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FISCAL POLICY, BIODIVERSITY, CONSERVATION,
SUSTAINABLE DEVELOPMENT AND LOCAL ECONOMIC
INCENTIVES: IMPORTANT LINKAGES AND POLICY ISSUES
FOR ZIMBABWE

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ABSTRACT

An estimated 30 to 35 percent of total GDP in Zimbabwe is dependent on the use of biological resources such as soils, forests, wildlife, aquatic organisms and ecosystems. Empirical evidence suggests that the depletion of natural capital stocks is serious and threatens sustainable development. Population growth has exceeded real GDP growth, thus breaking one basic condition for sustainability.

Fiscal policy, guided by economic reform programmes, has seriously constrained public investment in natural resource capital, as well as the government's capacity to monitor and enforce sustained utilisation of biological resources. Real public expenditures per capita on biodiversity conservation have declined at a significantly greater rate than general declines in real GDP per capita. The level of offset by external donors needs to be quantified, however this revenue source should not be viewed as sustainable in the long run.

A simple regression model suggests that environmental degradation, and changes in real GDP and real expenditures on conservation, influence social welfare represented by a per capita food production index. The model is hampered however, by major data gaps. Additional research is required to develop more robust models to guide policy makers.

This paper raises serious questions about the sustainability of development in Zimbabwe. The process of allocating fiscal resources among competing public interests in Zimbabwe needs to be reviewed. The substantive contribution of biodiversity to the national economy and rural development is at risk. More funds should be allocated to biodiversity conservation. The use of economic incentives to encourage improved conservation at the community level should be expanded from wildlife to a broader range of natural resources.

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FISCAL POLICY, BIODIVERSITY CONSERVATION, SUSTAINABLE RURAL DEVELOPMENT, AND LOCAL ECONOMIC INCENTIVES - IMPORTANT LINKAGES AND POLICY ISSUES FOR ZIMBABWE

1.0 INTRODUCTION

Zimbabwe's genetic, species and ecosystem biodiversity is a critical foundation of rural and national development. At the macro-level, at least 30 percent of total GDP is dependent on the use of local biological resources such as soils, forests, wildlife, aquatic organisms and ecosystems. This figure includes both primary and secondary forestry, fishing and agricultural production, as well as tourism. Approximately 75 percent of the country's total population of almost 12 million are directly dependent upon access to biological resources for subsistence food production and generation of modest cash incomes. Given the apparent dependence of the economy on biodiversity, conservation of this natural capital should be closely linked to positive sustainable economic growth and development.

Since 1992, IMF structural adjustment programmes have guided government fiscal and monetary policies. Economic reform has seriously constrained public investment in human, man-made and natural resource capital, as well as the capacity to monitor and enforce sustainable use of biological resources. Limited empirical and considerable anecdotal evidence suggests that natural resource degradation is a serious problem in Zimbabwe, thus threatening sustainable development.

This paper addresses several key questions related to biodiversity conservation, macro-economic policy and sustainable development. The primary objective is to examine relationships at a macro-level, between economic growth, fiscal policy in terms of government expenditure on biodiversity conservation, environmental degradation and resulting impacts on human welfare.

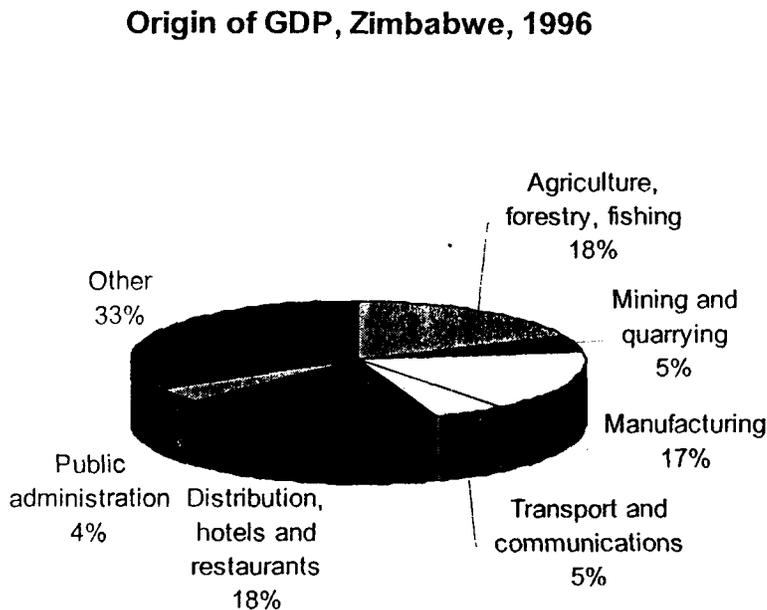
Section 2 outlines the contribution of biodiversity to national economy and important values associated with the use of biological resources. Section 3 examines trends in our depletion of natural resource capital, focusing on agriculture and forests, as far as data permit. Section 4 discusses how government macro-economic policy, especially reductions in real spending has influenced natural resource and biodiversity conservation/degradation. Section 5 reviews economic incentives for improved biodiversity conservation, especially at the local level. Section 6 suggests options for human development indicators related to biodiversity conservation and environmental degradation. Section 7 examines relationships between fiscal policy, environmental degradation, and social welfare. Section 8 provides conclusions and policy recommendations regarding economic incentives for improved biodiversity conservation in this country.

2.0 ECONOMIC CONTRIBUTION OF BIODIVERSITY TO ZIMBABWE

2.1 National Contribution

Zimbabwe is a developing country with a per capita income in 1996 of \$718 USD¹ based on total Gross Domestic Product (GDP in nominal terms) of \$85.5 billion ZD, total population of approximately 11.9 million, and an average exchange rate of \$10 ZD per USD. In local currency, real GDP per capita is largely unchanged from 1985. The country's economy depends heavily on natural resources for generating employment, income and foreign exchange. The dominant sectors and their contribution to GDP in 1996 were as follows: manufacturing, 17 percent; agriculture, forestry and fishing, 18 percent; mining, 5 percent; and distribution, hotels and restaurants (which includes tourism), 18 percent (Figure 1).

Figure 1. Origin of GDP, Zimbabwe, 1996



Source, (CSO, 1997)

¹ This figure is significantly higher than previous estimates published by the World Bank, World Resources Institute and FAO. The reason is that in recently released national statistics by the Central Statistical Office, estimates of GDP from the informal sector were included. This has increased official GDP per capital figures by almost 60 percent over previous values.

A general evaluation of these figures suggests that more than 30 percent of total GDP is based on the use of biological resources. For example, primary agriculture, forestry and fishing (18 percent of total GDP) are completely dependent on biodiversity including healthy soils and farm ecosystems, indigenous and exotic trees, and various aquatic resources such as fish. Secondary manufacturing of agricultural, forest and fish products could account for perhaps another 10 percent (out of the 18 percent manufacturing GDP). The GDP contribution of hotels, distribution and restaurants (18 percent) includes tourism, much of which is dependent on wildlife resources and supporting aquatic and terrestrial ecosystems. Although tourism GDP is not measured separately, some estimates suggest between 5 and 10 percent of total GDP is accounted for by tourism. After deducting imported raw resources for some manufacturing (a small portion of lumber and pulp for example), and taking a very conservative stance, biodiversity could directly and indirectly support between 30 and 35 percent of the national GDP.

2.2 Biodiversity Values

Ecological, cultural, social and economic values must be considered when making decisions about allocation of natural resources and the various services and products derived from them. Values fall along a continuum (Figure 2). The optimum situation is where all the benefits and costs of the good or service are measured in monetary terms. Developments could be assessed in terms of changes in "net social benefits". However, few examples exist where all costs and benefits can be measured. In reality we tend to move down the continuum to less perfect measures of net social value, where imperfect information can lead to inappropriate policy decision. For example, we often find values for some costs and benefits represented by a market price, or "value in exchange". However, even under conditions approaching "perfect competition", these values are often distorted by taxes and subsidies.

Further down the continuum, we may have items where no market prices exist. The previous estimates of biodiversity contribution to GDP only include goods and services traded in market transactions. Many biological resources, which support human and economic activity, are not traded commercially. These non-market goods and services include subsistence fish, fuelwood, fruits, bark, medicines, fodder, and building materials, among others. In addition, the ecological services provided by ecosystems are not measured in GDP. For example, forests help regulate water quality and prevent erosion. Wetlands act as filters to improve water quality. Both provide a habitat for market-based activities such as tourism, and wildlife production. Taking non-market values of biodiversity into account suggests that the contribution of biodiversity to the national economy is greater than the 30 to 35 percent of measurable GDP.

Biodiversity values may be measured by the benefits generated to society through its use (value in use), or even the amount spent by society on maintaining these resource stocks. These are only partial measures of value however. When we evaluate biological resources, the objective is to estimate what society is willing to pay to enjoy various economic, social and environmental values, or alternatively, are willing to accept in compensation if they are to lose these benefits.

Economists use the concept of *total economic value* as a framework to group different types of values together. The groupings fall under two main headings, use and non-use values (Figure 3).

Figure 2: The value continuum

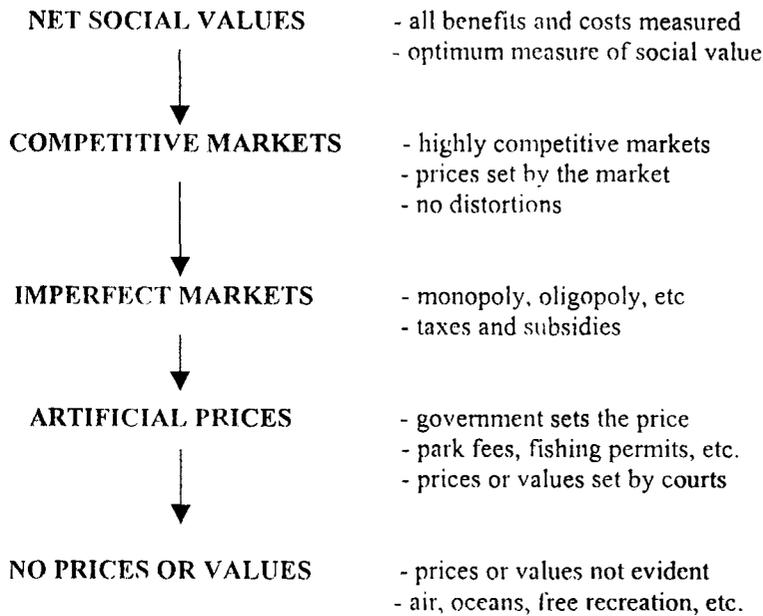
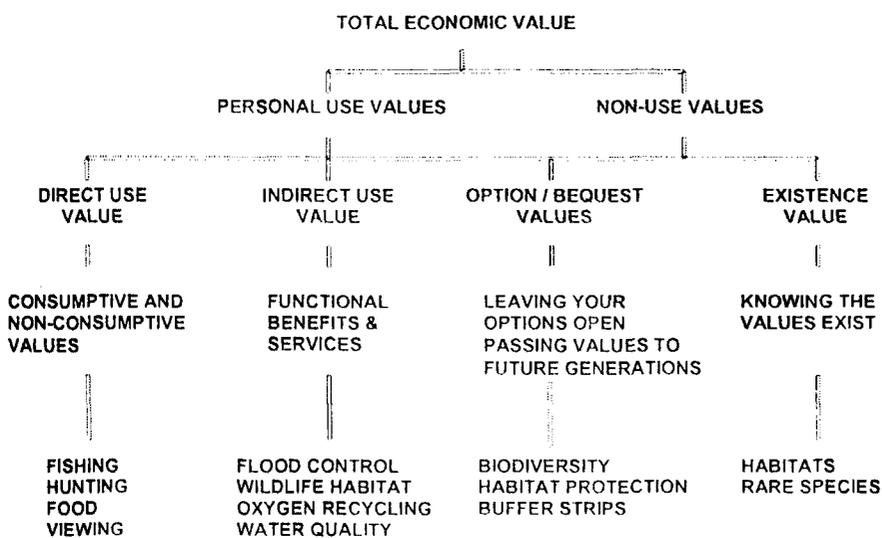


Figure 3. Total economic value



a) Use-values

People hold values for *participating* in activities involving biodiversity. These "use values" are both consumptive and non-consumptive. Consumptive-use values refer to activities that actually consume the biological resource and the values generated. Fishing and hunting are common examples.

Non-consumptive uses include activities such as wildlife viewing, ecological tourism, camping, etc. where biodiversity is not actually consumed. Other non-consumptive uses include people viewing biodiversity indirectly in magazines, on television, or in books. An individual might not want to physically visit Hwange National Park to see elephants, but may still value viewing these animals on television or in books.

b) Non-use values

Non-use values are more complex. These relate to values for goods and services where people do not actually participate directly or indirectly. For example, just knowing that biodiversity exists to be passed on to future generations is important to many people. The black rhino is a case from Zimbabwe. Most people in this country and outside have never seen a black rhino in the wild. Yet, many of these same individuals have probably contributed to various "Save the Rhino" campaigns. These people value the existence of the rhino (existence value) and may want to preserve the species for future generations (bequest value). By making decisions about development projects now that could affect rhino habitat, society might also want to keep the option of future direct and indirect use values (option value).

2.3 Sectoral Values - Agricultural Biodiversity ²

a) Direct-use values of agricultural biodiversity

Agriculture is a cornerstone of Zimbabwe's economic and social development. The sector provides food and incomes for more than 70 percent of the population, supplies 60 percent of the raw materials required by the industrial sector, and generates 45 percent of total export earnings. Except in years of severe drought, agriculture provides sufficient food to feed the nation. Production is diversified, compared with many other sub-tropical countries. In terms of total value, tobacco, maize, cotton, sugar and more recently cutflowers dominate. Beef, poultry, wheat, coffee, sorghum groundnuts, tea, citrus fruit and vegetables make significant but smaller contributions. Tobacco is the single most valuable export product in the country. In 1996, tobacco exports earned approximately \$700 million USD. Export values will be significantly less in 1998 due to lower tobacco prices on the world market.

² Much of the information on sectoral contributions from biodiversity is derived from Zimbabwe's National Biodiversity Strategy and Action Plan (Ministry of Mines, Environment and Tourism, 1998, in press)

b) Indirect-use values of agricultural biodiversity

Biodiversity is critical to the balanced functioning of agricultural production systems and ensuring that the direct-use values can be sustained:

- Diversified crops are a protection against uncertainties in the market, especially for less capitalised growers
- A diverse environment offers a shield for agro-ecosystems against natural or man-made disturbances. The diversity of species and habitats provide resilience to pests and disease
- Healthy soils help maintain nitrogen, carbon, energy and water cycles

Biodiversity offers a host of irreplaceable services and goods for agriculture, granting opportunities for enhancement in productivity and environmental quality.

c) Non-use values of agricultural biodiversity

Non-use values, such as existence values, bequest and option values are difficult to quantify without further research. There are indicative values that suggest non-use values are important. For example, expenditures to establish and maintain ex-situ gene banks could be a measure of value of keeping the option open to use a wide range of genetic seed sources for many crops in the future. More broadly, most genetic improvement programmes could be viewed in this way. Indigenous knowledge is another important non-use value that can benefit agriculture.

2.4 Sectoral Values - Forest Biodiversity

a) Background

Forest biodiversity plays an integral role in the social and economic development of Zimbabwe. Forests account for around 70 percent of the total land area in Zimbabwe. Forest products and services are derived from the stock of commercial plantations and the four indigenous forests cover types (natural forest, woodland, bushland, and wooded grassland).

b) Commercial forestry and economic activity

The commercial forest industry in Zimbabwe is grouped into three sectors:

- Primary logging
- Secondary lumber, panels, paper and board, newsprint
- Tertiary packaging, fine papers, furniture, small woodworking products

The bulk of commercial forestry occurs in eastern Zimbabwe since approximately 90 percent of the plantation forests are located in Manicaland Province. Further, 68 percent of commercial forest plantations consist of exotic pine species, with the balance comprising of eucalyptus, wattle and other minor species. The average annual roundwood consumption for the commercial forestry sector from 1987/88 to 1989/90 was approximately 656,000 m³, (Arnold et. al., 1993). The bulk of the fibre input was for sawmilling (Table 1).

Table 1. Commercial forestry sector characteristics, Zimbabwe

Initial Product	% Of Total Harvest	Main Species Used	Main End Products
Sawlogs	69	pine (90%)	rough and dressed lumber
Pulpwood	17	mostly pine	pulp and paper products
Poles, mining timber	9	Eucalyptus, wattle	poles and pit props
vencer logs	5	indigenous hardwoods	plywood

Source: Ministry of Mines, Environment and Tourism, 1998

The commercial forest industry employed approximately 16,000 people in 1991, representing about seven percent of total manufacturing employment. A lack of readily available statistics prevents a larger evaluation of the forest industry's contribution to the economy, for example as the percentage of total value of shipments and value added in the primary and secondary sectors. The CSO does not disaggregate these data. The World Bank (Arnold et. al., 1993) estimated that for 1984, the wood and furniture, paper, printing and publishing industries had a value of shipments of \$329 million ZD, or roughly 8 percent of all manufacturing. Other unpublished data suggest total employment and value of shipments in the forestry sector to be 10,000 people and \$50 million ZD respectively. These latter figures are assumed to apply only to sawmilling, yet they are widely divergent from the previous estimates. It again confirms the problems that arise without a consistent data set for forestry.

With indigenous forests, commercial production is mainly centred around two valuable hardwood species; mukwa, used in manufacturing high quality furniture, and teak, used for parquet flooring and some furniture. No estimates of production values were readily available.

c) Non-commercial forestry, values and wood supply

The 1996 inventory data provided by the Forestry Commission indicates a total of around 27 million hectares of non-plantation forest in Zimbabwe. However, no corresponding information on timber volumes by species and age class is yet available. Thus, while a significant proportion of the country contains indigenous forest, especially in the woodland category (20-80% crown closure and 5-15 metres in height), there is no way to determine at this point, a corresponding level of forest stock volumes and commercial values.

d) Direct and indirect-use values of forest biodiversity

Natural woodlands generate a wide range of timber and non-timber products and services (Campbell et. al. 1993; and Bradley and Dewees, 1993) as follows:

d-1) Products with a commercial value (can be sold in markets)

- fuelwood sold in rural and urban markets
- wood for charcoal. in rural and urban markets
- sawtimber and pulpwood cut by large concession holders (mainly in Matabeleland)
- building materials - poles, fencing, wood for implements, utensils
- wood for small artisan crafts
- fodder cut from forests and brought out for sale

- fruits, nuts, honey, wild vegetables, mushrooms, insects, bark for rope
- wildlife harvested for commercial use, for example in CAMPFIRE projects in rural areas
- tourism in some areas, mainly for wildlife viewing
- silk from caterpillars

d-2) products with a commercial value (but used for subsistence)

- domestic fuelwood
- building materials - poles, fencing, wood for implements, utensils
- fodder cut from forests and used by farmers
- fruits, nuts, honey, wild vegetables, mushrooms, insects, used for food
- bark for rope
- grazing resources in open forests and State Forests (legally and illegally used)
- wildlife harvested for personal use (poaching)

d-3) Non-market products (never usually sold in a market)

- medicines
- leaf litter for nutrients in grazing areas
- gum for various uses (bird traps)
- dyes from roots

d-4) Ecological services

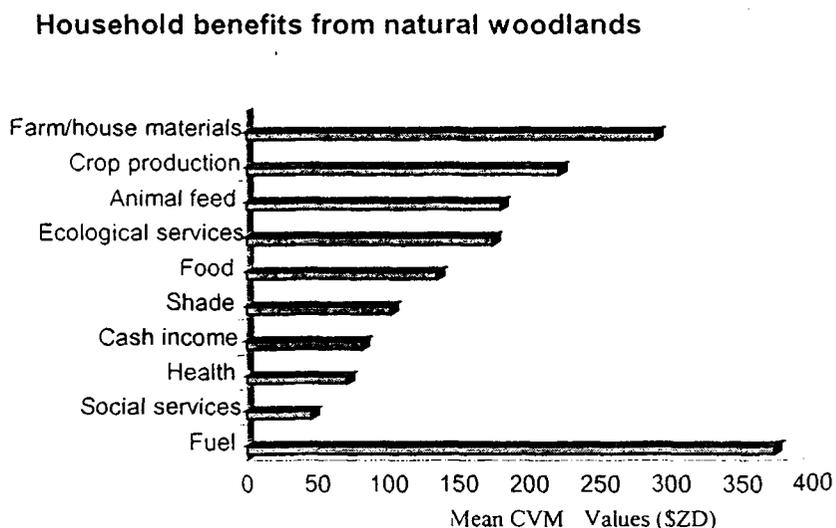
- windbreaks
- provision of shade
- soil stability

e) Examples of direct and indirect-use values of forest biodiversity

One of the better local studies of indigenous forest values was completed in 1991 (Campbell et. al). Based on the gross value of different product flows, the authors estimated the spatial value of indigenous woodlands at around \$1,000 ZD per hectare per year. Alternatively, based on a contingency value study in the same paper, the average value was about \$200 ZD per hectare per year spread around several specific products and services (see Figure 4).

Using the previous results of \$200 ZD per hectare per year, the potential value of woodland stocks can be estimated but with major qualifications. The 1996 Forestry Commission inventory data indicated the area of woodland cover type at around 21 million hectares. Applying a value of \$200 ZD per year results in a total stock value of \$4.2 billion ZD, or approximately \$375 million USD. If we assume these forests were being managed sustainably, the capital value of this flow over time (at a 10 percent discount rate) is \$42 billion ZD or \$2.33 billion USD. These values should not be interpreted too closely; at best they are order of magnitude estimates. The results from Campbell et.al. (1991) were based only on sampled households surveyed in specific agro-climatic zones and are subject to a number of technical limitations (Deweese, 1994). They can only be used to infer national values with caution.

Figure 4. Household benefits from natural woodlands in Zimbabwe.



The previous sections illustrate that natural woodlands in Zimbabwe have a very high local value to people based on their willingness to pay for the various direct and indirect benefits flowing from these forests. In turn, the aggregate value of forest stocks will also be quite significant. However, the previous estimates are very rough and must be improved with better data, both on rates of change in forest inventory, and stock and flow values.

Another important benefit from indigenous forests is the provision of habitat for wildlife, which in turn supports a significant proportion of the tourism industry in this country. Tourism earned an estimated \$3 billion ZD for Zimbabwe in 1997 (Ruzividzo, 1998).

2.5. Sectoral Values - Aquatic Biodiversity

Zimbabwe has no natural lakes, therefore aquatic biodiversity is restricted to river systems and dam reservoirs. Some of these reservoirs, such as Lake Kariba have developed into valuable recreational areas and commercial fishing zones.

a) Direct-use values

In Zimbabwe, the consumptive-use values include fish from both wild capture and commercial fish farms. In 1996, the volume of captured fish was approximately 32,500 tonnes, with more than half consisting of kapenta harvests from Lake Kariba. In terms of values, dried kapenta sells for approximately \$18 ZD/kg. wholesale. Based on a commercial harvest of 18,000 tonnes per annum, the gross value is in the order of \$27 million USD. With the kapenta fishery, approximately 235 rigs operate a total of 75,000 boat nights per year. Assuming an average of six crew per boat, the

total primary employment could be as high as 1,410. In addition, there is a large processing industry on shore that generates secondary employment and income.

For the same year, over 1,000 tonnes of other fish species were harvested from fish farms throughout the country. Fresh or frozen trout has a wholesale price of between \$25 and \$30 ZD/kg.

Consumptive values also include recreational fishing on inland lakes and dams. Fishing for small-scale commercial trading and personal subsistence also contributes to consumptive values generated by aquatic ecosystems.

Non-consumptive values centre on tourism related to aquatic ecosystems. The main contributors are the tourism industries on Lake Kariba and Victoria Falls. With Victoria Falls, aquatic tourism activities include kayaking, white-water rafting, canoeing, and boat cruises. Kariba has a significant luxury cruise boat industry to complement several hotels and a large number of smaller private tourist lodges along the shore. There is a lack of accurate data on the values generated from these activities. Representative examples can illustrate the range of benefits however. With luxury boat cruises on Lake Kariba, daily rates per boat can be as high as \$10,000 for a craft holding several visitors. Using an average utilisation rate of 100 days per year, an average cost of \$5,000 per boat-night, and 100 cruise boats, the potential gross revenues could be nearly \$3 million USD per year.

In Victoria Falls, an economic study (Dube and Milne, 1995) was carried out in association with the Zimbabwe-Zambia Strategic EIA report. The study indicated that water-related tourism activities of canoeing/kayaking, white water rafting, and river cruises generated almost \$7 million USD in gross revenues based on just over 100,000 participants. In particular, canoeing/kayaking and white water rafting accounted for 77 percent of all tourism based revenues for all activities in the area, excluding costs for accommodation.

b) Indirect-use values

These values are tied to the ecological benefits of aquatic biodiversity and supporting ecosystems such as wetlands. These values include:

- regulation of water flow
- maintenance of water quality
- habitat for aquatic and terrestrial fauna

These values are critical from an ecological perspective but are very difficult to measure in practice.

c) Non-use values

Non-use values can occur even when people may not even use aquatic resources such as wetlands. The value of knowing that the resources exist can be important (existence values), can be conserved to pass on to future generation (bequest values), or may be available in the future for other development options (option values). As an example, some Zimbabweans may place a high value on conserving the shores of Lake Kariba and associated biological resources even if they have never visited the area. These values have not been quantified to any extent in Zimbabwe.

2.6. Sectoral Values - Wildlife Biodiversity

a) Direct-use values of wildlife biodiversity

Wildlife is one of the major tourist attractions to Zimbabwe, hence the financial gains from the sector are, partly, a reflection of the value of wildlife resources to the country's economy. The value of wildlife can be indirectly estimated from other studies. A 1989 contingent evaluation study by Henry and Brown (1989) examined wildlife in Kenya, by surveying 22 safari operators and a random sample of visitors for each operator. The study found that for visitors on safari, the average value of seeing elephants (willingness to pay) was \$USD 89. A comparison question in the same survey found that visitors were willing to pay an extra \$USD100 to protect and maintain herds at present levels. The \$USD 100 represents only about 3 percent of the total safari costs paid by the visitor. Extending these two values to the whole country, the value of viewing elephants by 250,000-300,000 adult visitors was between \$USD 23-27 million. These amounts over and above the visitors' normal cash expenditures such as travel, hotels, meals, etc.

In 1997, Zimbabwe had more than 1 million visitors. Assuming only half were tourists coming to see wildlife, and applying the WTP value of seeing an elephant from Kenya (\$89 USD), the total willingness to pay for viewing elephants in Zimbabwe could be around \$45 million USD. Based on an elephant population of approximately 66,000 each elephant in Zimbabwe has an implied tourism value of \$681 USD. These numbers are very crude estimates that cannot be substantiated without more research, however they indicate the potential economic values accruing from tourism, based upon the viewing of only one species of mammal.

Valuation of the country's wildlife resources requires a detailed inventory of the specific numbers (quantities) of the individual species. Even then, the values of some other species like insects and other smaller species, apart from the difficulties of quantification, would still be rather crude. Some species such as mopani worms are sold in markets, however there are few data available on values and quantities consumed. One study in 1995 in the Bulilimangwe District found values of mopani worms sold at the collector level to be around \$60 ZD per 20-25 litre bucket (Ministry of Mines, Environment and Tourism, 1998). Average annual incomes per person ranged from \$110 to \$146 ZD. There is no accurate way of extrapolating these values to a national level.

Quantifying non-traded species and direct-use values would require application of complex methods such as contingent valuation and travel cost. Specific inventories, for even the larger wildlife species are not readily available. In fact elephants and endangered species seem to be the only ones where fairly reasonable estimates of stock size are available within the Department of National Parks and Wildlife Management.

Safari hunting can provide other measures of value through licences allocated in the Campfire programme (Table 2). In 1997, CAMPFIRE programmes raised about \$25 million ZD.

Table 2. Trophy values of larger wildlife species, CAMPFIRE programme, 1996

Species	Standard Value(Z\$)	Species	Standard value(Z\$)
Elephant bull	60 000	Reedbuck	2 000
Elephant cow	25 000	Wildebeest	4 000
Buffalo bull	8 000	Tsessebe	5 000
Buffalo cow	4 000	Zebra	4 500
Lion	25 000	Bushpig	450
Lioness	12 500	Warthog	1 000
Leopard	15 000	Impala male	500
Hyena	500	Impala female	250
Hippopotamus	9 000	Duiker	750
Giraffe	7 500	Steenbok	500
Crocodile	11 000	Klipspringer	2 000
Sable	11 000	Grysbok	500
Eland	7 500	Honey Badger	500
Kudu	5 000	Civet	600
Nyala	8 000	Jackal	500
Waterbuck	7 500	Wild Cat	500
Genet	500	Guinea Fowl	20
Porcupine	150	Francolin	10
Spring Hare	25	Sandgrouse	10
Baboon	100	Ducks/Geese	20
Velvet Monkey	50		

Source: Zimbabwe Government Gazette, 1996

(US\$1= Z\$10).

Another measure of value is the cost of permits and fees paid by people to enter National Parks and view wildlife resources. As an example, commercial permits for operators of canoe safaris in Mana Pools National Park are \$50,000 ZD per annum in addition to normal entry fees and a river usage charge of \$5.00 USD per client. While these types of fees represent a partial willingness-to-pay value, they are government-administered prices without much economic basis.

b) Indirect-use values of wildlife biodiversity

Indirect-use values would require separate studies based on the role of species within the ecological systems. As an example, the role of birds and large mammals in seed dispersal and species/ecosystem diversity might be considered an indirect-use value. Very little literature is apparent on indirect-use values of wildlife biodiversity in Zimbabwe.

c) Non-use values of wildlife biodiversity

Existence, bequest and option values need to be measured through contingent valuation studies and account for the values and preferences of different groups in society. A survey restricted to foreign tourists would provide skewed results by not accounting for local preferences and values. No literature was found to suggest that comprehensive CVM studies on wildlife, for both use and non-use values have been carried out in Zimbabwe.

3.0 TRENDS IN NATURAL CAPITAL DEPLETION IN ZIMBABWE

3.1 Background

As illustrated in the previous section, Zimbabwe is plagued with a lack of empirical change data for natural resources. There is no single database showing changes in forest cover or volumes, soil erosion, wildlife, fish stocks, etc. Instead, researchers must rely on various reports and papers scattered around, usually focusing on only one resource in limited locations. This study will focus mainly on forestry and agriculture because of the marginally improved data situation. As well, these two resources underpin a significant proportion of the economy at local and national levels. Other resources will be cited only briefly.

3.2 Agriculture, Soil Erosion and Crop Production

a) Soil erosion

The loss of soil through wind and water erosion is one criteria used to assess degradation in agriculture. The linkage of soil erosion to crop production is through lower soil productivity and ultimately crop yields. In the short term, soil productivity can be maintained by adding organic and inorganic fertilisers. In the longer term however, the increasing marginal cost of purchasing inorganic fertiliser may not be economically sustainable. In addition, there may be external costs of water pollution from chemical run-off to surface water, or contamination of ground water. Aside from reduced crop yields, erosion leads to siltation of reservoirs, especially smaller dams used for rural water supplies and commercial agriculture.

Whitlow (1988) undertook a comprehensive study of soil erosion in Zimbabwe. He concluded that soil erosion on croplands ranged from an average of 3 tonnes/ha/year in commercial grazing areas to 75 tonnes/ha/year in communal lands. In contrast, the rate of natural soil formation is very slow, in the order of 0.4 tonnes/ha/year. This situation is clearly unsustainable and has severe implications on long-term soil productivity in this country. Several factors are responsible for soil erosion such as loss of vegetation (through deforestation) and population density; these will clearly vary across the country. However as Whitlow pointed out, the problem of erosion is significantly more serious in communal areas, which are often characterised by lower levels of vegetative cover and higher population densities. In fact, his study indicated that communal lands accounted for 90 percent of all severe and very severely degraded lands, and 80 percent of all moderately degraded lands in the country.

The average population density in Zimbabwe has increased over time from 13.0 people/km² in 1969 to approximately 29.0 in 1997 (Table 3). Densities are significantly higher in communal areas.

Table 3. Population density in Zimbabwe, and communal lands (persons/km²)

Population density	1969	1982	1990	1996
Zimbabwe	13.0	19.3	25.5	29.0
Communal areas	17.8	25.2	34.4	40.1

Sources: (UNDP, 1997; CSO, 1997; Whitlow, 1988; ENDA/ZERO, 1992)

The population density on communal areas for 1990 and 1996 was estimated using 1988 information on the proportion of total population living in communal lands (Whitlow) and applied to more current estimates of total population in the country. These averages mask large regional differences in population density. According to Shumba et al. 1998, rural population densities in various districts ranged from 11 to 65 people per km². An average of around 40 persons per km² seems reasonable.

Whitlow (1988) found a positive correlation between population density in communal areas and the level of soil erosion. Generally, as population density increases, the proportion of communal lands in the more severe erosion classes also increases. Using relationships found in Whitlow (1988), erosion groupings are assigned to the change in population density from Table 3 (Table 4).

Table 4. Estimated erosion classes for communal lands, Zimbabwe.

Erosion Classification Groups by Percentage of Land Eroded	1969	1982	1990	1996
Negligible	15.2	3.7	2.9	1.6
Very Limited (0.1-4.0 %)	27.0	19.5	12.9	8.9
Limited (4.1-8.0 %)	22.8	23.8	21.5	16.2
Moderate (8.1-12.0 %)	13.4	16.4	19.6	17.0
Severe (12.1-16.0 %)	9.3	13.2	14.8	17.0
Very Severe (over 16.0 %)	12.2	23.4	28.3	39.3
Total Land in all Groups (%)	100.0	100.0	100.0	100.0

Using this logic, from 1969 an increasing proportion of communal land has moved into the severe and very severe erosion classifications. As an example, the proportion of land in the very severe category (where more than 16 percent of the land is eroded), increased from 12.2 percent in 1962 to almost 40 percent in 1996. These extrapolations must be tempered by various government and donor-funded measures to improve soil conservation over the past decade. In the absence of better data, it is difficult to determine how measures such as zero tillage, contour ploughing, etc have influenced the rate of soil degradation.

b) Crop Production

On an aggregate basis, Zimbabwe had a modest increase in the index of agricultural production, a measure of disposable output relative to the base period 1979-81 = 100 (UNDP, 1997). The agricultural production index increased from 103 in 1980-82 to 113 in 1990-92 (Table 5). Conversely however, the food production index decreased from 101 to 71 over the same period. More important, both indices declined on a per capita basis, which indicates a decrease in disposable agricultural output relative to

the increasing population of the country over the same period. The same report states that in the period from 1980-82 to 1990-92 the average production and yield of cereals declined by 31 percent and 12 percent respectively. While there are several reasons to explain these trends (drought, shortages of inorganic fertilisers, shift in crop choice to other products such as tobacco, etc.) one other reason to consider is erosion and the decreasing soil productivity, particularly in communal areas. Given the trend of increased soil erosion, and by implication, declining soil productivity, one would expect the use of chemical fertilisers to increase as a compensating factor. However, national consumption of these products actually declined from 59 kg/ha in 1979-81 to 56 kg/ha in 1989-91. Again, there are a number of reasons for this result such as a shift in agriculture from crops to livestock, improved efficiency in application methods (spurred by increasing real prices of fertiliser), cost constraints on farmers, etc.

Table 5. Agriculture and food production indices, Zimbabwe

Time Period	Agriculture Production Index (1979-81 = 100)		Food Production Index (1979-81 = 100)	
	Aggregate	Per Capita	Aggregate	Per Capita
1980-82	103	100	106	103
1990-92	113	79	101	71

Source: (WRI, 1994)

Related to domestic food production is the daily calorie supply per capita index with 100 being the average for developed northern countries. For Zimbabwe, this index has declined from 70 in 1965, to 64 in 1992 (UNDP, 1997). The decline would reflect the increasing population of the country, domestic food production and changes in per capita income over the time period. In terms of actual calories supplied per capita, Zimbabwe's figure of 1,989 calories ranks 45th out of 48 medium human development countries (UNDP, 1997).

c) Summary for Agriculture

Over the past few decades, Zimbabwe has witnessed a significant increase in population and population density, particularly in communal lands where most people survive partly through subsistence agriculture. There is a heavy dependence on soils for crop production and to support grazing. Available data suggest that soil erosion in communal areas is unsustainable. Rates of natural soil formation are nowhere near even the lowest rates of soil erosion. The implications of heavy and widespread soil erosion are reduced soil productivity and corresponding reductions in agricultural production per hectare (offset only by increased applications of fertiliser). These implied impacts are partially supported by available data for per capita agricultural, food production, and daily calorie supply.

3.3 Forests

a) Commercial Forests

With commercial plantations, projections were made in 1993 (Arnold et. al.), based on planned expansion of the forest industry and forecast areas and volumes of plantations managed under sustained yield policies. Using the most optimistic wood supply scenario of low economic growth, expanded plantation areas, and high yield forestry, there are no supply deficits projected for logs and smallwood for both pine and eucalyptus species up to the period 2016-2020.

However, using the most pessimistic scenario of high economic growth, no expansion of plantation areas, and low forest growth and yield, serious wood supply deficits are forecast for the period 2016-2020. These deficits are 336,000 m³ for pine sawlogs; 225,000 m³ for pine smallwood; and 102,000 m³ for eucalyptus. The most likely scenario lies somewhere in between these optimistic and pessimistic outlooks.

b) Indigenous Forests

The total demand for indigenous roundwood in 1989/90 was approximately 50,000 m³, based on information available for licensed concession operators in the Matabeleland region of the country, from State forests, communal land and large-scale commercial farms. Based on inventory surveys carried out by the Forestry Commission a few years ago, the current commercial harvest of hardwoods is already at unsustainable levels. Wood supply/demand projections suggest that even with conservation measures such as charging higher stumpage fees to operators and banning the export of rough squares, the annual commercial hardwood harvest will decline to less than 20,000 m³ by the turn of the century. The volume of high value hardwoods cut from concessions in Matabeleland North for 1991/92 was less than 22,000 m³.

On an aggregate level, the World Resources Institute (1994) indicates a total loss of natural forest in Zimbabwe over a ten-year period 1981 to 1990 at approximately 609,000 hectares, or an average loss of 61,000 hectares per annum. The UNDP (1997) estimated the annual average loss of natural woodland in Zimbabwe from 1981-1990 at 0.6 percent, mainly through clearance for agriculture. A recent study by Mabugu et al (1998) estimated that the total forest growing stock and net annual increment had declined from 1990 to 1996 (Table 6). Although the net annual increment is positive (annual depletions are less than annual growth) it is declining each year by approximately 3.8 percent. In the long-term, this trend will result in depletions beginning to exceed the annual increment and cause a net decline in forest stocks. Factors such as increasing rural population (and a corresponding demand for fuelwood and building materials), and continued land clearance for agriculture may actually accelerate the move towards unsustainable forest management.

c) Summary for Forests

The preceding sections suggest that forest depletion in Zimbabwe is on an unsustainable path. With commercial plantations, there are forecasts of timber supply deficits under conservative sets of assumptions. Already, some timber is being imported into the Eastern Highlands for processing. With indigenous forests, commercial stands of high-valued hardwoods have largely been exploited. Non-commercial woodlands are under severe pressure for agriculture and subsistence uses.

Table 6. Net annual increment estimates (million tonnes), 1990 - 1996

YEAR	1990	1991	1992	1993	1994	1995	1996
Total Growing Stock	1349.2	1319.1	1289.0	1258.9	1228.8	1198.7	1168.6
Accessible Stock	404.8	395.7	386.7	377.7	368.6	359.6	350.6
Accessible MAI	9.03	8.83	8.63	8.43	8.22	8.02	7.82
Total Depletions	1.15	1.18	1.22	1.26	1.29	1.35	1.40
Net Ann. Increment	7.88	7.65	7.41	7.17	6.93	6.67	6.42

Source: Mabugu et al. 1998

3.4 Terrestrial and Aquatic Resources

With terrestrial biological resources, there is a paucity of data on changes in stocks over time. Most research has concentrated on the larger mammals. Available data suggests that out of 38 mammals, many are either already very rare, not common, or in decline (Table 7). Given the importance of wildlife to the tourism industry, sustaining natural habitat and the wildlife stocks themselves is critical. For aquatic resources, few data are readily available, even for major commercial species such as kapenta in Lake Kariba. Anecdotal evidence of declining catches and smaller average fish size suggest that the fish stocks are being overexploited beyond sustainable levels. However, this assertion needs to be backed up by better data and more research.

Table 7. Population status of common mammals in Zimbabwe

Species	Population status
Elephant	66 000 animals. Downlisted to Appendix II in 1997.
Black rhino	320. Increasing by 3%/yr. Specially protected. Listed on Appendix I.
White rhino	150. Specially protected. On Appendix 1
Buffalo	50 000. Decreasing by 2.5%/yr.
Eland	1 854. Population is decreasing.
Kudu	10 652 animals.
Nyala	Found in Save and Lower Zambezi Valley.
Bushbuck	Not very common.
Roan antelope	395. Specially protected.
Sable antelope	11 232. Increasing by 1.4%/yr.
Gemsbok	100. Population static for 25 yrs. Specially protected (Wilson,1997).
Waterbuck	4 400 animals.
Reedbuck	200 animals.
Blue Wildebeest	1 500 in HNP. Decreasing by 3.6%/yr.
Red hartebeest	Very few individuals present.
Tsessebe	20 in HNP. Decreasing by 3.8%/yr.
Bushpig	Common
Hippopotamus	Common
Giraffe	200 in Gonarezhou and 2 220 in HNP.
Burchell's zebra	Common.
Lion	1 000 in HNP, 300 in Zambezi Valley, 200 in SE lowveld. (+ 4% in HNP)
Leopard	14 650. Increasing by 4.3%/yr. Specially protected.
Cheetah	830. Increasing by 17%/yr. Specially protected.
Serval	Very secretive species.
African wild cat	Fairly large.
Caracal	Rare and shy species.

Spotted hyena	1 500 in HNP. Population static (Wilson, 1997).
Black backed jackal	Very common.
Wild dog	600-700. Needs legal protection.
Chacma baboon	Very common.
Vervet monkey	Very common.
Pangolin	Very rare. Specially protected
Scrub hare	Common
Jameson's Rabbit	Found in Save, Limpopo.
Porcupine	Common.
Stripped polecat	Common.
Civet	Common.

Source: Ministry of Mines, Environment and Tourism, 1998.

Note: Based on 1995 aerial surveys and other sources.

4.0 MACRO-ECONOMIC POLICY AND BIODIVERSITY CONSERVATION

4.1 Background

Macroeconomics is the study of the economy as a whole and considers national output, employment, prices, trade and finance. Macro-economic policy can take three primary forms; fiscal, monetary and trade policy. All can influence biodiversity conservation.

a) Fiscal policy

Fiscal policy includes government expenditure and taxation with the objective of influencing national income, employment and prices. Through these policy instruments, governments can influence prices downward by subsidies (public spending) and upward through taxation. A key linkage of fiscal policy and the environment is through producer output prices, input prices, government spending and budget allocation process. Government spending and budget allocations are central to this paper and are covered in more detail in Section 4.3.

b) Monetary policy

Monetary policy refers to the actions of government to meet objectives related to money supply, interest rates, credit, and exchange rates. The central bank, or Reserve Bank usually implements these actions. The linkage between monetary policy and the environment is not always clear. For example, if a country is experiencing excessive government spending financed by external borrowing, programmes may be developed to promote export crops in agriculture to ease balance of payments problems from external debt repayment. Many crops supporting exports such as tobacco require higher levels of chemical inputs, which in turn can affect surface and ground water. High government spending, financed through domestic borrowing will usually absorb local liquidity and result in higher local interest rates. Aside from imposing higher costs to business, this can also encourage increased land conversion and growing high-input crops to increase farm revenues.

c) Trade policy

Trade policy by most governments is aimed at protecting domestic industries by restricting competing imports. At the same time of course, governments desire open access to foreign markets for their own country's exports. Since trade policy can influence domestic prices of products, there is scope for influencing how people use natural resources and various production inputs such as agro-chemicals. Trade policy can both help and hinder environmental management depending on the specific circumstances. As an example, high tariffs on imported chemical inputs for agriculture will raise the domestic price and reduce chemical consumption by farmers. There would be a price incentive to increase the efficiency of chemical use. Lower trade barriers may promote increased use of chemical inputs.

4.2 Structural Adjustment Programmes and Resource Degradation

Many developing countries face serious macro-economic problems stemming from slow economic growth, high levels of debt and resulting balance of payment problems, high inflation and interest rates, large bureaucracies, and restrictive financial markets. The World Bank and International Monetary Fund, often with the assistance of other donors, is leading the process of economic reform in developing countries through Economic Structural Adjustment Programmes (ESAP). Most SADC countries, including Zimbabwe are implementing such programmes. According to Chinyama et al. (1995), the objectives of these restructuring programmes generally include:

a) Fiscal policy reform:

- service reduce government current account budget deficits
- eliminate subsidies to parastatals
- civil reductions to lower the public wage bill

b) Monetary policy reform:

- slow the growth of money supply to reduce inflation
- interest rate liberalisation
- promote the liberalisation of the financial sector
- foreign exchange market decontrol

c) Trade policy reform:

- reduce government red tape for importers and exporters
- open up the foreign exchange allocation for importers
- reduce tariff barriers as per the GATT agreement

d) Regulatory policy and institutional reform:

- simplify private investment approval process
- relax exchange controls to encourage foreign investment
- simplify labour regulations

The change brought about by these programmes provokes the question as to whether or not they impact on the environment. While long-run effects are difficult to predict, in the immediate-term, there are some negative linkages with the environment.

As an example, under ESAP, slashing the size of the civil service is a key objective to reduce government spending. These cuts ultimately affect the numbers of staff in resource management agencies. A resulting impact is inadequate staff to monitor resource use and enforce government policy and regulations. Public resources such as forests can then become open access common property situations with a higher potential for degradation. Also, retrenched civil servants can turn to illegal extraction of natural resources to earn a living.

Keynsian theory calls for spending increases to stimulate economic growth, and reductions in spending to slow down an overheated economy. Regardless of the direction of fiscal policy, the actual funds allocated to Ministries responsible for natural resource management and conservation likely has significant impacts on the environment. If these Ministries do not receive adequate budgets to effectively deliver their programmes, impacts on the environment could take the form of less protection for endangered wildlife, reduced education and awareness, declining extension assistance to farmers in the area of soil conservation, fewer forestry plantations established, etc.

4.3 Government Expenditure on Biodiversity Conservation

a) Background

The costs of current conservation measures are important in determining strategic directions for policies related to sustainable development. In one sense, current costs are a partial measure of value placed by decision-makers on biodiversity conservation. However, costs or expenditures are always limited by government income, in this case through a combination of tax revenues and borrowings.

A developing country like Zimbabwe might place a high value on protecting biodiversity, yet because of fiscal constraints cannot allocate sufficient resources to properly address conservation objectives. In the OECD countries, aggregate average expenditures on internal environmental protection is between 1.0 and 1.5 percent of GNP or about \$100 to \$150 billion per annum (Pearce, 1996). On the other hand, in many lesser developed countries, the total tax revenues collected may be only 5 percent of GDP, from which countries must fund all government programmes such as health, education, and defence (Sterner, 1996). Spending on environmental protection is typically not a significant portion of government budgets and total GDP.

Despite these limitations, information on current expenditures can be useful in determining the costs and resource requirements of future strategies and actions to improve biodiversity conservation. Where resources are limited, trade-offs can be better appraised between biodiversity conservation (and the values sustained), and other options for public expenditures.

b) Estimated government expenditures on biodiversity conservation in Zimbabwe

Using the government budget estimates, public expenditures on biodiversity conservation can be calculated (Table 8). The table does not include all government agencies with some authority over, and impact on, biodiversity conservation. The agencies cited are felt to represent the main players only and provide an indicative sense of how much the government is spending for conserving biodiversity.

From Table 8, the relevant nominal government expenditures increased from approximately ZD \$171 million in 1987/88 to \$802 million in 1997/98. The large jump in expenditures for the last year mainly reflects huge nominal wage increases to government employees rather than expanded programme or investment budgets. This change in expenditure represents a 369 percent increase over the eleven-year period or an average increase of 33 percent per annum. This level of increase is quite significant until inflation is accounted for however. Using the GDP index (1990/91 = 100), real expenditures can be calculated that discount inflation. Real expenditure levels by government have fallen, from \$237 million in 1990/91, to around \$137 million in 1996/97, the last year for which published price indices were available (Figure 5).

A consistent way to view these trends is from 1990/91 when the GDP index was 100. Nominal expenditures in 1996/97 were \$482 million, a 103 percent increase from 1990/91. Over the six-year period 1990/91 to 1996/97, real expenditures declined by 73 percent, or 12 percent per annum. To put this situation in perspective, a government agency might have doubled its nominal budget over the period, but it buys 73 percent less than six years before in real terms.

The severe decline in real expenditures is a component of implementation failure and can be considered a contributing cause of biodiversity degradation through reduced real budgets to line departments tasked with conservation programmes.

c) Non-government and external financial contributions

To some extent, budget deterioration in the public sector is offset through donor and NGO programmes. Zimbabwe is host to numerous donors and NGO's who support biodiversity conservation. No comprehensive database was available to summarise these in-country expenditures. Some externally funded activities are hosted in various government Ministries as bi-lateral aid programmes, and records could possibly be collected with more time. As one example 3 however, the five year Canada-Zimbabwe Natural Resources Management Programme (funded by CIDA) had a total budget of approximately \$18 million CD, or around \$108 million ZD, using average exchange rates each year of the programme. The programme operated within the Ministry of Mines, Environment and Tourism. To put this into perspective, the average annual programme budget was approximately twice the entire budget of the Department of Natural Resources. This is only one donor-funded programme.

With forestry, information was available (Mujakachi and Sikwila, 1991) to show that from 1986/87 to 1990/91, donor funding to the Forestry Commission amounted to more than \$50 million ZD, not much less than the Commission's total A-base budget for the same period. It would only be reasonable to speculate that other government Ministries and departments are recipients of donor funds in greater or lesser proportions.

3 The author was a Senior Technical Advisor on this programme from 1992-1997

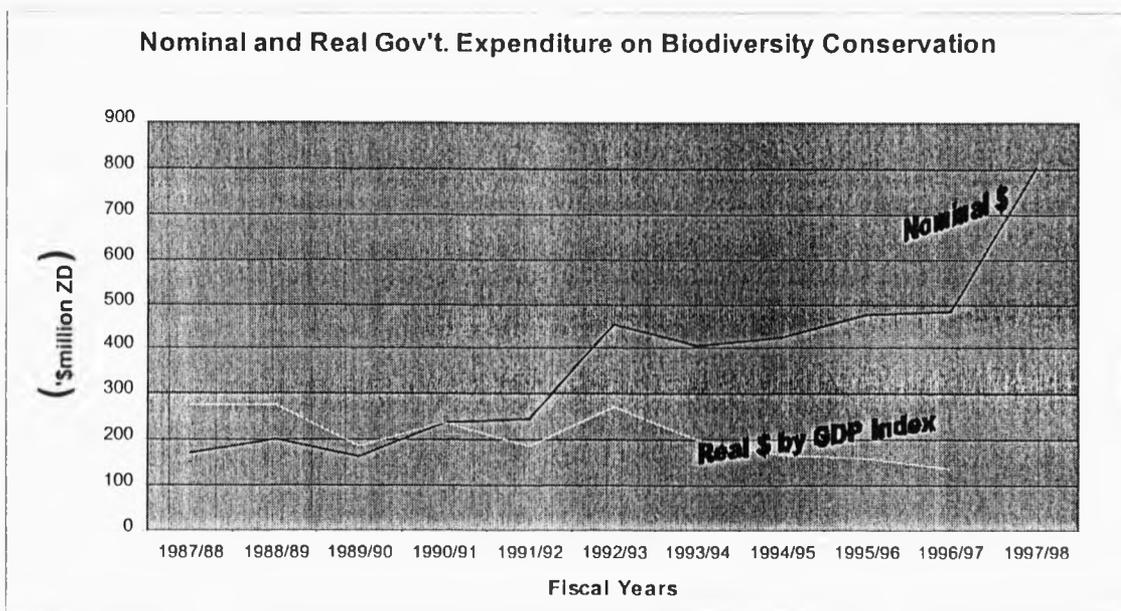
Table 8. Nominal and real Government expenditures on biodiversity conservation, 1987/88 to 1997/98

**GOVERNMENT BUDGETS FOR BIODIVERSITY
CONSERVATION (\$'000)**

	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98
Nominal Expenditures											
<i>a) Mines, Environment and Tourism</i>											
Forestry Commission	12360	14469	17992	19327	18950	21200	19700	18473	16277	23174	36645
DNR	4459	4952	6531	8271	9355	9640	12290	14011	12817	21468	40164
Parks and Wildlife	21929	19182	25073	31111	35143	37505	40235	47320	51787	48368	20000
Sub-Total (MMET)	38748	38603	49596	58709	63448	68345	72225	79804	80881	93010	96809
<i>b) Other Agencies</i>											
Agritex Extension	35440	39437	42417	53055	63958	185080	111458	152780	216215	169479	399640
Research and SC.	16993	19235	19554	24888	26695	29520	37560	43220	53115	73179	135406
Water Resources	80255	103929	51394	100306	92155	168981	185329	148418	124746	145960	169846
TOTAL	171436	201204	162961	236958	246256	451926	406572	424222	474957	481628	801701
Real Expenditures											
<i>Fiscal adjusted indices</i>											
GDP index 1990/91=100	62	73.3	87	100	131.6	165.9	201.4	250.6	293.8	351.4	
Real Expenditures	276	274	187	237	187	272	202	169	162	137	

Source: Ministry of Finance, annual budget estimates, various years.

Figure 5. Nominal and real government expenditure on biodiversity conservation



In addition to donor programmes that operate directly within government agencies, a plethora of NGO's operate small programmes and projects in rural areas at the community level. Some of these NGO's have head offices in Harare with several professional and technical staff. Information on expenditures by these organisations is difficult to obtain from one official source.

d) Summary

There is no doubt that government budgets have declined seriously in real terms over the past several years in response to structural adjustment programme goals of reducing public expenditures, and endemic inflation. For the Ministries and departments with responsibility for managing and conserving biodiversity, this decline in purchasing power means less ability to monitor and enforce policy and legislation. It also means less resources for direct project investment, for example in forestry woodlots. This constitutes implementation failure and must be closely linked to long-term degradation in both the quantity and quality of biodiversity in Zimbabwe.

INCENTIVES FOR BIODIVERSITY CONSERVATION

5.1 Background

Given the serious decline in real government spending on biodiversity conservation in Zimbabwe, public agencies must focus more attention on using economic incentives to help achieve the same goals. Fiscal policy is likely to continue to push for reductions in government spending. Consequently, government is not in a position to substantially fund biodiversity conservation programmes. In the absence of donor funding, which is not sustainable, other means must be used to encourage conservation of biodiversity as a component of rural development.

Incentives can be a powerful tool to address many of the previous causes of biodiversity decline and uneven distribution of costs and benefits of conservation. Incentives can often be applied most effectively at the local level to help overcome resistance to conservation programmes or practices that may not otherwise be supported for a range of economic, social, and cultural reasons. Incentives should be applied if they can stimulate appropriate conservation behaviour at a favourable cost-benefit ratio. All incentive programmes must be subjected to some form of economic appraisal to ensure that social welfare will be the same or better off with the incentive than before. As an example, a cash subsidy to provide an incentive for tree planting and community woodlot management should cost less than the estimated benefits gained by the programme.

5.2 Types Of Incentives and Disincentives

Incentives and disincentives have various forms and functions (McNeely, 1988)

a) National policy and legal disincentives to conservation

- customs and excise duties which encourage land clearing
- policies to encourage beef or crop production on lands better suited for wildlife
- tax subsidies or credits which promote land clearing for agriculture
- land/resource tenure which provides low security and incentives for conservation
- resource pricing (forests, fish) which does not encourage sound management
- low administered entry fees (into parks, fishery, forests, wildlife)
- input subsidies on agro-chemicals which encourage higher rates of application
- marketing boards and prices which encourage expansion into marginal lands
- poor policies regarding extraction of resources (net size, diameter limits, etc.
- high interest rates which encourage faster resource exploitation
- BOP deficit and policies to encourage exports of input-demanding crops

b) Incentives at the national level (mainly fiscal incentives)

- tax structures on under-utilised private land to either turn it over to sustainable agriculture, or keep the land in a natural state
- favourable tax structures for donations of cash and in-kind contributions to conservation programmes

- reduced import taxes and duties on capital equipment (and spares) required for conservation programmes
- increased rates of depreciation on capital equipment used in conservation programmes or more efficient resource use (water)

c) Direct cash incentives at the community level

- direct cash incentives for conservation where villagers get proceeds from resource use, or cash for conservation programmes
- sharing of entry fees for parks, etc.
- cash rewards for conservation efforts
- fines to act as a deterrent against non-sustainable use of natural resources
- compensation for damage to crops, forests, etc. by wildlife being conserved
- compensation for being excluded from State forests and national parks (to plant crops, cut trees, harvest wildlife, fish, non-timber products)
- grants for specific conservation programmes
- subsidies to support conservation programmes (for reduced cattle stocking, managing wildlife, managing woodlots, etc.)
- credit facilities at low rates of interest to finance conservation programmes

d) Direct incentives in kind at the community level

- food assistance where crop damage occurs due to wildlife
- providing improved crop and livestock breeds to improve efficiency of land-use
- providing better access to natural resources where sustainable management is the objective
- exchange of property rights (farmers can gain secure rights for forest estates in return for defined protection activities)

e) Indirect fiscal incentives to promote community support for conservation

- tax incentives to promote conservation (tax write-offs, double deductions, faster write-off periods, etc.)
- subsidised insurance against crop failure for low-income farmers (to prevent overfarming marginal soils)
- subsidies to shift rural people from fuelwood to fossil fuels, biogas and solar energy

f) Indirect service incentives

- community development programmes which are tied to better conservation practices
- free agricultural inputs for rehabilitating and stabilising lands and forests
- rural development project subsidies to improve management of resources (wood for crafts, medicines, foods, fruits, etc.)
- education and training

g) Indirect social incentives

- community involvement in resource management and conservation programmes
- policies that promote use of local labour for sustainable resource use programmes in eco-tourism, etc.
- information on the values of biological resources

One successful example of incentives at the community level in Zimbabwe is the CAMPFIRE programme, which generates approximately \$25 million ZD annually (and growing) for rural development programmes. Communities in CAMPFIRE projects are legally empowered to manage wildlife resources and share in the financial benefits. Revenues raised from tourism and commercial hunting for example, are ploughed back to the communities through Rural District Councils. Revenues are used for infrastructure such as schools and clinics, new investment in productive assets such as irrigation projects, and to compensate farmers who lose crops due to wildlife damage. These economic incentives encourage conservation of wildlife and the supporting ecosystems. While CAMPFIRE was originally focused on wildlife, recent projects have encompassed tourism, forestry and small-scale mining.

6.0 WELFARE INDICATORS

6.1 Background

Measuring changes in human welfare has been an intractable problem for economists over the years. The following measures of human welfare could be used;

- Real GDP per capita
- Human poverty index
- Index of nutrition
- Human development index

Real GDP per capita is a reasonable measure of economic development but has a weak relationship with broader social development, including education and health. It also ignores the value of natural capital stocks. The human poverty index combines the variables of percentage of adults expected to die before age 40, the percentage of adults who are illiterate, the percentage of people without access to safe water and health services, and the percentage of underweight children below the age of five (UNDP, 1997). This measure is a fairly good indicator of human development levels in a given country. Another option is to use some index of nutrition. Alternatives include daily per capita calorie supply, an index of average calorie supply per capita relative to developed countries, and an index of food production per capita relative to an index year for the same country (showing changes over time). The human development index (HDI) measures the average achievements in a country by accounting for life expectancy, educational attainment, and real GDP per capita (UNDP, 1997).

Each of the previous indicators has strengths and weaknesses. One challenge in this paper is to explore the relationship between indicators of environmental change such as population density (which impacts on erosion), the level of government spending on biodiversity conservation (a measure of value, impacted by fiscal policy), and some indicator of change in social welfare.

A priori, the HDI might not be a good measure to use because linking some of its components (education or life expectancy) with expenditure on biodiversity conservation and environmental degradation is rather tenuous. Many Zimbabweans can still be educated and live a long life without high levels of government spending on biodiversity conservation, and an associated degradation of soils or forests. How sustainable this might be is another question however.

The limitation of using real GDP per capita as a measure of human welfare has already been discussed.

The human poverty index would be a possible indicator although it shares some of the same problems with the HDI; government spending on biodiversity conservation and environmental degradation may not greatly influence illiteracy or access to safe water and health services, at least in the short-term. Over time however, degraded resources in rural areas might constrain the ability of people to earn a living (and pay for school fees), cause certain health impacts, and reduce the availability of safe water.

Of the indicators identified, the one that might be best suited for this study is some measure of nutrition because the majority of the population relies on the soil to grow subsistence food and generate modest incomes. Forests also provide various goods and services. If these resources are declining, especially on communal areas, food production, and/or daily calories per capita could decline as well. Inadequate daily nutrition certainly causes a negative change in human welfare.

6.2 Selecting an Indicator and Data Issues

For all indicators, a major limiting factor in deciding which specific measure to use was availability of data. Intensive searches of published reports and electronic (on-line through Internet) databases was frustrating for all of the previous indicators. The main sources of information included:

- UNDP, Human Development Reports (various years)
- World Bank, on-line economic and social data bases
- World Resources Institute, World Resources Reports (on-line for various years)
- Central Statistics Office, various reports
- UNEP, Environmental Data Report (1992-93)

With the exception of GDP per capita, no indicator was available in a consistent and long-term database. Problems encountered included slightly different data for the same indicator and year from alternate sources, different base years for some indices, and most serious of all, major gaps. The HDI was only available for a few years over the three decades examined. The poverty index was available for Zimbabwe only for one year.

Nutrition measures were somewhat better but still left much to be desired. The original objective of using a database stretching two or three decades had to be discarded. With the various nutrition measures, an index of food production per capita was the best available and is therefore used in this study.

7.0 LINKING ENVIRONMENT, FISCAL POLICY AND DEVELOPMENT

7.1 Background

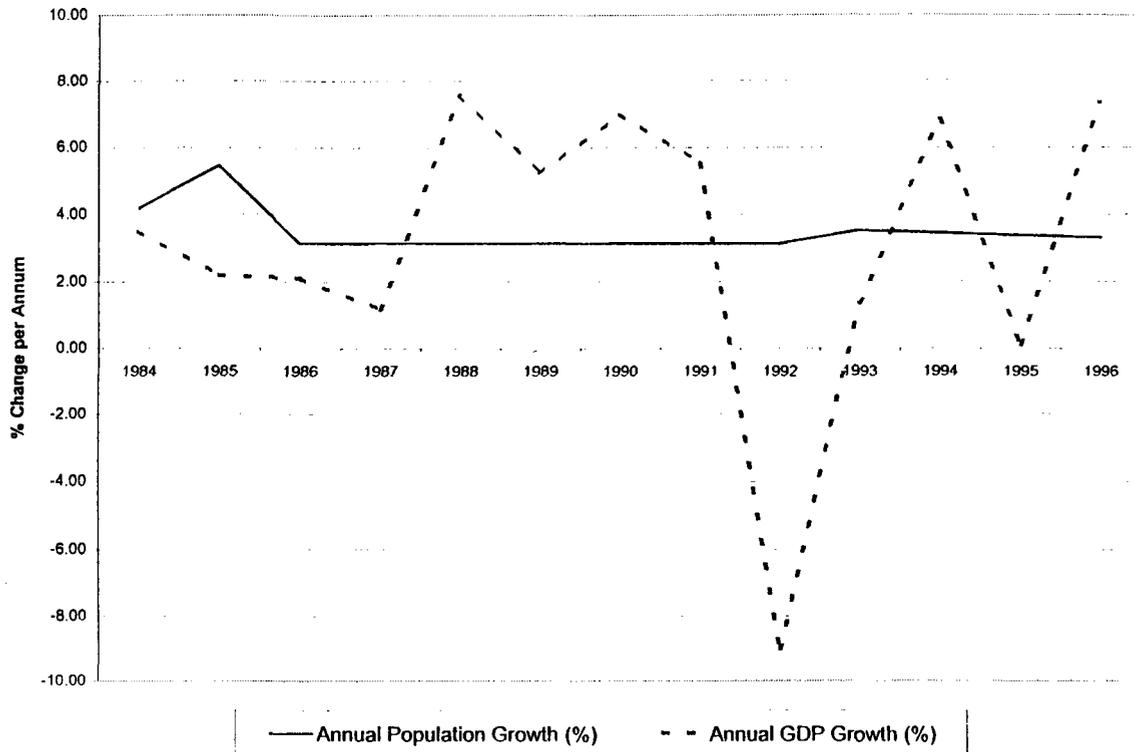
This section examines relationships between economic growth, population growth, environmental degradation, fiscal policy, and human welfare, and then establishes the degree of linkage using graphs and a simple multiple regression.

The relevant macro-economic data (Appendix 1) were derived from a mix of published sources. A number of data gaps in some time series were corrected using trend-line analysis. While a poor substitute for actual data sets, the time series were felt to be reasonably linear over the study period. Trend-line analysis is an acceptable method of interpolating missing data sets for linear time series data.

7.2 Economic and Population Growth Sustainability

At a macro-level, one basic condition for sustainable development is that the rate of growth in real GDP must be equivalent to or greater than the rate of population growth. This condition is based on the premise that if population growth exceeds real GDP growth, then real per capita incomes will decline and encourage greater exploitation of natural resources. A representative graph for Zimbabwe (Figure 6) indicates that over the period 1983 to 1996, the annual change in population growth has been fairly stable, at an average of 3.48 percent. On the other hand, the rate of real GDP growth has fluctuated wildly, however, the average over the same time period is 3.13 percent. Taking these average figures, the conclusion is that at a national level and for the period 1983 to 1996, the rate of population growth exceeded that of real GDP. Therefore, Zimbabwe has not met a very simple condition for sustainable development using these basic macro indicators. This rather course analysis masks sub-national impacts, especially in term of actual natural resource degradation throughout various provinces, between communal and non-communal lands, etc. However, this broad national indicator should still alert policy makers that the potential for biodiversity degradation exists in this country and stimulate more detailed analysis at a sub-national level.

Figure 6. Annual percentage change in population and real GDP, Zimbabwe

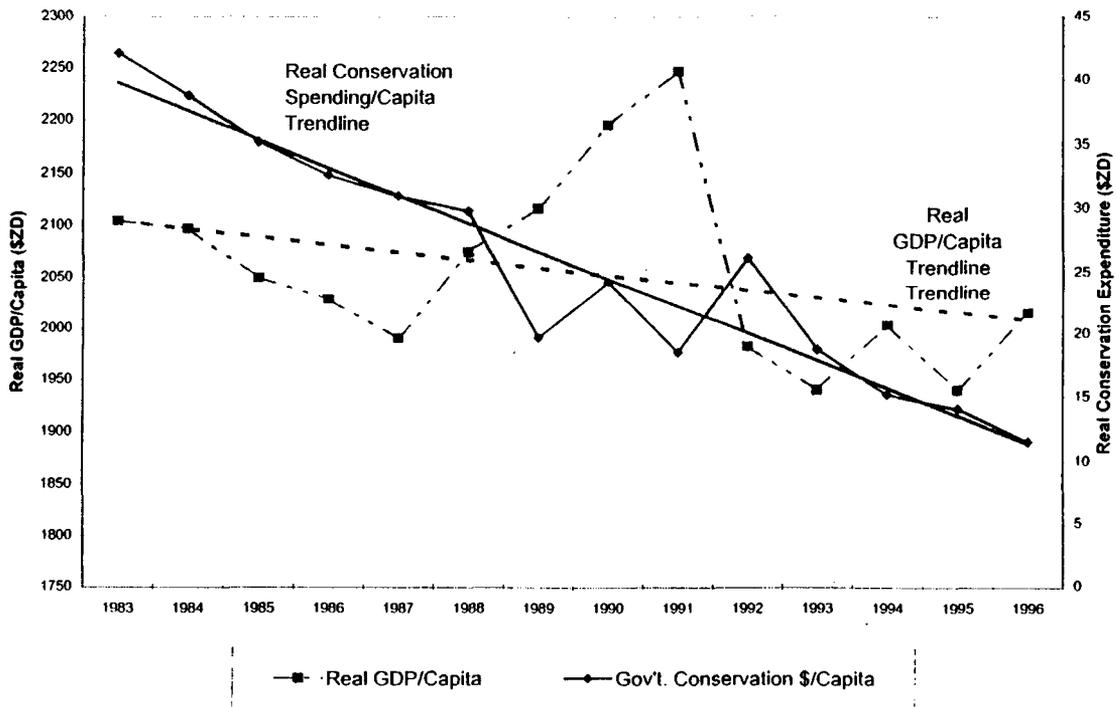


7.3 Real GDP per Capita and Real Expenditures per Capita

From a policy perspective, the linkage between real national income (GDP) per capita and the corresponding level of public investment in biodiversity conservation is important. This paper has clearly shown that biodiversity underpins a significant proportion of economic activity in Zimbabwe, in both measured and non-market goods and services. A sustainable development policy framework could include matching real government expenditures per capita on biodiversity conservation (to maintain the natural capital stock) with the level of real GDP per capita. As national income per capita increases or declines, government tax revenues should also change in the same direction with a corresponding influence on the ability of government to allocate revenues towards biodiversity conservation programmes.

The data for Zimbabwe (Appendix 1 and Figure 7) show that during 1983 to 1996, both spending per capita on biodiversity conservation (in real terms), and real GDP per capita declined. However, the decline has been significantly more severe for conservation spending. Real conservation expenditure per capita declined from \$42 ZD to \$12 ZD, representing a drop of 250 percent or an annual average decrease of 19.2 percent.

Figure 7. Real GDP per capita versus real government spending on conservation per capita



On the other hand, real GDP per capita is relatively unchanged over the 13 year period (\$2104 versus \$2015), representing a decline of 4.2% or an annual average of only 0.3 percent. Figure 7 shows the actual time series as well as fitted trend lines. The slope of the trend line of real government expenditures per capita is much steeper than of real GDP per capita. This trend is disturbing from a sustainable development perspective.

Another policy issue is to determine a minimum level of expenditure per capita for maintaining a reasonable level of biological diversity in Zimbabwe. Present levels of expenditure per capita of \$12 ZD (or about 67 cents USD) could be compared with other developing and developed countries. Whether the existing public investment level per capita is high enough or not depends on a comprehensive assessment of how the natural environment is changing and the perceived importance of maintaining biodiversity to support the national economy.

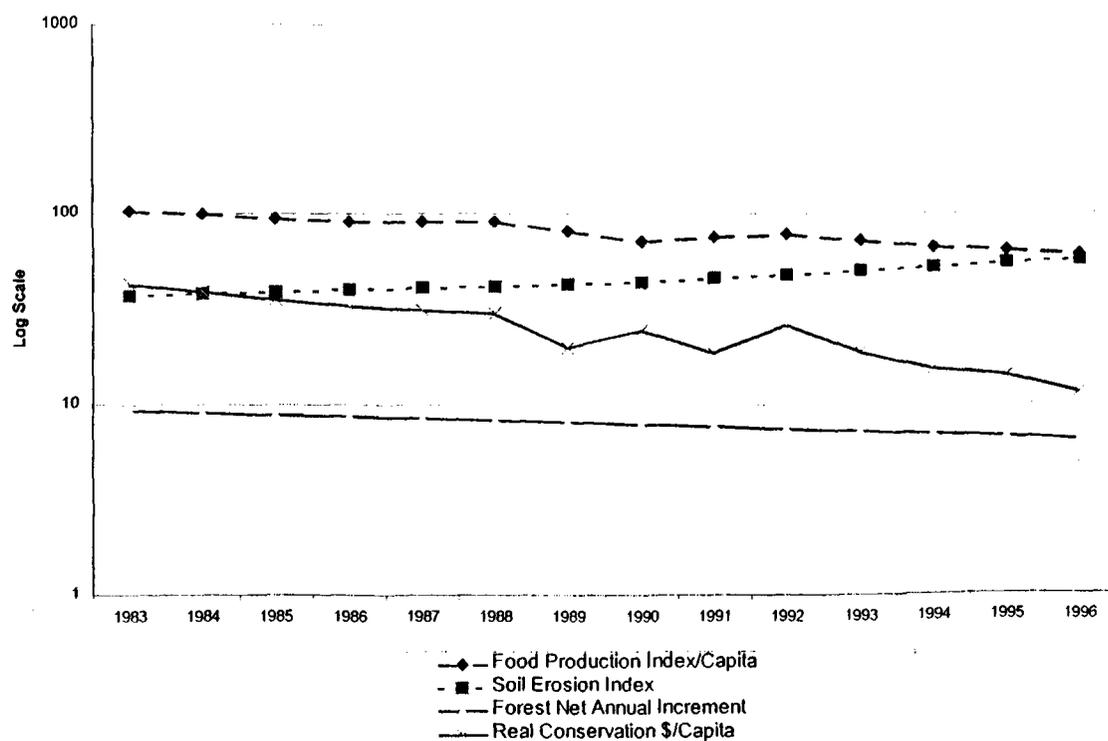
7.4 Trends in Environmental Degradation, Government Spending and Social Welfare

From Appendix 1, trends can be charted for environmental degradation, food production per capita, and real spending per capita on conservation (Figure 8). In general terms, the index for soil erosion (in communal lands) is increasing while all other indicators (per

capita food production, forest net annual increment, real government spending per capita on conservation) are in decline.

The index of soil erosion is correlated to population density, thus either could have been charted. Figure 8 uses a log scale to illustrate relative trends and avoid problems caused by plotting multiple variables with different scales on one graph. The trends again question how sustainable Zimbabwe's development path might be. The chart shows that the environment is being degraded, concurrent with reductions in real government expenditure per capita on biodiversity conservation. From previous charts, GDP per capita has also declined over the same period. The measure of welfare in this study, food production per capita has also declined. This may reflect a causal relationship between increasing population growth, density and soil erosion, reduced government spending on biodiversity conservation (including soil conservation) and reduced food production. Soils could be eroding through higher population densities in communal areas and loss of forest cover, coupled with real declines in government programmes to combat environmental problems. Increased soil erosion infers lower soil productivity for food production. As shown earlier in this report, the use of inorganic fertilisers has declined on a per hectare basis. Thus, offsetting declining soil productivity through increased use of fertilisers has not occurred. Taken together, these trends suggest that human welfare has been impacted as a result of environmental degradation and reduced real expenditures on conservation.

Figure 8. Environmental, social welfare and government expenditure trends, Zimbabwe



7.5 Regression Analysis

A multiple regression analysis was undertaken to examine the influence of four independent variables (real per capita GDP, real government spending on conservation per capita, and soil erosion in communal areas), on the dependent variable of food production per capita. In other words, can declines in the food production index per capita (dependent variable) be explained by changes in the different independent variables?

a) Independent variables

Real per capita income was selected because it is a crude measure of economic development. Also, when real GDP per capita is declining, the expectation is that low-income people will turn to natural resources for income and food supplements. Sustainable utilisation of natural resources is secondary to daily survival. People with low real incomes are in a difficult position to purchase inputs for growing food (for subsistence and cash), or food itself. Consequently, declining real GDP per capita could influence food production per capita.

Real government spending on conservation per capita was selected because of the relationship between these expenditures and environmental degradation. As soils become degraded, due to reductions in government conservation programmes, food production per capita should also decline.

Soil erosion was selected because of the intuitive linkage with food production, especially in communal lands. Given the high correlation between soil erosion and population density, only one of these variables could be used in the regression.

Forest net annual increment was not selected because most of the woodland clearing in Zimbabwe is for land conversion to agriculture. While forest loss is a serious environmental issue in this country, it results in more arable and grazing areas, hence increasing food production.

b) Regression characteristics and statistics

Dependent variable: food production per capita index

Independent variables: real GDP/capita

soil erosion index on communal lands

real government spending/capita on biodiversity conservation

From Appendix 1, the R^2 value is 0.94. A global test, using the F-statistic at the 0.05 level of significance indicates that the independent variables have the ability to explain the variation in the food production per capita index. In evaluating individual regression coefficients, both the computed t-statistics and p-values were used. With a two-tailed t-test at the 0.20 significance level, the null hypothesis that $b_1=0$ rejected all three independent variables. At this level of significance, all three variables may help predict changes in the food production index per capita. The regression statistics are shown in Appendix 2.

7.6 Analysis of Results

The model itself has an R^2 of 0.94 and all three independent variables are significant predictors at the 0.20 level. However, the model is fairly simplistic and not as robust as would be desired. At higher levels of significance (0.10 and 0.05) only soil erosion is retained, based on the t-test. Logically, we would expect real GDP per capita and real government expenditure on biodiversity conservation to be significant variables to explain declines in the food production index. That they are not significant at the 0.10 and 0.05 level, suggests considerably more research is needed to develop better data and models.

The food production index per capita could be influenced by a range of variables in addition to those evaluated in this paper. These include access to credit, government subsidies for inputs (seed packs, herbicides), weather, and the level of off-farm income. Perhaps the most important factor to examine in future work is the shift from food crops to cash crops. Also, much of the soil erosion is on communal lands whereas most food is grown on commercial farms, which have historically had better access to conservation information and where population density is less of a concern.

With the data, more current estimates of soil erosion would be helpful. Whitlow's erosion study is now ten years old. Also, the level of financial support from donors and NGO's for environmental programmes should be quantified if possible. Perhaps these financial contributions have more than offset declines in real expenditure by the government of Zimbabwe on biodiversity conservation. More broadly, donor funds could be offsetting declines in real GDP per capita through a range of programmes in existence in this country.

8.0 CONCLUSIONS AND POLICY RECOMMENDATIONS

This paper has demonstrated the importance of biodiversity to the national economy. Biological resources support between and estimated 30 and 35 percent of total GDP. This significant contribution underpins the importance of conserving biodiversity in Zimbabwe. More important, many of the non-market values generated by biodiversity are not captured by traditional measures of national income. This implies that the importance of biodiversity to the national economy through GDP may be grossly understated.

Data gathered from secondary sources (and derived where necessary), indicate that both real GDP and GDP per capita are declining. Nationally, a comparison of real GDP and population growth rates, suggests that Zimbabwe is not on a sustainable path. A basic condition for sustainable development is that GDP growth exceeds population growth. This condition is not being met in Zimbabwe.

Biodiversity loss is a serious problem for this country, at both the household and national levels in terms of economic values at risk. The longer-term outlook for national economic and social development is not positive if trends in biodiversity losses continue. There are few development options available to compensate for sustained degradation of soil, forests, and aquatic ecosystems and all the economic activity these support. While the economy

appears to be shifting towards a greater reliance on service sectors, many of these in turn are supported by traditional economic sectors based on biodiversity. Tourism is a classic example, and is one of the few sectors identified with high growth potential. Policy makers should be asking themselves about the cost of reduced tourism development in relation to continued degradation of the supporting natural environment.

One of the factors likely contributing to biodiversity decline and having an indirect impact on human welfare is the declining real government expenditure for biodiversity conservation. These reductions in expenditure are one outcome of current fiscal policy, which is largely directed towards Structural Adjustment Programme goals of cutting public spending to reduce domestic and external borrowing requirements. The level of real expenditure per capita on biodiversity conservation is approximately \$0.67 USD. Whether this is adequate or not can be determined by a comparison with other countries and a thorough empirical assessment of environmental degradation in this country itself. While real GDP per capita is also declining, the rate of decline in real expenditure per capita on conservation is significantly higher.

The limited data available for this study suggest that environmental degradation is increasing, as represented by an index of soil erosion and net forest annual increment. A simple log scale graph suggests some relationship between these two indicators, real government spending per capita on conservation, and a measure of welfare represented by a food production index per capita.

A very simple regression analysis suggests that changes in real government spending on biodiversity conservation and soil erosion (in communal areas) and real GDP per capita do influence social welfare as represented by a national food production per capita index. Overall, the model had an R^2 value of 0.94. However, these variables were only significant at the 0.20 level, which is far from satisfactory. At the 0.10 and 0.05 level of significance, only soil erosion is a valid variable in this model. Additional work is needed to develop more comprehensive models taking into account a wider range of variables.

Given declining real public budgets on biodiversity conservation, the government should increase its commitment to empowering communities to manage their natural environment and share in the benefits. There is a range of economic and non-economic incentives available for improving biodiversity conservation. These can include direct incentives such as cash and equipment, and indirect incentives such as capacity building and benefit sharing. Programmes in Zimbabwe like CAMPFIRE have a successful track record of improving community development through incomes raised from wildlife management and tourism. This type of programme needs to be expanded to indigenous forests as a mean of providing economic incentives for more sustainable natural resource management and biodiversity conservation. This is critical given the downward trend in real government spending for conservation, which is likely to continue in the face of severe fiscal policy pressure to cut back public expenditures. It would be ill-advised for the government to rely on external donor funds to offset real declines in government expenditure. This approach is not sustainable in the long run. Local solutions involving economic empowerment and incentives at the community level, offer a way of overcoming this difficult challenge.

Another policy issue relates to allocation of limited public funds through the annual government budget process. Investments in natural capital will help sustain the contribution of biodiversity to the national economy and provide the resource base for many communities to enhance their level of development. More funds are required for technical support provided by a range of government agencies charged with managing natural resources. Lack of funds constrains programmes related to technical assistance, information and education, inventory, monitoring changes in the environment, and enforcement of legislation and regulations governing use of biological resources. While economic incentives can go a long way to reducing the direct financial burden on government, there is still a need for public agencies to be involved in biodiversity conservation policy, legislation, and monitoring.

The process of allocating public funds within government needs to be reviewed. Budget allocations towards non-productive investment (Mercedes Benzes, military equipment, foreign travel, subsidies to parastatals, etc.) should be reviewed and justified in terms of the opportunity cost relative to more productive investments in human, man-made, and natural capital. A failure to provide the necessary fiscal resources and apply appropriate incentives to at least maintain the country's genetic, species and ecosystem biodiversity is leading Zimbabwe down an unsustainable development path.

A qualified conclusion is that human welfare is affected by environmental degradation and declines in both real GDP and real government spending on conservation. Substantially more research is needed to explore these relationships. Better data are required, especially in the area of social welfare indicators and biophysical changes. This study has raised a number of questions where additional and more focused research could be useful to policy-makers.

There are several important policy recommendations from this study:

- A major effort is required to improve the quality of information on biodiversity in Zimbabwe, especially in the area of change data. A comprehensive database on changes in soil erosion, forest cover (by species, area and volume), terrestrial and aquatic wildlife, etc. is needed to support more effective national policy formulation. This effort could build on existing work to date and institutions with the capacity to manage such a database. The Institute of Environmental Studies at the University of Zimbabwe is well-placed to be the lead agency to co-ordinate the development of a national biodiversity database.
- A database on external donor and NGO financial allocations to biodiversity conservation should also be developed. This would allow a more meaningful comparison of government allocations versus external support. External support relieves the government from public pressure that could arise from an inordinate level of unproductive investment using its own limited fiscal resources. Donor funds are not sustainable in the longer-term due to changing donor policies, donor fatigue and internal economic performance.

- These databases should encourage a greater effort to develop wider estimates of market and non-market values of biodiversity in this country. Such information could then fit into a longer-term programme to adjust the national accounts, adding the values of biodiversity stocks and flows.
- More focused research is needed, by sector, on the linkage between biodiversity conservation, fiscal policy and social development. More work is required to identify an indicator of human welfare and refine an econometric model for use by policy makers and researchers.
- The government must continue to shift management authority over natural resources to communities. The CAMPFIRE approach must be expanded to forests and aquatic resources.
- The government must complement this process by providing economic incentives to encourage better biodiversity conservation, especially through de facto natural resource ownership, open and transparent benefit sharing, preferential hiring practices on local development projects, and tax breaks.

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APPENDIX 1 – DATA TABLE

YEAR	National Population Level (' 000)	Real GDP (1990=100) (\$'000 ZD)	Real GDP per Capita (1990=100) (\$ ZD)	Food Production per Capita (1979/81=100)	Soil Erosion Index (severe and very severe)	Forest Net Annual Increment (million tonnes)	Population Density Communal (people/km2)	Real Gov't Spending: Conservation (\$million ZD)	Real Gov't \$/Capita Conservation (\$ZD)
1983	7635	16260	2104	103	36.60	9.27	25.20	321	42
1984	7954	16826	2097	99	37.53	9.06	26.51	308	39
1985	8387	17193	2050	94	38.46	8.85	27.83	295	35
1986	8650	17553	2029	90	39.39	8.65	29.14	282	33
1987	8922	17754	1990	90	40.31	8.45	30.46	276	31
1988	9202	19095	2075	90	41.24	8.25	31.77	274	30
1989	9491	20091	2117	81	42.17	8.07	33.09	187	20
1990	9789	21494	2196	71	43.10	7.88	34.40	237	24
1991	10096	22682	2247	75	45.30	7.64	35.35	187	19
1992	10413	20634	1982	78	47.50	7.41	36.30	272	26
1993	10779	20908	1940	72	49.70	7.17	37.25	202	19
1994	11150	22333	2003	66	51.90	6.93	38.20	169	15
1995	11526	22356	1940	63	54.10	6.68	39.15	162	14
1996	11908	23992	2015	60	56.30	6.42	40.10	137	12

Notes: All numbers in bold are from published sources or were derived from published sources
 Numbers not in bold were estimated using trend-line analysis
 Columns 2, 3, 4, from (CSO, 1997)
 Column 5 from (UNDP, 1997)
 Columns 6, 8 from (Whitlow, 1988)
 Column 7 from Mabugu et al, 1998
 Column 9 from Ministry of Mines, Environment and Tourism, 1998
 Column 10 derived from columns 2 and 9



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