

## EXECUTIVE SUMMARY

### The fishery

This report describes the Usangu Wetland fishery and indicates its importance in social and economic terms. It is estimated that the fishery produces an average of some 700 tonnes of fish a year, with annual ranges from about 400 to 1200 tonnes a year, depending upon rainfall patterns. Off this total catch, some 100 tonnes a year is thought to be taken for subsistence by people local to the wetlands. By far the greater part of the commercial catch is the catfish *Clarias gariepinus* or "kambale" with tilapia *Oreochromis urolepis* or "ngege" making up a very small proportion. Some other species (Mormyrids or "somo" and Schilbiid and Synodontid catfish) make a minor contribution of small-sized fish to the commercial catch and are also taken in the subsistence fishery

### Establishment of a game reserve

The establishment of the Game Reserve on the Usangu Wetlands effectively means that nearly all the dry season, and a major part of the wet season fishing activity is now completely illegal. It is essential that the Game Reserve is managed in such a way that the fishery, with its very low environmental impact is allowed to continue. Appendix 5 of the Report considers this problem in detail.

### Natural production and sustainability

The fishery exploits the production from a typical seasonally flooded wetland. The catfish, which are well adapted to the ambient conditions, enter onto the areas of inundation where they breed and large numbers of young fish are able to take advantage of the highly productive conditions of this habitat. As the flooded areas dry up the fish die. A few fish escape from the drying areas to reach the areas of permanent water. Here they contribute to the maintenance of the population of the breeding stock. This cycle continues from year to year. The numbers of young produced will vary with the intensity and duration of flooding. The numbers of adult breeding stock will remain roughly constant. It follows that if the major part of the young of the year are destroyed naturally at the end of the flood season these fish may be removed and "used" by the fishery without any restriction. This almost complete offtake of the production will have no effect on future populations of young - as long as the stocks of adult breeding fish are maintained in the permanent waters.

### Employment

The fishery employs an estimated 300 fishermen full-time, with probably an equal number of part-time opportunistic fishermen who fish the flooded areas for a few months of the year. There is a small number of individuals engaged in the "downstream" activities of processing, transporting and trading.

### Fishing methods

Fishing is predominantly carried out by nets (seine and gill) and hooks and lines. As the waters dry up fish are increasingly taken by barrier traps, and directly from the shallow waters. All access to the deeper waters is by dugout canoe.

### Processing

Processing is almost entirely by hot smoking and the product is a well-smoked, part-cooked fish reduced in weight by about half. It keeps well, travels well and commands a good price in the market. There is some air drying of poor quality fish.

### Transport

Access to the fishery is relatively difficult. The fishing and processing is carried out mainly in temporary camps which change their location to follow the pattern of inundation and drying out. A major part of the catch is processed at the remote fishing camps and transported by canoe to locations which are accessible by vehicle. The well-packed fish is then transported further afield along the Ikoga to Rujewa road and on to the main Iringa-Mbeya road. A significant quantity is transported in small quantities on bicycles, from the small fishing camps which are constructed when the flatlands are flooded. It appears that nearly all the fish are taken via the eastern route to the markets.

### Trading

Trading is carried out by individuals, increasingly associated with the co-operatives which have been formed in the last year or two. A lot of the catch goes to areas away from the Usangu area such as the Njombe Plateau and Mbeya. This latter route may continue as an export trade with Malawi and Zambia. The fish from the Usangu Wetlands are in commercial competition with fish from the much larger fisheries of Lakes Mtera and Rukwa.

### Incomes and revenues

There is an approximately 100% increase in price from the sale by fisher to the asking price in the retail market. This is a satisfactory mark-up and appears to give the trader/retailer a profit margin of some 30-40% on the transaction. With a yield estimate of 700 tonnes a year this will value the income to the fishermen at some 350 million shillings and a retail value of 700 million shillings a year. Revenue accruing to the local administration from the issue of licences and an impost on goods carried is apparently under-valued and inefficiently collected. This is currently assessed at less than 2 million shillings.

### Social issues

In the dry season most of the fishermen appear to be full-time, from the Makete District and the larger fishing camps have more permanence and social structure although there is little evidence of the ability of the fishing communities to make effective representation to local administrations. The part-time fishermen have little social cohesion, and they comment on lack of trading trust

and inability to organised the trading flow to and from their camps. There is a little complaint about the activities of the herders in making cattle causeways and driving cattle through nets, but these complaints do not appear to reflect grave practical problems, rather an expression of inter-ethnic bias.

### **Resource use and environmental issues**

The exploitation of the fish stocks and the support of the commercial fishery has a negligible impact on the environment. The natural sustainability of flood plain fish stocks allows maximum removal with no significant effect on future stocks. The simple and impermanent nature of the fishing camps makes virtually no demand on natural resources. Access to and from these areas creates virtually no impact due to the very low volume of vehicular traffic and small impact of bicycle passage. The only significant environmental impact that can be identified is that of the need to use wood for the processing of the fish. The annual demand has been assessed as an average requirement of some 4,000 cubic meters. Subjectively this does not appear to have an important implication for the sustainability of the natural wood production. Another, minor, use of wood is for larger trees to manufacture dugout canoes. There is no evidence of a shortage of these trees as there has been no increase in the difficulty of provision or price of these essential items. No other significant impacts can be identified or foreseen.

### **Fish bio-diversity**

Although only minor investigations have been undertaken, it appears that the number of species of importance to human exploitation are restricted half-a-dozen and the total number of species are not expected to rise significantly when the small-size fish groups (*e.g.* barbids and cyprinodonts) are intensively sampled. It is expected that additional sampling will demonstrate that this is an impoverished fauna with strong Zaire-basin affiliations. The low species-diversity is a reflection of the stressful environmental conditions of the wetlands and the faunal response of few species and high populations of those that are the better adapted to the ambient conditions.

### **Conclusions and recommendations**

These have been set out in detail in Sections 8 and 9 of the Report. The general tenor of the comments are to the effect that the Usangu Wetland fishery is a small but important component of the overall exploitation of the wetland. The exploitation is stable and sustainable and requires very little regulation. There is no identifiable courses of improvement at any part of the chain from producer to consumer that can be undertaken in an economic manner. There are no apparent constraints to the continuance of this exploitation that need to be considered. The question of the effect of the initiation of the Game Reserve has to be addressed urgently. If this question of access to the Game Reserve is resolved, then the Local Administration is in the position to control the activities and establish a significant revenue base.

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## 1. INTRODUCTION

### 1.1 General

This report paper covers the work carried out by Dr. Ian Dunn, Fisheries Specialist, during the two components of the Fisheries Survey and Evaluation input undertaken between 14 April and 26 May and 4 October and 15 November 1999. These two separate periods of investigation allowed an assessment of the conditions of the fishery in both the wet and the dry seasons. The Consultant's itinerary and work programme are summarised in Appendix 1. The work incorporates currently available information from other elements of the SMUWC project programme.

### 1.2 Acknowledgements

I would like to thank Messrs. Rojas Mwaluko (District Natural Resources Officer), Kadam Kassenga (District Fisheries Officer) and Cuthbert Niyrenda (Assistant District Fisheries Officer) for the great help that they have provided in carrying out the field work, and providing access to the administrative data available in their offices. Mr. Godfrey Sangar and his colleagues were also instrumental in providing information from the files held at the Regional Offices, Mbeya.

Thanks are also due to the numerous individuals at all levels in the fishery who have patiently answered questions and volunteered information throughout this survey. A, necessarily incomplete, list of contacts is provided in Appendix 2.

### 1.3 Terms of reference

These may be summarised as:

*... within the context of the overall work programme of the Project "Sustainable Management of the Usangu Wetland and its Catchment (SMUWC)" to provide an evaluation of the part played by the fisheries in the economic and environmental use of the available resources, and to provide recommendations for the future management of the resource and its exploitation.*

### 1.4 Approach to the survey

There are four major objectives of the fishery survey of the Usangu catchment. Each of these objectives to be considered from the standpoint of the impact of any future programme of management and regulatory measures that may be proposed.

- To evaluate the current systems of exploitation of the fish resources and to assess their long-term sustainability.
- To assess the importance of the fish resources in their impact on the food, economics and work opportunities for the local populations and, where applicable, further afield.
- To assess any environmental impacts arising out of the fishing and associated activities.

- To assess the fish resources in terms of their bio-diversity and ecological importance.

This work has drawn on a number of sources of information, including direct observations in the field, administrative and commercial records, and co-operation with other work currently being carried out within the SMUWC Project remit (hydrology, social and community work etc.).

It is apparent that the fish resources of the Usangu wetlands support a fishery that is highly heterogeneous in the status and origin of the participants, the seasonality of the fishing activities and the geographical centres of activity. The general pattern is that of a commercial fishery exploiting the inundated areas and the permanent swamp and water channels. This fishery is carried out by a mix of part-time and full-time fishermen working from temporary fishing camps and who export their catches mostly via the eastern shore line. This is supplemented by an extensive small-scale, mostly subsistence, fishery of the western areas and the areas to the north east around the exit of the Ruaha river from wetland basin.

This survey has necessarily concentrated on the commercial exploitation which accounts for the major part of the catch, where the areas of activity are more readily accessed and for which secondary sources of information are available.

Before any management measures can be suggested or implemented, it is essential that all facets of the exploitation of the fish resources are understood, as far as this is possible within the practical constraints imposed. This will involve and assessment of the theoretical available stocks of fish; the means and extent of their exploitation; and the seasonality and year-on-year changes. It is important that the social and economic implications are also taken into account. As in all human resource uses and habitat exploitation there are possible environmental impacts which have to be assessed. Each of these facets of the overall survey will be considered in the separate sections which follow.

The investigation of the Usangu fishery relies on numerical information which mostly the result of the evaluation of subjective impressions, by both investigators and informants. Throughout this report, assessed quantities and values have been presented as "rounded values" in order to avoid any impression of spurious accuracy

## **1.5 Project area**

The overall area of the SMUWC Project is the catchment of the upper drainage of the Ruaha river to the point where this exits from the Usangu Plains via the sill at the north-east corner. The only significant fisheries resources are those associated with the wetlands of the Usangu Plain.

The Fisheries Investigation has had to take into account the resources of the areas of the seasonally inundated woodland, the mbuga wetland (totalling 360km<sup>2</sup> at maximum extension); the two areas of permanent swamp (Ihefu and Ndembera , totalling some 100km<sup>2</sup>). To the west of the central area of the plain is a further 400km<sup>2</sup> of intermittently and lightly flooded land with a few small open pools. Across the area a number of river channels drain into the Ruaha which loses itself in the permanent swamp to emerge once more before it empties over the sill at Ngiriana. A map of the project area is presented in Figure 1.

## **1.6 Itinerary and fieldwork programme**

The consultant arrived in Dar es Salaam on 15 April and the first period of fieldwork was carried out between 16 April and 23 May. This period coincided with the beginning of the dry season when the water levels were at their peak and just starting to fall. A second period of field work was undertaken between 4 October and 14 of November, a period which coincided with the maximum dry season condition of the Usangu wetlands before the onset of the rains. A full summary itinerary and work programme is provided in Appendix 1.

The program of field work has consisted of visits, group meetings and interviews in villages and fishing camps, fish landing sites, traders and co-operatives in markets in towns and villages around the project area. Valuable sources of information included data from administrative records at the Rujewa District Fisheries Office and interviews and data provided from the Mbeya Regional Offices. A survey of fishery activity was made during two overflights of the area. Two statistical canoe counts were made as a part of the aerial livestock and game survey.

It is intended that the scientific aspects of bio-diversity investigations should be carried out by a specialist field team, in order that the full spectrum of aquatic habitats is adequately sampled. This field work will be carried out when access to the area is close to optimum. This should be the case at a water level halfway between the high and low extremes.

### **1.7 Layout of the report**

The first sections of the report consider the practicalities of carrying out the survey (Sections 1 and 2) and the description of the fishery and its exploitation of the available resources (Sections 3 and 4). The economic, environmental and social effects of the fishery are considered in Sections 5, 6 and 7. Conclusions and recommendations are presented in the final Sections 8 and 9. Appendices, Tables and Figures are provided separately at the end of the text of the main report.

## 2. INFORMATION SOURCES

### 2.1 General comments

The fishery of the Usangu Wetlands and Permanent Swamps is a highly dispersed, low input, artisanal<sup>1</sup> commercial and subsistence<sup>2</sup> fishery exploiting the natural production of a wetland area in the region of 800km<sup>2</sup>. The population and markets which take the yield from the fishery are scattered around the periphery of the plains. Apart from a main Iringa to Mbeya road, which crosses the southern margin of the project area from east to west, there are no easy lines of communication for the transport of fish from the sources to the markets and the consumers.

The nature of the wetland means that the fish, although plentiful in season, can only be fished by small units using very simple gears. Access to the stocks is difficult because of the nature of the swamp and its cover of vegetation. Once caught and processed the catches have to be transported considerable distances to locations where they can be passed on to traders.

This dispersed nature of the catching, processing, transportation and marketing with numerous individuals engaged, both full-time and part-time, makes the gathering of information very difficult, costly and time consuming. It is not surprising that there is no formal collection of fishery statistics for this fishery. To carry out any reliable fisheries data collection exercise and repeat it year after year would require an expenditure well above that which the size of the fishery dictates.

This lack of formal data can be compensated for by gathering and evaluating information from many, sometimes seemingly totally peripheral, sources. The comparison of the information gained with what is known from similar fisheries elsewhere and the clues these sources provide, enables a picture to be built of the size, periodicity, social significance and economic importance of the overall fishery.

### 2.2 Sources of information

#### 2.2.1 Direct observation

This chiefly involved visits to fishing villages, fishing camps and the waterside fish landing sites. At these locations, conversations with the fishermen, processors and traders (these latter also stopped and interviewed on the roads and tracks) have provided a spectrum of information. By posing the same questions to many individuals and posing the questions in various ways, a relatively faithful picture of the activities emerges.

#### 2.2.2 Visits to Cooperative Societies and retail markets

Visits to seven Co-operative Societies (Chimala, Igurusu, Mbalizi, Mbeya, Njombe, Rujewa and Ubaraku) yielded useful information on the activities of both the fishers and traders and the economics of the trade these Societies carry out. Discussions with market traders provided information on the consumer preferences and the prices paid for fish and fish products. The

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<sup>1</sup> "Artisanal" is here used as the industrial sector equivalent to the term "peasant" in the agricultural sector. Although an artisanal activity requires a significant investment in plant and equipment on the part of the operator, the scale of this investment is such that the capital is raised from the resources of the operators, their immediate families or community.

<sup>2</sup> "Subsistence" activities are those activities carried out for the use and consumption of the operator or the immediate family. Subsistence activities will usually be outside the cash economy

larger markets (*e.g.* Makambako and Mbeya) also allowed an assessment of the importance of the trade in fish from other areas (*e.g.* Lakes Rukwa and Mtera).

### 2.2.3 Aerial census of canoes

Low altitude flights over a large part of the project area was undertaken on 4 May and 14 October 1999. These dates corresponded approximately with the maximum and minimum flood extension. A count of the canoes seen on the landings and on the open water areas of the swamp and the Ruaha river located 115 canoes in May and 284 canoes in October, when a large number of canoes seemed to be “parked” and not in use<sup>3</sup>. A detailed aerial canoe census was undertaken as an integral part of the game and stock counts carried out between 5 and 11 May 1999. This census gave a total of 376 canoes (SE ± 143, n = 11).

As most fishing is carried out by a single individual in a canoe, although some canoes may be larger and used for transport, it can be assumed that a single canoe represents a unit of fishing effort<sup>4</sup>. Canoes both on the water, transporting or fishing, and moored or drawn up on the landings were counted. It appears that the number of canoes that are derelict is very small.

### 2.2.4 Administrative records

The records available from District and Regional sources are no more than rough records of the passage of fish through the area. These observations are associated with the collection of a fee or cess on the quantities carried. These data cannot therefore be regarded as “fisheries statistics”. However, with judicious assessment, and checking of the primary sources where possible, the information recorded about the revenue raised by the granting of licences to fishermen, for the right of individuals or organisations to trade, the revenue raised on packages of fish transported and the numbers of canoes licensed all provide secondary sources of information and historic data runs.

It should be noted that where these records refer to revenue that will be accounted for, they will always be minimum estimates of the activity being recorded.

The information obtained from the Mbeya Regional offices and the Rujewa office of the District Fisheries Officers have proved very useful and these data are discussed in detail in Section 4 below.

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<sup>3</sup> This supposition was confirmed later by comments from fishermen at the landings.

<sup>4</sup> As any individual fishermen may be part-time or fish only part of the available season, the sharing of canoes is common. It is here assumed that a canoe will not be left idle for significantly long periods.

### 3. FISHERIES RESOURCES

#### 3.1 General comments

The fish resources that are available for exploitation are of a type, quantity, seasonality and sustainability that directly reflect their immediate environment. Five distinct ecological systems contribute to the exploitable fisheries resources of the Usangu, although their areas will change in response to climate, particularly rainfall intensity and duration, and water resource use. Each of these ecological systems plays a well-defined role in the production process and as a result each will have a distinct fish population contributing to the yield. These areas are:

- Seasonally inundated terrestrial communities
- Seasonally inundated wetlands
- Residual waters
- Permanent swamp
- Main rivers and river channels

##### 3.1.1 Seasonally inundated terrestrial communities

These are areas of thorn scrub which, by rainfall and overspill, are flooded to a shallow depth for a short period. The length of inundation and the degree of saturation of the ground is insufficient to significantly change the nature of the vegetation complex from a dry land ecosystem. Within this area there are a number of very small swamps and open pools.

These areas are short period breeding and nursery areas for the fish, predominantly the catfish *Clarias gariepinus* ("kambale"), and will contribute significantly to the overall production of young fish in the wetland area as these retreat to the temporary and permanent watercourses as the water levels fall. These areas are found in the western side of the wetland and again to on the north and south margins.

##### 3.1.2 Seasonally inundated wetlands

These are areas of mainly grassland (mbuga) which with the rise in the rivers and the precipitation of the rainy season, flood to a shallow depth for a period of from 3 to 6 months. Their waterlogged nature precludes the establishment of tree species and they give the impression of an immense grassy plain. The main area is contiguous across the centre of the catchment with some smaller areas scattered towards the edges. The maximum area of these wetlands builds up to some 380km<sup>2</sup> in April (at the end of the rains) These seasonal inundated areas dry out steadily to reach their minimum extent by November - December of each year.

The vegetation and the chronology of the flooding (area and depth) are still to be defined. At the onset of the floods the fish enter the inundated area to breed. The adults and young of the year retreat back to the permanent swamp and river channels as the floods recede.

These seasonally inundated wetlands are extremely important in defining the levels of production of the fish populations. The area flooded constitutes a rich feeding area with nutrients derived from organic materials and recycled minerals in solution from the cracked and disturbed substrates, dry vegetation debris and animal excreta from the herds of cattle and other livestock that have been pastured over the area in the dry period. This enhanced nutrient status and conditions of shallow warm water and high insolation leads to an explosion of primary productivity and associated secondary production. The resulting algal and invertebrate

populations provide a rich food resources for developing small fish. Once past the nursery stage these fish can feed directly on the abundant detritus and predate on each other.

Where rainfalls are heavy and the floods of long duration their effects are seen in the increased catches for that year (*c.f.* the year 1998 in Figure 4.2).

### **3.1.3 The residual waters**

The residual water bodies are those areas of depressions or drainage channels that are cut off and isolated as the waters fall. For a short period these warm, highly isolated, shallow waters result in high growth rates of the fish that are trapped in them. They also are very easily fished as the water levels drop and all fish can be removed.

### **3.1.4 The permanent swamp**

The permanent swamp is concentrated in the Ihefu, the central drainage of the major wetland area with an area of some 80km<sup>2</sup>. To the east, a much smaller drainage area, the Ndembera Swamp is somewhat apart from the main wetlands and connects to them through the Ndembera river.

The permanent swamp areas function as a refuge for the fish that are forced off the wetlands as they dry up. In particular they provide good and productive habitats for the catfishes which are physically and physiologically adapted to life in waters that may often be low in dissolved oxygen. Small significant amounts of other species, particularly small species of Elephant-snout fish (Mormyrids) inhabit the swamp fringes.

### **3.1.5 The rivers and open channels**

These are less productive than the wetlands and the swamp area. In common with most flowing waters the passage of the water allows little opportunity for the establishment of a concentration of nutrients and for the natural production processes to build up. They have an important role in the collection of fish that have bred in the swamps and wetlands and migrated as the water levels fall. Ease of travelling along the open water channels and the slow flowing main river course allows the fishermen access to these fish stocks.

## **3.2 Potential production and yield<sup>5</sup>**

It is extremely difficult to define the basic production of an area of the type under survey and to make an assessment of how much of this basic production can, or is, being removed in the yield or fish harvest. In general it is necessary to use vague generalisations such as “extremely productive” which provide comparative guidelines but hardly provide a sound basis for estimation, or the imposition of regulations. With the future access to more precise data on the areas involved and the pattern of their flooding, a better estimate of production will be available. Section 4.2 provides some estimates of production and current yields, based on the information available to date.

The nature of the floodplain production system and the yearly removal of most of the production by natural forces (chiefly predation and isolation as the waters dry up) means that on the floodplain itself the sustainable levels of fishing may be very heavy indeed, as what man does not take will not survive anyway.

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<sup>5</sup> The term “production” is used in its biological sense of what the ecosystem produces from the reproduction and growth processes of its animals and plants. “Yield”, or “harvest”, is that part of the biological production which is removed from the system by humans.

## 4. THE EXPLOITATION OF THE FISH RESOURCES

### 4.1 Structure of the fishery

#### 4.1.1 Access

Apart from the legal requirement to obtain an annual fishing licence (1,500/-), the registration of a canoe (970/-) and the annual licence for a canoe (1,200/-); all issued by the District Fisheries Office, it appears that access to the fishery is open and free. There appear to be no community, tribal or clan privileges prevailing. We have not been able to discover any control over access or timing of the fishing either by law or custom.

#### 4.1.2 General pattern of activity

Any description or statements regarding a fishery as little organised or formalised as that of the Usangu flood plain must remain generalisations.

The exploitation of the fishery is carried out in a typically artisanal fashion with simple dug-out canoes poled across the shallows or paddled in deeper water. Each canoe is managed by one man with a small number of simple gill nets, or a long-line with a small number of hooks. With the fall in the waters residual pools in the drainage channels are fished by draining and the fish removed by hand or with baskets. This process is aided by the construction of barriers, sometimes enclosing only a few square meters, of mud bunds or grass and wicker fences. These latter may have an opening in which a reed or cane none-return trap is placed. The vegetation may be removed from these retained areas to facilitate the removal of the fish.

#### 4.1.3 Seasonality

Fishing is carried out throughout the year with its location following the pattern of the inundations. As shown by the transport of fish, the fishing activity and yield begin to increase at the beginning of the wet season (January) and decline after the rains stop and the waters recede (April-May). See Figures 4.3 and 4.5 for an assessment of these seasonal fluctuations.

#### 4.1.4 Employment in the industry

It appears that about half the fishermen work part-time with a short period (usually from 1 to 3 months) a year spent fishing as a means of raising cash. The fishing activity is interspersed with periods of work on their own shambas. The rest of the fishermen obtain all, or most, of their living from this activity and may spend more than six months or so at the water.

The division of labour among the activities which form the chain from the fishermen to the consumers is not strict and some individuals may do more than one type of work, or may change their activities from time to time.

##### *Fishermen*

Full-time fishermen, there are no women, who have no other employment apparently work fairly continuously on the plain. Although life is hard in the simple, isolated, encampments where they stay, without their families, they look on themselves as absentee workers. It appears that most of these full-time fishermen come from villages in the Makete District in the hills above the Usangu.

Part-time fishermen also will fish for a short period and alternate this occupation with work on their shambas. There is some conflict with the demands on availability as the period when fishing is easiest (after the onset of the rains) is the period of most active agricultural work.

There is an unquantifiable effort from individuals who fish the drying out residual ponds. It is possible that villagers from around the Usangu may specialise in this dry season activity which requires very little skill or special equipment and which will provide an opportunistic benefit in the dry season, before cultivation begins, when there is little other demand on their time.

#### *Processors*

The processors, who may also be fishermen and/or traders, smoke-dry the whole fish at the landings. If the fish are considered of low quality, they are gutted, split and sun dried.

#### *Transporters*

Small loads are transported in 25-50kg bundles on the backs of bicycles. This is the transport method from many of the small landings. Lorries and tractor-trailers carry loads of larger 500 to 750kg packets.

#### *Wholesalers/retailers*

The transport and onward selling functions are not highly formalised and are undertaken by a mix of individuals with some flexibility in their activities. Transported fish may be sold on for transport further afield; to Co-operatives acting as wholesalers/retailers; or directly sold by the transporter to retailers; or the transporters may act as retailers or be members of a Co-operative. There is no evidence of significant development of fish wholesalers or middlemen/women taking a major role at the markets local to the Project Area. Stallholders in the markets may be men or women. Apart from retail trading and some domestic activities and the provision of food and drink at some of the larger fishing camps, there is no stage in the fisheries exploitation in which women play a significant part.

#### *Consumers*

The final consumers are domestic buyers who purchase small quantities of the processed product at the market. This is sold by the piece or pile. The fish may be brushed with cooking oil to give a glazed and greasy look which is favoured by the buyers. At the markets observed, it was evident that the smoked kambale were a favoured product with the fried and dried fish (Tilapia and Tiger Fish) from Mtewa and Rukwa being less in demand. The selling price for the smoked *Clarias* was in the region of 1000 - 1500/- per kilogram f.w.e.<sup>6</sup>

#### **4.1.5 The product**

There is little consumption or transport of fresh fish. The major product is small (*ca.*20 - 40cm TL) *Clarias* catfish<sup>7</sup>. These are rolled and spitted before being smoked over a hot fire. Smokers may be pit smokers or raised mud-brick smokers with a wire grid on top. The result is a well-dried product which keeps well and presents as a good product in the market place. Drying is to about 50% of fresh weight. There is a perception that the moister product with more meat “body” is favoured by the consumer and the smoke-dried product will be dampened to achieve this. As the product is traded and sold in the market by the piece, there is no advantage in the processor producing a product that is badly dried and therefore relatively heavier although dampening will shorten the shelf life of the dried fish.

Fresh and smoked Tilapia (“Ngege”)<sup>8</sup> have also been seen but only in very small quantities. Small quantities of Mormyrids (“Somo”)<sup>9</sup>, and Schilbeids have also been seen on the landings.

<sup>6</sup> f..w.e. = fresh weight equivalent

<sup>7</sup> Identified as *Clarias gariepinus* (Burchell, 1815), local name “Kambale”

<sup>8</sup> *Oreochromis urolepis* (Norman, 1922) is apparently endemic to the Ruaha river basin. This species is synonymous with *Tilapia adolfi* Steindachner, 1916 and *Tilapia hornorum* Trewavas, 1966.

<sup>9</sup> *Marcusenius livingstonii* (Boulenger, 1898). This species is synonymous with *Gnathonemus livingstoni* and *Marcusenius macrolepidopterus* (non Peters).

It should be noted that the unit of trade is always considered to be a “fish” although this may be a number of small fish or cut pieces of a larger fish. The processed weight of this fish (or “fish equivalent”) is 500-600g. which can be assumed to represent a fresh-weight of 1kg.

#### **4.1.6 Technology and methods**

Throughout the whole fishing industry the gears and methods used are very simple and where possible utilise locally available materials and skills.

##### *Fishing gear*

At the time of the initial survey (towards the end of the wet season) the principal gear used was gill nets of 3 inch stretched mesh, 26 meshes deep. These are very loosely hung and used in full 100 yard lengths in the open-water. Here they are weighted to float. In the vegetation of the inundated areas these nets are cut up into short length of some 10 m or so and mounted with wood stakes as spacers. Net sizes down to 1 inch mesh are also in use. In the residual water areas at the end of the dry season the density of the set nets is high with separations of only some 5 or 10m across large areas of the open water.

It appears that in the last 5 years or so there has been a development of bank seining in the permanent river courses. A length of bank and the bank edge aquatic vegetation is enclosed in a small mesh seine net of some 20 to 30m total length. Teams of about 10 individuals then clear out the vegetation onto the bankside and pull in the enclosing net. Catches, nearly 100% catfish are good at up to 50kg or so. This technique which was seen to be in heavy use over a length of 7km of the Ruaha, before the river disappears into the swamp, has a significant role in keeping the river channel open.

During the second survey, at the end of the dry season, there was much more use of hand lines in the permanent waters of the river and swamp. Each long line may have 50 to 60 number 7 hooks.

In the dry season a few fences were erected across drainage lines, in some cases with an additional low earth bund constructed just downstream. The small opening that is left in the fence is blocked by a cane non-return trap.

Simple bunding and baling methods are also said to be used (not observed) to empty the small residual water bodies. This process is assisted by raising a small earth bund.

All the canoes seen have been dugout construction of *ca.* 3 to 5m in length. These may be poled or paddled according to the water conditions.

##### *Processing*

When the fish are considered to be of low quality usually because they have been dead too long and have begun to deteriorate, they are gutted and “cleaned” under primitive conditions. The offal is discarded close by the operation and the area is heavily infested with flies. When so prepared they are split and hung out on lines to sun-dry.

When the quality is adequate the fish, mostly catfish, are individually curled up and pinned with a piece of stick. Larger fish are cut into portions and these may be spitted on a cane to prevent breakage on drying. These fish or fish parts are then laid out evenly on a wood or metal grid some 1m above a slow-burning hot fire. Judging by the product sampled in the markets, the product is well preserved.

##### *Transportation*

When processed, the fish are bundled up in wood frame packets. Where there is road or track access to the landing these are usually taken by bicycle in packages of *ca* 50 fish (f.e.<sup>10</sup>) and weighs an estimated 25-50kg. Where there is vehicle access, the landing will attract canoe loads of smoked fish from distant parts of the fishery and it appears that a collection is made about every two weeks. The access may only be by a very rough track motorable only by a tractor and trailer. These selected landings change their location as they follow the margins of the receding water. In the wet season the collection was close to Kapunga (near Ikoga) and subsequently moved to access points on the edge of the wetlands where access by canoe could still be effected along creeks as the floods receded. By the end of the dry season this landing had moved to Magarimabovu, a location to the south and west of the original Kapunga landing. No other landing sites were noted as having a vehicle collection. For vehicle transport larger packets are carefully made up. The fish are carefully stacked and packed protectively in grass before being tightly bound into the wicker frames. Each package measure some 200 x 60 x 80cm and therefore has a volume of 1m<sup>3</sup> and is said to contain some 500 to 1,000 fish (f.e.). It is estimated that these packages will weigh an estimated 500-750kg<sup>11</sup>. About 15 of these bundles will be carried away from the landing by tractor and trailer or lorry. The processed fish are taken off the Usangu by the transporters to Rujewa or Igawa (on the main road) and then transferred to vehicles which take them to the retail markets.

## 4.2 The resources available

### 4.2.1 The exploitable resource

The fish landings are almost completely of the catfish *Clarias gariepinus* or kambale. Very small number of the tilapia, *Oreochromis urolepis* or negege, are landed. During the dry season, when the swamp margins of the river or the Ihefu are fished, smaller fish, such as Mormyrids, Schilbeids, are caught for subsistence or dried for onward trading. The Clariids and Mormyrids are typically adapted to the shallow, warm waters which are low in dissolved oxygen, which are typical of the swampy habitats.

The adult breeding *Clarias* spread out on to the freshly inundated areas at each rainy season. Their subsequent breeding success gives rise to many more individual fish than the dry season residual waters can support. The initial survival rates tend to be very high as the inundated wetlands provide, for a short time, a highly productive environment with high levels of food supplies derived from the breakdown of the flooded vegetation, cattle dung, invertebrate populations etc. However, most of the fish that hatch each year on the wetlands nursery areas will not survive to become part of the population of the residual waters. In fact in a stable, or near stable, system the survivors will, in theory, be just sufficient to replace any losses suffered by the residual populations. The mass of small “fish-of-the-year” will either be predated (by adults of the same species or piscivorous birds as the dominant predators) or will die as the waters dry up. Any fishing activity can therefore take practically 100% of the fish from the wetlands without having any significant effect on the survival of their populations to breed in the following season.

The sustainable exploitation of a flood-plain or seasonal wetland fishery can thus be pursued to its maximum with the use of whatever gears are efficient, economic and do not damage the environment, without reducing the resource that is available year-on-year. There will be fluctuations in the amounts that can be taken as the populations respond to the year-on-year variations in the climate and the effect these may have on the environment. These fluctuations can be as much as 300% from one year to another. In the long-term, sustainability of a flood plain fishery can be assured with no regulation or control.

<sup>10</sup> f.e. = fish equivalent or a number of fish or fish pieces added together to make the equivalence of approximately 1kg of fresh fish.

<sup>11</sup> All packet weights are estimated by eye and therefore the quoted rates can only be indicative.

Where the residual waters are very restricted in extent or very easily fished, that there may be some need to constrain fishing activity in order to preserve the residual breeding stocks. It is difficult to know to what extent the currently observed levels of fishing are related to the available stocks. It is not wise to draw specific conclusions from subjective impressions that are not supported by historical information, data or anecdote, which indicates changes that may have taken place. As yet we have no evidence of any significant changes in the fish populations for the Usangu.

#### **4.2.2 Potential yields**

The potential yield from a floodplain is a function of area flooded and the length of time that the shallow areas are under water. Studies of typical floodplains in tropical conditions allow us to generalise that 1km<sup>2</sup> will yield between 3 and 5t/year. As is argued in 4.2.1 above, this potential yield can be taken virtually completely, without any restrictions in methods or total effort, and this offtake will be maintained from year to year. If the area inundated each year is some 500km<sup>2</sup>, a potential sustainable catch of between 1,500 and 2,500 tonnes per year would be expected. As a rough guide, a potential of 2,000 tonnes of fish will be assumed to be the maximum annual yield available for exploitation from the Usangu. If the assessments of the current yield levels are close to the real situation, it would appear that the Usangu fish stocks are being taken at roughly half of their theoretical potential. This is the level of efficiency that would be expected from the intensity of the fishing and access to the stocks, and must also take into account the non-human predation on the stocks.

For an intensive fishery of a flood plain habitat the theoretical yield will approach the total production<sup>12</sup>. If for the Usangu we assume that a significant part of the natural production is shared with birds and that the efficiency of fishing is some 50% of the total catch possible, we would anticipate a natural production level close to 4,000 tonnes per year. From what is known from similar waters the ratio of the production to the biomass<sup>13</sup>(or standing crop) is in the region of 1:2. The unfished biomass of fish on the Usangu, at its annual maximum, would be in the region of 8,000 tonnes.

#### **4.2.3 Assessed current yields**

In default of a detailed, well designed and intensive system for collecting fisheries statistics from the Usangu - and in view of the fact that such a data collection would be totally uneconomic - it is necessary to approach the assessment of the current yields through the interpretation of any information that may be available.

##### **(a) Assessment of fishing effort by commercial fishers**

An assessment of the effort that is being made in a fishery can give a useful evaluation of the yield of that fishery. This is achieved by the multiplication of the number of "units" that are fishing and the likely catch of each "unit". From the current observations in the Usangu it can be assumed that one canoe is used by one fisherman at any one time. It can also be assumed that any individual canoe will be utilised to its maximum throughout the year.<sup>14</sup> As a working hypothesis, one canoe is assumed to represent 1 fisher-year of fishing effort. As a generalisation, an artisanal

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<sup>12</sup> Natural production is the increase in mass of the population from the beginning of a growing/breeding season to its maximum of that year.

<sup>13</sup> Biomass is the weight of the population that is present at its annual maximum.

<sup>14</sup> This does not imply continuous use as the intensity of fishing will vary with the seasons and the changing patterns of waterways, swamp and open water.

fisherman active under the conditions observed in the Project Area will catch between 1 and 2 tonnes each year.

In a fishery where the active fishermen are a mix of part-time and full-time participants and where fishing is practiced in an intermittent fashion, it is difficult to enumerate the actual number of fishermen or to assess their aggregate input. However, from the aerial canoe census, a canoe population estimate of 380 canoes has been assumed and this figure is taken to represent a measure of the extent of the fishing activity.

It would appear that the total catch from the Usangu, as estimated by this method, is, therefore, in the range 380 to 760t/year.

#### **(b) Subsistence fishing**

Subsistence fishing is difficult to gauge without access to accurate information of population size, the location of habitations, family size and make up, and the food habits of the people local to the fish stocks. We have here assumed a total of some 100t/year is taken in the subsistence catches<sup>15</sup>. The fish traps and rudimentary weirs are used by local populations as a source of small fish for subsistence.

#### **(c) Assessment from Fisheries Department records**

Over the 14 years 1985 to 1998, records from the District Department of Fisheries at Rujewa, have provided estimates of the transport of fish out of the area<sup>16</sup>. The transported fish, being a dried product, are approximately half the weight of the fresh fish. These records indicate transport of between 69 and 372 tonnes (d.w.<sup>17</sup>) per year with an average for this period of 179 tonnes (d.w.). The SD of 89.7 tonnes (d.w.), n= 13, shows a considerable year-on-year fluctuation. These data will allow us to assume an average of 360 tonnes a year (f.w.e.) as a working estimate based on records of transport. Table 4.1 summarises these data. There is some imprecision in recording these data but the overall orders of magnitude can be accepted<sup>18</sup>. If it is accepted that these records indicate the true weight of fish noted by the Fisheries Department and which incur a small local tax, and it is further assumed that an additional and equal flow of fish avoids paying the revenue dues and is therefore not noted, a total of some 240 - 1,500t/yr can be assumed to be transported out of the area and will represent the catch from commercial fishermen. By a similar reasoning we can accept that the average over the 13 year period from 1985 to 1998 is in the region of 720 tonnes per year. It should be noted that although this evaluation relies on rather gross assumptions of weights and numbers of fish it can be considered that they are valid in the context of the precision required.

It should be noted that records available from the Regional Office in Mbeya, where these data overlap, do not correspond with the figures available from the Rujewa District Office. As the Rujewa records are the primary source for this information, these have been given priority where appropriate.

#### **(d) Overall assessment of Usangu yields**

The combined estimates of (a), (b) and (c) are summarised in Table 4.4.

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<sup>15</sup> It has been assumed here that there are some 20,000 individuals with access to fishing areas living in the Usangu area. If each individual consumes 100g fish each week the total annual consumption will be in the order of 100 tonnes.

<sup>16</sup> The records from the Rujewa office refer to fish leaving the Mbarali District, whereas those of the Mbeya Regional Office refer to fish leaving the "Usangu Basin".

<sup>17</sup> d.w. = dry weight

<sup>18</sup> These data are based on records submitted by the District Fisheries Office to the Regional Authorities and represent what is apparently a subjective assessment of the weights of the dried fish packages that pass through Rujewa. There are no means of weighing these and although the records provide indications of value, these latter are simply derived from the estimates of weights.

It would appear that from the information that we have available annual yields from the Usangu will vary between 410 and 1,230 tonnes a year. Although any concept of an "average" yield must accept the role that natural climatic factors will play we have an estimate of 670 tonnes a year from evaluations based on the observed activity. Assessment from the indications provided by the transportation data of the District Fisheries Office, an average yearly yield of 720 tonnes is obtained. A figure of 700 tonnes a year can be taken as a working average between the minimum and maximum estimates.

The different estimates correlate well and it should be noted that the estimates derived from canoe counts and the assumed fishing activity do not fully allow for those years of exceptional natural production when it is presumed that the intensity of the fishing activity will increase as a response to the abundance of fish. It is likely that much of this additional activity will be at the level of minor and subsistence catches. It should be noted that Figure 4.2 indicates a threefold increase between the lower annual maxima and the upper.

### **4.3 Commercialisation of the catch**

Table 5.1 summarises one model of the chain of distribution and the economics of the trade in fish from the Usangu.

There appears that there is no significant development of the wholesaler stratum in the chain of commercialisation. This probably reflects the small total quantities of fish involved, the small unit quantities that are transported and the good shelf-life of the product which minimises storage problems.

There is no evidence of debt manipulation on the part of the traders with respect to the fishermen. It is evident that the fishermen, especially those in the semi-permanent fishing camps, rely on the trader-transporter for the delivery of necessary supplies and it appears that much of this trade is by barter with the fish on offer. After sale by the fishermen the fish are packed in sacking and wood framed packets for bicycle transport or tightly packed with straw in well-bound wood-framed packets for transfer by lorry or tractor trailer.

There is a strong and informal system of communication between the fishing camps and the traders. This is necessary to arrange for the delivery and onward distribution of the catches at the major fish transfer points.

In the relatively short chain of commercialisation which may be fisherman-processor-trader/transporter-retailer (with several of these stages being undertaken by a single individual) there is little mark up on the price of the product. It is stated that there is comparatively little fluctuation in the price from the period of high catches in the wet season and the low catches of the dry season. The fisherman will get some 150 - 250/- per kg<sup>19</sup> (w.f.e.) which is sold in the markets of Makambako, Njombe or Mbeya for 400 -500/. As this retail price is equivalent to approximately 800 to 1000/- per kilogram fresh weight it is close to the asking price for beef currently offered at 800/- a kilogram at Rujewa butchers.

The development of Fisheries Co-operatives, of which there are three in the Project Area (Igurusu, Rujewa, and Usambuku) and one pre-cooperative group (Chimala) is a recent phenomenon. The Co-operatives at Rujewa and Ubaraku do not seem to be working well as they tend to support a number of functions and their direction of commercial activity is rather ill-thought out. The group at Chimala is in its start-up phase and is engaged in fishing as well as trading. As is usual in similar situations elsewhere it is likely that the Co-

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<sup>19</sup> The price paid to the fishermen varies by season and with the remoteness of the landings where the transactions are carried out.

operatives have been formed in response to Central or Local Government initiatives and that they convey certain subsidies or privileges on the participants. Of direct relevance is the coverage of all traders by the single licence of the cooperative. This costs the cooperative 10,000/- a year which is the equivalent of a single trader licence.

## 5. ECONOMIC ISSUES

### 5.1 Income generation for the fishermen

Due to the displacement of the fishermen from their home communities, either on a quasi-permanent or a part-time basis, it is difficult to consider the economics of the fishing operations in relation to "fishing communities". The economic unit at the primary level of production is the

“fisherman”. An assessment of the fisherman population is made difficult by the very irregular nature (both in location and seasonality) of much of the fishing activity. As a generalisation it is assumed that there area some 400 fishermen-equivalents exploiting the Usangu fish resources. It is possible that three quarters of this total is made up of full-time fishermen for whom the income from fishing is their major income source.

The range of annual catch for an artisanal fisherman will be from about 1 tonne in a poor year to 2 tonnes in a good year. Should the fishing produce less than the equivalent of 1 tonne a year the artisanal fishermen will find that the level of benefit is below the acceptable levels for the effort put in, and he will withdraw from the activity. The fishermen claim<sup>20</sup> to receive 250/- for a dried-fish of 1kg (f.w.e.)<sup>21</sup>. It must be noted that the concept of a cash value must be rather nebulous where the trade at the fishing camps has a heavy component of barter for living necessities and gear.

The average full-time fisherman will therefore gain the equivalent of 250,000/- to 500,000/- a year for their work. In artisanal fishing of the type observed in the Usangu it would be expected that annual incomes would bracket the prevailing rate for unskilled labour. National official minimum wages are currently set at 420,000/- a year although the actual wage levels available in Rujewa are probably below this figure. The estimated income is therefore close to what would be expected. Equipment and other incidental costs are low and probably not more than 10,000/- to 20,000/- a year, so the net income represents an adequate living wage for unskilled work..

The total value of the fishery to the primary exploiters of the resource is therefore in the region of 10 to 20 million shillings a year.

## 5.2 Income generation in the non-fishing sectors

Under this heading we can place the whole chain of operators from the processors to the retailers. The fluidity of the contributions of individuals to the various sectors of the chain from landing to retailer allows only an overview of the economics of this trade.

### 5.2.1 Retail traders

Except for distant markets, the retail trader is often the transporter from the landings and may be engaged in the processing. Close to the Usangu Plain these activities appear to be increasingly carried out under the umbrella of a Cooperative Society. Table 5.1 summarises a model of the economics of the fish trading derived from interviews with Cooperative members.

The sale price of the product in the retails markets is approximately twice the price the fishermen get at the landing *i.e.* 500/- per kilogram dried product<sup>22</sup>. This mark up has to take into account transport costs, local taxes levied by the district, and the costs of trading in the market. If we assume that the weight of fish traded varies between 410 and 1,230 tonnes f.w.e. each year (see Table 4.4) it will be seen that this retail price indicates a total trade of between 200 and 600 million shillings a year. With retail margins estimated to be in the order of 40% of gross sales,

<sup>20</sup> Prices quoted as stated by the fishermen range from 150 to 250/- per fish, according to the location of the landings and the seasonal changes in abundance. Traders claim a somewhat higher buying price at the landings of from 250 to 300/- per fish.. Generally the figure of 250/- seems to apply.

<sup>21</sup> The fishermen employ the concept of a “notional” fish which may be a single fish, a number of fish, or cut portions of fish that weighs roughly 500g when dried. The fresh weight equivalent (f.w.e.) is assumed to be double the dry weight.

<sup>22</sup> This is the dry season market price. In the wet season when fish are more abundant the retail market price falls by about 20%.

this trade generates a net income of some 80 to 240 million shillings for the retail traders. The retail mark up of some 100% is approximately what would be expected in this type of trade.

A rough estimate of transport costs from the landing to the market is in the region of 40,000/- for each tonne f.w.e. delivered to the nearby markets of Njombe, Mbeya etc. District taxes on the transport of fish, are somewhat arbitrary in their imposition and the calculation as to value, but enquiries suggest that these may be in the region of 4,000/- per tonne f.w.e.

Incidental retail market costs are low and can be regarded as negligible. There is little risk to loss of stock due to spoilage. We have here discounted marketing costs.

### **5.2.2 Transporters, processors and ancillary operations**

The economic value of these elements of the fishing industry is difficult to assess due to differing scales of operation and the flexibility of involvement at all stages of the work. Benefiting are cycle transporters of small (25-50kg loads of fish and return loads of consumables); owners of motorised transport such as truck or tractor trailers (who also trade both ways); local minibus operators, smokers, wood gathers, water transporters, food and beer providers, etc.

## **5.3 Economic value to local communities**

Here we consider the value of the fishery to the local administration. The disbursement of funds obtained by the local administrations and the income re-distribution from the primary beneficiaries all cause an economic benefit flow through the communities affected.

### **5.3.1 Imposts and taxes accruing to District Administration**

It is understood that the policy on the imposition of taxes as licence fees, transport fees etc. by the district administration is currently in a state of change. It is likely that with an increased independence of action and the accrual of the imposts to the district government account, there will be an increased activity in the establishment of checks on transport and licence compliance. If the district administration is able to set the levels of charges, independently of Central Government, then it is likely that imposts and charges will rise to conform to current values.

Currently the fishing “industry” is subject to the following imposts:

**Canoe registration:** This is a single, “one off” payment. If the life of a canoe is assumed to be from 5 to 20 years, then the fleet of 350 canoes then a replacement of some 10 canoes a year can be anticipated. At a registration fee for each new canoe of 970/-, an annual income of 9,700/- can be expected.

**Fishing licence:** An estimated 400 fishermen paying 1,200/- each will provide a revenue of 480,000/- each year.

**Transport of fish:** Taking a median annual yield of 400 tonnes being transported out of the area of the Usangu, at a cess of 3,000/- a tonne this would provide an additional 1,200,000/- a year.

Trading licences for “fishmongers” are 10,000/- per year and these are taken up by the 4 fishtrading co-operatives in the district. Total value of these licences is 40,000/- per year.

At current levels of collection the total revenue available to the local administration would therefore be in the order of 1,300,000/- a year. Compared with a probable cost of 1,500,000/- a

year for the salary of the average local government officer and the overheads necessary to maintain a post, this total is obviously insufficient to maintain any sort of regulatory or management service for the benefit of the fishing industry of the Usangu Wetlands.

## 6. RESOURCE USE AND ENVIRONMENTAL IMPLICATIONS

### 6.1 Habitats

The construction of shelters for sleeping, as bars and entertainment centres, and the construction of smokers and smoker pits is all undertaken at a very simple level. The shelters are temporary structures usually made of grass and thin poles and are renewed as necessary from season to season.

The construction and use of these structures has no significant impact on the environment.

Some small fishing camps are quasi-permanent. Here there may be some clearance of the bush immediately surrounding the huts and the cultivation of small plots, but these can have little effect on the environment away from the immediate vicinity.

### 6.2 Access

The access tracks are traced across the floodplain as the waters recede and for the most part are used by travellers on foot or bicycle. Some landings have very light and infrequent lorry or tractor traffic.

These activities have no significant impact on the environment.

### 6.3 Wildlife impacts

There may be some opportunistic taking of birds or small mammals, but the areas where the fishermen camp are not rich in game and there has been no evidence seen of any hunting activity. It should be noted that the fishermen have abundantly available supplies of meat in the fish catches.

It is possible that some action is taken to drive off, and maybe attack, hippos and crocodiles. Currently these animals are so few that these activities must be minimal. With an increase in wildlife as the Game Reserve becomes established, it is likely that hippo and crocodile may become a problem to be addressed if fishing is allowed to continue in the Reserve.

There may be some damage to birds, and perhaps other animals from tangling with discarded fishing gear, or swallowing fishing gear materials and hooks. No evidence was seen to suggest that this impact is a significant problem.

The fishing activities appear to have no significant impact on the wildlife.

### 6.4 Impacts on the fish resources

The environmental impact and sustainability of the fish stocks under exploitation is considered in Sections 3 and 4. Any impacts from this activity on the stocks of young fish taken off the flood plain will be of short duration and no discernible long-term effects can be foreseen from this activity.

Intensive fishing of the residual waters can eventually have an effect on the stocks of mature breeding fish. There are insufficient data to enable any assessment of the current intensity of

fishing with respect to the fish stocks. It is not known how many refuges are available to the adult fish and how much these areas are accessible to the fishermen. Care should be taken in drawing firm conclusions from a subjective assessment of the visible fishing intensity.

The recent practice of clearing and seining the bankside of the main river channel will have the dual effect of increasing the intensity of fishing for the adult members of the population of breeding stock, but also may reduce the available nesting places for the breeding catfish. Again, it must be emphasised that subjective impressions do not allow for any firm conclusions as to the environmental importance of these activities.

## 6.5 Forestry resources

Wood resources are under pressure from a number of users in the floodplain. The most obvious of these, that are associated with the fishing activities, are timber felling and branch cutting for fish smoking. There is an additional use of wood in the construction of canoes. The clearance of bush to create small shambas near some of the fishing camps will have only a minimal effect compared with the large areas of clearance for agriculture at the margins of the wetlands.

### 6.5.1 Fish smoking and wood use

Exposing the raw fish to the heat and smoke of a slow burning fire creates a well-preserved product with a long shelf life. This is achieved by a combination of the biocidal effects of the tars and other chemicals in the smoke coating the surface and penetrating into the tissues, and by the partial drying and partial cooking of the fish flesh. The product thus prepared can be transported and stored at ambient temperatures, without the need for refrigeration.

Practically any available wood is used although *Dichrostachys cinerea* (Mimosaceae) or “mpangala” (wasangu and washehe) is the wood of preference.

It is estimated (see Appendix 4), taking the range of total yield assessments at from 410 to 1,230 tonnes per year (see Table 4.4), that annual wood use would range from a minimum of 2,400m<sup>3</sup> to 7,200m<sup>3</sup>. This represents a requirement for between 2,000 and 7,000 mature 20 to 25-year old trees, or the equivalent in smaller wood. The average annual yield assessment of 700 tonnes would require some 4,000m<sup>3</sup> of wood or approximately 4,000 mature trees. It should be noted that there are no signs of a significant transport of wood to the Usangu from outside the area.

Although there is no hard data on the productive capacity of the required woods throughout the Usangu Plain, conversations with Resource Officers at the Regional and district level suggest that subjectively this quantity of wood use is well within the capacity for sustainable replacement from the wild.

There is virtually no wood used specifically as firewood.

### 6.5.2 Canoe construction and wood use

There is a demand for large trunks for the construction of dug-out canoes. The preferred species in the Usangu are; *Pterocarpus angolensis* (mninga or bloodwood); *Afzelia quanzensis* (mkora or pod mahogany); *Faidherbia albida* (mkababu or apple ring acacia). Of these *Pterocarpus* and *Afzelia* are considered the best.

A 5m canoe takes about 1m<sup>3</sup> wood which requires a trunk of about 25 to 30 years. A canoe will last from 5 to 20 years which implies a demand for about 10 canoes a year as replacements.

There is some importation of canoes made from *Milicia excelsa* (mvuli) from Makete District.

Compared with the use of wood for fish smoking the volume impact of wood removal for canoes is minor. However, as the canoes have to be made from mature trees, it is highly likely that this resource is beginning to decrease significantly. The availability, or the price, of new canoes is not yet considered to be a problem by the fishermen.

## **6.6 Air and water pollution**

The impact of smoking will add insignificantly to any debasement of air quality. There are no other sources of air pollution associated with the fishery.

The only affect that the fishing will have on water quality will be by disturbance and this is of no significance whatsoever.

## **7. SOCIAL CONSIDERATIONS**

### 7.1 Involvement in the fishery

It appears that some 600 or 700 individuals are employed at least part-time in the exploitation of the fish resources of the Usangu Plains. This employment ranges from the actual fishing, processing, transporting and retail sales, to the trade in food, drink and other supplies to the fishing areas. This work is carried out almost exclusively by men, mostly young. The exception to this gender exclusion is the provision of food and drink by women traders at some of the more permanent and more accessible landings.

Of the total employed it would appear that some 300 individuals are effectively full-time fishermen for whom this activity is the chief source of income. These individuals may spend 9 months or more at the fishing sites. Predominantly, this group of full-time fishermen have their home bases in the Makete District in villages in the highlands to the south of the project area.

The involvement of part-time fishermen increases with the arrival of the annual floods. When the waters rise there is much opportunity for small-scale fishing with minimum gear and it is likely that many of these part-timers are from towns and villages around the wetlands.

There is a further group of opportunistic, subsistence fishermen. These will range from children fishing the irrigation drains and streams, to villagers building fences and setting fish traps along the residual watercourses at the end of the dry season.

There appears to be no group, tribal or clan exclusivity restricting activities in the fishing industry.

### 7.2 The fishing communities

The fishing communities proper, which are totally servicing the fishing industry, tend to occupy temporary structures situated at the water's edge. With the rise in fall of the waters and the inundation of the plains these sites are vacated and the occupants move to locations providing a more convenient access to the water.

The habitations are simply-made grass huts. These may either make up small villages or simple camps of grass shelters. Three villages were seen to contain family groups although most of the fishing camps were "bachelor dormitories". One village, Bosco on the Ruaha, has a small shop selling basic provisions. In general the fishing camps are very primitive often consisting only of a series of sleeping shelters in a line. Each camp will have one or more smokers that are either simple pits or raised on mud walls. Some fishing camps have small huts constructed to house the smoke pits. It is assumed that these are the locations occupied in the rainy season, and hence the need for the protection.

Minor camps are erected at the processed fish landings that represent locations where road transport can get down to the canoe transport at the water's edge.

Although the camps are vacated seasonally, their locations seem to be permanent from year to year and there is evidence of mounds being created to lift the huts above the water level.

There are some isolated, single-family huts scattered along the waterways, but these seem to be very few in number.

### **7.3 Social organisation**

The smaller fishing camps may have up to 10 or so men living communally. There is no apparent system of family or village relationships between the individuals sharing. There must however be a degree of trust between the members of the small groups as they have to trade their catches, buy their supplies and remit money to their families through the good offices of others.

Some fishermen groups complained that it was precisely this trust that was lacking in their relations with traders and other fishermen. These groups were of fishermen who were mostly part-time at the height of the rainy season and it is probable that these groups have far less cohesion and identity.

The larger groups of fishermen claim to have a leader who can act as spokesperson for the group. Any details of the social relationships and decision-making machinery is difficult to elucidate. The scattered and impermanent, in time and space, nature of the fishing industry makes it unlikely that a well-defined system is in place. It is noteworthy that there is no sign that the co-operatives have taken any role in such an organisation.

## **7.4 Communications**

### **7.4.1 Trading communications**

It is essential that there is a functional system of communication operating for the fishing industry. Messages travel by word of mouth as the opportunities arise. The notification of a day and a location for the bulk transport of fish must reach the transporters and buyers; the suppliers of dry goods and other provisions; the sellers of food and drink, etc. In the reverse direction the message must go to the scattered fishing camps to that the fish may be brought to the transport by canoe.

The seasonal price variance is relatively small, and the structure of the chain of commercialisation of the catch is very simple. There is no system of informing the fishermen of current prices or demand - and there is apparently no need of one.

### **7.4.2 Administrative communications**

There is little direct contact between local officials and the fishermen. In recent years the District Fisheries Officers have had no mobility and have not been able to visit the fishing camps. There only contact have been with the fishermen who visit their offices to obtain fishing and canoe licences. Traders who pass through Rujewa may also have contact with the Fisheries Officers as their loads are assessed and a fee is charged.

This lack of communication will cause difficulties if any changes in regulations occur. In particular the implementation of the Game Reserve, of which the fishermen are well aware, has left them confused as to what they are allowed to do and what action they should take. This should be seen in the context that practically every fishing camp is now illegal in its location and all the current fishing activity is carried out illegally.

## **7.5 Involvement in resource management**

There appears to be no sense of resource ownership, and this would be expected in a pattern of exploitation that was so diverse and widespread. There is a general feeling that the resources are indefinitely large and have little changed within the memory of those engaged in the industry. There is some comment about how the lower water levels in the dry season in recent years have made it more difficult to catch the larger fish.

The effect on resources due to other water uses does not impinge on the fishermen. They are too distant from other users for any abstraction implications to appear important.

Other resource users are the pastoralists. There is some conflict, judged not to be very important, in the stated loss of nets to trampling by cattle and the difficulty to canoe passage caused by the building of causeways for the passage of the herds.

There are also stated problems with hippo and crocodile, with occasional fatalities to fishermen and occasional loss of nets to hippo. The extent of this problem is not great, as the numbers of hippo and crocodile are small. However with the development of the game reserve and the presumed increase in wildlife, it can be expected that these two species will increase in numbers. This might give rise to conflicts with the authorities if the fishermen take it into their own hands to remove these game animals.

## 8. CONCLUSIONS

### 8.1 The resource and its utilisation

It is very difficult to make absolute estimates of total populations of fish in the wild. Estimates are usually derived from indicators that are relative to observable events (e.g. catch, passage of fish, nest counts, etc.) and these compared from year to year. In this way a picture of relative change is achieved and with it a knowledge of the relative stability of the stocks of interest.

In the Usangu Wetlands the fishery is effectively mono-specific with the bulk of the catch being the catfish *Clarias gariepinus* or kambale. This species is highly adapted to the physiologically stressful conditions, and high nutrient availability, of swamp and floodplain habitats.

For the Usangu Wetlands the estimate of yearly yields range from some 410 to 1,230 tonnes. These values are “best assessments” but must be considered in the light of the natural variations that will occur from year to year. Natural climatic changes can, and do, give rise to yield fluctuations, under natural conditions, of up to 300% from one year to another. Where necessary, in this report a working figure of an average a yield of 700 tonnes per year has been adopted.

The Kilombero floodplain<sup>23</sup> fishery provides a comparison of the Usangu Wetlands with a very similar waterbody. Estimates of the average yield from the Kilombero Swamp between 1971 and 1979, are 0.7kg/km<sup>2</sup>/year. This would indicate a potential yield from the estimated 800km<sup>2</sup> Usangu wetlands of some 560 tonnes per year<sup>24</sup>. These two estimates compare very well.

The available data (see Tables 4.1 to 4.3 and Figures 4.1 to 4.2) do not show any long-term trend of increase or decrease in the annual yields.

- **There is no evidence that the fishing activities on the Usangu Plains are having any significant, long-term effect on the sustainability of the fish stocks that are being exploited.**

## 8.2 Fishing opportunities

The fishing in the Usangu is not a highly skilled occupation and any individual can establish himself as a fishermen with a capital of some 10,000/-. In fact it represents an “entry level” occupation available to landless or otherwise unemployed individuals. It is certainly used as a means of earning cash to cover cash outlays (e.g. school fees etc.). Thus fishing is open to anyone living or wishing to move into the area. There is apparently no restriction on exploitation due to lack of manpower or interest in this occupation.

It is apparent that the life of a fisherman on the Usangu Plains is difficult and for much of the year probably considered to be very unpleasant. A rough estimate gives the number of fishermen who are more or less full-time employed at some 300 individuals, all men and those from the area of Makete at some distance from the resource. These fishermen live most of the year on the Usangu Plains and move their encampments in response to the rise and fall in water levels. There is probably an equal number of individuals who fish opportunistically for a few months at the times of high water when the fish are at their most abundant .

- **There appear to be no barriers to the entry into this occupation and the factors of difficulty of life in the fishery and the demand of individuals to benefit from the resources are in balance.**

<sup>23</sup> The Kilombero floodplain is situated on the headwaters of the Rufiji river at a distance of some 100km due east of the Usangu. Climatic and other ambient conditions can be considered to be very similar in the two wetlands.

<sup>24</sup> See Bernacsek, G.M., (1981) Freshwater fisheries and industry in the Rufiji River Basin, Tanzania: Prospects for coexistence. In: Seminar on river basin management and development. Kapetsky, J.M. (Ed.) Blantyre, Malawi, 8-10 December 1980. CIFA Tech Paper, 8: 302 pp.

### 8.3 Commercial opportunities

There is a, seemingly, very informal chain of transport and marketing of dried fish from the Usangu fishery. Prices at the fishery or at the retail outlets do not fluctuate greatly. The increase in price between fishermen and retail purchaser is approximately 100%. This would be expected from the relative short chain of the commerce and the good keeping qualities of the product.

All the markets in the region house a number of retailers selling dried-smoked or fried fish. It is noteworthy that, apart from the markets close to the Usangu (Ubaraku, Rujewa) the sales are dominated by fish from Mtewa reservoir and Lake Rukwa. It would appear that the consumers favour the products from the Usangu.

There are markets at some distance from the Usangu which take part of the catch. Figure 4.6 summarises the fate of the products leaving the immediate area. Some 60% of the total is exported to the areas around Mbeya.

- **There is no apparent constraint due to lack of market opportunities.**

### 8.4 Financing of fishing and marketing operations

The survey has found no evidence of any system of financial provision through middleman traders or community "bankers". This is possibly due to the relatively low level of commercial activity and the low capital inputs required. Gear is available on the open market at reasonable prices, although retail stocks of nets and hooks are small and it is possible that there may be a delay between requirement and availability. The fish trading chain allows these goods to be carried back from the retailers to the fishing camps. There is an element of barter for gear and consumer goods between the fishermen and the traders.

There is some concern expressed, particularly by the part-time fishermen, about insecurity in the marketing chain where the fishermen are isolated from the markets and are at the mercy of the goodwill of the traders. The general opinion is that they are unable to trust any of their own group and have to put their trust in the traders who sometimes cheat them by taking consignments and absconding with the proceeds. It is difficult to assess the seriousness of these complaints. The recent organisation of formal co-operatives may indicate the way in which this situation can be regularised to the benefits of both fishermen and traders.

- **No serious financial constraints have been identified at any level in the fishing industry.**

### 8.5 Equipment

The gear does not appear to be used to its optimum efficiency or well maintained. However, it may be that the efficiency and usability is quite adequate for the current needs of the fishermen.

The dug-out canoe which is essential, and quite adequate, for fishing and transport, requires access to large tree trunks which are said to be getting difficult to find in the quantities and at economic distances. However the stability of costs of manufacture and delivery suggest that this shortage has not yet made itself felt at an economic level.

In the future it may be necessary to introduce the technique of making simple 1 to 3-man plank canoes. Fishermen on many small lakes in East Africa use an 8-plank canoe which is simply made at the water's edge and will have a life of 3 to 5 years according to use and maintenance.

- **Currently there are no constraints due to lack of gear or equipment.**

### **8.6 Access and transport**

Access is difficult with bad tracks and wet season isolation of large areas. The large distances that are involved due to the movements of the shoreline as the wetlands dry out mean that small temporary camps have to be established, and may be re-established year-after-year at the same location. There are few (perhaps only one - Kapunga) permanent villages whose function is the servicing the fishery. The easier access to the east side of the wetlands is probably the reason for the importance of this shoreline in the commercialisation of the catch.

- **The current levels of access and means of transportation are adequate to the demands of the fishery.**

### **8.7 Social concerns**

The fishermen frequently refer to problems of losing nets to cattle when these are driven through the areas where the nets are set. Comments are also made about the construction of causeways to allow the cattle access to grazing areas and which are said to restrict travel by canoe. Although these problems have not been directly investigated, further questioning apparently shows that these problems are exaggerated and it may be that they are simply voicing inter-cultural prejudices.

Difficulty of access and impermanence of the communities means that there is very little contact with local administrations. As a corollary there is also apparently little internal organisation of the fishing communities.

- **The major difficulty that the fisherman currently face is the need to be informed of the implications of the Game Reserve and what is their legal position with regard to fishing activity and residence in the affected areas.**

### **8.8 Regulation and control**

Access to the official fisheries regulations is difficult even at the level of the district administration.

The current regulation of this fishery is minimal. The cost of trading licences; transport licences; fishing licences and canoe licences does not appear to present too much of a burden to those engaged in these occupations - although naturally there is some attempt at evasion there appears to be a very high level of compliance.

Apart from the issue of licences by the district administration, regulation of the fishing effort is virtually non-existent. There is a casual application of gear regulations. The proscription of damaging methods of fishing such as poisons and explosives, presents no obvious problem to fishermen. It should be noted that many of the regulations that are apparently in force have no technical relevance to the protection or maintenance of a fishery of the type practiced on the Usangu Wetlands.

The gazetting of the Game Conservation Area, which takes in a considerable area of the northern wetlands and the whole of the Ihefu swamp area, implies that all occupancy or exploitation of this area is now illegal. If this requirement is enforced it would mean a severe reduction in the overall yields from the fishery and an almost complete lack of fish for the market from this source for a good proportion of the dry season.

- **It is necessary to clarify the actual legal position of the fishery, both from the aspect of the imposition of the Game Reserve and the other fisheries regulations which may be extant. It is important that whatever regulations are in force, they are relevant to the needs of the sustainability of the fishery. It is equally important that the means are provided for the necessary enforcement.**

## 8.9 Issues of sustainability

The low level of technology and the low cost of equipment means that with changes in the profitability of the operation due to reduction in fishable stocks or low market prices due to a glut of fish from other fisheries, it is easy and relatively economically painless for individuals to stop fishing and take up other available earning opportunities.

With only a small financial burden to offset, the fishermen can stop fishing when the catches fall. The ease with which this withdrawal from the fishery can take place means that in the unlikely event of stocks being overfished and catches falling to "uneconomic" levels the pressure on the stocks are eased and their recovery can occur. Under the conditions of high tropical production levels, full recovery from low populations, from whatever cause, will occur in a very short time-span.

In view of this situation any attempt, from external sources, to raise the technological standards of the fishery (e.g. by the introduction of improved nets, motorised canoes, manufactured smoking kilns etc.) should be avoided. The increased economic efficiencies will benefit a few, and usually the more affluent, individuals and the increased demand on the resource could lead to significant and unwanted fluctuations in the available resources.

- **The current level of fishing effort appears to result in a sustainable catch which will maintain its level from year-to-year with fluctuations due to natural climatic factors. Any programme to increase the efficiency or the absolute levels of fishing should be avoided.**

# 9. RECOMMENDATIONS AND ISSUES

## 9.1 General comments

The current survey has established that the Usangu Plains and Wetlands support a small but sustainable fishery. This fishery exploits a renewable fish resource in a fully sustainable manner, creating employment and income for a small number of people and providing a well accepted food product on local markets.

In view of the findings of the survey the following recommendations for future actions have been made. These recommendations fall into four categories based on the expected outcome. These may be summarised as follows:

- Regulation of the use of the resource to ensure sustainability.
- Improvement of the social and economic conditions of the participants.
- Maintenance of social stability and avoidance of conflicts.
- Minimising the impact of resource use on the environment.

## 9.2 Issues of fisheries sustainability

Degradation of resources occurs when any exploitation is greater than the replacement from the natural production processes, or where this exploitation is carried out in a manner that modifies the environment in ways which reduce productivity. Such over-exploitation leads to a cycle of reduced stocks and an eventual situation where the yield is minimal and not worth the effort to fish.

The fishery of the Usangu Plain is a typical wetland/floodplain fishery in that it renews the fish stocks each year at a high rate of productivity. As has been discussed in Section 4, most of this production is available to be taken as the catch, and is relatively easily caught.

Over-exploitation of a fishery can come about through four main impacts:

- Where it is so easy to remove the fish that the rate of depletion of the population is significantly greater than its natural renewal. This may come about with improvements in technology of catching (*e.g.* improved fishing gears) or access (*e.g.* motorisation of canoes, road construction).
- Urgency of demand (as in cases of famine, gross human overpopulation or very high product value) makes any effort worthwhile.
- Investment in the exploitation process demands a pay-back even at low catching efficiencies.
- Unforeseen natural, or man-made, changes in the environment reduce the natural levels of production and catching effort remains the same.

## 9.3 Issues of fisheries management and regulation

Most exploited fish resources are assumed to be at risk to over exploitation and loss of sustainability. The generality of management measures are directed towards the mitigation of resource decline and the sharing out of the finite annual production. Management regulations are therefore targeted at controlling the fishing effort, and reducing the degree of exploitation to bring removal into balance with replacement. The goal of such management measures is to stabilise the resource and the industry that depends upon it. It is the case that many fisheries regulation measures, usually through legislation, are unable fully to take into account the effects of natural year-on-year and season-on-season fluctuations and the different biological behaviour of different water bodies.

Other aspects of many fisheries regulations concern the imposition of administrative control and revenue raising.

Regulatory options include:

- Licensing of fishermen as a means of administrative control of fishing communities, controlling fishermen numbers and therefore fishing effort and revenue raising.
- Licensing of boats or canoes as a means of limiting effort and revenue raising.
- Licensing of gear as a means of limiting effort, ensuring gear selectivity and catching methods do not damage the environment, match the requirements for a sustainable exploitation and revenue raising.
- Limitations as to the times of the year and/or the location of fishing activity in order to protect stocks at vulnerable periods of their life-cycle.
- Licensing of traders or processors allows for the easier collection of statistics of the offtake from the fishery, control of hygiene and food safety and revenue raising.

Many of the items noted above are susceptible to voluntary agreement and implementation by the fishermen and their communities. This will demand an appropriate social organisation and adequate education, information and training inputs.

When proposing management and regulatory measures it is essential to be aware of the following:

- There is often confusion between the concepts of management and regulation to ensure the stability of stocks and their revenue raising and social control functions.
- There is a tendency to promulgate “one regulatory regime fits all” management schemes, which ignore the fact that different fisheries are controlled by different sets of natural production processes, with different species exploited in different ways.
- It is better to have no regulations at all rather than impose regulations that cannot be enforced or monitored. Due to the logistical difficulties inherent in many fisheries, policing functions can be costly in finance and personnel. The same difficulties apply to the lack, or inefficiencies, of an extension service necessary to keep the fishermen and the communities aware of regulatory or voluntary management requirements.
- The need to take into account the difficulty that fishermen and fishing communities have in understanding or accepting the need for regulation of their offtake. In general this is seen by them to be an infinite (and invisible) commonly owned and free resource.

## **9.4 Sustainability of the Usangu wetlands fishery**

### **9.4.1 The natural production processes of the resource**

Although this has been discussed in detail in Section 4, it is of value to recapitulate the basics of the production processes of the fish stocks of the Usangu Wetlands.

The fish stocks, in particular the *Clarias* or kambale, follow a life cycle of resting as adults in the residual waters of the dry season, entering the flooded areas to lay their eggs, hatching of the young and growth in the flood areas, and return to the residual waters to add to the adult population. The success of this reproductive cycle (that is the number of young that will survive and grow) is dependent upon the length of time that the flood covers the shallow areas where food for the young is most abundant. It should be noted that nearly 100% of the young that are hatched each year do not achieve maturity and adulthood. The loss to predators, including larger specimens of their own species, stranding as the waters dry up, and starvation where food supplies are exhausted will mean that, on average, only enough will survive to ensure the maintenance of the adult stocks.

#### **9.4.2 The opportunities for exploitation**

It follows that if the bulk of the newly hatched fish on the shallow wetlands will eventually die within the season, then no harm can be done to the stocks by their almost total removal, by whatever method that is not destructive of the habitat.

There are four main fishing activities on the Usangu Wetland

*(a) Minor subsistence fishing*

Minor fishing, usually with hook and line, of small streams, irrigation canals etc. This is principally carried out for subsistence and represents a very low scale and insignificant use of the overall resource.

*(b) Wetland fishing*

Fishing of the inundated mbuga wetlands mostly using gill-nets. The passive fishing exploits a large population of mostly small fish and can do little damage to the overall resources as the populations will not survive the seasonal drying up.

*(c) Fishing of residual temporary waters*

Trapping of fish in isolated water bodies, drainage rivers etc. carried out mostly for subsistence. No damage to the resource as the fish populations of these water bodies will not survive drying up.

*(d) Fishing of residual permanent waters (river, lakes and swamps)*

This is carried out passively with gill-nets and hooks and lines, and actively with seine-nets. These methods exploit the populations that include the adult breeders of future years and there is a very small (currently insignificant) risk that these may be depleted to the extent where breeding success and recruitment levels are compromised.

#### **9.5 Recommendation for regulation of the Usangu wetlands fishery for sustainability.**

Any recommendations for the regulation of the Usangu Wetlands fishery must take into account, the year-on-year sustainability of the catch, the relatively small size of the fishery and the cost of regulating such a dispersed operation.

#### **9.5.1 Recommendations for regulating effort and fishing impact**

Currently there is no need or reason for any restriction in fishing activity on the Wetlands. The fishery should be pursued with no limit as to the numbers involved, the number or types of gear in use, or the location or timing of the activities.

The one exception to this freedom to fish is in the use of toxic materials, already proscribed by law, which may cause long-term damage to fish stocks and other aspects of the natural environment, and may be a public health risk.

### **9.5.2 Recommendations for regulating processing and trading activities**

The use of wood for smoking the catch before transportation is an essential part of the chain from fisherman to consumer. Although there is a significant wood use it is not seen that this will have a serious impact on available sustainable wood supplies. No restriction should be placed on the use of wood for fish smoking.

The activities of the trader/transporters respond to the requirements of the production and demand. There is no regulation required at any part of this chain.

### **9.5.3 Recommendation for regulating fishing locations or periods of fishing**

There is no necessity to interfere with the present system of opportunistic fishing.

### **9.5.4 Recommendations for regulating habitations and fishing communities**

The question of fishing activities within the Game Reserve will be considered in Appendix 5. The current sites and physical nature of the fishing camps do not represent a risk to any aspect of the environment, including the fish stocks. These camps are essentially of a temporary nature and although may have permanent locations are mostly vacated each year as the waters rise. No regulations are required for the control of these fishing camps.

### **9.5.5 Recommendation for the regularising of fisheries legislation with respect to the exploitation of the Usangu Wetlands**

It is understood that some or all of the foregoing recommendations are at variance with National fisheries legislation. As this legislation has clauses in the acts which allow the option of variance in the application of legal requirements at the decision of the Director of Fisheries. Application should be made at this level in order to regularise the laws under which the fishing on the Usangu wetlands is carried out.

## **9.6 Fishing activities and the designation of the Game Reserve**

With the designation of a Game Reserve it follows that no persons are allowed to reside, carry out any fishing activities or make any use of natural resources within the reserve boundaries. Effectively this means that much of the wetland area, and virtually all of the permanent waters, presently exploited by the fishermen are "out of bounds". The imposition of a Game Reserve in the Usangu Wetlands has, in theory, stopped all fishing activity. At present the fishermen are confused as to exactly what the situation is and how they should respond. As access is difficult to the fishing areas, little information has been made available.

### **9.6.1 Recommendation for authorisation of fishing within the Game Reserve**

The loss of a small but important and sustainable food resource, which has little impact on the natural environment, should be avoided. The legislation which refers to the activities that may be pursued in a designated Game Reserve includes the option for the Director of Natural Resources to waive rules at his discretion. Application should be made at the appropriate government level to draw up regulations under which the fishery of the Usangu Wetlands can continue.

Options for the future management of the Usangu Wetlands fishery within the Game Reserve are considered in Appendix 5.

## **9.7 Revenue and data collection**

It is possible to consider these disparate items under the same heading as revenue collection and the recording of accounts provides a cheap and easy way of obtaining long-term information on trends in the behaviour of the fishery and the appropriateness of its exploitation.

### **9.7.1 Recommendation for optimising revenue from the fishing activities**

Consideration has been given to the opportunities for raising revenue to the financial benefit of local administrations in Section 5. It is recommended that this revenue collection is put on a sound footing by the clear designation of licence fees and imposts. The appropriate Local Government Officers should be empowered to collect revenues and provided with the transportation that will allow them to check on compliance. This regulatory function can be combined with other control and regulation functions that are necessarily carried out in the Game Reserve and adjacent areas.

### **9.7.2 Recommendation for establishing a database of fisheries information**

The submission of revenue records, especially with regards to imposts on the trade in fish, should be regarded as an important function of the District Fisheries Office with records accurately kept and analysed.

## **9.8 Improvements in the social organisation of the fishing communities**

The participants in the fishing are apparently a loose social group with much movement of people into and out of the occupation and seasonal displacements around the area.

### **9.8.1 Recommendation for establishment of spokespersons as contact points with the fishing communities.**

The larger fishing camps such as Bosco and Mtembele should be encouraged to nominate individuals able to represent the community in communications with the Local Administrations. Scattered minor fishing camps could be grouped to enable this representation to be practical. Currently there is a system of leadership and representation, but this appears to be *ad hoc* and chiefly concerned with organising the trade in the fish.

Such spokespersons will also be instrumental in communicating with other communities who use the wetlands where there are apparent conflicts of interference with each other's activities.

### **9.8.2 Recommendations for improvements in the access to the fishing communities**

Although access is poor, this is due to the difficulties of the terrain and the seasonal fluctuations in accessibility, this does not appear to present any insurmountable problems to the fishing industry. Improvement in access by road, track or water would involve heavy costs and could not be justified on any economic grounds.

No recommendations are made to cover improvements in access.

## **9.9 Environmental resource use and its long-term effects**

Apart from the exploitation of the fish stocks, the only resource use that may be significant is the use of wood for smoking and canoe building.

### **9.9.1 Recommendations with regard to wood use for fish smoking**

Although the use of wood for fish smoking is not seen to be a significant threat to the forest resources of the area, the situation should be monitored.

It is recommended that within the scope of management of the Game Reserve the status of forest areas that are known to be exploited for smoker wood should be monitored over a period of years.

### **9.9.2 Recommendations with regard to the use of wood for canoe building**

At present the wood used comes mostly from outside the protected areas and, in theory, the necessary timber is derived from trees for which felling permission has been given and the necessary impost paid. There is no sign that shortage of suitable trunks is causing a problem with the supply of canoes.

It is recommended that the situation with regard to the supply of canoes is monitored and the relative cost inflation assessed as to its implications. It is foreseen that some time in the future it will be necessary to design and manufacture a plank canoe of a simple construction and make this widely available to the fishery.



**TABLES**

Table 4.1: Transport of dried fish through Rujewa and presumed destination of loads (kg)

Table 4.2: Total annual transport of fish through Rujewa estimated as fresh weight equivalent (F.W.E.) in tonnes

Table 4.3: Monthly totals for transport of dried fish through Rujewa (kg)

Table 4.4: Estimation of yields from the Usangu fishery

Table 5.1: Economics of marketing fish from the Usangu Wetlands fishery

**Table 4.1: Transport of dried fish through Rujewa  
and presumed destination of loads (kg)**

Data from District Fisheries Office records. (f.w.e. = d.w. x 2)

Date	Mbeya	Rungwe	Ilembula	Njombe	Makambako	Tunduma	Monthly Total
Jan-85	12135	5500		6432	1559	736	26362
Feb-85	9165	4725		6821	2636		23347
Mar-85	10963	2480		3610	1595		18648
Apr-85	3210	4500		7337			15047
May-85	5883	4800		7545			18228
Jun-85	4924	8750		6180			19854
Jul-85	3910	7500		2443			13853
Aug-85	3541	6975		2485	365		13366
Sep-85	6000	3446		1892			11338
Oct-85							nr
Nov-85	1214	2250					3464
Dec-85	2400	2550					4950
Jan-86	9455	7250			4868		21573
Feb-86	7932	6643			1023		15598
Mar-86	7345	6235			780		14360
Apr-86	8290	7687			1230		17207
May-86	7800	7180					14980
Jun-86	690	372			200		1262
Jul-86	800						800
Aug-86	1525	265		130			1920
Sep-86	1955	230			150		2335
Oct-86	2330	170			85		2585
Nov-86	2560	200		250			3010
Dec-86	10050	450		250	200		10950
Jan-87							13303
Feb-87	17625		75		125	62	17887
Mar-87	25500	150				125	25775
Apr-87	10630	250		500	1950		13330
May-87	49000	2500	2250	4500	780	33500	92530
Jun-87	22500	32500	1250	1500		2000	59750
Jul-87	9312			5150			14462
Aug-87	15710	14125	7705		5950	1015	44505
Sep-87	16310	15232	1605		2720	300	36167
Oct-87	12850	9100				4760	26710
Nov-87	9105	5730				2700	17535
Dec-87	1200	9000					10200
Jan-88	1375	300	310			100	2085
Feb-88	1275	255	200			125	1855
Mar-88	6250	750		1000	1250		9250
Apr-88	3980	2255	575		300		7110
May-88	3170	2305		470	1630	800	8375
Jun-88	3730	2720	710		430	310	7900
Jul-88	2130	1740		500	1125		5495
Aug-88	2625	162		1315	375		4477
Sep-88	4800	420	250	1270			6740
Oct-88	500			375	125		1000
Nov-88	1500				1000		2500
Dec-88	1500				500		2000

**Table 4.1 continued: Transport of dried fish through Rujewa  
and presumed destination of loads (kg)**

Date	Mbeya	Rungwe	Ilembula	Njombe	Makambako	Tunduma	Monthly Total
Jan-89	6364	3815	1210	570			<b>11959</b>
Feb-89	4220	4250	2100	750	900	1500	<b>13720</b>
Mar-89	17725				2000		<b>19725</b>
Apr-89	48070	3100	1320	2571	1200		<b>56261</b>
May-89	51000	2625			2375	625	<b>56625</b>
Jun-89	4225	3100	2250	1500	250		<b>11325</b>
Jul-89	30125	250			4000		<b>34375</b>
Aug-89	24206	605		3300	870		<b>28981</b>
Sep-89	4500			225	225		<b>4950</b>
Oct-89	3900	2000	125		80		<b>6105</b>
Nov-89	3250	750	1700		1400		<b>7100</b>
Dec-89	5200	4400	1800	2555	1225	250	<b>15430</b>
Jan-90	4300	2475		2700	1705		<b>11180</b>
Feb-90	2820	2150	1060	750	2650		<b>9430</b>
Mar-90	3100	2250	1950		250		<b>7550</b>
Apr-90	3700	3250		250	1600		<b>8800</b>
May-90	6400						<b>6400</b>
Jun-90	1250	600		225	400		<b>2475</b>
Jul-90	5350				3025		<b>8375</b>
Aug-90	4000	2250		750	500		<b>7500</b>
Sep-90							<b>5375</b>
Oct-90	1600	1200	600				<b>3400</b>
Nov-90	3450	2100	800		1100		<b>7450</b>
Dec-90	4600		1250		2700		<b>8550</b>
Jan-91	5100		2600	3800	4100		<b>15600</b>
Feb-91	12000	7000	1000	4500	3200	500	<b>28200</b>
Mar-91	14500	6800	2000	5600	4400	300	<b>33600</b>
Apr-91	16300	8400		6000	3200		<b>33900</b>
May-91	8220	5600	3100	4600	2800	300	<b>24620</b>
Jun-91	7420	5880	2430	3840	1500		<b>21070</b>
Jul-91	5200	3600	2190	3220	1120		<b>15330</b>
Aug-91	4900	4200	3000	3200	2500	1600	<b>19400</b>
Sep-91	6400	5200	3900	4400	2240		<b>22140</b>
Oct-91	5800	4600	3600	4200	3100	400	<b>21700</b>
Nov-91	3800		2260	2600	1500	500	<b>10660</b>
Dec-91	10100		6400	6600	5800	1600	<b>30500</b>
Jan-92							<b>13303</b>
Feb-92							<b>15028</b>
Mar-92							<b>21334</b>
Apr-92							<b>20063</b>
May-92							<b>24744</b>
Jun-92							<b>17769</b>
Jul-92							<b>14886</b>
Aug-92	6600		3400	5200	3500	500	<b>19200</b>
Sep-92	4500	4200	3100	3600	2100	500	<b>18000</b>
Oct-92	5300		2250	4000	2000	250	<b>13800</b>
Nov-92	5300		2250	4000	2000	250	<b>13800</b>
Dec-92	7500	6000	4650	4700	3275	250	<b>26375</b>

**Table 4.1 continued: Transport of dried fish through Rujewa and presumed destination of loads (kg)**

Date	Mbeya	Rungwe	Ilembula	Njombe	Makambako	Tunduma	Monthly Total
Jan-93	12500	10000	4200	5250	2750	250	<b>34950</b>
Feb-93	6000	4750	3200	4250	250	100	<b>18550</b>
Mar-93	5200	4100	2900	4000		1320	<b>17520</b>
Apr-93	6250	4100	2550	3250		2450	<b>18600</b>
May-93	7100	3150	2400	4850		2200	<b>19700</b>
Jun-93	6300	3200	2200	3900		1000	<b>16600</b>
Jul-93	4910	4220	2250	3630	750	1250	<b>17010</b>
Aug-93	4100	2500	1200	2000		600	<b>10400</b>
Sep-93	3200	2800	1800	2000		250	<b>10050</b>
Oct-93	2600	2000	1050	1400		625	<b>7675</b>
Nov-93	2600	2000	1050	1400		625	<b>7675</b>
Dec-93	2800	1250	250	750		100	<b>5150</b>
Jan-94	2100	1250	1050	1100		250	<b>5750</b>
Feb-94	1450	1200	750	750		250	<b>4400</b>
Mar-94	2550	2250	1450	2200		1375	<b>9625</b>
Apr-94	2550	2250	1450	2200		1375	<b>9625</b>
May-94	3400	1800	700	1200		250	<b>7350</b>
Jun-94	4300	2100	1300	2000		250	<b>9950</b>
Jul-94	3100	2800	1300	2200		500	<b>9900</b>
Aug-94	3000	2000	500	500		250	<b>6250</b>
Sep-94	2700	1800	900	1400		250	<b>7050</b>
Oct-94							<b>nr</b>
Nov-94	3125	1625	850	1550	625	375	<b>8150</b>
Dec-94	3125	1625	850	1550	625	375	<b>8150</b>
Jan-95	3875			875	1750		<b>6500</b>
Feb-95	5600	3600	1600	3250	1000	250	<b>15300</b>
Mar-95	7400	5250	3100	4100	3000	250	<b>23100</b>
Apr-95	6000	4200	2200	3100	2700	250	<b>18450</b>
May-95	4400	3100	1600	2100	500		<b>11700</b>
Jun-95	5000	2500	1100	1250	750	500	<b>11100</b>
Jul-95	4250	2500	1250	2500	500	250	<b>11250</b>
Aug-95	3100	2200	1200	1600	500	400	<b>9000</b>
Sep-95	2500	1600	750	1100	400	100	<b>6450</b>
Oct-95	3250	2700	1500	1600	500		<b>9550</b>
Nov-95	1500	1250	500	750	250	250	<b>4500</b>
Dec-95	2000	1000	750	750	500		<b>5000</b>
Jan-96	4200	2800	1700	2100	1200	250	<b>12250</b>
Feb-96	7000	4000	2200	3100	1400	250	<b>17950</b>
Mar-96	6000	3100	2400	3100	1250	250	<b>16100</b>
Apr-96	4700	4200	2400	3900	2000	500	<b>17700</b>
May-96	6800	5400	2200	4400	500		<b>19300</b>
Jun-96	4800	3400	1000	2200	1600		<b>13000</b>
Jul-96							<b>14886</b>
Aug-96							<b>0</b>
Sep-96	2400	2000	1600		1800	500	<b>8300</b>
Oct-96	3000	1800	1000		1500	500	<b>7800</b>
Nov-96	2200	1800	1000		1200	500	<b>6700</b>
Dec-96	1200	1000	800		1000	500	<b>4500</b>

**Table 4.1 continued: Transport of dried fish through Rujewa  
and presumed destination of loads (kg)**

Date	Mbeya	Rungwe	Ilembula	Njombe	Makambako	Tunduma	Monthly Total
Jan-97	3000	2100	1000		1500	500	<b>8100</b>
Feb-97	3500	2200	1000		1800	1000	<b>9500</b>
Mar-97							<b>21334</b>
Apr-97	2500	1500	1200		1000	1000	<b>7200</b>
May-97	1800	1400	800	800	300		<b>5100</b>
Jun-97	2500	1800	1600	1000	800	500	<b>8200</b>
Jul-97	2800	2000	1800	1600	1000	1000	<b>10200</b>
Aug-97	1800	1600	1200	1000	500	200	<b>6300</b>
Sep-97	1500	1480	1400	1300	1000		<b>6680</b>
Oct-97	10000	6800	4000	2000	1000	500	<b>24300</b>
Nov-97	9800	5000	4000	2000	1000		<b>21800</b>
Dec-97	9000	4500	4000	3500	2000	500	<b>23500</b>
Jan-98	6800	4000	2500	1000	1000		<b>15300</b>
Feb-98	8000	6200	4000	1000	1000		<b>20200</b>
Mar-98	18000	15000	10000	8000	5000		<b>56000</b>
Apr-98	12000	8000	6200	6000	4400		<b>36600</b>
May-98	10000	6000	4000	4000	2000	1000	<b>27000</b>
Jun-98	12000	8000	6000	4000	2000		<b>32000</b>
Jul-98	9500	6500	4000	2500	1000		<b>23500</b>
Aug-98	6800	4400	1000	2800	4000		<b>19000</b>
Sep-98	4800	4400	2000	1000	500		<b>12700</b>
Oct-98	3000	2500	1000	1000	500		<b>8000</b>
Nov-98	2000	1500	1500	1000	1000		<b>7000</b>
Dec-98							<b>5000</b>
Jan-99	2800	2000	1800	1500	1000	500	<b>9600</b>
Feb-99	3000	2000	1900	1700	1000		<b>9600</b>
Mar-99	5600	4400	3620	3000	2500		<b>19120</b>
Apr-99	5800	4400	4000	3800	2600		<b>20600</b>
May-99	4800	4200	3600	2800	1800		<b>17200</b>
Jun-99	2600	2000	1800	1400	1200		<b>9000</b>
Jly-99	1800	1000	1000	800	600		<b>5200</b>
Aug-99							<b>4300</b>

**Table 4.2: Total annual transport through Rujewa estimated as fresh weight equivalent (f.w.e.) in tonnes**

Data from District Fisheries Office records. (f.w.e. = d.w. x 2)

year	total tonnes (f.w.e.)
1985	336.9
1986	213.2
1987	717.7
1988	117.6
1989	533.1
1990	173.0
1991	553.4
1992	436.6
1993	367.8
1994	172.4
1995	263.8
1996	247.2
1997	261.8
1998	524.6

**Table 4.3: Monthly totals for transport through Rujewa**

**of dried fish (kg)**  
 Data from District Fisheries Office records. (f.w.e. = d.w. x 2)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1985	26362	23347	18648	15047	18228	19854	13853	13366	11338	0	3464	4950
1986	21573	15598	14360	17207	14980	1262	800	1920	2335	2385	3010	10950
1987	nr	17887	25775	13330	92530	59750	14462	44505	36167	26710	17535	10200
1988	2085	1855	9250	7110	8375	7900	5495	4477	6740	1000	2500	2000
1989	11959	13720	19725	56261	56625	11325	34375	28981	4950	6105	7100	15430
1990	11180	9430	7550	8800	6400	2475	8375	7500	5375	3400	7450	8550
1991	15600	28200	33600	33900	24620	21070	15330	19400	22140	21700	106660	30500
1992	nr	19200	18000	13800	26375							
1993	34950	18550	17520	18600	19700	16600	17010	10400	10050	7675	7675	5150
1994	5750	4400	9625	9625	7350	9950	9900	6250	7050	nr	8150	8150
1995	6500	15300	23100	18450	11700	11100	11250	9000	6450	9550	4500	5000
1996	12250	17950	16100	17700	19300	13000	nr	nr	8300	7800	6700	4500
1997	8100	9500	nr	7200	5100	8200	10200	6300	6680	24300	21800	23500
1998	15300	20200	56000	36600	27000	32000	23500	19000	12700	8000	7000	5000
Ave. "nr" months omitted	<b>14301</b>	<b>15072</b>	<b>20938</b>	<b>19987</b>	<b>23993</b>	<b>16499</b>	<b>13713</b>	<b>14638</b>	<b>11305</b>	<b>10202</b>	<b>8667</b>	<b>11447</b>
1999 to August not included	9600	9600	19100	20600	17200	9000	5200	4300				

**Table 4.4: Estimations of yields from the Usangu fishery**

	Method of estimation	Minimum estimate (t/yr f.w.e.)	Maximum estimate (t/yr f.w.e.)
(a)	Commercial fishing activity	380	760
(b)	Subsistence fishing activity	100	100
(c)	Transportation records data	120	750
(d)	Adjusted transportation records to account for evasion	240	1,500
	Total yield best estimates are therefore (a) + (b) and (b) + (c)		
(e)	(a) + (b)	480	860
(f)	(b) + (c)	340	1,600
(g)	<b>“Best estimates” of range of annual yield</b>	410	1,230
(h)	<b>“Best estimates” of average annual yield (a) + (b) 1985 – 1998</b>		670
(i)	<b>“Best estimates” of average annual yield (b) + (c) 1985 –1998</b>		720

**Table 5.1: Economics of the marketing of fish at the Usangu Wetlands fishery**

	<b>Operation</b>	<b>TShgs/kg (f.w.e.)</b>
(a)	Price received by fishermen at landing (A)	250
(b)	Processing costs (smoking wood and preparation of fish) (B)	15
(c)	Transportation fish to road head (C)	20
(d)	Licence fee for transportation (D)	5
(e)	Road transport to market	20
(f)	Transport in village	2.5
(g)	Cooperative cess	2.5
(h)	Retailer's selling costs	neg
(i)	<b>Total cost to retail seller</b>	<b>315</b>
(j)	<b>Retail selling price</b>	<b>500</b>
(k)	<b>Trader's net profit [(j) – (i)]</b>	<b>285</b>
(l)	<b>Net margin (E)</b>	<b>90%</b>

**Notes:**

- (A) As no records are kept, the prices used here are generalisations as actual prices will fluctuate with season, location of the landings and the perceived quality of the product.
- (B) One processed batch is assumed to be 200kg f.w.e.or *ca* 600 dried fish.
- (C) The model quoted was for the transport of fish from Magarimabovu landing – Kapunga on main road – Igurusu market by a Member of the trading cooperative.
- (D) Assumes large packet loads.
- (E) This margin would be expected from a short chain transaction of a relatively short life product which can deteriorate in transport.

## **FIGURES**

Figure 4.1: Annual transport of fish through Rujewa 1985 - 1998

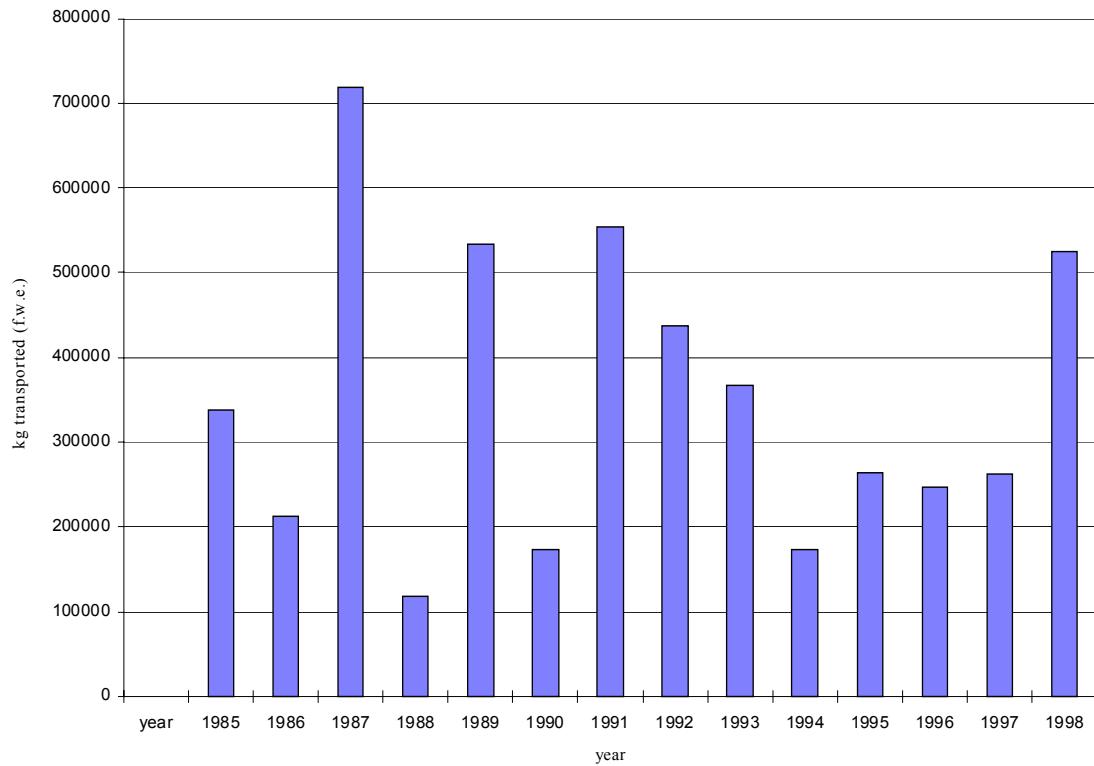
Figure 4.2: Monthly transport of fish through Rujewa 1985 – 1999

Figure 4.3: Average monthly transport of dried fish through Rujewa (data 1985 – 1998)

Figure 4.4: Rainfall records at Rujewa 1996/97 – 1998/99

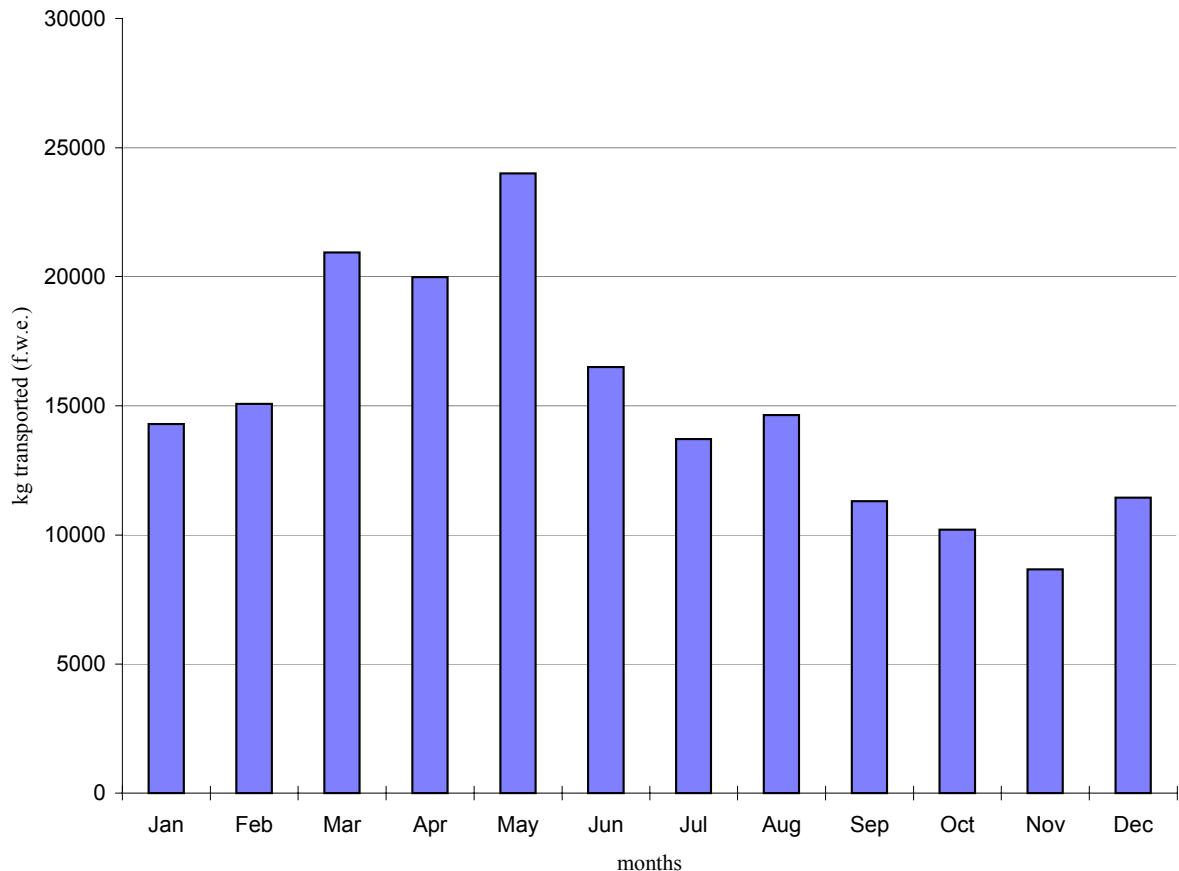
Figure 4.5: Rainfall and fish transport, Rujewa 1995 – 1999

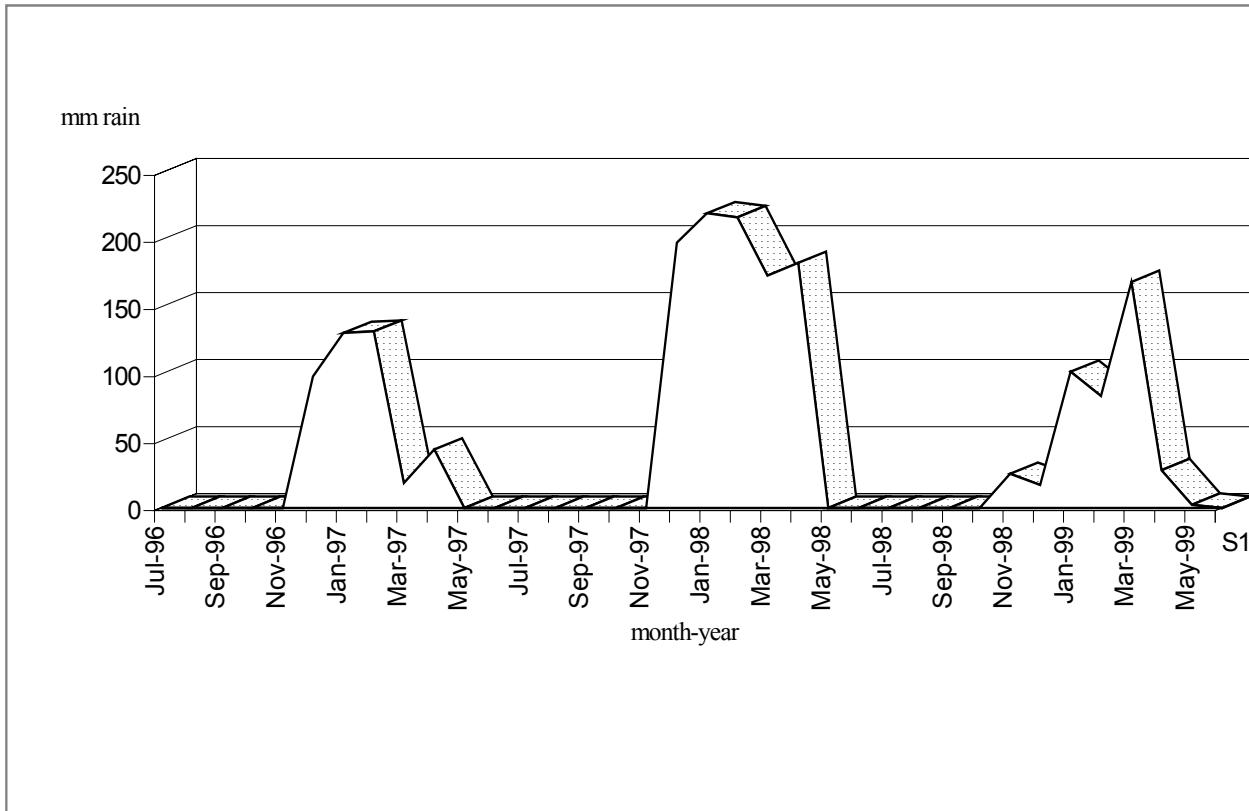
Figure 4.6: Distribution of fish passing through Rujewa, DFO records 1985 – 1998

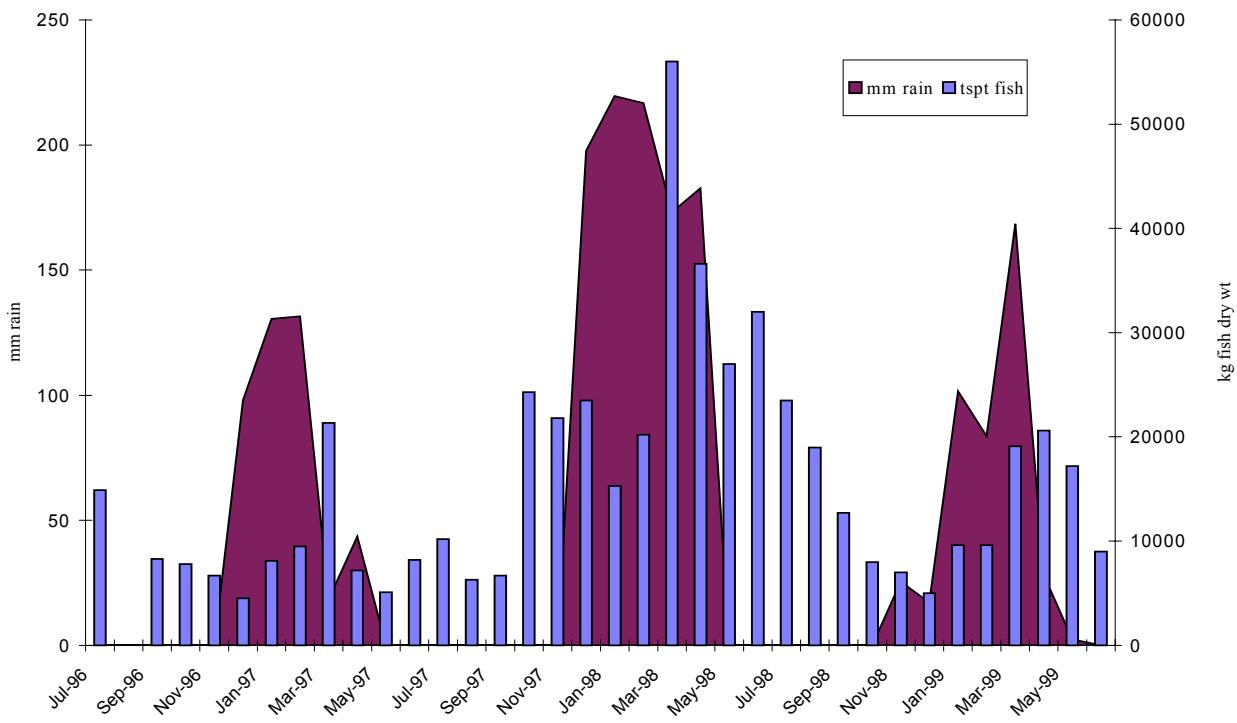
**Figure 4.1:****Annual Transport of Fish through Rujewa 1985-1998**

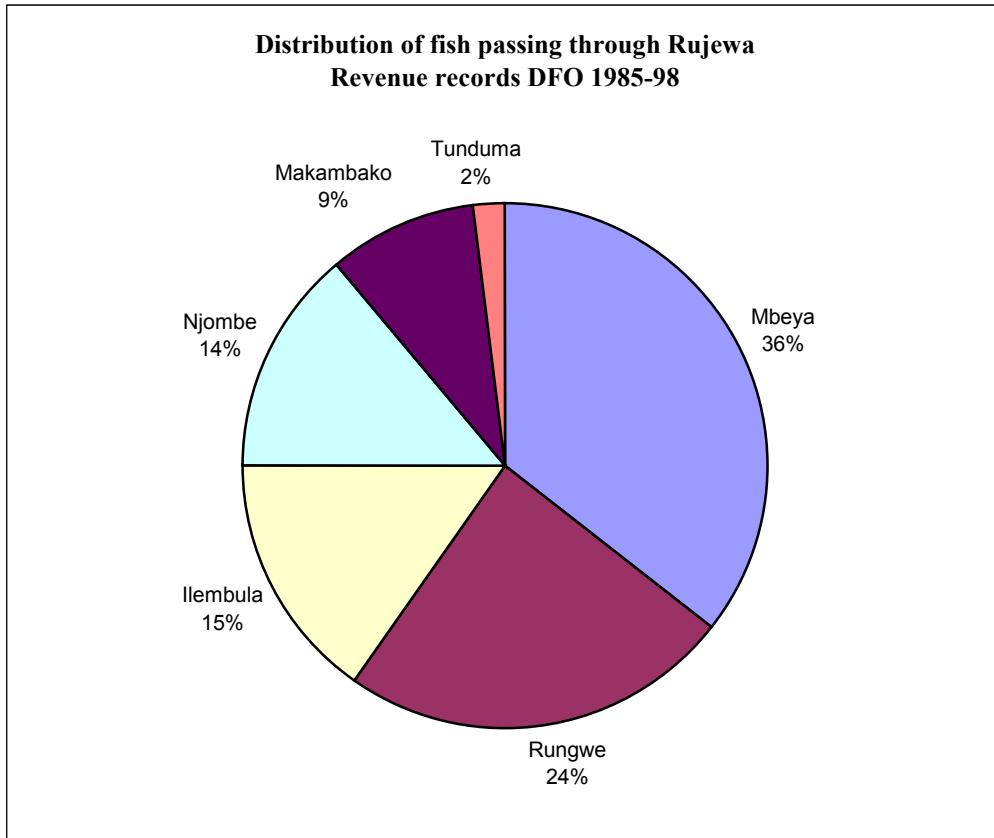
**Figure 4.3**

Average Monthly Transport of Dried Fish through Rujewa (data 1985-98)



**Figure 4.4****Rainfall Records at Rujewa 1996/97 - 1998/99**

**Figure 4.5:****Rainfall and Fish Transport, Rujewa 1995-1999**

**Figure 4.6:**

## **APPENDICES**

- Appendix 1: Travel Schedule and Itinerary
- Appendix 2: Contact List
- Appendix 3: Publications relevant to the Usangu Flood Plain Fishery
- Appendix 4: Wood use for Fish processing in the Usangu
- Appendix 5: The Usangu Wetlands Fisheries and the Impact of the Game Reserve
- Appendix 6: Notes on fish bio-diversity on the Usangu Wetlands

## Appendix 1

### Travel schedule and itinerary

**(April-May and October-November 1999)**

**Dr I. G. Dunn - Fisheries Specialist**

Date	Activities
<b>Visit 14 April – 26 May 1999</b>	
14.4.99	Depart Chatham for London Heathrow. Depart Heathrow EK 004 2045.
15.4.99	Arrive DSM EK421 1530. Road to Morogoro.
16.4.99	Depart Morogoro 0800 by road. Arrive Rujewa 1600.
17.4.99	SMUWC office for briefing and orientation.
18.4.99	Worked on planning notes. Discussions with Team Leader.
19.4.99	Meet briefly with the District Commissioner. Preliminary meetings with District Natural Resources Officer and Fisheries Officers, in Rujewa. Prepare next 3 days field itinerary.
20.4.99	Meeting with FOs and District Co-operatives Officer. Visit Rujewa market with FO. Data working up in p.m.
21.4.99	With FO and Asst FO on field visit to Ikoga, met with village officials and visited Fishing Camps at Matagovanu and Madawi to talk with fishermen, processors and transporters.
22.4.99	With FO and AFO on field visit to Nyota and Udegale fishing camps, talk with fishermen, etc.
23.4.99	With FO and AFO on field visit to Kapunga village and fishing camp. Met with village official.
24.4.99	Work up field notes etc., initial mapping.
25.4.99	Work up data sets from District Fisheries Office.
26.4.99	Worked up notes in office. Reconnaissance trip to investigate state of travel to the north and west past the Mbarali Rice Estate.
27.4.99	With AFO on field visit to Ikoga and Mapogoro. Met with Exec Officer Mapogoro. Visited Lyanywage fishing camp. Group meeting with fishermen etc. Return to Rujewa via Madebera and Makambako.
28.4.99	Worked up field notes in a.m. and attended Community Action and Planning Group Seminar in the p.m.
29.4.99	Field visit to Mbeya and Mbalizi with the District Natural Resources Officer. Visited Wasamba Cooperative Society, Mbalizi and talked to Society officials. Visited Mbalizi market. Visited the Mbeya Regional Offices and met the Regional Natural Resources Officer.
30.4.99	With the FO and District Coops Officer visited the Fishery Co-operatives in Ubaraku and Rujewa. Work up field notes later in p.m.
1.5.99	Attended all day meeting of senior officials of the RBM-SIP team. DC and DEO in attendance.
2.5.99	Worked up field notes etc.
3.5.99	Data from DF Office not available as a National Holiday. Worked up notes and drafted initial report sections.
4.5.99	Survey flight over the plains and canoe census.
5.5.99	Field trip to Kapunga fish landing and major transit point. Met with official of Igova village.
6.5.99	To Mbeya to meet with Regional Nat Res Officer and Regional Fisheries Officer. Leave request for data extraction from Regional Administration archives.
7.5.99	Transfer field data to map. Extract data from DFO files.
8.5.99	Continue to collate and analyse data from DFO. Mapping and continue initial report drafting.
9.5.99	Work on report in office and mess.
10.5.99	DFO extracting data from archive files.
11.5.99	Field visit to Mission at Ubaraku talked with Mission Father. To the Mbarali Rice Scheme and talked with manager i/c aquaculture activities. Visited ponds and watched harvesting. In p.m. a 2 h talk with fisherman and AFO.
12.5.99	Field trip to Iringa. Visited markets at Iringa, Makambako and Mafinga.
13.5.99	Worked up notes and data in office.
14.5.99	Visited retailer in Rujewa and worked up notes and data.

- 15.5.99 Worked up notes and data.  
 16.5.99 Field visit to west and north of the project area with AFO. Visited Igurusi, Utengule, and Madundas. Meeting with Madundas village Chairman.  
 17.5.99 Field visit to Kapunga landing with AFO.  
 18.5.99 Work up field data and report drafting.  
 19.5.99 Collated data from DFO in a.m. Analysed data in p.m.  
 20.5.99 Collated data from DFO in a.m. and p.m. Preparations for Seminar.  
 21.5.99 In a.m. gave Seminar on work to date. In p.m. worked up data, notes and reports.  
 22.5.99 Completed drafting of interim report and administrative matters.  
 23.5.99 Depart Rujewa for DSM by road.  
 24.5.99 Meet with Leader and Dr Nick Howells (University of Dar es Salaam) to discuss future work and biodiversity programme.  
 25.5.99 Depart Dar EK 422 1545.  
 26.5.99 Arrive London Gatwick by EK 007 0655. Return to Chatham by train and car.

#### **9.10 Visit 4 October – 15 November 1999**

- 04.10.99 Mon Depart Chatham for London Gatwick. Depart Gatwick BA 0267 2300.  
 05.10.99 Tue Arrive Dar es Salaam BA 0267 1215.  
 06.10.99 Wed Discussed Biodiversity component with Dr Mgaya at UDSM. Visited FAO library in DSM. Arranged reservations for coach to Igawa. Liased with Local Perspective.  
 07.10.99 Thu Coach depart 0700 Dar arrive Igawa 1800. Transfer to Rujewa.  
 08.10.99 Fri Discussion with Team Leader updating of team information and re-orientation.  
 09.10.99 Sat Worked up schedules, field itineraries and organised paper work.  
 10.10.99 Sun Organised documentation and computer work files. Logistic support for flight survey crew.  
 11.10.99 Mon Office for logistics meeting. Visit District Fisheries Office and arrange local support.  
 12.10.99 Tue With AFO to Ubaraku, Rujewa and Makambako markets. To Njombe, meet with DFO, visit market and meeting with fish marketing Cooperative officials.  
 13.10.99 Wed With AFO drive to current fish landing at Magarimabovu north of Rujewa.  
 14.10.99 Thu With D Nat Res O and AFO survey and reconnaissance flight over project area fishing activities. Work up notes in afternoon.  
 15.10.99 Fri Meeting with District Forestry Officer to discuss wood use. Office work  
 16.10.99 Sat Visit Ubaraku R C Mission to discuss canoe building. Worked up notes and initial report drafting in office.  
 17.10.99 Sun Work up notes etc.  
 18.10.99 Mon CLOSED for Nyerere's funeral arrangements.  
 19.10.99 Tue With AFO to Magaimbovu landing in am. Office in pm.  
 20.10.99 Wed With AFO travel to N of the Ruaha via Upagama. Visited fishing camps and fish landings.  
 21.10.99 Thu CLOSED for Nyerere's funeral arrangements.  
 22.10.99 Fri Talk with District Fisheries Officers and District Natural Resources Officer. Office in pm.  
 23.10.99 Sat CLOSED for Nyerere's funeral arrangements.  
 24.10.99 Sun Office work  
 25.10.99 Mon With D Nat Res Officer and AFO to Mbeya for meeting with Regional Natural Resources Officer.  
 26.10.99 Tue Office work  
 27.10.99 Wed Office work and visit with AFO to Ubaraku Mission to talk with woodworkshop supervisor.  
 28.10.99 Thu With AFO visited the landings to the south of Ruaha.  
 29.10.99 Fri With AFO to Chimala and Ugurusi to talk with local officials and the Chimala Cooperative.  
 30.10.99 Sat Office work  
 31.10.99 Sun Report drafting  
 1.11.99 Mon With AFO travelled on wetlands in airboat, to the west along the Ruaha.  
 2.11.99 Tue With AFO travelled on wetlands in airboat, to the north to try and find way to Ihefu  
 3.11.99 Wed Office work  
 4.11.99 Thu Office work  
 5.11.99 Fri Office work  
 6.11.99 Sat Office work and at house  
 7.11.99 Sun Work at house  
 8.11.99 Mon With DFO to Ugurusi and meet with Coop members.  
 9.11.99 Tue Office work

10.11.99	Wed	Office work
11.11.99	Thu	Office work
12.11.99	Fri	In morning gave seminar of findings and recommendations. Completed office work and submit draft report
13.11.99	Sat	Travel to DSM by road
14.11.99	Sun	Leave DSM for London EK 1245
15.11.99	Mon	Arrive London EK 007 0650 and transfer to Chatham.

## Appendix 2

### Contact List (April-May and October-November 1999)

	Name	Position
<b><i>Regional Authority</i></b>		
Mr	MUNISI Stanley L.	Game Officer, Mbeya Region
Mr	SANGA Godfrey L.	Forestry Officer, Mbeya Region
<b><i>Mbeya Rural District Authority</i></b>		
Mrs	SEMBO Selestina	District Fishery Officer
<b><i>Mbarali District Authority</i></b>		
Mr	MWALUKO Rojas	District Nat Resources Officer
Mr	KASSENGA Kadam	District Fisheries Officer
Mr	LIPINGU Melito	District Forestry Officer
Mr	NYIRENDIA Cuthbert	Asst. District Fisheries Officer
Mr	MWANJALA Samuel	District Co-operatives Officer
Mr	MWAPONGO Lusekelo	District Trading Officer
Mr	IRANGA Haji	Game Scout, Upagama
<b><i>Chimala (Ilongo) Division Authority</i></b>		
Mr	KADAHYA Fideus	Secretary
Ms	KAYUPA Consulata	Asst Forestry Officer
9.10.1 Njombe District Authority		
Mr	SIMON Joseph	District Fishery Officer
<b><i>Songwe Division</i></b>		
Mr	GUMBWA Leonard H.	Fishery Officer
<b><i>Village Authorities</i></b>		
Mr	MKOMOLE Henry	Exec. Sec. Mungano Vill. Council
Mr	NINDI Justin	Exec. Sec. Mapogoro Vill. Council
Mr	TINDA Damas	Finance Off. Ikoga Vill. Council
<b><i>Chimala Fish Trading Group</i></b>		
Mr	FIDAS John	Chairman
Mr	JACKSON Elisha	Secretary
<b><i>Ugurususi Fishing and Fish Trading Cooperative</i></b>		
Mr	SIFAELI Alli	Chairman
Mr	MWATIJA Amos	Accountant
Mr	GILLIARD Ngwema	Member
<b><i>Wasamba Cooperative Society Ltd. Mbalizi</i></b>		
Mr	MIMABOWGO Aden M.	Chairman
Mr	MWAMBOPE Granton	Secretary
Mr	MAHASIBU Samli Soloko	Accountant
Miss	MBOYA Oliva Isenyi	Chair, Savings and Credit Society
<b><i>Wauza Samak Cooperative Society Ltd., Njombe</i></b>		
Mr	SANGA Salum	Vice-Chairman
Mr	KYANDO Alfeo	Secretary

Mr	BILINI Michael	Treasurer
Mr	<b><i>Uwabisumko Cooperative Society Ltd. Ubaruku</i></b> MSIGWA Paulinus	Secretary
	<b><i>Uwasaru Cooperative Society Ltd. Rujewa</i></b>	
Mr	KYANDO Antony Juliasi	Chairman
Mr	KYANDO Zeno L	Secretary
Mr	MUTUZA Fideris Sanga	Accountant
Mr	MAHENGE Morphati	
	<b><i>Mbarali Rice Scheme</i></b>	
Mr	SAHINI Ephron	Aquaculture Man. Livestock Sect.
	<b><i>Ubaraku Mission</i></b>	
Fr	DRAZEN Klapez	Mission Priest
Mr	DONDOLLA Marius	i/c Carpentry Workshop
	<b><i>National Microfinance Bank, Rujewa</i></b>	
Ms	LUVANDA Doris A.	Manager
	<b><i>Rujewa</i></b>	
Mr	TUMBAKA	Shop owner

### Appendix 3

#### Publications relevant to the Usangu flood plain fishery

Asterisk (\*) indicates references that are available at SMUWC Office.

Bagachwa, M.S.D., Hodd, M.R.V., and Maliyamkona, T.L. (n.d.) Fisheries Development in Tanzania. Macmillan Press Ltd., UK, 185 pp.

*[This publication is intended specifically to provide information for Fisheries Officers and others directly interested in fisheries administration and development in Tanzania. Copy seen in FAO library in Rome, but any other copies have been impossible to find.]*

\* Bernacsek, G.M., (1981). Freshwater fisheries and industry in the Rufiji River Basin, Tanzania: Prospects for coexistence. In: Seminar on river basin management and development (Kapetsky, J.M. (Ed). Blantyre, Malawi, 8-10 December 1980. CIFA Tech. Paper., 8: 302pp

*[Useful comments on production levels in Kilombero swamps]*

Eccles, D. H., (1992). FAO species identification sheets for fishery purposes. Field guide to the freshwater fishes of Tanzania. Publ. FAO. Rome. 1992. 145 pp.

*[An excellent field guide and the source book for other field guides in recent reports]*

\* Government of Tanzania, Gazette (1994), Marine Parks and Reserves Act, 1994.

\* Government of Tanzania, Ministry of Natural Resources and Tourism, (1997). National Fisheries Sector` Policy and Strategy Statement. Draft 1. Dar es Salaam, September 1997

\* Government of Tanzania, Draft Policy Document (1998). Tanzania Forest Policy, Final Draft Approved March 1998.

\* Mapunda, X.E., (1980). The economic impact of the fisheries of the Kilombero River Basin in the Morogoro Region of Tanzania. In: Seminar on river basin management and development (Kapetsky, J.M. (Ed). Blantyre, Malawi, 8-10 December 1980. CIFA Tech. Paper., 8: 302pp

*[Overview of the yields and economic value of Kilombero fishery as a useful comparison for the Usangu fishery. Some rather drastic errors of estimation in Table 2]*

\* MRAG Limited (Payne, I. and Cowan, V.) (1995). Ruaha ecosystem wildlife management project (REWMP) Tanzania: Fish and Fisheries of the Ruaha. *MRAG Report, No 1* :57pp and 2 Appendices.

*[Paper more concerned with the lower reaches of the Ruaha system.]*

\* MRAG Limited (Townsley, P.) (1995). Fisheries resources for community wildlife management in the Ruaha Ecosystem Wildlife Management Project, Tanzania. *MRAG Report*, No 2: 61 pp.

\* MRAG Limited (Payne, I., Cowan, V. and Townsley, P.) (1995). Ruaha Ecosystem Wildlife Management Project (REWMP) Tanzania: Determination of the potential for fisheries utilisation in Lunda-Mkwambi Game Control area. *MRAG Report* 58 pp and 2 Appendices

\* Walsh, M. T., (1996). Fish and Fishing in the rivers and wetlands of the Usangu. *Paper submitted to East Africa Natural History Society Bulletin January 1996.*

[*This paper refers specifically to findings of an anthropological field study of Usangu in Itengule 1981-82.*]

#### **Appendix 4**

## Wood use for fish processing in the Usangu

The major product of the Usangu fishery is hot-smoke-dried fish. This is processed on racks above wood-fuelled fires. This wood represents the major resource use resulting directly from the fishing activities. It is important to define the environmental and economic implications of the use of this fuel.

### The smoker installation

The fish are laid out on racks that are usually made from metal grills or from wood branches. These are placed about 50cm above a slow-burning fire. The grill may be laid across low mud-brick walls or above a simple pit dug in the ground. Grass screens may be set up to shelter the fire from strong winds and the resultant excessive heat from a fast burn.

### The product

The dominant fish caught on the Usangu fishery is the catfish *Clarias gariepinus* ("kambale"). This is rolled and spitted, or if large cut into portions of approximately 1kg each. These are laid out and turned at intervals for 2 or 3 days. The final product is assessed to be reduced to about 50% of the fresh weight. At this degree of processing the product will be preserved for a relatively long time and is well sought after in the retail markets.

Smaller quantities of other fish such as *Oreochromis (Tilapia) urolepis* ("ngege"), Mormyrids, *Marcusenius livingstoni* and *Petrocephalus ?catastoma*, Schilbeids, *Schilbe moebiusii* are also processed but compared with the catfish the catch of these latter species is negligible.

### Fuel Use

Practically any wood can be used although *Dichrostachys cinerea* (Mimosaceae) or "mpangala" (kisangu and kihehe) is said to be the wood of preference.

Investigation of fish smoking processes associated with other fisheries in East Africa have noted that between 0.6 to 1.5kg of wood is required to smoke 1kg of fish (*Lates niloticus* or Nile perch). In Uganda smoking pit kilns similar to the type used in the Usangu Wetlands fishery require about 0.5kg of wood for 1kg of fish (Tilapia).

It is of value here to assume a low efficiency, and thus be presented with a worst case scenario. Fishermen and processors claim that it takes 0.3m<sup>3</sup> of wood to smoke 200 fish. 200 fish will usually weight some 50 to 100kg. This suggests that 1m<sup>3</sup> of wood is required to process between 150 and 300kg.

These figures give, what is apparently, a remarkably high wood usage of between 2.5 and 5kg per kilogram wet-weight of fish (see Table A4-1 for summary of these estimates<sup>25</sup>).

### Overall fuel wood demand

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<sup>25</sup> It is here assumed that 1m<sup>3</sup> of wood will weigh 750kg.

If a total yield of 850 tonnes a year is assumed to be the average yearly catch, this will require some 1,750 to 3,500 tonnes of wood each year. This will be equivalent to approximately 2,300 to 4,700 cubic meters of wood each year. A median figure of 4,000 cubic meters can be assumed to be the yearly demand.

**Table A4-1: Parameters for estimating smoke wood requirements of the Usangu fishery**

a)	Number of fish in each batch smoked	200
b)	Average weight per fish (wet-weight kg)	0.3
c)	Total weight of fish per batch (kg)	60
d)	Total yield of fishery -median estimate (kg)	700,000
e)	Total number of smoke batches fishery-wide per year [(d)/(c)]	11,700
f)	Unit of estimation is the “log” 2.5m x 0.1m diameter	
g)	Volume of log ( $m^3$ )	0.02
h)	Single smoke batch requires 18 logs with a volume ( $m^3$ )	0.35
i)	Total volume of wood fishery-wide per year ( $m^3$ ) [(e) x (h)]	4,095
j)	<b>GENERAL ESTIMATE FISHERY-WIDE TOTAL (<math>m^3</math>)</b>	<b>4,000</b>

### **Environmental considerations**

All the wood that is used must be dry and easily burnable. It follows that most, if not all, is gathered from fallen timber. This timber may be from natural tree fall or from the extensive clearances that are made to obtain land for agricultural small holdings. It is likely that this latter sources predominates. It is difficult to assess the environmental impact of this demand, although discussions with Resource and Game Officers suggest that this quantity can be well supported by the wood production of the Usangu Plains.

### **Appendix 5**

#### **The Usangu wetlands fisheries and the impact of the game reserve**

## Introduction

As a wildlife conservation measure a large area of the Usangu Plain adjacent to the Ruaha National Park was designated a Game Reserve on 24 July 1998<sup>26</sup>. The District Administration was officially notified on 3 December 1998. This letter of notification stipulated that the Game Reserve was now active and that the livestock herds should be removed from the area. A final reminder to remove livestock from the area was transmitted to the owners of the livestock on 19 October 1999. Arrangements were made for the payment of financial compensation to those units displaced. This compensation appeared to be related to the abandonment of fixed assets, such as houses.

## Legal implications

The regulations that apply within the perimeter of a designated Game Reserve derive from the legislation embodied in The Wildlife Conservation Act (No 12 of 1974). These regulations, effectively section 7 to 12 of the act, include the following proscriptions: no entry or residence, except to residents of registered villages, no farming, fishing, grazing of livestock, hunting in any form, no fires, no wood cutting (although it would appear that fallen wood can be taken).

It is noted in the act that the Director of Wildlife of the Ministry of Natural Resources, is empowered to waive any of the regulations if applied to and permission given in writing. Trees can be felled, if permission is granted by the Director of Forestry, who will in turn be authorised by the Director of Wildlife. The Regional Natural Resources Officer, who is responsible for the activities of the District Forestry, Fisheries and Wildlife Departments can liaise directly with the Regional Wildlife Officer, although in practice would normally work through the Ministry in Dar es Salaam.

There is some conflict as to how these regulations should be applied as currently the District Fisheries Office is issuing fishing licences which imply, but do not specify, that the holders can carry out their activities in the usual fishing areas.

The occupants of the fishing camps, who in the dry season are mostly full-time “professional” fishermen, apparently are aware of the implications of the changes but as yet have taken no action.

## The effect of the game reserve on fisheries activities

The overall effect would be disastrous to any attempt to exploit the fish stocks of the Usangu wetlands. Although only rough estimates can be attempted it would appear that most of the permanent waters and about half of the mbuga wetlands are removed from open access and incorporated into the Game Reserve. Virtually all of the northern part of the eastern wetland, including the north bank of the Ruaha river from the Ulanga drainage line down to its confluence with the Ruaha is now within the Game Reserve. All the permanent waters of the Ihefu and its associated small lakes and watercourses are included as is a large area of the southern part of the eastern mbuga.

The inclusion of both banks of the Ruaha in the Game Reserve now means that the larger fishing villages/fishing camps are effectively illegal gatherings. These camps (*e.g.* Bosco, Langulyage, Nyamalala, Mtmbele etc.), although seasonal, have stable locations and form stable communities from year to year. Many more, smaller, fishing and processing camps are also illegal.

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<sup>26</sup> Gazetted in Government Notice No 436A.

In addition to having no legal access to the water, the fishermen are unable to evacuate their catches. The bicycle and vehicle tracks which follow the same lines from year to year as the waters recede at the end of each wet season, also pass through the areas where access is now forbidden.

The strict application of the regulations will reduce the fisheries of the Usangu to the exploitation of the mbuga of the western end of the wetlands and a small amount of the mbuga to the north and east of Ikoga at the eastern end. This implies that the fishery will only be carried out for a few months at the end of each rainy season and is likely to be undertaken by part-time, opportunistic, fishermen.

- **The major part of the wetlands production will be totally unutilised and, as it will never survive to maturity, wasted.**

### **How can the fishery be preserved and co-exist with the game reserve?**

It is obvious that fishing demands the access of fishermen to the area. This access implies that the fishermen must be able to reside in the area close to the fishing grounds and the transport routes. In addition, in order to carry out the essential processing of their catches, there must be access to supplies of wood for smoking.

- **This access, and the accompanying activities, will have negligible implications for the status of the Game Reserve.**

However, the presence of a population, of any sort, within the Game Reserve boundary can create opportunities for illegal activities. The most serious of these would be poaching with firearms and traps. Of lesser importance would be wood felling for fuel and ground clearance and the encroachment that this may entail.

### **Regulation and management of access**

As with all regulatory activities, their successful application should be based on strict and fair enforcement and continuous monitoring.

The following proposals should be considered.

### **Licensing of fishers and other operators**

Fishing licences will be issued by the District Administration. A single, uniform, licence will be obligatory for all operators who wish to fish, or carry out any other commercial operation associated with the exploitation of any fish stocks, within the jurisdiction of the District Administration. This licence will cover all fishing activities in any free-access waters in the District, but will not carry any right to enter into the Game Reserve for any activities whatsoever.

These licences will be available for inspection on demand by authorised officials where licensed occupations are being carried out.

### **Licensing for operations within the Game Reserve boundaries**

Any fisher, or other operator who wished to carry out activities within the Game Reserve, in addition to the licence required by all fishers and operators in the District, should be in possession of a licence to be present and/or resident within the protected area. These licences will be issued only to fishing licence holders and will cover members of their *bona fide* immediate family members. Family members covered by these licences will not be permitted to engage in fisheries occupations, unless they individually hold fishing licences.

The number of licences should be limited in number. Initially residence licences should be issued to fishers who already have been active and licensed (*i.e.* “Grandfather rights”).

- **It is essential that fishermen are properly licensed and documented and that this licensing, in allowing them access to the Game Reserve, is seen by them as a privilege which sets them apart from other individuals and provides them access to an effective monopoly exploitation of the resource.**

### **Monitoring of licence compliance**

Any monitoring exercise, involving a system scattered over a large area where communications are poor, will be costly in terms of personnel and transportation. The licensing system should be so designed that any effort required to ensure compliance is reduced to a minimum.

### **Revenue levels**

All licence fees should reflect the net incomes of the licensee. If the fees are considered reasonable the temptation to avoid payment is reduced. Licence fees should be revised, from time to time, to keep them in line with the level of prices and incomes.

### **Application procedures and formalities**

Any regulations for the application and issue of licences must take into account the practicalities of travel and infrastructure throughout the area. Information as to opening hours of issuing offices should be readily available and the adhered to on the part of the administration. Regulations as to completion of forms, countersignatures, photographs etc., must be practical.

### **Form of licence documents**

Bearing in mind the exigencies of living and working in the wetland environment, licences should probably be laminated and incorporate a colour coding for the year of issue. This will enable compliance to be checked at a distance if the regulations specify that they should be on display at all times.

## **Appendix 6**

### **Notes on fish biodiversity on the Usangu wetlands**

#### **Introduction**

The flat basin of the Usangu Plain supports a typical tropical wetland. This wetland is subject to a seasonal pattern of annual flooding with inundation periods which may range from a matter of days to several months. In the lowest areas the plain supports permanent swamps and lakes and the residual drainage channels of the permanent watercourses.

The whole of the plain lies in the eastern limb of the Rift Valley with the mountains of the Southern Highlands providing a watershed between the plains and the waters of Lake Nyassa/Malawi to the south and Lake Tanganyika to the west. Prior to the formation of the Rift and the mountain barriers, it is thought that the drainage of the area of what is now central and south-west Tanzania was towards the west and the Atlantic Ocean through what has now become the Congo/Zaire drainage basin.

With the establishment of the mountain ranges to the south and west, the drainage of the Usangu Plains contributed to the catchment of what is now the Rufiji river basin to discharge into the Indian Ocean.

It can be assumed that prior to the change of drainage the species make up of the aquatic fauna would have had close affinities to the fauna of the Zaire basin. On isolation from this western catchment the fauna would tend to mirror that of East Africa

### **Habitat types of the Usangu Wetlands**

As the habitats are defined by the topographical gradients, the seasonal fluctuations in precipitation, waterlogging and bank overspill, and all of these change over time, it follows that there can be no clear demarcation of habitat types or the periods in which they are ecologically important.

#### **Seasonally inundated land**

This flat grassland, the “mbuga”, is inundated for several months each year and is clearly demarcated by the change of vegetation from the drier “miombo” of open thorn scrub. This mbuga vegetation is heavily grazed by livestock and reduced to a flat cracked mud surface before the return of the floods with the onset of the next rainy season.

These inundated lands present an aquatic habitat of environmental extremes (*i.e.* “stress”) as the shallow waters, rich in nutrients, reach high temperatures and suffer low levels of dissolved oxygen.

#### **Temporary residual waterbodies**

Drainage channels and depressions remain as the waters recede. These isolated areas of water gradually dry up. As these waters dry, the extremes of their environment gradually make conditions unsupportable for the aquatic flora and fauna and these are eventually eliminated.

#### **Permanent water courses**

Some of the major drainage channels, particularly the Ruaha river and some small permanent lakes, stay full and continue to flow. Although changes in water quality have not yet been documented, it can be assumed that the aquatic environment of these waters changes little from season to season.

### Permanent swamp

There are two main areas of permanent swamp, the Ihefu of some 90km<sup>2</sup> and the Ndembera which covers only some 100ha or so. These swamps are areas of shallow water, lily pads and floating grass mats. These fluctuate in the depth of the overlying water to end as areas of wet mud at the end of the dry season. These permanent swamp areas are a typical swamp habitat presenting extreme aquatic environmental conditions.

### Effective of habitat type on species biodiversity

In general, it can be accepted that the higher the ecological stress imposed by a particular habitat, the smaller the number of species that are able to exploit it. The usual pattern is of large populations of few species. The species that can exploit the habitats tend to be specialised and to demonstrate increased physical or physiological adaptations. Because particular species are able to exist in an extreme habitat, the lack of competition for food and space allows for the development of large populations of the adapted organisms.

This is exactly the situation found on the Usangu Wetlands where the totally dominant fish species are catfish of the family Clariidae. It is this species that dominates (probably more than 99%) the commercial catches of the fishery. Present to a smaller extent, and also exploited, are populations of species of the elephant-snout fishes of the family Mormyridae, which are adapted to swamp-fringe habitats.

The small numbers of Cichlidae, which are also found in the commercial catches, are indicative of populations that exploit the clearer waters of the permanent lakes and rivers.

### Fish species found

**Note:** The identification of fish species in this Appendix must be regarded as tentative until confirmation is obtained from access to formal taxonomic references and collections.

#### Family: Clariidae

##### *Clarias gariepinus* (Burchell, 1815)

Major synonym: *Clarias mossambicus* Peters, 1852.

Other synonyms: *C. guentheri* Pfeffer, 1896 "Zanzibar"; *C. microphthalmus* Pfeffer, 1896; *C. lazera* Valenciennes, 1840.

Local name: Kambale

This fish is widespread in freshwaters throughout Africa where it may grow to a size of up to 1.5m. It is particularly well adapted to shallow and swampy conditions by possessing organs which allow it to breathe air. It can therefore survive in conditions of very low oxygen and where residual waters may be of very low quality.

On the Usangu Wetlands this fish follows a life cycle where the adults, which have survived the dry season in the residual waters, move out on to the flooded flatlands where they lay "clutches" of eggs in rudimentary grass nests. The young hatch and grow as they utilise the massive growth

of food resources of the fertile flood areas. After heavy mortality due to predation, starvation and drying up of the habitat; the survivors return to the residual waters until the next flood season.

In the Usangu Wetlands, this species dominates the catches in the fishery with a removal of some 700 tonnes in an average year.

There is no indication that this species is under any threat to its continued survival in the area.

### **Family: Cichlidae**

#### ***Oreochromis urolepis* (Norman, 1922)**

Synonyms: *Tilapia urolepis*; *T. adolfi* Steindachner, 1916; *T. hornorum* Trewavas 1966.

Local name: Ngege

This species is the “secondary” component of the Usangu Wetlands fishery., although probably not amounting to more than 1- 2% of the total catch. The maximum size is in the region of 200mm total length.

It is reported as commercially exploited in the Ruaha catchment.

### **Family: Mormyridae**

#### ***Marcusenius livingstonii* (Boulenger, 1898)**

Synonyms: *Gnathonemus livingstoni*; *Marcusenius macrolepidotus* (non Peters)

Local name: Somo

This species is widespread and has been reported from the Rufiji catchment and is recorded from the Ruaha. It is said to live in the quiet waters of rivers and enter onto flood plains to breed. The specimens seen have all been roughly some 100mm total length although it is reported to reach a maximum size of 300mm.

It is caught in the nets set along the edge of flooded vegetation in the wet season. This species forms a small but significant part of the commercial catch.

#### ***Petrocephalus steindachneri* (?) Fowler, 1958**

Synonym: *Petrocephalus affinis* (non Sauvage) Steindachner, 1916

This species is reported from the Rufiji catchment but has not been reported from the Ruaha river. It has been noted from dry season catches at the Ruaha. (The specimen taken was very similar to *P. catostoma* (Gunter, 1886)). This is a small species probably not exceeding some 100mm. The specimen identified measured 75mm total length.

**Family: Mochokidae**

Specimens in the size range 100 to 200mm total length, probably referable to *Synodontis*, appear frequently in the subsistence fishery catches and as a minor catch in the main fishery. No further identification has been possible.

Local name: Kolekole

4 members of this family have been reported from the Ruaha.

**Family: Schilbidae****(?) *Schilbe moebiusii* (Pfeffer, 1896)**

Synonym: *Eutropius mobibii* Steindachner

This species has been reported from the Ruaha catchment. The two specimens, tentatively identified, were taken from subsistence catches, and measured 80 and 95mm total length.

**Family: Cyprinidae****(?) *Labeo cylindricus* Peters, 1852**

Synonyms: *Tylognathus montanus* Gunther, 1889; *Labeo kirkii* Boulenger, 1903; *Labeo kilossae* Steindachner 1916; *Labeo loveridgei* Regan, 1920; *Labeo forskalii* (non Ruppell) Bailey *et al.*

This species would be expected in running clear waters with a hard substrate. It is common and widespread. This species has been reported from the Ruaha catchment.

One small and deteriorated specimen was identified. Total length 120mm.

**Family: Cyprinidae**

The *Barbus* genus of the Cyprinidae are a wide-spread groups of many species. This implies some difficulty in accurate identification.

***Barbus* (?) *paludinosus* Peters, 1852**

Synonyms: *Barbus vinciguerrai* Pfeffer, 1896; *Barbus macropristis* Boulenger, 1904.

This is a shallow water species which can be abundant in some locations. This is a small species and the two specimens taken measured 65 and 67mm total length.

This species has been reported from the Ruaha.

**General comments**

It will be expected that careful sampling of some of the peripheral areas of the swamp and inundated vegetation will sample a number of additional species of small size fish. In particular *Barbus* spp., and possibly members of the Cyprinodontidae.