9 ECONOMIC VALUE OF FISH STOCKS AND THE NATIONAL WEALTH OF NAMIBIA

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Abstract

Since the establishment of the EEZ at independence, Namibia's fish stocks have contributed an important share of national income and exports, and constitute an important component of national wealth. Proper management of fish assets is very important for Namibia's economy. Government must balance the pressure from industry for higher TAC, and with it the danger of further collapse of the fish stocks, against the goal of rebuilding fish stocks by restraining fishing activity to prudent levels. An economic assessment of the value of the fish stock, the economic loss incurred through over-exploitation and depletion of the stock, and the potential value of the stock under different management regimes is an essential tool for government. This assessment can be provided, in part, by natural resource accounts for fisheries, which estimate the value of natural capital, such as fisheries, and account for the use of resources in economic activities. This chapter presents the fisheries accounts for Namibia and the contribution of fisheries to national wealth. The chapter provides a brief introduction to environmental accounting, describes the methodology and the data sources used to construct accounts for Namibia's major commercial fish stocks: hake (*Merluccius capensis* and *Merluccius paradoxus)*, horse mackerel (*Trachurus capensis*) and sardine (*Sardinops sagax*), presents the physical and monetary accounts for each fishery and discusses the contribution of fisheries to national wealth.

INTRODUCTION

National income and economic well-being depend on a country's wealth—produced assets, natural capital, human and social capital. Economic

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sustainability[1] has been shown to require that per capita national wealth is non-decreasing over time (e.g. Dasgupta and Maler, 2000; Hartwick, 1977; Pearce and Atkinson, 1993; Solow, 1986). Although natural capital is a large component of wealth, it has not yet been systematically included in the national economic accounts of most countries.

With regard to fisheries, for example, the system of national accounts (SNA) has treated aquaculture and capture fisheries quite differently[2]. With aquaculture, the SNA records both production and changes in the fish stock so that the consequences of depletion or increases in stocks are accounted for. With capture fisheries, however, the SNA records only the income from fishing, but not changes in stocks. Consequently, the economic impact of the historical devastation of Namibia's fish stocks, described elsewhere in this volume, appeared in the national accounts of that time to be an economic success because only the economic value of the fishing activity was recorded, not the corresponding depletion of the fish stocks on which that activity was based. This omission in the SNA is being corrected by the gradual implementation of environmental accounts, which treat both produced and non-produced assets in the same way (United Nations, 1993b, 2003).

Since the establishment of the EEZ at independence, Namibia's fish stocks have contributed an important share of national income and exports, and constitute a significant component of national wealth. Proper management of fishery assets is essential for Namibia's economy. An economic assessment of the value of fish stocks, the economic loss incurred through depletion of stocks, and the potential value of stocks under different management regimes is an essential tool for government. This assessment can be provided, in part, by environmental accounts for fisheries.

Namibia has joined a regional initiative in southern Africa to construct fisheries accounts, as well as accounts for other major resources. (See Lange *et al.*, 2003 for a discussion of this initiative and its results.) The monetary fisheries accounts provide a useful assessment of the impact of the changing management strategy and also an indicator of what Namibia stands to lose if the fish stocks are depleted. The fisheries accounts also help to provide a more complete picture of Namibia's national wealth, which is necessary for sustainable macroeconomic development. Section two of this chapter begins with a brief overview of environmental accounts then describes the method-

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[1] Strictly speaking, sustainability only requires non-declining wealth; sustainability that is equitable toward future generations requires non-declining per capita wealth.

[2] This differential treatment has a conceptual basis in the SNA definition of assets (United Nations, 1993a), but also a practical basis: the knowledge about capture fisheries is limited and very uncertain, and capture fisheries are not economically significant in many countries.

ology and data used to construct accounts for Namibia's major commercial fisheries: hake, sardine and horse mackerel. Section three presents the physical and monetary fisheries accounts for Namibia. This is followed in section four by a discussion of Namibia's national wealth.

Methodology and data

Overview of Environmental Accounts

Environmental accounts have evolved since the 1970s, initially through the efforts of individual countries and practitioners, and later through the concerted effort of major international organizations: United Nations Statistics Division, Eurostat, OECD, World Bank, and national statistical offices. The United Nations published an interim handbook on environmental accounting in 1993 called the *Handbook of Integrated Economic and Environmental Accounting*; a revised and expanded version of this handbook is now available (UN, 1993b, 2003).

Environmental accounts consist of stocks and flows of environmental goods and services. They provide a set of aggregate indicators to monitor environmental-economic performance at the sectoral and macroeconomic level, as well as a detailed set of statistics to guide resource managers toward policy decisions that will improve environmental-economic performance in the future. The accounts have four major components:

- asset accounts record stocks and changes in stocks of natural resources such as fisheries, forests and minerals;
- flow or production accounts provide information at the industry level about use of materials and energy and emissions of pollution, in effect an extended input-output table for the environment;
- environmental protection and resource management expenditure accounts identify government expenditures for resource management as well as the taxes and other levies on resource use;
- environmentally adjusted macroeconomic aggregates include indicators of sustainability such as environmentally adjusted Gross Domestic Product (GDP), Net Domestic Product (NDP), national saving and national wealth.

Fisheries accounts are based on the UN's System of Integrated Environmental and Economic Accounts (SEEA) and a more specialised manual for fisheries accounts (FAO and UN, in press). A number of countries have constructed accounts for fish or are planning to do so in the near future (Table 1). Relative to other resources, fisheries accounts are not constructed by

many countries. In part, that may be because fisheries are not economically significant in many countries. In addition, the compilation of fisheries accounts presents a combination of challenges greater than many other resources. For example, fish, like minerals, cannot be directly observed the way forest resources can, but in addition, multi-species fisheries are affected by complex predator-prey interactions, inter-annual variations can be quite large, and fish may migrate out of a country's exclusive economic zone (EEZ).

Structure of physical and monetary accounts for Namibia[3]

Namibia's accounts have been constructed for the three main commercial fisheries: hake, sardine, and horse mackerel. Namibia also has other commercial fisheries, artisanal freshwater fisheries that form an important component of rural livelihoods in northern Namibia, and a recreational fishing industry that is important for tourism. There are not yet sufficient data to include these resources in the accounts.

Table 1. Countries compiling accounts for fisheries.

	Physical	**Monetary**
Regular compilation by statistical offices		
Norway	X	Pilot studies
Iceland	X	Pilot studies
Namibia	X	X
New Zealand	X	Planned for future
Canada*	X	X
United Kingdom*	X	X
Occasional studies		
Australia	X	
Philippines		X
Korea		X

* Countries planning to introduce fisheries accounts.

The list includes only countries for which accounts were constructed within government offices and does not include one-time academic or other studies.

[3] For more detailed discussion of methodology and data sources, see Lange *et al.* (2003) and Lange (2003).

Physical stock accounts for fish are constructed for opening stocks, changes that occur during the accounting period (usually one year), and the closing stock. Changes that occur during the year consist of catch, recruitment, natural mortality, and other volume changes. Other volume changes can include factors such as the migration of a fish stock out of the country's EEZ due to environmental events. In practice, there is not enough information to quantify recruitment, natural mortality and other volume changes, so the changes in the accounts collapse into two categories: catch and other volume changes.

Monetary accounts are constructed by estimating the value of the physical accounts. The value of fish stocks, like any other asset, is the net present value of the stream of resource rent it is expected to generate in the future. Constructing monetary accounts has two components: 1) defining how rent is to be calculated and 2) making projections about the future rent a fishery is likely to generate. Both these components raise unique challenges for fisheries.

Measuring Resource Rent

Resource rent is the value of the resource *in situ*, defined as the value of production minus the marginal exploitation costs. Fisheries managed under an individually transferable quota (ITQ) system such as Iceland or New Zealand may develop a market for quotas that, under the right circumstances, accurately reflect the rent. When markets are lacking, as in Namibia, rent is measured with the residual approach in which resource rent, *RR*, is calculated in each year as total revenue, *TR*, minus intermediate consumption, *IC*, compensation of employees, *CE*, consumption of fixed capital, *CFC*, and normal profit, *NP*. Normal profit is calculated as the product of Fixed capital stock, *K*, used in fishing and the rate of return on capital stock, *i*:

$$RR_{j,t} = TR_{j,t} - (IC_{j,t} + CE_{j,t} + CFC_{j,t} + NP_{j,t}) \quad (1)$$

$$NP_{j,t} = i \times K_{j,t} \quad (2)$$

for each fishery, j, where j = 1,2,3 for hake, sardines, horse mackerel.

Note that in actual implementation of the residual approach, average cost is used rather than marginal cost because data about marginal cost are not generally available. This practice introduces an upward bias into the measure of rent when average cost is lower than marginal cost, which is normally assumed to be the case (e.g. see Vincent, 1997 for an estimate of marginal and average costs). The relationship between marginal and average cost is an empirical issue that must be determined for each fishery.

In Namibia, data from the national accounts have been used to calculate rent because they are the only source that covers all species and all years

since independence in 1990[4]. Revenues are obtained for each species from highly detailed information about catch and the value of catch gathered by the Ministry of Fisheries and Marine Resources (MFMR); the data are reasonably good. Cost data, on the other hand, are based on average production costs for each species estimated with a model developed by the MFMR (pers.comm., N. Kali, CBS, 1998). Estimated costs may differ from actual production costs in any given year. Quotas are awarded to each company for a single species only, and high by-catch fees discourage excessive by-catch (see other chapters in this book for further discussion of Namibia's fisheries policy).

The only figure required by equations 1 and 2 that is not provided by the national accounts is the rate of return, or opportunity cost, on fixed capital. There is little long-term borrowing in the fishing industry that might indicate an appropriate cost of capital for that sector. The Ministry of Fisheries recommended a 20 to 30 per cent return on fixed capital because unpredictable environmental disturbances make fishing a very high-risk activity. In this report, a 20% return is used, which is considerably higher than the return used in other countries.

In calculating resource rent, fishing and fish processing industries were combined. This was done for two reasons. First, much of the fish is processed offshore on factory trawlers whose continuous-process operation makes the separation of fishing from fish processing somewhat arbitrary. Second, there is a high degree of vertical integration in the industry, which makes the separation very difficult. The combination of a primary industry and its immediately downstream processing industry is common practice in accounting for forestry (Eurostat, 2000).

Projecting Future Resource Rent

The value of each fish stock is the net present value of the rent it will generate in the future. The present value calculations require projections of future prices, technology, costs of production, fish stock levels, and resource exploitation paths. Future stock levels depend partly on fisheries policies and partly

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4 There is a survey of fishing companies, which would provide a better source of data, but reliable data from the survey are not yet available for a sufficient number of years. There is no ITQ system which might provide a reasonable measure of resource rent. Namibia has a system of individual *non*-tradable quotas. Trading of fishing quotas is discouraged and failure to utilise one's assigned fishing quota can result in loss of rights of exploitation. Some limited trading occurs, but most is unofficial and unrecorded. For these reasons, the quota trading price is not expected to reflect the resource rent very well, nor is it easy to obtain reliable information about the trading price.

on environmental conditions and their impact on fish stocks, which are difficult to forecast. The economics of fishing also depends on fisheries policy: a more efficient fishery generates higher rent and is of greater economic value.

In some relatively well-understood fisheries, a bioeconomic model can be used to assess the likely future stocks, costs of fishing, and rent under different management regimes. Such a model was used, for example, to assess the value of Iceland's fisheries resources (Danielsson, 2000). In addition to uncertainty about future prices, it is exceedingly difficult to determine whether Namibia's fish stocks will, in the long term, remain at current levels, increase to previous higher levels, or collapse further. Each of these possibilities has different implications for future rent and the present value of the asset. Assuming prices and costs are constant, if fish stocks remain constant, then rent and asset value will remain constant. If there is a recovery from depletion and fish stocks increase, the rent will increase over time and the present value of the asset is much higher, than under the constant-stocks assumption. If, on the other hand, fish stocks decline, then the asset value will be much lower.

Despite the MFMR's goal of restoring fish stocks to previous higher levels, there is little evidence that this objective will be achieved in the near future. For the calculation of monetary fisheries accounts it has been assumed that the stocks have stabilized at current levels and will generate the same rent in the future. While the fluctuation of fish stocks and rent over the past ten years shows that this is an unrealistic assumption on a year-to-year basis, this assumption is used for lack of any other information at this time. Under this assumption, the net present value of the stock, *V*, is simply the rent, *RR*, divided by the social discount rate, *r*, for each fish stock, j*:*

$$V_{j,t} = \frac{RR_{j,t}}{r} \tag{3}$$

A social discount rate of 10 per cent is used[5]. While this rate may appear rather high, it is used for comparability with other public sector policy analysis. This rate is commonly used by a number of governments in southern Africa for project evaluation.

For Namibia's mineral accounts, which extend back to 1980, the value is estimated using a 5-year moving average of rent. Because the time series for

5 The social discount rate is typically lower than the private discount rate or the private rate of return on capital used in calculating resource rent for a number of reasons (explained by Hanley and Spash, 1993, pp. 127-151).

Namibia's fisheries is still so short, the moving average has not yet been introduced. It will be introduced when 15 years' data are available.

As with many economic variables, in order to assess trends over time, current values must be converted to constant value measures. Two different approaches have been proposed for constructing a constant price measure of natural capital: one is production oriented and the other is income oriented. For its minerals and natural forest accounts, the Australian Bureau of Statistics takes the production approach and treats the annual unit rent as the price of the asset *in situ*. Constant price asset accounts are then obtained by applying the prices for the benchmark year to physical accounts throughout the times series (Johnson, ABS, pers. comm.). An alternative, income-based approach, under consideration by Statistics Canada (Gravel, pers. comm.), deflates current-price unit rent using the GDP deflator to represent the changing purchasing power of rent over time, similar to deflating financial assets or wages. Informal discussions with other economists and national accountants indicate more support to the income-oriented approach, so that is the method applied here. See Lange (2002) for further discussion of this issue and its implications for estimates of constant value natural capital.

PHYSICAL AND MONETARY ACCOUNTS FOR FISH

The physical accounts for the 11-year period, 1990 to 2000, show that net change has been positive only for hake, which ended the decade 30% higher than in 1990 (Table 2). If the lower bound of the confidence interval was used for both years, the stock growth was much lower. Indeed, the confidence interval was 20% of the stock size or greater in all years. Sardine was less than half its volume at the beginning of the decade and horse mackerel, which improved during the late 1990s, fell below the 1990 level in 2000. (Confidence intervals were not estimated for these fisheries.) The tremendous amount of inter-annual variation in stock indicates how difficult it is to manage Namibia's fisheries.

Sardine generated the most rent at the beginning of the decade, but was eventually surpassed by hake (Table 3). This is not surprising since Namibia had an established sardine fishery prior to independence but only achieved control over the other fisheries over the past decade. The rent per tonne for hake has been steadily rising, reflecting both improvements in the industry and also the devaluation of the Namibian dollar over time, which has a major impact on earnings because most Namibian hake is sold to the lucrative European market. Sardine has shown the greatest volatility of rent over the decade. Rent fell to near zero in 1996 when almost no sardine (only two thousand tons) was caught and the industry suffered considerable losses.

Table 2. Physical accounts for hake, sardines, and horse mackerel in Namibia, 1990-2000 (thousands of tons).

		1	2	3	4	5
		Opening Stock	**Catch**	**Other volume changes**	**Net annual change (col. 3- col. 2)**	**Closing stock (col. 1+ col. 4)**
Hake	1990	906	55	100	45	951
	1991	951	56	176	120	1072
	1992	1072	87	127	40	1112
	1993	1112	108	90	-18	1094
	1994	1094	112	108	-4	1090
	1995	1090	130	158	28	1118
	1996	1118	129	170	41	1159
	1997	1159	110	145	35	1194
	1998	1194	141	136	-5	1188
	1999	1188	161	159	-2	1186
	2000	1186	160	143	-17	1170
Sardine	1990	500	89	249	160	660
	1991	660	68	49	-19	641
	1992	641	82	-128	-210	431
	1993	431	116	-100	-216	215
	1994	215	115	25	-90	125
	1995	125	95	-25	-120	5
	1996	5	2	147	145	150
	1997	150	32	182	150	300
	1998	300	65	40	-25	275
	1999	275	42	-8	-50	225
	2000	225	27	-108	-135	90
Horse Mackerel	1990	1450	409	309	-100	1350
	1991	1350	434	1184	750	2100
	1992	2100	426	126	-300	1800
	1993	1800	479	179	-300	1500
	1994	1500	360	260	-100	1400
	1995	1400	314	114	-200	1200
	1996	1200	319	119	-200	1000
	1997	1000	306	1106	800	1800
	1998	1800	258	258	0	1800
	1999	1800	288	238	-50	1750
	2000	1750	320	-180	-500	1250

Source: based on National Marine Research and Information Centre (2001).

Table 3. Resource rent for sardine, hake, and horse mackerel, 1990-1998 (millions of Namibian dollars)[1].

	Sardine	Hake	Horse mackerel	Total rent
1990	117	27	9	153
1991	65	30	30	125
1992	135	36	20	192
1993	201	68	37	306
1994	229	159	40	429
1995	201	209	39	449
1996	*	192	51	243
1997	95	261	49	406
1998	150	640	91	881

* Less than 1.0

[1] Assumes a 20% rate of return to fixed capital.

Source: based on Lange (2003).

Horse mackerel, though harvested in higher volumes than either of the others, generates the least rent; its unit rent has been positive, but an order of magnitude lower than hake and sardines.

Table 4 shows the monetary accounts in current prices and in constant 1990 prices. Over the past decade, there has been a remarkable 180 per cent increase in the real value of fish stocks from N$1,526 million to N$4,276 million in 1998, even though there was a decline in physical stocks of sardine and horse mackerel over that period. This increase in value is attributable to the increase in the hake stock as well as an increase in the international price of fish. The emergence of hake as the most valuable fish stock represents a success for government policy, which targeted the development of the hake fishery, controlled almost entirely by foreigners prior to independence.

FISHERIES AND NAMIBIA'S NATIONAL WEALTH

As described in the introduction, sustainable development requires that the value of assets be non-decreasing over time; sustainable development that is also equitable with regard to future generations requires that *per capita* wealth does not decline over time. A country's total wealth amounts to a national asset portfolio that can be analysed in terms of its diversity, distribution of ownership, and volatility. Diversity is important because, in general, the more diverse an economy is, the more resilient it will be to economic disturbances. Volatility is also important in planning for the future—lower

volatility contributes to more stable economic development. The distribution of the ownership of assets—between public and private sector, the concentration among different groups in society, and between domestic and foreign owners—can have significant economic implications and can influence the sustainable management of resources.

In using national wealth to monitor economic sustainability, it is crucial to include all assets, or at least the most important ones. Namibia's asset accounts include produced and natural capital but exclude human and social capital because there is not yet a method for measuring it. The natural capital accounts include minerals and fisheries, but omit three major resources due to measurement problems: land, wildlife and water. While the impact of water and wildlife is expected to be rather small, the omission of land is significant. Given the large share of land under traditional tenure and state

Table 4. Monetary accounts for hake, sardine, and horse mackerel in Namibia, 1990-1998 (millions of Namibian dollars)[1].

	Sardine	Hake	Horse Mackerel	Total
1990	1,168	268	90	1,526
1991	646	304	301	1,250
1992	1,348	365	204	1,916
1993	2,008	683	365	3,056
1994	2,292	1,591	402	4,285
1995	2,011	2,089	389	4,489
1996	3	1,918	509	2,431
1997	950	2,615	493	4,057
1998	1,500	6,402	911	8,813
Constant 1990 prices				
1990	1,168	268	90	1,526
1991	617	290	287	1,194
1992	1,175	318	178	1,671
1993	1,613	549	293	2,455
1994	1,590	1,103	279	2,972
1995	1,308	1,359	253	2,921
1996	2	1,111	295	1,407
1997	508	1,399	264	2,171
1998	728	3,106	442	4,276

[1] Values were estimated for the closing stock using the present discounted value method assuming a 10% social discount rate and a 20% cost of fixed capital. Constant price values were calculated using the GDP deflator. Figures may not sum to total because of rounding.

Source: based on Lange (2003).

ownership (roughly 56 per cent), it is not possible to estimate a market value for land at this time. It is most likely that the economic value of land has been relatively stable over the past 20 years[6] with the result that growth in wealth, as reported here, is overestimated.

Namibia's total national wealth has increased 16 per cent in real terms from N$29 billion to N$34 billion over the period 1980 to 1998 (Table 5).

The period from 1990 onward is especially important for Namibia. Prior to independence in 1990, the exploitation of Namibia's resources was con-

Table 5. National wealth of Namibia (millions of Namibian dollars in constant 1990 prices) 1980 to 1998.

	Produced Assets	Minerals	Fisheries	Total wealth
1980	22,485	6,729		29,214
1981	23,201	4,863		28,063
1982	23,622	3,815		27,438
1983	23,717	3,237		26,954
1984	23,670	2,740		26,410
1985	23,629	3,013		26,641
1986	23,530	3,933		27,464
1987	23,558	4,108		27,666
1988	23,599	4,009		27,608
1989	23,731	3,824		27,556
1990	23,989	3,227	1,526	28,743
1991	23,987	2,787	1,194	27,969
1992	24,381	2,243	1,671	28,295
1993	24,814	1,440	2,455	28,709
1994	25,374	1,070	2,972	29,416
1995	25,907	864	2,921	29,692
1996	26,505	1,121	1,407	29,034
1997	27,002	1,377	2,171	30,549
1998	28,350	1,262	4,276	33,888
Percent change, 1980 to 1998	26%	-81%		16%

Source: based on Lange (in press).

[6] Because the physical volume of land does not change over time, only changes in land productivity would cause the value of land to change. Namibia has experienced both land degradation (reducing value) and land improvements (increasing value), so, for lack of other information, it seems reasonable to assume that the value of land has remained fairly constant.

trolled by South Africa, with relatively little concern for Namibia's own national development. As a result, by the time Namibia had achieved independence its resources were vastly depleted—major fish stocks were less than 25 per cent of their former level and onshore diamonds were largely exhausted, forcing the industry to move to more costly offshore diamond mining. However, Namibia's wealth increased significantly with the establishment of its 200 mile Exclusive Economic Zone at independence, which brought many of its fisheries under national control for the first time, adding this asset to the national wealth[7]. Without fisheries, Namibia's wealth would have remained virtually unchanged from 1980 and 1998.

As in most countries, produced capital dominates Namibia's national wealth. Nevertheless, there is a fair degree of diversity among sources of wealth. Natural capital accounted for 17% of total wealth in 1998, of which fisheries accounted for 13% and minerals for 4%, which has declined from 23% in 1980. But the value of natural capital is quite volatile, leaving the country's economy vulnerable to changes in natural conditions and international markets.

So far, only trends in total wealth have been considered. However, Namibia's population is still growing and per capita wealth for Namibia shows a disturbing trend: per capita wealth has declined by 33 per cent from 1980 to 1998 (Figure 1). Not surprisingly, Namibia's real per capita GDP has stagnated over time, falling at an annual rate of –0.025% (CBS, 2001).

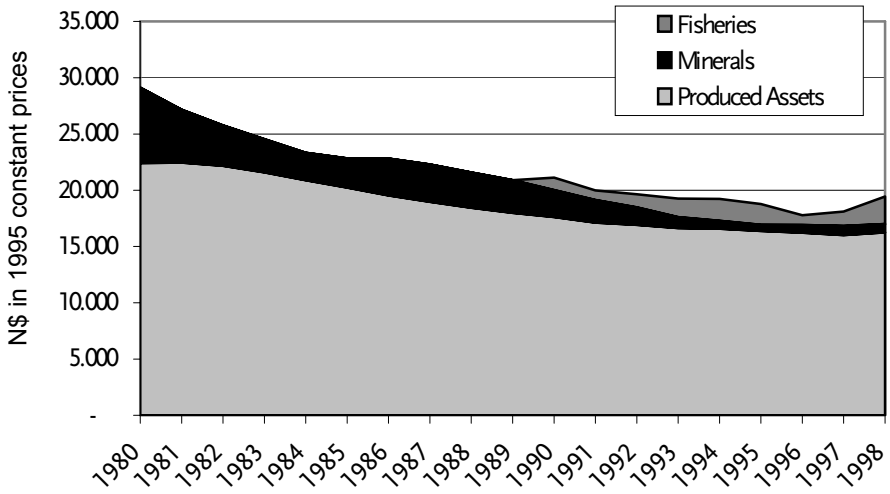

Figure 1. Per capita national wealth of Namibia, 1980 to 1998. Source: based on Lange (2002a).

7 Resources are only considered assets when they are under the ownership and economic control of a country. Prior to 1990, Namibia only controlled its 12 mile territorial zone.

CONCLUSIONS

In a relatively short period of time since independence, Namibia has achieved some success in managing its fisheries. It has established a regime for sustainable fisheries management based on a system of TAC that is relatively well enforced. It has also vastly increased the economic contribution of fisheries to the Namibian economy while avoiding the subsidization of the industry seen in so many other countries, and Namibia's fisheries have become an increasingly important asset, accounting for 13% of national wealth. However, it is unclear whether this trend will continue. The uncertainties surrounding estimation of stocks and establishing an appropriate TAC, combined with pressure from the fishing industry, make sustainable management a difficult challenge. The confidence interval for the stock of hake was 20% of the stock size or greater, which was larger than the TAC. Stocks of both sardine and horse mackerel ended the first decade of independence lower than they started, and hake was not much higher. The Ministry's goal of restoring fisheries to previous highs, last seen in the 1960s, seems unlikely to occur. Despite the addition of fish to Namibia's national asset portfolio, per capita national wealth has declined by 33 per cent over the past two decades and real per capita income has stagnated. In addition, the economy is vulnerable to fluctuations in the value of natural capital. These factors suggest that it is especially important to protect Namibia's fisheries as a source of wealth and income for future generations. Fisheries also provide Namibia with an opportunity to build national wealth by designating a portion of the resource rent for reinvestment in other forms of productive capital, but this opportunity has not been taken; rent goes into government's general revenue fund.

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