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Conservation of biodiversity in the Arabuko Sokoke Forest, Kenya

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Abstract. Using an economic approach to provide a rationale for rainforest conservation has been a popular exercise in recent years. This paper uses such an approach to assess the net value of the Arabuko Sokoke Forest in Kenya. The economic benefits associated with the forest derived by local and global populations are estimated by combining evidence from existing studies and the results of a contingent valuation study carried out by the authors. These benefits are set against the cost of preserving the forest to the Kenyan Forest Department. Even when the opportunity cost of the forest land is omitted from the costs of forest preservation, and when the revenues generated from the Global Environment Facility (GEF) funded project are included, the costs of forest conservation outweigh the benefits. It is only when non-use and existence values are included (which are not realised by the Kenyan population) that the forest benefits exceed the costs. The paper concludes by arguing that, although some projects within the Arabuko Sokoke Forest have been successful in capturing some of the economic value associated with the forest, more needs to be done to design additional capture mechanisms so that a greater proportion of the global benefit of the forest can be realised by local populations and local governments.

Introduction

In 1991 Pearce suggested an economic approach to saving the tropical rainforest whereby monetary estimates of different 'values' associated with forest preservation might be estimated and shown to exceed the costs associated with rainforest preservation, thereby providing a rationale for their conservation. This type of analysis has since become popular, but one problem remains. Many of the identified benefits do not accrue to the countries that bear the cost of rainforest preservation. Although forests may maintain biodiversity, store carbon and cycle nutrients (Pearce 1991), the benefits of such activities are shared by the world population and are often not realised in terms of financial benefits to local populations.

Some efforts have been made to facilitate the transfer of benefits, such as debt for nature swaps, and the transfer of funds under global institutions such as the Global Environment Facility (GEF). However, the design and implementation of capture mechanisms, alongside the measurement of economic benefits, is key if the economic approach is to provide a practical rationale for helping to preserve rainforests.

This paper assesses the economic case for saving the Arabuko Sokoke Forest in

Kenya. Although it has become unusable for commercial logging due to past unsustainable logging practices, the forest may still be valuable both to local people and global populations. Overseas visitors to Kenya value the forest for recreational purposes. Local people value it for its subsistence uses and the Forest Department gains revenues from licensed uses of the forest. In addition, global populations may value the existence of the forest and the associated biodiversity (existence value) and may value the forest as an asset to be passed on to future generations (bequest value). The paper estimates the economic benefits the forest has for different categories of people, and shows that even in its current degraded state, the forest appears to have considerable value both to local and global populations. However, practical means to capture these values are urgently required if the economic approach is to provide a realistic rationale for conserving the forest.

The Arabuko Sokoke Forest

Arabuko Sokoke Forest is located near the North Coast of Kenya and occupies an area of 41 676 ha (Wass 1995). The forest is a protected area and is under the management of the Kenya Forest Department in collaboration with the National Museums of Kenya, the Kenya Wildlife Service, the Kenya Forestry Research Institute, with technical assistance provided by Birdlife International (an international NGO). The forest is managed in line with Kenyan forest policy, which requires preservation of forest areas for watershed protection, timber and other forest produce, and conservation of both flora and fauna. However, in practice this policy has not been effectively implemented in the past.

Arabuko Sokoke Forest is located in a hot and humid climate with an average temperature of around 29 °C. There are two rainfall seasons of over 1000 mm in the wet part, declining to 600 mm in the dry part (KIFCON 1995)★. Four distinct vegetation types are identified: mixed forest; *Brachystegia* woodland; *Cynometra* forest and thicket; and finally the mangrove forest around Mida Creek (KIFCON 1992). This environment has provided tree species of high valuable timber for both the furniture and construction industry and due to the rapid growth of coastal towns, the forest became a major source of fuel-wood, timber and poles in the 1970s. Growth of the international tourism industry along Kenya's North Coast has led to additional demand for wood for use in hotel construction and carving for tourists. The result of this demand has been over-logging of the forest to the extent that the forest has latterly been reduced to a secondary forest with few tree species of quality wood.

Despite this, the forest has a high level of biodiversity. A survey in 1994 identified nearly 600 plant species (KIFCON 1992) and 230 birds, of which six are listed in the Red Data Book for African Birds (KIFCON 1991). One of these birds, Clarke's weaver, is endemic, while the *Sokoke* scops owl, *Amani* sun bird and

★ Kenyan Indigenous Forest Conservation Project.

Sokoke pipit are near endemic (KIFCON 1995). The forest is listed as the second in importance for bird conservation in Africa (Wass 1995). In addition to its importance for birds, the forest also provides a habitat for many species of invertebrates including 250 species of butterfly, as well as large and small mammals (KIFCON 1993). Three globally threatened mammals occur in the forest: Golden-Rumped Elephant Shrew, Sokoke Bush Tailed Mongoose and the Alder's Duiker (Kingdon 1997).

It is clear that despite the lack of good quality timber, the forest's continued conservation is beneficial for biodiversity, and for a number of other benefits which accrue to local and global populations. However, the costs of conserving the forest to the Kenyan Forest Department are not inconsiderable, and given that it no longer provides revenue from timber production, a rationale for continued conservation of the forest is required.

The economic benefits which accrue to local populations might be estimated in a variety of ways, using a combination of data from existing studies conducted in Arabuko Sokoke Forest, data from the Forest Department and from environmental projects which derive an income from forest-related activities. The economic benefits which accrue to global populations may also be estimated from a variety of sources, including data from the Forest Department and primary data collection on visitor values. Combining the various sources of data allows a comprehensive picture to be drawn of the total economic benefit of the forest.

These benefits may come in two forms. First, benefits from direct use of the forest, such as revenue from the sale of timber products, recreational and subsistence use of the forest. Second, some people may be willing to pay for indirect use values related to the forest such as carbon storage, or for non-use values such as existence value or bequest value. Table 1 shows direct use value, indirect use value and non-use value, and indicates how each might be estimated in the Arabuko Sokoke Forest context.

As the table shows, the Arabuko Sokoke Forest is used for tourism and recreation, and although the number of visitors to the forest for recreation is currently small, there is potential to derive economic benefit from this use by charging an entry free. Currently, no entry fee is charged to visitors. In such circumstances contingent valuation studies provide a means by which these values can be estimated (Kramer and Mercer 1997). One such survey has been carried out by the authors to assess the maximum entrance fee that visitors and potential visitors to the park would be willing to pay. A second category of economic value relates to a number of legal

Table 1. The values associated with the Arabuko Sokoke Forest, and methods of estimation.

Value	Method of estimation
Direct use value	
– Tourism and recreation	WTP entry fee (CV)
– Legal uses–royalties paid	Forest department annual accounts
– Butterfly farming	Project annual accounts
– Illegal subsistence use	Participatory valuation (Emerton 1994)
Indirect use value and non-use value	WTP for conservation (CV)

uses of the forest for which the users pay royalties to the Forest Department, and for which annual reports are available. A third value derives from a butterfly farming project which was set up in 1993 with assistance from the GEF. This project yields income in the form of export sales of butterfly pupae, sale of guide books on the butterfly farm, visits to the farm, and camping at the farm. Data on all of these activities are available through the project annual reports. A fourth category of benefits relates to illegal uses of the forest, such as hunting for bushmeat and collecting poles by local communities. Emerton (1994) made an assessment of the value associated with this activity. Finally, evidence suggests that populations who may never visit the forest, nevertheless may be willing to pay for its conservation, as they value the existence of the forest and the species it provides a habitat for (Pearce and Moran 1994). The authors have conducted a contingent valuation survey to estimate these values. As long as each of these benefits can be realised by local populations or the forest managers, an economic rationale exists for the continued protection of the forest.

Contingent valuation of Arabuko Sokoke Forest

Contingent valuation is a widely used method to assess non-market values. It is a survey-based technique where respondents to a survey are asked their willingness to pay for environmental assets[†] in carefully described circumstances (Mitchell and Carson 1989). In the study of Arabuko Sokoke Forest a contingent valuation questionnaire was conducted using mostly people who had never visited the forest, to estimate two different values. Firstly, respondents were given information about the forest and asked, if they were to visit the forest, the maximum entrance fee they would be willing to pay, allowing estimation of use value of the forest. Currently entrance to the forest is free. Secondly, respondents were asked to suppose that they had no intention of visiting the forest now or in the future, and were asked how much they would be willing to donate as a contribution towards conservation of the forest, allowing estimation of indirect use value and non-use value.

The questionnaire comprised four sections. The first section requested general information about whether the respondent was a visitor to Kenya, their participation in outdoors and wildlife activities, and attempted to determine the general environmental attitude of the respondent. The second section provided respondents with information about the forest and included maps, pictures of the flora and fauna in the forest, and a description of the problems facing the forest. The third section comprised the valuation questions. First, respondents were asked whether in principle they would be willing to pay to enter the forest. They were then asked specifically 'Could you inform me of the most you would be willing to pay to use the forest for recreation per day'. They were asked to select their answer from a payment card containing amounts from $1 to over $100. The second set of valuation

[†] Although these techniques are also used to value other non-market assets such as health benefits.

questions asked whether respondents would in principle be willing to make a one-off contribution towards forest conservation, and how much they would contribute (also based on a payment card with amounts from $0.5 to $100). Respondents were reminded of their budget constraint, and that they may have already contributed to conservation in other areas. The exact question was 'I want you to consider how much you are willing to give as a contribution for conservation of the forest'.

Although the dichotomous choice (DC) elicitation format was favoured by the NOAA panel (Arrow et al. 1993) for use in CV studies, more recent evidence suggests that it may not be the most favoured option, not least because it opposes one of the other NOAA recommendations of choosing the most conservative CV design. There is substantial evidence in the literature which proves that the DC format leads to higher values than other CV elicitation formats (Boyle et al. 1996; Ready et al. 1996). It is suggested that the payment card elicitation method facilitates the respondents' valuation process (Mitchell and Carson 1989; Ready et al. 1996), and has been found useful in similar cases to this (Edwards-Jones and Kenyon 1998; Bann 2000).

The final section of the questionnaire included questions on the socio-economic characteristics of the respondents, including membership of conservation organisations, nationality, age, gender, number of children in the household, level of education, employment and income.

Since only a small number of tourists currently visit the forest for recreational purposes, only a small number of questionnaires were conducted within the forest area itself. The majority of the survey was conducted away from the forest area. These off-site interviews were carried out at beach locations, approximately 10 km from the forest. Interviews were held face to face and were conducted in June and July 1999. A total of 318 respondents were interviewed.

The sample was composed of 15% Kenyans and 85% foreigners. Only 3% of the respondents knew about the forest. The majority of the sample stated that their main holiday interest was wildlife viewing (89%). Seventy-seven percent were interested in sun bathing and beach walking, while only 38% were interested in bird-watching. Of the total respondents, 7% were protesters, indicating that they rejected the contingent scenario. A follow-up to the valuation question allowed protesters to be identified, by asking respondents why they had made the response they had. Those respondents who felt that funds for conservation of the forest should come from other sources, or that their donation may not go towards forest conservation, were classed as protesters and excluded from further analysis (Hanley and Ruffell 1993; Alfarez-Farizo et al. 1999). Analysis of the willingness to pay (WTP) questions was divided into two categories, locals and foreigners. Table 2 shows the mean, median and range of the bids as well as the percentage of non-zero bids in each category.

Interestingly, the entire sub-sample of foreigners was willing to pay a fee to enter the forest, and nearly all were willing to contribute to the conservation of the forest. The sub-sample of Kenyans who were willing to pay an entry fee and to contribute to the conservation of the forest was significantly smaller, with the mean amounts being bid also significantly smaller. Responses to the questionnaire indicate a

Table 2. Descriptive statistics for willingness to pay (WTP) a donation and entrance fee to Arabuko Sokoke Forest.

	% with positive WTP	Mean US$	Median US$	Range US$	Population	Aggregate US$
Foreigners (n = 251)						
– Entrance fee	100	7.77	5	2–40	1200	9324
– Donation	98.84	21.78	12	1–100	800000	17.4 million
Kenyans (n = 44)						
– Entrance fee	76.36	2.23	2	2–3	1200	2676
– Donation	70.91	5.33	2.5	1–20	1 million	5.3 million

number of reasons for this difference. The economic circumstances of the subsamples were different. Some Kenyans felt they already paid enough in taxes for forest conservation, and others were worried about corruption, fearing that an entrance fee or donation would not be put towards conservation of the forest.

The Arabuko Sokoke Forest Annual Report (1999) indicates that 1200 people visited the forest in 1998. If the mean tourist entry fee was aggregated over this population, potential income from entry fees would be US$9324. If the mean Kenyan entry fee was used as an entry fee, the overall potential income would be US$2676, both at current visitor levels.

Aggregation of the donations for conservation of the forest, however, is more complicated. Some calibration is clearly necessary, as it would be extremely optimistic to assume that all tourists that visit Kenya (approximately 8000000 per year, giving an aggregate sum of approximately $17.4 million) would be willing to donate to the Arabuko Sokoke Forest. Similarly, it is highly unlikely that the total population of the coastal area of Kenya (approximately 1 million, giving a total of $22.73 million) would be willing to donate to the forest. There may also be error due to free riding. It has therefore been suggested in the literature that CV figures should be 'calibrated' to reflect the fact that it is unlikely that hypothetical donations would reach the same level as real donations. However, it is unclear exactly how values should be calibrated, since many practitioners are unwilling to accept the arbitrary 50% suggested by the NOAA panel (Arrow et al. 1993). Debate about the precise nature of calibration of CV figures lies outside the boundaries of this paper; however, given the debate, it should be noted that the aggregate figures donating to conserve the Arabuko Sokoke Forest should be treated with caution.

One means by which validity of CV results can be evaluated is through construct validity, which involves testing the relationship between WTP and different variables against *a priori* expectations. Table 3 shows the independent variables that were used in regression analysis to assess the validity of the WTP results presented above.

As might be expected, intuitively there is a significant and positive relationship for both the donation and the entrance fee for income and educational level. Donations to conservation organisations have a statistically significant and negative relationship with WTP, although most CV studies (Carson 1994) show a positive relationship between membership of conservation group and WTP. The negative

Table 3. Regression of log donation, and log entrance fee against explanatory variables.

Variable	Explanation	Donation	Entrance fee
Constant		−1.73 (−0.81)	
Wildlife[a]	Respondents who have participated in wildlife viewing	−0.829* (−3.27)	−0.2384 * (−2.07)
Don. org.	Number of donations made to other conservation organisations	−0.0185 (1.63)	−0.158** (−2.62)
Age	Age of respondent	0.0198* (2.58)	0.003 (0.45)
Edu. level	Level of education of respondent	0.206* (2.79)	0.160*** (3.37)
Child	Number of children respondent has	0.252* (2.96)	0.015 (0.36)
Income	Log of gross annual household income	0.380* (3.04)	0.342*** (5.44)
R^2		0.293	0.399

[a]Coded yes = l, no = 2. T-statistic in parentheses. *Significant at the 90% level. **Significant at the 95% level. ***Significant at the 99% level.

relationship may be because respondents are already contributing to other organisations and are not prepared to add to their charitable budget.

One of the more interesting points to note is the fact that the number of children of the respondent has a positive relationship with the donation and the entrance fee, although this relationship is only statistically significant in the case of the donation. An explanation for this may lie in the fact that those who are willing to donate for future conservation may be keen to ensure that such habitats are available to their children in the future (bequest value). Those respondents with children would therefore be more likely to donate more to ensure the future preservation of the forest.

Respondents' participation in wildlife viewing has a statistically significant and negative relationship with WTP for an entry fee. This implies that availability of alternative recreation, such as wildlife viewing in other National Parks, reduces the motivation of the respondent to visit and pay to enter Arabuko Sokoke Forest. This might be expected, since most of the foreign visitors to Kenya are interested in wildlife safaris in National Parks where they can watch big mammals, which are not available in the Arabuko Sokoke Forest.

Overall the results of the regression confirm *a priori* expectations. The overall fit of the models is good, with a R^2 of 29% for the donation and 40% for the entry fee. In both cases this is above the 15% recommended by Mitchell and Carson (1989), showing that the results can be considered reasonably sound.

Forest department royalties and revenue

The Arabuko Sokoke Forest not only provides benefits to Kenyans and the rest of the world through use and non-use values, as the evidence above suggests, but generates revenues for its managing institution, the Forest Department. Revenue is currently generated from direct use of the forest and is realised in the form of timber royalties, fuel-wood licences, grazing fees and compensation for offences committed against the forest laws. Such revenues are reported each year by the Forest

Table 4. Forest Department royalties and revenues (US$).

	1994	1995	1996	1997	1998
Timber royalties					
– Mangrove	5578.62	1792.00	3914.46	2925.61	1765.56
– Natural forest	5698.76	3053.19	2058.14	1413.05	284.16
Poles	34.28	496.05	509.4	1914.17	1316.90
Fuel wood	721.03	399.80	1164	1858.5	2989
Compensation	102.71	145.3	1513.91	366.67	255.70
Grazing			73.82	1.71	53.57
Seedlings	1739.28	1934.90	170.57	165.5	205.94
Rents and fees	70			154.36	119.29
Christmas trees	502.11	694.29	265.03	195.50	545.93
Total	14446.79	8545.53	9669.33	8995.07	7536.05

Source: Forest Department Annual Reports 1994–1998.

Department in its annual report. Table 4 shows the revenues and royalties paid to the Forest Department from 1994 to 1998 for a range of items such as timber, poles and fuel-wood.

The figures show a decline in revenues over the reported period, which may be attributed to the decreased availability of wood over the years, due to over-logging and the subsequent poor regeneration of the forest. However, the total amount remains a significant source of income to the Forest Department.

The figures in Table 4 show the benefit relating to certain licensed activities, however, most forest exploitation takes place outside the licensing system. Such activity has been historically difficult to measure, however, work by Emerton (1994) has attempted to place values on the unlicensed, subsistence uses of the Arabuko Sokoke Forest.

Subsistence use of the forest by the local community

Much of the subsistence use of Arabuko Sokoke Forest by local people is not reflected in the current forest licensing system and is considered illegal. This section reports results from a study, commissioned by the Forest Department, carried out around Arabuko Sokoke Forest in 1994 with the objective of measuring the value of subsistence use of the forest by local communities (Emerton 1994). The forest uses were identified using a social economic survey of households residing within a 5 km radius of the forest. After ascertaining the quantity of forest goods used by each household, economic benefit was calculated using the forest edge values (Table 5).

The forest edge values were derived from market prices of close substitutes less transport, labour and the price of other inputs. For example, the price of water was inferred from the charges levied on piped water, while the price of bush meat was inferred from the price of meat of domestic animals. To obtain the aggregate values, population density was multiplied with the area and then multiplied by the average consumption of products per household. As Table 5 shows, the value of subsistence use was estimated at US$21 183, with the largest proportion of value coming from

Table 5. Subsistence use of forest by the local community.

Source	Illegal value (US$)	Percentage of total illegal value
Water	493.07	2.33
Land poles	533.3	2.5
Wild meat	11725	55.35
Fuel-wood	8062	38.06
Honey	102.65	0.48
Utility items	43.57	0.21
Medicine	223.92	1.06
Total	21183.51	100

Source: Emerton (1994).

wild meat and fuel-wood (Emerton 1994). These results should be seen as estimates only, due to difficulties in calculating shadow prices of the subsistence goods used in attributing values to the illegal forest products. However, evidence from the literature endorses these estimates. Pearce et al. (1994) suggested that there would be high dependence on forests for fuel-wood by the local communities in Kenya, since 71% of the population derive their domestic energy requirement from fuel-wood. The Kenya Development Plan estimated this dependence to be 73%, which implies significant use of local forests for fuel-wood. The importance of forests in Kenya as a source of meat has been reported by Fitz-Gibbon et al. (1995) who, like Abelson (1996), suggested that the high dependency on the forest by the local communities may be explained by the high level of poverty, i.e. per capita income of $540 in 1991. The figures produced by Emerton (1994) therefore are indicative of the importance that Arabuko Sokoke Forest has for the local communities.

Revenues from tourism and butterfly farming

As well as offering benefits to the local population in terms of subsistence goods, the forest has also brought income to local communities through a butterfly farming project started in 1993 through assistance of the GEF. The activities of the project involve collection of butterfly eggs and forage from the forest by the forest adjacent communities. The eggs are kept in crossed cages and after hatching, the larvae are fed with forage until they develop into pupae which are packed and exported to the Far East for ornamental purposes. The benefit of this project can be seen not only in income from export sales, but also from visits to the butterfly farm, sale of guide books, and camping fees collected on the farm (Table 6).

Evidence suggests that butterfly farming has no impact on the biodiversity of the forest (Ayiemba 1998). All the income from the butterfly farming is shared between the members of the community. Unlike licensing revenue to the Forest Department (Table 4), revenue from the butterfly farming project has increased to over US$31000 in 1998, significantly more than was ever shown in the Forest Department Annual Report as income from other licensed uses of the forest.

Table 6. Revenues from tourism and butterfly farming (US$).

Year	1994	1995	1996	1997	1998
Butterfly export	13224.1	15297.1	26893.31	30157.04	29454.26
Visits to butterfly farms	1241.1	1312.2	1682.3	2154.86	1939.86
Sale of guide books	210	158.60	231.42	262.86	408.6
Camping fee			53.20	48.60	60
Total	14675.20	16767.90	28860.03	32623.36	31862.72

Source: Kipepeo Project Annual Reports (1994–1998).

Cultural values

Although many of the values of the forest have been reported or estimated, some are not easily estimated in monetary terms. Within the Arabuko Sokoke Forest there are sacred groves which are traditionally referred to as 'Kaya', meaning 'homestead' in several local languages (Negussie 1997). The local ethnic groups have historical and spiritual relationships with the 'Kayas'. The shrines are used for worship where the local communities conduct religious rites, use traditional burial grounds and offer spiritual connection between the living and the ancestors. Although the cultural and spiritual value of these shrines are in decline due to erosion of traditional culture, the traditional institutions play an important role in the protection of the forest (Negussie 1997). Through a council of elders the locals enact customary rules which regulate access to use of the forest resources through a mixture of spiritual belief and superstition (Kamuaro 1998). Clearly, the Arabuko Sokoke Forest has significant, if declining, cultural value. However, it was not possible to quantify the cultural value in this study, since the survey focused on visitors to the forest and Kenya, and did not include local people. However, an indication of cultural value can be illustrated with reference to a case study from Zimbabwe, where cultural value was ranked in order of its relative importance to local communities, and was placed above medicines and crafts, but below poles and fuel-wood (International Institute of Environment and Development 1997).

Forest costs

The forest clearly has values that can be translated into realisable benefits to the Forest Department and local populations. However, these values should be weighed against the costs of conserving and protecting the forest. The costs associated with conservation of forests or protected areas are both direct and indirect (Dixon and Sherman 1991). Direct costs are the management costs, which include cost of staffing, maintenance of vehicles and other conservation operations. A large portion of recurrent expenditure is spent on policing to stop poaching of forest produce by the local people. Indirect costs are the opportunity costs of developments forgone due to conserving land as forest (Dixon and Sherman 1991).

The direct management costs borne by the forest managing authorities are shown in Table 7. The costs of forest conservation are in excess of US$100000 per year.

Table 7. Forest management costs (US$).

Item	1997/1998	1998/1999	% 1997/1998	% 1998/1999
Salaries	114098	104383	89.18	98.02
Transport operating expenses	9533.43	1071.43	7.45	1.01
Travelling and accommodation	–	140.14		0.13
Passage and leave	108	–	0.08	–
Postal and telegrams	142.86	21.43	0.11	0.2
Telephone expenses	1142.86	82.71	0.9	0.08
Electricity expenses	–	31.71		0.03
Water charges	–	102.86		0.1
Fungicides, insecticides and sprays	–	214.29		0.2
Purchase of uniform and clothing	–	101.14		0.09
Purchase of stationary	–	140.57		0.13
Supplies for production	1607.43	–	1.25	
Advertising and publicity	–	35.14		0.03
Miscellaneous and other charges	–	19.30		0.02
Purchase of plants and equipment	1135.71	12.86	0.9	0.01
Maintenance of machinery	–	44.57		0.04
Maintenance of water supply	–	35.14		0.03
Maintenance of roads	171.43	60.43	0.13	0.06
Total	127940	106497		

Source: Government Printed Estimated, Republic of Kenya, 1997/1998 and 1998/1999.

Much of the budget allocation goes to payment of staff salaries; however, this and other aspects of the budget have reduced in recent years, indicating the declining budget allocated to Arabuko Sokoke Forest. This may be attributed to the Structural Adjustment Programmes which advocate the reduction of budget deficit through reduction of expenditures and budget rationalisation (Republic of Kenya 1997).

The opportunity cost of conserving the Arabuko Sokoke Forest is evident from arable farming and other land use patterns in forest adjacent areas. Estimation of indirect costs of conserving the forest is beyond the scope of this study[‡]. Other costs associated with conservation of Arabuko Sokoke Forest include the losses due to game damage on neighbouring farmland. Abelson (1996) has estimated this at US$ 45000 per year for farms bordering the forest.

Discussion

By combining existing and new data relating to both local and distant populations, it has been possible to build up a comprehensive picture of the costs and benefits of the Arabuko Sokoke Forest in Kenya. Despite the poor state of the forest for logging purposes, the continued conservation of Arabuko Sokoke Forest clearly yields multiple economic benefits (Wass 1995; Abelson 1996). Table 8 shows the esti-

[‡] The opportunity costs of conserving protected areas in Kenya as a whole have been estimated and reported by Norton-Griffith (1995).

Table 8. Quantified costs and benefits of Arabuko Sokoke Forest (US$).

Cost of forest conservation	
Forest management cost in 1997	106 497
Cost of wildlife damage to farmlands in 1997	45 000
Actual direct benefits	
Forest Department revenues in 1997	7536
Tourism revenues in 1997	469
Revenues from butterfly farming in 1997	31 394
Illegal subsistence use of forest in 1994	21 184
Potential income from entry fee in 1999	2676–9324
Potential donation for forest conservation (one off donation)[a]	22 730 000

[a]Note the discussion on calibration in the text, which means that these figures should be treated with some caution.

mated values of the different uses of the forest, and an estimate of the non-use value derived from the contingent valuation survey.

Clearly, it would be wrong to aggregate these figures, as they relate to different years, and the methods of data collection are not compatible. However, they do illustrate the asymmetry between costs of conserving the forest and the revenue the forest is currently bringing into the Kenyan Forestry Department. Even when the benefits to local communities of illegal uses of the forest are taken into account, the costs appear to be significantly greater than the benefits of conserving the forest.

Currently no entry fee is charged to visitors of the forest, however, a significant increase in income could come from making some charge. Even if this was to take place however, the evidence indicates that income from the forest would not outweigh the costs incurred to the Forest Department. It is only when non-use values are taken into account that it becomes economically sound to conserve the forest. This highlights the problem that, although there is clearly additional value for the forest both within Kenya and the rest of the world, the means to capture this value in terms of benefits to local populations and the Forest Department are not currently available.

The butterfly farm project is of interest and may indicate means by which such global non-use values can be captured. Although the project itself captures use-value of the forest, the funding comes from the GEF, and represents a transfer of funds from international populations to local populations. The GEF is a financial mechanism that provides funds to recipient countries for projects and activities that aim to protect the global environment. It is jointly implemented by the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP) and the World Bank. The funding which facilitates the butterfly farming project in the forest could therefore be argued to relate to international non-use values for the forest. This GEF funding can be seen as a means by which some of the global value such as that estimated from the contingent valuation survey can be captured. This facility not only allows such value to be transferred, but allows additional use-value to be captured which then becomes a sustainable source of income from the forest for local communities.

Conclusions

This study shows that even when a forest has been degraded to such an extent that commercial logging is no longer viable, it may still hold significant value, which suggests that conservation of the forest should take place. Although much of this value is captured by local people in terms of legal and illegal use of the forest, other values do not accrue to local people. Capturing some of these values may be a relatively simple matter, such as charging an entry fee to the forest, and to attempt to increase visitors in the area through the establishment of a visitor centre, nature trails and trained guides. However, it may be more difficult to realise other benefits, such as international non-use value. The Arabuko Sokoke Forest has benefited from the transfer of some international funds, which may be seen as a realisation of international non-use value. However, a large proportion of non-use value of the forest remains unavailable to local populations and the Forest Department.

The case of the Arabuko Sokoke Forest illustrates that, whilst it is possible to quantify many aspects of value of a forest, according to the economic approach to saving the tropical rainforests, further efforts are required to design capture mechanisms which allow benefits to be realised. Such mechanisms are particularly vital for the capture of global non-use values, which in the case of the Arabuko Sokoke Forest are captured to a limited extent only. It is only when practical capture mechanisms are implemented that the economic approach provides a robust rationale for conserving rainforests such as the Arabuko Sokoke Forest.

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