ASSESSING NATURAL RESOURCE SCARCITY IN THE OKAVANGO DELTA: CASE STUDIES OF KEY RESOURCES

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Abstract

The paper makes an assessment of the scarcity of the following key natural resources in the Okavango Delta: arable land, basket-making resources, fish stocks, and river reeds. Non-data intensive socio-economic indicators (as opposed to the conventional data-intensive indicators) of trends in resource prices, trends in labour time for resource extraction, substitution for the less preferred commodities, trends in production levels of resource products, and perceived scarcity were utilised to assess the scarcity of the resources. The study reveals that basket-weaving resources, land for flood recession arable agriculture (*molapo)*, and river reeds are increasingly becoming scarce, whereas fish stocks are still in abundance. It is recommended that appropriate policies for the management of natural resources should be introduced. Property rights could be granted to the communities to manage natural resources such as fish and veld products in line with the wildlife model for Community Based Natural Resources Management (CBNRM). In addition, the Government should take the responsibility for allocating land for *molapo* arable farming, as its ownership is insecure and not well defined, and therefore vulnerable to abuse.

INTRODUCTION

Wetlands are a major source of livelihoods for the rural communities (Matiza-Chiuta, 1995). Not only are they a major source of water for the local communities, they are also a source of income derived from the utilisation of flora and fauna (Shumway, 1999). Moreover, they are often converted into other uses, such as irrigated agriculture and industrial development, as their total economic value is usually undervalued due to lack of knowledge on economic valuation of environmental resources (Barbier, 1991). This contributes to their degradation. Research indicates that wetlands are among the most threatened of all environmental resources (Brouwer *et al.,* 2001).

The Okavango Delta, a globally renowned Ramsar Site, is characterized by large amounts of open water and grasslands, and is home to a variety of wildlife and vegetation species. For instance, there are 2000 to 3000 plant species, over 162 arachnid species, more than 20 species of large herbivores, over 450 bird species (Monna, 1999), and approximately 70 fish species (Kolding, 1996). The Delta is a major source of livelihoods for the local communities, and also an important attraction for tourism, the second most important economic activity in Botswana after diamonds (Mbaiwa, 2002). In 1997, tourism

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contributed P800 million which accounted for 4.5% of the Gross National Product (GDP) or 7% of the non-mining GDP (Department of Tourism, 2000). As a result of the rapidly increasing population and expanding tourism, there is an increasing process of commoditisation and "privatisation" of the land and its natural resources, leading to pressure and scarcity of natural resources. It is, therefore, crucial to monitor wetlands in order to avoid their degradation. This idea is consistent with the "strong sustainability" approach which promotes the conservation of "critical natural capital" essential for the survival of human beings (Pearce, 1993).

This paper uses socio-economic indicators to assess the scarcity of natural resources in the Okavango Delta. It then suggests how natural resources could be monitored from time to time. Scarcity is discussed in a broader context that incorporates an analysis of its underlying causes. The study is mainly based on secondary sources and data from on-going studies at the Harry Oppenheimer Okavango Research Centre. The studies include the European Union funded research project on "Water and Ecosystem Resources in Regional Development" and the University of Botswana funded research projects on the "Sustainability of the Use of Basket-making Resources in the Lower Okavango Delta", and the "Patterns of the Use of Reeds and Grass in Shakawe, Botswana". In addition, some of the information was obtained from informal interviews with resource users and policy-makers. The major limitation of the paper is that it lacks sufficient data on trends in resource prices, and this greatly limited the analysis on the scarcity of natural resources in the study area.

The paper first discusses conceptual issues on natural resources scarcity. The next two sections discuss the importance of Okavango wetlands and presents case studies on the assessment of natural resource scarcity in the Okavango Delta. Finally, the paper makes suggestions for future monitoring of the Okavango Delta.

NATURAL RESOURCE SCARCITY: DEFINITION, CAUSES, AND MEASUREMENT

This section discusses the meaning, underlying causes, and measurement of natural resource scarcity, drawing examples from the Okavango Delta. A number of indicators are discussed as possibly relevant for the assessment of natural resource scarcity in the Okavango Delta.

Natural Resource Scarcity: A Definition

Natural resource scarcity is a "reduction in economic well-being" resulting from the reduction in quantity or quality of natural resources (Clevelend and Stein, 1997:1). When resources are scarce, there are forgone benefits as result of the loss in goods and services. Thus, there is an opportunity cost incurred, referred to as the marginal user cost. This is the present value of the forgone opportunities of using natural resources (Tietenberg, 1992). Natural resource scarcity, therefore, results in the loss of "environmental entitlements" which are important sources of livelihoods for the rural population. A decline in environmental entitlements aggravates rural poverty, further aggravating environmental degradation (Mearns, 1995). This will, however, depend on a number of factors such as the socio-economic, political, historical, demographic and environmental (Mearns, 1995).

Causes of Natural Resource Scarcity

Natural resource scarcity is caused by such factors as rapid population increase, poverty, the failure of economic systems, and lack of knowledge about economic value of environmental resources (Barbier, 1991; Nyirendra *et al.,* 1994). Poverty is not an underlying cause of environmental problems but it accelerates this process (Barbier, 1991). Thus, the extent to which poverty causes environmental degradation depends on options available to the poor to respond to the problem, but usually such options are limited and consequently the poor often resort to the over-use of natural resources (Pearce *et al.,* 1991). On the other hand, population is a driving force behind environmental degradation (Nyirendra *et al*., 1994). In Ngamiland, human population increased by the rate of 3.6% from 68 063 to 94 534 between 1981 and 1991, and by 2.8% from 94 534 to 124 712 between 1991 and 2001 (Bendsen, 2002). Such a rapid increase in population drives up the demand for natural resources.

The failure of economic systems, due to market and policy failures, is an important cause of environmental problems in the study area. Market failure refers to markets which are "malfunctioning, distorted, or totally absent" such that the price they generate does not reflect the social costs and benefits of resource use (Panayotou, 1993:33). Natural resources may be held under different categories of management regimes such as open access, common property, state property and private property (Berkes, 1995). In the Okavango Delta, most of the natural resources tend to have overlapping management regimes

(Hasler, 2001) but the dominant regime is open access. This suggests that natural resources will tend to be over-utilised because access is not restricted, and also because rules for their management do not exist. Resources such as fish, water, and grazing are held under open access in communal areas in the study area, and in most cases they have a low or zero price. Thus, the prices of marketed resources reflect the costs of labour and capital (private marginal costs) rather than the wider social opportunity costs.

Policy failure is the "failure to intervene when necessary and beneficial and the failure to refrain from intervention when unnecessary and detrimental" (Panayotou, 1993:63). Thus, different forms of policy failure include those which cause market failures, those which fail to correct market failures, those which aggravate market failures, and those which make no attempt to correct market failures (Panayotou, 1993). The last type of policy failure is the most common in the study area. For instance, groundwater from private boreholes is free of charge in Botswana, despite the high scarcity value of this resource, and there is no government intervention to correct this market failure. This results in over-use of the resource. In Maun, some of the households who live near the Thamalakane River have a tendency to over-use groundwater they obtain near the river for luxurious uses, despite the scarcity of this resource, as it is not priced. It is important, however, to note that the households incur capital costs for developing boreholes and fuel costs (diesel or electricity) for day to day water supply.

Measurement of Natural Resource Scarcity

It is necessary to monitor the levels of natural resource scarcity in order to device appropriate policies consistent with the ideals of sustainable development. However, there is often a lack of data to carry out such assessments. Consequently, non-data intensive indicators will be used in this paper as opposed to the conventional methods of assessing natural resource scarcity (Cleveland and Stern, 1997). These methods include trends in resource prices, trends in labour time for resource extraction, substitution for the less preferred commodities, trends in production levels of resource products, and perceived scarcity. Below, we state how these indicators can be used to assess natural resource scarcity, and discuss their advantages and disadvantages.

- ***Resource prices*** are a good indicator of natural resource scarcity when markets are present and working perfectly, and a poor indicator when markets are absent, malfunctioning, or distorted (Panayotou, 1993). Scarcity is determined by the trends in real prices, in other words by the extent to which resource prices rise faster than the rate of inflation. Resource prices will tend to

signal economic scarcity rather than physical scarcity in the study area, because they are related to the costs of labour and capital rather than to the general changes in physical resources. According to Dewees (1989), the price of a passenger pigeon, first harvested in the 1890s and became extinct in the 1890s, did not rise even when it was on the verge of becoming extinct because the costs of its harvesting did not rise. The advantage of this indicator is that it can predict future trends in scarcity, particularly if sufficient time series data are available.

- ***Labour time*** is an important measure of the scarcity of resource commodities in rural areas of developing countries. Evidence from a number of developing countries suggests that the increase in labour time for extraction of resource commodities such as fuelwood, fish and veld products is one of the ways in which people adapt to the scarcity of these resources (Pearce and Turner, 1990; Kgathi, 1992). The labour time for the extraction of resources increases in direct proportion with distances to points of resource collection, assuming that a similar mode of transport is used (Kgathi, 1992).

- ***Switching from the most preferred resource products to the less preferred ones*** is one indicator of natural resource scarcity (Kgathi, 1992; Kgathi and Mlotshwa, 1997; Leach, 1987). To determine whether there is scarcity, a comparison is made of the frequencies of the extraction of the most preferred resource products, and those of the less preferred ones. If the frequencies of the extraction of the less preferred resource products are significantly more than those of the most preferred products, it could suggest that there is scarcity of the resource. However, this method should be used with caution as the distribution of natural resources has a spatial variation, and this could distort the responses of households on scarcity. The other disadvantage is that the indicator cannot be used to predict the future trends.

- ***Perceived scarcity*** is obtained by asking resource users to state whether or not there is scarcity. This approach is not common among economists as a measure of scarcity since they have a tendency to use resource prices. Norgaard (1990, cited in Cleveland and Stern, 1997) contends that it is better to ask resource users whether there is scarcity rather than use inefficient resource prices, which may not be accurate. Perceived labour costs tend to influence resource users to adapt in various ways in order to obtain the resources. This indicator is not able to predict future trends in scarcity, and can only be obtained from survey data.

- ***Catch per unit effort (CPUE)*** is an indicator used to assess the scarcity levels of fish stocks, assuming constant catchability. Traditional fisheries theory states that the average catch of fish increases as fishing effort increases, until the maximum sustainable yield (MSY) is reached (Hiborn and Walters, 1992). Once this point is reached, further increases in fishing effort will be associated with a decline in the average catch of fish. The fall in the CPUE is associated with a decline in fish stocks and changes in the species composition of fish (Hiborn and Walters, 1992). The main limitation with this indicator is that it needs long time series data to make robust assessments of fish stock abundance.

ECONOMIC IMPORTANCE OF THE OKAVANGO WETLANDS

The degradation of the Okavango Delta wetland may result in the loss of its *total economic value* (TEV) or some of its components. The TEV of such a resource comprises use and non-use values (Hanley and Splash 1993; Munasinghe 1992; Kahn 1997; Figure 1). Use values are comprised of direct and indirect use values. Direct use values are those benefits that arise from people's direct use of the resource from wetlands (Turner *et al.*, 2000; Oglethorpe and Milaidou, 2000). On the other hand, indirect use values are

derived from environmental functions such as floodwater retention, groundwater recharge, water flow control, and nutrient cycling (Achrya, 2000).

Non-use values are intangible values that people derive from preservation of the environmental assets such as wetlands (Oglethorpe and Miliadou, 2000). Two categories of non- use values are existence and bequest values. Existence value is the value associated with the existence of environmental goods and services, even though the value attributers may not be interested in consuming the resource concerned (Barbier *et al.,* 1997; Oglethorpe and Miliadou, 2000; Turner *et al.*, 2000). The concept of existence value is fundamentally related to the deep ecologists' view that resources should have the right to exist. According to Chopra (1993) existence value is related to the extent to which the loss of a resource is irreversible and irreplaceable. Bequest value is the satisfaction derived by individuals from environmental assets if they have the knowledge that the resources will benefit the future generations (Turner *et al.,* 2000; Oglethorpe and Miliadou, 2000). Put slightly differently, "it is the utility derived from individuals from the knowledge that an environmental asset will be conserved for the future generations" (Perman *et al,* 1998:253). Strictly, bequest value is an aspect of existence value, but some authors prefer to differentiate it from this concept (Pearce, 1993).

Direct Use Value: Some Examples

Examples of direct use values include harvesting of fish and veld products collected from a wetland, and drawing of water for human and livestock consumption from a water catchment. Collected veld products in the Okavango Delta include palm leaves (*Hyphaene petersiana),* thatching grass (*Eragrostis pallens, Aristida stipitata,* and *Cymbopogon excavatus),* river reeds, floristic materials, various fruits and fuelwood. Fish is exploited at three levels of subsistence, commercial and sport fishing. According to Mosepele (2001), 65% of the Ngamiland north population depends on fishing activities, and the total annual economic turnover in the Okavango fishery is approximately P1.5 million. The value of recreational fishery generated through tourist fishing activities is in excess of P750 000. (Merron, 1995).

A recent survey undertaken in the Okavango Delta revealed that almost all households in the surveyed villages collected water directly from the Okavango Delta (ADRC, 2001). The households used the water for various purposes such as cooking (22%), washing (45%), and livestock watering (33%). The

water from the Okavango Delta is also used for flood recession agriculture as will be shown later in this paper. Another example of direct use value is option value, which is the willingness of individuals to pay for the conservation of environmental assets for future use, as they may be uncertain about their availability in the future (Barbier *et al.,* 1997). The availability of technology in the future may also justify why resources such as wetlands may have option value (Chopra, 1993).

Indirect Use Value: Some Examples

Wetland functions are internal, but the benefits they provide are external. For instance, at the local level, wetlands reduce flooding downstream, and at regional and global level they provide habitats for threatened species (Novitzki *et al.,* 1993). In the Okavango Delta, the urban village of Maun depends on the groundwater resources recharged by the Delta. The wellfield in this village, which depends on outflows from the Delta to recharge the aquifer, is the main source of water for Maun. The Okavango Delta and Panhandle riverine area are also adapted to low inputs of nutrients such as nitrogen and phosphorus, as the wetland vegetation is very efficient in removing them. This results in water of good quality.

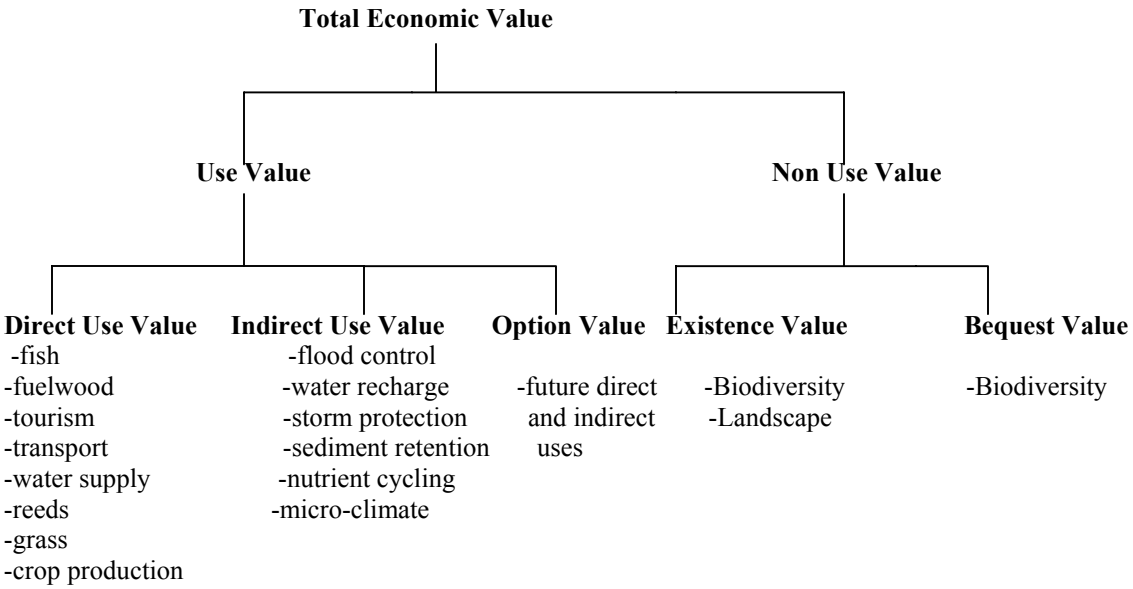

Figure 1. *Components of total economic value*
Sources: Pearce (1995) and Perman et al. (1998)

Non-use values: Some Examples

The Okavango Delta is a fragile ecosystem without notable man-made development (Okavango Liaison Group, 1998). However, the proposal of the Namibian Government in 1996 to abstract water from the Okavango River in order to supply central Namibia raised fears among the local and international communities that the implementation of water abstraction plans would lead to drying up of the Okavango Delta (Ramberg, 1997). Such concerns demonstrate that the Okavango Delta does not only have direct use values, but it also has non-use values. The contingent valuation method was used to elicit the willingness of tourists to pay for the conservation of the Okavango Delta in December 2001. The tourists were asked to assume that the Permanent Okavango River Basin Commission (OKACOM) wanted to establish the Okavango River Conservation Fund (ORCF), which could be used in the best way possible to conserve the Okavango Delta. The average willingness to pay of the tourists was USA $ 165/annum in 2001 prices (Mmopelwa, 2002). This figure shows that the Delta has indirect use values, which could be in the form of existence and/or bequest values. The Government could tap such values and use them for the conservation of the Okavango Delta.

CASE STUDIES OF NATURAL RESOURCE SCARCITY

The previous section has discussed the economic importance of the Okavango Delta. This section makes an assessment of the scarcity of natural resources in the Okavango Delta. There is a general concern that natural resources in the Okavango wetlands may be depleted in the long run if appropriate conservation measures are not adopted. According to Musundire (1995), the Okavango wetlands are threatened by the rapid increase in population growth, expansion of tourism, and the possibilities of alteration. A recent socio-ecological survey undertaken in 22 villages in the Okavango Delta revealed that most of the households interviewed reported the non-availability of resources such as water lillies, medicinal plants, palm trees, building materials, and papyrus (Figure 2) due to an increase in their demand and the changes in the patterns of the annual Okavango floods. Resources such as fish, birds, and wildlife were reported to be increasing in availability (Figure 2). Fish was reported to be increasing in availability because good

harvesting methods were being used, whereas wildlife and birds were increasing in availability because their use is controlled by the government (ADRC, 2001). In the subsequent section, the scarcity of arable land, fish stocks, basket-making resources, and reeds is assessed in more detail.

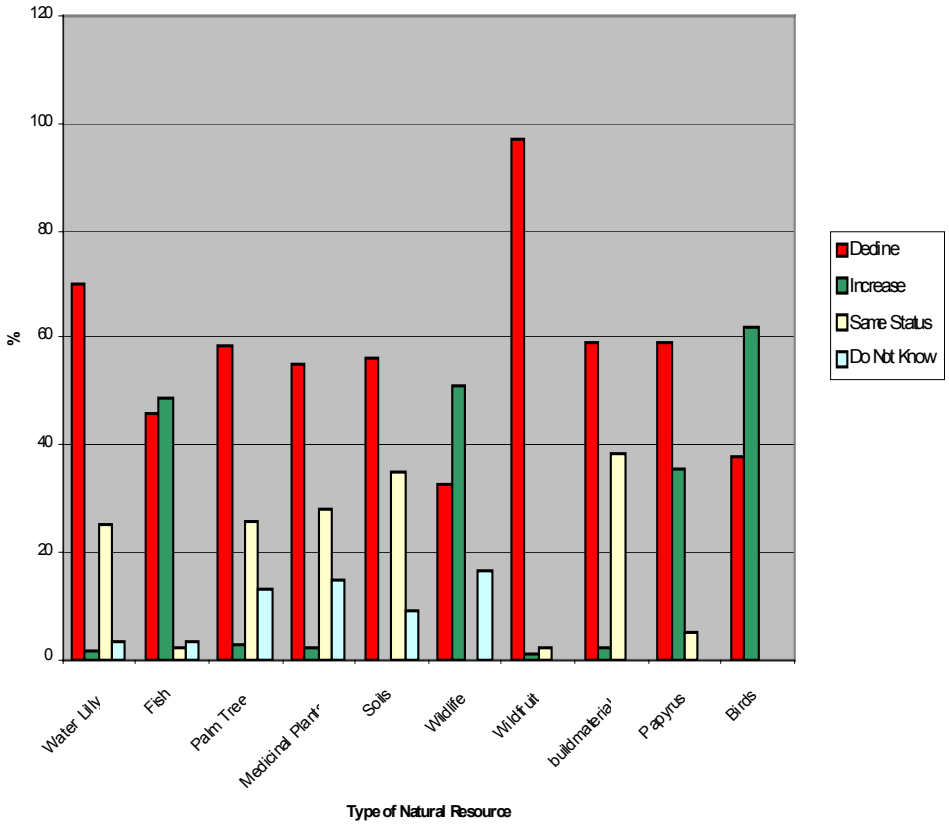

Figure 2. *Perceived Status of Natural Resources in The Okavango Delta*
Source: ADRC (2001)

Land for Arable Agriculture

There are two arable farming systems in the Okavango Basin: dryland and flood recession (or *Molapo)* (Tlou, 2000; Sutherland, 1982). The former takes place in dryland, and the latter on flood plains Dryland farming is more common than *molapo* farming in Ngamiland partly because most of the settlements are in dryland, and also because there are places where the Land Board prevents the expansion of *molapo* farming such as in the riverine floodplain called the Panhandle. The arable lands survey of

1978/79 revealed that 65% of the farmers practiced dryland farming in Ngamiland (Ministry of Agriculture, 1979). Recent figures for 1997 and 1998 reveal that the proportion could have increased over time since 73% and 84% of the farmers had farms on dryland, respectively (Table 1). The Land Board only allocates arable land for dryland farming, and does not allocate land for *molapo* farming.

Recent surveys of 1997 and 1998 suggest that the proportions of farmers who practised *molapo* farming in Ngamiland were 27% and 16%, respectively (Figure 3). Allocation of the land for *molapo* farming is still based on the traditional land tenure system (Rashem, 1988; Ministry of Agriculture, 2002). In most cases, the allocation is done by the title-holders as they have control over the use of the land. These are people "who have been born and raised in the area" and are "descendants of the aboriginal and pioneer cultivators" (Sutherland, 1982:6). According to Rashem (1988), the title-holders have inherited the right to allocate the land, suggesting that this traditional land tenure system is a private property regime. They may refuse to allocate the land, or discontinue the existing land rights if they wish.

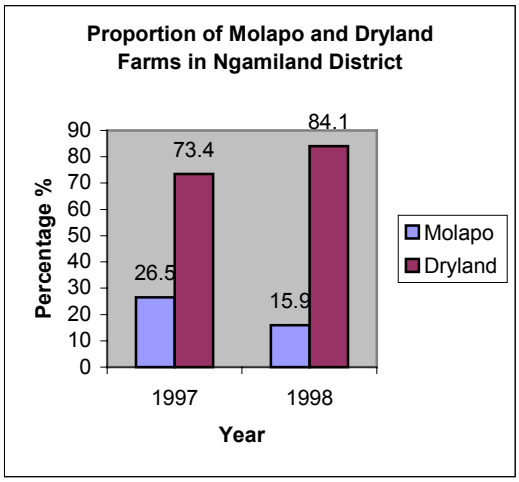

Figure 3. *Proportion of Molapo and Dryland Farms in Ngamiland*
Source: CSO, 2002

They may either lend a field with no obligations (*go adima*) or by asking the borrower to pay in kind by providing his labour services to their field (Dorloechter, 1989). Self-allocation of the land for *molapo* farming is also a common practice. Thus, the land for *molapo* farming is insecure, not well defined, and not exclusive. According to Panayotou (1993), owners of resources with such property rights will not have an incentive to invest in them, conserve, and use them in an efficient manner.

Various sources of literature suggest that there is no scarcity of land for dryland arable farming in Ngamiland, but there are isolated cases of scarcity of land for *molapo* farming (Ministry of agriculture, 1981). A study undertaken in the villages of Motsaudi, Makakung, Danega, and Xaoga in the Okavango Delta revealed that access to land (dryland and *molapo*) for crop production was not considered a major problem (Ministry of Agriculture, 1981). In the village of Matsaudi, however, access to the fields for *molapo* farming was limited and restricted (Ministry of Agriculture, 1981). The baseline and monitoring surveys of the constraints of *molapo* farming also revealed that there was shortage of land for *molapo* farming in the Okavango Delta (Molapo Development Project, 1991). It suggested that women and young farmers were most affected by this shortage. A recent study undertaken in Tubu in 2001 also revealed that there was scarcity of land for *molapo* farming in this area (Ministry of Agriculture, 2002).

There was also a concern about access to the fields for *molapo* farming by young members of the community. The following quotation describes the situation: "people with access to *molapo* farming are refusing to allow others to use them even if the family is not using them at present, people are holding to them as inheritance" (Ministry of Agriculture, 2002: 21). The scarcity of the land for *molapo* farming was attributed to population growth, and the drying up of the Thaoge river as a result of changes in the distribution of water in the Okavango Delta (Ministry of Agriculture, 2002).

Fish Stocks

This section examines the extent of the scarcity of fish stocks in the Okavango Delta, and related issues such as the structure, property rights and management of the fishery**.**

Structure of the fishery

Estimates of the total number of fishers in the Okavango Delta increased from 700 to 5 000 from the mid 1970's to the late 1990's (Mosepele, 2002). The number of gill net fishermen decreased from 700 in the mid-1980s to 300 in the mid 1990s. This is due to the collapse of the Government market for dried salted fish in the 1990s, and the consequent emergence of a high capital fresh/ frozen product in the mid 1990s, which limited the number of people entering the fishery (Mosepele, 2002). The structure of the Okavango Delta fishery suggests that it is an artisanal fishery with a small-scale commercial gill net

fishery. Artisanal fisheries are characterized by a predominance of crude gear with low fishing efficiency and production (Hillborn and Walters, 1992; Mosepele *et.al*., 2002). According to Mosepele *et al*. (2002), the low efficiency of artisanal fishing gear (e.g. fishing baskets, traditional hook and line etc) generates low annual off-takes from the fishery. Therefore, it is expected that this relatively low fishing pressure in a non-selective multi-gear fishery will have very little impact on fish stocks (Mosepele *et.al*., 2002).

Property Rights and Management

According to Campbell (1976) and Tlou (2000), in the pre-colonial and pre-independence era, some of the villages in Ngamiland held exclusive fishing grounds in designated areas, and poaching was punished by either heavy fines or confiscation of fishing equipment. It is possible that the failure to acknowledge these traditional management practices, and the commercialisation of the fishery could have contributed to erosion of these traditional institutional arrangements for the management of the fishery in Ngamiland. Moreover, save for an outdated Fisheries Act (of 1975), there are currently neither regulations in the fishery nor a national fisheries policy (Nengu, 1995; Mosepele, 1997, 2001; Bills, 1996). Lack of regulations (or clearly defined user rights), predicated by lack of a national fisheries policy has not only created an open access regime in the fishery, but also friction among the stakeholders (Merron and Bruton, 1988; Nengu, 1995; Bills, 1996; Mosepele, 2001). The imperfections inherent in an open access regime in a fishery invariably create room for fish stock decline (Hannesson, 1993).

Demarcation of the Okavango Delta into Wildlife Management Areas (WMA) and Controlled Hunting Areas (CHA) is also at the core of current fisheries management problems in the delta. Fishers argue that tourist operators claim exclusive rights over fish resources within their concessions (Ramberg and van der Waal, 1997) despite the fact that the local communities are given traditional resource rights of fishing and collecting veld products for subsistence purposes. Commercial fishing is forbidden in Moremi Game Reserve (Republic of Botswana, 2000).

Scarcity or abundance of fish stocks?

The scarcity or abundance of the Okavango Delta fish stocks has been assessed using the following indicators; time series catch data, catch per unit of effort (CPUE), fishermen perceptions, species

substitution, and trends in real prices. Short time series data has restricted the use of CPUE as an index of relative stock abundance and is used rather to illustrate catch rates in the fishery. Mean CPUE (kg/ fisherman/ year) estimates for tilapia/ bream, the most preferred fish species in the fishery (Mosepele, 2001), remained relatively stable between 1996 and 2002 indicating that there is no significant decline in fish stock abundance (Figure 4). This trend supports recent research finding which indicate that the Delta's fish stocks are not declining (Bills, 1996; Mosepele, 2000).

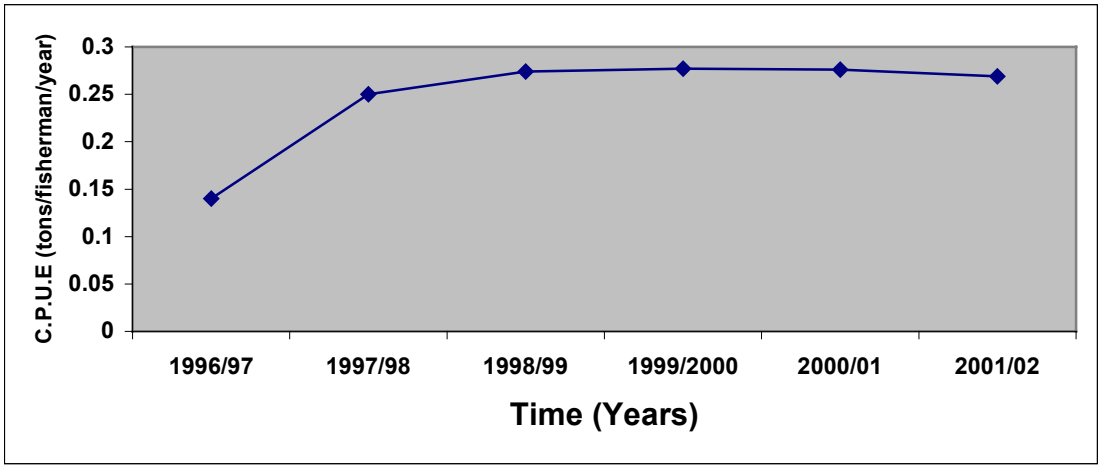

Figure 4. *Estimated annual mean catch per unit of effort (CPUE) for bream (tons/ fisherman/ year) from the Okavango delta fishery between 1996 and 2002. Apart from an initial increase between 1996/'97 and 1997/'98, mean CPUE in the fishery has remained stable suggesting no significant decline in fish stock abundance.*

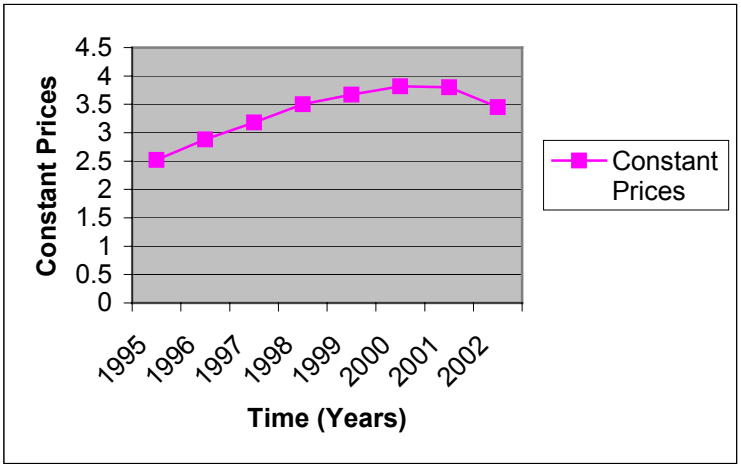

Figure 5. *Trends in Real Prices of Fish at Samochima Cold Storage Facility (1995 to 2002).*

A household survey undertaken in 22 villages in the Okavango Delta also indicated that the fish stocks were not declining, except in villages where fishing areas had dried up (ADRC, 2001). For instance, the drying of Lake Ngami, due to low floods and drought, resulted in the reduction of the annual fish production (Mmopelwa, 1989, 1991, 1992; OKACOM, 1998). According to Mosepele (2000, 2001, 2002), most fishermen still catch their most preferred fish species of Tilapia/bream. A 1997 frame survey (Mosepele, 2000) revealed that while 96% of fishers preferred bream, 95% of them reported that it still contributed the highest proportion of their catches, suggesting that these species were not in short supply since fishers still managed to catch their preferred species. Between 1996 and 2002, bream catches were the highest, followed by those of catfish and tigerfish, consecutively (Mosepele, 2002). Higher catches of the less preferred species of catfish as compared to those of the more preferred tigerfish were due to the higher availability of catfish within the fishing areas. Mosepele (2000, 2001) has shown that most gill-net fishing occurs in floodplains and lagoons which are also catfish habitats, while tigerfish is mainly found in the main channel (Merron and Bruton, 1988; Mosepele, 2000).

Figure 5 presents trends in constant or real prices (inflation adjusted prices) for fish at Samochima Cold Storage. The prices, which were adjusted for inflation, or deflated, using consumer price indices for 1995 to 2002, normalised to the year 1995 (e.g. 1995=100), suggest that there was scarcity of fish resources between 1995 and 1998 as revealed by the increase in the real prices of fish during this period. The prices reached a plateau between 2000 and 2001, and then decreased after 2001. Real prices could have increased because there was market failure as the company monopolised fresh/frozen fish supplies from the Okavango Delta for several years from the mid 1990s until the late 1990s. This suggests that trends in resource prices were not a good indicator of scarcity due to lack of competition. The shortness of the time series data is also a limitation, and definite conclusions cannot be reached if long time series data is not available.

The various indicators used in this section, therefore, seem to suggest that the Okavango Delta fish stocks are not over-exploited. These findings are consistent with those of other studies which suggest that the fish stocks of the Okavango Delta are not over-exploited (Bills, 1996; Kolding, 1996; Mosepele, 2000). However, lack of a national fisheries policy (Mosepele, 2001) and the increasing pressure on the fish stocks (Mosepele, 2001, 2002) present a clear danger to the future environmental sustainability of the Okavango Delta fish stocks. This status quo might not remain indefinitely.

Basket-Weaving Resources

Basket-making has been an important commercial activity in Ngamiland since the early 1970s. Through the efforts of Malcolm Thomas, who was then the HaMbukushu Refugee Settlement Officer, the people of Etsha (Angolan refugees who settled in the area) were able to market their baskets nationally and internationally through the Botswana Craft Marketing Company as from this period (Terry, 1986; Cunningham and Milton, 1982). Basket making also became an important commercial activity in other parts of Botswana. In 1990, the economic benefit from basketry was estimated to be in the order of P225 000 in Botswana, a figure which accounted for 7% of the total economic value of all natural resources used in craft production (Terry, 1999). In Etsha and Gumare/Tubu villages, basket weaving provided self-employment to 1 500 and 400 women, respectively, in the 1980s (Terry, 1987), and this seems to be the case even today. Currently, Botswana Craft and Botswana Christian Council are the main buyers of baskets in the Okavango sub-District. In 2000 and 2001, Botswana Christian Council spent P336 000 and P400 000, respectively on the buying of baskets in this sub-district (Botswana Christian Council, 2002) and Botswana Craft spends P300 000 annually on baskets in this area (Botswana Crafts Marketing, 2002).

The raw materials used for the production of baskets are leaf fibre and dye. These resources are held under an open access management regime in communal areas of the Okavango Delta. The fibre is obtained from palm trees, *Hyphaene petersiana (mokola),* mainly found in the islands of the Okavango Delta. The dye for *mokola* leaves is mainly obtained from the roots of *Euclea divinorum* (*motlhakola)* and *Berchemia discolor (motsentsila)* (Cunningham, 1988). These are the most preferred species for dye because they have a dark colour, preferred by the buyers because it adds quality to the baskets, as they do not fade when the dye is used (Cunningham and Milton, 1982).

In the pre-independence period, there were rules and sanctions for the management of basket-weaving resources in some areas in Ngamiland. According to Bishop *et al.* (1994), in the islands of Wabe and Qoroga near Etsha, there were rules for regulating the harvesting of *Hyphaene petersiana* and for excluding others from harvesting these resources in the 1950s and 1960s. In the 1990s, such rules and sanctions were not practised, and this contributed to the depletion of dye resources in the early 1990s (Bishop *et al.,* 1994). However, in the islands of Oxge near Danega, the village headman had introduced rules for harvesting *Hyphaene petersiana* in the 1990s, and basket makers were advised not buy the fibre

harvested by hoes or axes, as these devices are not selective and are therefore more destructive to the plant. These rules and sanctions were effective in managing the palm resources (Bishop *et al.*, 1994).

Commercialisation of basket making has resulted in the scarcity of raw materials used for producing baskets in some parts of the Okavango Delta (Terry, 1999; Cunningham, 1988; Kgathi and Motsholapheko, 2002). In the villages of Etsha and Gomare/Tubu, 97% and 55% of basket makers, respectively, complained about the scarcity of fibre leaves for *Hyphaene petersiana* in 1983 as they travelled longer distances than in the past (Cunningham, 1988). This had an adverse effect on productive and reproductive activities such as agricultural work and household chores, respectively (Cunningham and Terry, 1993). Terry (1986) also notes that more than 55% of the respondents said there was scarcity of fibre leaves for *Hyphaene petersiana* in Gomare/Tubu in 1983 as compared to 97% in Etsha. Species for producing dye were also perceived to be becoming increasingly scarce. For instance, 79% of basket-makers in Etsha perceived a scarcity of *Berchemia discolor* dye resources in 1983, as compared to 57% of the basket-makers in Gumare/Tubu in 1985.

The scarcity of the raw materials for making baskets seems to be at present worse than in the 1980s. An interview of basket makers who attended a workshop (10/11/2002) organised by the Kgalagadi Conservation Society in Etsha 6 in the Okavango sub-district, aimed at exchanging views with basket-makers and craftsmen about conservation issues, indicated that the scarcity of basket-making resources had become worse. Basket makers who were based in Etsha 6 said that they collected the raw materials in Jau which was estimated to be more than 10 kms away. The monthly labour time for the collection (travel and extraction) of the raw materials for producing 3 baskets worth P225 was 12 hrs. The labour time for collecting the same resources was 3 hours as far back as in 1984. As a result of the destructive harvesting methods, most of the resources were depleted in areas close to Etsha 6. Further analysis of the "Every River Has Its People" research Project questionnaires revealed that most of the households interviewed in Etsha 6 (44%) thought that over-harvesting of palm trees was the main cause of their depletion. The remainder thought the destruction by elephants (32%), lack of rainfall (16%), veld fires (8%), and high temperatures (4%) were the causes of the depletion of palm trees (Kalahari Conservation Society, 2002).

Table 1. *Perceptions of basket weavers about scarcity of palm resources*

	Matsaudi		Shorobe		Total	
	Number	%	Number	%	Number	%
Scarcity	6	42.9	10	62.5	16	53.3
No Scarcity	8	57.1	6	37.5	14	46.7
Total	14	100	16	100	30	100

Source: Kgathi and Motsholapheko, 2002

Our recent survey on basket-making resources in the lower part of the Okavango Delta revealed that 63% of the basket-weavers in Shorobe perceived the scarcity of raw materials from palm trees (Table 2). However, the scarcity for these raw materials was perceived by only 43% of the weavers in Matsaudi, reflecting the reduced pressure on this resource in this village. The raw materials for dying the palm leaves were reported to be very scarce in both Shorobe and Matsaudi, and hence 79% of the weavers purchased them (Kgathi and Motsholapheko, 2002). Almost all the weavers (89%) said they collected their most preferred dye species, and these were not easily substitutable. An analysis of the questionnaires for the "Every River Has its People" research project revealed that the decrease in the availability of palm resources was mainly attributed to the destruction by elephants by 56% of the respondents. Other reasons given for the decline in the availability of the palm trees were over-harvesting of the resource (17%), lack of rainfall (17%), and veld fires (11%) (Kalahari Conservation Society, 2002).

River Reeds

Two types of river reed, *Phragmites australis* and *Phragmites mauritianus,* are among the many natural resources harvested in the Okavango Delta. *Phragmites mauritianus* is spinier, compared to *Phragmites australis*. The latter is the most common reed, and it is tall and highly productive (SMEC, 1987). Household use of river reed varies according to the needs of the households. When the reed is not harvested for sale, it is generally used as a building material, whereby the dried reeds are made into walls, screens, palisades, ceilings, and fences (Scudder *et al.,* 1993). It also used to make floor mats. A cleaned

Phragmites australis would last for a period of one and a half to two years as a fencing material before it deteriorates or is eaten by insects and must be replaced (Baar, 2000).

There has generally been less research on the availability and scarcity of river reed in the Okavango Delta. However, Campbell (1976, cited in Scudder *et al*. (1993)) indicated that there was much less river reed in the mid-1970s than in the past, a trend that has not been caused by over-exploitation, but by clearance for agriculture and external or undesirable interventions in the water system where reed grows. This trend has been observed in the Thamalakane River. However, river reed is abundant in some areas, even though it is generally scarce in the Okavango Delta. Our most recent survey on household perceptions on availability and scarcity of river reed, thatching grass and palm resources in Shakawe village, indicated that river reed was not declining. This was the view of 52% of the harvesters of river reed as compared to 39% who reported that reeds were becoming scarce.

According to ADRC (2001), river reed was harvested in all the 22 villages that were surveyed. The proportion of households who said they harvested and utilised reeds ranged from 48% to 96%. Of the 22 focussed group discussions that were held in these villages, 12 or 64% of them indicated that river reed was a source of income, but not the most important option. In addition, group discussions conducted by ADRC (2001) indicated that river reed was declining because of the changes in the distribution of floods of the Okavango River. The floods had become lower in most of the villages. Thus, the decline in the amount of river reed is attributable to fluctuations in natural conditions rather than human related activities (Baar personal communications, 2002). Fire has also been reported to be a cause of scarcity of river reed in other parts of the Okavango Delta. In our most recent survey, the concern that fire may be a cause of concern in the scarcity of river reed was expressed by 40% of river reed harvesters. The implication of unavailability of river reed in the vicinity of villages is that households are subsequently required to walk long distances to reach harvesting sites where river reed is still available. At times, household incur transport costs either by hiring or using their own transport to reach these sites. Thus, the physical scarcity of river reed as caused by fire, may lead to an increase in the labour time for its collection. However, due to lack of data and poor recall information from respondents on the magnitude of labour time utilised to travel and harvest this resource, the opportunity cost associated with the harvesting river reed was not estimated.

The market for reeds is not well developed but they are a potential source of income for the rural population in the Okavango Delta. A small bundle, which is slightly larger than that which can be held in a closed hand, was valued at P1.00 in the past (*Scudder et al.*, 1993). Based on this information, Scudder *et al.* (1993) calculated the value of river reed to be P10, 000/ha/year. A much larger bundle, which could be held in both hands, and weighing approximately 6 kg, was valued at P10.00 in 1991, while the same bundle is valued at P15.00 today (Baar, 2002, Pers. Comm). Lack of available data on past demands and prices of reeds, made it impossible to assess the scarcity of reeds using trends in real prices. Although household perceptions suggest that river reed is declining, trends in real prices of river reed would help in providing additional information on the extent of the of the scarcity of reeds.

Changes in property rights have also contributed to the scarcity of river reeds in the Okavango Delta (ADRC, 2001). For instance, in villages such as Gudigwa, Gunitsoga, Xaxaba, Boro and Sepopa, it was reported that river reed was plentiful, but inaccessible in areas that have been leased out to Safari companies. The inaccessibility to such areas may imply that harvesting pressure for this resource would increase in areas that were not leased out. Subsequently, there would be increases in labour time taken to harvest an equivalent bundle of reeds in the site destroyed by fire, as compared to a situation whereby fire had not occurred.

CONCLUSION

A number of socio-economic indicators were used to assess the scarcity of the following natural resources in the Okavango Delta: land for floodplain recession arable agriculture (*molapo*), fish stocks, raw materials for basket-weaving, and river reeds. The study revealed that basket-weaving resources, land for *molapo* arable farming, and river reeds were increasingly becoming scarce, whereas fish stocks were still in abundance. Apart from the rapid increase in human population, which is a general cause of scarcity of most natural resources in Botswana, the scarcity of land for *molapo* arable farming is exacerbated by the changes in the flood patterns of the Okavango Delta. The failure of the Land Board to administer the allocation of this land makes it vulnerable to abuse. Those who hold this land are likely to have no incentive to conserve and use it efficiently. Basket-weaving resources and river reeds are scarce because they have been over-exploited due the high demand resulting from their commercialisation. This has been

exacerbated by market failure resulting from their open access nature, lack of appropriate conservation policies, and changes in the distribution of the Okavango water. Fish stocks are in abundance because they are under-exploited, and also because of the good methods used in harvesting them. However, these resources might be over-exploited in the future due to their open access and increase in human population.

There is need to introduce appropriate policies for the management of natural resources. Property rights could be granted to the communities to manage natural resources such as fish and veld products in line with the wildlife model of Community Based Natural Resources Management (CBNRM). The communities will have an incentive to manage these resources since financial and other benefits will accrue to them. This recommendation is in line with the draft "National Policy on the Use and Management of Natural Resources" which states that open access to natural resources should be transformed into community managed access in Botswana (Government of Botswana, 1999). In addition, the Government should take the responsibility for allocating the land for *molapo* farming, as the ownership of this land is insecure, not well defined and not exclusive, and therefore vulnerable to abuse.

There is also need for continuous monitoring of natural resources in the Okavango Delta. The Central Statistics Office should try to collect data on the production, consumption, and prices of natural resources such as fish, thatching grass, fuelwood, and river reeds on a regular basis in order facilitate their monitoring. Research institutes such as the Harry Oppenheimer Okavango Research Centre should also make attempts to carry out surveys on natural resources in the Okavango Delta as part of the process of monitoring natural resources.

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