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THE ROLE OF INLAND WATERS IN NATURE CONSERVATION, FOOD PRODUCTION AND OUTDOOR RECREATION IN ZIMBABWE

by

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Zimbabwe is a landlocked country with no significant natural lakes. It lies astride the watershed between the Zambezi and Limpopo rivers and forms part of the high southern African plateau, which is here separated from the coastal plains of Mocambique by the eastern border mountains. Despite this it is generally well watered, particularly above the 1200 m contour and towards the east of the country. As in most of southern Africa rain falls mainly in summer (November to March or April), when more than half the country enjoys an average precipitation of over 800 mm which rises to above 1400 mm in the eastern mountains. It is only in the Limpopo and lower Save Valleys that this rainfall declines to less than 400 mm.

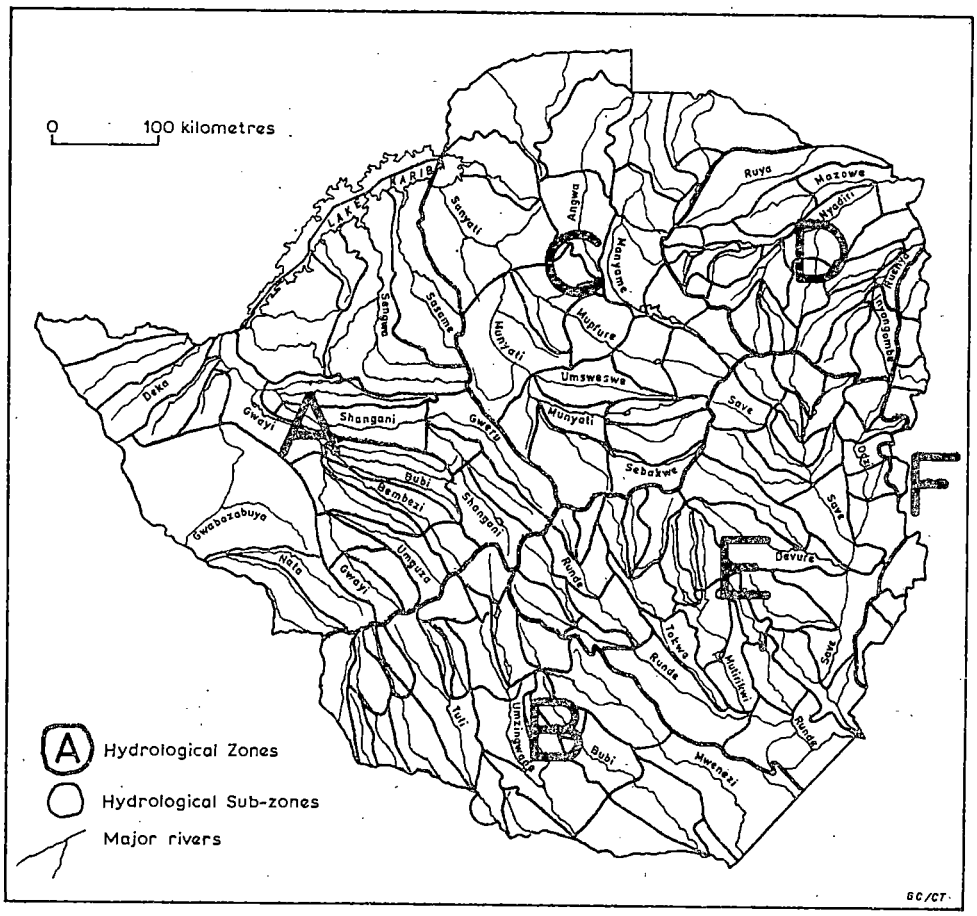
The country has numerous good dam sites which have been exploited steadily for agriculture, industry and urban water supplies. Irrespective of their primary purpose these water bodies greatly enhance the potential of the natural rivers and streams as a source of food and for outdoor recreation. Where impoundments do not flood extensive fertile bottom-lands and so destroy the productivity of these important habitats and the related catinas, the environmental costs of such development are generally low and more than off-set the benefits in human welfare. This discussion is mainly a brief overview of the potential for so-called secondary uses of dams in Zimbabwe.

INLAND WATERS

Zimbabwe is divided into six hydrological zones (Figure 1) for the rationalised use of its surface water resources and for their apportionment between competing users. These major catchments are a useful starting point for land use planning.

There are a number of sizeable rivers draining north and south from the spinal watershed or the eastern mountains. They vary from high altitude cold water streams through more or less perennial rivers to the fossil water courses in the west of the country, which bear testimony to the wetter epochs through which southern Africa has passed during the course of geological history. Rivers vary in character from fast running streams cascading over spectacular waterfalls, to those that meander through extensive

FIGURE 1: HYDROLOGICAL ZONE MAP OF ZIMBABWE



alluvial bottom-lands with magnificent biotic communities, leaving ox-bows as evidence of their former routes.

Besides ox-bows or other flood plain lakes and the numerous more or less seasonal pans that are such a feature of lowveld areas in particular, Zimbabwe has a number of permanent pans associated with the Kalahari sand sheet in the north-west of the country. Historically these provided important waterfowl habitats, but their significance in this regard has declined in recent decades. Many have become silted due to overgrazing by domestic stock, but fortunately their place as essential waterfowl refuges has been replaced by the numerous dams (7 200 in 1974; Loewenson, 1974) which have become such a feature of the landscape in Zimbabwe, especially since World War II. These dams range in size from small stock watering points to 80 or more large lakes of which the biggest are Robertson, Kyle and Kariba.

Although not true inland waters, no discussion of the conservation of Zimbabwe's surface water resources is complete without touching on its extensive vlei systems. These open grassed drainage lines vary in nature from those forming a mosaic with the *Brachystegia/Julbernadia* woodland of the high and middle veld, to the basalt vleis of such areas as Matetsi in the north-western corner of the country. Vleis are important sponges on the headwaters of many streams and rivers, where they hold water during the rains, releasing it into the streams for much of the dry season. Unfortunately vleis are sensitive to mismanagement and the erosion of micro base levels along their lengths. This apparently minor symptom of veld deterioration can have far reaching influences on their physical and biotic characteristics and hence on their capacity to hold and release water into the rivers.

THE CONSERVATION OF AQUATIC ECOSYSTEMS

The changing nature of many of Zimbabwe's aquatic ecosystems as the result of poor land management, pollution and the impoundment of rivers or vleis, presents the wildlife ecologist with a range of positive and negative challenges. On the one hand he must seek to preserve the quality and production of natural water bodies, while on the other there is the opportunity to maximise sustainable benefits from large water bodies where none existed before.

This programme involves both aquatic and terrestrial biologists and the management actions flowing from their investigations and those of colleagues in related fields. Like so many tasks in the conservation field, this work urgently needs to be expanded if the resources are to be conserved and used wisely towards optimising the realisable benefits in human welfare which they represent, particularly for rural people. Already the Department of National Parks and Wild Life Management, either alone or in co-operation with other technical agencies inside and outside

Government, is involved in research and development in a wide range of disciplines. These include:-

- monitoring and controlling water quality in natural and artificial water bodies;
- conserving natural aquatic and riparian ecosystems, with their wide biological diversity;
- determination of the physical, chemical and biological properties of water bodies;
- research into the biology of fish and other aquatic organisms;
- research into crocodiles, hippopotami and waterfowl;
- research to cushion the ecological effects of impounding rivers; and
- research and development into the best methods of using such resources for human welfare within the limits imposed by their ecological characteristics.

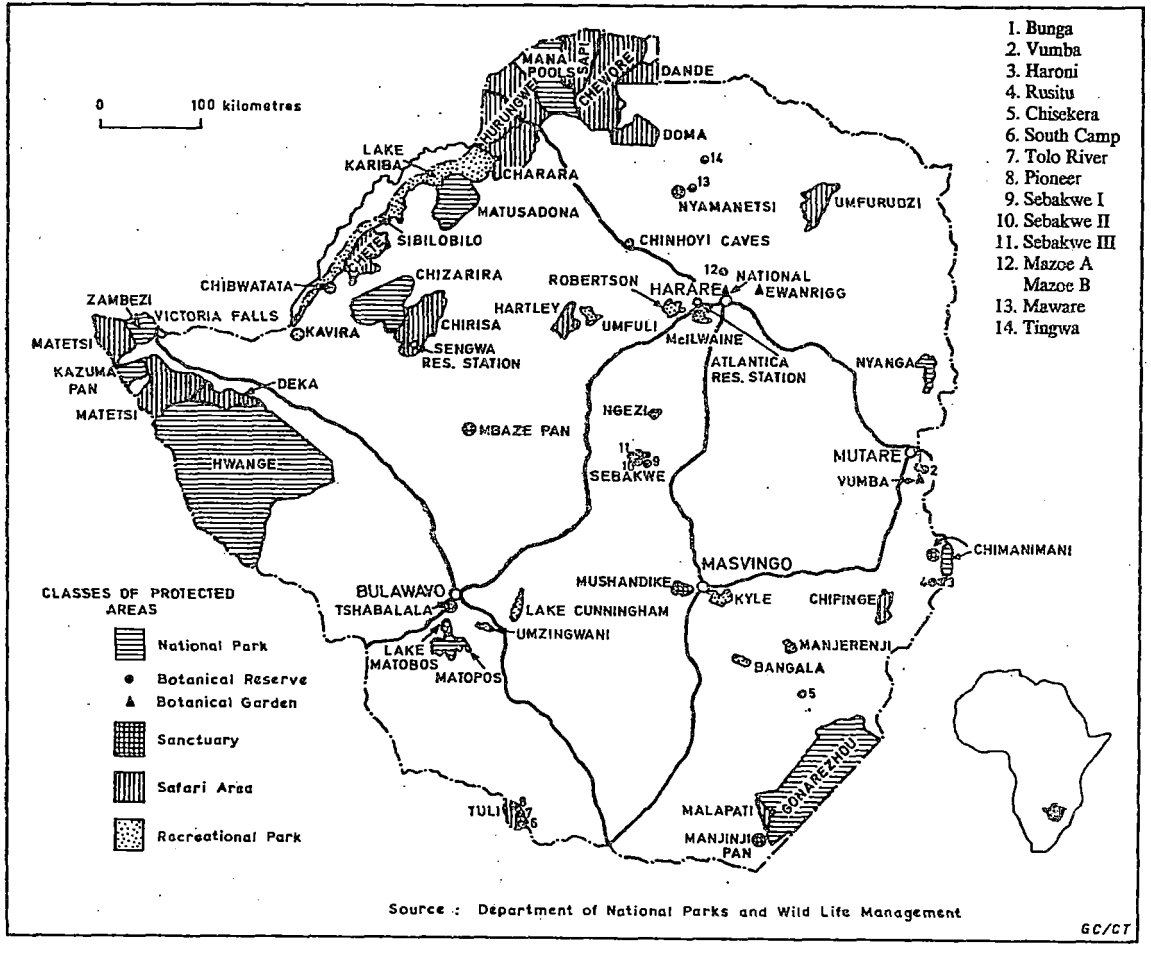
Lake Kariba and a number of other large impoundments fall within the Parks and Wild Life Estate (Figure 2) where they are constituted as Recreational Parks. Stretches of some of the larger rivers and examples of most other types of inland water bodies enjoy similar protection, although few escape the modifying influences of upstream developments and land management practices outside the Estate.

FISHING AND RELATED ACTIVITIES

Fishing in Zimbabwe is divisible into subsistence fishing, including angling with unsophisticated tackle where the main objective of participants is to obtain fish for domestic consumption; sophisticated angling mainly for sport; and artisanal or large scale commercial fishing. In addition, the harvesting of wild laid crocodile eggs is the basis of a local but significant industry in remote rural areas of the Zambezi Valley which it is hoped to extend to the south of the country (Child, in press). Preliminary investigations suggest the potential for a freshwater mussel industry on Lake Kariba and perhaps elsewhere (Kenmuir, 1980).

Although reliable statistics of the countrywide harvest are not available it is probable that the various types of fishing in Zimbabwe yield 20 000 tonnes of fish per year. At a landed value of Z$1.50 per kg this represents a primary industry worth Z$30 million annually, but this figure is constrained by the Government controlled price of some fish and is therefore closer to Z$20 million. It is clearly also a very important source of cheap animal protein for human consumption and the importance of a sustainable subsistence fishery to a protein hungry

FIGURE 2: PARKS AND WILD LIFE ESTATES IN ZIMBABWE (1984)



peasantry should not be under estimated. While developments for a fishery are capital intensive, fish are more efficient than warm blooded animals at converting natural and artificial feed into human food so that it is likely that fish culture will expand in response to popular demands as the human population grows.

Of the estimated 20 000 tonnes of fish landed by commercial fishermen in Zimbabwe in 1985, about 17 000 tonnes came from Lake Kariba (Mabayi, 1986). While production and marketing costs are high relative to cheap marine fish, or imports of freshwater fish from neighbouring states where labour costs are very low, this disadvantage is off-set by the savings in foreign exchange.

In 1972 Lake Kariba yielded about 2 000 tonnes of fish and the growth of that fishery to a peak of 17 000 tonnes in 1985 is a reflection of the wisdom of Government's investment in research and development (Anon, 1986; Marshall, Junor and Langerman, 1982). Although the Lake is intrinsically rather unproductive and remote from markets, the increased catches reflect the results of careful attention to controlled harvesting in the light of reliable scientific knowledge.

This is well illustrated by the growth of the Kapenta industry. With the damming of the Zambezi river at Kariba in December 1958 a very large lake replaced the seasonally fluctuating river with its rather depauperate fish fauna of 28 species, whose behaviour was adjusted to withstand the dry season stresses associated with low river levels. These essentially riverine fish prospered in the lake, but did not exploit the deep water niche later occupied by the Kapenta, *Limnothrissa miodon*. These small fresh water sardines were introduced to Kariba from Lake Tanganyika in 1968 and soon colonised the whole lake (Marshall and Langerman, 1979).

Small scale fishing methods similar to those in Lake Tanganyika were disappointing, but the Lake Kariba Fisheries Research Institute, under Mr Frank Junor at that time, was convinced that the sardines were a harvestable resource, despite pessimistic foreign advice. Junor and his team set about studying the biology of the fish in its new environment and developing appropriate gear to catch them in commercial quantities.

Commercial landings have increased steadily from 66,5 tonnes in 1973 through 1 050 tonnes in 1976, 8 000 tonnes in 1978 to almost 14 000 in 1985 (Anon, 1986; Marshall, Junor and Langerman, 1982). The sardines are attracted by light at night and this is used to concentrate them preparatory to netting them. Kapenta are plankton feeders, living mainly off two small species of crustaceans. Numbers fluctuate through the year depending on food supply which in turn is sensitive to the level of nutrients in the lake. These reach a peak in August, after lake turn over in July, when the temperature induced stratification of the

lake waters breaks down in response to the lower ambient temperatures in winter. This allows nutrients from deeper waters to be released into surface layers where the fish live.

The species breeds throughout the year with a peak in August when food is plentiful. There is a secondary crest during the rains when the lake is enriched by affluent rivers. The population crashes in September or October due to food stress and it is likely that, in future, annual catches will reveal poor years due to low levels of nutrients in the Lake.

Licences for nets are issued by the Department of National Parks and Wild Life Management, which limits their availability in the interests of evolving a sound sustainable industry yielding fair profits. The product is usually lightly brined and sun dried and is especially popular with the low income sector, as it is relatively cheap and has a long shelf life without refrigeration.

Tiger fish, *Hydrocynus vittatus*, which are the top fish predator in the lake, soon moved into deep water to prey on Kapenta. At one time they made up 10%, by weight, of the fish caught in Kapenta nets, but this proportion has declined and with it a promising canned product. Tiger fish also contribute a small but significant proportion to the in-shore gill net fishery and are a prized sporting fish much sought after by anglers. Unfortunately stocks are threatened by heavy poaching.

The species migrates up rivers to spawn early in the rainy season and at this time falls easy prey to poachers' nets set across such rivers. A high proportion of each season's breeding potential may be lost in this way. Such poaching is also a serious threat to fish stocks in many of Zimbabwe's rivers, some of which have been severely over-fished, resulting in loss of a sustainable source of protein for remote rural communities. For example, catches in the Save/Runde river system, outside the Gonarezhou National Park, have declined almost to zero in the past five or six years as poachers have resorted to smaller and smaller mesh nets. Some now use mosquito netting to catch tiny fish fry.

A similar situation is reported on the Save in neighbouring Mocambique. This illustrates the importance of a National Park as a reservoir of biological diversity from which neighbouring areas could be restocked, if fishing were disciplined and limited to a sustainable annual harvest. Surviving stocks under protection in the Gonarezhou could either recolonise the rivers upstream and downstream of the park naturally, or the process could be accelerated by human intervention.

Surveys undertaken by the Department of National Parks and Wildlife Management indicate that angling with

unsophisticated tackle, angling with modern tackle and commercial fishing are complimentary rather than competitive, provided they are controlled (Child, 1976). The species taken by the three methods of fishing, their size and/or their age classes overlap to a remarkably limited extent. Subsistence fishing with rod and line tends to remove small fish and thus prevent stunting in impoundments and this is beneficial, at appropriate intensities, for both sophisticated anglers and commercial fishermen.

While many angling enthusiasts are opposed to commercial fishing, blaming their lack of success on the fish removed in nets, pragmatic evidence weighs heavily against this popular belief. If a real conflict exists it is between the outboard motors of anglers and fish nets which tend to obstruct boating, especially where the nets have to be totally submerged as a precaution against theft. This conflict is largely obviated by the zonation of lakes, in which commercial fishing is prohibited in certain areas and elsewhere during weekends and public holidays, when boating is at a peak on waters that are popular outdoor recreational destinations. The zonation against netting also protects important spawning grounds.

Sophisticated angling, with some 12 000 anglers registered through clubs affiliated to the Zimbabwe National Anglers' Union, is probably the most popular recognised sport in Zimbabwe, especially as there are a great many participants who do not register. It is difficult to estimate the economic activity generated by this pursuit, but preliminary guestimates indicate that it is in the region of Z$10 million, or more, per year with a ripple effect through the economy (Child and Heath, in prep.). An evaluation of the expenditure, excluding that on capital items such as boats, motors and tackle, undertaken by the Lake Kariba Fisheries Research Institute during the annual International Tigerfishing Competition at Kariba, indicates that it costs participants over Z$90 per kilogram of fish caught during a competition.

With a growing human population and urbanisation, fishing for pleasure and as a source of protein is increasing. This calls for the intensification of management in existing water bodies and new dams, the development of aquaculture to suit local conditions and greater restraint by the public so as not to abuse this valuable renewable resource. It is also important that the value of the resource is taken fully into account in the planning and implementation of all rural development programmes involving modification of natural water systems. Cost effectiveness is achieved, for example, if the needs of a fishery can be provided for during dam or canal construction, rather than at some later date when it may be prohibitively expensive.

OUTDOOR RECREATION

The importance of angling as a form of outdoor recreation has already been touched upon and in many cases subsistence fishing, besides providing food, satisfies similar social benefits. Preliminary results of a survey of patterns and demands for outdoor recreation among Zimbabwean citizens of all classes confirms the importance of water bodies for this purpose (Child and Heath, in prep.). Water has an aesthetic attraction as well as providing a venue for a range of activities besides angling.

Outdoor recreation opportunities within Recreational Parks are integrated, with those in other elements of the Parks and Wild Life Estate, to provide a wide spectrum of public attractions to suit a range of tastes and pockets. Table 1 lists large water bodies that have been included within Recreational Parks, indicating their salient features. Other Recreational Parks, with the exception of Umfuli (12 700ha), are small and do not exceed 150ha (Figure 2). These include the Chinhoyi Caves, which are occasionally used by aqua-lung enthusiasts, and two thermal springs in the Binga District on the shores of Lake Kariba. While the water spouts up only 30 to 40 cm from the Chibwatata Hot Spring at Binga it is believed to be the only geyser in southern Africa.

The visitor potential of these and other undeveloped thermal springs in Zimbabwe is high, but would require development of visitor services, including accommodations, in most instances. The qualities of open spaces for passive outdoor recreation are well documented by urban planners, in particular, and in this regard open water ranks highly. Although such qualities are difficult to quantify they are nevertheless real and must be reconciled against the use of water bodies for more active pursuits. Clearly they depend heavily on aesthetics, including tranquility, and an absence of disruptive visual impacts. This also applies to many forms of more active outdoor recreation, such as hiking, game-viewing and yachting. The Park planner must weigh these interests against more intrusive activities like power boating which, although popular with participants, is an affront to other visitors seeking tranquility.

To date there have been few curbs placed on visitor activity on Lake Kariba, where zonation outside the Matusadona National Park is limited to restrictions applicable to commercial fishing, either in the interests of the resource or of anglers and other users of the Lake. This is also largely true of Kyle where certain bays are reserved for angling or research and where commercial fishing is prohibited. There is one area set aside against power boats. There are few restrictions on McIlwaine (Child and Thornton, 1981) except that no boating is permitted in a small bird sanctuary. Angling is also not permitted from this shore or along large portions of the

TABLE 1: Recreational Parks

Recreational Parks	Area (ha)	Area Water (ha)	Main features and Visitor activities
Bangala	2 700	1 133	Large dam with good recreational potential but so far undeveloped
Kyle	16 900	9 105	Attractive impoundment with adjacent game park; angling and other water orientated outdoor recreation; commercial fishing; high quality game-viewing, ungulate grazing research.
*Lake Cunningham	4 172	1 600	Undeveloped large impoundment for outdoor recreation for Bulawayo
*Lake Kariba	287 200	-	Lake and Islands. Angling, game-viewing, water sports, commercial fishing.
*Lake Matobos	2 900	58	Undeveloped large impoundment for outdoor recreation for Bulawayo Administratively part of Matobo Nat. Park complex. Historically Good game-viewing, hiking, etc.
*Lake Robertson	11 200	6 140	Undeveloped large impoundment for outdoor recreation for Harare.
Manjirenji	3 400	2 023	Large dam with good recreational potential but so far undeveloped.
Ngezi	5 800	580	Medium-sized dam; Great Dyke; reasonable game populations; quiet outdoor recreation based on widely spaced accommodation amenities.

(Continued ...)

TABLE 1 (Continued)

Recreational	Area (ha)	Area Water (ha)	Main Features and Visitors Activities
Robert McIlwaine	6 180	2 630	Large impoundment near Harare with adjacent game park; high intensity water orientated outdoor recreation; commercial fishing; fisheries and ornithological research station.
Sebakwe	290	2 310	Medium dam especially suited to yachting - wall to be raised; Great Dyke; some angling; commercial fishing.
Umfuli	13 933	-	Rough wilderness land on the shores of a proposed impoundment - will serve Midlands towns in particular.
TOTAL	354 851	28 035	

game park shore on the southern bank of the Lake. Lake Robertson is zoned into areas reserved for yachting, power boating and canoeing and certain bays have been reserved for angling and in these bays commercial fishing is prohibited.

Ngezi and Sebakwe are in close proximity to each other and are complementary. Ngezi is reserved for quiet pursuits such as game-viewing and angling. Although power boats are permitted, speeds are severely controlled. This does not apply to Sebakwe which is also a good yachting water. Commercial fishing is permitted on Sebakwe but not Ngezi.

With the exception of Lake Kariba and Ngezi, game animal populations are managed in the interests of the Parks' primary purpose which is recreation. To this end, such species as crocodile and hippo are controlled where they are in conflict with recreational pursuits. In the case of Ngezi it is policy to preserve these species as one of the attributes of the Park.

Cold water streams on public and private land in the eastern highlands support a significant trout industry based on quality angling and the production of table fish. Fish production and extension services are centred in the Nyanga National Park, where fly fishing is a popular tourist attraction. Research and management of the Mashonaland highveld is based at the Robert McIlwaine Recreational Park, while the south eastern lowveld and the rest of the Masvingo Province are served from laboratories in the Kyle Recreational Park. Matabeleland waters are catered for by a research unit stationed in Bulawayo and the Lake Kariba Fisheries Research Institute is responsible for effecting Government policy in the Zimbabwean waters of Lake Kariba.

Outside Recreational Parks, the Zambezi River, in the complex of protected areas below the Kariba dam wall, is a splendid attraction. This area comprises the Hurungwe, Sapi and Chewore Safari Areas and the Mana Pools National Park, all of which front onto the river (Figure 2). Mana Pools is a Natural World Heritage Site and a popular destination for visitors seeking a primitive but rewarding wilderness experience accessible by ordinary motor car. Power boating on the river is permitted within the Hurungwe, but not lower down on the Zambezi. Canoe Safaris have become especially popular between Kariba and Kanyemba. Two non-hunting Safari Camps are located on the banks of the Zambezi, one each on the up river and down river boundaries of the Mana Pools National Park. Angling is popular along this whole reach of the river where creel limits have had to be imposed on visitors. Cross-border fish poaching from Zambia is a problem that is difficult to control on this international waterway.

CONCLUSION

Despite the absence of natural lakes in Zimbabwe, water bodies, ranging from cold water trout streams to Lake Kariba, are very important outdoor recreational destinations for many Zimbabweans. They are also important as a basis for commercial fishing. Together these represent an industry worth some Z$46 million per annum, (1985 values) if the overall tourism to these areas is taken into account (Child, 1986).

Recreational Parks situated around large artificial impoundments are an integral component of the Parks and Wild Life Estate which offers a wide range of outdoor experiences. Their development is also integrated with the local regional plan for the area in which they are situated and they make an important contribution to the national fishing industry. Within each such Park it is policy to maximise human benefits without detracting unduly from the intrinsic atmosphere, on which the area depends to attract visitors.

Zimbabwe's natural and artificial water bodies are thus an important component of its food producing and tourist infrastructure. On large impoundments these so called secondary benefits represent a significant contribution to the national economy and to human welfare in remote parts of the country.

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