SAND AND WATER

CHAPTER
FIVE

OKAVANGO

The flow of a lifeline

Popa Falls

Much of what happens in Kavango is linked to the Okavango River, and the very fact that so many people live here is due to the presence of the river. However, any discussion on the importance of the river should take care to distinguish between the values of the river itself and that of the surrounding riverine valley and habitat. Statements are often made, for example, that the large numbers of people living along the river are dependent on the Okavango. This seems logical, but it clearly implies that people derive most of their resources from the river. However, it is certain that the immediate livelihoods of most people are almost entirely independent of the river (see Chapter 8). Even the presence and use of alluvial soils has nothing to do with the existing river, for instance. These soils were deposited hundreds of thousands or millions of years ago, and the river now contributes nothing to the quality of the soils in the valley.

This is not to deny the importance of the Okavango, but rather to emphasize that its true value should be recognized for the lifeline that it really is: a relatively pristine place in which plants, fish, birds and other wildlife can live in abundance; a source of limited quantities of water for irrigation and other purposes (see Chapter 6, page 58); and an attraction for tourists that can bring substantial economic gains to the Kavango Region and Namibia, amongst other values. And so the river should be put to appropriate uses – not abuses – that recognize these resources. Making good use of the river also requires an understanding of the Okavango's catchment, the nature of water flow, the quality of water and the fish that live in it. The pages that follow summarize information on these aspects.

THE CATCHMENT

The total area of the catchment in Angola is 148,860 square kilometres, of which 60,860 square kilometres belongs to the Cuito River (FIGURE 20). The Okavango is called the Cubango River in Angola, and the distance from its source on the Bié Plateau to the Cuito confluence is 930 kilometres.[1] Rocks on the Bié Plateau are granites and layered gneisses but the plateau makes up a small part of the Cubango's catchment area. Kalahari sands cover the remaining much greater area of its catchment, and the same sediments cover the entire Cuito catchment. It is these sediments that are most important in giving the river its clear and clean water (see below). There are few nutrients in the sands that can leach into the water and tiny particles are trapped as the water percolates through the sand.

The Cubango River rises as one of several main tributaries that run parallel with each other from north to south. From west to east the main tributaries are the Cubango, Cutato, Cuchi, Cucuchi, Cuelei, Cuebe, Cueio and Cuatir Rivers.

The Cuito River is 730 kilometres in length[2] from its source to the confluence, and this is the Okavango's only significant tributary. Indeed, for seven months of the year the Cuito contributes more water than the Okavango (see below). Five main tributaries feed the Cuito, from west to east: the Luassinga, Longa, Quiriri, Cuito and Cuanavale Rivers.

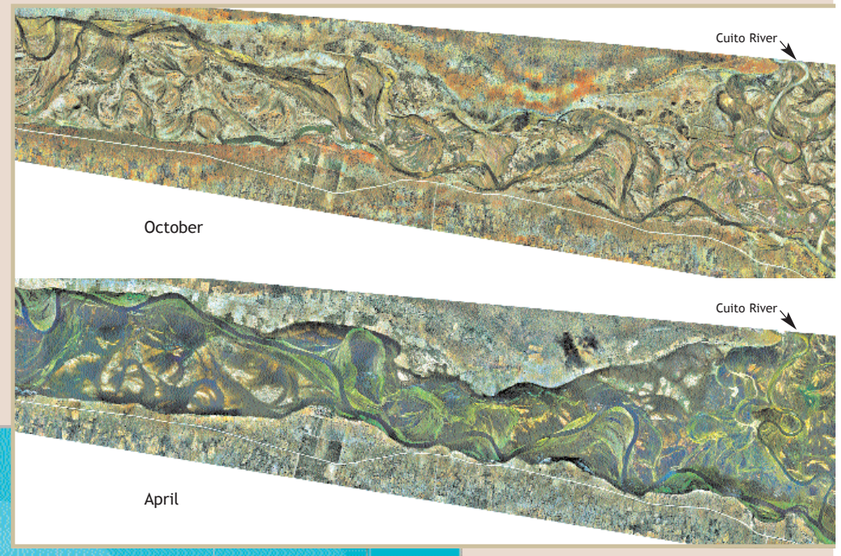
Several dry rivers are shown in FIGURE 20. By far the longest of these is the Omatako Omuramba covering a substantial potential drainage area of about 55,700 km². It has never been seen to flow into the Okavango, but it was a significant tributary in much wetter periods long ago (see page 29). The length of the Omatako is 635 kilometres from its source near the Omatako hills to its confluence at Ndonga. A number of other river courses (for example, Ekuli, Mpuku, Ndonga, and Rukange) also meet the Okavango but they, too, are always dry.

Higher areas in Angola where the Cubango and Cuito have their sources have average annual rainfalls of over 900 millimetres per year (FIGURE 20). From those wetter areas, the river progressively flows through drier and drier areas until it reaches the Okavango Delta in Botswana, where the average annual rainfall is less than 450 millimetres. Rainfall across the whole catchment thus decreases from north to south and from west to east. Throughout the catchment there are distinct wet and dry seasons, with almost all rain falling between October and April (see FIGURE 13, page 41).

In the upper reaches of the Cubango the river drops rather steeply, at least in comparison to the extremely shallow gradient along the rest of its course to its confluence with the Cuito and, indeed, all the way to Maun (FIGURE 21). The Cuito also has a very shallow gradient throughout much of its catchment area, partly reflecting the fact that much of the area is swampy.

The river valley in the Namibian section varies between two and six kilometres in width. For much of its length, it is relatively narrow and confined by higher ground (FIGURE 22). Most areas of floodplains are small compared with the extensive floodplains along certain stretches: between Tondoro and Bunya, between Mupini and Shambyu, around the Cuito confluence where very large areas are flooded on the

Some of the largest floodplains are around and to the west of the confluence of the Cuito River, shown here as it meanders south on the right hand side of these two aerial photographs. The two photographs were taken in October 1998 when the floodplains were dry because the rivers were very low and in April 1999 when large volumes of water covered the floodplains. The old main gravel road runs along the southern banks of the river and passes Nyangana Mission (the area of large square fields in the centre of the photographs), while the sports field and buildings of Linus Shashipapo Secondary School are clearly visible just below the actual confluence of the Cuito.



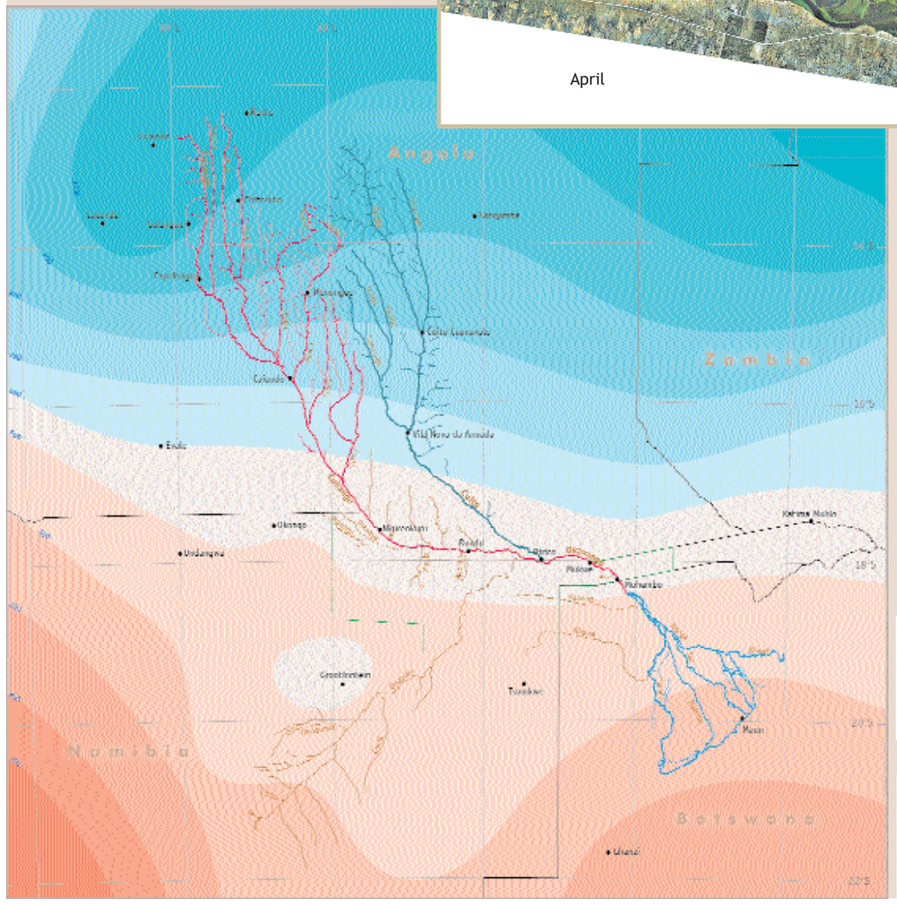


FIGURE 20
The Okavango Basin stretches across Angola, Namibia and Botswana, as shown by the positions of the various rivers that make up the Basin. The map also shows average annual rainfall across the area.

Angolan side (see photographs on page 49), and then from Bagani south to the Botswana border. Some of the floodplain in Mahangu Game Reserve is flooded permanently and is similar to the extensive areas of marshes downstream in the Okavango Delta.

THE FLOW OF WATER[3]

Water leaving Kavango and entering the Okavango Delta is provided both by the Okavango and Cuito Rivers. The actual contributions made by the two rivers can be measured by comparing the flow of the Okavango at Rundu (before they join) with that at Mukwe (below the Cuito confluence). These are the two places where water flow is gauged, and subtracting the Mukwe runoff from that measured at Rundu gives a measure of input from the Cuito. The figures show that the Cuito contributes about 45% and the Okavango 55% of the total water flow per year. However, the volumes contributed by the two rivers vary greatly during the year (FIGURE 23). The Okavango's peak flow measured at Rundu is usually in April, while that of the Cuito is normally in April or May. The peak flows later reach the lower reaches of the Okavango Delta in Botswana about three or four months after passing Rundu.

The highest flows at Rundu are much higher (the average in April is 405 cubic metres/second (m^3/s)) than peaks for the Cuito (average of only 175 m^3/s in April), and so the Okavango brings in much more water during floods. The Okavango also has a much more variable flow than the Cuito: the highest rate of flow ever recorded for the Okavango (962 m^3/s) is about 90 times greater than the lowest rate ever recorded (11.1 m^3/s). The same figures for the Cuito only vary by a factor of less than 10: from a highest of between 550 and 600 m^3/s to the lowest of 64 m^3/s. The higher discharge rates of the Okavango mean that it carries more water than the Cuito between January and May, but it

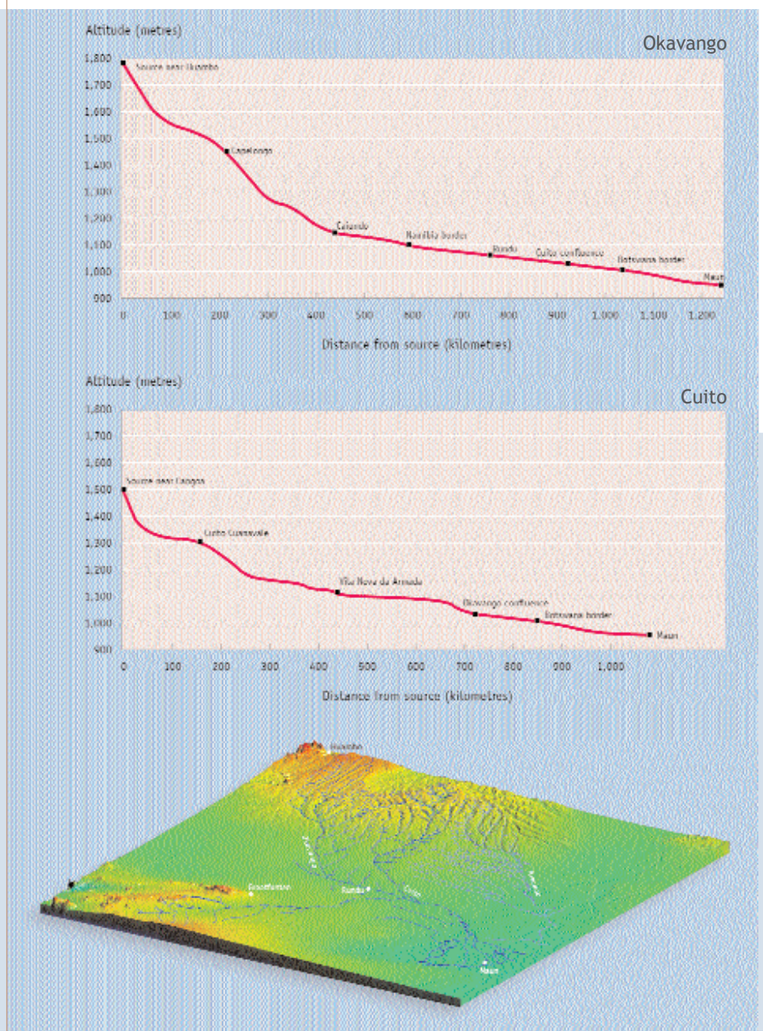


FIGURE 21-
The Okavango (left above), and Cuito (left below), have extremely shallow gradients along much of their courses. The steepest flows are in the upper catchment of the Cubango after it leaves the Bié Plateau. The graph shows the altitude of the rivers at different places, while the three-dimensional model gives a pictorial view looking from the south-east over the Delta and then towards the Bié highlands in the far north-west.
Part of the drainage of the Kwando River in the east is also shown.

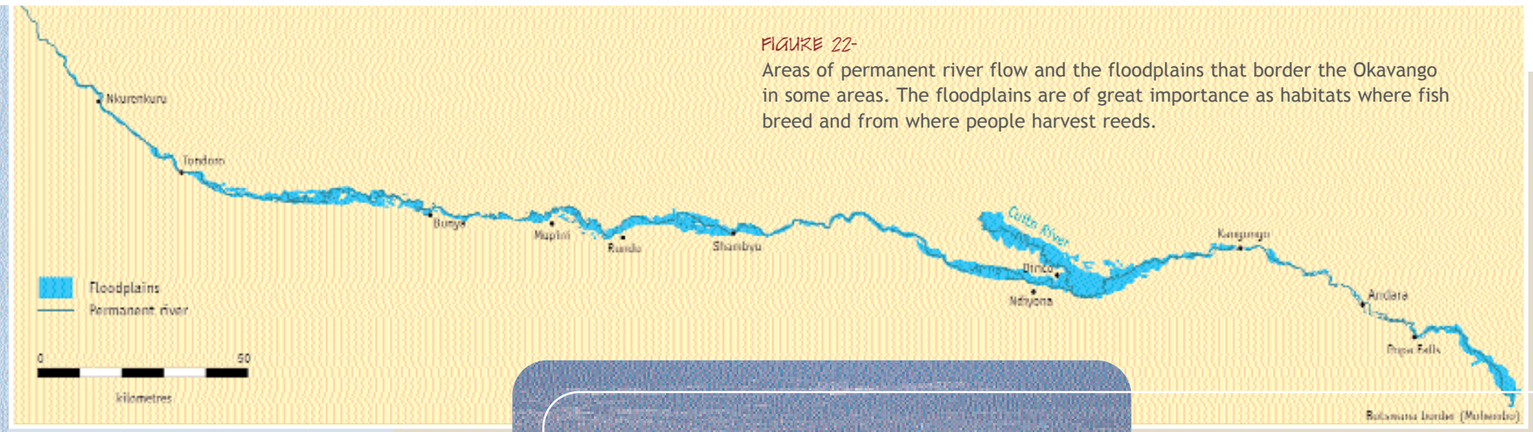
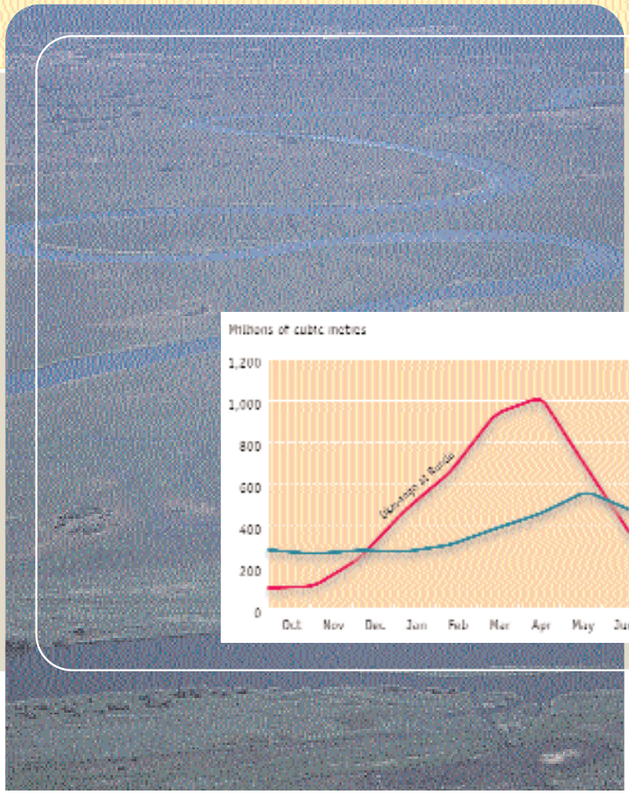


FIGURE 22-
Areas of permanent river flow and the floodplains that border the Okavango in some areas. The floodplains are of great importance as habitats where fish breed and from where people harvest reeds.



The broad meanders of the Cuito River just before its junction with the Okavango River at the bottom of the photograph.

FIGURE 23-
The volume of water carried each month by the Okavango is greater than that of the Cuito between January and May, but the Cuito provides more water during the rest of the year.

then drops so much that the Cuito contributes more water for the remaining seven months of the year (FIGURE 23).

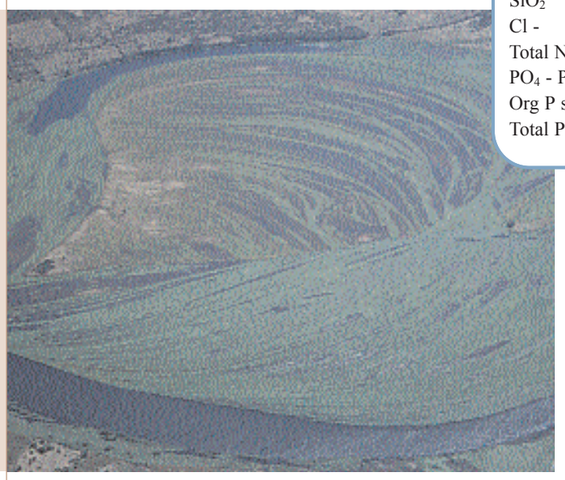
The following table provides measures of annual runoffs above the Cuito's confluence (at Rundu) and below the Cuito at Mukwe. The differences between maximum and minimum volumes are substantial: about four times at Rundu and about three times at Mukwe.

Total average, minimum and maximum annual runoffs at Rundu and Mukwe in million cubic metres (Mm^3).

Place and years of data	Average	Minimum (year)	Maximum (year)
Rundu (1945-2001)	5,207	2,260 (1971/72)	9,810 (1962/63)
Mukwe (1948-1998)	9,594	5,607 (1995/96)	15,354 (1967/68)

It is also clear that river flows differ widely between high and low years, as shown by the year-to-year changes in FIGURE 24. There are thus many years when the flow is high and many other years with little runoff. This graph also reflects some longer-term changes, especially the lower flows during the 1980s and 1990s, much of which are attributable to lower rainfall in those two decades.

Annual variations in runoff in the months of October and April are compared in FIGURE 25. The April flows fluctuate greatly from year to year, reflecting great year-to-year differences in rainfall and runoff. By contrast, there is relatively little variation from year to year in October volumes, showing that the river subsides each year to a fairly stable rate of discharge. The only significant change is the lower flows in recent years.



THE QUALITY OF THE WATER

Information on the quality of water in the Cubango and Cuito in Angola is not available, but the Okavango's water is generally clean and clear along its entire course. There are few nutrients or sediments, and its turbidity (or muddiness) is low. The chemical composition of river water measured during a survey in 1994 is given in the following table.

Chemical features of Okavango River water in Namibia.[4]

	Unit of Measurement	Mainstream Sites	Backwater Sites
Conductivity	Siemens/cm	30-45	45-205
PH		6.8-7.2	6.7-7.5
Total dissolved solids	mg/l	25-42	30-172
Alkalinity	as $CaCO_3$ m/l	10-20	20-95
Na ++	mg/l	1-3	3-10
K +	mg/l	1-2	1-3
Ca ++	mg/l	6-16	7-46
Mg ++	mg/l	3-8	6-22
SiO_2	mg/l	8-15	9-36
Cl -	mg/l	0.5-1.0	1.0-5.6
Total N	mg/l	0.1-1.5	0.1-6.2
PO_4 - P	mg/l	0.01-0.07	0.02-0.15
Org P sol	mg/l	0.01-0.10	0.02-0.32
Total P	mg/l	0.01-0.15	0.04-0.37

The table shows that the concentrations of chemicals are generally higher in the river's backwaters than in the main stream. It is likely that concentrations of phosphates have increased in recent years, especially close to Rundu as a result of effluent from the town.[5] Such chemicals from sewage and fertilizers could have severe effects on aquatic life in the river, and there is concern that increasing chemical concentrations may rise as the number of people and farming activities along the river increase.

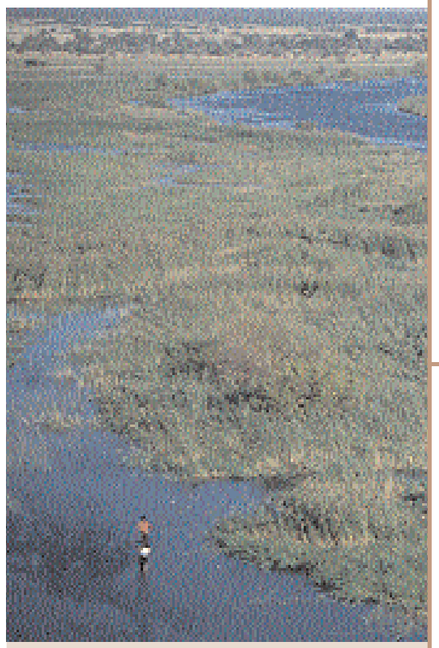


FIGURE 24-
Total volumes of water passing Rundu and Mukwe vary greatly from year to year. The columns show the actual values while the red lines are moving averages over five years.

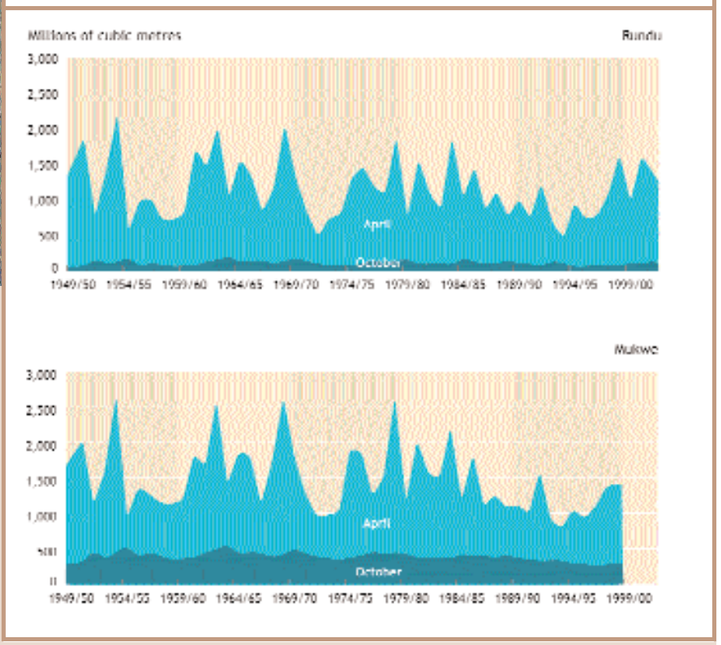


FIGURE 25-
Compared to April, the volume of water carried in October is much lower but also much more stable than in April when flows fluctuate widely from year to year. The river also carries much more water at Mukwe during October than at Rundu because of the greater input of water from the Cuito during the drier months.

FISH AND FISHING

An abundance of fish was one of the resources that attracted people to live along the Okavango River long ago, and today fish remain a significant feature in the lives of many people. Fish also form an important part of the river's natural ecology. A total of 76 species have been recorded in the stretch of river in Namibia, and this relatively high diversity is due to the fact that the fish community is divided along two dimensions. Firstly, species are separated in terms of their different kinds of food into so-called detritivores that eat tiny particles of food that float in the water, herbivores that feed on plant material, and predatory carnivores that eat other fish. A second, and more important level divides species into the different habitats they prefer and to which they are adapted. Thus, different species occupy the river's five main habitats: the mainstream, rocky areas and rapids, backwaters, permanent swamps, and the floodplains.[6]

The different species also vary in abundance. Fish that are caught most frequently are the red-breasted tilapia, barbs, catfish, tigerfish and squeakers. By contrast, the ocellated spiny eel and the broad-head catfish are extremely rare and are regarded as species requiring special conservation attention.

While separate areas in the river provide different fish species with their preferred habitats, the floodplains are of greatest value as places in which most fish breed. The floodplains start to become inundated in the later summer months once the rising waters push out over flat surrounding ground. Very large areas become floodplains in the best years when the river's level rises up to 4.5 metres above its lowest levels (see photographs on page 49). The most important feature of the flooded areas is that they are very rich in nutrients. Whole communities of plants and animals flourish as a result of the abundant nutrients, all of which provides young fish with a rich supply of food. The floodplains also provide the young fish with a refuge where they are comparatively safe from larger, predatory fish. The best survival of young fish and overall increase in fish populations occurs in years when water levels are highest and the flooding lasts longest. Indeed, the annual flooding is the main driving force for the breeding of fish. The greatest danger to the fish resource occurs when patterns of flooding are changed and every effort should be made to protect the limited floodplain areas (FIGURE 22).

Aquatic plants start to die off as the floodwaters recede during autumn and winter. Nutrients from the decaying plants are then returned to the soil, and young fish leave the floodplains to live the remainder of their lives in the main stream or in permanent backwaters of the river. However, large numbers of fish are sometimes trapped when the water drops, and great numbers of birds, people and other predators then enjoy a feast of helpless fish.

Many people catch fish on a regular basis, either as a source of food for their homes or as a commodity to sell. Three surveys have estimated that between 32 and 47% of households along the river have family members catching fish.[7] The surveys were done between 1987 and 1994, and in today's figures of something like 20,000 rural homes along the river, these percentages would translate into roughly 6,000–9,000 households. However, this does not mean that people from all these homes fish every day. The proportions of fishing households may also have declined since these surveys because of the recent drop in fish numbers (see below). Fish are also traded. In one study, about 42% of rural households along the river reported that they sold fish and 29% stated that they bought fish rather than catching them themselves.[8]

The peak period for fishing is between September and December, when the river is at its lowest, the fishing grounds are most accessible and the fish are most concentrated. This is also the period of the year when mahangu from the previous season's harvest may be in short supply and fish can then form an important supplement to the diet of the poorest people. Compared to other incomes, however, fish contribute little to the overall cash or material, in-kind incomes of the majority of rural homes (see page 107). Two of the surveys mentioned above estimated the total weight of fish caught per year as 840 and 1,045 metric tons, respectively. Taking these figures and the number of households that catch fish into account, each person along the river consumes an average of only 10-20 kilograms of fish per year.[9]

The kinds of traps or gear used to catch fish are usually divided into traditional and modern methods. The most widely used traditional gear are fish funnels and kraal or corral traps, while other methods include using fish fences with valved traps and corrals, scoop baskets, push baskets, bows and arrows, set fish hooks, and spears. Modern gear consists of gill and seine nets, line and hooks, wire mesh fykes and mosquito nets.

The use of mosquito nets is often seen as problematical because fish eggs and the tiniest young fish are caught in the fine mesh. Indeed, the use of nets and overall pressure placed on fish populations by the growing number of people fishing in the river is widely believed to have caused a major decline in the fish resource. There are, however, several aspects to this issue. The first is that it is both the numbers of fish and especially their sizes that have decreased, and so the overall weight of fish caught has been reduced a great deal. A second feature is that the populations of some species have remained fairly stable, while others may have declined. The third aspect is that the succession of years with relatively low flows of water has probably also contributed to a reduction of fish. With smaller floods and the floodplains remaining inundated for shorter periods, fewer fish would have produced eggs and the survival rates of young fish would have been reduced. However, more research is needed to understand the nature and severity of human fishing pressures and patterns of flooding on fish populations in the Okavango.

Key notes

- Assessments of the importance of the Okavango River need to distinguish between the value of the river itself and that of the surrounding riverine valley and habitat.
- The river's clean and clear water is mainly due to the fact that most of the water filters through and out of Kalahari sands over much of the catchment area.
- Rainfall across the whole catchment decreases from north to south and from west to east, and the river increasingly becomes a linear oasis the further downstream it flows.
- The Cuito contributes about 45% and the Okavango 55% of the total water flow per year, but the contributions vary: more water comes from the Okavango between January and May and the Cuito then contributes a greater flow from June to December.
- Flows in the Okavango are very much more variable from year to year and month to month than in the Cuito.
- The volume of water leaving Kavango in the year of highest recorded flow (15,354 million cubic metres in 1967/68) was almost three times greater than that in the lowest year (5,607 million cubic metres in 1995/96).
- There are extensive floodplains along certain stretches: between Tondoro and Bunya, between Mupini and Shambyu, and around the Cuito confluence. Most fish breed in the floodplains and changes to flooding patterns pose a great danger to the fish resource.
- The use of nets and overall pressure placed on fish populations by the growing number of people fishing in the river are believed to have caused a major decline in the fish resource.