iisd International Institute for Sustainable Development / Institut international du développement durable

http://www.iisd.org

Poverty and Ecosystems: Prototype assessment and reporting method – Kenya case study

By Dr. Anantha Kumar Duraiappah and Marlene Roy

July 2007

© 2007 International Institute for Sustainable Development (IISD)

Published by the International Institute for Sustainable Development The International Institute for Sustainable Development contributes to sustainable development by advancing policy recommendations on international trade and investment, economic policy, climate change, measurement and assessment, and natural resources management. Through the Internet, we report on international negotiations and share knowledge gained through collaborative projects with global partners, resulting in more rigorous research, capacity building in developing countries and better dialogue between North and South.

IISD's vision is better living for all—sustainably; its mission is to champion innovation, enabling societies to live sustainably. IISD is registered as a charitable organization in Canada and has 501(c)(3) status in the United States. IISD receives core operating support from the Government of Canada, provided through the Canadian International Development Agency (CIDA), the International Development Research Centre (IDRC) and Environment Canada; and from the Province of Manitoba. The institute receives project funding from numerous governments inside and outside Canada, United Nations agencies, foundations and the private sector.

International Institute for Sustainable Development
161 Portage Avenue East, 6th Floor
Winnipeg, Manitoba
Canada R3B 0Y4
Tel: +1 (204) 958-7700
Fax: +1 (204) 958-7710
E-mail: info@iisd.ca
Web site: http://www.iisd.org/

Poverty and Ecosystems: Prototype assessment and reporting method – Kenya case study

By Dr. Anantha Kumar Duraiappah and Marlene Roy

This project was funded by the Innovation Fund of the International Institute for Sustainable Development. The IISD Innovation Fund is an internal mechanism designed to test and advance novel ideas in sustainable development research, communications and policy analysis.

Table of Contents

Acronyms iv
1.0. Introduction 1
2.0. State of Ecosystems and Poverty in Kenya 4
Ecological surety 5
Economic facilities 10
Participative freedom 12
Protective security 14
Social opportunities 15
Transparency guarantees 17
Ecosystem–poverty links 18
2.1. Drivers of Ecosystem Change in Kenya 19
Local land-use and cover changes 20
Harvest and resource consumption 20
Demographics 21
Economics 22
2.2. A Way Forward: Evaluating Kenya's PRSP 23
Response effectiveness 23
PRSP responses linked to instrumental freedoms 24
PRSP responses linked to the drivers 25
Overall response effectiveness in addressing drivers 31
3.0. Conclusions 32

Appendix A: UNEP and MA frameworks 44
Appendix B: Ecological surety and instrumental freedoms: indicators and sources 45
Appendix C: Drivers (ecosystem-human interactions): Method and results 46

Table 1: Eco-regions/species/drivers/trends 6
Table 2: Ecosystem services (except biodiversity) – status and trends 9
Table 3: Kenya – state of poverty 13
Table 4. Ecosystem–poverty links 18
Table 5: Instrumental freedom/PRSP response/response type/ effectiveness of drivers 25
Table 6: Response option/number of times used in PRSP 31

Figure 1: Ecosystems–poverty conceptual framework 4
Figure 2: Some indicators from Kenya's MDG status report 16
Figure 3: Types of direct and indirect drivers 19

Acronyms

ASALs	Arid and semi-arid lands
ERS	Economic Recovery Strategy for Wealth and Employment Creation
MA	Millennium Ecosystem Assessment
MDGs	Millennium Development Goals
NWFP	non-wood forest products
PRSP	Poverty Reduction Strategy Paper
UNDP	United Nations Development Programme
UNEP framework	United Nations Environment Programme's poverty and ecosystems conceptual framework
WWF	World Wildlife Fund – United States (also known as World Wide Fund for Nature)

1.0. Introduction

> *"Life can only be understood backwards, but must be lived forwards."*
> – Soren Kierkegaard

The United Nations and aligned partners renewed their efforts to ease poverty and environmental degradation in the early part of this decade. One initiative, the Millennium Development Goals (MDGs), set a direction for human development efforts with concrete targets and timelines. The second initiative, the Millennium Ecosystem Assessment (MA), showed levels of ecosystem degradation worldwide, and how these are linked to human well-being. Each initiative has coalesced desperately-needed public attention to difficult social problems, but neither provides the detailed road-map needed by governments.

IISD tackled this need head-on by developing an integrated poverty-ecosystems framework with the United Nations Environment Programme (UNEP framework) that can be used at multiple levels from the local to the national. This framework required testing, though. Is it the detailed road-map needed by governments to help them improve the lives of their citizens? To answer this question we applied the framework to Kenya, a country with high levels of poverty and environmental degradation and also with readily available trend data. The result is a prototype report, which assesses sustainable development in Kenya, and concurrently helps us answer our initial question and find ways to improve both the method and the report. Specifically we want to know if it is feasible to apply this type of assessment to other countries.

Our aim, then, is to show one way that national-level sustainable development assessment and reporting can be done by assessing the state of ecosystems and human poverty in Kenya, showing how they are linked and analyzing the potential effectiveness of one of the government's main policy interventions, namely its poverty reduction strategy. The UNEP framework and the MA,[1] which incorporates aspects of the UNEP framework (Duraiappah 2004, 35; Reid *et al*. 2005, vii), are used to structure the assessment.

Our work is based on several assumptions drawn from research on ecosystems and human poverty:

[1] Both frameworks are illustrated in Appendix A.

1. The ecosystem approach is used to conceptualize the natural environment. Ecosystems are the "dynamic complex of plant, animal, and micro-organism communities and the non-living environment interacting as a functional unit" (Duraiappah and Naeem 2005, 1; Alcamo *et al*. 2003, 3). This approach considers the nature of the relationships among complex organisms and does not focus on a single environmental issue or species (Milton 1996, 56).
2. Ecosystems exist independently of people and underpin all life. They provide humans with products for consumption and absorb or sequester human wastes. The ability of ecosystems to do this is limited, however, and declining in many parts of the world (Reid *et al*. 2005).
3. Biodiversity (diversity of life) is essential to the functioning of ecosystems and fundamental to human well-being. Level of biodiversity is an indicator of the state of ecosystem functioning and hence its ability to provide ecosystem services. In our analysis, levels of biodiversity are determined for eco-regions defined by the World Wildlife Fund's (WWF) "Terrestrial Ecosystem Mapping" system.
4. Ecosystem services are the benefits that people obtain from ecosystems. Ecosystem services are framed using the UNEP conceptual framework as *provisioning* (products people obtain from ecosystems such as food, fuel, freshwater and so on); *regulating* (benefits people obtain from the regulation of ecosystem processes including air quality, climate and disease regulation, and erosion control); and *enriching* services (non-material benefits people obtain from ecosystems such as recreational, spiritual or aesthetic).
5. Poverty, defined as the pronounced deprivation of well-being (Chopra *et al*. 2005, 29), is considered multi-dimensional and evaluated using five dimensions of well-being derived from the instrumental freedoms of Sen's capabilities approach (Sen 1999).[2] These freedoms or capabilities underpin support-led[3] development processes rather than strictly growth-led processes and include:
   a. participative freedom (ability to participate in decisions through such institutions as free speech and democratic elections);
   b. protective security (safety nets against adverse effects of natural disasters and other events that may render an individual helpless);
   c. economic facilities (ability to participate in trade and production);
   d. social opportunities (ability to access education and health services, etc.); and
   e. transparency guarantees (culture of openness and trust).

---

[2] Delamonica and Mehrotra (2006) provide an analysis of the synergies among the instrumental freedoms and how policies can be designed that take advantage of these synergies to reduce poverty and improve human functioning (i.e., development).

[3] A support-led process does not "rely on economic growth but applies directly to the other social services such as education, health care, gender equality, etc." (Kilbourne 2006, 49).

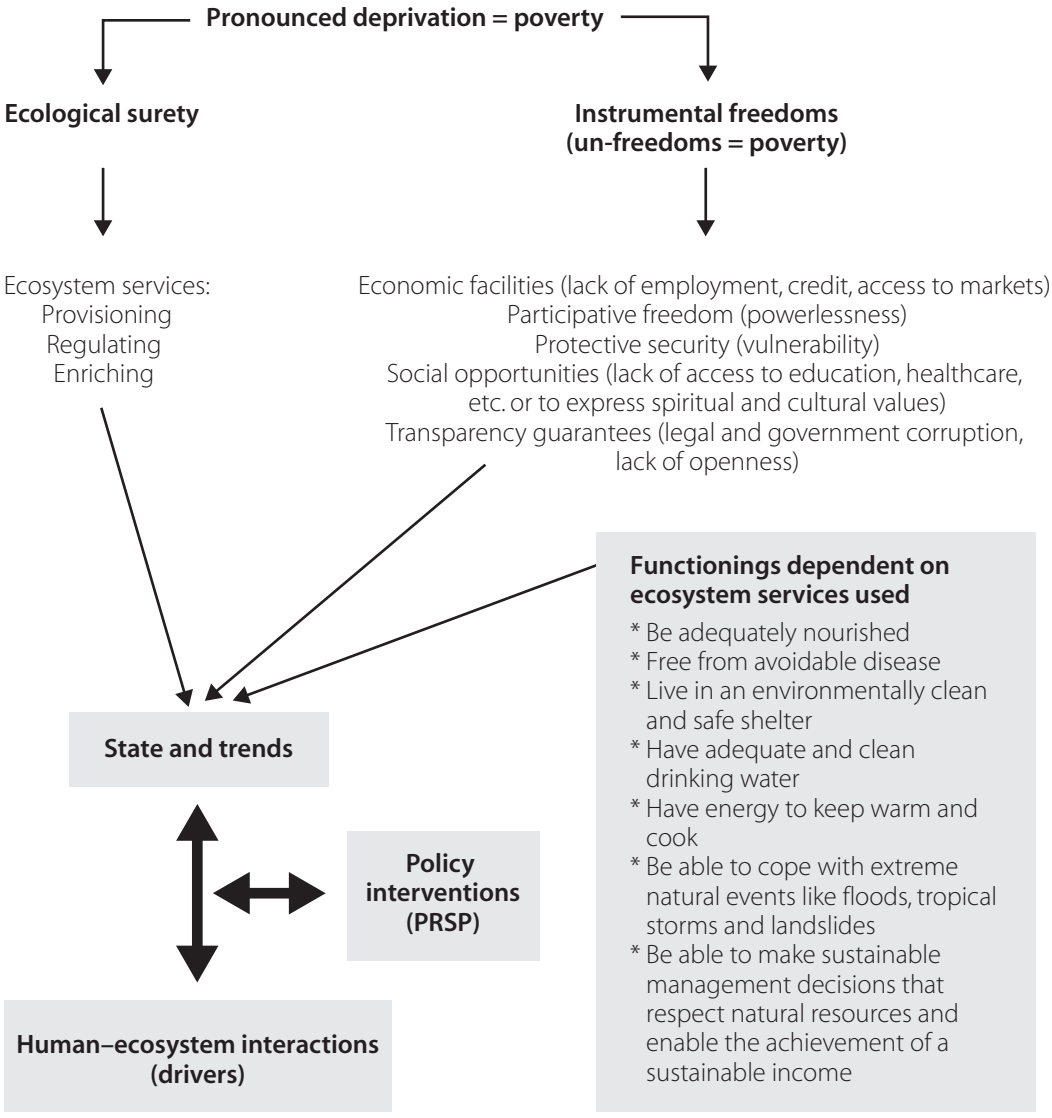
6. Ecological surety is also an instrumental freedom. Ecological surety includes: setting aside a critical mass of an ecosystem that will ensure that vital ecosystem services are kept intact; and the processes by which communities make decisions to arrive at this critical mass. Not including such participatory processes "inevitably results in short-lived community-based ecosystem management regimes promoting ecosystem services that are sabotaged by rent-seeking" (Duraiappah and Abraham 2004, 15).
7. Poverty is linked to the state of ecosystem services. Several human functionings (also called *constituents* and *determinants* of human well-being) that people need to be able to achieve to obtain well-being are directly dependent on ecosystem services.
8. Humans continually interact with ecosystems in mutually constitutive ways. We use the typology of direct and indirect drivers developed for the MA to describe human-ecosystem interactions.
9. The relationship between human well-being and the environment can only be understood within particular sets of institutions (Kilbourne 2006, 57).
10. To improve human well-being, especially by reducing poverty, countries develop various interventions and their probable effectiveness can be analyzed. To do this we use the MA method which consists of measuring the probable effectiveness of a range of policy responses to drivers (Chambers *et al*. 2005, 58–59).[4]

Working from these assumptions, several indicators are adopted to assess the state of ecosystems and poverty in Kenya and their links.[5] Crucial human-ecosystem interactions (drivers) are identified and the potential policy responses to improve human and ecosystem well-being, as outlined in Kenya's latest "Poverty Reduction Strategy Paper" (PRSP) are evaluated.

A schematic of the working paper approach follows.

[4] For a complete explanation of the MA method of response impact please see Chambers *et al*., 2005, 57–50.
[5] A list of indicators and data sources is in Appendix B.

Figure 1. Ecosystems–poverty conceptual framework



2.0. State of Ecosystems and Poverty in Kenya

Many other reports have assessed various aspects of human poverty and well-being and the environment in Kenya. One example is the "Human Development Report" in which Kenya ranked 154th of 177 countries in 2005. National-level reports include: the "Millennium Development Goals Status Report," state of the environment reports, as well as reports on biodiversity, desertification and

climate change deposited at relevant UN convention secretariats. Each one contains vital information about various aspects of the state of human well-being and the environment and development needs, but none fully conveys an assessment of essential ecosystem-poverty links. When the wide-ranging elements found in these reports are structured using the UNEP framework, a clearer picture of the state of ecosystems and poverty in Kenya emerges. Three elements bring this picture into sharper focus: two describe the state of ecosystem services and poverty, respectively, by assessing indicators for ecological surety and for each of the five instrumental freedoms; and the third links the two sets of indicators and data.

Ecological surety

One critical element of ecological surety involves keeping enough of a critical mass of an ecosystem to ensure that vital ecosystem services are kept intact. Biodiversity can be used to determine ecosystem intactness, and biodiversity and ecosystem services are closely related. "Products of biodiversity include many of the services provided by ecosystems… and changes in biodiversity can influence all the other services they provide" (MA 2003, 10). With this in mind, we bring together data on the state of biodiversity before focusing on the status of provisioning and regulating ecosystem services.

Indicators	**Source**
Supporting services:	
• Biodiversity	Case studies, WWF, IUCN Red List
Provisioning services:	
• Food provision: yield cereals/hectare	GEO data portal and FAOSTAT
• Fibre provision: yield seed cotton, cotton lint and sisal in hectograms/hectare	FAOSTAT
• Forest coverage rate: % land covered in forests and plantations	Africa development indicators (World Bank)
• Freshwater supply	FAO Aquastat
Regulating services:	
• Freshwater purification: water pollution – BOD in total kilograms/day	GEO data portal
• Climate regulation: land-cover change	Case studies
• Erosion regulation: % land degraded	FAO Terrastat
• Disease regulation: malaria (no. clinical cases reported) and diarrhea incidence rate	WHO
• Natural hazard regulation: loss of wetlands and mangroves and number of flood events	Case studies GEO data portal

Kenya abounds in environmental diversity ranging from coral reefs and mangroves along the Indian Ocean coast to arid shrub land in the north, to thick mountain forests and to the shores and waters of Lakes Victoria and Turkana. This biodiversity and associated ecosystem services, however, are in a state of decline everywhere. Table 1, using the concept of bio-regions and based on a review of several case studies cited after the general references in this report, provides an overview of these changes.

All forest areas are now fragmented to some degree with mangroves being seriously degraded.[6] Portions of grass- and shrub-lands are also highly degraded. This level of land degradation is linked to biodiversity loss in all eco-regions with the one exception being the "Somali Acacia-Commiphora bushlands and thickets" in North East Province, which is sparsely populated, and for which little data were found. Of more than 6,400 known species, 551 are designated as being either at risk, vulnerable, threatened or endangered (WWF 2005; IUCN 2005).

Table 1. Eco-regions/species/drivers/trends

Eco-region (biome)	Number of species	Number red listed*	Habitat	Land-use intensity	Drivers (Interactions) (D) – Direct (I) – Indirect	Trend
East African montane forests (AT0108): Rift Valley, Western provinces	891	73	Increasingly fragmented	Cultivated/ protected areas	**Direct** Deforestation; charcoal production; illegal logging; cattle grazing; land erosion; agro-chemical pollution; partially treated effluents; poor sanitation **Indirect** Human population increase	Declining
Northern Zanzibar-Inhambane coastal forest mosaic (AT0125): Coast province	970	83	Forest highly fragmented	Cultivated/ protected areas	**Direct** Forest fragmentation; deforestation; conversion to cropland; tree cutting for building poles; low-level impact harvesting of forest products; irrigation **Indirect** Human population increase; human population density increase	Declining

[6] Degraded is defined as being "extractive use at a rate exceeding replenishment and widespread disturbance… Productive capacity reduced to approximately 60 per cent of 'natural' state" (Scholes and Biggs 2005).

Eco-region (biome)	Number of species	Number red listed*	Habitat	Land-use intensity	Drivers (Interactions) (D) – Direct (I) – Indirect	Trend
Northern Acacia-Commiphora bushlands and thickets (AT0711): Coast, Central, Eastern and Rift Valley provinces.	1,014	86	Moderately fragmented	Moderate/ cultivated	**Direct** Land conversion to agriculture; land degradation; drought; deforestation; devegetation of catchment area; growth of permanent settlements; forest regeneration by shifting agriculture; land fragmentation; better use of farm inputs; use of terracing, contour cultivation; hunting; wood fuel; heavy water abstraction; poaching; climatic variability increasing number of flash floods; access to water **Indirect** Human population increase; in-migration; sedentarization of former pastoral communities; human population density increase; opportunities for irrigated horticulture; market-oriented production; distance to market for mechanized agriculture; living near villages to access social services for smallholders; development interventions; construction of boarding educational institutions; land use conflict; immigrants to pastoral areas are crop cultivation communities	Declining
Somali Acacia-Commiphora bushlands and thickets (AT0715): North Eastern province	903	76	Degradation mainly near human settlements. Riverine vegetation degraded	Moderate	n/a	Little or no change

Eco-region (biome)	Number of species	Number red listed*	Habitat	Land-use intensity	Drivers (Interactions) (D) – Direct (I) – Indirect	Trend
Southern Acacia-Commiphora bushlands and thickets (AT0716): Nyanza and Rift Valley provinces	883	78	Areas of largely intact habitat in protected areas; greatly reduced number of wildlife corridors	Cultivated/ protected areas	**Direct** Conversion for agriculture and human settlements; deforestation; land degradation; water hyacinth invasion; over-fishing; poaching; drought **Indirect** Human population increase; in-migration; land appropriation	Declining
Victoria Basin forest-savanna mosaic (AT0721): Nyanza province	996	92	Forest patches small and fragmented. Forest habitat have largely been replaced by savannahs and agriculture	Cultivated/ protected areas	**Indirect** Human population increase; slaughtering livestock for funerals and/or selling them to pay funeral expenses	Declining
Masai xeric grasslands and shrublands (AT1313): mainly Eastern province and small portion of Rift Valley province	466	49	Most habitats degraded.	Degraded with protected areas	n/a	Declining
East African mangroves (AT1402)	279	14	Habitats degraded	Degraded with protected areas	**Direct** Deforestation; oil spills; wood fuel; salt and titanium extraction; tannins and dyes; timbers and poles for export; land conversion for salt works and for aquaculture; increasing industrial pollution; charcoal **Indirect** Prawn farming; increase in tourism and number of hotels	Declining
All	6,402	551				Declining

Sources: World Wildlife Fund 2005 and case studies[7]

[7] Case studies are listed after the References.

The overall decline in biodiversity is reflected in the state of ecosystem services (Table 2).[8] Both provisioning and regulating services are declining. Cereal, cotton and sisal yields and forest coverage rate were lower in 2003 than 1992; water pollution is increasing; 93 per cent of land is degraded; and disease regulation, as evidenced by rates of malaria and diarrhea, is not improving.

Table 2. Ecosystem services (except biodiversity) – status and trends

Year	Provision		Forest coverage rate*	Freshwater		Regulation			Diarrhea incidence	Natural hazard regulation
	Food	Fibre yield		supply (IRWR/ capita)	purification	Climate	Erosion	Disease malaria		
1992	15,231	4,615	30.7	—	43,883	—	—	—	—	—
1993	14,874	4,403	30.6	719.8	45,009	—	—	—	18.8	—
1994	19,232	4,993	30.4	719.8	46,430	—	—	—	—	—
1995	18,644	5,049	30.3	719.8	48,354	—	—	—	—	—
1996	14,225	5,904	30.1	719.8	47,816	—	—	—	—	—
1997	14,024	5,450	29.9	719.8	49,125	—	—	—	—	—
1998	15,482	3,759	29.7	656.3	49,304	—	—	80,718	17.1	—
1999	14,279	3,395	29.6	656.3	—	—	—	122,792		—
2000	13,746	3,329	29.5	656.3	—	—	93% overall	74,194		—
2001	16,061	3,038		656.3	—	—	—	132,590		—
2002	14,843	3,601		656.3	—	—	—	124,197		—
2003		3,930		630.7	—	—	—	—	21.4	—
Trend	-	-	-	-*	-	-**	-	-***	-	-****

- = declining + = improving 0 = little or no change
*based on data from FAO Aquastat. Projections show increasing water scarcity
**based on case studies and biodiversity trends (Table 1)
***malaria data from a few districts only
****based on biodiversity trends (Table 1), declining forest coverage rate, increasing land degradation and frequency of droughts

[8] Enriching services were not included in this analysis.

Variables and Sources
Food provision: yield cereals hectograms/hectare, (UNEP. *GEO data portal*. http://geodata.grid.unep.ch/page.php/ FAO. *FAOSTAT*. http://faostat.fao.org/).
Fibre provision: yield – seed cotton, cotton lint and sisal in hectograms/hectare, (FAO. *FAOSTAT*. http://faostat.fao.org/).
Forest coverage rate (% total land covered in forests and plantations) 1990 and 2000 data from World Bank. 2003 Africa Development indicators, pp. 344–345. Data between 1990 and 2000 estimated by using interpolation.
Freshwater supply and regulation: IRWI, (FAO. *Aquastat database*. http://www.fao.org/ag/agl/aglw/aquastat/dbase/index.stm).
Freshwater purification: water pollution – BOD in total kilograms per day, (UNEP. *GEO data portal* http://geodata.grid.unep.ch/).
Climate regulation: land cover change. Deforestation and land degradation and data from Table 1
Erosion regulation: % total land degraded, (FAO *Terrastat*. http://www.fao.org/ag/agl/agll/terrastat/index.asp).
Disease regulation: malaria (no. of clinical malaria cases reported) and diarrhea incidence rate. (WHO. Regional Office for Africa. *Malaria [country profiles]*. http://www.afro.who.int/malaria/country-profile/index.html. USAID. *Demographic and health surveys*. http://www.measuredhs.com/statcompiler/
Natural hazard regulation: loss of wetlands and mangroves and number of flood events. (Case studies and UNEP. http://geodata.grid.unep.ch/).

Economic facilities

People need to be able to use ecosystem resources for consumption, production and exchange. "Being able to gain a productive livelihood through the means of one's choice requires adequate and supporting facilities" (Khosla and Samuels 2005, 47; Duraiappah 2004, 24). All too frequently, poor people are unable to garner a subsistence livelihood or earn a sustainable income because they lack ownership of

Ecosystem services	Linked to	Human well-being constituent/determinant
Provisioning		Able to make sustainable management decisions that respect natural resources and enable the achievement of a sustainable income

and easy access to the necessary resources and supporting facilities such as credit and markets. In addition, transaction costs may be too high for many to improve their incomes.

Indicators	**Source**
GDP/capita (PPP US$)	Human Development Index (UNDP)
Gini coefficient	Human Development Index (UNDP)

In Kenya, per capita income is lower now than a decade ago (Table 3). By 2002, 56 per cent or 17 million people were living below the poverty line[9] and of these, 82 per cent lived in rural areas (Kenya, Ministry of Planning and National Development 2005, 8, 9; Kenya 2004b, 9, 12). Improving one's income is fraught with problems. Agriculture sector productivity is lagging and prospects in the formal employment market are bleak: 500,000 job seekers are entering the labour pool every year while only 80,000 formal sector jobs "have been created in the last six years" (Kenya. Ministry of Planning and National Development 2005, 9).

Government responses have been hindered by prolonged weak economic growth that slowed development efforts and contributed to a decline in government revenues, which fell from 29 per cent of GDP in 1999/2001 to 22 per cent in 2002/03 according to government sources (Kenya 2004b, 8). During the period from 1991–2000, Kenya recorded an average growth of two per cent per annum, but with population growth factored in, per capita growth was -1 per cent (World Resources Institute 2003). This rate of economic growth continues. In 2003, GDP grew by 1.3 per cent and 2.5 per cent was estimated for 2004 (Kenya 2004b, 12; World Bank 2005, 32). Several factors have contributed to this pattern of growth, including droughts and famine in 2000 and 2004, which caused water and energy rationing and reduced agricultural output, thus diverting development money into famine relief; low levels of donor inflows; and low private sector investment (Kenya 2004b, 8).

[9] Kabulo-Mariara and Ndeng'e (2004, 7) note that the absolute poverty line used in the PRSP is Kshs 1,239 per person per month for rural areas and Kshs 2,648 for those living in urban areas. A detailed description of the calculation method is available in the paper.

Snapshot of income poverty in Kenya

Although smallholder agriculture accounts for 70 per cent of Kenya's marketed agricultural production and is the lifeline of the majority of Kenya's rural poor, yields are below potential and only contribute just over 25 per cent to the GDP (Kenya 2000; Kenya 2004b, 56; World Resources Institute 2003). While the poor generally cultivate more land and have more livestock than the non-poor, the non-poor earn more than 2.5 times more income through the sale of cash crops, and 1.5 times more through livestock sales. "This pattern can be partly attributed by differences in the fertility of land and the affordability of inputs to improve productivity [while] for livestock, cultural factors and the lack of high-grade stock and poor access to markets could account for low sales among the poor" (Kenya 2000).

Women represent the majority of the poor. Of the working female population, 69 per cent are subsistence farmers and constitute over 50 per cent of the total poor in Kenya (Kenya 2000). In addition, the landless (25 per cent of rural households), smallholder farmers, pastoralists in arid and semi-arid areas, agricultural and casual labourers, female-headed households, the physically impaired, HIV/AIDS orphans and street children constitute the poorest Kenyans (Kenya, Ministry of Ministry of Planning and National Development 2005, 12).

In Kenya, the 10 per cent richest households control more than 42 per cent of incomes and in Nairobi, the top 10 per cent of households command 45 per cent of the income (Odhiambo 2004, xiii, 13). Based on the inequality in incomes prevalent in Kenya and incidence of poverty data, all provinces have an unacceptable incidence of income poverty.

Participative freedom

Individuals need to be able to participate in decisions affecting their well-being, including those related to ecosystem management. Indeed, researchers such as Khosla and Samuels (2005, 58) in their analysis of the capabilities approach termed this instrumental freedom "political freedom," and include being able to vote and access various institutions such as law and order services, and media/telecommunications, among others, as essential constituents of well-being. Being able to participate in decision-making also increases self-esteem and an individual's sense of power (Duraiappah 2004, 23).

Indicators	Source
Political rights and civil liberties	Freedom in the World database (Freedom House)

Previous to the election of a new government in 2002, limits on political and civil rights were extensive in Kenya. Since then the inclusion of civic groups and associations in various government commissions has become more common (Table 3), but by 2004, democratic decentralization was still not realized (Freeman, Ellis and Allison 2004, 166). The present government has generally respected freedom of assembly, though there have been occasions when undue force was used at demonstrations. Civil society is vibrant and most workers have the right to join unions of their choice.

Table 3. Kenya – state of poverty

Year	Economic facilities		Partici-pative freedoms	Trans-parency guarantees	Social opportunities				Protective security
	GDP per capita (PPP US$)	Gini	Political rights Civil liberties*	Level of corruption 0=highly corrupt 10=highly clean	Life expectancy at birth (years)	Adult literacy rate (% ages 15 and above)	% population with access to improved water – urban areas/ rural areas	Energy: per capita kg of oil equivalent (renewables)	Vulnerability (number of people affected by droughts and floods)
1993	1,400		n/a	n/a	55.5	75.7	90/34	311.6	0
1994	1,404	44.5	6, 6 not free	n/a	53.6	77	89/36	—	0
1995	1,438		7, 6 not free	n/a	53.8	78.1	89/37	347.2	1,200,000
1996	—	—	7, 6 not free	n/a	—	—	89/38	—	0
1997	1,190	42.5	6, 6 not free	n/a	52.0	79.3	89/39	392.8	2,500,000
1998	980		6, 5 not free	2.5	51.3	80.5	89/40	—	200
1999	1,022	57.0	6, 5 not free	2.0	51.3	81.5	88/41	391.3	0
2000	—	—	6, 5 not free	n/a	—	—	88/42	—	4,212,600
2001	980		6, 5 not free	2.0	46.4	83.3	—	—	4,400,000
2002	1,020		4, 4 partly free	1.9	45.2	84.3	—	—	308,008

Year	Economic facilities		Partici-pative freedoms	Trans-parency guarantees	Social opportunities				Protective security
	GDP per capita (PPP US$)	Gini	Political rights Civil liberties*	Level of corruption 0=highly corrupt 10=highly clean	Life expectancy at birth (years)	Adult literacy rate (% ages 15 and above)	% population with access to improved water – urban areas/ rural areas	Energy: per capita kg of oil equivalent (renewables)	Vulnerability (number of people affected by droughts and floods)
2003	1,037	42.5	3, 3 partly free	1.9	47.2	73.6		—	64,300
2004	1,140		3, 3 partly free	2.1	47.5	73.6	83 / 46	—	1,027,000
Trend	-	-	+	0	-	-	-/+	**+	-**

- = declining + = improving 0 = little or no change
*A rating of 1 indicates the highest degree of freedom and 7 the least amount of freedom (Freedom House http://www.freedomhouse.org).
**As this trend data were not indicative, the frequency data and case studies were also used.

Unfortunately, the judicial system remains weak and human rights violations by police are not unusual. Women's rights also suffer; violence against women is common, especially domestic violence, and their role in politics is limited by traditional attitudes.

Over the past decade there has been an improvement in political rights and civil liberties as shown by increased public consultation, but several problems still need to be tackled. These problems include strengthening the judicial system, eliminating human rights violations, improving women's rights and finding ways to deal with ethnic tensions that often arise from land disputes (this section largely drawn from information provided by Freedom House 2005).

Protective security

Societies provide various formal and informal safety nets to protect against adverse events that may render individuals helpless (Duraiappah 2004, 29). Unfortunately many informal safety nets are collapsing just when natural disasters are increasing.

Ecosystem services	Linked to	Human well-being constituent/determinant
Regulating		Able to live in an environmentally clean and safe shelter
Regulating		Able to cope with extreme natural events like floods, tropical storms and landslides

Kenya is especially vulnerable to recurring droughts and floods, regularly and adversely affect large numbers of people (Table 3). While data for the number of people affected annually by these disasters from 1993 to 2004 show considerable variance, drought frequency appears to be increasing. Of the 12 droughts from 1964 to 2006, seven occured on or after 1992 (Université catholique de Louvain 2006). This trend could have dire consequences, particularly for rural subsistence farmers in semi-arid and arid regions, who are most affected by drought due to high levels of poverty (Christiaensen and Subbarao 2005, 535, 551). Moreover, when natural disasters occur frequently, and negatively impact the lives of millions of people, there is little or no time to re-build communities and livelihoods. Unfortunately, poverty is increasing, especially in rural areas, just when there is an increasing number of natural disasters and this trend is expected to continue due to climate change.

Indicators	**Source**
Vulnerability (total # people affected by droughts and floods)	UNEP

Social opportunities

Social opportunities are the arrangements society make to provide or increase access to education, health and other vital services and resources, which allow citizens to live better lives and be productive members of society. Social situations and power relationships have a strong influence on individual well-being, as they mediate access to ecosystem services essential to life including food, water and energy. Social opportunities are especially relevant to women and children, as their access to resources will greatly enable human development (Sen 1999; Duraiappah 2004, 27). Even literacy, a key social opportunity thought to be less directly dependent on ecosystem services, is linked to the ability to better survive natural disasters. Christiaensen and Subbarao (2005, 552) found that adult literacy campaigns along with better access to markets looked quite promising in reducing household vulnerability.

Ecosystem services	Linked to	Human well-being constituent/determinant
Provisioning		Able to be adequately nourished
Regulating		Able to be free from avoidable disease
Provisioning and regulating		Able to have adequate and clean drinking water
Provisioning and regulating		Able to have clean air
Provisioning		Able to have energy to keep warm and cook
Regulating		Able to use traditional medicine

In addition to reducing vulnerability, increasing the literacy and education level of the head of the household and spouse play key roles in determining poverty levels. Unfortunately, adult literacy rates show a drop of 73.6 per cent in 2003, down from 84.3 per cent in 2002 (Kenya 2004b, 10) (Table 3). To help reverse this trend, the government has introduced free primary education and is looking to improve the number of students making critical transitions from primary to secondary and secondary to post-secondary education (Kenya, Ministry of Planning and National Development 2005, 14).

Indicators	Source
Life expectancy at birth (nourishment and free from disease)	Human Development Index (UNDP)
Adult literacy rate	Human Development Index (UNDP)
% population with access to improved water – urban and rural	Kenya DHS and MDG database
Per capita kgoe (kg of oil equivalent) (energy)	World Resources Report

Individual health status has also been dropping (Table 3). Life expectancy has declined overall from 55.5 years in 1993 to 45.2 years in 2002. In 2003, there was a modest increase to 47.2 years. Moreover, child mortality rates have increased and several million people have HIV/AIDS and are exposed to malaria.

Figure 2. Some indicators from Kenya's MDG status report (Kenya, Ministry of Planning and National Development 2005)

- Increases in mortality of children under age five from 90 per 1,000 to 112 per 1,000 in 1998, and 115 in 2003.
- More than three million people are currently infected with HIV/AIDS; more than two million have died and there are over 1.8 million orphans. Over 60 per cent of those infected live in rural areas.
- 20 million people, or 70 per cent of the population live in malaria-prone areas and are at risk of infection.
- Access to safe water is estimated to be 89 per cent in urban areas and 49 per cent in rural areas.
- Sanitation access is 94.8 per cent in urban areas and 76.6 per cent in rural areas, but varies greatly from region to region.

Access to adequate and clean drinking water and energy to keep warm and cook varies spatially. While there has been a slight improvement in access to improved water in rural areas (from 42 to 46 per cent), there has been a decline in urban areas (from 88 to 83 per cent). Biomass energy accounts for almost 97 per cent of household energy requirements and the few data found suggests that per capita consumption has been increasing slightly (Table 3 and Kenya Central Bureau of Statistics 2001). Firewood, paraffin and charcoal continue to be main sources of cooking fuel, with 68.8 per cent of households using firewood as their main cooking fuel (Kenya Central Bureau of Statistics 2006).

Transparency guarantees

Lack of openness and government trust contributes to social instability and works against development efforts and more equitable access to ecosystem services. Two conditions indicating lack of openness and trust are high levels of corruption in the bureaucracy, polity, judiciary and business, and high levels of inefficiency in the same institutions (Duraiappah 2004, 27).

Indicators	Source
Level of corruption	Corruption Perceptions Index (Transparency International)

High levels of corruption have persisted in Kenya for some time (Table 3). To put this situation in perspective, Kenya ranked 129th out of 146 countries surveyed in Transparency International's recent "Corruption Perceptions Index," situating it among countries with high perceived levels of corruption. The present government is tackling corruption and so far has: struck an independent anti-corruption commission; appointed high court judges to replace those tainted by corruption; and increased police salaries. "The Kenya Bribery Index [2004] argues that the incidence of corruption has dropped significantly compared with that of 2002," but a 2006 assessment by Transparency International is less optimistic (Transparency International 2006). According to the 2006 report, anti-corruption efforts are losing support and "the prognosis for the future fight against corruption is not good" (Transparency International 2006, 190). Further evidence on the level of corruption is available; villagers reported having to pay bribes to obtain services that should be free. Illegal taxes were also levied "under various guises by individuals or groups holding positions that enable them to exercise that sort of leverage" (Freeman, Ellis and Allison 2004, 165).

Ecosystem–poverty links

Based on this overview of ecosystem services and poverty, the well-being of people in Kenya continues to decline. The one bright spot appears to be in the vibrancy of civil society and improvements in participation and civil liberties. Even these gains are modest and appear jeopardized, however, by a recent clamp-down on the print media and loss of support for the government's anti-corruption initiatives.

Table 4 links the state of ecological surety with the state of poverty and shows some of the ecosystem-poverty trade-offs that are currently being made in Kenya that have future implications for both ecosystems and people. Renewable energy use per capita is modestly improving (this result is based on little data and should be interpreted with caution), but offset by high deforestation rates, indicating that even such modest improvements in human well-being will likely be short-lived without corresponding improvements in ecosystem services. The trend towards increasing human vulnerability due to natural disasters such as droughts and floods is also alarming, further signalling that ecosystem improvements are urgent and necessary for human development.

Table 4. Ecosystem–poverty links

		Ecological surety	Economic facilities		Participative freedoms	Protective security	Social opportunities					Transparency guarantees
			GDP per capita	Gini	Political rights and civil liberties	Vulnerability: number of people affected by droughts and floods	Life expectancy	Literacy	Water access: urban	Water access: rural	Renewable energy use	Level of corruption
Supporting services: biodiversity -	Ecological surety -				+			-				0
	Provisioning - Food Fibre		-	-								
	Regulating - Freshwater Climate Erosion Disease Natural hazard					-	-	-	-	+	+	

- Declining + = Improving 0 = Little or no change

Policy responses are needed for multiple and urgent environmental and social problems. Furthermore, they need to be sustainable and ways to do this are better illustrated by looking at how people interact with ecosystems. In the next section drivers of ecosystem change are identified.

2.1. Drivers of Ecosystem Change in Kenya

People continually modify ecosystems in intended and unintended ways. The MA uses the term "drivers" to describe this interaction and considers a driver to be "any natural or human-induced factor that directly or indirectly causes a change in an ecosystem" (MA 2003, 87). Drivers are categorized as being either "direct" in that it "unequivocally influences ecosystem processes" or "indirect" in that it "operates more diffusely, from a distance, often by altering one or more direct drivers" and can rarely be observed through direct observation of the ecosystem (MA 2003, 87).

Appendix C provides a list of the drivers identified from a review of the case studies cited after the references and how these were evaluated in terms of their significance. Figure 3 lists the summary categories and distinguishes between direct and indirect drivers.

Figure 3. Types of direct and indirect drivers

Direct drivers	Indirect drivers
Changes in local land-use and cover	Demographic
Species introduction or removal	Economic
Technology adaptation and use	Sociopolitical
External inputs	Science and technology
Harvest and resource consumption	Cultural and religious
Climate change	
Natural, physical and biological	

An examination of drivers in Kenya shows the top four categories:[10]

1. local land-use and cover changes;
2. harvest and resource consumption;
3. demographics; and
4. economics.

[10] A complete list of drivers and method of identification is in Appendix D.

Interestingly, land conversion to agriculture, human population increase and deforestation were the most frequently identified specific drivers (not categories) in the case-study literature, thus demonstrating the link between biodiversity loss and population growth. A closer examination of the four most predominant drivers provides further insight into the ongoing trends and changes occurring in Kenya.

Local land-use and land-cover changes

Local land-use and cover changes are largely driven by food and fibre provision. Land conversion to agriculture and deforestation are taking place in many parts of Southern Kenya such as the Embu highlands and the Tana Floodplains. These activities are related to several indirect drivers such as the expansion of mechanized large-scale agriculture (wheat cultivation), growth in trade in horticultural products, sedentarization of pastoralists, population growth and an increasing number of permanent settlements. Furthermore, "the growth in population has outstripped the agricultural capacity of the land in well-watered areas and resulted in migration to drier, low agricultural potential areas designated in official policy as arid and semi-arid areas (ASALs)" (Kameri-Mbote 2005, 1). Migration to and settlement in the ASALs is adversely impacting wildlife as five per cent of Kenya's protected areas are located there, thus exacerbating competition with pastoralists for range resources (Kameri-Mbote 2005, 1). Even in the more sparsely occupied northern areas, many herders are settling in the vicinity of small towns, trade centres, famine relief stations and mechanized water sources, thus contributing to severe environmental degradation on a limited spatial scale.

Land-use and land-cover changes are contributing to land degradation, a serious problem affecting 93 per cent of land in the country. Such changes impact local and regional climatic conditions, which contribute to droughts, thus reducing ecological and protective security and social opportunities (Balling 2005, 41).

Harvest and resource consumption

Harvest and resource consumption is prevalent in Kenya. Forests are particularly vulnerable and are being degraded by activities such as wood demand for tea processing, timber felling for domestic and export markets, agricultural production, urbanization, bushfires and demand for fuel in both rural and urban households (Ardayfio-Schandorf 1998). Fuel demand is largely met through charcoal-use due to the cost and limited availability of commercial alternatives such as kerosene, liquefied petroleum gas (LPG) and electricity (Ardayfio-

Schandorf 1998). Thus charcoal production is extensive. For example, the Kenya Wildlife Service recently discovered 2,465 charcoal kilns in the Mount Kenya reserve (United Nations Office for the Coordination of Humanitarian Affairs 2000). This activity is illegal and operates informally and underground, but provides substantial profit to those involved (Barnett 2003).

Forests provide several important non-wood forest products (NWFP) including fodder, medicinal plants, dye, tannins, essential oils and beeswax (FAO Forestry Department 2003). One example of the importance of such NWFP is the wide use of traditional medicine, which is more affordable than Western-style medicine. Exploitation of wildlife medicinals and associated habitat destruction are, however, jeopardizing many plant populations. Moreover, if this situation continues, the well-being of people in the region also will be threatened (Traffic 1998).

Hunting and poaching of wildlife is common in forests as well and is an important meat source for many households due to its low cost. This "bush meat" is consumed in areas where there are high levels of malnutrition and child stunting and is thought to mitigate even worse health impacts (Traffic 2000). Although used throughout the year, more bush meat is consumed during times of economic hardship such as droughts (TRAFFIC 2000). Increasingly, bush meat is being traded to generate cash income, which is contributing to a decline in wildlife populations that are already being adversely impacted by land-use and land-cover changes. This situation is also contributing to off-take from protected areas and erosion of traditional hunting seasons that allow species to regenerate their numbers.

In addition to forests, wetlands provide vital ecosystem services, but are stressed. Researchers have noted heavy water abstraction from wetlands and over-fishing, thus increasing the risk of floods and reducing biodiversity.

Demographics

Population density in Kenya is highly skewed, with 80 per cent of the population concentrated on 17 per cent of the land area. As the north and northeast areas of the country are arid and not hospitable, population is sparsely scattered and density hardly reaches eight people per square km there, but rises to as much as 280 people per square km or more in western areas where there is a more salubrious climate. Approximately 25 per cent of the population live in urban centres such as Nairobi, Mombasa, Nakuru and Kisumu (Kenya, Central Bureau of Statistics 2003).

Kenya has recently experienced a period of rapid population growth, which is linked to increased forest clearing and fragmentation, in-migration to pastoral areas, the establishment of permanent settlements and so on. Population growth, an indirect driver, contributes to land-use and land-cover changes and rates of resource consumption.

Economics

Economic activities influence rates and method of land-use and land-cover change and resource consumption. Even though subsistence agriculture is widespread in Kenya, commercial and cash crop production provide important sources of income and account for 65 per cent of exports (Kenya Project 2002). Industrial and cash crops include coffee, tea, pyrethrum, flowers and cotton, and these crops cover 500,000 ha of cultivated land (FAO Land and Water Development Division 2005). Horticulture is the fastest growing sector of Kenya's economy, earning over US$270 million in 2000, with cut flowers alone providing US$110 million (FAO 2002). Although this industry began in 1972, revenues from it now compete with Kenya's traditional hard currency earners such as tea, coffee and tourism and generate vital income for households (FAO 2002). In Central Kenya's Nyeri, for example, over 5,500 women's groups grow high-value export crops such as flowers, snow peas and legumes as alternatives to subsistence farming (FAO 2002).

The tourism sector accounts for approximately 19 per cent of Kenya's GDP and is the second largest foreign exchange earner (Association for Strengthening Agricultural Research in Eastern and Central Africa 2002; Kenya 2000). Tourism is primarily located in two areas. One is the savannas that are home to large charismatic wildlife; the other is the coast where tourism is having a negative impact largely due to an increase in the number of hotels being built and the clearing of mangrove forests. Mangroves are also highly threatened by other economic activities such as: prawn farming; export demand for poles; and extraction of salt, tannins and dyes.

As the description of the four predominant drivers shows, interactions between ecosystems and people are dynamic and linked and development strategies need to consider these linkages if they are to be effective. The government's development strategy is laid out in the most recent Poverty Reduction Strategy Paper, but the extent to which it might improve well-being by addressing necessary institutional reforms related to ecosystems and poverty needs to be determined.

2.2. A Way Forward: Evaluating Kenya's PRSP

Kenya's response to poverty is detailed in their 2005 Poverty Reduction Strategy Paper (PRSP). Coined as the "Economic Recovery Strategy for Wealth and Employment Creation" (ERS), it started with the 2003/04 budget, and is based on three main streams, namely "economic growth," "equity and poverty reduction" and "governance" (Kenya 2004b I.2). Numerous activities and policies (i.e., responses) are listed under each of these three streams in the PRSP logic framework matrix. Of these, 35 were judged[11] to be responses directly linked to improving ecosystems and reducing poverty that could be evaluated using the paper's ecosystem-poverty framework (Table 3).[12] Hence, this sub-set of 35 responses is drawn from support-led PRSP responses, which fall under the "equity and poverty reduction" and "governance" streams and not the economic growth stream, thus leaving out macroeconomic stability and financial sector reforms, infrastructure improvements not in the other sections and production sector growth.

Response effectiveness

Chambers *et al*. (2005, 57) developed a method to evaluate the effectiveness of the main categories of responses, (i.e., actions, policy interventions) by assessing their impacts on the direct and indirect drivers of ecosystem change for the MA. This method includes:

1. establishing the extent to which a given response is expected to modify the driver on a scale of one to five, with five indicating highest expected effectiveness; and
2. showing the proximity of the response to the driver in a chain of cause-effect mechanisms. The higher number on a scale of one to five indicates a smaller number of transmission steps.

This method is employed here to evaluate two aspects of development: response effectiveness in addressing ecosystem services and poverty; and the first four key drivers of ecosystem change. Table 5 lists PRSP responses (actions and/or policy interventions) by instrument freedom, type of response based on the above referenced MA typology, and likely impact on the four key drivers for Kenya.

---

[11] These results are open to interpretation as many of the PRSP responses were items in a list with little, if any, description.

[12] Strategic interventions (responses) are listed for each instrumental freedom in Duraiappah 2004. Responses in the PRSP that corresponded to those listed by Duraiappah were selected.

PRSP responses linked to instrumental freedoms

The majority of responses relate to improving social opportunities; namely health, water, education, housing, transport and energy (Table 5). Moreover, some are aimed specifically at poor, ASAL and rural communities. Responses to improve economic facilities also target rural communities and areas and include: support for the agriculture sector; the provision of micro-credit; and fostering eco-tourism and wildlife conservation enterprises. Ecosystem services responses are much less focused though. They mainly include the implementation of several pieces of environmental legislation such as the Forestry Act and National Environment Action Plan as well as broad agendas such as the WSSD and MDGs, but do not stipulate how this will be done. One response to improve ecological surety, which is to work with local communities in the conservation of wildlife and benefit-sharing, is slightly more specific though.

Provisions to improve transparency guarantees, protective security and participative freedom are included, but less extensive. Transparency guarantees receive the most attention and include two anti-corruption measures, local-level government reform and better dissemination of government information. Protective security is to be enhanced by improving food security and drought management and strengthening security in the ASALs where conflicts and cattle raids proliferate. Participative freedom, however, receives little attention. Only one response addressed the decentralization of decision-making to stakeholders and this was in the area of education.

Overall, PRSP responses mainly address all the instrumental freedoms except participative freedom and only generally address ecological surety. Efforts to alleviate poverty through improved health care, education and the provision of infrastructure are laudable, but if people are to benefit, then ecosystem functioning and hence ecosystem services must be drastically improved. People cannot exist over longer periods of time without clean water, food, shelter and fuel. While addressing ecological surety through domestic regulation, law implementation and better environmental management would go a long way to helping development, the actual commitment by the government to do so appears to be low. Transparency guarantees and participative freedom are also vital to this enterprise. Specifically, better environmental management rests on participation in decision-making, and this instrumental freedom is given the least attention in the PRSP. One response, though, namely fostering eco-tourism and wildlife conservation enterprises, would improve both economic facilities and ecological surety.

PRSP responses linked to the drivers

The PRSP includes a range of legal, economic, social and behavioural and cognitive response options with social and behavioural and legal responses used most frequently (Table 5). The question is whether these are the more effective responses for the previously identified key drivers in Kenya. To answer this question, each of the four predominant drivers is considered in turn by comparing the PRSP responses to the most effective available response options for that driver (Table 5).

Table 5. Instrumental freedom/PRSP response/response type/effectiveness of drivers

Instrumental freedom	Responses listed in PRSP related to instrumental freedoms	Type of response (MA typology)	Driver 1: Local land-use and land-cover changes	Driver 2: Harvest and resource consumption	Driver 3: Demographics	Driver 4: Economics
Ecological surety	Work with local communities in conservation of wildlife and benefit-sharing; manage human–wildlife conflicts and strengthen KWS capacity	Social and behavioural: empowering communities	4/5	4/5	3/4	4/4
	Implement Forestry Development Policy; enforce Forestry Act	Legal: domestic environmental regulation	5/5	5/5	5/5	5/5
	Implement the National Environment Action Plan, Environment Management Coordination Act, WSSD and MDG; Lake Victoria Environmental Management Project; and consolidate National Environment Management Authority functions	Legal: international treaties	2/1	1/1	n/a	4/4
Economic facilities	Foster community-based eco-tourism and wildlife conservation by supporting new SMEs	Economic: financial/monetary measures	4/5	3/3	3/5	5/5
	Develop a coherent land policy to address land use and administration, land tenure and land delivery systems	Legal: domestic administrative law	4/4	3/3	2/3	2/3
	Implement a broad-based livestock development policy	Economic: incentive-based	4/5	5/5	3/5	5/5

Instrumental freedom	Responses listed in PRSP related to instrumental freedoms	Type of response (MA typology)	Driver 1: Local land-use and land-cover changes	Driver 2: Harvest and resource consumption	Driver 3: Demographics	Driver 4: Economics
	Promote commercialization of farm products by reducing costs for transport, fuel taxes, irrigation and electricity, and improving access to market information	Economic: incentive-based	4/5	5/5	3/5	5/5
	Micro-credit: Build institutional capacity to deliver micro-finance services to the poor	Economic: financial/monetary measures	4/5	3/3	3/5	5/5
	Micro-credit: Enact Micro Finance Institutions Act	Legal: domestic legislation outside environmental sector	3/4	3/4	5/5	5/5
	Provide crop and livestock information services through radio, bulletins, Internet and so on	Social and behavioural: public education and awareness	3/5	3/5	n/a	4/5
Participative freedom	Decentralize decision-making to district and school-level administrators and parents' organizations	Social and behavioural: empowering communities	4/5	4/5	3/4	4/4
Protective security	Strengthen food distribution and targeting mechanism; develop and implement disaster management policy and establish community-based drought early warning systems	Social and behavioural: public education and awareness (partial)	3/5	3/5	4/5	4/5
	Strengthen security apparatus in ASALs; ensure that customary mechanisms for conflict resolution are recognized; and increase border surveillance	Cognitive: legitimization of traditional knowledge	3/5	3/5	2/5	2/5
Social opportunities	Improve child and maternal health	Social and behavioural: empowering women	4/5	4/5	3/4	4/4
	Improve cross-sector cooperation for health promotion and public health	Legal: domestic administration law	4/4	3/3	2/3	2/3

Instrumental freedom	Responses listed in PRSP related to instrumental freedoms	Type of response (MA typology)	Driver 1: Local land-use and land-cover changes	Driver 2: Harvest and resource consumption	Driver 3: Demographics	Driver 4: Economics
	Investments in pro-poor health: immunization, HIV treatment, mortality rate for malaria, cure rate for TB and urban health services for poor	Social and behavioural: empowering communities	4/5	4/5	3/4	4/4
	Strengthen community-based health care systems in pastoralist communities	Social and behavioural: empowering communities	4/5	4/5	3/4	4/4
	Clean water: government in partnership with CBOs and private providers carries out programs to extend WSS to urban poor and rural communities	Social and behavioural: empowering communities	4/5	4/5	3/4	4/4
	Clean water: implement 2002 Water Act	Legal: domestic environmental regulations	5/5	5/5	5/5	5/5
	Drill boreholes	Social and behavioural: empowering communities	4/5	4/5	3/4	4/4
	Rehabilitate dams and pans; 20 irrigation systems; irrigation canals and flood control dikes	Social and behavioural: empowering communities	4/5	4/5	3/4	4/4
	Enact housing legislation to facilitate private-sector development of affordable housing	Social and behavioural: empowering communities	4/5	4/5	3/4	4/4
	Education: ensure equitable enrollment	Social and behavioural: public education and awareness	3/5	3/5	4/5	4/5
	Education: promote ICT adoption and skill development	Social and behavioural: public education and awareness	3/5	3/5	4/5	4/5
	Initiative: an out-of-school program for pastoralist children	Social and behavioural: public education and awareness	3/5	3/5	4/5	4/5

Instrumental freedom	Responses listed in PRSP related to instrumental freedoms	Type of response (MA typology)	Driver 1: Local land-use and land-cover changes	Driver 2: Harvest and resource consumption	Driver 3: Demographics	Driver 4: Economics
	Provide learning materials and improve the learning environment	Social and behavioural: public education and awareness	3/5	3/5	4/5	4/5
	Improvement and rehabilitation of rural roads and bridges under Road 2000 program	Social and behavioural: empowering communities	4/5	4/5	3/4	4/4
	Mainstreaming gender: National Gender and Development Commission; Sessional Paper of Gender and Development	Social and behavioural: empowering women	4/5	4/5	3/4	4/4
	Youth and vulnerable groups: policy development, improve targeting and programming	Social and behavioural: empowering youth	3/4	3/4	2/3	3/3
	Implement rural energy program	Social and behavioural: empowering communities	4/5	4/5	3/4	4/4
Transparency guarantees	Mount anti-corruption campaign involving stakeholders and community leaders	Legal: domestic legislation outside the environmental sector	3/4	3/4	5/5	5/5
	Prepare a five-year anti-corruption strategy	Legal: domestic legislation outside the environmental sector	3/4	3/4	5/5	5/5
	Deepen local government reforms including enacting the Kenya Local Government Reform program	Legal: domestic legislation outside the environmental sector	3/4	3/4	5/5	5/5
	Develop strategy to improve public sector efficiency in agriculture and livestock	Cognitive: knowledge acquisition and acceptances	3/5	3/5	2/5	2/5
	Implement e-government services	Social and behavioural: public education and awareness	3/5	3/5	4/5	4/5

First entry = effectiveness of the response in influencing the driver. On a scale of 1 to 5, high marks indicate the high expected effectiveness of the response.
Second entry = proximity of the response option to the targeted driver (i.e., how long is the chain of the cause-effect mechanisms from the response to the driver). The smaller the number of transmission steps in the response process, the higher the number (Chambers *et al*. 2005, 57).

Driver 1. Land-use and land-cover change

Most effective response options for this driver using MA method (5/5 and 4/5 rating):

- domestic environmental regulations (legal);
- command-and-control interventions (economic);
- incentive-based (economic);
- financial/monetary measures (economic);
- empowering communities (social and behavioural); and
- empowering women (social and behavioural).

(responses used in PRSP are highlighted)

The PRSP uses all of these options except command-and-control interventions, indicating that if all of these measures were implemented, then there would be some degree of influence on rates and types of land-use and land-cover change.

Driver 2. Harvest and resource consumption

Most effective response options for this driver using MA method (5/5 and 4/5 rating):

- domestic environmental regulations (legal);
- command-and-control interventions (economic);
- incentive-based (economic);
- empowering communities (social and behavioural);
- empowering women (social and behavioural); and
- incentives for innovation and R&D.

(responses used in PRSP are highlighted)

The PRSP uses all these responses except command-and-control interventions and incentives for innovation and R&D. Hence, some impact on harvest and resource consumption can be expected, but this impact would probably be stronger with a full complement of responses.

Driver 3. Demographics

Most effective response options using the MA method (5/5 and 4/5 ratings):

- domestic environmental regulations (legal);
- domestic legislation outside the environmental sector (legal);
- command-and-control interventions (economic);

- population policies (social and behavioural);
- domestic constitutional law (legal); and
- public education and awareness (social and behavioural).

(responses used in PRSP are highlighted)

In this case the PRSP does not use three of the six most effective options suggesting much less success in influencing demographics using the present strategy.

Driver 4. Economics

Most effective response options using the MA method (5/5 and 4/5 ratings);

- international customary law (legal);
- domestic environmental regulations (legal);
- domestic legislation outside the environmental sector (legal);
- command-and-control interventions (economic);
- incentive-based (economic);
- financial/monetary measures (economic);
- international trade policies (economic); and
- public education awareness (social and behavioural).

(responses used in the PRSP are highlighted)

Three of these responses are not used in the PRSP, namely international customary law, command-and-control interventions and international trade policies, though in this case international trade policies are listed in other parts of the PRSP that were not directly linked to the instrumental freedoms and hence not used in this analysis.

Table 6. Response option/number of times used in PRSP

	Response Option	No. times used in PRSP sub-set
Legal	International treaties	1
	International soft law	0
	International customary law	0
	International agreements outside the environmental sector	0
	Domestic environmental regulations	2
	Domestic administrative law	2
	Domestic constitutional law	0
	Domestic legislation outside the environmental sector	4
Economic	Command-and-control interventions	0
	Incentive-based	2
	Voluntarism-based	0
	Financial/monetary measures	2
	International trade policies	0
Social and behavioural	Population policies	0
	Public education and awareness	7
	Empowering communities	10
	Empowering women	2
	Empowering youth	1
	Civil society protect and disobedience	0
Technological	Incentives for innovation and R&D	0
Cognitive	Legitimization of traditional knowledge	1
	Knowledge acquisition and acceptance	1

Overall response effectiveness in addressing drivers

This mix of PRSP responses would be most effective at controlling land-use and land-cover change, harvest and resource consumption and economic drivers, and less successful at addressing the demographic driver. Domestic environmental regulations and command-and-control interventions are highly effective in controlling all four drivers; however, only the former is used in the PRSP. Moreover, even though the PRSP lists the implementation of several pieces of domestic environmental regulation—including the "Forest Development Policy," "National Environmental Action Plan," the "Environment Management

Coordination Act" and the "World Summit on Sustainable Development" agenda—there is no implementation strategy in the PRSP. If implementation does indeed happen, then all four drivers would be addressed.

Economic command-and-control interventions, a response not used in the PRSP, are promoted by financial penalties rather than anti-criminal measures and includes banning access to ecosystem services, prescribing particular types of land use, fixed quota systems and so on. While rated as a highly effective response option, the level of poverty in Kenya and mix of property rights including traditional communal lands, suggests that it may not be that effective in this particular situation. For example, poor people in many areas are already encroaching on protected areas for the basic necessities of life such as wood fuel and bush meat and doing so illegally.

Incentive-based interventions are considered effective in controlling three of the four drivers, namely land-use and land-cover change, harvest and resource consumption and economic drivers. In the PRSP, the two incentive-based responses include: subsidies to the agriculture sector that involve reducing transport and input costs; and implementing broad-based livestock development involving livestock marketing, water provision, animal health delivery and so on. As these incentives are narrowly applied to income poverty alleviation, the other instrumental freedoms, such as ecological surety, are not directly addressed.

Responses for controlling the drivers also address instrumental freedoms. For example, the most effective response for all four drivers, namely domestic environmental regulations, is linked to both ecosystem services and social opportunities; while incentive-based responses effective for controlling three of the drivers are linked to economic facilities (Table 5). Empowering communities, which is effective for controlling "land-use and land-cover change" and "habitat and resource consumption" drivers, affects ecological surety, participative freedom and social opportunities (Table 5). Public education and awareness, which is linked to economic facilities, protective security, social opportunities and transparency guarantees, is effective in controlling only the demographic and economic drivers (Table 5).

3.0. Conclusions

Sen's capabilities approach with the addition of ecological surety was used to assess human well-being in Kenya and link human development to ecosystems. To clarify poverty–ecosystem links, we identified predominant ecosystem–people interactions and related them to instrumental freedoms by pointing out some

policy response options that address these interactions and support development at the same time. One of the primary pillars of the PRSP, namely economic growth, was not included in the analysis, as the emphasis was on support-led development processes.

By using instrumental freedoms to assess the well-being of people in Kenya, we took the approach that poverty, defined as pronounced deprivation of well-being, is best alleviated through the enlargement of human capabilities rather than economic growth. Furthermore, healthy and bio-diverse ecosystems are essential for human development. When the human well-being of Kenya was assessed, we found low scores for all instrumental freedoms, indicating high levels of poverty overall, along with declining biodiversity and land degradation in most parts of the country.

A particularly enlightened set of policy responses is needed for multiple and urgent environmental and social problems. To make sense of such an extensive agenda, the four predominant ecosystem-human interactions, (i.e., drivers), were identified and policy responses in Kenya's latest PRSP that supported instrumental freedoms, were evaluated for their effectiveness in addressing them.

The most effective PRSP responses for controlling land-use and land-cover change, habitat and resource consumption, demographic and economic drivers included the implementation of domestic environmental legislation including the Forestry Act, the National Environment Action Plan and others; stimulating economic facilities by subsidizing the agriculture sector and more specifically pastoralists in ASALs; empowering communities through the provision of health care, education, water, roads, energy and housing; and empowering women by mainstreaming gender. Other responses that were rated as effective, though not used as frequently, included domestic legislation outside the environmental sector such as enacting the Micro Finance Institutions Act; anti-corruption measures; and financial/monetary measures that include delivering micro-credit and supporting new SMEs undertaking community-based eco-tourism and wildlife conservation.

Command-and-control interventions, a response option rated as highly effective in controlling all four drivers, was not used in the PRSP. Given the level of poverty in Kenya, it is doubtful that this policy response, which uses monetary penalties, would work.

PRSP responses to drivers also address instrumental freedoms, the implementation of domestic environmental regulation is, for example, linked to ecological surety and social opportunities. Such synergies provide guidance to policy-makers on how to develop in more sustainable ways.

References

Ardayfio-Schandorf, Elizabeth. 1998. *Fuelwood/energy crisis in Sub-Saharan Africa*. http://www.unu.edu/unupress/unupbooks/80918e/80918E0u.htm

Association for Strengthening Agricultural Research in Eastern and Central Africa. 2002. *Foodnet: Marketing and Post-harvest Research in Eastern and Central Africa. Market Information*. http://www.foodnet.cgiar.org/market/Kenya/Kenya.htm#cashcrops

Balling, Robert C. 2005. "Interactions of desertification and climate in Africa," in *Climate Change and Africa*, by Pak Sum Low. Cambridge: Cambridge University Press. p. 369.

Barnett, Rob. 2003. "Black gold: Searching for a sustainable alternative to charcoal," *Dispatches* (20, February 2003). Retrieved from the WWW August 2006. http://www.traffic.org/dispatches/feb2003/black_gold.html

British Broadcasting Corporation. 2004. "Crisis. Kenya faces food shortage," August 17, 2004. http://www.planusa.org/contentmgr/showdetails.php/id/683

Chambers, W. Bradnee *et al*. 2005. "Typology of responses," in *Ecosystems and human well-being: policy responses: findings of the Responses Working Group of the Millennium Ecosystem Assessment. Volume 3*. Eds. Chopra, Kanchan *et al*. Washington, D.C: Island Press. p. 621.

Chopra, Kanchan *et al*. eds. 2005. *Ecosystems and human well-being: Policy responses. Findings of the Responses Working Group of the Millennium Ecosystem Assessment. Volume 3*. Washington, D.C.: Island Press. p. 621.

Christiaensen, Luc J. and Kalanidhi Subbarao. 2005. "Towards an understanding of household vulnerability in rural Kenya," *Journal of African Economies.* Vol. 14 (4): 520–558.

Delamonica, Enrique and Santosh Mehrotra. 2006. *A capability centred approach to environmental sustainability: Is productive employment the missing link between micro- and macro policies?* Working Paper No. 13. Brasilia: UNDP International Poverty Centre. p. 22. http://www.sarpn.org.za/documents/d0001955/index.php

Duraiappah, Anantha Kumar. 2004. *Exploring the links: Human well-being, poverty and ecosystem services*. Nairobi: UNEP; Winnipeg: IISD. p. 44.

Duraiappah, Anantha Kumar and Arun Abraham. 2004. "Ecological surety and capabilities: normative issues." Working draft in progress. [Paper for] 4th International Conference on the Capability Approach: Enhancing Human Security September 5–7, 2004, University of Pavia, Italy. [s.l.]: [The authors]. p. 25.

Duraiappah, Anantha Kumar and Shahid Naeem. 2005. *Ecosystems and human well-being: Biodiversity synthesis*. A report of the Millennium Ecosystem Assessment. Washington, D.C.: Island Press. p. 86.

Economic Commission of Africa. 2003. *Poverty mapping for selected African countries*. http://www.uneca.org/eca_resources/Publications/ESPD/PovertyProfiles.pdf

FAO. 2000. "FAO appeals for more than US$30 million emergency aid fro the Horn of Africa," *News and Highlights*. http://www.fao.org/News/2000/000601-e.htm

FAO. 2002. "A thorn on every rose for Kenya's flower industry," *Newsroom*. http://www.fao.org/english/newsroom/news/2002/3789-en.html

FAO. Forestry Department. 2003. *Country profile: Kenya.* http://www.fao.org/forestry/foris/webview/forestry2/index.jsp?siteId=2181&sitetreeId=5966&langId=1&geoId=73

FAO. Land and Water Development Division. 2005. "Aquastat: Country profiles: Kenya [html]." http://www.fao.org/ag/agl/aglw/aquastat/countries/kenya/index.stm

FAO. Land and Water Development Division. 2005a. *Terrastat*. Last update 2005. http://www.fao.org/ag/agl/agll/terrastat/index.asp

Freedom House. "Freedom in the world: Kenya." http://www.freedomhouse.org/template.cfm?page=22&year=2004&country=2960

Freeman, H. Ade, F. Ellis and E. Allison. 2004. "Livelihoods and rural poverty reduction in Kenya," *Development Policy Review.* Vol. 22 (2): 147–171.

IUCN The World Conservation Union – IUCN Species Survival Commission. 2005. *IUCN red list of threatened species*. Retrieved from the WWW December 2005. http://www.redlist.org/

Kameri-Mbote, Patricia. 2005. *Land tenure, land use and sustainability in Kenya: Towards innovative use of property rights in wildlife management*. IELRC Working Paper 2005–4. Geneva: International Environmental Law Research Centre. p. 25.

Kenya. 2000. *Interim Poverty Reduction Strategy Paper 2000–2003*. July 13, 2000. http://www.imf.org/external/NP/prsp/2000/ken/01/INDEX.HTM#II

Kenya. 2004. *Climate change impacts/vulnerability assessments and adaptation options*. Nairobi: Kenya. National Environment Management Authority. pp. 36–42

Kenya. 2004a. *Climate change mitigation options*. Nairobi: Kenya. National Environment Management Authority. pp. 111–162.

Kenya. 2004b. Investment programme for the economic recovery strategy for wealth creation 2003–2007. IMF Country Report 05/11. Nairobi: Kenya, 2004. p. 105. http://www.imf.org/external/pubs/ft/scr/2005/cr0511.pdf

Kenya. 2004c. *Kenya: Enabling activities for the preparation of initial national communication related to the UNFCCC*. Nairobi: Kenya. National Environment Management Authority, 2004, p. 35.

Kenya. Central Bureau of Statistics. 2001. "National energy consumption [html]." Retrieved January 2007. http://www.cbs.go.ke/sectoral/energy/energy_hsehld_energy_cons.htm

Kenya. Central Bureau of Statistics. 2006. "Energy consumption [html]." Retrieved January 2007. http://www.cbs.go.ke/sectoral/energy/energy_population.html

Kenya. Central Bureau of Statistics *et al*. 2003. *Kenya demographic and health survey 2003: Preliminary report*. Nairobi: Kenya Central Bureau of Statistics. p. 39. http://www.afronets.org/files/KenyaDHS2003.pdf

Kenya. Ministry of Environment and Natural Resources. 2000. *A summary of the Kenya National Biodiversity Strategy and Action Plan*. Nairobi: Kenya. Ministry of Environment & Natural Resources. p. 37.

Kenya. Ministry of Planning and National Development. 2005. *MDGs status report for Kenya*. Nairobi: The Ministry. p. 40. http://www.undg.org/documents/6585-Kenya_Second_MDG_Report_-_Report.pdf

Kenya Project. 2002. "About Kenya." University of Cambridge. http://www.cam.ac.uk/societies/kenyap/kenya.html

Khosla, Romi and Jane Samuels. 2005. *Removing unfreedoms: Citizens as agents of change in urban development*. London: ITDG Publishing. p. 188.

Kilbourne, William E. 2006. "The role of the dominant social paradigm in the quality of life/environment interface," *Applied Research in Quality of Life*. Vol. 1: 39–61.

Millennium Assessment. 2003. *Ecosystems and human well-being: A report of the Conceptual Framework Working Group of the Millennium Ecosystem Assessmen*t. Washington, D.C.: Island Press. p. 245.

Milton, Kay. 1996. *Environmentalism and cultural theory: Exploring the role of anthropology in environmental discourse*. New York: Routledge. p. 266.

Ochieng, Zachary. 2003. News from Africa. "Lake Victoria chokes under the water hyacinth," http://www.newsfromafrica.org/newsfromafrica/articles/art_783.html

Odhiambo, Walter. 2004. *Pulling apart: Facts and figures on inequality in Kenya*. Nairobi: Society for International Development. Eastern Africa Regional Office, pp. xiv, 70. http://www.sidint.org/Publications/Docs/pulling-apart.pdf

Oywa, John. 2003. "Kenya: Outrage at pollution of Lake Victoria." *Water Conservation Portal*. http://www.waterconserve.info/articles/reader.asp?linkid=23104

Reid *et al*. 2005. *Ecosystems and human well-being: Synthesis*. Washington, D.C.: Island Press. p. 137.

Scholes, R. J. and Biggs, R. "A biodiversity intactness index," *Nature*. Vol. 434: 45–49.

Sen, Amartya. 1999. *Development as freedom*. New York: Anchor Books, pp. xvi, 366.

United Nations Development Programme. *Human development report*. New York: UNDP.

TRAFFIC: the wildlife trade monitoring network. 1998. *Searching for a cure: Conservation of medicinal wildlife resources in East and Southern Africa*. Retrieved from the WWW, August 2006. http://www.traffic.org/africa/discussion.html

TRAFFIC: the wildlife trade monitoring network. 2000. *Food for thought: The utilization of wild meat in Eastern and Southern Africa*. Retrieved from the WWW, August 2006. http://www.traffic.org/bushmeat/

Transparency International. 2006. "Corruption perceptions index," http://www.transparency.org/policy_research/surveys_indices/cpi

United Nations. International Strategy for Disaster Reduction and Universite catholique de Louvain Centre for Research on the Epidemiology of Disasters. 2005. Disasters in numbers. http://www.em-dat.net/figures_2005.htm

United Nations Environment Programme. 2004. UNEP.net. Kenya. http://www.unep.net/profile/index.cfm?countrycode=KE

United Nations Office for the Coordination of Humanitarian Affairs. 2000. "Deforestation Threatening in Kenya," *AfrolNews*. http://www.afrol.com/Categories/Environment/env033_kenya_deforest.htm

Universite catholique de Louvain. 2006. "Country profile for natural disasters: Kenya." EM-DAT: The OFDA/CRED international disaster database. http://www.em-dat.net/disasters/Visualisation/profiles/natural-table-emdat.php?country=Kenya&Submit=Display+Country+Profile#summarized%20table

World Health Organization. Regional Office for Africa. *Malaria country profiles: Kenya*. http://www.afro.who.int/malaria/country-profile/kenya.pdf

World Resources Institute. 2003. "Economic Indicators: Kenya," *Earthtrends: Country Profile*. http://earthtrends.wri.org/pdf_library/country_profiles/Eco_cou_404.pdf

World Wildlife Fund. *Wildfinder: Mapping the world's species* [database]. Retrieved on December 8, 2005. http://www.worldwildlife.org/wildfinder/

Abuodha, P. A. W. and J. G. Kairo. 2001. "Human-induced stresses on mangrove swamps along the Kenya coast," *Hydrobiologia.* Vol. 458 (1–3): 255–265.

Akotsi, Eric and Michael Gachanja. 2004. *Changes in forest cover in Kenya's five "water towers" 2000–2003*. Nairobi: Kenya. Department of Resource Survey and Remote Sensing/Kenya Forests Working Group, 2004. p. 56. http://www.kenyaforests.org/reports/changesNOV2004web.pdf

Alidina, Hussein M. 2005. "Local level fisheries management in Diani-Chale, Kenya: current status and future directions," *Coastal Management.* Vol. 33 (4): 459–470.

Aloo, P. A. 2003. "Biological diversity of the Yala Swamp alkes, with special emphasis on fish species composition, in relation to changes in the Lake Victoria Basin (Kenya): Threats and conservation measures," *Biodiversity and Conservation.* Vol. 12 (5): 905–920.

Bagine, Richard K. N. 1998. "Biodiversity in Ramogi Hill, Kenya and its evolutionary significance," *African Journal of Ecology.* Vol. 36 (3): 251–263.

Barbier, Edward B. 2000. "The economic linkages between rural poverty and land degradation: some evidence from Africa," *Agriculture, Ecosystems and Environment.* Vol. 82 (1): 355–370.

Bernard, Kigomo N. *State of forest genetic resources in Kenya*.

Campbell, David J. *et al*. 2000. "Land use conflict in Kajiado District, Kenya," *Land Use Policy.* Vol. 17 (4): 337–348.

Daniels, Robert and Thomas J. Bassett. 2002. "The spaces of conservation and development around Lake Nakuru National Park, Kenya," *Professional Geographer.* Vol. 54 (4): 481–490.

de Leeuw, Jan *et al*. 2001. "Distribution and diversity of wildlife in northern Kenya in relation to livestock and permanent water points," *Biological Conservation.* Vol. 100 (3): 297–306.

Eriksen, Siri. 2005. "The role of indigenous plants in householde adaptation to climate change: the Kenyan experience," in *Climate change and Africa*, ed. Pak Sum Low. Cambridge, MA: Cambridge University Press. pp. xii, 369.

Erixon, Fredrik. 2003. "Poverty and recovery: The history of aid and development in East Africa," *Economic Affairs.* Vol. 23 (4): 27–33.

Gichuki, J. *et al*. 2001. "Species inventory and the local uses of the plants and fishes of the Lower Sondu Miriu wetland of Lake Victoria, Kenya," *Hydrobiologia.* Vol. 458 (1–3): 99–106.

Githinji, Mwangiwa. 2000. "Income distribution and dualism: the case of Kenya," *Review of Development Economics.* Vol. 4 (3): 326–339.

Homewood, Katherine, Ernestina Coast and Michael Thompson. 2004. "In-migrants and exclusion in East African rangelands: access, tenue and conflict," *Africa: Journal of the International African Institute.* Vol. 74 (4): 567–610.

Imbernon, Jacques. 1999. "Pattern and development of land-use changes in the Kenya highlands since the 1950s," *Agriculture, Ecosystems and Environment.* Vol. 76 (1): 67–73.

Jayne, T. S. *et al*. 2003. "Smallholder income and land distribution in Africa: Implications for poverty reduction strategies," *Food Policy.* Vol. 28 (3): 253–275.

Kabubo-Mariara, Jane and Godfrey K. Ndeng'e. 2004. *Measuring and monitoring poverty: The case of Kenya*. Paper presented at the Poverty Analysis and Data Initiative (PADI) Workshop on Measuring and Monitoring Poverty, Mombasa, Kenya, May 7–8, 2004. [s.l.]: [Kabubo-Mariara Economics Department University of Nairobi and Ndeng'e Central Bureau of Statistics Ministry of Planning and National Development [Kenya]. p. 27.

Khaemba, Wilson M. and Alfred Stein. 2001. "Spatial statistics for modeling of abundance and distribution of wildlife species in the Masai Mara ecosystem, Kenya," *Environmental and Ecological Statistics.* Vol. 8 (4): 345–360.

Kirubi, C., W. N. Wamicha and J. K. Laichena. 2000. "The effects of woodfuel consumption in the ASAL areas of Kenya: the case of Marsabit Forest," *African Journal of Ecology.* Vol. 38 (1): 47–52.

Koyo, Anderson *et al*. "BINU project: Kenya: Biodiversity indicators for national use. National indicator fact sheets report," [s.n.; s.l.] p. 28.

Kristjanson, P. *et al*. *Pathways out of poverty in Western Kenya and the role of livestock*. International Livestock Research Institute. Pro-poor Livestock Policy Initiative, Series title: PPLPI Working Paper No. 14. URL: http://www.fao.org/ag/againfo/projects/en/pplpi/docarc/wp14.pdf

Mokaya, Sophia, Jude M. Mathooko and Maria Leichtfried. 2004. "Influence of anthropogenic activities on water quality of a tropical stream ecosystem," *African Journal of Ecology.* Vol. 42 (4): 281–288.

Neven, David and Thomas Reardon. 2004. "The rise of Kenyan supermarkets and the evolution of their horticulture product procurement systems," *Development Policy Review* Vol. 22 (6): 669–699.

Oba, G., N. C. Stenseth and R. B. Weladji. 2002. "Impacts of shifting agriculture on a floodplain woodland regeneration in dryland, Kenya," *Agriculture, Ecosystems and Environment.* Vol. 90 (2): 211–216.

Odhiambo, Walter. 2004. *Pulling apart: facts and figures on inequality in Kenya*. Nairobi: Society for International Development. Eastern Africa Regional Office. pp. xiv, 70.

Oindo, B. O. and A. K. Skidmore. 2003. "Mapping habitat and biological diversity in the Maasai Mara ecosystem," *International Journal of Remote Sensing.* Vol. 24 (5): 1053–1069.

Okello, Moses Makonjio and John Warui Kiringe. 2004. "Threats to biodiversity and their implications in protected and adjacent dispersal areas of Kenya," *Journal of Sustainable Tourism.* Vol. 12 (1): 55–69.

Ottichilo, Wilbur K. *et al*. 2000. "Population trends of large non-migratory wild herbivores and livestock in the Masai Mara ecosystem, Kenya, between 1977 and 1997," *African Journal of Ecology.* Vol. 38 (3): 202–216.

Pakia, M. and J. A. Cooke. 2003. "The ethnobotany of the Midzichenda tribes of the coastal forest areas in Kenya: 1. general perspective and non-medicinal plant uses," *South African Journal of Botany.* Vol. 69 (3): 370–381.

Reid, R. S. *et al*. 2005. "The changing face of pastoral systems in grass-dominated ecosystems of eastern Africa," in *Grasslands of the world*, (eds.) J. M. Suttie, S. G. Reynolds and C. Batello. Rome: FAO. pp. xxii, 514.

Schwartz, H. Jurgen. 2005. "Ecological and economic consequences of reduced mobility in pastoral livestock production systems," in *As pastoralists settle: social, health, and economic consequences of pastoral sedentarization in Marsabit District, Kenya*, (eds.) Elliot Fratkin and Eric Abella Roth. New York: Kluwer Academic Publishers. pp. x, 280.

Serneels, S., M. Y. Said and E. F. Lambin. 2001. "Land cover changes around a major east African wildlife reserve: the Mata ecosystem (Kenya)," *International Journal of Remote Sensing.* Vol. 22 (7): 3397–3420.

Serneels, Suzanne and Eric F. Lambin. 2001. "Proximate causes of land-use change in Narok District, Kenya: a spatial statistical model," *Agriculture, Ecosystems and Environment.* Vol. 85 (1): 65–81.

Sorbo, Gunnar M. 2003. "Pastoral ecosystems and the issue of scale," *Ambio.* Vol. 32 (2): 113–117.

Stave, Jorn *et al*. 2003. "Spatial and temporal woodland patterns along the lower Turkwel River, Kenya," *African Journal of Ecology.* Vol. 41 (3): 224–236.

Taylor, Michelle, Corinna Ravilious and Edmund P. Green. *Mangroves of East Africa*.

Terer, Taita, George G. Ndiritu and Nathan N. Gichuki. "Socio-economic values and traditional strategies of managing wetland resources in Lower Tana River, Kenya," *Hydrobiologia.* Vol. 527 (1): 3–14.

Thenya, Thuita. 2001. "Challenges of conservation of dryland shallow waters, Ewaso Narok swamp, Laikipia District, Kenya," *Hydrobiologia.* Vol. 458 (1-3): 107–119.

Wahungu, G. M. *et al*. 2005. "Changes in forest fragment sizes and primate population trends along the River Tana floodplain, Kenya," *African Journal of Ecology.* Vol. 43 (2): 81–90.

Walpole, Matthew J., Moriaso Nabaala and Charles Matankory. 2004. "Status of the Mara Woodlands in Kenya," *African Journal of Ecology.* Vol. 42 (3): 180–188.

Waswa, Fushaka, C. K. K. Gachene and Helmut Eggers. 2002. "Assessment of erosion damage in Ndome and Ghazi, Taita Taveta, Kenya: towards an integrated erosion management approach," *GeoJournal.* Vol. 56 (3): 171–176.

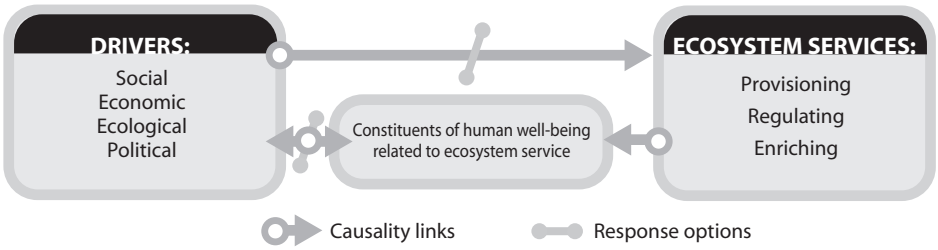
Western, D. and D. L. Manzolillo Nightingale, in AEO: Case studies. Environmental change and the vulnerability of pastoralists to drought: The Maasi in Amboseli, Kenya.

Zorini, L. Omodei *et al*. 2004. "Participatory appraisal for potential community-based mangrove management in East Africa (87)," *Wetlands Ecology and Management.* Vol. 12 (2): 87–102.

Appendix A: UNEP and MA frameworks

UNEP conceptual framework

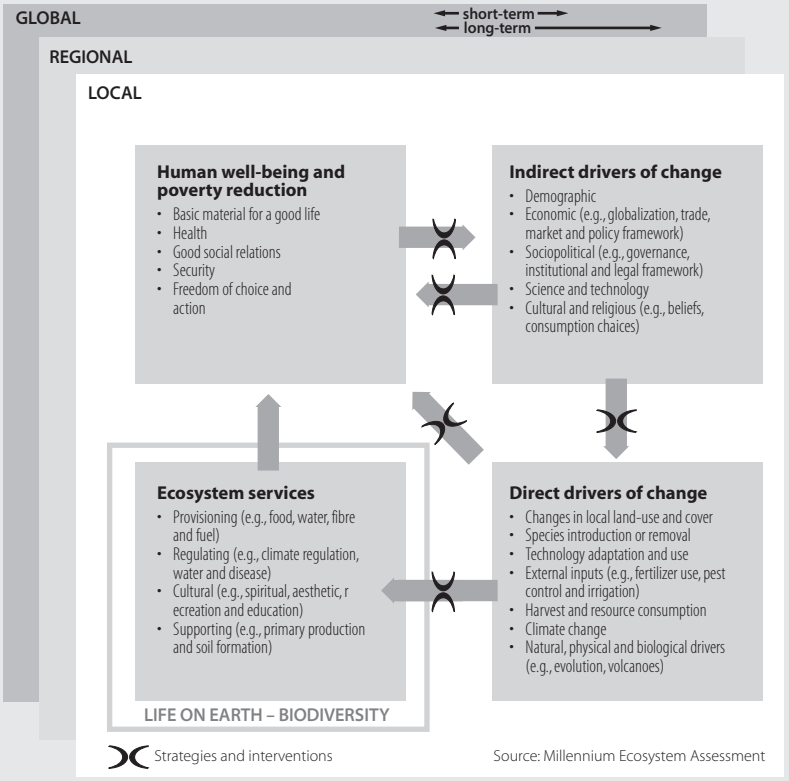
The conceptual framework linking human well-being and ecosystem services



Millennium Ecosystem Assessment Framework

Millennium ecosystem assessment conceptual framework of interactions between biodiversity, ecosystem services, human well-being and drivers of change

Changes in drivers that indirectly affect biodiversity, such as population, technology and lifestyle (upper right corner of figure), can lead to changes in drivers directly affecting biodiversity, such as the catch of fish or the application of fertilizers (lower right corner). These result in changes to ecosystems and the services they provide (lower left corner), thereby affecting human well-being. These interactions can take place at more than one scale and can cross scales. For example, an international demand for timber may lead to a regional loss of forest cover, which increases flood magnitude along a local stretch of a river. Similarly, the interactions can take place across different time scales. Different strategies and interventions can be applied at many points in this framework to enhance human well-being and conserve ecosystems.



Ecosystems and Human Well-being Synthesis

Appendix B: Ecological surety and instrumental freedoms: Indicators and sources

List of indicators for instrumental freedoms (capabilities approach)

Instrumental freedom	Indicators used*	Source
Economic facilities	GDP per capita (HDI) Gini coefficient	Human development index
Participative freedom	Political rights and civil liberties	Freedom in the World database (Freedom House)
Protective security	Vulnerability (total number of people affected by droughts and floods)	UNEP
Social opportunities	Life expectancy at birth (HDI) Adult literacy rate % population with access to improved water – urban/rural Per capita kgoe (kg of oil equivalent)	Human development index Human development index Kenya DHS & MDG database World Resources Report
Transparency guarantees	Level of corruption	Corruption perceptions index (Transparency International)

* Indicators are derived from "Removing unfreedoms: citizens as agents of change," by Khosla and Samuels (2005, 134–135).

List of indicators for ecological surety

Indicators	Source
Supporting services:	
• Biodiversity	Case studies, WWF, IUCN Red List
Provisioning services:	
• Food provision: yield cereals/hectare	GEO data portal and FAOSTAT
• Fibre provision: yield seed cotton, cotton lint and sisal in hectograms/hectare	FAOSTAT
• Forest coverage rate: % land covered in forests and plantations	Africa development indicators (World Bank)
• Freshwater supply	FAO Aquastat
Regulating services:	
• Freshwater purification: water pollution – BOD in total kilograms/day	GEO data portal
• Climate regulation: land-cover change	Case studies
• Erosion regulation: % land degraded	FAO Terrastat
• Disease regulation: malaria (no. clinical cases reported) and diarrhea incidence rate	WHO
• Natural hazard regulation: loss of wetlands and mangroves and number of flood events	Case studies GEO data portal

In addition to the above data sources, 44 case studies were mined for data that were hard to locate elsewhere and to identify human–ecosystem interactions.

Appendix C: Drivers (ecosystem–human interactions): Method and results

Drivers were identified from the literature review of 43 mainly peer-reviewed case studies and then categorized according to the "drivers" framework identified in the MA (Reid *et al*. 2005, vii).

Literature review method

Over 40 case studies and reports, mainly published after 1998, were reviewed. The case studies are listed after the References on page 39.

First several databases which indexed peer reviewed literature were searched. Specifically these included SD-Cite (IISD's database), Ingenta, Econlit and various environment literature databases. Several keyword searches were employed using the following terms (using Kenya as an example): Kenya and poverty, Kenya and development, Kenya and biodiversity, Kenya and well-being, Kenya and vulnerability, Kenya and floods, Kenya and droughts, and Kenya and disasters.

The following inclusion/exclusion criteria were applied:

- study covered the topic of concern;
- study was in a respectable publication or published by a reputable organization;
- study was in English;
- study was published after 1998, though the data used in the study may have been collected much earlier. This will be noted in the analysis;
- adheres to acceptable methods to gather sound evidence;
- key terms are defined;
- method is explained;
- data and evidence: use sound quantitative and qualitative sampling methods; and
- study contains results, conclusions and limitations.

Interactions (drivers) identified/number of times referenced in 44 case studies and reports reviewed

---

Local land-use and land-cover changes (D) (40)

Conversion to agriculture: 12
Deforestation: 11
Land degradation: 6
Conversion to permanent human settlements: 4
Forest fragmentation, forest regeneration related to shifting agriculture, de-vegetation of catchment area, conversion to salt works, conversion to aquaculture and illegal grazing of livestock, loss of vegetative cover in rangelands: 1 time each

Harvest and resource consumption (D) (26)
Poaching: 4
Wood fuel: 4
Charcoal: 4
Salt: 2
Tannins and dyes: 2
Poles and posts: 2
Hunting, over-fishing, unsustainable use of water, plant resources and minerals, collection of non-timber forest products, pit sawing, titanium extraction, heavy water abstract, illegal logging: 1 each

Demographics (I) (21)
Population increase: 12
Population density increase: 4
Migration to traditional pastoral areas: 3
Sedentarization of former pastoral communities and urbanization: 1 each

Economics (I) (13)
Change to market oriented production: 2
Increase in tourism and number of hotels: 2
Agriculture/food expansion: 2
Opportunities for irrigated horticulture, use of resources for building materials for export, prawn farming, foreign aid, slaughtering of livestock for funerals and selling livestock to pay for funerals, distance to market and proximity to villages to access social services: 1 each

Natural, physical and biological (D) (12)
Drought: 6
Forest fires, increasing number of flash floods, flooding, access to water, highly dynamic watercourse leading to death of trees along river, and land erosion: 1 each

External inputs (D) (10)
Increased use of and pollution by agro-chemicals: 4
Oil spills: 2
Increased industrial pollution: 2
Partially treated effluents and poor provision of sanitation facilities to the riparian communities: 1 each

Socio-political (5)
Land appropriation, corruption, development interventions, construction of boarding educational institutions, land-use conflict: 1 each
Technology: (4)
Better use of farm inputs, use of terracing, agricultural intensification, irrigation: 1 each

Climate change (3)
Yes (Kenya and Kenya b): 2
Climate variability: 1

Cultural and religious (2)
Changing lifestyles and less reliance on traditional methods and in-migrants to rangeland areas are crop cultivation communities

Species introduction/removal (1)
Water hyacinth