4.2.4 Property Rights and Market Failure

One condition for optimal resource allocation in a market economy is the existence of efficient property rights, defined as meeting three specific requirements (Tietenberg 2000):

- **Exclusive**: All benefits and costs from owning and using the resource should accrue to one owner. This avoids problems of multiple owners competing for the resource and not investing in sustainable management practices.
- **Transferable**: All the property rights must be transferable from one owner to another through lease, sale, or bequest in a voluntary exchange. This avoids the problem of owners not investing in resource improvements because of uncertainty about capturing future benefits.
- **Enforceable**: Property rights should be secure from involuntary seizure or encroachment by others. Where property rights cannot be enforced or where the threat of expropriation is high, owners may not invest in resource improvements and conservation.

A well-defined system of property rights provides incentives for efficient resource use and investments in sustainable management practices. Market failure can occur if one or more of these requirements are absent. Efficient property rights in themselves do not however, guarantee better management in all cases (Pearce 1990).

4.2.5 Alternative Property Rights Systems

There are four main types of property rights regimes in the region to consider: open access, communal lands, private property, and state property.

a) Open access

Open access represents the classic case of common property ownership where degradation occurs. Property rights over the resource (land, fish, etc.) are not exclusive and usually not transferable. Access is unregulated thus rendering the property rights unenforceable. Individual users do not bear the cost of ownership. Consequently, no incentive exists for individuals to act responsibly. The rational behaviour of users is to exploit as much of the resource before others do[3]. In this situation, the resource can be overexploited and stocks may collapse. Examples in the eastern and southern Africa region include the exploitation of offshore and inland fisheries (see Boxes 4.2 and 4.3), deforestation, overgrazing of common lands and the slaughter of the Black Rhino. Often, exploitation of open access common property resources is tied to institutional and implementation failure. Local legislation and policy governing resource management may be both poorly developed and inadequately implemented.

Box 4.2: Market Failure in Property Rights - The Fishery off southern Africa's West Coast

The waters off the West Coast of southern Africa provide a rich habitat for fish production. The waters of the cold, north-moving Benguela current are rich in plankton. The mixing of warmer and colder waters produces an upwelling of nutrients. A vast fish resource was relatively untouched until "discovered" about 50 years ago. Foreign fishing fleets and those of South Africa gradually began to exploit the sardine and hake resources in these waters. Without adequate management controls, the fishing sector in this region developed into an open access, common property situation with predictable consequences.

Present stock levels are estimated to be only 15% to 30% of levels found in the early 1960s. Since 1977, foreign fishing has been gradually phased out, but stock levels were still under pressure by local fishing industries. By 1984 however, 68% of the fishing fleet and processing plants in Walvis Bay has either closed or moved to South America. By 1993, the South African catch had dropped to 50% of catch levels in the 1980s.

Source: Konstant (1995).

[3] Refer to module 5 for economic aspects of open access resource exploitation.

Box 4.3: Market Failure in Property Rights - The Lake Victoria Fishery

Lake Victoria is a transnational water body shared by Kenya, Uganda, and Tanzania. It is Africa's largest freshwater lake. The lake provides a rich habitat for fish production. Over time, the composition of fish species has changed from a diverse mix to mainly three species. This transition is due to human fishing practices, pollution, and the introduction on Nile Perch, which has evolved into a dominant species. The estimated maximum sustainable harvest is approximately 31,000 tonnes per year. However, since 1981, annual harvests have exceeded this sustainable figure. The annual harvest in 1991 was almost 180,000 tonnes of fish. Fishing is still quite profitable, however the mean catch per unit of effort for some key species has been dropping steadily since 1986. These are clear signs of overfishing, due in large part to a lack of efficient property rights over the resource.

Source: Ayoo (1994).

b) Communal property

With communal property rights, a community or group of users holds resources under de facto ownership. The actual land or the resources on that land may in fact be owned by the state, but local people control management and use. A mistake by many policy makers is to assume that a communal property situation will always lead to resource degradation. This is not true: there are many examples of successful and sustainable resource management under a communal property rights regime. The "Campfire" programme for communal wildlife management in Zimbabwe is a good example. Where resource use is regulated successfully, property rights tend to be exclusive, transferable, and enforceable. The most important point is that access by "outsiders" must be controlled. Often, sound communal resource management is linked to strong cultural and traditional practices.

The communal property system can still fail however. If there is a shift towards economic rather than subsistence production, some people in the community may exploit the system to increase personal incomes. Also, high population growth and resource demand may at some point exceed sustainable levels of supply from the limited resources under communal management. In either case, adding cattle to a limited grazing area or cutting more trees from a given forest may eventually put too much pressure on the resource base and lead to degradation.

c) State property

In most countries in the region, the state retains ownership of the majority of natural resources. Examples include state forests, national parks, inland waters, and even agricultural and rangeland

held under communal management. Legal resource ownership and authority for management rests with the state. The state may allocate resource use through the form of leases (for timber rights, safari areas, farming), permits (for hunting, fishing, fuelwood, mining), quotas (for fishing, timber and wildlife) and in the case of communal lands, acknowledge traditional management rights and decisions over resource allocation. Sustainable resource management may not always occur on state lands however, and might begin to mirror an open access situation. Some reasons for this market failure include:

- Control of access is not enforced (institutional failure);
- Monitoring of resources use by government agencies may be weak (institutional failure);
- Corruption in government can lead to excess resource exploitation; and
- High population pressure in surrounding areas can lead to illegal resource use.

d) Private ownership

Where at least the last three conditions for efficient property rights are met (exclusive, transferable, enforceable), there is a stronger possibility that private resource management will be sustainable. Most individuals will act rationally and favour conservation under efficient property rights. However, situations can arise under private ownership, which can contribute to resource degradation. First, owners of the resource may face an uncertain future about their long-term ownership. If land expropriation were a possible future outcome (uncertainty of transferable rights), most rational owners would not invest in improving their resource. Many large-scale commercial farmers in Zimbabwe face uncertainty, following government's moves in 1998 to designate certain farms for resettlement. This has led to a decline in capital investment in the sector. Second, for very large tracts of private land, monitoring can be difficult and expensive. Failing to restrict access by outsiders can lead to an open-access problem (enforcement failure). Poaching of timber or wildlife on large private farms is an example. Third, owners may simply respond to government policies regarding land use, prices and export incentives. As an example, farm owners may over-apply chemical inputs or waste water if these are subsidised by the state. Also, farm producer prices and supporting government policy over export crops may influence crop selection towards cash crops such as tobacco, which are more demanding on nutrients and water. Finally, landowners may lack the technical capacity to manage their natural resources and environment sustainably.

4.3 POLICY FAILURE

4.3.1 Background

As described previously, the state owns the bulk of natural resources in the eastern and southern Africa region. There are also many cases of joint natural resource ownership:

- Rivers such as the Zambezi (Zimbabwe, Zambia, Namibia, Angola, and Mozambique);
- Lakes such as Victoria (Kenya, Uganda, and Tanzania); and
- Migratory resources such as fish in Lake Kariba (Zimbabwe and Zambia) and elephants (western Zimbabwe and eastern Botswana).

In this context, government policy can influence natural resource management and environmental conservation. Policy can be defined in several ways (Worrell 1977). One definition is that policy provides guidelines for society to act in certain ways. Another is that policy provides a sense of direction to achieve specific goals. With natural resources and the environment, policy usually provides principles or direction as to how society uses the resources to achieve certain national development goals.

Most countries in the region have broad economic, social, and environmental policy goals defined in a national development strategy. These strategic policy goals are usually shaped by global and national initiatives related to macroeconomics, environment, and sectoral development. At a lower level, sectoral policies specific to forests, water, minerals, agriculture, etc. will be formulated, leading to specific programmes and projects through the planning and budgeting cycle. Resource degradation can result from policy failure in three ways. First, broad macro-economic policies can influence how people use natural resource production inputs. Second, regulatory policies governing natural resources may not be adequate to correct for market failure. Finally, conservation policies may be poorly designed and implemented (see Box 4.4).

Box 4.4: Policy Failure - Soil Conservation in Kenya

In 1972, the Kenyan Government declared that soil degradation was the country's most serious obstacle to national food production and development. Nearly 85% of the population lives in rural areas, yet only 20% of the total land base is suitable for highly productive agriculture. A number of policy initiatives were implemented in the 1970s to counteract soil degradation. Farmers are required by law to conserve their soil through practices such as building terraces, planting trees, etc. An elaborate system of graduated sanctions or penalties is used to ensure compliance by farmers. A number of economic studies have shown conclusively that these practices will, in the long run, conserve soil and maintain productivity at high levels. Despite these facts, some farmers have not conserved their soil. The reasons are that conservation measures are expensive. Cash flows are sometimes too small for the farmer to invest in conservation even if he or she is fully aware of the long-term benefits. This is a good example of policy failure and illustrates the problem of proclaiming policies that make people trade-off immediate food and income gains for longer-term conservation benefits. In this case, farmers will be more likely to invest in better farming methods that conserve soil if crop prices are higher (to increase their incomes) and access to credit is improved.

Source: Ekbom (1995).

4.3.2 Macro-economic Policies and Natural Resource Degradation

Macroeconomics is the study of the economy as a whole and considers national output, employment, prices, trade and finance[4]. Macroeconomics looks at the broad picture of a national economy. Macro-economic policy can take three main forms: fiscal, monetary and trade policy. All can influence natural resource conservation and the environment.

a) Fiscal policy

Fiscal policy consists of 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 and input prices.

Subsidised producer output prices and environmental degradation

Government development objectives may include sustaining a strong domestic agricultural sector. Governments want to keep farm producer prices high to increase farm incomes and address rural

poverty. At the same time, public pressure usually exists for lower agricultural commodity prices at the consumer level. To address these conflicting goals, the government may establish agricultural marketing boards or similar parastatals where farmers must sell their raw production at a given price. These marketing boards then sell the production to food processors and distributors at a lower price. The difference in price is a subsidy paid by the state to the farmer to keep incomes high while consumer food prices are reduced. Where consumer prices are fixed for basic food commodities, the subsidy is usually paid to the food processor/distributor. Common examples include marketing boards for dairy products, grains, and beef. By using marketing boards, governments can influence both producer and consumer prices. A case of subsidies and policy failure in the forestry sector is presented in Box 4.5.

The environmental effects of subsidised producer prices come from the influence of inefficient crop prices on farmer behaviour. Subsidies can provide an incentive to increase production into marginal farming areas more susceptible to erosion. Farmers may also increase livestock numbers beyond the land's carrying capacity. These are “scale” effects, where expanded production results in increased resource use and waste generation. Degradation occurs if the activity pushes into more environmentally sensitive sites. More intensive use of chemical inputs such as fertiliser may also occur, which carries the risk of ground and surface water pollution. This is an “intensity” effect where for a given area of land, increased inputs are added in response to some stimuli such as subsidies. Both scale and intensity can occur together.

[4] Basic macro-economic theory is presented as a separate Annexure after module 10.

Box 4.5: Policy Failure - Forest Management in Malawi

In Malawi, forests provide approximately 90 percent of the nation's domestic and industrial energy requirements plus a large volume of commercial timber. Rural demands on the forest for fuelwood and poles account for about 60 percent of the national consumption of timber. Tobacco and tea estates account for another 23 percent where wood is used for curing. In the 1980s the government invested in the planting and management of 15,000 hectares of eucalyptus state forest to be used for future fuelwood production. The state would sell the fuelwood to commercial users such as tobacco farmers at low, government-set stumpage prices. The government also established a number of nurseries where small-scale farmers could purchase subsidised seedlings to plant for fuelwood. Fuelwood from these private woodlots could then be sold to commercial users at the same government-set stumpage prices.

The programme was not successful. The cost of maintaining the large public fuelwood plantations was found to be higher than expected while growth rates were lower than anticipated. The demand for subsidised seedlings by private farmers was quite low. A main reason for this policy failure was the low stumpage rates for commercial fuelwood. These were set and enforced by government in order to reduce prices to consumers. These low stumpage prices discouraged private investment in fuelwood plantations and caused a major deficit in state plantations. This is a clear example where a policy of below-market wood prices contributed to an unsuccessful programme for increasing wood supply and addressing deforestation.

Source: Armitage and Schramm (1991).

Subsidised input pricing policies and environmental degradation

Government fiscal policy can also have negative impacts on the environment through input pricing subsidies. As an example, high taxes on paraffin or electricity may encourage low-income urban residents to consume fuelwood, thus putting extra pressure on indigenous woodlands. Subsidised water prices provide no incentive for efficient use among agricultural, industrial and domestic consumers. Subsidised prices of chemical inputs such as fertiliser and pesticides can encourage greater usage in agriculture and forestry (intensity effect).

Positive environmental effects of fiscal policy

The preceding examples illustrate negative linkages. However, fiscal policy can be used to directly improve conservation and reduce environmental impacts. For example, taxing agro-chemicals may reduce consumption by farmers, depending on average income levels. Subsidies can be paid to farmers either directly as cash or through tax credits for implementing conservation measures. Villages can be encouraged to plant trees through direct subsidies on the cost of seedlings and fencing materials. Providing water at its full marginal cost to users will often discourage waste. The

cost of subsidies and changes in social welfare are important to consider. Subsidies paid by government to achieve specific goals, such as increasing farm incomes, or encouraging people to plant trees are a cost to society as a whole. The environmental benefits of such fiscal measures should be compared with the costs to weigh the net change in welfare to society.

b) Monetary policy

Monetary policy refers to the actions of government to meet strategic objectives related to money supply, interest rates, credit, and exchange rates. The central bank or Reserve Bank usually implements these actions. Developing countries have a number of monetary problems:

- High real and nominal interest rates due to high domestic inflation;
- Fixed official exchange rates (often overvalued);
- Seriously depreciating exchange rates (once they are deregulated and freely floating);
- High levels of government debt (local and foreign); and
- Balance of payment problems (BOP).

The linkage between monetary policy and the environment is not always clear. For example, developing countries often have high domestic interest rates due to high inflation and excessive government spending and borrowing from the local money market. Governments may then offer low-cost credit to local farmers. The subsidised credit may encourage increased production, which is positive, but it could have negative impacts on the environment.

Most countries in the region are in the process of relaxing exchange controls. Often, the value of the local currency relative to stronger currencies, such as the US dollar, drops as currencies formerly held at artificial and overvalued rates adjust to market forces. Zambia and Zimbabwe are good examples where local currencies depreciated after controls were lifted[5]. This depreciation[6] makes exports cheaper to foreign buyers and thus can encourage local exports. An expansion of local production for exports (certain input-intensive farm products, indigenous timber, fish, minerals, etc.)

[5] Zimbabwe returned to exchange rate controls in mid-1999 after a severe depreciation of the local currency in response to growing inflation and several questionnable economic policy decisions.

might have negative environmental impacts. Similar effects can occur where balance of payments problem caused by high external government debt results in government encouraging export production to increase foreign exchange inflows.

c) Trade policy

Trade policy refers to government actions designed to influence international trade in goods and services. Trade policy is usually aimed at protecting domestic industries by restricting competing imports. At the same time, governments desire open access to foreign markets for their own country's exports. Tariff barriers consist of levies on imports, (duties and taxes) which raise government revenue and thus the domestic cost of the imported products. Non-tariff barriers such as quotas, cumbersome customs clearance and inspection procedures can also increase transaction cost and reduce imports. Tariff barriers represent a shift in welfare from consumers to domestic producers and government.

High trade barriers discourage imports by raising the local price. Local producers of similar commodities can then raise their domestic prices to at least that of the imported border price plus taxes and duties. Conversely, lower trade barriers can increase imports and lower the domestic price of the products. Since trade policy can influence domestic prices, there is scope for influencing natural resource use, production efficiency, and waste generation. 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 consumption by farmers. Lower trade barriers may promote increased use of chemicals. Tariffs can be used to restrict imports of polluting equipment. Vehicles with pollution control devices could have reduced import tariffs.

Trade barriers can also influence the domestic cost of imported environmentally friendly technology, particularly for industry. High tariffs might discourage industry from investing in cleaner technology. This could be important in mining, coal fired power generation, chemical industries, and textiles where pollution problems often require imported western technology. Trade

[6] Depreciation: When a nation's currency declines in value relative to other currencies when freely floating. Devaluation: When a nation's currency is officially depreciated relative to other currencies or gold. Source:

barriers in export markets can also influence the local environment. For example, trade barriers in an export market for one crop may encourage local farmer to plant another crop, which could be more demanding on the environment in terms of water and artificial inputs. Thus, trade policies in western markets can influence crop selection in this region.

Free trade would clearly reduce these welfare losses at a global level by eliminating all forms of trade barriers. To achieve this goal, more than 100 countries are members of the General Agreement on Tariffs and Trade (GATT) which, through negotiation, works to reduce trade barriers and settle trade conflicts. The Uruguay of negotiations was completed in 1993, and signed in 1994. This agreement established the World Trade Organisation (WTO), which has substantial powers to enforce international trade agreements. Late in 1999, formal discussions were held in Seattle, Washington to move the free trade agenda forward. One of the hottest issues at these talks concerned the linkage between trade and environment. Pro-trade delegates argued that free trade would increase national income and allows poor countries to invest in environmental protection. Anti-trade delegates argued that free trade increased environmental degradation. Some western governments floated an idea for global environmental standards linked to trade. Countries not meeting these standards could face trade sanctions.

Delegates from developing countries argued that this was nothing more than an attempt to establish informal trade barriers.

The relationship between the WTO and the environment is complex and touches on trade related environmental measures (TREM's) such as environmental taxes, recycling regulations, packaging standards, and eco-labelling. As one example, environment/trade issues with forestry include eco-labelling for final products, lowering import tariffs in developed countries, and designing criteria and indicators of sustainable forest management. Many industrial countries now require imported forest products to be certified as originating from sustainably managed plantations. Countries that meet these standards can export into western markets. Developing countries view this as a non-tariff barrier to their exports.

Samuelson and Nordhaus (1995).

Box 4.6: Trade and the Environment – The Case of Danish Bottles

In the 1988 *Danish Bottles Case*, the European Court of Justice considered a challenge to Danish regulations that required both domestic and foreign suppliers of beer and soft drinks to use returnable and recyclable containers in shapes approved by the Danish National Agency for the Protection of the Environment. The regulations effectively required the use of glass containers. Importers complained that the regulations disproportionately burdened them because glass containers weighed more and hence, cost more to transport than other materials. Higher transportation costs meant that compliance with the take-back obligation cost importers more. Being forced to use approved shapes hindered importers' ability to use distinctive bottle designs in competing with domestic suppliers. Denmark modified the law to exempt suppliers of less than 3,000 hectolitres per year from the shape-authorisation requirements. Unsatisfied, the European Commission sued Denmark before the European Court of Justice for a declaration that the regulations constituted an equivalent quantitative restriction, in violation of Article 30 of the Treaty of Rome establishing the European Economic Community.

The Judge Advocate General, an official associated with the Court to provide it with an unbiased legal analysis and recommendation agreed that Denmark's objective to preserve its environment by reducing the amount of waste to be disposed of in the country could justify the regulations in principle. In practice however, both the take-back and the shape-authorisation requirements were disproportionate to the burdens they caused on trade and should be declared a violation.

The European Court of Justice agreed only partially. It found that protection of the environment could be an adequate justification not only in principle, but also in fact for the mandatory take-back obligations. Of special significance was the Court's ruling that environmental protection was a mandatory objective of the Community, even in the absence of express language to this effect in the Treaty of Rome at the time. Accordingly, the Court concluded that the mandatory take-back obligations were a necessary element of the system, and hence necessary to achieve the environmental aims being pursued. The Court agreed with the Advocate General, however, that the added burden of requiring approval of container shapes was disproportionate to any environmental harms that might be caused by allowing an unlimited number of containers to be used, since these would still be required to be returnable and recyclable. The Court concluded that the take-back obligation did not violate the Treaty of Rome, but the ban on sales without official authorisation of the container did violate the Treaty.

The *Dutch Bottles Case* stands as recognition that environmental objectives may justify burdening trade, but that trade restrictions must be proportionate to the environmental aims.

Source: Ewing, K.P, and R. Tarasofsky (1997).

The WTO is also linked with multi-lateral environmental agreements (MEAs) such as CITES[7], which limits trade in endangered species. Questions often arise about environmental policies, agreements and measures acting as informal trade barriers and how these might conflict with the WTO (see Box 4.6). On the one hand, free trade can stimulate economic growth, which by implication could increase the consumption of natural resources and quantity of waste products flowing into the environment. On the other hand, free trade can increase national income and allow more fiscal resources to be spent on environmental protection. Some experts feel that sound environmental policies such as environmental impact assessment would reduce natural resource and environmental degradation caused by trade expansion.

4.3.3 Structural Adjustment Programmes and Resource Degradation

The World Bank and the International Monetary Fund are leading the process of economic reform in developing countries through Economic Structural Adjustment Programmes (ESAP). Most eastern and southern African countries are well into the implementation of such programmes. The objectives of these restructuring programmes generally include Matienga and Milne (1994):

a) Fiscal policy reform:

- Reduce government current account budget deficits;
- Eliminate subsidies to parastatals; and
- Civil service reductions to lower the public wage bill and government expenditure.

b) Monetary policy reform:

- Slow the growth of money supply to reduce inflation;
- Change interest rates from government to market driven; and
- Promote the liberalisation of financial sector

[7] Convention on International Trade in Endangered Species of Wild Flora and Fauna.

c) Trade policy reform:

- Reduce government red tape for importers and exporters;
- Open up the foreign exchange allocation for importers; and
- Reduce tariff barriers as per the WTO agreement.

d) Regulatory policy and institutional reform:

- Simplify private investment approval processes;
- Relax exchange controls to encourage foreign investment; and
- Simplify labour regulations.

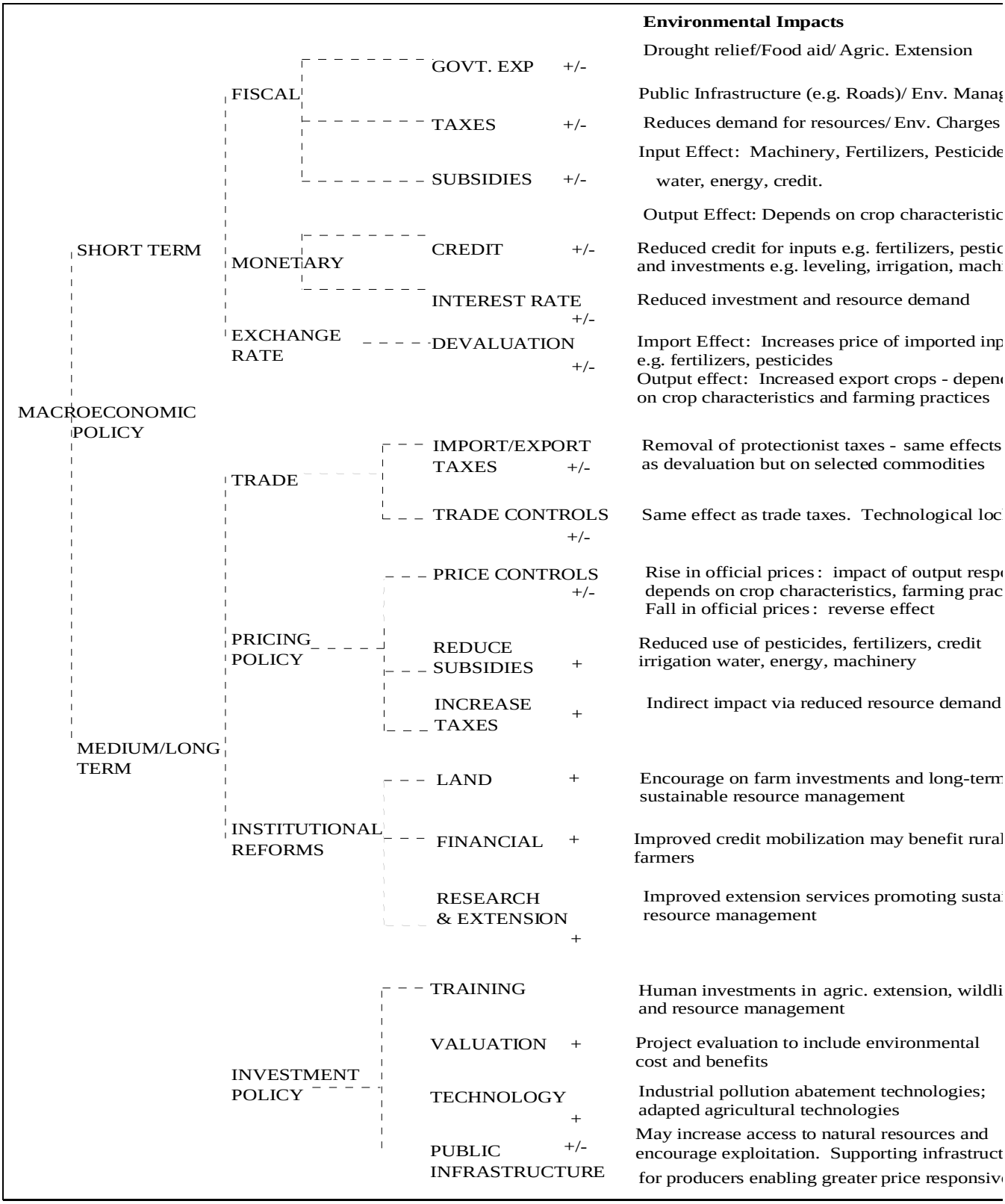
The short-term success of such a programme depends on political and social acceptability and the economy's ability to respond to this new set of price incentives. During the transition, the balance of payments may even worsen, depending on import and export elasticity. This explains the existence of structural and sectoral adjustment loans. However, these contractionary policies do not ensure long-term balance-of-payment stability or increase the economy's capacity to respond to external shocks. That is up to medium-term structural and sectoral adjustment packages.

The changes brought about by structural adjustment programmes raise the question about environment impacts. While long-run effects are difficult to predict, in the immediate-term, there are some negative linkages with the environment (see Box 4.7). One example is that under economic reform, there is a need for governments to increase foreign exchange reserves by increasing net exports, often with natural resource commodities. The touches on the debate between economic growth and environmental protection with pressure to increase exports and economic activity. If economic pressure becomes too great, degradation can occur as natural resources are exploited. For example, valuable indigenous timber forests could be leased, cut and exported. There could be pressure for mining exploration and production in National Parks and wilderness areas. Farmers could be encouraged to grow export crops, which require higher levels of chemical inputs and water.

Under ESAP, reductions in the size of the civil service are a key objective in reducing government spending. These cuts ultimately affect the numbers of staff in resource management agencies. A resulting impact can be 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.

As developing country economies open up to increased global competition, older and inefficient industries find they cannot compete. Investment in new capital for modernisation is also too expensive due to high interest rates in the local money market, or exchange rate disadvantages for offshore financing. As factories and other businesses close, employees with few marketable skills cannot easily secure alternative employment. Often, they turn to "free" natural resources as a means of earning a living. This can result in increased game poaching, illegal cutting of firewood, and small-scale mining such as gold panning. Without adequate management controls, natural resource and environmental degradation can occur.

Box 4.7. Effects of Structural Adjustments on the Environment



Source: EDI (1998).

4.4 INSTITUTIONAL AND IMPLEMENTATION FAILURE

4.4.1 Background

Institutions include government policy, legislation and supporting regulations, as well as the government organisations themselves. Institutions play an important part in effective natural resource and environmental management. Their failure can often be a significant contributor to degradation. Legislation usually defines broad issues, sets objectives and definitions, and identifies the legal mandate of the government in the area of concern. Supporting regulations define how the legislation will be implemented through specific rules, incentives, fees for users, penalties for non-compliance, and technical procedures.

4.4.2 Institutional Failure

Institutions can fail for a number of reasons. Policies not supported by legislation cannot be legally enforced. A government might prescribe a policy of sustained yield for fisheries and forests. It might also proclaim a policy of sustained management of rangelands, or requiring environmental impact assessments for large development projects. In each case, resource users and project developers could not legally be held accountable under these policies in the absence of underlying statutes and regulations.

With legislation, different government agencies are often responsible for implementing parts of environmental and natural resource laws. This leads to fragmentation. In Zimbabwe for example, more than two dozen separate pieces of legislation touch on environment and natural resources, most of which are implemented by different agencies. In this situation it is difficult to determine which agency and legal statutes relate to specific natural resource and environmental issues. A major objective of a recent law reform process was to draft new legislation to rationalise all the conflicting environmental laws. Legislation and supporting regulations can also become outdated. Patterns of natural resource use, pressures and conflicts are always changing and it is important that legal institutions also evolve. Most countries in the region have, or are in the process of consolidating natural resource and environmental legislation.

Regulations can also fail. Examples of regulatory failure include:

- In commercial forestry, regulations should govern reforestation and harvesting practices. If timber operators are assessed stumpage (royalties) from state forests based on a flat rate per cubic meter cut rather than on merchantable stand volume, there is an incentive to "high-grade" the forest during harvesting, taking only the largest and best quality timber.
- Laws and regulations that prevent people outside a National Park from legally utilising wildlife can create a climate of confrontation. This can then lead to increased poaching rather than joint management and sharing of benefits.
- Regulations that do not clearly specify how and to what standard mine operators should rehabilitate their operations, could be exploited by some companies.

Clearly, there is wide scope for resource degradation through failure of policy, legal and regulatory institutions.

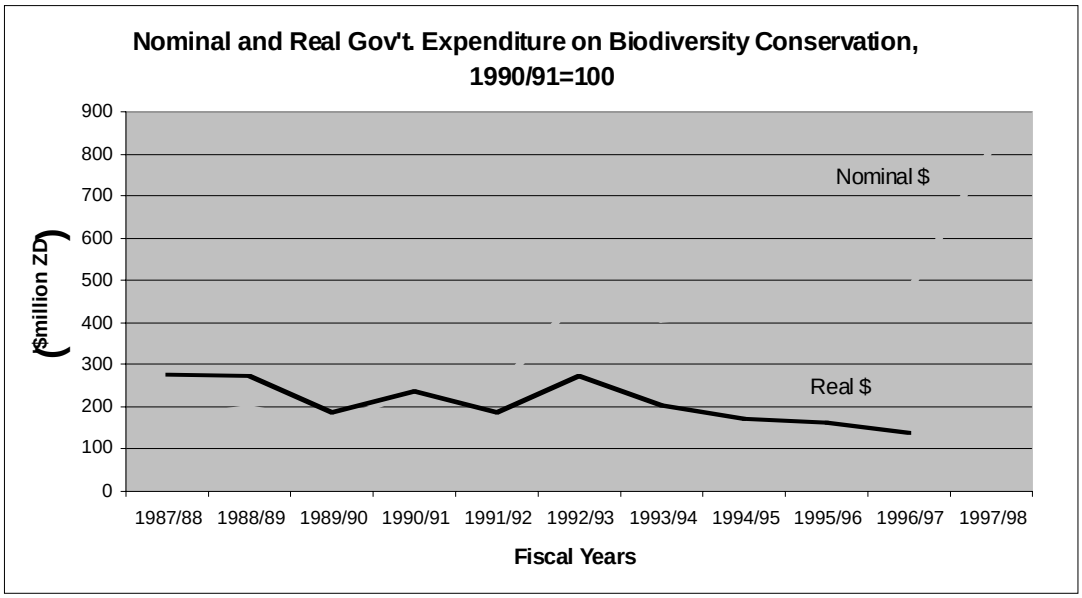
4.4.3 Implementation Failure

A country might have effective policy, legislation and regulations governing natural resource management and the environment. However, if these institutions are not implemented effectively, resource degradation can still occur. Implementation failure arises for a number of reasons. **First**, governments in developing countries often have inadequate numbers of staff with advanced technical skills. **Second**, most developing countries lack sufficient data on the natural resource base such as location, distribution, and rate of utilisation. **Third**, environmental economics and resource valuation is rarely used to weigh the cost/benefit trade-offs in alternative development projects, or measure the full impact of resource degradation. **Fourth**, there is often a lack of understanding by decision-makers of the importance of natural resources and the environment to the national economy. This knowledge-gap can become an issue during annual government budget appropriations. The usual case for most countries in the region is for declining real budgets for natural resource management and environmental protection (see Box 4.8).

Box 4.8: Implementation failure in Zimbabwe

During the development of Zimbabwe's national biodiversity strategy in 1997/98, trends in government spending on biodiversity conservation were estimated. First, government agencies responsible for natural resource and environmental management were identified. Second, the official government spending estimates (budgets) were used to compile the actual, or nominal audited expenditures of these agencies. Finally, the nominal expenditures were converted into deflated, or real dollars by applying the official GDP index from the Central Statistics Organisation.

The results (see below) show quite clearly that for the agencies evaluated, real expenditures declined significantly from 1987/88 to 1996/97. This means that these government agencies had less purchasing power in their budgets in 1996/97 than they did almost ten years earlier. Using real dollars takes away the effect of inflation, which can distort actual budget trends.



Obviously, government budgets are limited, especially in developing countries. Basic needs such as health and education are most critical. However, if politicians were clear as to the full value of natural resources and the environment, and the role they play in economic and social development, more funds might be allocated to the implementing agencies. Inadequate budgets to resource management agencies can also have other effects. Staff cuts, heavy workload, low pay and insufficient resource (vehicles, travel allowances, equipment, etc.) only frustrate the efforts of many dedicated professionals in these agencies. High staff turnover, especially of the more experienced officers, is an endemic problem in resource management agencies in most developing countries.

Finally, corruption is a problem in some countries in the region. It can range from a district wildlife officer turning a blind eye to poaching by villagers in his area, to senior government officials and politicians involved in illegal hunting, or trading in restricted products, etc.

4.5 POPULATION GROWTH, POVERTY, AND THE ENVIRONMENT

4.5.1 Defining Poverty

Many researchers suggest a strong linkage between poverty and the environment in developing countries[8]. The thinking is that most of the world's poor live in rural areas and depend upon natural resources and the environment for daily survival. As poverty increases, pressure on natural resources increases, leading to environmental degradation. Population pressure is felt to be a major factor in this poverty/environment cycle. This view has many supporters but is also challenged by others who feel there is insufficient evidence for a strong causal relationship.

One point of agreement however, is that poverty is a serious problem in developing countries and that conserving natural resources is essential to sustained economic growth. Poverty can be defined in two ways, absolute and relative. Absolute poverty is the minimum level of income required to sustain basic needs. What comprises basic needs is a point of debate however. One definition is the income required to purchase the minimum caloric intake to survive plus other basic items essential to participate in everyday life. Relative poverty defines poverty in comparison to other groups in society. The theory of income distribution suggests that in any society, some groups will be better off relative to others. In eastern and southern Africa, as in highly developed and industrialised countries, there is a range of income levels among people. Problems arise with this definition of poverty when we begin comparing different groups and establishing who is actually poor. In practice, absolute poverty is more commonly used to define poverty.

[8] A similar argument has been made to link wealth creation in developed countries with environmental degradation. For example, most of the emissions causing global warming are from western, industrialised countries.

4.5.2 Measures of Poverty

There are several accepted measures or indicators of poverty, namely:

- The headcount index (% of people below the poverty line out of total population);
- Poverty lines (income/capita or household required for certain levels of needs);
- Depth of poverty (average distance between average income and poverty line income);
- GDP per capita (national income divided by total population);
- Human development index (composite of life expectancy, education, and real GDP/capita); and
- Human poverty index (composite of deficiencies in HDI variables versus standards).

Of these, the human development index (HDI) has evolved as a principle measure of poverty. Developed by the UNDP in 1990, the HDI is a composite of indicators comprising of average life expectancy, adult literacy and combined primary-secondary-tertiary enrolment, and real GDP per capita based on purchasing power parity (PPP$).[9] The index focuses on progress in a country as whole. Where data exist, trends can be shown for human development within and between countries. The optimum value of the HDI is 1.00. Developed countries tend to have the higher rankings. For example, in the 1997 Human Development Report (UNDP), Canada ranked highest HDI value of 0.960, out of 175 countries measured. In contrast, the average HDI value for Sub-Saharan countries was 0.380.

Countries in eastern and southern Africa had an average HDI value of 0.491 and average real GDP/capita of approximately $2,898 USD (Table 4.3). The wide range of values for the countries listed suggests major differences in economic and social development. The trends in the HDI from 1960 imply that development has not progressed evenly. From 1960 to 1980, the change in the average HDI was almost 46 percent while for 1980 to 1994, the percentage increase was only 28 percent. The table also illustrates the danger of using GDP/capita as a measure of development. Countries with higher GDP/capita do not necessarily have a corresponding HDI ranking. By

[9] Using exchange rates that reflect the purchasing power of local currencies for specific goods or services based on what is costs in USD, in the United States. A well-known example is the Economist Magazine's periodic "Big Mac" index that shows whether local currencies are over or undervalued based on the PPP of a popular hamburger sold globally!

including education and health indicators to income, a more complete picture is painted of relative development and changes over time.

Table 4.3: Human development indicators for eastern and southern African countries

HDI Rank	Country	Real GDP/Capita	HDI Index	HDI Index	HDI Index
1994		(PPP$ 1994)	1960	1980	1994
52	Seychelles	5,925	n/a	n/a	0.845
61	Mauritius	13,172	0.486	0.626	0.831
90	South Africa	4,291	0.464	0.629	0.716
97	Botswana	5,367	0.207	0.414	0.673
114	Swaziland	2,821	n/a	n/a	0.582
118	Namibia	4,027	n/a	n/a	0.570
129	Zimbabwe	2,196	0.284	0.386	0.513
134	Kenya	1,404	0.192	0.34	0.463
137	Lesotho	1,109	0.245	0.404	0.457
143	Zambia	962	0.258	0.342	0.369
149	Tanzania	656	0.162	0.282	0.357
152	Madagasgar	694	0.237	0.344	0.350
159	Uganda	1,370	0.185	0.215	0.328
166	Mozambique	986	0.169	0.247	0.281
168	Eritrea	960	n/a	n/a	0.269
170	Ethiopia	427	n/a	n/a	0.244
Average		2,898	0.263	0.384	0.491

Source: UNDP (1997). Source: UNDP (1997).

While all countries in Table 4.3 suffer from environmental degradation, it is an open question as to whether poverty is a prime contributor. Detailed data for specific environmental indicators would have to be correlated with the HDI values to see if changes in poverty as measured by the HDI result in greater environmental degradation.

4.5.3 Population Growth, Economic Development and Environmental Degradation

The world's population has doubled in the past 50 years and could double again in the next century. Population levels are projected to reach approximately 10 billion by the year 2050. Alarmingly, most of this increase will be in developing countries (World Resources Institute 1994). Presently, the population of eastern and southern African countries is an estimated 234 million (Table 4.4).

Approximately 70 percent of this population is rural based. The annual average population rate of growth, to the year 2000 is 2.5 percent. Projecting this growth rate to the year 2010 results in a total population of 356 million.

These projections are fraught with assumptions about the level of family planning, education, health services and nutrition which ultimately affect birth and mortality rates. The impact of AIDS, viewed as a serious problem in some of the countries listed, is not accounted for. However, the object here is to simply show that by the year 2010, more than 100 million additional people could be living in the region, with the majority residing in rural areas. This would likely increase pressure on scarce land resources, forests, and water. Expanded urban populations would increase the generation of wastes.

Table 4.4: Population, growth and projections to 2010, eastern and southern Africa

		Population	Rural	Population	Estimated
HDI Rank	Country	1994.0	Population	Growth %	Population
1994		(milion)	(%)	1994-2000	2010.0
52	Seychelles	0.1	46	0.9	0.1
61	Mauritius	1.1	59	1.1	1.3
90	South Africa	40.6	50	2.2	57.5
97	Botswana	1.4	73	2.3	2.0
114	Swaziland	0.8	70	2.8	1.2
118	Namibia	1.5	64	2.5	2.2
129	Zimbabwe	10.9	69	2.2	15.4
134	Kenya	30.3	73	2.3	43.6
137	Lesotho	2.0	78	2.5	3.0
143	Zambia	7.9	57	2.5	11.7
149	Tanzania	29.2	76	2.4	42.7
152	Madagasgar	14.4	74	3.2	23.8
159	Uganda	19.1	88	2.8	29.7
161	Malawi	9.6	87	2.3	13.8
166	Mozambique	16.6	67	2.7	25.4
168	Eritrea	3.1	83	3.6	5.5
170	Ethiopia	54.6	87	3.2	90.4
		243.2	71	2.4	369.3

Source: UNDP (1997).

Sustainable development must address the large numbers of people in developing countries who live in absolute poverty. Poverty reduces the capacity of people to use resources sustainably and intensifies pressure on the environment. Raising per capita incomes implies that the real rate of economic growth for a specific country must exceed the average rate of population growth over a given period of time. A minimum condition contributing to sustainable development is that the annual average growth in real GDP/capita must exceed annual average population growth (World Commission on Environment and Development (1990). This is admittedly a very narrow aspect of sustainable development[10] focused on economics and growth. Income distribution, access to resources, property rights, intergenerational equity, human rights, etc. are also part of the broader sustainable development equation. However, comparing rates change in population and real GDP per capita can help policy-makers understand key influences on national poverty and environmental degradation.

Over a 34 year period, countries in eastern and southern Africa experienced average annual real GDP growth of only 1.2 percent (Table 4.5). Average annual population growth was 2.7 percent. For the aggregate region, this basic condition of sustainability was not met. In fact, only four of the 16 countries listed had population growth less than real GDP growth (Seychelles, Mauritius, Namibia and Lesotho). Swaziland had similar growth rates for both variables. For the other countries however, the disparity between the two growth rates paints a dismal picture of sustainability. The question of what will happen in the next few decades is critical. Many countries in the lower half of the table have not experienced high economic growth rates since 1994 and the outlook is not positive, given recent global economic problems, especially in commodity prices.

What is the impact of rapid population growth on poverty and environmental degradation? History is littered with misguided forecasts about population growth and resulting social and environmental impacts. Ehrlich (1968) gained recognition with his book “The Population Bomb” that predicted overpopulation would result in imminent famines across the world. Meadows *et al.* (1972) developed a pessimistic model that suggested within 100 years, non-renewable resources would run out, leading to economic collapse, famine and massive mortality from starvation. Other studies

[10] Refer to module 2 for a discourse on sustainable development.

based on economics suggest a more optimistic outlook[11]. Evidence from the region suggests that high population growth relative to income and natural resource levels is not sustainable but more empirical work is needed to understand these complex relationships.

Table 4.5: Average annual growth in GDP/capita versus population, eastern and southern Africa

HDI Rank 1994	Country	Average Real GDP Growth/Capita 1960-1994 (%)	Average Population Growth 1960-1994 (%)
52	Seychelles	3.0	1.6
61	Mauritius	3.2	1.5
90	South Africa	0.5	2.5
97	Botswana	6.1	3.2
114	Swaziland	2.7	2.8
118	Namibia	-0.9	2.6
129	Zimbabwe	0.9	3.2
134	Kenya	1.6	3.5
137	Lesotho	3.6	2.4
143	Zambia	-1.4	2.8
149	Tanzania	0.6	3.1
152	Madagasgar	-1.5	3.0
159	Uganda	1.1	3.2
161	Malawi	0.8	3.0
166	Mozambique	0.2	2.4
168	Eritrea	n/a	2.3
170	Ethiopia	-1.8	2.6
		1.2	2.7

Source: UNDP (1997).

4.6 SUMMARY

This module examined some of the major causes of natural resource and environmental degradation. These problems are not unique to developing countries. Examples abound of serious degradation in high-income, industrialised countries. The concern in developing countries is that degradation has a greater impact. Most developing countries in the eastern and southern African region are characterised by economies largely based on natural resource harvesting and processing.

[11] Refer to module 5 for more detailed information on these conflicting models of the future.

Most of these countries also have high rural populations directly dependent on natural resources and the environment for basic needs of food, energy, water, building materials and income generation. Developing countries also lack the financial resources, technology and social programmes to effectively address natural resource and environmental degradation. Degradation stems from a number of underlying causes including:

- Market failure from inadequate resource prices, unclear property rights, and externalities;
- Indirect impacts from fiscal, monetary, trade policies and environmental policies;
- Badly designed and ineffective legislation, regulations, government institutions;
- Failure to properly implement institutions;
- High population growth and poverty; and
- Population growth in excess of real GDP growth/capita.

These factors do not usually operate in isolation. Strong linkages exist between most of these factors. As an example, deforestation may be due to a combination of:

- Poverty: driving rural people to cut trees for fuelwood and income generation;
- Open-access, common property rights regime;
- Explicit values for indigenous trees are represented by low cutting permit fees;
- Government cutbacks from fiscal policy and retrenched people cutting forests for income;
- High import taxes on paraffin, leading to substitution to fuelwood or charcoal;
- Inadequate legislation governing forest allocation and harvesting; and
- Forestry Officers do not have sufficient budgets to enforce regulations.

These factors are not solely incident on government or the rural poor. They affect resource allocation and use decisions by the private sector as well, leading to over-exploitation and pollution. Natural resource and environmental degradation can be partially explained by a complex web of underlying economic, social, and environmental factors. Addressing these issues through various policies and programmes is therefore not simple. Understanding the causal factors and inter-relationships between them is critical in designing more effective conservation actions.

CASE STUDIES

CASE STUDY 1: Small Scale Alluvial Gold Panning in Zimbabwe[12]

Small-scale alluvial gold panning is a significant activity in many parts of Zimbabwe. The environmental impacts are very severe with river systems being destroyed and downstream dams being silted. The Ministry of Environment and Tourism undertook a major study in 1994 in one region of the country. The objectives of the study were to use a statistically sound approach to collect primary social and economic data from the panners and assess environmental degradation from panning. The results were then be used by government to design more effective policy measures to address this serious problem.

The results showed that most panners operated in groups of about four people. The majority of panners, both male and female were less than 30 years of age. A significant number of panners entered the sector due to the Economic Structural Adjustment Programme and resulting retrenchments. The drought in the early 1990s was also a factor in former communal farmers turning to gold panning to earn income. Panners generally lived in squalid conditions with inadequate water and sanitation facilities. Children often did not attend school but instead help with the panning.

The median income was about $200 USD per year per full-time panner. Most gold was marketed on-site to roving dealers or purported claim holders who only paid two-thirds the world price (at that time) in return for providing the panners with quick cash. A $20.00 permit is required under present legislation, but most panners were operating illegally.

The environmental costs of gold panning are very high. There is severe siltation from poor mining practices, deforestation along riverbanks, and pollution of water from sewage and chemicals such as mercury, used to separate gold.

[12] Author: Dr. Grant R. Milne, International Consultant, Harare, Zimbabwe.

At the panner level, the activity is economic to individuals. Annual incomes, while not high, were similar to what unskilled and uneducated people could earn in formal sector as menial labour in the city, in the informal sector as golf caddies or hawkers, or even working in subsistence farming. The lure of a "big strike" seemed to keep many panners in the sector. There are few cost barriers to entry and the lack of enforcement allows panners to work almost anywhere with impunity.

A social cost-benefit analysis at the Provincial level showed that gold panning is clearly uneconomic to society as a whole. The full range of economic, social and environmental costs greatly outweighed the value of income generated by gold sales.

This is a good example of the many factors, which can contribute to natural resource degradation:

a) Market failure

- Most alluvial gold is a common property, open access resource. Property rights are very weak and few controls exist to prevent encroachment on a permit area by other panners.
- Externalities are generated downstream without compensation. Mercury is used to separate the gold and often is spilled into the river. Human waste and garbage are put into the river system. The worst downstream impact is siltation of dams, shortening their economic life and clogging irrigation systems.
- No economic incentives exist for panners to use better practices. The off-site external costs are not internalised back to the panners, following the polluter-pay principle.
- Gold panners sell their gold to roving dealers on-site for cash, but at far less than the revenue they could receive if the gold were marketed in Harare to buyers authorised by the Reserve Bank. The market structure for gold sales does not allow for panners to receive world prices for their production.

b) Policy failure

- Macro-economic policies associated with structural adjustment programmes have increased the numbers of panners operating in the country. Government cutbacks (to reduce the size of the civil service) and private sector retrenchments (as local markets are opened up) have resulted in many people with few options to earn income other than exploiting natural resources.
- Economic reform has been hampered by the failure of government to reduce expenditures against targets. A significant component of public expenditure is directed to non-productive investment and current consumption, financed largely by domestic borrowing. Impacts include high inflation and interest rates, contributing to business failure. Also, this situation contributes to a short time horizon for projects and personal investments. Gold panners have a very short-term planning horizon with little regard for longer-term environmental sustainability.
- The high cost of improved technology due to tariffs limits the importation of more efficient small-scale mining equipment.

c) Institutional failure

- Existing laws are very unclear on property rights. Miners have various rights under the Mining Act to stake claims and explore on private lands. This can impact on commercial farms that border gold-bearing river systems.
- Policies and supporting legislation is weak on rehabilitation requirements for small-scale mining.
- Different agencies are responsible for monitoring and enforcing small-scale mining. The Department of Natural Resources, the Department of Agriculture Extension, and the Forestry Commission all have some statutory authority over gold panning (legal and illegal panning). The Zimbabwe Republic Police have statutory authority over illegal panning. Local Authorities also have been delegated legal status over panning that occurs within municipal boundaries. This confusion over who has what level of authority often means that enforcement is confused and sporadic.

d) Implementation failure

- As a result of reduced allocations to government Ministries (in real terms at least), there is a lack of financial resources to effectively monitor gold panning regulations. It is not uncommon for a district Natural Resource Officer to use his/her monthly mileage allocation within a few days or a week. The alternative is to spread out the monitoring over a month but cover a very small geographic area.

Potential policy directions:

The study provided good data on gold panning. The next step was to develop improved policy to address this problem. Three policy workshops were organised by the Ministry of Environment and Tourism with key stakeholders in the small-scale mining sector. A point of departure was to agree with stakeholders that banning the activity would not be feasible. Proclaiming that all small-scale gold panning is illegal, while simple and attractive to politicians, would fail. Panners would still operate since monitoring and enforcement would continue to be inadequate. The sheer numbers of panners throughout the country would exceed the limited budgets of various monitoring agencies. The reality is that people struggling to survive will still engage in gold panning. The policy challenge is therefore to manage the sector more efficiently, remove many of the distortions, and in so doing, address the associated environmental degradation.

A new policy and legal framework must address these objectives:

- the polluter must pay (gold panners must pay for environmental degradation caused);
- gold panners must work within the law (either existing or amended laws);
- panning must be monitored and existing/new regulations enforced;
- panning sites must be rehabilitated to specific standards agreed to by all parties;
- panners must be encouraged to work in larger groups or co-ops because:
  - they can pool their money and buy simple, but more efficient technology to extract more gold; they could also pay more for a mining permit,
  - better technology will allow them to extract more gold per tonne and increase gross incomes, and
  - increased income can then provide resources for better rehabilitation of panning sites.

The revised legal and policy framework discussed by stakeholders includes the following points:

a) Delegate the legal authority for issuing panning permits to local government, in town councils who are in the area and more familiar with local conditions, people, etc. The local government would keep part of the permit fee in return for carrying out monitoring and enforcement activities.

b) Increase the permit cost to $500 or more to encourage panners to work in larger groups and weed out inefficient “lone” operators. This will encourage more of a small business culture rather than a culture of exploitation.

c) Part of the permit fee would be held as a damage deposit against future rehabilitation of their claim site. If panners rehabilitate their site up to given standards, they would get the deposit portion of their permit fee refunded.

d) If the group did not complete the rehabilitation, the deposit would be used by local government to pay for rehabilitation.

e) The other "non-deposit" portion of the permit fee would be used to support increased monitoring and enforcement by designated agencies. This provides a revenue-earning incentive by local government to enforce laws and regulations.

f) A permit registration system would be kept on a provincial-level computer system to track permit holders and their claim status. Permit holders who failed to follow guidelines and regulations would not be allowed to acquire a new permit in any area for a specific time period.

g) Permit holders would be granted a longer stretch of river to allow more stability and make the investment in simple technology such as a pump and sluice-box worthwhile. The panners could work the claim thoroughly for a longer time, increasing gold recovery.

h) The Department of Natural Resources would develop clear guidelines for panning operations, and standards of rehabilitation.

i) Demonstrations of new technology would be organised by the Ministry of Mines, University of Zimbabwe and the Small-Scale Mining Association to improve mining efficiency. There are two projects presently ongoing, which could be used as examples and for training both panners and monitoring agencies.

j) Legal marketing of gold would be improved by having official agents operate on site to eliminate the roving dealers and allow panners to receive a higher price; their higher incomes will also allow them to install better water and sanitation facilities. The Reserve Bank would licence more institutions to act as official agents to purchase gold.

From 1995 to present, many of these policy ideas have been developed further and implemented with key stakeholders. The present situation is far from perfect in some areas. However, in other areas, local councils, in co-operation with many other agencies, have worked hard to regulate small-scale mining activity with impressive results.

CASE STUDY 2: Degradation of a Fishery, the Example of Lake George[13]

a) Introduction

Lake George occupies a small shallow depression on the western arm of the Rift Valley formation in Uganda. It has a surface area of 250 square kilometres. To the north, it is flanked by the Rwenzori mountain range, which tower some 5000 metres above sea level with peaks that are permanently snow-capped, and a papyrus swamp that stretches 15 kilometres from the shore of the lake (Kazoora 1999). The lake does not exceed three metres in depth and is filled with deep mud consisting mainly of dead algae. Its open water is generally uninterrupted.

The Equator passes right through the lake, giving it very unique features. For example, its mean incident solar energy is about 1970 joules per square centimetre with only minor variations. The mean air temperature is always equitable throughout the year. There are two dry seasons in Uganda whose impact on the lake is cancelled by the runoff from the Rwenzori mountains, which create a continuous flow through the lake. The flow results in an annual flushing rate equivalent to 2.8 times the volume of the lake and a mean retention time of 4.3 months. Mt. Rwenzori contributes nearly 60 percent of the lake's water inflow. This flushing process sustains the supply of primary nutrients and promotes continuous productivity.

Given this setting, mixing of nutrients at the lake is a daily affair, providing the lake with a very rich chemistry. The nutrients run down from the Rwenzori mountains through the swamps. There are also hippos that feed on the shores and deposit dug into the lake, creating a mechanism through which, the organic matter in the form of vegetation is transferred from the dry land to fertilise the lake.

b) Lake George's Natural Resource Base

Lake George supports an enormous crop of algae that thrives on the internal recycling of nutrients. The result is a permanently dense population of phytoplankton, of which the blue algae is a major component. It is estimated that phtytoplankton account for 95 percent of the biomass

[13] Author: Professor Peter Kimuyu, Acting Executive Director, Institute of Policy Analysis and Research Nairobi, Kenya

in the open water (Kazoora 1999). The growth of phytoplankton is enhanced by excreta from hippos[14]. Plankton provide food for other aquatic life such as fish.

Under the Convention on Wetlands of International Importance especially 'waterfowl habitats', the wetland north of Lake George was designated as a special site because it supports rare, vulnerable or endangered species and maintains ecological and generic diversity. The site was also recognised as a habitat for plants and animals during a critical stage in their biological cycles and to have endemic animal and plant communities and species.

The lake's wetlands are also a habitat for juvenile fish. There are eight families of 32 fish species in the lake. Of these species, 17 belong to the *haplochromines* group and 16 species of the *haplochromis* type are endemic to the lake basin. The lake is considered one of the most productive lakes in the world with a fish biomass of 23.3 ± 5.6 tonnes per square kilometre and a population density of 47000 - 55000 fish per hectare. A recent fish stock assessment reported in Kazoora (1999) showed that *haplochromines* account for more than one, half and *leucostictus* about a third of the fish population in the lake. Other important varieties include *niloticus and aethiopicus*.

c) Biological and Economic Characteristics of Fisheries

Fisheries are renewable in the sense that their stock can be replenished. However, their renewability critically depends on the quality of management that they are subjected to. Poor management makes the resources prone to depletion. The growth of the population of such resources depend on the size of the population, which can be drawn down to a point where a species is driven to extinction (Tietenberg 1992).

Fisheries are also interactive resources since the size of the fishery stock is determined jointly by actions taken by society as well as by biological characteristic of the species. Because of the interactive attribute of fisheries, human activity determines their availability over time. In other

[14] Estimates suggest that a hippo can introduce 2.48- 5.46 kilograms of fecal material daily. The high level of primary productivity in the form of rich blooms of phytoplankton in the lake is credited to this daily infusion of organic matter.

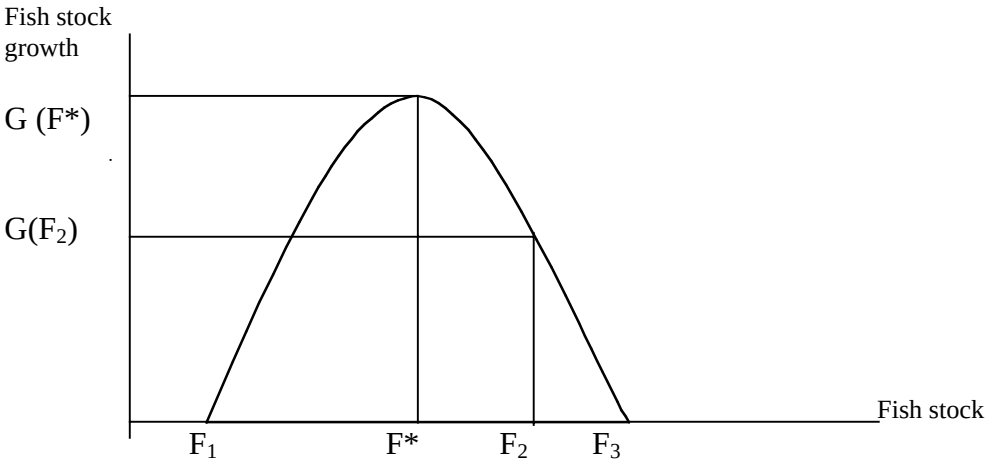
words, this availability is purely a natural outcome, giving rise to the concept of optimal use rate through time and inter-generationally.

A biological model quoted in the literature (Tietenberg 1992) demonstrates the existence of a functional relationship between the growth of fish population and the size of the population[15] (Figure 1). According to the biological model, a range of fish population (denoted by F_1 and F*) exists in which growth in fish stock increases with the fish population, and another range (F* and $F_{3)}$ in which the growth in fish stock declines as the population of fish increases. F_3 is referred to as the natural equilibrium point, denoting the population of fish that would exist, given the biological characteristics and in the absence of external influence. This represents the point at which any reduction in the stock resulting from an interplay of such factors as out-migration or mortality would be off-set by increases in stock resulting from growth in the remaining stock, in-migration, and new birth.

This natural equilibrium population is stable and therefore tends to persist. It is stable because disturbances are followed by a restoration of the population. F_1, on the other hand, represents the level of fish population below which population growth is negative. Unlike F_3, this minimum is unstable: any disturbance is not followed by a restoration, on the contrary, could lead to extinction.

[15] The model is an average model in the sense that it abstracts from important considerations such as the impact of the age structure and water temperature on the fish population. The model is therefore a long term one.

Figure 1: Relationship between growth and population of fish stock



Source: Adopted from Tietenberg (1992).

Fish catch levels represent sustainable yields when they are equal to the growth rate of the fish population. This is because in theory, they can be maintained in perpetuity. Given the biological characteristics, as long as the population remains constant, so does the growth rate and therefore the catch. F* is biologically the maximum sustainable yield population, since it is the population yielding maximum growth. The yield corresponding to such maximum growth rate is also the maximum sustainable yield or the largest catch that can be perpetually sustained. For this reason, G(F*) is the maximum sustainable yield.

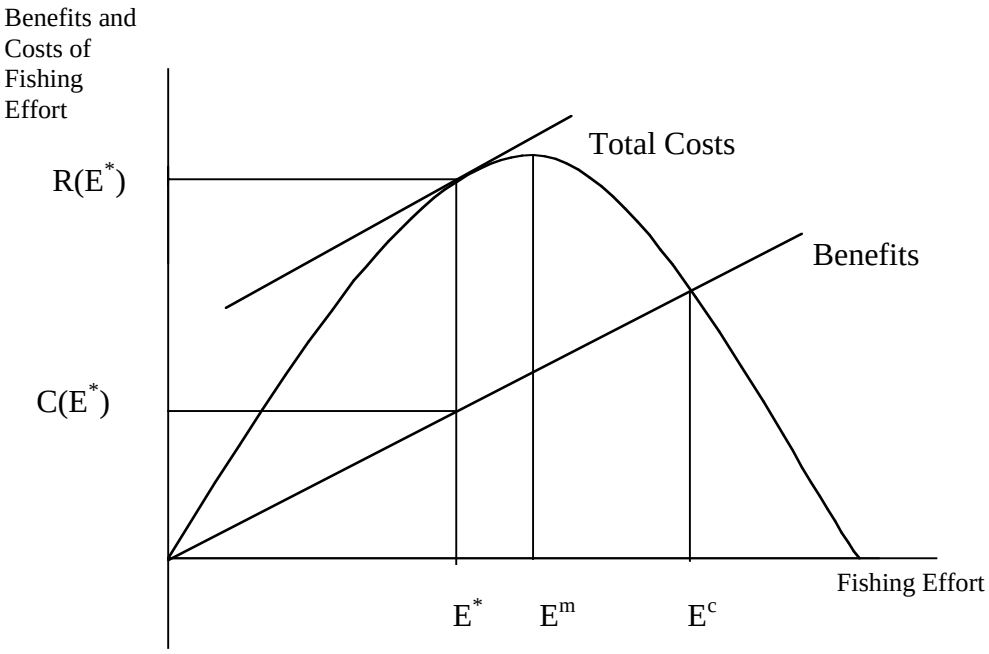
But there is a difference between such maximum sustainable yield and economically efficient sustainable yield, since the later has to take costs and benefits into account. An efficient (or optimal) sustainable yield is a fish catch level, which produces the largest net benefit. Assuming that; 1) the price of fish is constant and is independent of the amount sold; 2) the marginal cost of a unit of fishing effort is constant, and; 3) the amount of fish caught per unit of effort is proportional to the size of the population of fish, then the revenues and costs of fishing can be viewed as functions of fishing effort measured through a convenient metric[16]. If fishing effort is sustained, point E^m is reached beyond which any further effort leads to a reduction in the sustainable catch (Figure 2). The net benefit is the difference between revenues and costs. E* represents the efficient level of effort, shown as the level at which the difference between

[16] Tietenberg (1992) suggests that fishing effort can be measured in hours of fishing and vessels years.

revenues and costs is maximised. It is also the level of effort for which the marginal revenue equals the marginal cost.

Higher levels of effort are inefficient because the value of the additional fish caught falls short of the extra cost associated with the extra catch. Lower levels of effort are also inefficient because at such levels, profitable opportunities are forgone. The maximum sustainable yield is therefore efficient only if the marginal cost of additional effort is zero. This is because the marginal benefit at the maximum sustainable yield is itself equal to zero.

Figure 2: Efficient sustainable fish yield



Source: Adopted from Tietenberg (1992).

Unrestricted access to a fishery creates intergenerational and contemporaneous externalities. The first of these externalities is borne by future generations since open access leads to over-fishing, which in turn reduces fish stock and future profits. The second externality, on the other hand, is borne by the contemporary generation when it over-commits resources to fishing, and therefore earns a low rate of return on effort. Due to unrestricted access, many fishermen end up accessing the fishery, so that the property rights over the fish can not be efficiently defined. Efficiency

requires that each fishing vessel that represents fishing effort should earn profits equal to its share of scarcity rents. Such rents, however, serve as baits for new fishermen, who increase the costs of fishing and dissipate the rents. Given unrestricted access, fishermen can expand effort beyond that which maximises benefits from the fishery, reducing profits from the fishery but not necessarily to the individual fishermen. Under this property rights arrangement, each individual fisherman has an incentive to increase fishing efforts up to the point of zero profits.

When a resource owner has exclusive property rights, it is possible to balance use value and asset value. With open access, exclusivity is not possible and it is perfectly rational for the fishermen to concentrate on use value at the expense of asset value, since it is not possible for such fishermen to fully appropriate asset values. One outcome of this strategy is dissipation of all scarcity rent. Free access therefore leads to exploitation of resources in ways that violate the sustainability and efficiency criteria. Property rights are a critical element in fisheries management.

d) Falling Catch from Lake George

Theoretical analysis suggests that the maximum sustainable fish yield from lake George is 3000-5000 tonnes per annum, which compares with an actual, 39 year average of 3171 ±1093[17]. The catch from the lake has been declining since 1970. In 1975, fish catch from the lake was about 4000 metric tonnes but dropped to about 1500 in the early 1990s. Furthermore, the weight of the fish has been also declining. Evidence shows that the average weight of *oreochromis niloticus* (commonly known as tilapia), which accounted for 80 percent of the commercial species, fell from 0.90 kilogrammes per fish in 1950 to 0.60 kgs in 1970 and 0.30 kg in 1998 (Kazoora 1999). In other words, the tilapia caught from Lake George in 1998 were only a third the average size of those caught in 1950. There are other structural changes in the lake's fishery, the dominance of tilapia in commercial fish declining from 80 percent in 1963 to 56 percent in 1980 and 39 percent in 1998. In other words, the lake's fishery has been gradually degraded.

[17] This annual yield, reported in Kazoora (1999), represents a sustainable yield ranging from 2085 to 4271 corresponding to E* in figure 2.

Why this extent of degradation? Open access to the lake's fishery is probably the most important cause since such access has resulted in extensive illegal fishing. The property rights over the fishery are not well defined, creating an outright market failure. Since the fishing villages are contiguous with Queen Elizabeth National Park, land tenure and access to fishery resources in the lake are interwoven. This is because Park laws limit activities of households living in the fishing villages[18]. It is therefore not easy to clearly define property rights over the lake's fisheries in ways consistent with the natural boundaries of the ecological system without developing spatial congruence to align household decisions with ecological interactions.

The Fish Act of 1964 brought the waters within the gazetted National Parks under specific schedules. Other areas within the lake are not subject to such schedules. According to the Fish Act, 145 fishing licences were issued, one licence per fishing canoe. Each licence holder is also allowed 10 nets per canoe, implying 10 nets per licence. The legal size of such nets is 5 inches, and only 100 hooks of gauge 7 are allowed for every long line. All licences are personal to the holder, and are neither transferable nor assignable. Residents are rewarded for reporting any violation and there are fines for such violation[19]. Fishing licences therefore give holders primary right of access the fishery resources.

A physical count done in 1997 revealed that there were 550 fishing canoes plying the lake, three times the licensed the licensed number. There is active informal secondary market for fishing licences in the fishing villages and illegal fishing is common. The incidence of licence leasing is high and enjoys unofficial, corruption-related support from some Fisheries Department's personnel. Although night fishing is illegal, most fishing takes place at night to permit transportation and marketing during the day. There is also evidence of use of meshes that are half the legal size, which catch not only the smaller haplochromines variety but also immature fish of other varieties. Although the guidelines related to mesh sizes and hooks are clear, there is an obvious implementation failure. Fishing in the lake is also not guided the true value of fish to Ugandan, present and future. The Fish Act is out of step with developments in the fishery, and most of its provisions have become avenues for rent extraction. Although actual figures are not

[18] Livestock keeping, for example, is not allowed within the park.
[19] According to Kazoora (1999), the fines are, however, less than US$ 1.

available, the Fishery Department is under-funded and lacks the necessary capacity to enforce fishing regulations. There is therefore an implementation failure.

Although the Fishing Act guides the management of fishery resources in Lake George, the specific ministries responsible for the application of the act have been changing. Also, there is no clear framework for harmonising the roles of fishing village organisations, government departments and various districts sharing the resources of the lake. Local and cross-border markets for fish from the lake are extant. Unfortunately, some of the trade is in immature fish, and there does not seem to be mechanisms for internalising the full costs of use of the fishery.

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