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Property rights and the marginal wildebeest: an economic analysis of wildlife conservation options in Kenya

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This paper discusses policy responses to the potential loss of biodiversity in the Mara Area of Kenya from the conversion of essentially wild and undeveloped rangeland to developed agriculture. Property rights are central to the debate, and raise two fundamental issues. First, to what extent do the Maasai, the traditional users and owners of the land, have the right to benefit from the development potential of their land to further their economic, social and political standing, even if by so doing they create domestic and global externalities through the loss of biodiversity. Second, if the state alienates their development rights in the name of conservation, then to what extent should the state compensate the Maasai for their lost economic opportunities. To the Maasai, conservation as implemented through Government policy is a public bad: they are denied access to resources, their costs of production are significantly increased, and development is slowed down or actively discouraged. A cost:benefit analysis suggests that it is neither supportable nor sustainable to condemn the Maasai to a poverty trap on behalf of conservation, and that it is instead socially profitable for the Kenyan Government to meet in full their opportunity costs of forgone economic benefits.

Keywords: property rights; biodiversity conservation; marginal costs and benefits; GEF.

Introduction

Loss of biodiversity arises from three main causes: first the over-exploitation to extinction of individual species (e.g. the dodo, the great auk, and probably in time the African rhino and the Asian tiger); second, the pernicious degradation and modification of habitats by pollution, spot development, transport infrastructure and the like; and third, the wholesale conversion of habitats from an essentially undeveloped and natural state to a developed state. Pearce (1991), Pearce and Moran (1994) and others (e.g. Cervigni, 1993) consider this third cause to be the most important and present a unified theory of market and Government failures as the underlying fundamental cause, arguing that it is the lack of appropriate pricing mechanisms coupled with inappropriate government interventions which leads to the failure to capture the true externalities of biodiversity loss at local, domestic (national) and global levels.

This paper considers policy and land management responses to this third cause of biodiversity loss in Kenya, the conversion of essentially wild and undeveloped land to developed agriculture. Debate on the most effective policy response revolves around a number of key issues, including environmental ethics and human rights, the nature of the property rights, the nature of the externalities involved, the opportunity costs, and the private, social and economic optima for conservation.

The fundamental ethical issue surrounds the extent to which traditional users and owners of land have the right to benefit from the development potential of their land to further their economic and social progress (Bromley, 1989), even if by so doing they create domestic and global externalities through the loss of biodiversity. Alternatively, to what extent should they be compensated if the state denies them these rights.

Property rights are also central to the debate (Bromley, 1989; 1991), for policy responses will be quite different in the case of state owned land such as forests, or ungazetted land under traditional communal tenure like the savannas of eastern Africa, or privately owned land on which the owners have, within reason, the absolute discretion to do what they wish. Here we discuss the interaction between three competing property rights: the state over its own land, private Maasai land owners over their land, and the state over individual wild animals which migrate between state and privately owned land.

The issue of externalities also underlies an appropriate policy response. On the one hand, the development decisions of private landowners create both national and global externalities through the loss of biodiversity. On the other, the pursuit of conservation by the state creates externalities for private landowners, in this case in the form of dangerous wild animals which greatly increase their costs of production. To complicate matters further, individual landowners can in principle shift these externalities onto other land owners through defensive activities.

Opportunity costs provide the economic incentives either to develop or to conserve land, depending upon the nature of the property rights. Broadly speaking, the conservation values of land – no matter in whom the property right is invested – can be maintained only by leaving the land undeveloped or by freezing development at a particular stage. This imposes opportunity costs on the owners of the property right by denying to them the benefits of developing their land further, and they will only remain indifferent to the conservation: development choice if these opportunity costs are met.

It is one thing to identify and quantify the market failure leading to a loss of biodiversity: it is quite another to decide how much biodiversity is needed, or how much is enough, and debate on the conservation of biodiversity is greatly hindered by the failure to come to terms with this issue. Recently, great strides have been made in the concepts of safe minimum standards, in terms of genetic diversity, habitat size and patchiness, population sizes, ecosystem integrity and maintenance of critical functionalities (for example May, 1994; Caughley and Sinclair, 1994). Nonetheless, conservationists in eastern Africa still take all they can while hanging on to what they have, with little debate on whether they need more, or less (Anderson and Grove, 1993). This leads inevitably to policies that are reactive rather than proactive and to a consistently adversarial socio-political environment.

Property rights and conservation values in the Mara Area

This paper examines these issues in the light of enforceable property rights in the Mara Area in Kenya which forms the northern part of the 40 000 km^2 Serengeti ecosystem (Sinclair and Norton-Griffiths, 1979). At its core (Fig. 1) lies the 1368 km^2 Maasai Mara National Reserve (MMNR), formal conservation estate owned and managed on behalf of

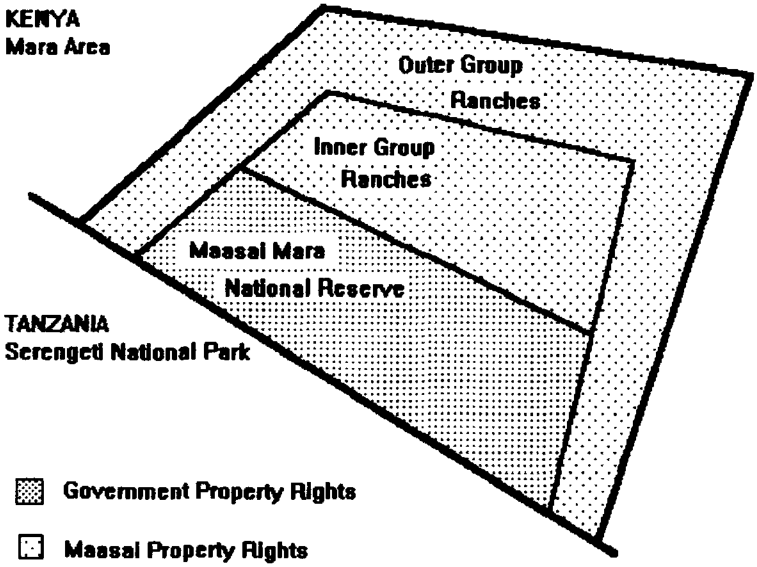

Figure 1. Schematic diagram of the Mara Area.

the government of Kenya by the Narok County Council, which is surrounded by 4566 km^2 of Group Ranches which are owned and managed by the pastoral Maasai. The base year for this study is 1989.

The MMNR was formally established in 1961, and the property right to the MMNR was vested in the Narok County Council (NCC) which is itself an institution of the Government of Kenya (GOK). In turn, the NCC manages the MMNR on behalf of the Maasai of Narok District and fees earned from the MMNR devolve to the NCC for social investment in the District (Talbot and Olindo, 1990). However, in practice funds to the NCC rarely go to social projects (Monbiot, 1994; Anderson, 1995) and the result from the Maasai's viewpoint is the alienation of resourcs and the diversion of benefit flows from landowners to politicians.

The exact nature of the 'Group Ranch' property right also needs clarification (Galaty, 1980; 1992). Whereas Maasai land was traditionally under a communal tenure regime, the governments of eastern Africa were (and are) notoriously prone to ignore usufruct rights and alienate such land for development – for example, large wheat schemes in northern Tanzania (Lane and Pretty, 1990). This made it effectively impossible for pastoralists to obtain investment capital for land development. In the mid-1960s, under the aegis of the IBRD Kenya Livestock Development Project, most land in Kajiado and Narok Districts (the major Maasai districts of Kenya) had been demarcated into Group Ranches, owned under legally recognized, private title by a registered group of members.[1]

The Government of Kenya uses the Mara Area for conservation. It enforces its property rights to the MMNR, denying access to Maasai pastoralists but admitting tourists, and preventing any development within the MMNR except for tourism infrastructure. Outside the MMNR, the Kenyan game laws (Bragdon, 1990) enable the GOK to enforce its

[1]The Maasai of Kenya therefore have at least the possibility of benefiting from the development potential of their land, unlike those in Tanzania where land alienation remains the prerogative of the government (Ndagala, 1982; Lane and Pretty, 1990; Homewood and Rodgers, 1991).

property rights to the wild animals resident on the Group Ranches and to the migratory wildlife which move seasonally from the MMNR onto the Group Ranches.

The MMNR and the Group Ranches accordingly support a great wealth of both resident and migratory wildlife and their associated habitats, and the principal conservation value of the Mara Area is the dry season grazing for the Serengeti migratory wildebeest population (Maddock, 1979). The wildebeest number some 1.5 million animals and each year migrate over an area of some 30 000 km^2, from the short grassland of the Serengeti National Park and Ngorongoro Conservation Area 150 km to the southeast to the open grasslands of the Mara Area. During the dry season the wildebeest graze the Maasai Mara National Reserve, but also spill out in huge nmbers over the grazing lands of the Group Ranches.

The Mara Area has now become the premier destination in Kenya for wildlife tourists. The MMNR attracts some 10% of all tourist bednights and generates $20m in gross revenues (Douglas Hamilton, 1988). Wildlife tourism, along with agriculture and traditional livestock management, is also very important on the Group Ranches, where these land uses generate, respectively, gross annual revenues of $10m, $3.8m and $2.4m.

By enforcing their property rights to the land area of the MMNR and to the wild animals on the Maasai group ranches, the GOK imposes significant externalities on the Maasai. First, the Maasai are denied their traditional access to, and use of, the MMNR (Talbot and Olindo, 1990). Second, the presence of wildlife greatly increases the costs of livestock and agricultural production. For example, wildlife (especially the migratory wildebeest, zebra and gazelle) compete directly with the Maasai livestock for grazing,[2] they also spread disease, and wildlife are dangerous – they kill and maim livestock and people. In response, the Maasai must undertake all sorts of defensive activities and expenditures, for example constructing large thorn bomas,[3] moving away from wildlife to prevent disease transmission[4] and protecting fields and agricultural plots. Third, these necessary defensive activities also raise the costs of development.

However, the Maasai are also enforcing their property rights on their privately owned land and are in turn imposing externalities on the Government of Kenya and on the world. Although the Maasai can only directly destroy wildlife (e.g. by shooting) in immediate defence of life and property, they can significantly influence wildlife numbers and distributions through habitat modification (burning, and conversion to cropland), by

[2]The competition between wildlife and Maasai livestock can be approximated by converting the average density of each wildlife species to metabiomass (Croze *et al.*, 1978; Caughley and Sinclair, 1994) and expressing the results in cattle equivalents (CEQU). Broten and Said (1995) present the results of 16 aerial censuses of wildlife on the group ranches and the MMNR between November 1977 and April 1991. For each of the i wildlife species censussed, let d_i be the mean density across all censuses, bwt_i be the population mean body mass, 0.75 be the scalar for metabiomass, and 49.14 be the average metabiomass for one Maasai cow, then

$$\mathrm{CEQU} = \left(\sum_{i=1}^{N} d_i * bwt_i^{0.75}\right) / 49.14$$

This indicates that on average the wildlife consume grazing and browsing resources equivalent to 18.05 cows km^{-2} representing 30% of the average density of livestock on the Group Ranches.

[3]Although there are few quantitative data on the resources expended in building thorn fences, it is instructive to compare accounts of livestock production among the Maasai (e.g. Bekure *et al.*, 1991) with the pastoralists in the Ferlo of Senegal (UNEP/FAO, 1988; Juul, 1990; Toure, 1990) where all wildlife and predators were exterminated years ago, where the simplest of fences suffice and where herds can be left out at night attended only by a herd boy.

[4]In the early 1980s, in the course of aerial surveys covering 400 000 km^2 of pastoral rangelands in Tanzania, Kenya and southern Sudan (Norton-Griffiths, 1994a), the 25% of the area occupied by pastoralists at the time of the surveys contained 66% of all livestock yet only 3% of all wildlife – an almost complete separation from and avoidance of wildlife by the pastoralists.

defensive expenditures on fencing around properties, waterholes and fields, and by strategically siting new infrastructure developments. Furthermore, they could actively deny access to tourists if they so wished (as opposed to passive denial following agricultural developments).

The dilemma facing conservationists in the Mara Area is that despite the seemingly vast revenues generated each year by wildlife tourism – $20m in the MMNR and a further $10m on the Group Ranches – there is a clear trend on the part of the Maasai both to develop their land and to sell land to developers, so that land use is changing from traditional pastoralism to agriculture and ranching (Douglas Hamilton, 1988; Parkipuny, 1991; Anderson, 1995; Norton-Griffiths, 1995). Already some 15 000 ha along the western boundaries of the Mara Area are farmed intensively by smallholders and commercial operators (EcoSystems, 1985), mainly non-Maasai who have purchased land from the Maasai,[5] while within the Mara Area itself the land leased by the Maasai to wheat farmers has increased from 18 000 hectares in 1973 to more than 27 000 hectares in 1987 (Douglas Hamilton, 1988). Elsewhere in Narok district, in which the Mara Area lies, large-scale wheat and maize farming is now so extensive that the district, which was formally entirely pastoral, now produces a major share of Kenya's grains. These newly converted agricultural areas are entirely bereft of wildlife and are no longer visited by tourists.

There persists a romantic notion that Maasai (and other) pastoralists co-exist with wildlife in an harmonious relationship. The truth is, of course, quite different and what one observes and interprets as co-existence is in fact a shortage of capital and technology on the part of the pastoralists to change the *status quo.* Perhaps in the past, when population densities were low, pastoralists could indeed afford to ignore wildlife. But today, burgeoning human populations and ever increasing financial requirements and economic expectations create the absolute necessity to raise productivity per unit area of land. Pastoralists simply can no longer afford the extra costs of production associated with wildlife.

The wholesale eradication of wildlife from these pastoral areas is revealed unambiguously by a series of aerial censuses of wildlife (Broten and Said, 1995; GOK 1995a; 1995b) covering Narok District as a whole as well as the Group Ranches and the Maasai Mara National Reserve individually. The censuses were made between January 1974 and December 1995 and demonstrate a catastrophic loss of wildlife density and diversity (Table 1). Although the rates of loss are significantly lower on the Group Ranches than for the District as a whole, and are not yet statistically significant within the MMNR itself, 73% of all wildlife has been eradicated from Narok District since 1977 and 50% from these Group Ranches.

The contemporary rates of increase in wheat and maize hectares (Table 1) are astonishing and probably represent the root cause of the loss of wildlife, along with a trend towards more modern methods of livestock production and perhaps direct predation (poaching). The implication of such land developments for biodiversity conservation is straightforward: while nomadic pastoralism is still in principle compatible with wildlife conservation and eco-tourism, developed ranching and agriculture is not, so development in the District and on these Group Ranches is ultimately at the expense of wildlife. More specifically, the numbers of migratory wildebeest are controlled primarily by thir dry

[5]That the Maasai now realize the value of the development potential of their land is evidenced by the recent tribal warfare in Narok District in which settlers on land purchased legally from the Maasai are being evicted by force of arms.

Table 1. Trends[a] (% per annum) in wildlife numbers and diversity, and in maize and wheat hectares Narok District, Kenya 1977–94

		Narok district	Group ranches	Maasai Mara National Reserve
Wildlife numbers	Trend	−4.32	−2.93	−1.88
	p value	<0.001	<0.02	ns
	Loss[c]	−73%	−50%	—
Wildlife diversity[b]	Trend	−0.71	−0.53	−0.41
	p value	<0.001	<0.02	ns
Agricultural hectares				
Maize and wheat 1985–90	Trend	+19.85	na	na
	p value	<0.001		
Wheat 1981–9	Trend	+13.47		
	p value	<0.001		
Maize 1985–90	Trend	+19.75		
	p value	<0.001		

[a] From OLS regression of wildlife numbers converted to natural logs (Broten and Said, 1995; GOK 1995a; 1995b).
[b] Shannon-Weiner function.
[c] Total % loss 1977–94.
Wildlife numbers: trend (% pa) for Narok District > Group ranches ($p < 0.001$) > MMNR ($p < 0.03$)
Wildlife diversity: trend (% pa) for Narok District > Group ranches ($p < 0.04$) = MMNR

season food supply (Sinclair and Norton-Griffiths, 1982; Sinclair *et al.*, 1985) so any reduction to the area of dry season grazing will lower the equilibrium level of the wildebeest population and lead to a general reduction in the animal and habitat diversity of the Mara Area.

Wildlife managers and conservationists in the Mara Area must therefore address three critical issues. First, why are Maasai developing their land in the face of these seemingly vast revenues from tourism? Second, is it cost effective for the GOK to counteract these trends to develop this land? Third, is there an economically optimum area and an economically optimum number of animals which the GOK should strive to conserve?

Why do the Maasai develop their land?

The net gains to the Maasai from alternative land uses was first analysed from the perspective of a cost:benefit analysis (CBA) by Norton-Griffiths (1995) who made a careful distinction in explicit money terms between gross and net revenues. Gross revenues (*GR*) represent total annual revenues from agricultural and livestock production while net revenues (*NR*) represent the gross revenues less the direct and indirect costs of production, i.e. the annual profits. The gross and net revenues generated for Kenya in the Mara Area (Table 2, A and B) clearly support the view that tourism is the most economic form of land use, and from the viewpoint of the Government or of a conservation NGO it is clear that:

$$NR_{\text{Conservation}} >> NR_{\text{Agriculture}} > NR_{\text{Livestock}}$$

However, the Maasai landowner sees the world from a quite different perspective. He sees

Table 2. Gross and net revenues in the Mara Area

Land use	Gross and net revenues to Kenya[a]		Net revenues to Maasai landowners[a]	
	(A) Gross ($ million)	(B) Net ($ million)	(C) Over the total area of group ranches ($ million)	(D) Per hectare devoted to each land use ($ million)
Tourism	30.0	9.6[b]	0.2	0.35
Agriculture	3.8	1.4	0.2	6.25[c]
Livestock	2.4	0.9	0.9	1.99
Totals	16.2	11.9	1.3	na

[a] Sources: Douglas Hamilton (1988) and Norton-Griffiths (1995)
[b] See section 4.2 Benefits
[c] per hectare cultivated

first the net revenues to himself as a landowner (Table 2, C) and then, more importantly, the net revenues or profits from each hectare of land devoted to each use (Table 2, D). For the Maasai landowner:

$$NR_{\text{Agriculture}} >>> NR_{\text{Livestock}} >> NR_{\text{Conservation}}$$

so the Maasai will always favour either of the alternative land uses over tourism and conservation.[6]

The reasons for this are straightforward. Agriculture is a very intensive form of land use on relatively few cultivated hectares, so the rents per hectare cultivated are far higher than are those from livestock or tourism. Although the Maasai have as yet neither the capital nor the expertise to carry out intensive mechanized cultivation of this kind, they are becoming widely involved in cultivating smaller plots of maize and vegetables and they effect control over large scale agriculture in the sense that it is their decision as to how much land to rent to commercial farmers. In contrast, livestock rearing is an extensive form of land use over the entire area of the Group Ranches which the Maasai control themselves and from which they accordingly benefit in terms of all revenues and profits.

Tourism, like livestock rearing, is also an extensive form of land use but one whose revenues are generated largely by tour companies. The Maasai landowners again have neither the capital nor expertise to participate fully in the tourism trade, and they have little influence of any sort over the numbers of tourists coming to the Mara Area. Their returns (profits) are in the form of access fees, bednight fees and other minor revenues. In 1989, these amounted to 1.6% of gross tourist revenues from the Group Ranches or 0.5% of all tourist revenues in the Mara Area. (A similar situation occurs around the Amboseli National Park, Kenya, where the landowners of the wet season dispersal zone received in 1990 only 1% of the $15 million of wildlife revenues generated there). These tourism rents (returns per hectare) are derisory, and are unlikely even to compensate the Maasai for the grass eaten by wildlife let alone the added risks from disease and predation.

[6]Put somewhat more bluntly, if one Maasai family on one Group Ranch wished to raise the extra $10 000 required to put one child through college, the ranch would have to increase current tourist revenues by 35%, or livestock revenues by 14% or the area under agriculture by 2%.

Wildlife managers and tour operators in Kenya are keenly aware of this disparity and have embarked upon a number of policy initiatives. First, the Kenya Wildlife Service is diverting some $2.5 of the $20 daily visitor fee to the MMNR directly to the landowners which effectively doubles their rents from tourism. Second, individual tour and safari companies are negotiating sole use contracts with individual Group Ranches in which the ranch owners, in return for significant payments, restrict certain types of development and deny access to other tourists.[7]

Sadly, however, these and similar endeavours are based upon a fundamental misunderstanding of the true opportunity costs of the land, which to the Maasai on the Group Ranches are the potential net revenues from full development rather than from the particular stage of development that the land happens to have reached at any specific moment in time. Norton-Griffiths and Southey (1993; 1995) developed a concept for the opportunity costs of conserved land in Kenya (National Parks, Reserves and Forests) which they equated to the contemporary average net returns from agricultural and livestock production on land of similar agro-ecological conditions (primarily climate and soils). This concept has the dual advantage of reflecting the contemporary stage of agricultural development averaged over Kenya as a whole while avoiding absurd estimates of opportunity costs based on intensive irrigated production (or full industrial development with highrise office blocks).

Applying this concept to the Group Ranches of the Mara Area, the opportunity costs to the Maasai of not developing their land is equal to the contemporary average net revenues from agricultural and livestock production on land with the same agro-ecological conditions, but outside of Maasailand. These opportunity costs (Table 3) have been calculated with the same two-step procedure as described by Norton-Griffiths and Southey (1993; 1995).

Over the whole area of the Group Ranches, the potential net revenues are:

$$NR_{\text{Potential}} = \sum_{z=1}^{6} (Ha_z * NR_z) \tag{1}$$

where the z are the six zones of land potential as defined by Norton-Griffiths and Southey (1993; 1995) the Ha_z are the hectares of each zone in each Group Ranch, and the NR_z are the average contemporary net returns from agricultural and livestock production within each zone.[8]

Using this concept of opportunity costs reveals the full scale of the problem facing

[7]These are essentially free market (Coasian) solutions, for the Maasai own the property rights to the land on which the wildlife live while the safari companies wish access to the land for their clients. However, there are such manifest inequalities between the initial endowments of the parties in terms of wealth, information, political connections and experience in commercial negotiations that the free market approach cannot effect either an optimal or a sustainable outcome. This is evidenced by the recent bargain struck on the Koyaki group ranch in the Mara Area, after which the combined payments from the KWS and from private safari companies represent less than 10% of the true opportunity costs of the Maasai owners – which, of course, is why the Maasai continue to develop the range to the annoyance, confusion and bafflement of the other parties.

[8]Norton-Griffiths (1994b) has made two important modifications to his initial estimates of contemporary net returns (NR_z) in each land potential zone (Norton-Griffiths and Southey, 1993; 1995). First, agricultural production in each zone has been weighted by the probability distributions of growing season rainfalls to accommodate between year variations in yields (from multiple cropping, average cropping and crop failure). Second, the net values of the timber, fuelwood and charcoal obtained from the rural landscape (from woodlots, hedgerows, riparian strips, communal tree and bush cover etc.) have been included. The potential net returns reported here for the group ranches are accordingly somewhat larger than those previously reported by Norton-Griffiths (1995).

Table 3. Current and potential net returns to the landowners of the group ranches

Land uses	Units	(A) Current net returns	(B) Potential net returns[b] = opportunity costs	Net opportunity costs (A – B)
Tourism	$ ha^{-1}	0.35	0.00[c]	0.35
Total production from agriculture[a] and livestock	$ ha^{-1}	2.43	61.55	59.12
Total $ ha^{-1}	$ ha^{-1}	2.78	61.55	58.77
Total $ millions	$	1.27	28.81	26.83

[a] now averaged over all hectares
[b] from Norton-Griffiths and Southey (1993; 1995) as modified by Norton-Griffiths (1994b)
[c] no tourism if the land becomes developed

wildlife managers (Table 3). There is an annual discrepancy of some $26.8 million between the current annual net returns (i.e. profits) to the Maasai landowners of $1.3 million and the potential annual net returns of $28.8 million if their land were fully developed. This discrepancy provides a massive financial incentive for the Maasai to develop their land at the ultimate expense of conservation values, and in the face of the current returns from conservation and tourism it is inevitable that the Maasai will select the development path. This discrepancy also provides a financial incentive to outsiders to acquire land from the Maasai for agricultural development.

Is it cost effective to meet the Maasai's opportunity costs?

Introduction

If we acknowledge the basic rights of the Maasai to benefit from the development potential of their land and if we also acknowledge the rights of the Government of Kenya to promote conservation for the benefit of all Kenyans and the world at large, then these $26.8 million represent the compensation due each year to the Maasai for freezing their land development at its present stage. This sum is not trivial: it represents 89% of the total tourist revenues of $30 million generated in the Mara Area and is equivalent to approximately $80 per visitor per day. This immediately raises the question as to whether it is cost effective to meet these compensation payments – in other words is it socially profitable for Kenya to meet the opportunity costs of the Maasai not to develop their land any further.

This can be approached by a social cost:benefit analysis of conservation in the Mara Area. The opportunity costs to the Maasai (OC_{Maasai}) are a function of the potential net revenues from their land (Norton-Griffiths and Southey, 1993; 1995), while the net benfits of conservation ($NB_{\text{Conservation}}$) are a function of local, domestic and global net benefits (Norton-Griffiths, 1994b), each of which are in turn functions of direct and indirect use values, option and existence values (Pearce and Moran, 1994). In principle, therefore, it will be socially profitable (CE = cost effectiveness ratio) to meet the opportunity costs of the Maasai if the ratio of net benefits to opportunity costs is greater than unity:

$$CE = NB_{\text{Conservation}} / OC_{\text{Maasai}} > 1.0 \qquad (2)$$

Parameters for a cost:benefit analysis (Table 4)

Area to be conserved (Table 4.1). The CBA in Table 3 treated the Group Ranches as a single entity. However, the ranches differ fundamentally in development potential (Norton-Griffiths, 1995) and to reflect this the Mara Area is now divided into the core conservation area of the MMNR and into the 'inner' and 'outer' Group Ranches (Fig. 1). The inner group ranches are of much poorer agro-ecological potential so the opportunity costs to the Maasai of leaving their land undeveloped – and therefore of the required compensation payments – are significantly lower than on the outer group ranches. The CBA now compares opportunity costs and net benefits within each of these three sub-divisions, but from the perspective of the Government of Kenya rather than that of the Maasai.

Property rights (Table 4.2). The property rights to the MMNR belong ultimately to the GOK and are neither transferable nor divisible, in that it is not possible (except by act of parliament) to sub-divide the MMNR or to develop any part of it. In contrast, the property rights to the Group Ranches belong to the Maasai and are both transferable (they can sell part or some of their land) and divisible (they could transfer the development rights to all or part of their land). However, for this CBA all property rights within these three distinct and contiguous areas of land are treated as non-transferable and non-divisible.

Table 4. Elements of the cost:benefit analysis

		MMNR	Inner group ranches	Outer group ranches
1	Area conserved (km^2)	1368	1665	2901
2	Property right	GOK	Maasai	Maasai
3	Wildebeest conserved (million)	0.173	0.210	0.367
Costs				
4	Opportunity cost to land ($ million)	8.127	3.069	25.036
Benefits				
5	(a) Gross revenues from tourism ($ million)	20.000	4.700	5.300
	(b) Net revenues (32%) from tourism ($ million)	6.400	1.504	1.696
	(c) *CE* ratio (5b/4) ($ million)	0.787	0.490	0.068
6	Other domestic benefits ($ million)	2.740	3.335	5.811
7	(a) Total domestic benefits (5b + 6) ($ million)	9.140	4.839	7.507
	(b) *CE* ratio (7a/4) ($ million)	1.125	1.577	0.300
8	Global benefits ($ million)	16.416	19.980	34.812
9	(a) Total benefits (7a + 8) ($ million)	25.556	24.819	42.319
	(b) *CE* ratio (9a/4) ($ million)	3.145	8.087	1.390
Net transfer to meet opportunity costs				
10	Current net revenues ($ million)	6.400	0.546	0.716
11	Net transfer (4–10) ($ million)	1.727	2.532	24.320

Wildebeest to be conserved (Table 4.3). The size of the migratory wildebeest population is controlled primarily by the dry season food supply (Sinclair *et al.*, 1995) which is in turn dependent mainly upon rainfall during the dry season. The long-term equilibrium level of the wildebeest population, here taken to be 1.5 million animals, is accordingly a function of rainfall fluctuations and other events such as fire, poaching and outbreaks of disease (Hilborn, 1995). The Hilborn model assumes a proportional effect between the equilibrium level of the wildebeest population and any reduction in dry season grazing area, so loosing 10% of dry season grazing area will, *ceterus paribus*, lower the equilibrium population by 10%.

The importance of the Mara Area for the wildebeest is itself a function of both their numbers and the actual patterns of rainfall. When numbers were low, 200–300 000 as in the early 1960s, the Mara Area was quite unimportant; once numbers had risen to some 600–800 000 they were spending over 40% of the dry season there (Pennycuick, 1975; Maddock, 1979); and with numbers now at around 1.5 million they spend perhaps 60% of the dry season grazing in the Mara Area (Huish and Campbell, 1990). The long-term average proportion of dry season grazing provided by the Mara Area is therefore taken as 50%. The numbers of wildebeest (*N*) lost from the equilibrium population (*Pop*) by developing any part (a) of the Mara Area (A) is accordingly given by

$$N = Pop\ (\mathrm{a} \times 0.5 / A)$$

The MMNR and the Group Ranches hold many other animals and habitats as well as the wildebeest. However, the wildebeest can be considered here to be a flagship species, in that by conserving their dry season range these other wildlife and habitats will be conserved as well.

Opportunity costs to land (Table 4.4). To the GOK, as to the Maasai on the Group Ranches, the opportunity cost of not developing their land for the sake of conservation is the potential net returns from full development. These opportunity costs have been recalculated for each of the three sub-divisions with the same two-step procedure (1) as described above, by multiplying the Ha_z in each sub-division by the NR_z.

Benefits (Table 4.5–4.9). The benefits from conservation are classified here as local, domestic and global to highlight the policy implications of these different scales of benefits and the possible market failures associated with each. They represent benefits to Kenya and to the Kenyan wildlife managers rather than benefits to the Maasai landowners, for the essence of this CBA is the conflict between the benefits to society and the world on the one hand and the private opportunity costs of traditional land users on the other.

In this analysis, the local benefits (Table 4.5) are considered to be those deriving solely from the gross revenues from tourism (Table 4.5a) which amount to $20 million in the MMNR and $10 million on the Group Ranches, apportioned $4.7 million and $5.3 million between the inner and outer ranches, respectively (Douglas Hamilton, 1988). These gross revenues cannot be used directly in the CBA for what is needed are the net economic returns from tourism, in other words the gross revenues less the costs to Kenya of earning those revenues. Estimates of net economic returns from eco-tourism in Kenya range from 24–40% of gross revenues (Norton-Griffiths, 1994b), so the average of 32% is used here to estimate the net local benefits from tourism (Table 4.5b).

Domestic benefits (Table 4.6) reflect all the other benefits that accrue domestically to

Kenya from biodiversity conservation in the Mara Area. They include net benefits from forestry, from watershed services (erosion and flood control), from the potential value of as yet undiscovered pharmaceutical products, from the potential consumer surplus of wildlife tourists (Moran, 1994), and existence values as manifested by the direct support to biodiversity conservation in Kenya from the international community. A mean value of $20.03 per hectare for all net domestic benefits was derived from a stochastic simulation model of biodiversity values in Kenya (Norton-Griffiths, 1994b). This mean value was applied to each sub-division in turn. Total domestic benefits (Table 4.7a) therefore represent all the direct net benefits to Kenya from conservation in the Mara Area.

The global benefits (Table 4.8) represent the benefits to the rest of the world, that is benefits accruing not to Kenya but outside of Kenya, generated from biodiversity conservation in the Mara Area. They include consumer surplus from tourism, existence and option values, and the values of carbon sequestration. A stochastic simulation model of biodiversity values in Kenya (Norton-Griffiths, 1994b) generated a mean value of $120 per hectare for these global benefits, which was applied in turn to each sub-division. Total benefits (Table 4.9a) show all benefits derived from conservation in the Mara Area – local, domestic and global.

Cost effectiveness of meeting the opportunity costs to land

The cost effectiveness (*CE*) decision rule (2) compares the net benefits from conservation with the opportunity costs to the land. The total annual benefits from biodiversity conservation in the Mara Area (Table 4.9a) amount to some $93 million compared to annual opportunity costs of $36 million (Table 4.4), giving a cost effectiveness (*CE*) ratio of 1:2.6. Clearly, conservation in the Mara Area is socially profitable to Kenya and to the world at large: but a closer examination reveals a more complex and interesting situation.

If we look first at the Maasai Mara National Reserve itself, it is clearly not in the least socially profitable on the basis of local (tourist) benefits alone: the MMNR contains land of excellent agricultural potential, so the opportunity costs to land of $8.13 million are significantly higher than the net tourist benefits of $6.40 million, giving a *CE* ratio of 0.79. However, when all the domestic benefits of conservation are included ($9.14 million), the *CE* ratio becomes 1.13. The net benefits to Kenya from keeping the MMNR under conservation are therefore greater than the opportunity costs to the land. The picture improves dramatically when global values are taken into account: the world gains $16.4 million annually from conserving the MMNR.

The inner Group Ranches show a similar picture. Even though the opportunity costs to land are much lower, so too are net tourist benefits, giving a *CE* ratio of 0.49. However, when domestic benefits are taken into account the inner Group Ranches are clearly socially profitable, with a *CE* ratio of 1.58. As with the MMNR, the global benefits from conservation on the inner Group Ranches are larger still. In contrast, the outer Group Ranches are problematic. They are of such high agricultural potential that it is only socially profitable to Kenya to conserve them when global biodiversity values are taken into account.

The CBA shows that the net returns from tourism alone are clearly inadequate to justify conservation in the MMNR or on any of the Group Ranches. However, when all domestic benefits from conservation are taken into account the CBA suggests that it would be socially profitable for Kenya to conserve both the MMNR and the inner Group Ranches, and to meet the opportunity costs of the Maasai on the inner Group Ranches for not developing their land any further. The CBA would accordingly support a policy decision to maintain both the Maasai Mara National Reserve and the inner Group Ranches for conservation. In contrast, it is clearly not socially profitable for Kenya to prevent the development of the high potential land on the outer Group Ranches for the sake of conservation, unless of course some mechanism can be devised through which Kenya can realize the significant global benefits associated with these areas.

An effective economic policy instrument

Any actual transfer to make the Maasai indifferent to the conservation:development choice would be based on their net opportunity costs, namely the difference between opportunity costs (Table 4.4) and current net revenues (Table 4.10). Current net revenues for the inner and outer Group Ranches were derived from the current land uses (Table 2, C) on each as reported by Norton-Griffiths (1995). The annual net transfers (Table 4.11) would therefore amount to $2.5 million on the inner Group Ranches and $24.3 million on the outer Group Ranches.

It is only relevant to discuss here the broad characteristics of an effective policy instrument. The principle is that a transfer of $2.5 million each year should be paid directly to the Maasai of the inner Group Ranches as compensation for not developing their land any further: in return, the Maasai would continue to live on their land and follow their traditional livestock culture, but they must transfer the development rights to their land back to the state – or to some conservation organization acting on behalf of the state.

An effective economic instrument might therefore consist of a lump sum payment and an annual incentive payment. The lump sum payment would represent the once-and-for-all transfer of the development rights of the inner Group Ranches, and could be based on an agreed proportion of the net present value of the annual compensation payment: for example, a lump sum payment of $20 million would represent the net present value of $1 million per year (out of the $2.5 million) at a 5% rate of discount. This capital sum could be raised from the national exchequer, or from the donor and conservation NGO community.[9] In contrast, an annual incentive payment of the remaining $1.5 million would maintain the active cooperation of the Maasai in conservation and tourism and would provide incentives to them to become more involved in the commercialization of eco-tourism on their land. If it were tied to the numbers of tourists visiting the Mara Area and/or to those visiting the inner Group Ranches it would represent a modest increase of $5 to the current daily visitor fee of $20.

Optimal size of protected area and wildebeest population

The previous CBA was based on the total costs and benefits in each area and so says nothing about the optimal size of area to be protected or the optimal number of wildebeest to be conserved. The question now is: given that the State will fully compensate the Maasai for not developing their land, what is the optimum area of land for the State to conserve? This requires an analysis of the marginal costs and benefits to the state from conserving land, which can be derived (in principle) from the data in Table 4.

First however we must release the constraint on the property rights and assume they are

[9]While it is clear from Table 4 that the payment of $2.5 million compensation to the Maasai produces clear global benefits of $20 million, the project would *not* necessarily qualify for GEF funding since the incremental cost of $2.5 million is significantly less than the incremental domestic benefits of $4.8 million.

both divisible and transferable. Second, we must impose a spatial constraint to the 'with' and 'without' conservation scenario. The conservation scenario can be implemented only in the order of conserve the MMNR first, followed by the inner and then the outer Group Ranches (Fig. 1). In contrast, the development (without conservation) scenario can be implemented only in the reverse of outer Group Ranches first, then the inner Group Ranches, and finally the MMNR itself.

The conservation scenario – the optimal size of protected area

Table 5 shows the average costs and benefits for each additional square kilometre conserved in the Mara Area. Table 5.1 shows the square kilometres conserved in each sub-area and Table 5.2 the cumulative square kilometres conserved under the conservation scenario. Referring next to Table 5.3, 5.6, 5.9 and 5.12, and using the opportunity costs to land as an example, for each area in turn ($A = 1, 2$ or 3) the average opportunity costs are given by:

$$\text{Average costs} = \sum_{a=1}^{A} \text{Opportunity costs} \Big/ \sum_{a=1}^{A} \text{Area conserved}$$

The average cost (AC) curve (Table 5.5) is clearly quadratic, and a quadratic solution gives:

Table 5. Average costs and benefits of conserved land

	From table	(1) MMNR	(2) Inner group ranches	(3) Outer group ranches
(1) Square kilometres conserved	4.1	1368	1665	2901
(2) Cumulative square kilometres		1368	3033	5934
(3) Opportunity cost to land (OCL)	4.4	8.127	3.069	25.036
(4) Cumulative opportunity cost to land ($ million)		8.127	11.196	36.232
(5) Average OCL ($ million) per km^2 (4/2)		5941	3691	6106
(6) Net revenues from tourism (NRT)	4.5	6.400	1.504	1.696
(7) Cumulative net revenues from tourism		6.400	7.904	9.600
(8) Average NRT ($) per km^2 (7/2)		4678	2606	1618
(9) Domestic benefits (DB) ($ million)	4.7	9.140	4.839	7.507
(10) Cumulative domestic benefits ($ million)		9.140	13.979	21.486
(11) Average DB ($ million) per km^2 (10/2)		6681	4609	3621
(12) Global benefits (GB) ($ million)	4.9	25.556	24.819	42.319
(13) Cumulative global benefits ($ million)		25.556	50.375	92.694
(14) Average GB ($) per km^2 (13/2)		18681	16609	15621

$$AC = \alpha + \beta X + \gamma X^2 \tag{3}$$

where X is the area conserved. From (3) a total cost curve (TC) is derived by multiplying through by X:

$$TC = \alpha X + \beta X^2 + \gamma X^3$$

and, by differentiation, a marginal cost (MC) curve:

$$MC = \delta TC/\delta X = \alpha + 2\beta X + 3\gamma X^2 \tag{4}$$

In contrast, the average benefit (AB) curves (Table 5.8, 5.11 and 5.14) are clearly linear, so:

$$AB = \alpha + \beta X \tag{5}$$

where X again is the area conserved. Multiplying through by X gives total benefit (TB) curves:

$$TB = \alpha X + \beta X^2$$

and by differentiation the marginal benefit (MB) curves

$$MB = \delta TB/\delta X = \alpha + 2\beta X \tag{6}$$

The marginal cost curve (Fig. 2) shows the point solutions for the MMNR, inner and outer Group Ranches. Marginal costs decrease sharply when the land of poor agricultural potential on the inner Group Ranches is included, but rise steeply again in the face of the high potential land of the outer Group Ranches. In contrast, the marginal benefit curves all decrease with land area due to the lower tourism potential of the outer Group Ranches.

Conserving the MMNR on its own is clearly sub-optimal, with marginal costs considerably less than even the marginal local benefits. The solution to Equations 4 and 6 for local tourist benefits is 2800 km² which, as would be expected from the CBA, is less than

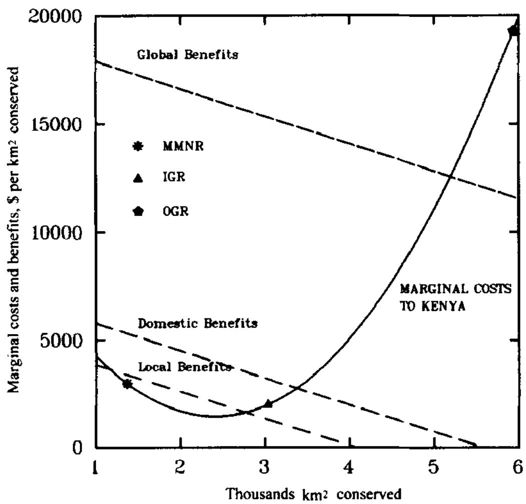

Figure 2. Optimum size of protected area.

the combined areas of the MMNR and the inner Group Ranches (3033 km^2). Solution of Equations 4 and 6 for domestic benefits gives 3400 km^2 as the optimal area which would take in some 370 km^2 of the outer Group Ranches, while the solution for global benefits yields 5200 km^2 which would take in some 75% of the outer Group Ranches.

The conservation scenario – the optimal size of the equilibrium wildebeest population

The average costs and benefits for each additional wildebeest conserved (Table 6 and Figure 3) were derived from Table 4 in exactly the same way as for Equations 3–6 only using wildebeest as the numeraire. Also shown are the point solutions equivalent to the areas of the MMNR, the inner and outer Group Ranches. Solving Equations 4 and 6 for local benefits gives an equilibrium population of wildebeest of 1.11 million animals, which increases to 1.19 million and 1.41 million, respectively, when domestic and global benefits are taken into account.

In this specific analysis, the marginal costs of conserving wildebeest are derived from the opportunity costs of the land required to conserve a wildebeest population of a given size, while the marginal benefits (local, domestic and global) of each successive wildebeest conserved are derived from the benefits accruing to the additional land needed to conserve that extra wildebeest. This approach may well provide a general solution to the problem of estimating marginal costs and benefits of individual or flagship species, and appears to be a more straightforward approach than some used elsewhere (e.g. Montgomery *et al.*, 1994).

Discussion

This analysis clearly requires a much finer spatial resolution than the three contiguous land areas used here.[10] Nonetheless, the problem of finding a socially optimum area to conserve, or a socially optimum population to conserve, is clearly tractable and open to straightforward solution. Furthermore, differentiating between the opportunity costs of land to society as opposed to land owners and users, and itemizing local, versus domestic and global benefits clearly strengthens the analysis and would allow, for example, the full extent of the various market failures to be calculated. More land and more wildebeest are conserved when global versus domestic versus local benefits are taken into account.

It is clear that when all the domestic benefits to Kenya from biodiversity conservation are considered, the optimal area to conserve (and therefore in this analysis the optimal number of wildebeest) includes both the Maasai Mara National Reserve, the inner Group Ranches and some 370 km^2 of the outer Group Ranches. It is, however, quite unlikely to be worth the while of the KWS to pursue this policy option, given the potentially high transaction costs associated with the complexity of Maasai property rights and the difficulties of subdividing Group Ranches.

Conserving the optimum area to capture full global benefits is much more problematical, and depends ultimately on how the Government of Kenya views its responsibilities to global environmental welfare and whether it considers it could ever capture some or all of these global values. Optimising on global benefits (5200 km^2) requires an incremental area of 1800 km^2 over the optimum for domestic benefits (3400 km^2), all on the outer Group Ranches. This would cost the GOK a further $16 million

[10]Using standard geographical information system (GIS) technology, it would be possible to divide the Mara Area into contiguous blocks, for example into 5 × 5 km UTM grid cells, and calculate opportunity costs and benefits within each. The 'with conservation' model would then entail an expanding perimeter of contiguous grid cells from the inner core of the MMNR.

Table 6. Average costs and benefits of conserved wildebeest

	From table	(1) MMNR	(2) Inner group ranches	(3) Outer group ranches
(1) Wildebeest (wld) conserved (millions)	4.3	0.173	0.21	0.367
(2) Cumulative wildebeest (millions)		0.173	0.383	0.750
(3) Cumulative opportunity cost to land ($ million)	5.4	8.127	11.196	36.232
(4) Average OCL ($) per wildebeest (3/2)		47	29	48
(5) Cumulative net revenues from tourism ($ million)	5.7	6.400	7.904	9.600
(6) Average NRT ($) per wildebeest (5/2)		37	21	13
(7) Cumulative domestic benefits ($ million)	5.10	9.140	13.979	21.486
(8) Average DB ($) per wildebeest (7/2)		53	37	29
(9) Cumulative global benefits ($ million)	5.13	25.556	50.375	92.694
(10) Average GB ($) per wildebeest (9/2)		148	132	124

annually in compensation payments (from Table 5.3) to secure incremental domestic benefits of $5 million (Table 5.9) and global benefits of $26 million (Table 5.12). Technically this would qualify for funding under GEF rules for the 'incremental' domestic costs of $19 million produce net incremental global benefits of $21 million ($26–$5

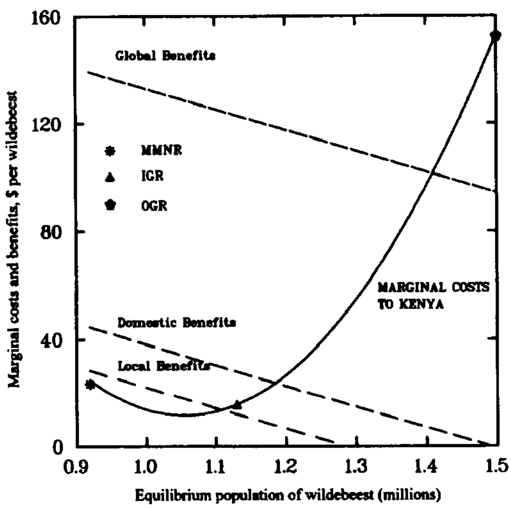

Figure 3. Optimum wildebeest population.

million). However, the cost effectiveness ratio of 1:1.1 might not be particularly attractive, neither is the GEF structured to provide streams of payments in perpetuity (Norton-Griffiths and Southey, 1995; Norton-Griffiths, 1995).

Discussion

Central to this discussion of conservation versus development are the nature of the property rights and the nature of the externalities. Both the Government of Kenya and the Maasai have clear, legal and enforceable rights to the benefit streams from their land, the GOK to the MMNR and the Maasai to their Group Ranches. The Government of Kenya produces conservation on its land and, to some extent, on the Maasai's land as well. To the *consumers* of conservation, namely the international community of eco-tourists and the vast array of users of the global commons, these actions of the Government of Kenya are perceived as a public good. In contrast, conservation is perceived to be a *public bad* by the Maasai, for both its production and its consumption greatly increases their costs of production and hinders their development.

The dilemma facing the GOK and the international conservation community is that if they wish to maintain the conservation values of the Group Ranches then the land must be kept at a relatively undeveloped state. However, like other Kenyan pastoralists and like other traditional users and owners of land elsewhere in the world, the Maasai are comparatively poor: their one asset is their land, and their main route to political, economic and social progress is to profit from its potential for development, be it for tourism, for the consumptive utilization of wildlife, for agriculture or whatever.

Given that tourism and wildlife use are broadly compatible with conservation aims and values, then there are all sorts of possibilities to involve the Maasai more in the tourist and wildlife utilization industries so that the rents received by them for the use of their land become significantly larger. But the potential rents from development will always be larger still, even on the more marginal areas of the Group Ranches, so the Maasai will always be able to 'do better' by taking the development option.

Governments have two standard policy responses to this situation, both of which are at the ultimate expense of the traditional users and owners of the land. First, they can simply alienate the development rights and declare the land to be 'development free' or 'conservation areas'; second, they can tax development in some way so that the developer would meet the full social costs (in terms of lost biodiversity benefits) of developing their land.

The potential political fallout in Kenya from either of these policy responses would be very severe. First, while the concept of zoning or development restrictions on land is widely accepted in the developed world (and that a landowner cannot always build what and where he wills, or remove trees and woodlands to plant crops), the situation is quite different in developing countries, especially with traditional owners and users of land. In Kenya there is very little zoning of land outside urban and industrial conurbations and there are at present no easements of any kind on the Maasai property rights.

Second, the cost benefit analysis shows clearly that (1) the Government of Kenya is providing conservation far too cheaply to the consumers of conservation; that (2) it is the Maasai who are providing the hidden subsidies; and that (3) it is socially profitable for the Government of Kenya, or for international conservation organizations, to meet in full the potential development benefits of the Maasai's land.

The transfers (tax or compensation) are the same, but who should transfer what and to whom? It is manifestly clear that it is the consumers of conservation, who up to now have been getting their conservation far too cheaply, who should meet the full opportunity costs of the Maasai. It would be a gross abuse, and neither equitable nor sustainable, to deny to the Maasai the potential benefits of their land and to condemn them in the name of biodiversity conservation to a perpetual poverty trap.

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