting for wood products, poaching and inappropriate fishing gears and techniques such as use of poisonous chemicals (NEMA, 2001). Short fallow periods and vegetation clearing affect the occurrence, distribution and richness of plant species (Eita et al., 2003). Moreover, Uganda’s critically endangered plants are threatened by habitat loss and degradation from small-holder farming, large-scale plantations, clear-cutting wood extraction, infrastructure development and local and international harvest and trade (IUCN et al, 2004).

3.3 Ecosystems and their Susceptibility to Human Pressure

The susceptibility of ecosystems to pressure from human activities, and its implication on the sustainability of service provision by these systems is crucial. Ecosystems such as forests, wetlands, soil, marine and so forth play a very important role in supporting the well being of societies. They provide food and fibre materials, fuel wood, employment and income, in addition to the provision of a vast range of ecological services. Further, where property rights clearly prevail, private holders of some of these resources have their asset base greatly enhanced. Ecosystems vary in their natural susceptibility to over use or stress. This susceptibility depends on land use, on demographic, market, and institutional circumstances, and on the regulatory framework and control strategies adopted by different countries. Habitat fragmentation, habitat conversion, and agricultural disturbance have all been blamed for increasing the susceptibility of ecosystems to stress. It has been shown that many of Uganda’s ecosystems are under stress (IISD & UNEP, 2005). The reasons behind this stress include; deforestation, wetland destruction, poaching, the rapid population growth that has persistently led to increased demand for settlements and arable land. Thus human activities are the key forces behind the stress of ecosystem services. Human activities can cause complex changes within the structure and function of ecosystems. Impacts include disturbances in the ecosystems that may lead to restructuring established foods webs, importing new diseases.
and alien species to the surroundings, and the total
destruction of systems and the resulting loss of
biodiversity. The level of biodiversity in an
ecosystem determines its capacity to respond to
external shocks, whether by the market or by
environmental-induced factors. From an
ecological perspective, biodiversity protects
ecosystem resilience by underwriting the provision
of ecosystem services over a range of
environmental conditions (Perrings et al., 1992).
Loss of resilience means both an increase in the
time taken to return to equilibrium following some
shock and a narrowing of the range of
environmental conditions over which the system
can maintain the flow of ecosystem services
(Holling et al., 1995). Further, if a system
sufficiently flips from one state to another,
production sets may be rendered non-convex
(Perrings et al., 1992). This actually implies
irreversibility conditions, and that the range and
structure of goods and services changes
drastically. This may have severe consequences
for management of natural resources and for the
riparian communities. Further, it may imply the
non-controllability of the system itself. That is,
management decisions based on observed market
prices, and policy instruments geared toward
control of the system may fail to achieve the
desired goals, as the system dynamics would be
out of conformity. Thus, pressure from human
activity may lead to situations in which
ecosystems with limited resilience flip. And once
systems flip, a range of ecosystem services may be
completely lost, implying adverse welfare effects
on riparian communities.

Human actions leading to the long-term clearing
and loss of woody vegetation have and continue to
contribute significantly to greenhouse gases in the
atmosphere. In many cases the loss of species
diversity associated with forest clearing leads to a
long-term transition from a forest to a fire and/or
grazing maintained, relatively low diversity
grassland with significantly lower carbon content
than the original forest. Deforestation and land-
clearing activities contributed about a fifth of the
greenhouse gas emissions (1.7±0.8 Gt C yr-1)
during the 1990s with most being from
deforestation of tropical regions.

Bwindi Impenetrable National Park (321 km²) in
southwestern Uganda (0° 53'–1° 08'S, 29° 35'–
29° 50'E) is one of a series of protected areas in
the Albertine Rift, a region globally famous for its
biodiversity thought to result from proximity to a
Pleistocene refugium for many species of flora and
fauna now endemic to the Rift (Hamilton 1976).
For example, the mountain gorilla (Gorilla
beringei beringei) is found only here and in one
other site, namely the Virunga Volcanoes located
25 km to the south. The Park comprises steep-

sided hills and spans an altitude range of c. 1400
m, tilting from the highest point 2607m in the
south-east to the lowest 1190m in the north-west
(Butynski, unpublished report 1984). The
boundary is typically an abrupt transition between
forest and a matrix of croplands and settlements. It
was upgraded to a national park from a forest
reserve in 1991. Prior to this the forest was under
severe human pressure. Many people entered the
area daily to illegally remove wood, bamboo,
livestock forage, minerals, honey and meat (Butynski, unpublished report 1984). Until 1991,
timber extraction, gold mining and hunting were
the gravest threats, leading to opening up of large
forest gaps and the extinction of at least two
mammal species, namely buffalo (Syncerus caffer)
and leopard (Panthera pardus). Following the
change of status to national park, greater effort
was made to stop extractive exploitation, although
limited extraction of plants for medicinal and
weaving purposes was subsequently permitted in seven zones.

A critical challenge for land use and management involves reconciling conflicting goals and uses of the land. The diverse goals for use of the land include: resource-extractive activities for example, forestry, agriculture, grazing, and mining; infrastructure for human settlement (housing, transportation, and industrial centers); recreational activities; services provided by ecological systems for example, flood control and water supply and filtration; support of aesthetic, cultural, and religious values; and sustaining the compositional and structural complexity of ecological systems (Lindsay, 2003).

Prior to BINP attaining national park status in 1991, there was widespread timber harvesting and other forms of resource exploitation, including hunting and gold mining, and gathering of firewood, poles and stakes (Butynski, unpublished report 1984; Howard 1991). These activities were widespread, but were most intensive within 1 km of the Park edge (Butynski, unpublished report 1984), while the outer 61% of the Park was heavily logged (Howard 1991). Changes in habitat extent through time have been recorded (Westman et al. 1989; Ito and Adams 1998; Hudak & Wessman 2000; Mayaux et al. 2000; Vascouceslos et al. 2002; Ambrose & Bratton 2005; Sivrikaya et al. 2007; Forrest et al. 2008). Cascading effects of edge creation have been reported, for example, high fire frequency can trap woodlands in a regeneration phase and persistent burning can slowly regress the woodlands to fire climax grassland (Croze 1974; Norton-Griffiths 1979).

Like all other resource bases, ecosystem services can decline in quality and quantity if the utilisation and management patterns do not support their ability to regenerate themselves, and this in turn affects the quality, adequacy and diversity of services provided. The degradation of ecosystems affects human well-being by slowing down, reversing or even grounding to a halt, the services provided, over time. This explains why ecosystem degradation affects the poor most because, their ability to absorb the shocks caused by ecosystem degradation is low compared to the well-off who can have alternative options. Indeed, studies have shown that the poor people’s economic dependence on natural resources makes them particularly vulnerable to environmental degradation (Duraiappah, 1996). Environment quality is a very important determinant of their health, earning capacity, secure energy supplies and housing quality (Dasgupta, 1993).

While human life unquestionably depends on healthy ecosystems which supply life sustaining resources and absorb wastes, current growth and consumption patterns in Uganda are placing increasing stress on ecosystems. Land degradation, biodiversity loss, deforestation and wetland destruction, are among the most visible indicators of stressed ecosystems. The relationship between poverty and environment in Uganda is best understood in the context of people’s livelihoods, especially the poor who constitute 35 percent of the population (Appleton, 2001). The activities of the rural poor have significant implications for the environment. The poor generally live off the land on which they grow crops for subsistence and sale, graze their livestock, and obtain wood for cooking, lighting and construction of houses. Since they depend on the land for most of their needs, they tend to use the land intensively, leading to degradation. As the land deteriorates, the poor become poorer (MFPED, 1999). This leads to the well known vicious circle of poverty.
Making ecosystems work as an economic asset for the poor should be seen not as an isolated goal but part of a larger strategy for rural development. When the poor engage in good ecosystem stewardship, they create the conditions for higher productivity and greater direct environmental income for themselves. But they also safeguard ecosystem services whose benefits extend beyond their immediate surroundings. By maintaining a healthy forest cover, for example, they are helping to preserve watershed services like flood control, continuous water supply, and erosion control that landowners downstream will benefit from.

From the 1960s to 1990s, biodiversity richness declined steeply and 25% of wildlife has become extinct; losses of biodiversity have been registered for forests and woodlands, wildlife protected areas, wetlands and aquatic ecosystems (Uganda National Environment Management Authority, 2001). Now some 372 animal species face some level of threat and of these, 15 species are critically endangered, 33 are endangered, 44 are vulnerable and 16 species are extinct. Insufficient data exists for 15 animal species and details of threatened status are lacking for 1373 species (IUCN et al, 2004; Gowa, 2003). Of plant species, 50 are critically endangered; in the 1990’s 32 tree species already were threatened. Freshwater fish are also endangered or threatened. Nine critically endangered freshwater cichlids are located in Lake Nawampasa, two are in Lake Nabugabo, and one is in Lake Victoria (IUCN et al, 2004).

Over the last two decades, a number of policy initiatives have been undertaken to conserve the country’s biodiversity. To date, there are 682 forest reserves nearly 90% of which are under the management of the central government; wildlife protected areas have increased from 4 in 19, nine National Parks (including portions of Bwindi Impenetrable Forest), 11 game reserves, two forest parks, 21 Nature Reserves, 10 sanctuaries, two wetlands of international importance, and one UNESCO Biosphere Reserve in the country (Gowa, 2003). These areas protect about 17% of tropical forests, and 65.2% of sparse trees and parkland (World Resources Institute, 2003). Uganda’s IUCN protected areas are concentrated in the northeast in Kotido, Moroto and Kapchorwa districts, northwest in Arua, Moyo, Gulu, Masindi districts and in the west in Kibaale, Kabarole, Kasese, Bushenyi, and Mbarara districts (Gowa, 2003). Two main closed forest areas remain: the forests surrounding Lake Victoria in Eastern Region and those of the Western Rift Escarpment in the Western Region (FAO Forestry Department). Kabarole District in Western Region contains the most fully stocked tropical high forest, covering 999.20 sq km (FAO – Forestry).

Uganda has 150 sq km of internationally important wetlands; the two Ramsar protected areas are along the western border in Bundibugyo, Kabarole, Kasese, Bushenyi, Rukungiri districts (World Resources Institute, 2003a; Gowa, 2003). Not only are wetlands centres of high biodiversity, providing indispensable habitat, but they are also used by people to make such things as papyrus mats and fences, soundproof houses and thatch outdoor kitchens and bathrooms (National Wetlands Programme, 2004; Maclean et al, 2003).

While Uganda’s land reserves hold considerable potential for agricultural development, tourism and water/energy resources development they can easily be degraded due to either uncontrolled and poor of landuse practices or climatic change. The most fragile ecosystems in Uganda are the highlands and the dry lands comprising the cattle corridor (rangelands). The main environmental problems in Uganda and a potential forcing to various climate change scenarios include Land
degradation, recurrent droughts and floods, deforestation, soil erosion, overgrazing and over-cultivation. In recent times, the frequency of extreme weather events has increased leading to more severe drought and flood impacts Bwindi Impenetrable National Park, Uganda (BINP). The site was upgraded from forest reserve to national park in 1991; it is surrounded by a densely populated rural community heavily dependent on natural resources for a living and is similar to many forested parks in the tropics (Chapman & Peres 2001). Over 90 percent of the populations surrounding the region’s protected areas practice subsistence level agriculture, and many access the protected areas for water, firewood, and food and for their livelihood production strategies (IGCP, 1996). The development of the relationship between park management and the communities is crucial. Except in Nkuringo, on the southern side of Bwindi Impenetrable National Park in Uganda, the national parks do not have buffer zones between the local communities and the parks’ resource base. Conflicts between wildlife and local communities are therefore inevitable, either linked to access to natural resources in the park, problem animals damaging crops in fields near the edge of the park, and other conflicts with local populations.

Problem statement

The problem is ecosystems in and around Volcanoes are under stress and this is attributed to land use practices that include agriculture, deforestation, forest fires, wetland destruction, encroaching and population pressure that has persistently led to increased demand for settlements and arable land. The effects among others include changes in feeding habits, rate of growth, migration of animals, destruction of habitats, food webs, breeding grounds and variation in reproduction cycles. Not only that some animals which include the gorillas, birds, elephants and apes have expanded their territories which in turn affect eco-tourism activities in the parks. Above all poverty among the local communities makes them look at the parks’ ecosystems as the only source of survival. So they enter the park to harvest honey, firewood, timber, bush meat and burn charcoal to earn income. So these affect the natural resources and yet they are relied on for eco-tourism which is a vital economic activity for foreign exchange in Rwanda.

Objectives

The main aim was to analyse the challenges of land-use practices on ecosystems in and around the park.

Specific objectives:

i) To determine the effects of land use practices on ecosystems in and around the park.

ii) To find out how effects of land use practices on ecosystems impact on eco-tourism

iii) To ascertain the mitigation measures that can be used to achieve sustainable eco-tourism.

Research questions

- What are the effects of land use practices on ecosystems in the park?
- What the effects of land use practices on ecosystems impact on eco-tourism?
- What are the mitigation measures that can be used to achieve sustainable eco-tourism?

Research methods

This section focused on the research design, area of study, population and sample, instruments and analysis of data.
Research design

This involved use of qualitative that was be majorly explanations and discussions with the respondents and quantitative data which included the statistic about the trends in numbers of, tourists, animals, plants cover, areas of forest cover as well as frequencies in how events have unfolded. The study utilized the primary data that was obtained from the field especially the feedback from the respondents and secondary sources that yielded data on aspects like past and present tourist numbers, population (of animals and people), national park area and policies in place. The study considered a period of 21 years (1991-2012).

Study area

Volcanoes National park lies at the latitude of 1.47°S 1°28‘0°5 ‘S longitude of 29.492°E 29°29‘30°E of the republic of Congo and Rwanda. After several excisions, the PNV portion comprises 160 km² of higher altitude forest. The landscape in this area is rugged and steep and ends up abruptly in the crops of the local communities. It consists of mainly tropical vegetation. The area has extremely high human population pressures with an average of 300 people per square kilometer (Lanjouw et al. 2001), with some rural areas attaining 820 people per square kilometer (Waller 1996).

Population and sample of study

The population of study will include the community leaders, UWA staff, conservation staff on ground, the leaders of tourism associations, cultural groups. The study used findings from a population of fifty (105 People) and samples of 30 respondents to get the picture on the ground. Purposive random sampling will be used because the researcher intends to pick the respondents that are deemed to be knowledgeable and with experience about the problem under question. Slovin’s formula \( n = \frac{N \times \text{e}^2}{1 + N \times \text{e}^2} \) was used to get the sample.

The sample in the field comprised of 4 staff at the RDB headquarters, 12 RDB staff in the park, 4 district officers in the section of environment education, 6 community representatives, 2 staff from Dian Fossey International and 2 student researchers on the ground.

Instruments

The instruments included the use of interview guide, oral interviews and observation. The researcher however used interview guide, orals and observation for the collection of data by visiting the area of study and interacting with the respondents. This gave the researcher the opportunity to get the first hand perception of the participants about the problem under study and through observation was able to get clear view of the situation. The combination of these tools enabled the researcher to generate the reasonable data.

Sample questions

- What are the different land use practices in this area?
- How are these land use practices affecting the ecosystems?
- How are they affecting the eco-tourism activities?
- What is being done to stop land-use effects from affecting both ecosystems and ecotourism?
The findings and analysis

Data findings from the field were collected from respondents by use of interview guides, oral interviews and observation. On interacting with the staff of UWA, the majority 85% pointed out that land issues around the national park are crucial. According to the respondents land shortage plays a big role in sustainably conserving the park because people want to cultivate but have no land to grow the crops. According to the deputy in charge of conservations, pointed out that the local communities have cultivated up to the boundary of the park. He added that the park has no proper buffer zone around the park and so the local communities have access to the park to harvest firewood, honey and also hunt bush meat to supplement on family food. However 15% of the respondents argued that the land issue was a long time issue because most the locals are resettled or move to trading centers due to land shortage to do business and look for employment.

The findings show that 90% respondents said that the local communities lack land and this has led to many of them resort to entering the park. Also some of the local communities still have the perception that the park or forest is a gift from God so should be allowed to enjoy the resources. During the interaction with the respondents, many said that high population pressure is another factor that is a threat to the conservation of the park. Many local communities rely on agriculture and so demand for land to carry out agriculture, the respondents said. On the other hand it was revealed by 10% of the respondents that those that have no land have resorted to business and other activities like handcrafts and community associations.

The researcher also established from the park staff that the communities around the park practice different land use activities. According to the respondents 50% said the community members plant tea, 40% argued that the local communities do subsistence farming, 5% indulge in businesses and 5% plant trees for future sale.

Among the respondents interviewed at park head quarter offices, 75% argued that land use practices are challenging because the local people prefer to stay around the park, though 15% said that some of the people have resorted to bee keeping and tree planting as an alternative and 10% said the local communities that have no land decide to migrate to town centers or to other districts or even cross to DRC.

According to the respondents in the field, 78% pointed out that the main land use practice among the local communities around the national park is agriculture. Another activity carried is the construction of houses for settlement that accounted for 15% and road construction 7%. This was argued that most people rely on agriculture as an economic activity and these other activities are not core. On inquiring more on how these activities are affecting the sustainability of ecotourism, 60% of the respondents argued that it is the problem animals that strain the relation between the park management and the communities and these lead to communities killing some of the animals in retaliation. Though the 45% pointed out that it is the illegal activities like bush hunting and firewood harvest that may affect sustainability of park resources while the 55% said that the agricultural activities still remain the threat.
One of the community leaders emphasized that the problem of using fertilizers by the farmers has a profound effect in the long run on the ecosystems especially water bodies and soil in the protected areas. In addition to that 70% of the respondents concurred that population pressure is another big problem that needs to look into and avoid putting pressure on the resources used for ecotourism activities. This also led to soil erosion that greatly affected the aesthetic appeal of the area. The 5% of the respondents said that deforestation is another factor that is intense around the park which implies if in future the accessible trees are no more the the park trees will be the target.

To the respondents interacted with, especially the park officials 85% emphasized that the main ecosystems that are affected by the land use practices include swamps that have been affected due to soil erosion deposition and communities entering in to fish and harvest handicraft materials. Further these respondents added that most of the water bodies in the park are drying up and this will impact greatly on animals that rely on them. Also the respondents argued that deforestation is one other factor that will drive the ecosystems to extremes since many locals believe it’s a quicker way of earning income.

The researcher inquired about the effects of land use practices on ecotourism and 50% of the respondents argued that ecosystem sustainability is priority because environmental degradation is occurring. This is exacerbated in the destruction of habitats for some animals and the change in general behavior of animals especially the gorillas and other apes like baboons and monkeys. It was revealed by some respondents that even the feeding habits of the animals is changing for instance the gorillas are now eating alien species and other herbs which never happened before. More to that 25% argued that due to tourists presence in the area, commoditization of commodities has increased and this further put pressure on ecosystems by the local people around the park. However 10% of the respondents said the problem also goes further to the new policies that are difficult to implement and work within a short time. This is accelerated by the mindset of the locals that still believe in free access to natural resources. Some of the respondents 5% pointed out that it is good the government has put in place revenue sharing as one of the ways communities can benefit from the park, the revenue is channeled through the community associations but sometimes it does not trickle down to the common poor person. It implies that the children cannot access good education and so the local communities devise other means of sustenance thus going for natural resources. These respondents from communities argued that financial benefit should go to schools or hospitals for everyone to feel it or benefit.

However, on the good side some of the challenges have been and 80% of the respondents said the government together with park management have built a buffalo wall on the Rwandan side to stop problem animal issue. The rest 20% still said some animals cross over and destroy some local communities crops though the rates are not so high like before. The tourism manager pointed out that sensitization of the communities on anti-poaching, and sustainability of resources is ongoing. One of the district officials concerned with environment education said that the government through policy makers like REMA is trying to implement policies that will guide sustainability. One of the respondents further argued that through Dian Fossey an NGO there has been continuous training
programs from primary to university level especially in environment and biodiversity conservation. However 20% pointed out that there a new programme known as citizen science that started and mainly deals with biodiversity conservation and sustainability. In addition to that, 95% of the respondents said that meetings and trainings organized by the park management or government must be attended by all stakeholders in conservation and tourism around the park to enlighten the people on benefits of the resources in and around the park.

Conclusion

It can be concluded from the findings that land use practices around Bwindi Impenetrable National park play a major role in influencing the ecosystems in the area thus ecotourism. It was found out that the main influencing factor is the high population that needs land for agriculture. The results also showed that ecotourism is indirectly affected by human factors especially when they destroy the natural resources used for ecotourism. The results further indicated that other land use practices like construction of houses for settlements and other government projects like road construction destroy trees that are habitats to certain animals. More findings showed that some of the animals that are mainly tourist attraction have changed their feeding habits and this impacts heavily on the tourism activities. It was found out that the mindset of the locals still is a problem because they still believe the protected area is their source of living. However the government and other NGOs are trying their best to ensure the protected area and the local communities live in harmony.

Recommendations

- The government and the park management should design a buffer zone between the park and the local community agricultural land in order to avoid problem animal issue and the local communities cultivating up to the buffalo wall.

- The park management with all its stakeholders should combine efforts to ensure that any activity that will directly or indirectly affect protected areas is analyzed before implementation especially construction in the park.

- There should be other alternative in revenue sharing from the park because the method in place seems not to be appreciated by all the beneficiaries.

- There should be more sensitization efforts to the local communities to be more embracing since some of the tourists are interested in visiting local community settings not only the park.

References


