Private farmers compensation and viability of protected areas: The case of Nairobi National Park and Kitengela dispersal corridor

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ABSTRACT

Nairobi National Park is unable to incorporate the spatial and temporal dynamics of many migratory mammals that rely on the area as a dry season refuge because of its small size. During the wet season, wildlife must be able to migrate to the south into the Kitengela dispersal area. This area is privately owned and in a fast process of land use change that affects the structure and function of the dispersal corridors, jeopardizing the ecological sustainability of the Park. Private land holders in Kitengela are the ones who share most of the costs to keep open the dispersal areas, but do not receive any compensation or revenue from the large amount of benefits derived from tourism in the Park. Here we present an analysis of the willingness to pay of Nairobi and Kitengela residents for a new land management scheme in the dispersal area in which local pastoralists leave their land open to wildlife and not engage in fencing, land subdivision or poaching activities, receiving a monetary compensation for the incremental costs derived of the use of their properties as a wildlife dispersal area. The results of the study suggest that the financial

support of urban residents' might exceeds the economic losses caused by wildlife and different financial schemes could be implemented to ensure payments in perpetuity.

Keywords: Nairobi National Park, Kitengela, dispersal corridors, valuation, conservation.

1. Introduction

People, wildlife and livestock have interacted in East African savannahs for millennia. In recent times, human population growth, agricultural expansion, deforestation, and hunting have had profound cumulative impacts on the environment, natural habitats and wildlife populations (Bourne and Blenche 1999). In Kenya, the human population has doubled over the past 20 years, generating pressure for the conversion of extensive natural grasslands to croplands. At the landscape level livestock number and species have fluctuated widely without a clear trend following changes in primary productivity (Kristjanson et al. 2002), but wildlife population has declined by *c.a.* 45% mostly because of the habitat loss and unauthorised hunting (Norton-Griffiths 1998).

In some Kenyan regions, conservation policies which exclude local people and livestock from the national parks, the loss of grazing areas and water sources in pastoral lands, and the countrywide banning of consumptive use of wildlife have deprived the livelihoods of many people affecting their food security and intensifying human-wildlife conflicts. (Campbell et al. 2000, Serneels et al. 2001; Thompson and Homewood, 2002).

This situation is exacerbated since many of the parks created in Kenya are object rather than process orientated (Hales 1989). These kind of protected areas are geographically static entities that do not incorporate the spatial and temporal dynamics of organisms and

ecosystems, neither entirely sustains the ecosystem goods and services that human depend upon (see Bengtsson et al. 2003). The functional relationship between the Kenyan parks and the surrounding areas was not taken into account in the original parks design and few parks have enough extension to include the territory involved in the seasonal movement of migratory large mammal species. Thus, many species disperse into the surrounding areas under human occupation for part of their seasonal cycles and over 70% of the wildlife lives outside protected areas on privately or communally owned land (Western and Pearl 1989).

Threats to the dispersal areas beyond the park boundaries have significant implications for the environmental and economic sustainability of many parks in East Africa (c.f. Gichohi 2000). The loss of dispersal areas caused by fencing and conversion to croplands might affect the viability of the parks reducing the flow of benefits provided by them and affecting human well-being. However, the benefits generated by the parks accrue mainly at the national and international levels, whilst most costs associated with maintaining the viability of such parks arise at the local level. Thus, in Kenya the economic benefits provided by wildlife within the parks has been estimated in $400 - $500 million per year (Norton-Griffiths, 1998), but most of the costs to keep open the dispersion areas that sustain these parks are shared by local farmers which suffer the increased costs of competition between livestock and wildlife for water and forage, livestock losses though predation and wildlife-borne diseases, as well as damage in their croplands through herbivory (Gichohi 2000, Nkedianye 2004).

We consider that new land management schemes in which local pastoralists receive direct payment to compensate the extra costs derived of the use of their properties as a wildlife

dispersion area, could provide the incentives for more appropriate use of the land promoting the sustainability of the conservation areas and reducing the negative impacts of the conservation policy on people's livelihood.

Nairobi National Park (NPP) is an ideal place to evaluate local people's willingness to participate in new land management schemes in order to ensure the sustainability of this protected area. This park is too small to permanently contain viable populations of many of the migratory mammals that rely on the area during the dry season and in order to continue providing benefits; wildlife must be able to disperse to the south into the Kitengela area during the wet season. However, Kitengela is under private ownership and currently in a process of subdivision, fencing, and conversion of grasslands to croplands, jeopardizing its capacity to contribute to the dispersion of wildlife and the viability of the park.

We hypothesize that the recognition of the contribution of ecosystem goods and services provided by the parks to the well-being of local people, and the perception of the costs and benefits of distinct land management schemes might affect people's incentives to participate and contribute to conservation initiatives. This study aims to provide empirical evidence of the perceived importance of some ecosystem goods and services provided by NNP to the people living in the urban area of Nairobi and people living in the dispersal area of Kitengela, as well as estimate their willingness-to-pay for a compensation program for private landholders in the dispersion area, in order to promote land use managements which preserve the structure and function of the dispersal corridors and promote the sustainability of Nairobi National Park.

The paper proceeds as follows. Section 2 provides a brief overview and background of

Nairobi National Park. Section 3 describes the fieldwork methodology. Section 4 shows the results of the field study, and finally section 5 discusses the results and presents the conclusions of the study.

2. Background

Nairobi National Park has an area of 114 km^2 and lies only 7 km from the centre of Nairobi. The climate is dry and the vegetation cover is predominately savannah grassland. The Park is separated from the city by only a fence on its northern, eastern and western boarders (see Figure 1), while the southern boarder is open and allows the in and out migration of wildlife into the private lands located in the Kitengela and Athi-Kapiti Plains which conform a dispersal area of around 2500 km^2 (Gichohi 2000). The importance of Kitengela dispersal area for the sustainability of NNP is well documented (Nkedianye 2004). The park is a dry season refuge (June – November) for much of the area's wildlife which then disperses into the surrounding areas during the wet season (March – May). The NPP is too small to be ecologically viable without the surrounding dispersal area and thus much of the park's wildlife is dependent on the willingness of private land owners in the dispersal area to tolerate wildlife on their properties. Based on its importance for the sustainability of the Park, the Kitengela Plains (390 km^2) were declared a conservation area in order to provide protection for migratory wildlife. However, this status was never legalised and the area has no land use constraints (Gichohi 2000). Currently as a consequence of increasing population pressures and the proximity to Nairobi, the Kitengela plains are in a fast process of subdivision, fencing, development of permanent settlements, conversion of grasslands to croplands, and

creation of industries for export. These changes in land-use affect the integrity of the dispersal area; declining primary productivity, diminishing animal biodiversity, and reducing wildlife migratory corridors (Nkedianye 2004).

Land owners currently have no incentives to tolerate wildlife on their land and most households report a very significant increase in human–wildlife conflicts caused mainly by the reduction of farm sizes, lack of economic benefits from wildlife, increasing human population, livestock and wildlife competition for water and grasses, and frequent episodes of predation on farm animals (Gichohi 2000).

The inequity in the distribution of the costs and benefits of conservation provides local actors with limited incentives for the adoption of appropriate land uses in the Kitengela dispersal area, jeopardizing the sustainability of Nairobi National Park. Currently there are no mechanisms for local people to receive revenues from tourists visiting the park, although some initiatives have been proposed (e.g. Western 1997). In recent years, a pilot project administered by a charity association working with external funds is operating with relative success in the Kitengela area promoting sustainable land use in the corridor and changing the attitude of residents towards wildlife (Nkedianye 2004).

3) Methods

3.1 Importance of ecosystem goods and services provided by Nairobi National Park to people's wellbeing

Following, de Groot e al. (2002), the structures and processes occurring in Nairobi National Park can be characterized under four ecosystem functions *i.e* production

function, habitat function, regulation function and information function, which in turn provide environmental goods and services that human depend upon.

Based on focus group meetings with stakeholders from Nairobi and Kitengela, a subset of seven ecosystem goods and services provided by the four ecosystem functions were selected for the study: Food and raw material, recreation, education, quietude, air quality and water supply/regulation. Table 1 presents a brief definition of each good and service in the context of the study site. A short survey explored the perceptions of the importance of the addressed ecosystem goods and services to the well-being of Kitengela and Nairobi residents, using a Likert scale from one to five (1= least important/valuable, 5 most important/valuable) similar to the method described by Schaberg et al. (1999). A total of 240 respondents were considered in this study.

3.2 Willingness to pay for a compensation program in the Kitengela area

A contingent valuation was developed in order to estimate the willingness to pay for a compensation program for private landholders in the Kitengela dispersal area, to promote land use managements which preserve the structure and function of the dispersal corridors and promote the sustainability of Nairobi National Park.

Semi-structured surveys were used to gather information from 149 households from March-June 2004. The selection of the surveyed households responded to simple random sampling requirements under a voluntary participation scheme. Respondents were asking to express their willingness to pay for a new land management scenario in the Kitengela dispersal area which includes the following four points:

1) Wildlife access to the park and migrations are ensured through leasing agreements with landowners outside the park preventing unsuitable land use.

2) The park maintains its wildlife populations.

3) Continued recreation and education opportunities within the park.

4) Continued protection for endangered species

The Contingent Valuation Survey followed a single-bounded dichotomous choice format based on Hanemann's (1984) Random Utility Maximization model (RUM). We developed focus groups meetings in both Kitengela and Nairobi, to define six bid options: 25, 50, 100, 250, 500 and 1000 Kenya Shillings per month for a 5 year period. That amount will be hypothetically provided to an autonomous non-government charity institution, which later will distribute the collected amount among the private landholders in the dispersal area to establish and maintain appropriate land management schemes in the corridors in order to ensure the ecological sustainability of Nairobi National Park.

Based on the random utility model, the respondent's will accept the bid if the utility or satisfaction achieved under the scenario of improved land management in the dispersal area is higher than the cost (the accepted bid), or the utility under the new management scenario is greater than the utility achieved under the current situation (Habb and McConnell, 2002).

Following Park et al. (1991), the indirect utility function for each respondent can be expressed as a random variable:

$$U(i, y; s) = V(i, y; s) + \varepsilon_i \qquad [1]$$

where y is household income, s is a vector of household socioeconomic characteristics, and i is the binary choice variable (1 if the respondent is willing to pay the bid amount, 0 otherwise); in addition ε_{ij} is the stochastic, and independently and identically distributed random error. It is assumed that when faced with a bid, b, for the proposed new land management scheme, the respondent will accept the bid, i.e. i=1, if

$$v(1, y\text{-}b; s) + \varepsilon_1 > v(0, y; s) + \varepsilon_0 \qquad [2]$$

Hence, the probability of accepting the bid is given by:

$$\Pr[i = 1] = \Pr[v(1, y\text{-}b; s) + \varepsilon_1 > v(0, y; s) + \varepsilon_0] = F_{\varepsilon}(\Delta v) \qquad [3]$$

where F_{ε} (Δv) represents the cumulative density function of the respondent's WTP for the new land management scheme that will promote the sustainability of Nairobi National Park. This is commonly modelled as a logistic function:

$$\Pr[i = 1] = \frac{1}{[1 + \exp(\Delta v)]} \qquad [4]$$

which can be easily estimated using a binary logit model (Hanemann, 1984).

Recalling [1], a linear model for the indirect utility of individual j in the scenario i is represented as follows:

$$V_{ij} = \alpha_i s_j + \beta_i y_j + \varepsilon_{ij} \qquad [5]$$

where, as above, y_j is household j's discretionary income, s_j is the vector of variables related to household j; α_i is a vector of parameters and ε_I is the unobservable error term. Considering that the WTP is small relative to the available income it is not likely that the marginal utility of income varies with the income of a given respondent. Variation among urban and rural areas is more likely. One practical way to incorporate the effect of sites, and at the same time allow the marginal utility of income to vary across individuals is to use site categories and to let the coefficients vary according to income. Following Haab and Mc Connell, (2002), in order to let the marginal utility of income to vary across individuals with different places of residence, we define $\beta=\delta wj$, where $w_j = \{1, w_{1j}, \ldots w_{Kj}\}$ is a vector of individual specific covariates associated to the parameter bid vector δ. In our case, wj represents a vector of variables indicating if the respondent belongs to a specific site. Hence, income y_j is classified as a categorical variable such that a household in each location has a different marginal utility of income. We define $w_{ij}=1$ if the respondent is resident in Nairobi; 0 otherwise, and $w_{2j}=1$ if the respondent is resident in Kitengela ; 0 otherwise. Hence, the sample is divided into two subsamples according whether the household belongs to Kitengela or Nairobi. Thus, from (1) the utility model becomes:

$$u_{ij} = \alpha_i s_j + \delta_1 w_1 y_j + \delta_2 w_2 y_j + \varepsilon_{ij} \qquad [6]$$

The variables in vector s are presented in Table 2 and include a set of demographic and socio-economic characteristics of the respondents: age, gender, education level and job security. Two variables provide information about the environmental attitudes of the respondent (Green score) and about the importance of the goods and services provided by Nairobi National Park to their well-being (Value score). The first one was obtained totalling the score obtained by the respondents to a set of environmental statements related to economic development, loss of species, destruction of habitat and animal rights. The second variable was obtained totalling the Likert values expressed by the respondents to the set of ecosystem services presented in table 1. Finally, since the perceptions of problems and actions toward their solution are mainly determined by peoples' ties to the land, and the perceived benefits and costs of the problem and solution, we included the variables time of residence, and concern to the problem of the park in the analysis.

4) Results

4.1. Importance of ecosystem goods and services provided by NPP to people's wellbeing.

The results of the field study revealed differences in the importance of the ecosystem good and services provided by Nairobi National Park to the inhabitants of the city of Nairobi and Kitengela dispersal area (Table 1). The result of comparing the value of each ecosystem service between both groups shows that Nairobi residents assign statistically higher scores to conservation i.e. the provision of habitat for plants and animals ($p<0.03$), while the Kitengela residents show statistically higher score for the regulation function

represented by the ecosystem services of water supply/regulation ($p<0.01$) and air quality ($p<0.01$). No statistically differences between groups were found for any of the ecosystem services derived from the information function such as recreation, education and quietude, neither for those derived from the production function i.e. provision of food and building material.

4.2 Willingness to pay for a compensation program in Kitengela.

A total of 149 surveys were completed in Nairobi (77%) and Kitengela (23%). In general terms, the total sample included 84% of males and the average reported time of residence in the area was 14 years. In terms of income, the analysis of the sample shows concordance with the figures for the Nairobi region (CBS 2003). Thus, about 49% of the respondents receive fewer than 5,000 Kenya Shillings (KSh) per month (1 USD= 78 KSh), 31% of the sample get a monthly amount between 5,000 and 10,000 KSh, while 16% of the respondents have a monthly income between 10,000 and 30,000 KSh. Finally, just about 4% of the respondents, report a monthly income above 30,000 KSh per month. The education level reported by the respondents was higher than the expected (UNDP 2002). About 5% of the respondents were illiterates, 17% completed primary education, 43% of the sample has attended secondary school, while about 34% of the respondents have received any kind of higher education. From the total sample, 61% accepted the bid expressing their willingness to pay for a new land management scenario in the Kitengela dispersal area. From the 38 respondents who rejected the bid, over 55% expressed that the Kenyan Government should pay the farmers to maintain the corridors open, 23% considered that only the users and visitors of the National Park should be the ones who

will pay for the maintenance of appropriate land management in the Kitengela area, while over 16% of the respondents mentioned that they can not allocate money to conservation because of their limited income. Finally about 5% of the respondents who rejected the proposed bid gave other diverse reasons for their decision.

Table 3 presents the results of the binomial Logit model to estimate the effects of the *s* and site variables on WTP for a compensation programs for private stakeholders in Kitengela to promote land management schemes that support the sustainability of Nairobi National Park. Following Habb and McConnell (2002) the mean WTP is given by: $E(WTP) = -\frac{\delta}{\beta}$, where β is the value of the coefficient of the cost variable in the estimated logit equation, and δ is the sum of all other terms in the equation evaluated at the mean values of the explanatory variables. The analysis reveals a mean monthly WTP of 355 Kenya Shillings.

The model indicates that as expected, the likelihood for respondents agreeing to pay the proposed amount decreases as the bid increases in both Kitengela and Nairobi areas. In addition, older heads of the households are more likely to reject the proposed bid. The likelihood of accepting the bid significantly increases if the respondent has a secure job and expresses a higher value score i.e. perceive the ecosystem goods and services provided by the park as important for his wellbeing.

5) Discussion

5.1. Importance of ecosystem goods and services provided by NPP to people's wellbeing.

The fieldwork results suggest the existence of statistically significant differences in the perception of the importance of some ecosystem goods and services to the wellbeing of Nairobi and Kitengela residents. Nairobi residents express higher importance to the Habitat function i.e. conservation, than the residents in the Kitengela dispersal area. This finding may be explained based on the differences in the conservation costs between the different groups; with the Kitengela residents sharing the extra-costs of keeping the corridors open (c.f. Gichohi 2000). Just in terms of wildlife-related damage, the Kitengela average farmer losses about 43,500 KSh annually (Mwani and Warinda 1999). Similar differences in the conservation attitudes between urban and rural respondents have been presented in many other systems and sites (e.g. Bandara and Tisdell 2003).

Regarding the regulation function and the ecosystem services of water supply/regulation and air quality, Kitengela residents consider them more important for their wellbeing than the residents in the city of Nairobi. The inhabitants of Kenyan rural areas are more aware and dependent of the cyclic changes in the abundance of water resources and its effect on primary productivity, livestock and wildlife migration and the increasing conflicts between different users for the limited water resources (e.g. Mbonile 2005). In the Kitengela area the only permanent water course, the Mbagathi river runs inside the Park boundaries and local pastoralists go there with their cattle for watering during the dry season. In addition, about 80% of the Kitengela households are engaged in some cultivation. The yields are extremely low and dependent of the long rain season (April-June) precipitation levels (Kristjanson et al. 2002). The water sources in many Kenya sites have been significantly reduced in the last decades and the demand for water increased two-to eightfold in some areas. In rural areas the situation is exacerbated

because of the lack of capacity of the involved stakeholders to negotiate water allocation, and establish allocation thresholds (Liniger et al. 2005). Thus, the scarcity of water resources, the importance of the Park's water course for livestock keepers during the dry season and the recognition of the effects of changes in water availability on peoples livelihood through its effect on livestock and croplands productivity and wildlife abundance makes the ecosystem service of water supply/regulation statistically more important for the Kitengela pastoralists than for Nairobi residents

Traffic, biomass and waste burning emissions are implicated as the main sources of air pollution in the Nairobi area (Gatari et al. 2005). The increasing pollution levels have been related to higher prevalence of respiratory complaints and lower health status, especially among the inhabitants of Nairobi's marginal areas (Gulis et al. 2004). This situation could lead to a higher concern of urban people to the issues of air quality. However, the installation of two large cement factories in the proximity of Kitengela has affected the air quality in the area. Because of the wind direction, people report that the factories often spread fine dust particles into the residential and grasslands areas, covering the roofs and pastures with particulate material. Scientific evidences in diverse sites and conditions indicate that the pollutants emitted by cement plants can be hazardous to people living in the surrounding areas (e.g. Abdel-Halim et al. 2003) and the exposition to cement dust seems to increase the risk of develop chronic respiratory problems (Mwaiselage et al. 2005). In Kitengela, the evidence of pollutant existence, the clear identification of the sources and its effects on residents' properties seems to influence the respondents to express a high importance to air quality issues.

The study did not identify statistically significant differences in the ecosystem services of recreation, education and quietude. These services derived of the information function have the higher scores for both the Kitengela and Nairobi residents. For both groups, these ecosystem services are the main perceived benefits provided by Nairobi National Park. Most respondents of both groups had either visited the park as school students or expect their own children to visit in the future. For many urban Kenyans living in Nairobi this represents their only chance to experience the country's wildlife. In addition, many people who had not visited the park still ranking highly these services as they expect others to benefit from them or expect to visit the Park themselves at some point in the future or receive revenues from tourism (Henson 2004).

The results suggest that there are no statistically significant differences between the residents in Nairobi and the inhabitants of Kitengela regarding the Production functions i.e. provision of ecosystem goods such as Food/Raw material. This is an expected result since current conservation policies in the area exclude people from the Park denying access to resources such as pastures for livestock, and banning economic activities such as quarrying or extraction of building materials.

The differences between these groups support the view that the discernment of the importance of ecosystem services is socially constructed and the interpretation and understanding of Nature in terms of human needs may explain how social groups select which set of ecosystem services to be concerned about. (see Irwing, 2001).

5.2 Willingness to pay for a compensation program in Kitengela.

The analysis of the determinants of the willingness to pay for a compensation program for private landholders in the Kitengela dispersal area indicates as expected, that the likelihood of respondents agreeing to pay the proposed bid decreases as the bid amount increases in both Kitengela and Nairobi areas, and the respondent considers himself able to have a regular source of income for the following five years. These relationships between income related variables, bid amounts and willingness to pay for conservation initiatives are in concordance with economic behaviour and have been described in many other studies in developing countries (e.g. Schultz et al. 1998, Maharana et al. 2000, Turpie 2003).

The model suggests that older heads of the households are more likely to reject the proposed bid. In Kenya as in many other places in Africa, there is a clear linkage between poverty and age. Older people are identifiably poor (Help Age International 2003). Few old people can fully support themselves through current earnings. The relationship between increasing age, lower incomes and reduced capacity to contribute or maintain a livelihood is a well documented pattern (Baltenweck et al. 2003, Gorman and Heslop 2002). Thus, based on their poverty level and reduced income is not unexpected that older heads of the households have a lower capacity to allocate money out of the subsistence sphere towards investment in conservation activities. Significant relationships between willingness to pay for conservation and older age have been reported for many other studies, often linked with education related variables (e.g. Bandara and Tidell 2004, Lee and Han 2002, Pouta 2000).

The perceived importance of the ecosystem goods and services provided by the Park to the respondents' wellbeing seems to be a significant variable to increase the likelihood of

accepting the bid and therefore be involved in a program to promote the sustainability of Nairobi National Park through encouraging appropriate land management schemes in the Kitengela dispersal area. Several studies have demonstrated the importance of ecosystem services to human wellbeing (e.g. Howarth and Farber 2002) and it is known that human preferences and knowledge about Nature can influence the recognition of the ecosystem services by local groups (Lewan and Soderqvist 2002). In Kitengela, as in many other sites, increasing knowledge and experience about Nature and natural systems seems to have a positive influence on the willingness to pay for conservation initiatives (e.g. Tisdell et al. 2005), and on the vision of what represent appropriate management of natural areas (e.g. Ryan 2005).

5.3 The extrapolation of WTP benefits to compensate private landholders in Kitengela dispersal area.

Following a simple transferring point estimate approach (Loomis et al. 2000), the benefits of the WTP can be extrapolated to the city of Nairobi assuming in a conservative perspective that the income level of the sample is comparable to 10% of the city residents. According to the projections of the last Kenya Census (CBS 2001), there are 382,863 households in Nairobi from which 10% represents about 38,286 households. Taking into account that the respondents who accepted the bid correspond to 61% of the sample, and assuming that the WTP of those with protest-bids is zero, this leaves about 23,354 households paying 355 KSh per month. Thus, the WTP of the Nairobi residents for a land management program in the Kitengela dispersal area represents 8,290,898 Ksh per month. The annual collected amount corresponds to 99,490,779 Ksh. (c.a. USD

1,275,523) which in the five year period considered in the proposed scenario and with a discount rate of 12% represents a net present value of 358,641,992 Ksh (c.a. USD 4,598,000).

5.4. Compensating private landholders: comparison of the aggregate WTP of Nairobi residents and wildlife-related losses in the Kitengela dispersal area.

Compensate private landholders in Kitengela for the additional costs caused by wildlife could be a valid policy option to encourage pastoralists to keep the dispersal corridors open and promote the viability of Nairobi National Park.

The notion of compensating people for their role in maintaining resources of global importance is not new and direct payments to compensate local populations for the costs they incur to conserve biodiversity have been proposed and implemented in both industrial nations and developing countries (e.g. Ferraro 2001, Ferraro and Kiss, 2002, Balmford and Whitten 2003).

Estimate the economic losses of farmers caused by wildlife is an important step to evaluate whether the WTP of Nairobi residents for a new land management scheme in the Kitengela dispersal area is sufficient to compensate private landholders for the damages and losses caused by the use of their properties as a wildlife dispersal corridor. In a survey developed by the African Conservation Center in Kitengela (Mwani and Warinda 1999), the average annual loss per household caused by predation on livestock represents about 22,116 KSh, while the losses from crop damage amounts 12,216 KSh., and the costs related to wildlife-borne diseases were estimated in 9,249. Ksh. Thus, the cumulative average annual losses amount about 43,581 KSh. per household.

The human population in the dispersal corridor of Kitengela has significantly increased in the last years and currently there are about 5,000 households in the area. Most of them are immigrants attracted by the proximity to the city of Nairobi, who now live in the town of Kitengela and are not directly involved in agriculture or pastoral activities (GOK 2001). Before the changes in land policies which led to private land ownership in pastoral areas and later to land subdivision, the number of pastoralist households in Kitengela was about 700. However, recent estimates indicate that just in the most threaten and subdivided area, the one between Nairobi National Park and the tarmac road that goes through the town of Isinya there are about 880 households and for the total dispersal area the number of pastoralists households should be about 1,200. These households are very diverse in terms of livelihood strategies. A cluster analysis identified four types of households which represent distinct combinations of assets, landholding size, cultivation capabilities and livestock numbers, therefore having different returns of the land and distinct income levels (Kristjanson et al. 2002). Taking into account the existence of differences in the frequencies of farms subject to wildlife damages and the differences in the amount of losses, in order to not underestimate the total losses of private landholders, we considered the wildlife-related average annual losses per household in Kitengela dispersal area (i.e. 43,581 Ksh), and assume that all the 1,200 pastoralists landholders are equally affected. The required amount to compensate them for their losses and keep the dispersal corridor open should be about 52,297,200 Ksh per year, which is lower than the 99,490,779 Ksh. that represents the aggregated annual willingness to pay of Nairobi residents for a new land management plan in Kitengela dispersal area to promote the viability of Nairobi National Park.

5.5. The design of an appropriate payment scheme in Kitengela is important for the success of the program and the viability of Nairobi National Park.

It is argued that the design of appropriate institutions and payment schemes are important issues for the success of the direct payment programs, enabling the effective allocation of resources in the precise time and sites, as well as providing adequate incentives for conservation (Ferraro 2001).

In Kitengela, is clear that the additional costs derived of the use of private property as a dispersal area will persist in perpetuity and farmers will continue experiencing losses derived from damage in their croplands through herbivory, livestock predation and wildlife-borne diseases. Our research estimated the aggregate WTP of Nairobi residents for a period of 5 years, but the WTP for a longer period of time is unknown. Following Bandara and Tisdell (2004), one way to compensate farmers in perpetuity is invest the contribution of Nairobi residents over 5 years in the capital market and use the estimated returns to compensate farmers. This approach could generate an estimated return of the capitalized sum of over 60.7 million KSh. per annum at a 12% real rate of interest, which is more than sufficient to implement annual payments to the totality of beneficiaries at the end of the fifth year.

In view of the fast changes in Kitengela and the risk for Nairobi National Park, the option of starting the payments and the land management program in the fifth year is not desirable. If the contribution of Nairobi residents (i.e. about 99 million KSh. per year) is used to implement the compensation program (i.e. about 52 million Ksh per year) starting the payments since the first year to the totality of landholders, the difference between the amount available to implement the program and the total cost of compensation could be

invested in the capital market. This approach could generate an annual return of the capital of over 28 million Ksh. However, about 24 million KSh. per year should be lacking to cover the costs of the compensation program. This represents that approximately 39 million KSh. per year for a period of five years, should be needed from external funds to complement the contribution of Nairobi residents to ensure the payments in perpetuity to the totality of the involved households.

Considering the limited resources existing for conservation, alternative payment schemes can be designed based on the available budget. One of many potential approaches should be develop a scheme that based on the importance of specific sites for the structure and function of the Kitengela dispersal corridor, select a set of priority stakeholders who should start receiving payments the first year, and increment the number of involved households every year until the total landholders be compensated. The difference between the aggregated WTP of Nairobi residents for a land management program and the total amount spent in compensation every year can be invested in the capital market and the returns used to ensure the payments in perpetuity. A simple scheme starting with 400 beneficiaries and adding 200 new landholders every year until complete 1,200 the fifth year, will ensure to obtain an annual return of over 54 million KSh. and continue the payments in perpetuity without external funds. This approach could represent a valid alternative when the resources are scarce and the need of intervention is high, however it requires a refined knowledge of the natural system to define conservation priorities and a clear understanding of the social systems to define strategies to reduce the potential conflicts caused by the decisions of resource allocation.

5.6. The Friends of Nairobi National Park leasing program.

The Friends of Nairobi National Park is a charity institution that administers a small so called "leasing programme" in Kitengela. This program provides private land owners with a standard payment of 300 Ksh./acre per year if they abstain from erecting fences, converting grasslands to agriculture and selling or subdividing the land. The program depends of foreign donations, and concerns remain over the sustainability of the initiative once the external support disappears. Currently the payments are distributed among 115 household for a total of 8,400 acres and there is a waiting list of landholders that are eager to join the program. However, because of the limited budget, the program can not be expanded and payments have been concentrated in the most critical areas.

The extension of the Kitengela dispersal area is 390 km^2. This represents a surface of 96,371 acres. Considering the current amount of the payments, the annual cost of the leasing program represents 28,911,300 Ksh, Thus, the contribution of Nairobi residents might be more than enough to start the payments since the first year for all the Kitengela area and the difference between the aggregated contribution and the total cost of the leasing program could be invested in the capital market to ensure the payments in perpetuity. However, we should be aware that the willingness to accept of the landholders within the programme do not necessarily represents the willingness to accept of the average Kitengela landholder and previous studies have evidenced that this value can be as high as 60,000 Ksh/acre per year (Mwani and Warinda 1999). However, an evaluation of the leasing programme suggests that although for most of the landholders enrolled in the initiative the received amount does not fully compensate the costs derived of using their land as a dispersal area, it helps to reduce the losses caused by wildlife and under

the alternative of zero payment and the lack of secure returns from the land due to environmental variability most farmers choose to join and stay in the programme (Nkedianye, 2004). The payments seem to have a positive impact on participants' households and most of the money is invested in paying education fees, improving the houses and acquiring veterinary medicines. In addition, the leasing programme has generated a change in the attitude of residents towards wildlife, reducing the number of retaliation events against predators after livestock losses, changing the patterns of illegal game meat consumption and reducing the magnitude of the human-wildlife conflicts (Nkedianye, 2004).

Conclusions

Our study provides empirical evidence of the differences in the perception of the importance of some ecosystem services provided by Nairobi National Park to the wellbeing of Nairobi and Kitengela residents. The comparison of the economic estimates of the losses caused by wildlife to private landholders in Kitengela with the aggregated willingness to pay of Nairobi residents for a new land management plan in the dispersal area to promote the viability of Nairobi National Park, suggests that the financial support of urban residents' may exceeds the economic losses caused by wildlife. Different payment schemes with or without complementary external funds, could be developed to ensure payments in the precise time and sites to compensate landholders in perpetuity for their estimated wildlife-related losses. Finally, small pilot payment initiatives have had a positive impact on people's livelihood and in the reduction of human-wildlife conflicts.

References:

Abdel-Halim, A.S., Metwally, E., and El-Dessouky, M.M. 2003. Environmental pollution study around a large industrial area near Cairo, Egypt. Journal of Radioanalytical and Nuclear Chemistry 257: 123-124

Balmford, A. and Whitten, W. 2003. Who should pay for tropical conservation and how should the costs be met. Oryx, 27, 238 - 250.

Baltenweck, I., Staal, S., Ibrahim, M.N.M., Herrero, M., Holmann, F., Jabbar, M., Manyong, V., Patil, B.R., Thornton, P.K., Williams, T., Waithaka, M. and de Wolf, T. 2003. Crop-Livestock Intensification and Interaction across Three Continents. Main Report. CGIAR Systemwide Livestock Programme, ILRI, Addis Ababa, Ethiopia. 124 p.

Bandara, R., and Tisdell, C. 2003. Comparison of rural and urban attitudes to the conservation of Asian elephants in Sri Lanka: empirical evidence. Biological Conservation 110: 327-342

Bandara, R. and Tisdell, C. 2004. The net beneft of saving the Asian elephant: a policy and contingent valuation study. Ecological Economics, 48, 93 - 107.

Bengtsson, J., Angelstam, P., Elmqvist, T., Emanuelsson, U., Folke, C., Ihse, M., Moberg, F., and Nystrom, M. 2003. Reserves, resilience and dynamic landscapes. Ambio. 2003 :389-396

Campbell, D. J., Gichohi, H., Mwangi, A. and Chege, L. 2000. Land Use Conflict in Kajiado Districy, Kenya. Land Use Policy, 17, 337 - 348.

CBS, 2001. Kenya Population Census 1999: Analytical report on population projections. Vol VII. Nairobi: Central Bureau of Statistics, Ministry of Planning and National Development.

De Groot, R. S., Wilson, M. A., and Boumans, R. M., 2002. A Typology for the Classification, Description and Valuation of Ecosystem Functions, Goods and Services. Ecological Economics, 41:393-408

Ferraro, P. J. 2001. Global Habitat Protection: Limitations of Development Interventions and a Role for Conservation Payments. Conservation Biology, 15, 990 - 1000.

Ferraro, P. J. and Kiss, A. 2002. Direct Payments to Conserve Biodiversity. Science, 298, 1718 - 1719.

Gatari, M., Wagner, A., and Boman, J. 2005. Elemental composition of tropospheric aerosols in Hanoi, Vietnam and Nairobi, Kenya. Science of the Total Environment 341: 241-249

Gichohi, H. 2000. Functional Relationships Between Parks and Agricultural Areas in East Africa: The Case of Nairobi National Park, Kluwer Academic Press, London.

GOK (Government of Kenya). 2001. 1999 Population and housing census. Volume II. Counting our people for development. Socio-economic profile of the population. Ministry of Finance and Planning, Nairobi, Kenya. 381 pp.

Gorman, M. and Heslop, M. 2002. Chronic poverty and older people in the developing world. University of Manchester Institute for Development Policy and Management Research Centre on Chronic Poverty.

Gulis, G., Mulumba, J.A.A, and Juma, O. 2004. Health status of people of slums in Nairobi, Kenya. Environmental Research 96: 219-227

Haab, T. and McConnell, K., 2002. Valuing Environmental and Natural Resources. The Econometrics of Non-market Valuation. Edward Elgar Publishing. Cheltenham.

Hales, D. 1989 Changing Concepts of National Parks, Oxford University Press, Oxford.

Hanneman, W.M., 1984. Welfare evaluation in contingent valuation experiments with discrete responses. American Journal of Agricultural Economics, 66:332-241.

Help Age International 2003. Off the margins: older people, human rights and poverty reduction in Africa in the 21st century. Linking ageing to national poverty policies, the PRSPs and the Millennium Development Goals. Ageing and Poverty Workshop Dar es Salaam, 29 - 31 October 2003.

Henson, D. 2004. An Economic Evaluation of Nairobi National Park Using the Contingent Valuation Method. MSc. Dissertation, University of Edinburgh. U.K.

Howarth, R.B., and Farber, S. 2002. Accounting for the value of ecosystem services. Ecological Economics 41: 421-429

Irwin, A., 2001. Sociology and the Environment: A Critical Introduction to Society, Nature and Knowledge. Polity Press, Cambridge, 210 pp.

Kristjanson, P., Radeny, M., Nkedianye, D., Kruska, R., Reid, R., Gichohi, H., Atieno, F. and Sanford, R. 2002. Valuing alternative land-use options in the Kitengela wildlife dispersal area of Kenya. ILRI Impact Assessment Series 10. Nairobi, Kenya. 61 pp.

Lee, C.K. and Han, S.Y. 2002 Estimating the use and preservation values of national parks' tourism resources using a contingent valuation method. Tourism Management, 23, 531 - 540.

Lewan L, and Soderqvist, T. 2002. Knowledge and recognition of ecosystem services among the general public in a drainage basin in Scania, Southern Sweden. Ecological Economics 42: 459-467

Liniger, H., Gikonyo, J., Kiteme, B., and Wiesmann, U. 2005. Assessing and managing scarce topical mountain water resources - The case of Mount Kenya and the semiarid Upper Ewaso Ng'iro Basin. Mountain Research and Development 25: 163-173

Loomis, J., Kent, P., Strange, L., Fausch, P., and Covich, A. 2000. Measuring the total economic value of restoring ecosystem service in an impaired river basin: result from a contingent valuation survey. Ecological Economics 33:103–117

Maharana, I., Rai, S. C. and Sharma, E. 2000. Valuing ecotourism in a sacred lake of the Sikkim Himalaya, India. Environmental Conservation, 27, 269 -277.

Mbonile, M.J. 2005. Migration and intensification of water conflicts in the Pangani Basin, Tanzania. Habitat International 29: 41-67

Mwaiselage, J., Bratveit, M., Moen, B.E., Mashalla, Y. 2005. Respiratory symptoms and chronic obstructive pulmonary disease among cement factory workers. Scandinavian Journal of Work Environment and Health 31: 316-323

Mwangi A. and Warinda E. 1999. Socio-economic dimensions of sustainable wildlife conservation in the Kitengela wildlife dispersal area. African Conservation Centre (ACC), Nairobi, Kenya. 67 pp.

Nkedianye, D.K. 2004. Testing the attitudinal impact of a conservation tool outside a protected area: The case of the Kitengela Wildlife Conservation Lease Programme for Nairobi National Park. Master of Arts Thesis, University of Nairobi, Kenya. 150 pp.

Norton-Griffiths, M. 1998. The Economics of Wildlife Conservation Policy in Kenya, Blackwell Science Ltd, Oxford.

Park, T., Loomis, J. and Creel, M., 1991. Confidence intervals for evaluating benefits estimates from dichotomous choice contingent valuation studies. Land Economics, 67: 64–73.

Pouta, E., Rekola, M., Kuuluvainen, J., Tahvonen, O. and Li, C.Z. 2000. Contingent valuation of the Natura 2000 nature conservation programme in Finland. Forestry 73: 119-128

Ryan, R.L. 2005. Exploring the effects of environmental experience on attachment to urban natural areas. Environment and Behavior 37: 3-42 .

Serneels, S., Said, M. Y. and Lambin, E. F. 2001. Land cover changes around a major East africa wildlife reserve: the Mara Ecosystem (Kenya). International Journal of Remote Sensing, 22, 3397 - 3420.

Schaberg, R.H., Holmes, T.P. and Lee, K.J., 1999. Ascribing value to ecological processes: An economic view of environmental change. Forest Ecology and Management 114: 329-338

Shultz, S., Pinazzo, J. and Cifuentes, M. 1998. Opportunities and Limitations of Contingent Valuation Surveys to Determine National Park Entrance Fees: Evidience from Costa Rica. Environment and Development Economics, 3, 131 - 149.

Thompson, M. and Homewood, K. 2002. Elites, entrepreners and exculsion in Maasiland Human Ecology, 30, 107 - 138.

Tisdell, C., Wilson, C., and Swarna Nantha, H. 2005. Policies for saving a rare Australian glider: economics and ecology. Biological Conservation 123: 237-248

Turpie, J.K. 2003. The existence value of biodiversity in South Africa: how interest, experience, knowledge, income and perceived level of threat influence local willingness to pay. Ecological Economics 46:199-216

Western, D. 1997. Nairobi Zoo? Swara, 19 - 21.

Western, D. and Pearl, M. 1989. Conservation without Parks: Wildlife in the Rural landscape, Oxford Universtiy Press, Oxford.

Tables and figures

Figure 1. Location map of Nairobi National Park and the Kitengela Dispersal Area

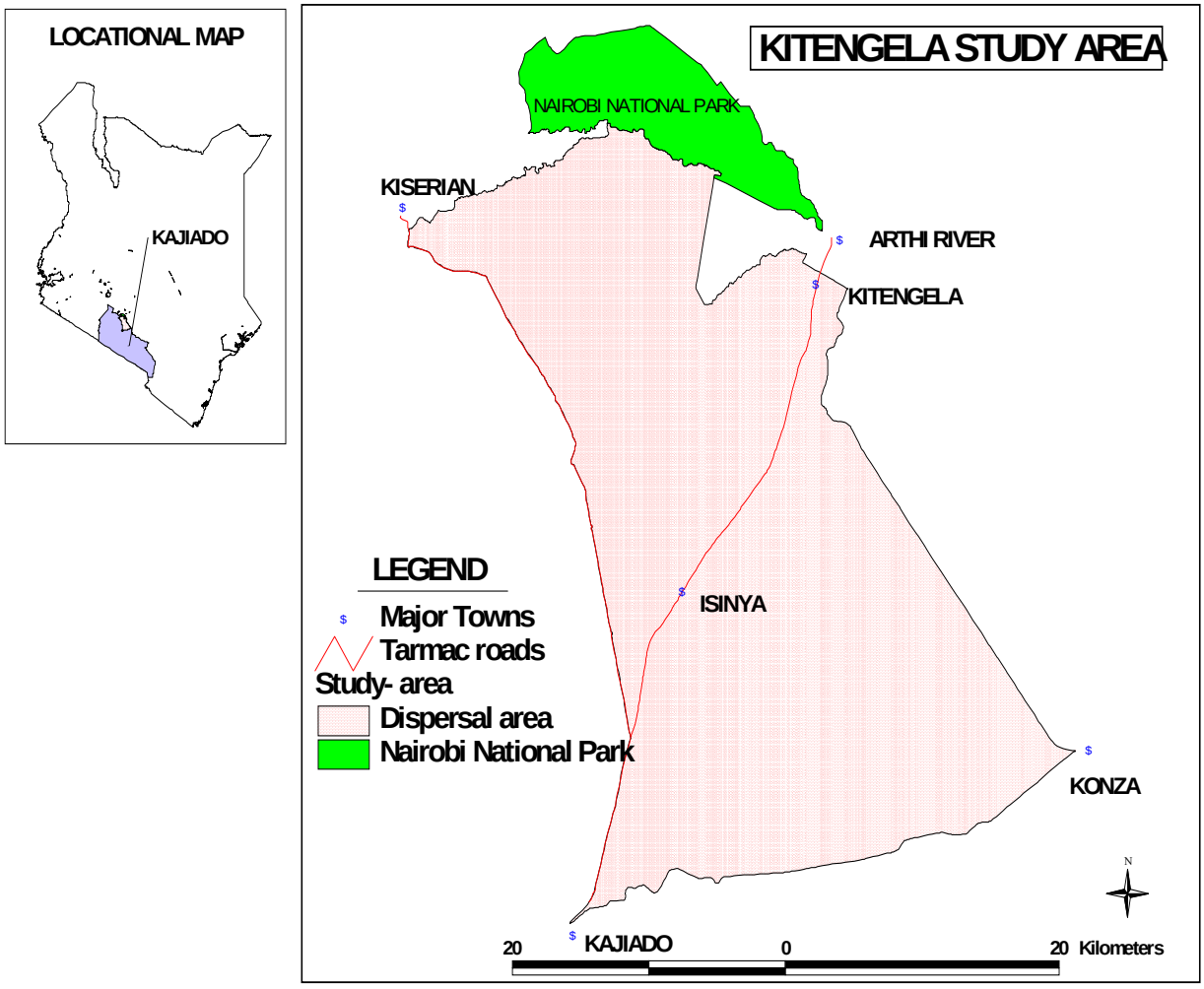

Table 1: Ecosystem services considered in the study and their Likert scale values for Nairobi and Kitengela respondents.

Ecosystem function /Ecosystem service	Nairobi N=166 Mean ± St Dev.		Kitengela N=74 Mean ± St. Dev.		Level of significance p
Production function: **Provision of natural resources**					
Food/Raw material: provision of pastures for livestock and wildlife and extraction of building material in the area of the NNP.	3.07	±1.399	2.56	±1.401	0.097
Information function: **Provision of opportunities for cognitive development**					
Recreation: Development of tourism activities and wildlife viewing in NNP	4.48	±.686	4.50	±.815	0.84
Education: school visits to NNP and implementation of research projects in the area.	4.70	±.566	4.70	±.735	1
Quietude: Perception and use of NNP as a peaceful natural place to escape from the city stress	3.66	±1.185	3.73	±.941	0.65
Habitat function : **Provision of suitable living space for wild plant and animal species**					
Conservation: Provision of refuge for endangered wildlife within the park boundaries.	4.36	±.870	3.99	±.972	**0.0037**
Regulation function: **Maintenance of essential ecological processes and life support systems**					
Water supply/regulation: Provision of water for human consumption, livestock and wildlife, as well as for industry and agriculture	3.53	±1.346	4.01	±1.153	**0.0132**
Air quality: positive effect of the Park open space to air circulation.	3.50	±1.257	4.35	±.818	**0.001**

Table 2: Definition and sample descriptive statistics of variables used in the contingent valuation analysis of the WTP for new land management schemes in the Kitengela Dispersion Area.

	Definition of variables	**Mean**	**Std.Dev.**	**Min.**	**Max.**
SEX	Gender of the respondent. 1 if male, 0 if female.	0.845638	0.362514	0	1
AGE	Age of the respondents. Categories 1, under 30 yrs old; 2, between 31-50 yrs old; and 3, over 50 yrs old	1.51678	0.576617	1	3
EDUCATION LEVEL	Education level reported by the respondent. 1 non education, 2 Primary, 3 Secondary, 4 Higher education	3.22819	0.8064	1	4
JOB SECURITY	Job security. 1 If the respondent considers himself able to have a regular source of income for the following five years; 0 otherwise.	0.818792	0.38649	0	1
GREENSCORE	Total score obtained by the respondents to a set of environmental statements related to economic development, loss of species, destruction of habitat and animal rights.	18.3221	2.55551	10	25
VALUESCORE	Total score the Likert values for the ecosystem services presented in Table 1	28.1879	3.83682	13	35
CONCERNS	Degree of concern with the future of the park.	1.42953	0.699952	1	3
TIME OF RESIDENCE	Number of years living in the area of residence	14.0268	10.4687	0	44
SEGNBO	The bid multiplied by the Dummy variable of location (1 if the household belongs to Nairobi; 0 otherwise)	142.45	229.05	0	1000
SEGKITE	The bid multiplied by the Dummy variable of location (1 if the household belongs to Kitengela; 0 otherwise	33.0537	118.06	0	1000

Table 3: Parametric Binary Logit Model of the Determinants of the WTP for new land management schemes in the Kitengela Dispersion Area.

Variables	Coefficient	Marginal Effect		t-ratio
Constant	-3.355	-0.813		-1.197
Gender	-0.922	-0.223		-1.224
Age	-0.883	-0.214	**	-2.001
Education level	0.378	0.091		1.172
Job security	2.377	0.576	***	3.839
Green score	0.047	0.011		0.515
Value score	0.113	0.027	*	1.802
Concern	-0.240	-0.058		-0.684
Time living in the area	0.033	0.008		1.331
Segnbo	-0.007	-0.002	***	-4.011
Segkite	-0.012	-0.002	**	-2.290
Log likelihood function	-60.56886			
Restricted log likelihood	-99.59409			

***: Statistically significant at P<0.01; ** Statistically significant at P<0.05; * Statistically significant at P<0.10;