Designing a Sustainable Future with Natural Resource Accounts: The Experience in Namibia and Implications for Southern Africa[1]

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1. The Need for Natural Resource Accounting

All economies are heavily dependent on the environment as a source of materials and energy, as a sink for waste products, and as the physical habitat for human communities. This capacity of the environment constitutes our "natural" capital. Over the past decade, many countries have begun to seek environmentally sustainable strategies for development. Few people would dispute the importance of integrating environmental concerns into economic thinking and into the design and implementation of development projects. The question is, how can this be done in practical, operational terms? One approach to operationalize sustainable development has been in the area of national accounting by incorporating aspects of sustainability into the system of national accounts (SNA) through the natural resource accounts (NRA).

The national accounts are particularly important since they constitute the primary source of information about the economy and are widely used for analysis and decision making in all countries. However, the national accounts have a number of well-known shortcomings regarding the treatment of the environment. For example, even though the wealth of a nation includes "natural capital" such as minerals, fisheries, and wildlife, this natural capital is often not included at all, or only partly included in the capital accounts. Furthermore, the extraction and sale of assets are recorded as income but not recorded as depletion of natural capital, even of the nonrenewable assets like minerals. Consequently we do not keep track of the rate at which natural assets are being used up and what they are being used for. This practice is in marked contrast to the depreciation allowance applied to produced capital (buildings and equipment) in national accounts and the depletion allowance used in the internal accounting practices of resource-based firms. In addition, we do not record the use of all natural capital as inputs to production or consumption (like non-marketed fuelwood or other forest and veld products) if the inputs do not have a market price, nor do we record the cost of degradation of natural capital resulting from economic activities, like soil erosion, bush encroachment, or water pollution.

NRA are designed to correct these problems, hence giving us a better indication of how the economy really functions by making explicit the role of natural capital. NRA are currently constructed by a number of industrialized countries, including Norway, Sweden, the Netherlands, US, Japan, Germany, France, and the UK. The statistical agencies of industrialized countries have also formed a group, called the London Group, to meet regularly to discuss NRA. Some developing countries are institutionalizing the construction of NRA, including the Philippines, Indonesia, Korea, Mexico, Colombia, and Costa Rica. Many other countries construct NRA on an experimental or intermittent basis.

2. Policy Uses of Natural Resource Accounts

NRA are a set of formal, structured accounts, like the national economic accounts, that record stocks and changes in stocks of natural resources, as well as annual use of resources. The NRA use or flow accounts are linked to economic accounts through the use of a common classification of economic activities and can be compiled in both physical and monetary units. As Henry Peskin (1996) notes, NRA function like any other accounts whether constructed by an accountant for

a single business or by statisticians for a national economy, that is, the accounts provide a set of aggregate **indicators** for monitoring including a "bottom line," e.g., a statement of profits or losses that tells a company how well it is doing, as well as a **detailed set of statistics**. These statistics guide resource managers toward policy decisions that, hopefully, will improve the "bottom line" in the future.

As a monitoring framework, the NRA can provide aggregate physical indicators and an improved indicator of macroeconomic performance, Environmentally-Adjusted Domestic Product (EDP). EDP deducts from GDP (or NDP) net depletion and degradation of natural capital and thus provides a more accurate indicator of whether we are "living off our capital (produced plus natural capital)." For broader monitoring, NRA record physical and monetary values for specific resource variables such as soil erosion, water pollution, and losses of biological diversity and link these variables to economic activities which cause or are affected by them.

NRA also provide the environmental and natural resource database for economic tools and models used for analysis at the regional and national levels, or for sectoral and project management. This helps answer the following questions:

How bad or good is the current environmental-economic situation?
What are the economic consequences (the "damage costs") of resource degradation or depletion?
Who or what activity is causing damage and who bears the cost of the damage?
What can be done to prevent or mitigate environmental damage and at what cost?

The emphasis of NRA, compared to other sorts of data about the environment, is the direct linkage with economic accounts for integrated environmental-economic analysis. The advantage of a direct linkage over separate analyses of economic problems and of environmental problems is that it forces economists to recognize the links and to take into account potential tradeoffs between economic and environmental goals. NRA, of course, provide only one of many economic tools for sound resource management. Policy analysis and decision-making take place on three relatively distinct levels: the local or field/firm level, the sectoral/industry level, and the macroeconomic (national) or regional level. The contribution of NRA to policy analysis has been primarily at the macroeconomic and sectoral levels as a tool for coordinating policies in different Ministries. Policy-makers at this level have the responsibility for multi-sectoral strategic planning that requires setting national priorities and policies of all sectors and based on weighing alternatives and tradeoffs among sectors. This is important when allocating resources like water or land among competing needs like crops, livestock, and wildlife-based tourism.

3. The Namibian Natural Resource Accounts

With a current population of nearly 1.6 million, Namibia is one of the world's most sparsely populated countries. It is sub-Saharan Africa's driest country; roughly 80% of its 842,000 square kilometers consist of desert, arid, and semi-arid land. Rainfall is not only low but extremely variable over much of the country; periodic droughts are a common occurrence. Much of the land is suited only to grazing livestock and the carrying capacity varies a great

deal with annual rainfall, requiring considerable flexibility in stock management to prevent land degradation. However, Namibia is richly endowed with other resources, notably minerals such as diamonds and uranium, as well as one of the world's most productive fisheries (Table 1).

Under South African rule until 1990, two very different and separate economies developed: the so-called communal sector in which the majority of the people were restricted to a disproportionately small land area and practice mostly subsistence agriculture, and a commercial economy based on export-oriented mining and agriculture controlled by a minority. The highly skewed distribution of income and access to resources has resulted in uneven population pressure on land and water; the pressure is most severe in communal areas where population is growing very rapidly and there are relatively few alternative sources of employment.

Namibia now faces the enormous task of integrating the two economies. Rapid economic growth is a primary objective of virtually all countries, but this goal has added significance in Namibia because of the urgency of reducing the great social and economic inequalities. Namibia faces competing demands for the use of resources from a growing population and economy, as well as the threat of resource degradation. Opportunities for industrialization are limited and economic development will continue to remain highly dependent on the natural resource based sectors. In 1995, the Ministry of Environment and Tourism began a pilot project to construct NRA in order to evaluate current natural resource policy from a nation-wide economic perspective and to assist in the design of ecologically-sound development policies. The pilot project was completed in January 1997 and a new phase of the work to institutionalize NRA began shortly thereafter.

The Namibian NRA generally follow the UN's System of Integrated Environmental and Economic Accounts (UN, 1993), though strongly influenced by the Norwegian system (Alfsen, 1996; Alfsen et al., 1987) with its emphasis on compilation of a detailed physical database and the integration of NRA with economic models for policy analysis. The Namibian NRA include water (6 categories), fisheries (3 commercial species), livestock (3 kinds of livestock for two categories of land tenure and 40 geographic areas), land (for 8 categories of carrying capacity, two categories of land tenure, and 40 geographic areas), land degradation, wildlife (roughly 20 species), and minerals (diamonds and uranium). Both stock and use accounts are constructed where appropriate. In the future, accounts will be constructed for forests, energy and pollution. Detailed accounts for each of these resource variables are given in (Lange, 1996, 1997b).

The NRA play the following role in policy-making in Namibia:

- to address specific policy issues at the national level (which are discussed below)

- to introduce a new way of thinking about resource management. This new way of thinking has two components. First, NRA are based on a **systems approach** in which the key feature is to understand the interdependence of activities, of economic and

Table 1. The Namibian Economy in 1995

Population	1.6 million
Urban	29%
Rural	71%
GDP	N$ 11,470 million
	US$ 3,186 million

GDP by Sector of Origin	**percent of total**
Agriculture	12
Commercial	8
Subsistence	4
Fishing	4
Mining	11
Manufacturing	9
Services	38
Government	28
Total	**100**

Principal Exports	**percent of total**
Animals and animal products	9
Fish, unprocessed and semi-processed	3
Mining	42
Processed fish	19
Meat products	7
Other	20
Total	**100**
Total value of exports	**N$ 6,268 million**

Source: Central Statistics Office, 1996a.

environmental considerations, and consequently of tradeoffs. Secondly, the use of NRA is based on a **pro-active approach** to policy-making rather than a reactive one, an approach to policy based on anticipation of possible future situations through a series of What if? scenario simulations.

- to provide a concrete basis for productive dialogue among line ministries about policy alternatives and tradeoffs. NRA provide a transparent system of information about the state of the environment and relationships between human activities and the

environment in situation. The power of the SNA for economic information is that it has become an information system to which all parties agree (despite recognized limitations). The NRA organizing framework could play a similar role in searching for common ground to describe the environment and environment-economic linkages in a potentially conflict-ridden situation.

- to bring environmental considerations into macro-level economic policy analysis in a formal and consistent way which, in turn, provides a concrete basis for productive dialogue among line Ministries about alternative, multi-sectoral development strategies and the associated policy tradeoffs.

The major policy issues addressed using the NRA in Namibia include:

Minerals and Fisheries. How successful has the government of Namibia been in recovering resource rents from these sectors?

Water. How is water currently used in the economy?
What is the economic contribution of water use in each sector and to what extent is water use subsidized?
Does the current pattern of water use and infrastructure development represent the best use of scarce water and financial resources?
What are future water demands likely to be and what will this cost?

Land and Livestock. What is the cost of rangeland degradation measured in terms of lost productivity?
What are the implications of land degradation for long term carrying capacity, especially in the context of global warming, which is expected to increase the variability of already erratic rainfall?
What is the value of land used for extensive livestock ranching compared to mixed livestock and game ranching, or ecotourism, taking into account the different degrees of variability of economic returns to each activity due to drought?

Wildlife. What is the current status of Namibia's wildlife population? With tourism one of the major sources of economic growth, what is its current and future economic potential?

Strategic Planning: Namibia's First National Development Plan. Estimation of the impact of the development strategies described in Namibia's First National Development Plan on the natural resource base, through an integration of the NRA with an input-output model of Namibia, and an assessment of alternative strategies to achieve Namibia's longer-term development objectives in the future.

4. Policy Analysis from the Namibian Natural Resource Accounts

Broadly speaking, there are two approaches to the management of natural resources: natural resources can be commercially exploited to maximize economic rent which is then appropriated by the government for use on behalf of society, or resources can be managed to achieve a combination of economic, social, and political objectives in which the assessment of the purely economic benefits and costs of a given resource management strategy may play a more limited role in decision-making. Like most countries, Namibia has adopted the first approach for some resources and the second approach for other resources. Minerals and fisheries are suitable for commercial exploitation since there are large resource stocks, a well developed industrial infrastructure, and virtually no competition form artisanal activity. Other resources such as water, land, and livestock are largely managed according to the second approach.

The results of some of the policy analyses based on the NRA completed during the pilot project are summarized here: minerals and fisheries, water management, and the commercial livestock sector. Full reports can be found in (Lange and Motinga, 1997; Lange, 1997a; Lange, Barnes and Motinga, 1997), respectively.

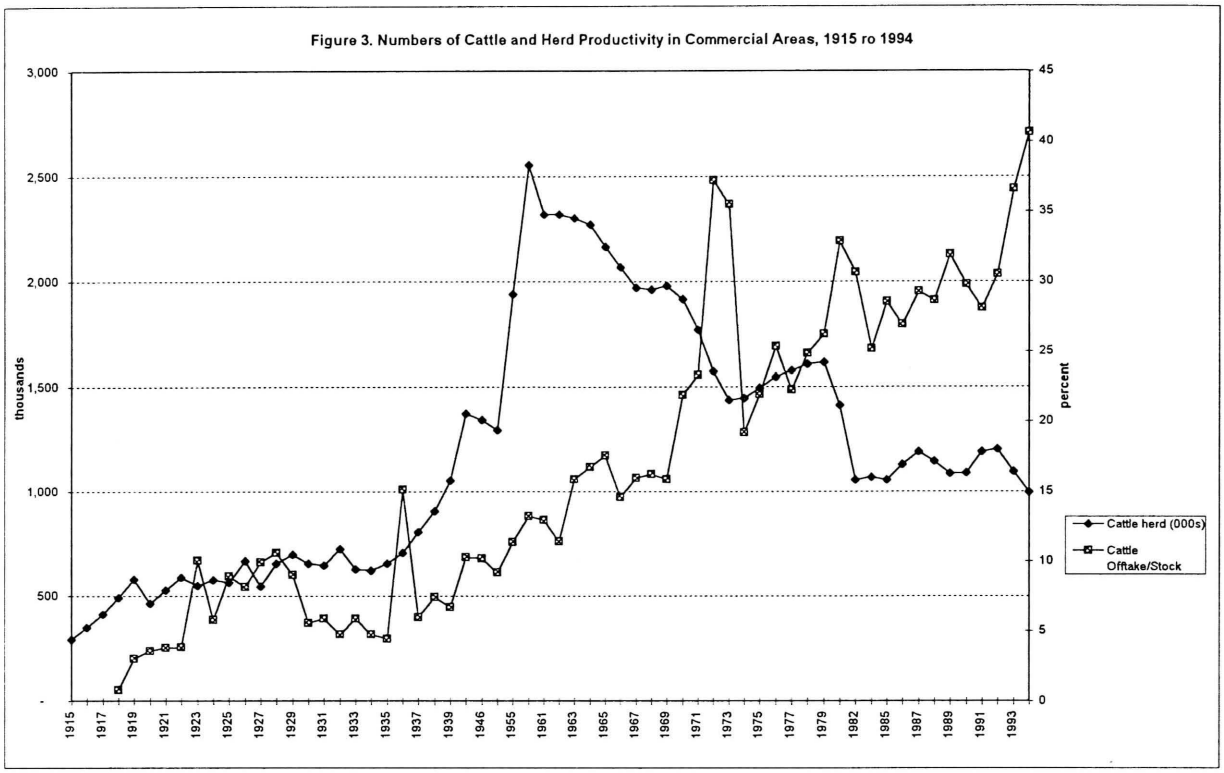
The Recovery of Resource Rents from Mining and Fisheries

Extractive resources like minerals and fisheries are capable of generating a great deal of "resource rent," that is, a profit higher than the average for the economy, attributable to the scarcity of the resource relative to demand for the resource on the world market. Both of these sectors are important contributors to government revenues, GDP, and export earnings.

From an economic perspective, sustainable and equitable management of these resources requires that the resource rent be recovered by the government through appropriate taxes. Non-renewable resources like minerals will eventually be exhausted, and the employment and incomes generated by this activity will come to an end. A major objective of governments is to recover resource rent and to use it for the benefit of the country. It is especially important that these rents be invested in other kinds of economic activity which can replace the employment and incomes of the resource-based industries once the resources are exhausted. In this way, exploitation of the resource can be **economically** sustainable -- because it creates a permanent source of income -- even though non-renewable resources are, by definition, not biologically sustainable.

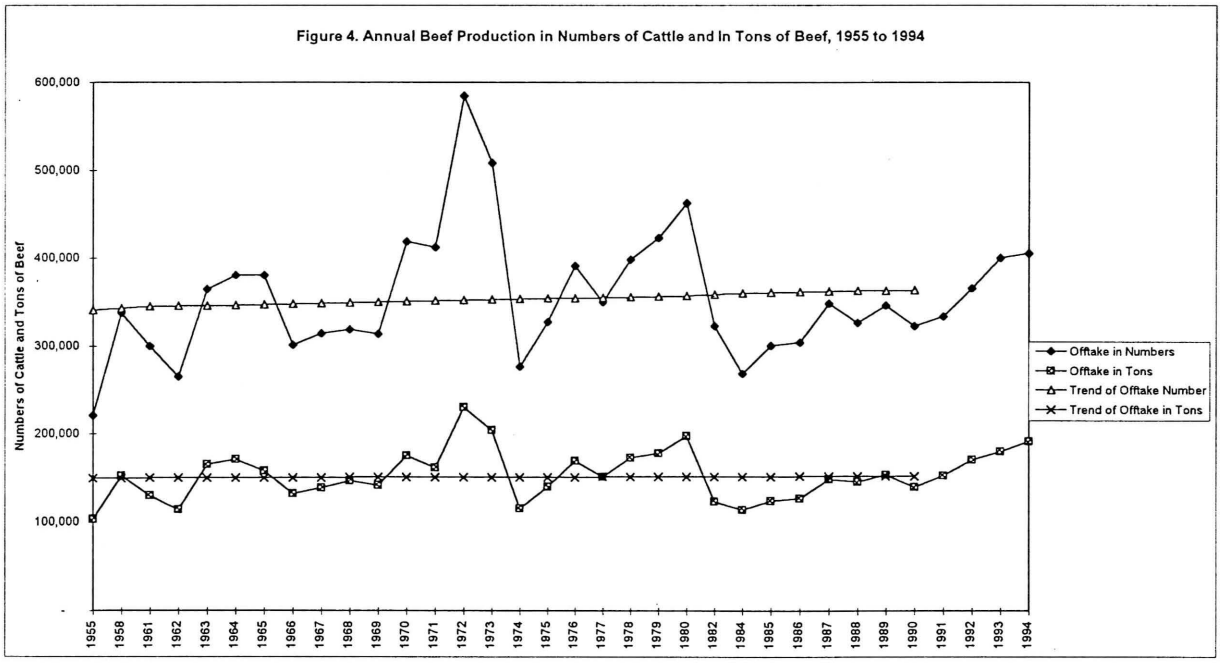
Renewable, open-access resources like marine fisheries are capable of providing an income for all future generations, but, in the absence of regulation, are often subject to over exploitation and eventual exhaustion. Regulatory instruments to guarantee sustainable management include setting quotas to limit the amount of fish that can be caught and levying fees to provide an economic disincentive to overfish. By setting the fish quota fee high enough to recover resource rent at the economically most profitable and sustainable level of fishing, it becomes unprofitable for companies to fish at levels that deplete the stock. Thus, Namibia's quota fees can play an important role in the sustainable management of the resource.

In general, the government has been fairly successful at recovering the rent generated by mining over the past 15 years (Figure 1). However, it is not possible to determine whether the depletion of mineral assets is being offset by the accumulation of other economically-productive



Notes: Livestock numbers not available for all years in the 1940s and 1950s.
Herd productivity calculated as the ratio of annual offtake to numbers of cattle.

Source: Livestock numbers for 1915-1992 from (Rawlinson, 1994). Livrestock numbers for 1993 and 1994 from Directorate of Veterinary Services.
Offtake obtained from annual production reported by the Meat Board of Namibia.



Source: Calculations in (Lange, Barnes, and Motinga, 1997) based on data from the Meat Board of Namibia

assets. Under current practices, the rent obtained through taxes goes into general government revenue and is not earmarked for a specific purpose such as a resource depletion fund. However, the government of Namibia is investing a great deal in the development of human capital -- nearly 40% of its budget is for education and health expenditures which amounted to nearly 13% of GDP in 1995 (CSO, 1996a).

There has been less success at recovering resource rents from fisheries; quota levies are considerably lower as a share of rents than that obtained in the mining sector, averaging only 30% of resource rent since 1990 when quota levies were first introduced (Figure 2). The relatively low recovery of rent from fisheries reflects, in part, a decision to sacrifice some of the rent in the interest of promoting the domestic fishing industry through a system of differential quota levies, based on the degree of Namibian ownership and participation. It also reflects a cautious approach by government to taxation of a relatively new domestic industry requiring substantial investment, much of it foreign. The great uncertainty in the fishing industry created by poorly understood environmental factors affecting the fish stock reinforces this cautious approach. In the future, as the domestic industry becomes better established, quota levies may be re-examined. The introduction of quota auctions in Namibia, not officially allowed at present, might result in better recovery of resource rent. Full rent recovery would eliminate windfall profits to fishing company owners and generate funds that could be used to support development of other sectors of the economy.

Water Policy and Rural Development

Water is the primary constraint to development in Namibia. Water use has grown rapidly over the past 25 years and there is concern that water supplies are not being used sustainably: water tables have sunk and fossil water is being extracted in some areas. Namibia's only perennial rivers form its boundaries with neighboring countries and must be shared with them. Increased harvesting of ephemeral surface water diverts water from downstream users and may have negative effects on ecosystems, vegetation necessary for livestock and wildlife, and recharge of groundwater. At the same time, water is wasted through losses in the distribution network due to poor maintenance, and low water prices have discouraged water conservation measures by end users. In 1990, it was estimated that only 50% of the rural population had access to a reliable source of safe drinking water; urban areas are generally well-supplied with safe water, though access is limited for low-income groups (National Planning Commission, 1996).

The government provides about 60% of annual water use; the remaining 40% is supplied by rural users themselves at their own expense. Despite having reached the limits of most domestic sources of water, no sector of the economy receiving water from the government pays the full cost of water (Table 2). Water subsidies are highest for two sectors: commercial crop agriculture and rural subsistence households. Commercial crop farmers use nearly 15% of all water and pay only 3% of total costs of providing the water. The rural population, accounting for 22% of all water use (17% for agriculture, 5% for domestic purposes), has been provided water free of charge, a subsidy of 100%.

It is difficult to justify continued subsidy of commercial farmers, a relatively well-off minority which was historically privileged at the expense of the majority of the population. Given the scarcity of water in Namibia as well as the scarcity of government revenues, a re-examination

Table 2. Water Subsidies by Sector as a Percent of Capital and Operating Costs in 1993

Sector	Subsidy as Percent of the Cost of Delivery	Percent of Total Water Use
Agriculture		
Commercial Crops	96	14
Communal Livestock	64-100[a]	9
Communal Crops	100	9
Mining	71	2
Manufacturing		
Fish Processing	69	*
Other Manufacturing	59	2
Other Services		
Hotels/Restaurants (Tourism)	21	1
Transportation	64	*
Other Services	59	2
Households		
Rural	100	5
Urban	67	17
Unsubsidized Water Use: Sectors Supplying Own Water		
Commercial Livestock	-	11
Commercial Crops	-	19
Mining	-	9
Subsidy by Institutional Source		
Bulk water supply	71	42
Rural water supply	100	19
Own supply	-	39
Total	49	100
Cost of Subsidy (millions of Namibia dollars)		
Bulk water supply	N$37.3	
Rural water supply	N$30.0	
Total	N$67.3	

[a]Water from bulk water supply subsidized at 64%. Water from rural water supply subsidized at 100%.
*less than 1%
Note: Water is supplied by two institutions, bulk water supply (mainly supplying commercial activities and urban centers) and rural water supply (supplying mainly the communal areas).
Percentages may not sum to 100 because of rounding.

Source: Lange, 1997a, 1997b.

of policy toward commercial crop agriculture seems in order. Under current practices, farmers would not be able to pay the full costs of water and remain profitable. It is possible that the introduction of higher-value crops combined with water conservation measures would make irrigated farming profitable with full cost recovery for water, but further study of these options is needed. Decisions about water pricing for this sector need to be coordinated with other policy decisions which affect agriculture, such as trade liberalization. Policies would be needed to assist in what would be a difficult transition to agriculture which is more sustainable both ecologically and economically.

It is a widely-supported position that the poor population of communal areas, constituting 70% of the population, merits assistance, including water subsidies, to help reduce the sizeable inequality of income and access to resources in Namibia. The analysis based on the NRA water accounts, however, raises concerns about the most effective means to provide that assistance, recognizing that there are tradeoffs inherent in any development strategy: the more money government spends on one program, the less it will have to spend on others.

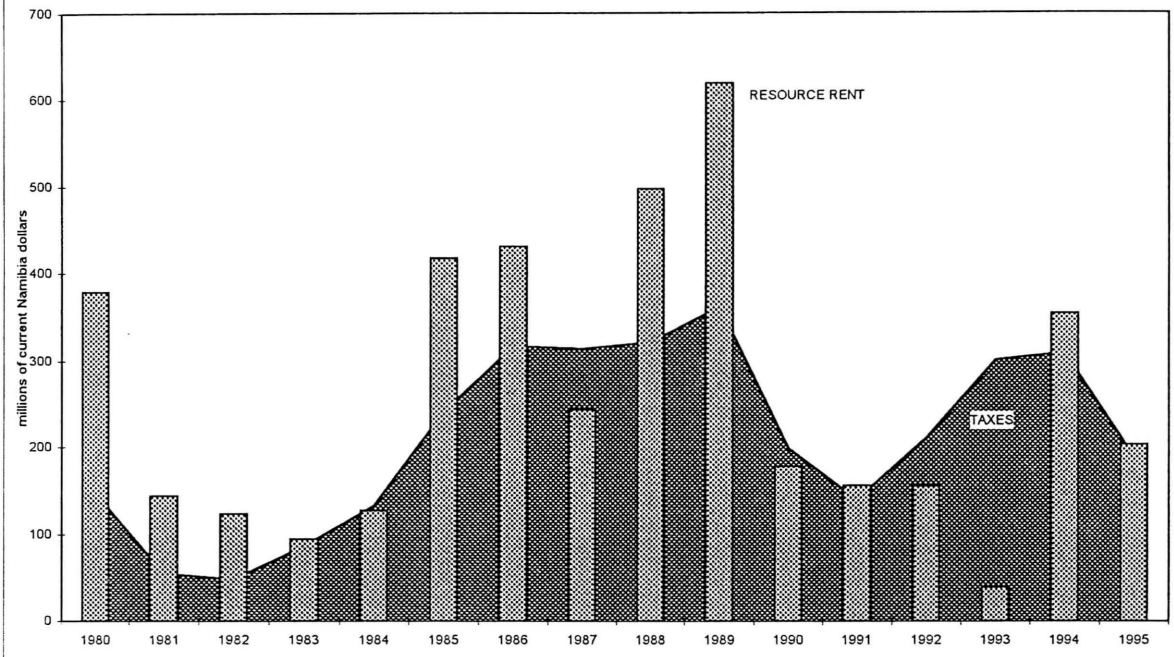
Rural water policy is one component of a development strategy based on bringing basic services (not just water, but also education, health care, and marketing services) to the rural population. Given Namibia's low carrying capacity and highly dispersed population, it is extremely expensive to provide services to all rural households. Many rural households earn only a minimal subsistence living and rely on pensions and remittances from family in urban areas (Central Statistics Office, 1996b). They could not afford to pay the full costs of water. A number of rural development projects have been initiated by the government based on irrigated crop farming. These agricultural projects are particularly costly and have so far proven unable to pay even their operating costs. Low-value crops are often grown which generate less employment than other crops, reducing the effectiveness of these development schemes in alleviating rural unemployment and poverty. Furthermore, the opportunity cost of using water for irrigation has not been taken into account. For example, one irrigation project is up-river from a hydroelectric power plant, reducing the water available for electricity production.

Alternative development strategies need to be considered, such as the promotion of more rapid growth of regional towns where infrastructure and services like water as well as education, health, and other social services could be provided more cheaply. Such a policy would have the advantage of increasing the financial resources available for additional development projects and might allow the government to improve the standards of living of a greater number of people.

Livestock and Land Degradation

Accounts for livestock and land feature prominently in the NRA project since they provide the basis of livelihood for much of Namibia's population. Reliable time series of data are only available for the commercial sector so policy analysis has focused primarily on this sector so far. Numbers of livestock in the commercial sector increased from the beginning of the century till 1960, but have steadily declined by more than 50% since then, though there has been no decline in grazing land (Figure 3). Some analysts have interpreted this decline as evidence of declining land productivity due to land degradation. Our analysis, while not ruling out land degradation,

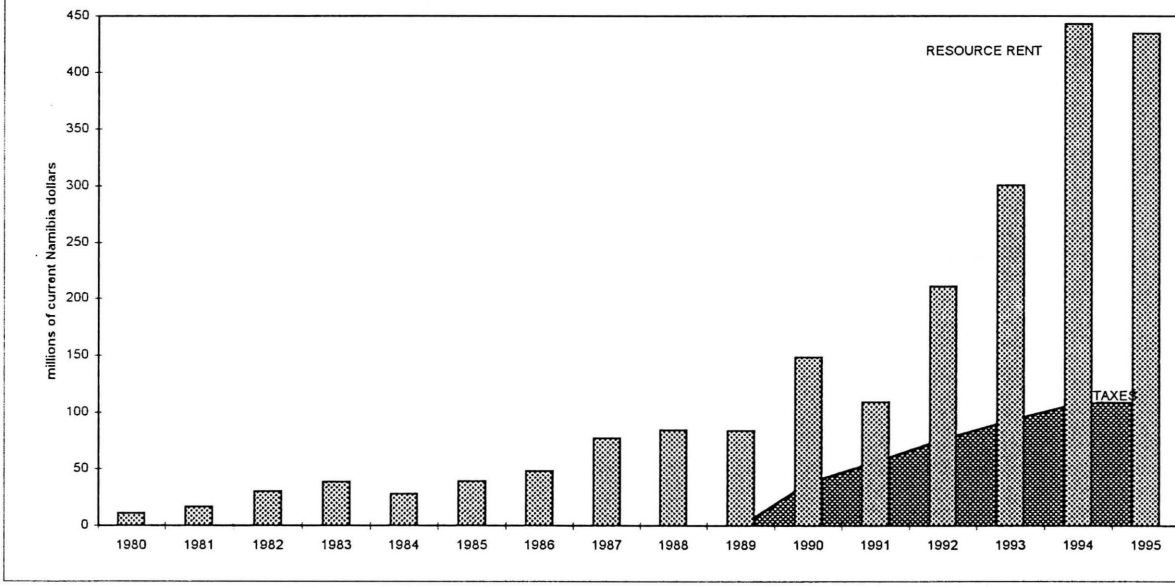
Figure 1. Resource Rent and Taxes from Mining, 1980 to 1995



Note: Resource rent calculated with the net rent method assuming a 10% return on capital stock.
The difference between resource rent and taxes is the net rent accruing to the private sector.

Source: Authors' calculations based on (CSO 1996a, 1996c; Ministry of Finance 1989, 1990, 1994)

Figure 2. Resource Rent and Taxes from Fisheries, 1980 to 1995



Note: Resource rent calculated with the net rent method assuming a 10% return on capital stock.
The difference between resource rent and taxes is the net rent accruing to the private sector.

Source: Author's calculations based on (CSO 1996a, 1996c).

has determined that the decline is mainly the result of a changing management strategy to achieve higher rates of offtake. Meat production (the primary product of the commercial sector) has not declined even though herd size has fallen and the average size of cattle has fallen slightly (Figure 4). Consequently, it appears that improvements in herd productivity have compensated for any decline in carrying capacity that may have occurred over the last 35 years.

Despite improvements in herd management, beef production per hectare has not reached the standard for the beef industry (in terms of higher calving rates). Range degradation, in the form of bush encroachment, and, possibly, changes in rainfall may be contributing factors. Without range degradation and a decline in effective rainfall over the period, herd productivity might have reached higher levels, and beef production from the land could have improved. In order to analyze the potential impact of bush encroachment, information about the rate of spread of bush encroachment over the past 40 years is required. Such information is not currently available, but this problem will receive further attention in future work

5. Conclusions and Directions for Future Work

The government of Namibia has made tremendous progress in meeting the challenges of economic development and sustainable resource management in the short time since Independence. In the long term, sustainable resource management requires coordination of the many sectoral and national policies designed to achieve different objectives, sometimes set by different ministries. For example, the future of commercial irrigated crop farming will be affected by at least three policy decisions taken by three different government bodies: water pricing policy, international trade liberalization policy, and food self-sufficiency policy, which are determined by the Directorate of Water Affairs, the Ministry of Trade and Industry, and the Ministry of Agriculture, respectively.

Realistic national development alternatives need to be identified and evaluated in a multi-sectoral framework that takes into account the full range of development objectives and the sectoral strategies for achieving them. This multi-sectoral analysis will be undertaken in the next stage of the NRA work by integrating the NRA with a simple economic model. The analysis will help coordinate sectoral policies, reveal the opportunity cost of resource use, and provide the basis for evaluating sustainable development strategies. In particular, it is essential to coordinate water policy with strategic planning for energy, agriculture, mining, and trade policy. Some of the components of scenario analysis about alternative development strategies for the future include alternative energy strategies (hydroelectric power and the development of natural gas fields), the development of new diamond and copper mines, alternative water supply strategies (long distance carriers, desalination, demand management), expansion of fish processing and of tourism, and several factors directly affecting agriculture: a national policy of food security vs. food self-sufficiency, trade liberalization and its impact on the livestock market, water pricing reform, land reform and alternative rural development strategies.

This approach to resource management also needs to be extended to other countries in Southenr Africa, especially for water since all countries in the region rely on international sources of water. Namibia is taking steps to coordinate its work on NRA with similar work in

neighboring countries, notably Botswana and South Africa, in order to develop a common analytical framework and database capable of assessing alternatives for management of cross-border resources. The construction of similar water accounts for Namibia's neighbors will make it possible for each country to explore alternative domestic water strategies, taking the regional consequences more fully into account.

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