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# The opportunity costs of biodiversity conservation in Kenya

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**Abstract**

This paper estimates the opportunity costs of biodiversity conservation in Kenya from the potential net returns of agricultural and livestock production, and compares them with the net returns from tourism, forestry and other conservation activities. At the national level, agricultural and livestock production in the parks, reserves and forests of Kenya could support 4.2 million Kenyans and generate gross annual revenues of $565m and net returns of $203m. These forgone net returns of $203m, some 2.8°0 of GDP, represent the opportunity cost to Kenya of biodiversity conservation. The current combined net revenues of $42m from wildlife tourism and forestry are quite inadequate to cover these opportunity costs to land.

The government of Kenya is clearly subsidising conservation activities whose chief values are all indirect and external to Kenya. and their ability to continue doing so will be a function of growth and modernisation in the Kenyan economy. Dependency on land will increase if the economy stagnates and rural populations continue to grow. and while the government of today may not consider degazetting parks and reserves, the situation could be quite different in 25 years when rural populations have doubled yet again. In contrast, dependency on land will fall only once the economy grows and modernises and rural populations arc drawn off the land and into industrial and service sectors.

Given the global nature of the benefits from Kenya's conservation efforts, it is quite inappropriate that so much of the cost is born by Kenya. The present scale of subsidies should instead form the basis for international negotiations to transfer funds to meet all or part of them. At present the global environment facility (GEF) is the only operational programme through which such contributions can be channelled to meet the incremental costs of biodiversity conservation, but situations such as the one described here for Kenya were never envisaged when the GEF was designed. If the developed world expects a country like Kenya to maintain conservation estate on its behalf, then it must be prepared to contribute substantially towards these costs until such time as Kenya can afford to carry the burden itself.

*Keywords:* Biodiversity conservation; GEF; Incremental costs; Opportunity costs

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## 1. Introduction

The economic arguments supporting biodiversity conservation in national parks, reserves and forests are well known and are widely publicised (Dixon and Sherman, 1990; McNeely et al., 1990; Panayotou, 1990; Pearce, 1990; Braetz, 1992; Brown and Wyckoff-Baird, 1992; McNeely, 1993; Pearce et al., 1993). Authors distinguish carefully between use and non-use values. Use values can include the direct values from eco-tourism (Lindberg, 1991; Kiss, 1992) and from the yields of timber and non-timber products, and the indirect values flowing from the immediate or future benefits of nutrient recycling, watershed and erosion protection, biodiversity and carbon sequestration. In contrast, non-use values are concerned more with existence, cultural and aesthetic values. Panayotou (1992) also distinguishes between internal, external and global values. Internal values are represented by rents that can be realised, however inefficiently, by the owners of the resource (typically the national governments). External values, such as the off-site value of erosion and watershed protection, are more difficult to cost and to realise, while global values (typically impacts on regional climate patterns through maintenance of vegetative cover, and impacts on global warming through carbon sequestration) are particularly difficult either to quantify or to realise.

In contrast to the extensive research into the values, costs and benefits of biodiversity conservation, their opportunity costs have received much less attention although they are acknowledged to be important (Dixon and Sherman, 1990; Pearce et al., 1993; Panayotou, 1994). Yet the economic case for conservation could be compromised if these opportunity costs are not fully considered when calculating total economic values. This paper examines opportunity costs at the national level and compares opportunity costs to the net benefits of conservation activities.

Biodiversity conservation is a matter of development, and the essential characteristic of state lands set aside in parks, reserves and forests (PRF land) for biodiversity conservation is that the land remains undeveloped. This carries an opportunity cost, in that the value of other economic activities are forgone. In Kenya, land in the parks and reserves is used mainly for wildlife-based tourism and forest land is used mainly for forestry and for gathering non-timber forest products. In contrast, land not set aside for parks, reserves and forests (non-PRF land) is used for settlement, agriculture and livestock. We therefore use the net returns from agricultural and livestock production on non-PRF land to estimate the opportunity costs of leaving the parks, reserves and forests of Kenya undeveloped.

## 2. Scope of the analysis

We adopt here an essentially financial and partial equilibrium approach for a single year (1989) in which we compare opportunity costs with net benefits from tourism and forestry. In more formal terms, within the parks, reserves and forests of Kenya we define the net benefits (NB) of biodiversity conservation to be:-

$$NB_{Conservation} = NB_{Direct\ Use} + NB_{Indirect\ Use} + NB_{Non\ Use} - OC_{Conservation}$$

where the direct uses are tourism and forestry; the indirect uses could be soil and watershed protection, pharmaceuticals and carbon sequestration; the non uses represent such things as existence values; and $OC_{Conservation}$ represents the opportunity costs from setting the PRF land aside for conservation.

Our data have sufficient detail to address only the net benefits from direct uses, and the opportunity costs for a single base year of 1989. We assume the net benefits from tourism and forestry to be equivalent to their net returns (NR), which we estimate as the difference between their gross revenues (GR) and costs (C). Thus

$$NB_{Tourism} = NR_{Tourism} = GR_{Tourism} - C_{Tourism}$$

and

$$NB_{Forestry} = NR_{Forestry} = GR_{Forestry} - C_{Forestry}$$

Similarly, we define the opportunity costs of biodiversity conservation ($OC_{Conservation}$) to be equivalent to the net benefits from the forgone potential agricultural and livestock production ("potential development") within the PRF lands of Kenya. Following the same idiom as above

$$OC_{Conservation} = NB_{Potential\ Development}$$

and

$$NB_{Potential\ Development} = NR_{Potential\ Development} = GR_{Potential\ Development} - C_{Potential\ Development}$$

## 3. The national opportunity costs of biodiversity conservation

### *3.1. Net returns from agricultural and livestock production in Kenya*

The value of agricultural and livestock production, in terms of gross revenues, costs and net returns to landowners, is very much a function of land potential: land with good soils and rainfall will produce more than will drier lands with poor soils. Short and Gitu (1990) divide Kenya into six land potential zones on the basis of elevation, rainfall and temperature - each of which affects crop and livestock production. They consolidated these six zones (Table 1) from the 49 agro-ecological zones identified earlier by Jaetzold and Schmidt (1982). The six zones represent the dominant climatic gradients within Kenya, from per-humid to arid, with decreasing elevations and rainfalls and increasing ambient temperatures.

**Table 1**
**Environmental characteristics of the land potential zones**

| Zone | Elevation (m) | Rainfall (mm) | Temp ($^0$C) | Slope (%) |
|---|---|---|---|---|
| 1: Per humid | 2500 | > 2000 | < 15 | 9 |
| 2: Humid | 1700 | 1600 | 15-21 | 5 |
| 3: Sub-humid | 1400 | 1400 | 21-24 | 3 |
| 4: Transitional | 1100 | 700 | 21-24 | 2 |
| 5: Semi-arid | 700 | 600 | 24-31 | 2 |
| 6: Arid | < 700 | 400 | > 31 | 1 |

Short and Gitu (1990) also calculate the area of each land potential zone within the 515 450 km2 of land that is potentially available for use for settlement, agriculture and livestock (Table 2). We derive net returns from agricultural and livestock production within each zone from (i) the areas of individual crops and the densities of livestock and (ii) the revenues and costs from individual crop and livestock production activities (full details are given in Norton-Griffiths and Southey (1993), annex 1).

**Table 2**
**Areas ($km^2$) of land potential zones in the parks, reserves and gazetted forests of Kenya**

| Zone | Total land area | Parks and reserves | Gazetted Forests | Available for use and cultivation cultivation |
|---|---|---|---|---|
| Zone 1 | 2240 | 350 | 1,210 | 680 |
| Zone 2 | 22,290 | 1,030 | 2,050 | 19,210 |
| Zone 3 | 70,440 | 1,980 | 6,170 | 62,290 |
| Zone 4 | 94,860 | 9,500 | 1,630 | 83,730 |
| Zone 5 | 163,050 | 23,590 | 6,520 | 132,940 |
| Zone 6 | 223,190 | 4,970 | 1,620 | 216,600 |
| Totals | 576,070 | 41,420 | 19,200 | 515,450 |

**Table 3**
**Land use in each land potential zone**

| Zone | Area (km2) | Cultivation (ha/km2) | % cash crops | Population (No./km2) | Livestock (No. km2) |
|---|---|---|---|---|---|
| 1: Per humid | 680 | 17.1 | 25% | 29.8 | 33.8 |
| 2: High | 19,210 | 49.9 | 45% | 314.0 | 146.5 |
| 3: Medium | 62,290 | 36.6 | 38% | 187.2 | 122.6 |
| 4: Arable | 83,730 | 20.7 | 23% | 58.5 | 128.7 |
| 5: Ranching | 132,940 | 2.9 | 46% | 17.9 | 90.7 |
| 6: Pastoral | 216,600 | 0.0 | - | 3.7 | 22.9 |

Land use surveys dating from 1981-1986 (EcoSystems, 1987) give the hectares of individual crops within each zone, classified by management (e.g., commercial versus smallholder). The data come from aerial point sampling (Norton-Griffiths, 1988) and are strictly comparable within and between zones (Table 3). Livestock data from these same surveys have been augmented from Bekure et al. (1991) for zone 5 and from EcoSystems (1985) for zone 6. Livestock are classified by type (grade cattle, indigenous cattle and smallstock) and by management (stall fed, open grazing and ranching). Human population data (at sub-location level) originate from the 1979 census of Kenya and were adjusted to the 1989 base year by an annual growth factor of 1.035% per annum. All data are integrated spatially by standard GIS (geographic information system) procedures.

Farm level budgets, based on the policy analysis matrix (PAM) approach of Monke and Pearson (1989), give the revenues, costs and returns from individual crop and livestock production activities. The Policy Analysis for Rural Development programme in Kenya (PARD, 1991; Sellen, 1991) has interviewed a cross section of smallholder and commercial farmers in seven districts, concentrating always on the dominant agro-ecological conditions and the dominant crop and livestock production systems. Each PAM budget can be assigned to a specific land potential zone, and each may represent the average of thirty or more farmer interviews.

The PAM budgets itemise total revenues and total costs on a unit area basis. Revenues include the value of a crop and its residues at the prevailing district prices or, if relevant, at the prevailing national prices (e.g., for estate grown crops). Costs identify all fixed and intermediate inputs, and include all direct and indirect costs as well as marketing costs and the opportunity costs of working capital. Costs are also based on the conditions prevailing in a district at the time of the survey. Family labour, for example, is valued at its opportunity cost - namely, the local unskilled wage. For livestock production activities, PAM budgets were available from zones 1-4 for zero, semi-zero and extensive grazing, and data from Bekure and Chabari (1991) were used for ranching and pastoral management in the lower potential zones 5 and 6.

**Table 4**
**Gross revenues and net returns from agricultural and livestock production within land potential zones, 1989 base year ($/ha/yr)[(a)]**

| Zone | Gross revenues | Net returns |
|---|---|---|
| Zone 1: Per humid | 118.4 | 38.3 |
| Zone 2: High potential | 411.7 | 150.7 |
| Zone 3: Medium potential | 232.0 | 90.7 |
| Zone 4: Arable | 149.4 | 54.2 |
| Zone 5: Ranching | *21.2* | 5.3 |
| Zone 6: Pastoral | 1.6 | 0.6 |

[(a)] 1989 KSh converted at $1 = KSh 20.6

Private profits to the landowner are given in the PAM budgets as total revenues less total costs. These profits are not strictly net since they leave out the cost of land so they show returns to land rather than returns to capital. We in turn calculate the gross revenues and net returns for all crop and livestock activities within each zone by multiplying the crop hectares and livestock densities by the relevant PAM budgets. This gives the average gross revenues and net returns across the whole area of each zone, not the values for each cultivated hectare.

Revenues and returns (Table 4) are meager in zone 1 where the high elevations and low temperatures restrict land use mainly to forest use with little cultivation. Zone 2 is the land of highest potential, holding most of the estate and smallholder tea and coffee and the highest densities of rural populations and livestock. Almost half the crops are cash crops, and revenues and returns average a substantial $412 and $151 per hectare per year. Intense smallholder cultivation and cash cropping is also found throughout zone 3 (most crop production in Kenya takes place within these two zones) where revenues and returns remain high. Zone 4 is more marginal for cropping with fewer cash crops and more modest revenues and more modest revenues and returns, whereas zone 5 is generally unsuitable for agriculture, though suitable for ranching. Zone 6 represents the vast arid rangelands suitable only for pastoral livestock production.

It should be noted that our aggregated estimates for gross revenues and net returns are deficient in three important respects. First, no reliable data are available for small animal production (chickens, rabbits, geese, pigs), which is known to be important at the level of the smallholder farm. Second, it proved simply not feasible to develop a supportable function for double cropping across all zones: depending upon the crop, double cropping usually occurs in zone 2, often in zone 3 and sometimes in zone 4. Third, we were unable to generate supportable figures in each zone for the net returns from non-crop, woody resources such as communal bush and tree cover, and managed (i.e., private) windrows, shade trees, hedgerows and woodlots. Accordingly, our aggregated gross revenues and net returns are undoubtedly underestimated.

### *3.2. The opportunity costs of parks, reserves and forests* ($OC_{Conservation}$)

We define the opportunity costs to Kenya of setting land aside for parks, reserves and forests to be the net benefits that might have been generated from agricultural and livestock production had this land been developed just like other land in Kenya. In turn, we equate these net benefits to the net revenues from such activities. Short and Gitu (1990) give the areas of each land potential zone within the 41420 $km^2$ of PRF land in Kenya (Table 2). We calculate the opportunity costs by multiplying these areas by the average net returns for each zone (Table 4). We also calculate the potential gross revenues for the PRF land (from Table 4); and the potential human population, livestock population and hectares under cultivation (from the average densities in each zone, Table 3). This procedure matches exactly the ecological potentials of the PRF and non-PRF land. Strictly speaking, we are estimating the numbers of people, livestock, hectares of cultivation, gross revenues and net returns on a same area of land with exactly similar agricultural potential, only outside the parks, reserves and forests.

**Table 5**
**Potential population, gross revenues and net returns from parks, reserves and forests if converted to agricultural and livestock production, 1989 base year**

| | Forests | Parks and reserves | Total |
|---|---|---|---|
| Area ($km^2$) | 19,200 | 41,420 | 60,600 |
| Population | 2.1m | 2.1m | 4.2m |
| Livestock | 19m | 3.9m | 5.8m |
| Cultivated Hectares | 0.4m | 0.4m | 0.8m |
| Gross Revenues | $280m | $285m | $565m |
| Net Returns | $104m | $99m | $203m |

Potentially, the parks, reserves and forests of Kenya could support 4.2 million Kenyans, 5.8 million livestock and 0.8 million hectares of cultivation, and generate gross revenues of $565m and net returns of $203m (Table 5). These forgone net returns of $203m, some 2.8% of GDP, represent the opportunity cost to Kenya of maintaining the network of PRF land for biodiversity conservation.

We are assuming for the purposes of argument that gross revenues and net returns would be unchanged if the PRF land were indeed released to agricultural development, for in theory, the provision of more land should drive down rents. We ignore this for the moment on two grounds. First, the process of conversion would be gradual rather than epochal. Second, rural populations are expected to continue growing at 2.5% each year so additional land will not necessarily increase the land/labour ratio for very long. Indeed, in the very short term the reverse is more likely and land rents will rise (e.g., maintaining demand by releasing land at less than the rate of increase of the rural population). This is particularly so as technical change takes place. Furthermore, there is evidence that rural Kenyans are quite fully employed (Lewis, 1991) so even the number of jobs created by the conversion of PRF land to agriculture could be far higher than those lost from the tourism and forestry industries.

## 4. Net benefits from direct uses ($NB_{Direct\ Use}$)

### *4.1. Tourism*

Tourism generated some $419m in 1989 (GOK, 1992) and the typical overseas visitor came to Kenya for about 14 days, spent 6.1 nights in a coastal hotel, 1.9 nights in a Nairobi hotel, 1.1 nights in a gamepark and 4.9 nights elsewhere (Sinclair, 1990; Southey, 1992). To some extent tourism in Kenya is a composite good, but for this analysis we isolate the gamepark or eco-tourism component of it and derive gross revenues and net returns specifically for the sub-sector.

There was a fall in the number of visitors to Kenya between 1973 and 1983, and the very modest growth in hotel usage was due only to longer stays (Southy, 1992). Tourism only really took off in 1983, but with very different sectoral growth rates. Park usage achieved a high, if erratic, 12% annual growth up to 1990, and its share of bednights increased to 11.2%. To a significant extent the lodge growth was at the expense of Nairobi tourism which had low or even negative growth rates throughout the 1980s, though recovering recently. By contrast, coastal growth rates were very high in the late 1970s and early 1980s, declined rapidly to negative numbers in 1983, but then recovered dramatically after 1990. By 1989, 61% of all non-resident hotel usage was spent at the coast and only 12% inside gameparks. Even allowing for the time spent in Nairobi by game safari visitors, the coastal trade dominated the hotel business by a factor of 4 or 5.

These significantly divergent growth patterns suggest that the different kinds of tourism may be quite weakly interconnected and the high degree of specialization by nationality of tourist also argues for low interdependence. Europeans (67% of visitors) spend 80% of their bed-nights at the coast and 10% in gameparks, while North Americans (12% of visitors) spend 30% equally in gameparks and at the coast. Sinclair (1990) suggests that 26% of tourism is directly due to wildlife and a further 27% is indirectly due to it, while Southey (1992) concluded that by 1990 some 27% of the coastal trade was a derivative of the gamepark trade whereas 28% of the gamepark trade was a derivative of the coastal trade. Tourism might therefore decrease by as little as 29% if there were no parks (or even less since private wildlife sanctuaries and the marine parks could still meet some of the demand), but by as much as 67% if there were no coast (Southey, 1992).

While the presumption that gameparks drive the tourist trade in Kenya is accordingly quite suspect, clearly there remains some linkage between the sub-sectors. We have therefore used a somewhat conservative estimate of 50% as the proportion of tourist revenues directly attributable to the wildlife parks and reserves.

### *4.2. Net returns from tourism ($NR_{Tourism}$)*

Recent data on the profitability of tourism are scarce, so we have used the data collected by the Economist Intelligence Unit (EIU) in 1977 for their study of tourist pricing (EIU, 1979). It is likely that many of these 1977 figures on revenues and costs are of the same general order of magnitude as today, after allowing for inflation and changes in foreign exchange rates, since much of the relevant data refers to relative prices and costs for a unit of output.

The EIU study found a foreign exchange retention rate of 82.4% and operating surpluses in the private sector of some 10% of retained earnings. In the public sector, revenues came from hotel and entertainment taxes, taxes on fuel, training levies, import duties, park fees, water and electricity charges, etc. The EIU subtracted from these revenues all current expenditures incurred in providing services for visitors (note that most of the services were then, and still are, provided at charges well below costs) to obtain a public sector operating surplus of 15.6% of retained foreign exchange.

These calculated surpluses did not allow for most of the public and private sector capital, and particularly for outlays on buildings and structures. The EIU computed these capital outlays and expressed the surpluses as a percentage of them. This suggested a return on capital of 13%. However, due to the persistent over-valuation of the Kenyan shilling, the EIU advocated adding to the surpluses a 20% premium on net foreign exchange earnings. This added greatly to the net returns to investment in tourism. The overall surplus was raised to 46% of retained earnings which, when expressed as a return to capital, yielded a 21% rate of return.

**Table 6**
**Gross revenues and net returns to the wildlife tourism sector ($m) 1989 base year**

| | |
|---|---|
| Gross revenues from tourism - 1989 | $419.0m |
| Attributed to the wildlife sector - 50% | $209.5m |
| Foreign exchange retention - 82.4% | $173.0m |
| Operating surplus - 30% of retained foreign exchange | $51.9m |
| Gross capital charges (opportunity costs of capital) - 12.5% | $58.2m |
| *Net returns to wildlife tourism sector - no FEP*[a] | ($6.3m) |
| Foreign exchange premium - 20% | $34.6m |
| Net returns to wildlife tourism sector - with FEP | $27.2m |

[a] FEP = foreign exchange premium.
Number between parentheses denotes a negative figure i.e.. a loss

These surpluses must meet foregone profits, risk premiums, real interest charges and depreciation of capital structures, both public and private, which tourists use. Put differently, in calculating returns from tourism allowance must be made for the fact that the capital could have been invested elsewhere, that is, it also has an opportunity cost. (Furthermore, much of the private capital is foreign owned and payments to the owners of foreign capital will not add to the returns earned by Kenya.) Planners estimate for the early 1980s a gross real return to capital (inclusive of depreciation) in the formal sector of the Kenyan economy of 15%. To be more conservative, however, we have set the opportunity cost of capital at 12.5% gross.

Table 6 shows our calculated revenues and returns from the wildlife sector of Kenya's tourism, assuming the same scale of figures that prevailed in 1979. Fifty percent of the gross revenues generated from tourism are attributed to the wildlife sector. We have used a foreign exchange retention rate of 82.6% and combined operating surpluses of 30%. Against these surpluses we assign gross capital charges of 12.5%.

If no allowance is made for a foreign exchange premium (FEP), the net loss to the Kenyan economy from the wildlife component of the tourism sector is $6.3m. In contrast, using a more plausible 20% FEP gives a net gain to the Kenyan economy of $27.2m. This represents 6.4% of the $419m of gross revenues from all tourism.

### *4.3. Relevance of these figures to 1989*

Although tourist bed-nights have risen by 220% since 1977, the constant dollar cost of a one day's visit to a foreigner (using the CPI for the USA) in 1990 was only 42% of what it was in 1977, while the real resources demanded and paid for by each visitor (using the Kenyan GDP deflator) have risen by 54%. The terms of trade have turned hard against Kenya, particularly following the devaluation of the shilling in the early 1980s. Since 1977, trade, hotel and restaurant costs have risen 11% faster than the GDP deflator while the costs of construction have risen by a huge 2.78 times the increase in the GDP deflator. These changes will generally detract from the net gains from tourism. However, much of this loss will already be included in the relatively low real dollar earnings incorporated into the 1989 figure for retained foreign exchange.

Net government real outlay for the Department of Tourism fell 70% from 1977 to 1990. If we include the large hotel and entertainment taxes as revenues attributable to the department, tourism became a net generator of public revenues in 1986 and raised a considerable surplus by 1989 (Southey and Nderitu, 1993). However, unlike the EIU study, this calculation of government surplus does not include public sector losses through providing water, electricity, transport and other services used in tourism, nor does it allow for the large increase in real expenditure that the Kenya Wildlife Service (KWS) is required to make to redress past under-funding (KWS, 1990).

The foreign exchange premium of 20% used in the EIU study is particularly critical to the profitability of tourism and almost doubles the returns on capital. Without the premium, tourism would be a net drain on the economy even if land had no opportunity costs at all. Although dated, the above figures are the best available on the profits from tourism and are certainly of the right order of magnitude.

### *4.4. Forestry*

Firm data on the costs and benefits from forests are even harder to come by. The Kenya Forestry Department (KFD) has had great difficulty in matching the actual royalties collected with those it might expect to receive. Only about 30% of the planned royalty yields are being collected so the department is a major drain on the treasury. Were the royalties collected, it would more than cover the cash flow requirements of the department. Indeed, if the department sold all available timber and collected all the royalties gazetted, it would average over $28.5 million per year as pure profits for the years 1992-1999 (Omwani, 1992). This profit would increase by a further 31% if, besides collecting royalties, large quantities of surplus labour could be redeployed.

In 1989, the total value added contributions of forestry to GDP was $148m (GOK, 1992) of which $57.5m (39%) was in the non-monetary sector. This is primarily gathering fuelwood which the government values at the opportunity cost of labour used (compare with Paddoch and de Jong, 1989; Peters et al., 1989; Godoy and Lubowski, 1992). The monetary sector component amounted to $90.57m in 1989. This incorporates the value of trees felled (including labour and machinery costs for felling trees) and royalties, which are meant to cover re-establishment costs by the forestry department. Also included is the growth in value of standing timber net of any harvesting, an unusual and progressive departure from standard national income accounting procedures.

### *4.5. Net returns from forestry* ($NR_{Forestry}$)

The Forestry Department uses more than three times the labour needed, and when computing re-establishment costs adds only 15% to total labour costs to allow for interest (a huge understatement of real interest costs as poles take thirty years to mature). It then proceeds to collect a fraction of the gazetted royalty (which encourages the wasteful use of timber). The 1992 World Development Report (World Bank, 1992) notes that in the late 1980s logging fees in Kenya were about 12% of the true replacement costs. It is not surprising that the forest department incurred a net loss of $15m (FINNIDA, 1992).

While much of this leakage stems from lax enforcement of rules, exemptions to parastatals, under-reporting of volumes and poor inventory and monitoring, it is also the policy of the Department to keep the price of wood products down and thus prevent imports. This could create benefits downstream to consumers, although in recent years imports of paper products have become necessary so that these consumption benefits are less likely. If managed efficiently, forestry could perhaps generate substantial surpluses after labour, machinery and interest costs. If, for example, the Forestry Department could match the 42-52% profitability of the private sector (World Bank, 1987) just in its pole and pulp operations, and merely break even on all other operations, its annual profits could be $4m.

It is therefore most unlikely that there is any net surplus from this sector, and it is far more likely there is a net loss. Nonetheless, we have used the figure of $14m in Table 7 as a plausible estimate of the returns to forestry lands in Kenya. This figure should include other unquantified benefits such as prices for sawn timber lower than import prices, and surpluses from gathering products such as fuelwood and traditional medicines from gazetted areas.

**Table 7**
**Gross revenues and net returns to the forestry sector ($m)**
**1989 base year**

| | |
|---|---|
| Gross monetary revenues | $90.7m |
| Gross non-monetary revenues | $57.5m |
| Total revenues | $148.2m |
| Estimated profits (maximum) | 10% |
| *Net returns to the forestry sector* | $14.8m |

## 5. Net benefits from indirect and non-uses ($NB_{Indirect\ Uses}$)

Any assessment of the total economic value of formal conservation estate must include estimates of the net benefits from the indirect uses of PRF land (Pearce, 1990; Pearce et al., 1993). We briefly consider here the potential scale of net benefits from indirect uses, through watershed and erosion protection, pharmaceuticals and carbon sequestration (we have no information on possible values of non-uses). Net benefits from these indirect uses are of a very different nature than those from tourism or forestry, in that the benefits stem from not doing something. The benefits relate to differences between the current state and some future state, such as the conversion of the PRF land to agricultural use. Such benefits are difficult to quantify in Kenya because of the paucity of data.

### *5.1. Watershed and erosion protection*

Net benefits from watershed and erosion protection arise from the reduction of on-site and off-site costs. On-site costs are associated with the direct effects of soil erosion and land degradation following conversion to agricultural use. At the local farm level, all financial impacts of runoff and erosion are factored into the PAM crop budgets which account for the costs of land management, terracing and fertilising (green or chemical). Our calculated opportunity costs are therefore largely net of these direct, on-site impacts of runoff and erosion.

Off-site (external) costs are associated with changes at the watershed level in runoff and sediment yields under conservation and under agricultural use, and their impacts downstream. While it is clear that in Kenya both are influenced by land use (Dunne, 1979) and increase greatly following perturbations in land cover (Blackie, 1979; Wolman, 1989; Mortimore, 1991), they stabilise quickly once land use and cover have matured, often to rates very similar to the undisturbed state (Edwards, 1979; and see also Bruijnzeel, 1990). This process is noted even after what many might consider to be cataclysmic events (Collins and Dunne, 1986, 1988). There is accordingly no a priori reason to think that runoff, as expressed in flood hydrographs, for instance, or sediment yields might be radically altered following the conversion of PRF land to agricultural uses.

Nonetheless, we have used Dunne's (1979) equations to indicate the possible scale of change in sediment yields following conversion, treating each land potential zone as an individual watershed with characteristic rainfall and slope relief (Table 1). Although Dunne's land use classes do not correspond easily with those presented here, it is still possible to calculate best and worst cases. We calculate the annual sediment yield for Kenya under existing land uses to be 151 million tonnes (2.62 t $ha^{-1}$ $y^{-1}$): converting all PRF land to agricultural and livestock production might increase sediment yields by between 11m t (7%) and 24m t (16%).

*5.2. Pharmaceuticals*

Net benefits from biodiversity in terms of the value of pharmaceutical discoveries should reflect differences between present biodiversiry values and future values once conversion has taken place (Lugo et al., 1993). There are few data from Kenya with which to work, and other studies suggest that benefits are likely to be both modest and difficult to capture (McNeil and McNeil, 1989; Joyce, 1991; Aylward and Barbier, 1992; Simpson and Sedjo, 1992; WRI, 1993). One recent analysis of tropical rain forests (Pearce et al., 1993) suggests a range in values of between $0.01 and $21 per hectare. Furthermore, Africa is poor in biodiversity compared with South America or Asia, and individual countries are not as distinctive in their flora and fauna. Any market for biodiversity in Africa is therefore quite likely to be competitive and efficient since neighbouring countries will have broadly similar products to offer: competition between countries will tend to drive down prices and minimise national benefits.

*5.3. Carbon sequestration*

The net benefits from carbon sequestered in forests and other undeveloped areas can be expressed in terms of the damage the carbon would do if released into the atmosphere as carbon dioxide following conversion of land, and would reflect the difference between the amount of carbon sequestered under present and future land uses. Panayotou (1992), quoting the analyses of Nordhaus (1991a,b), Schneider (1991) and the World Bank (1991) forest sector policy paper, gives a range of possible values for the carbon sequestered in tropical forests of between $15003500 per hectare per year; while Brown (1992) and Pearce et al. (1993) give values of $320 to $1600 per hectare as the net global costs of converting tropical forests to agricultural use. It is not at all clear how such data can be modified to suit the forests in Kenya's protected areas or how Kenya could ever internalise such a manifestly external and global benefit. However, the scale of the net benefit seems impressive.

## 6. Net benefits of biodiversity conservation

We calculate the net benefits to Kenya of setting land aside in parks, reserves and forests as the summed net benefits from direct uses, indirect uses and non-uses, net of the opportunity costs, namely, the net revenues that the land would generate if it were used in its next best alternative, which we take to be settlement, agriculture and livestock.

Returning to our more formal notation above, within the parks, reserves and forests of Kenya:

$$NB_{\text{Conservation}} = NB_{\text{Direct Use}} + NB_{\text{Indirect Use}} + NB_{\text{Non Use}} - OC_{\text{Conservation}}$$

From Tables 6 and 7

$$NB_{\text{Direct Use}} = NB_{\text{Tourism}} + NB_{\text{Forestry}}$$
$$= \$27m + \$15m = \$42m$$

and from Table 5

$$OC_{Conservation} = NB_{Potential\ Development} = \$203m$$

Given that at the moment we cannot make any realistic estimate of the net benefits from indirect and non-uses,

$$NB_{Conservation} = \$42m + [ NB_{Indirect\ Use} + NB_{Non\ Use}] - \$203m = -\$161m$$

The current benefits of $42m from wildlife tourism and forestry within the parks, reserves and forests of Kenya are completely inadequate to offset the opportunity costs of leaving these lands undeveloped. Overall, Kenya could be forgoing some $161m each year of lost benefits from development, equivalent to 2.2% of the 1989 GDP of $7234m. Living space is also being denied to some 4.2m Kenyans.

Even the foreign exchange earning potential of tourism is open to critical examination. Agricultural exports from Kenya have always been significantly greater than tourist earnings (Table 8), and in 1989 agriculture earned $621m in foreign exchange from gross revenues of $2639m (GOK, 1992). The PRF land in Kenya might therefore generate $133m in export earnings.

**Table 8**
**Tourist statistics for Kenya, 1989-1992**

| | 1989 | 1990 | 1991 | 1992 |
|---|---|---|---|---|
| Holiday arrivals (000s) | 642 | 696 | 673 | 588 |
| % change on previous year | +15% | +8% | -3% | -13% |
| Total hotel bed-nights (000s) | 5317 | 6046 | 6519 | 5526 |
| % change on previous year | +4% | +14% | +8% | -15% |
| Beach bed-nights (000s) | 2521 | 3200 | 3882 | 3483 |
| % change on previous year | +5% | +27% | +21% | -10%r |
| Gamepark bed-nights (OOOs) | 582 | 671 | 531 | 440 |
| % change on previous year | +13% | +15% | -21% | -17% |
| Ratio beach:gamepark bed-nights | 4:1 | 5:1 | 7:1 | 8:1 |
| Total $ receipts from tourism [(a)] | $420 m | $444 m | $423 m | $394 m |
| % change on previous year | +7% | +6% | -5% | -7% |
| Total $ receipts[(a)] from agricultural exports | $621 m | $623 m | $605 m | $530 m |
| % change on previous year | -4% | -°Jo | -3% | -12% |
| Ratio tourism $ agricultural $ | 1:1.48 | 1:1.40 | 1:1.43 | 1:1.35 |

[(a)] Current $m; Source: GOK (1992, 1993)

## 7. Improving the net benefits from conservation

Clearly, the net revenues currently being earned by Kenya for its parks, reserves and forests are quite inadequate to cover the opportunity costs of the land. The implications of this are serious, for the opportunity costs could create economic incentives to develop PRF land at the expense of conservation. Is it possible to improve net benefits of conservation, either by improving tourism and forestry revenues, or by modifying opportunity costs?

*7.1. Improving the net revenues of tourism*

Net revenues from wildlife tourism must improve from $27m to $99m to match the opportunity costs of the land set aside in parks and reserves (Table 5). This can be done by increasing tourist numbers, by increasing the revenues per tourist or by diversifying the wildlife tourism sector. The first two approaches both have problems: increased numbers incur risks through over-crowding (already problematical) and increased revenues might scare away tourists (there is little known about the elasticity of demand). Nonetheless, some careful mix of increased price, increased tourist numbers and some form of levy could be attempted.

*Increasing tourist numbers*

According to the Economic Intelligence Unit (Edwards, 1992), African tourism in the 1980s was sustained only by considerable declines in the costs to tourists compared with other destinations (in Kenya, the costs to visitors in 1990 were 42% in real terms of the costs in 1977). Although eco-tourism remains a potent motive for travel, Africa faces strong negative trend factors as poverty, political instability, lack of law and order and diseases such as AIDS deter visitors. Overseas holiday visitors to Africa are forecast to grow by 4% per annum for the next decade (Edwards, 1992), well below world tourism as a whole. The prospects for Kenya are possibly even less encouraging as the forecast growth in people coming to Africa from Kenya's traditional sources of tourists (particularly Germany and the UK) is lower than average.

Furthermore, tourists, especially eco-tourists, are fickle and respond quickly to perceived threats and dangers (Table 8). In 1991, the year of the Gulf war, the bed-nights of coast-seeking European visitors to Kenya increased by 21% whereas those of gamepark-viewing North American visitors declined by 21%. Similar patterns were apparent in 1992: visitors declined by 15% overall, gamepark tourism was very badly hit (34% decrease in bed-nights) and foreign exchange receipts decreased in real terms by some 30% compared with 1989 (GOK, 1993). Between 1989 and 1992 the beach:gamepark bed-night ratio doubled from 4:1 to 8:1, and the foreign exchange revenues from wildlife tourism compare unfavourably with those from agricultural exports. Accordingly, the prospects for large increases in tourist numbers (by a factor of four) in the next decade are very limited.

*Increasing tourist revenues*

It is possible to extract greater revenues from each tourist, though this may result in fewer numbers through increased competition from Tanzania, Uganda and southern Africa. The most obvious avenue to generate revenues from wildlife is through higher entrance fees to parks which the KWS plans to do. In budgeting for 1991/21995/6 (KWS, 1990), KWS assumes fees are raised to $15 per day and that there is a 10% annual growth in numbers of visitors. Brown and Henry (1990) estimate a significant consumer surplus just for elephants of around $25m for visitors to national parks in Kenya, more than adequate to cover these projected increases in entry fees. Yet even with these assumptions, KWS would not cover even its recurrent operating costs by 1995, let alone their required capital expenditures (estimated at 75% of recurrent costs). Park revenues per se will certainly not be able to cover the opportunity cost of the land, let alone the land surrounding national parks and reserves which also has conservation values and significant opportunity costs (Norton - Griffiths, 1993).

Furthermore, the chief source of the profit in tourism in the 1980s was the over-valued Kenyan shilling, and the high premium (of around 40%) prevailing in the parallel markets is evidence of the considerable real premium still on foreign exchange. It is, however, the policy of the Kenya government, and a condition of structural adjustment loans, that the economy move speedily towards a truly flexible exchange rate, and in February of 1993, the government allowed 50% of tourist dollars to be converted at the premium rate. This will result in a further worsening of the terms of trade in the tourist sector. The challenge as Kenya moves in this direction will be to find ways for the country to secure enough from its gross tourist earnings even to maintain the $27m of surpluses that were being generated in 1989, never mind raising them to cover the opportunity costs of the parks and reserves.

*Diversification of the wildlife sector*

Revenues and returns in the wildlife sector could be enhanced through diversification, especially into sport hunting (Edwards and Allen, 1992; Kiss, 1992; IUCN, 1993). Game cropping remains more problematical since it is quite rare for such schemes to generate anything other than massive losses (Macnab, 1991).

### *7.2. Improving the revenues from forestry*

The same considerations apply to the forestry sector which would have to generate net revenues of $104m to meet the opportunity costs of the forest land (Table 5). It is not clear how this might be achieved given the current lamentable performance of the KFD. If FINNIDA (1992) is correct and the KFD is collecting only a fraction of the gazetted revenues, then it should be comparatively straightforward to make the department self-supporting. If it collected all royalties and could find markets for all its wood, it might cover a third of the opportunity cost of the land. It is quite open to question whether the KFD could subsequently raise production and productivity by a factor of 3 and find markets for the product to generate the net revenues needed to cover the opportunity costs of the land.

### *7.3. Modifying the opportunity costs to land*

The opportunity costs to land are the major influence on the net benefits of conservation. Dependency on land is likely to increase sharply if the Kenyan economy continues to stagnate and rural populations continue to grow, thus exacerbating these opportunity costs. In contrast, dependency on land should fall if the economy grows and modernises and rural populations are drawn off the land and into expanding industrial and service sectors. Under this scenario the pressure on land would be less while the foregone revenues from lost agricultural production in the PRF lands would represent a much smaller proportion of GDP. Current predictions on the rate of growth and modernistation of the Kenyan economy are quite pessimistic.

## 8. Conclusions

The net revenues from wildlife tourism and forestry are unlikely to meet the opportunity costs of the land set aside in parks, reserves and forests for decades to come - if ever. In effect, therefore, the Kenya government is subsidising these conservation activities to the amount of $161m each year (1989 prices). To these subsidies should be added the benefits to the rest of the world from the continued existence of the flora and fauna and the undisturbed habitats of Kenya. To put all this into context, our calculated net loss from foregone agricultural output (2.2% of 1989 GDP) is equivalent to almost 30% of net investment in 1989 and to 70% of all external (aid) grants to Kenya in 1989/90.

When viewed candidly, the chief values of these conservation activities are all indirect and external. Very few Kenyans visit parks, reserves and forests: furthermore, many of the indirect values of conservation, such as wildlife experience, existence values, biodiversity values and carbon sequestration, are also external to Kenya. These benefits exist even for the millions who do not visit the country and can never be captured through tourism.

The global benefits from Kenya's conservation efforts are certainly worth the cost, but the fact that so much of the cost is born by Kenya is quite inappropriate. The present scale of subsidies is an awesome burden for a developing country to carry on behalf of the developed world, and the ability to shoulder the burden of these subsidies will be a function of growth and modernisation in the Kenyan economy. While the government of today could not consider degazetting parks and reserves, the situation may be quite different in 25 years when rural populations have doubled yet again. Then, the size of the opportunity costs relative to GNP might provide enough economic incentive to drive the conversion of PRF land to settlement and agriculture, at the expense of conservation.

These subsidies should instead form the basis for international negotiations to transfer funds to meet all or part of them, with projections of the speed of modernisation of the Kenyan economy determining for how long such transfers should be made. The global environment facility (GEF) is the only operational programme through which the incremental costs of biodiversity conservation, as defined under Article 20 of the Biodiversity Convention, can be met by the international transfer of funds through projects, capacity building and trust funds. None of these instruments are particularly suitable to the task in hand, added to which the provision for meeting such costs on an annual basis over many years was never envisaged when the GEF was designed. Furthermore, the current interpretations of incremental costs (Pearce and Barrett, 1993) do not envisage the situation where a country can *no longer afford* the costs of biodiversity conservation which it used to carry. The accepted definition of incremental costs under the biodiversity convention needs to be broadened to accommodate developing situations such as we predict for Kenya.

Kenya is often used to epitomise the economic benefits from biodiversity conservation, especially through eco-tourism. The reality is seen to be different. Clearly, conservation always involves opportunity costs and it is questionable whether these costs can ever be covered adequately through revenues from conservation activities. Net revenues from tourism, forestry, wildlife culling or whatever may offset some proportion of the costs, but there will always be residual costs left to bear. The question is - who should bear them? If the developed world expects a country like Kenya to maintain conservation estate on its behalf, then it must be prepared to contribute substantially towards these costs until such time as Kenya can afford to carry the burden itself.

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