Contribution To The Technical And Policy Options For Adaptation To The Consequences of Climate Change In Tanzania, With Specific Reference To The Rufiji District.

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1.0 Introduction

In order to understand the present and to have a better basis for discussions about the future, it is necessary to go to the past particularly since, for the foreseeable future people in the district will depend on their natural resources for their livelihood. Major past trends and interventions in the livelihood of people, provide clues and makes the future less hazy. There is a rationale and a basis, for some realities to probable emerge in the future, even if there is some speculation about the parameters to consider.

The potentialities of the Rufiji District for the development of its own inhabitants and for the sustained growth of Tanzania are immense. Because little of the resources have been formally developed and since the district has been outside the formal communication and transport sectors the area has been generally neglected and despite some efforts the area still remains underdeveloped. Since the Rufiji is not just another district in Tanzania, this study will first try to reflect on the importance of Rufiji District and how it in fact epitomizes Tanzania. The opening up of the District and its natural resources to the process of globalization, without putting in place adequate safeguards in the interests of the local people would be a major folly.

Compared to the previous Tanzanian contributions to the Netherlands Climate Change Assistance Programme (NCAP) this study will in significant areas differ from earlier presentations. This study will deliberately have a historical approach particularly because the Warufiji who inhabit the area have been adroit in coping, adapting and managing an ever changing environment. Consultants in the previous studies gave a picture of the Rufiji District from a generalized and official perspective especially of the sector policies and their probable avenues or channels for having an impact on climate change in Tanzania. In yet other perspective, this study will put greater focus on grassroots studies that were initiated in the 1970's and thirdly go beyond them by stressing the appreciation of the local knowledge base for natural resource use and management. Such an approach could have a greater impact on the livelihood of the people. Basically, the focus will be on how people have coped with the natural processes on the ground. It is the knowledge and skills of people that have shaped development. National polices as an instrument to bring change in an ecological area is a relative newcomer and despite attempts in the past, they did not directly influence change among some communities especially in the delta.

A more grassroots approach will help to bring a better understanding of the part that people can play.

There is a close and complex relationship between rural livelihoods and natural resources management and use. The dependence on natural resources and its contribution to well being, even in urban areas is grossly underestimated especially in terms of domestic energy, household utensils and furniture and natural products be it food or medicines. The relationship between livelihoods and resources can easily be misunderstood. The link is not linear but a complex one.

Improvements to the infrastructure in the rural areas, and the emergence of the formal economy, do not automatically ensure improvements in the quality of life of the majority of the inhabitants of Rufiji district. Therefore it is important to find out:

- who benefits and who loses,
- what are the options and
- How to ensure that there is room for adjustment and mitigation despite climate change.

This also means that it is also necessary to recognize that what happens in Rufiji District is powerfully influenced by two main factors occurring outside the area. First is the fact that the regime of the river is not just determined by the physical factors in the district but by the climate and human activities in the Southern Highlands. These highlands have the very large bulk of the closed forests of Tanzania. Secondly, the city of Dar es Salaam, the biggest urban area and the largest commercial centre of Tanzania, is now a scant one and half hours of drive on an all season road. Despite all this factors the micro physical and social determinants greatly impinge on the life of the people in the district..

1.1 The Sleeping Giant

The Rufiji river basin system covers an area of 178,085 skm and is the largest out of the 14 basins in Tanzania. (URT 1978). The Rufiji Basin covers nearly a fifth of the country and the Rufiji and its tributaries have their origin in the Southern Highlands, which are the highest and wettest parts of Tanzania. The potentialities of the Rufiji District and especially the river that gives the district its name, have dominated the interest of successive administrations of Tanzania, both colonial and national[1]. To the Germans the Rufiji was awaiting to be developed like the Mississippi: with barges for transportation, cotton as a plantation crop, labour fully utilized etc. The British rule was less ambitious in Tanganyika Territory but managed to convince the United Nations Food and Agricultural Organization, soon after its inception in the 1940's, to mount one of the largest and earliest hydrologic surveys in Africa of a river system.

Independent Tanzania, had similar very ambitious aspirations. In 1974, the Rufiji Development Authority was created and consisted of Senior Ministers: from Planning

[1] In 1880, the Sultan of Zanzibar sent an expedition by boat, under William Beardall, to explore the resources of the Rufiji river.

and Development, Finance, "Water, Power and Energy" Agriculture and Industry and a lone University Professor to keep the five Ministers company. The development of the river basin was touted in superlatives: 1200 MW of hydroelectric power to be generated by the construction of the Stiglers Dam, creating the fourth largest manmade lake in Africa. The controlled flow of water would lead to one of the largest irrigation project and the immense agricultural production in the delta would make it the breadbasket of the country. None of these plans materialized.

1.2 Making The Rufiji Developable

At various times there were attempts from the outside to bring development. There was a Greco-Roman settlement and there will be evidence of their interest in the area. The Sultan of Zanzibar's expedition has been mentioned. The colonial and national Governments had good reasons to be interested.

The Rufiji is the largest river in East Africa. During the rainy season fed by its various tributaries it carries enormous quantities of water and at such times the delta and river are impossible to cross. In some years disastrous floods are caused bringing in their wake great destruction of crops, property and even human lives. It has been assumed that a coastal road from Dar es Salaam to Mtwara would be a magic wand to bring development to the whole of the south. The main obstacle was how to cross the river? Therefore, the river had to be managed and tamed.

1.2.1 Bridging The Gap

The conventional notion was to regard the river and the difficulty of crossing it as one of the major barrier to the development of the District and to the whole of the southeastern Tanzania. After years of discussions, the Third Phase Government, gave priority to the construction of the bridge and despite its huge cost it was completed in 2002. Triumphantly it was opened and named the President Mkapa Bridge. The building of the Mkapa Bridge has been the most recent major intervention in the district.

1.2.2 Resettling The People

It is worth mentioning one other intervention that had a major direct impact on the people. Following a disastrous flood in 1968 a successful prototype for a villagization programme was designed and implemented for the district by the Government of Tanzania with zero inputs from any donors. Through *Operation Rufiji*[2] the entire range of Government resources and technical staff were mobilized to resettle all people in new villages located on higher grounds away from the floods. All these new villages had the basic infrastructure – water supply, schools, improved housing and basic health facilities.

[2] The following year there was *Operation Dodoma*, in Dodoma District which had experienced a severe drought and famine. Mwalimu Nyerere spent several weeks in the Dodoma, mobilizing the people to resettle. The following year *Operation Vijijini* was launched practically for the whole country (Mascarenhas 1980)

Yet, until the 1970's, these hydrological and edaphic studies, as well as the resettlement programme gave us little information about the people.

1.2.3 The Health Factor

For decades the Rufiji has been characterized as an unhealthy backwater with malaria and other diseases, such as filarisis and schistomiasis endemic to the area. A survey mounted by Latham before Independence in 1961, found incredibly high rates of infant and child mortality. Data from the late 1970's at the Swedish run health centre, supplemented by field work revealed that not only was the incidence of malaria high but women and children were very vulnerable in months when the demand for agricultural labour was at its peak (during the rainy season) and before the beginning of the harvest in July (Bantje 1979?).

More recently following the great concern for malaria and health in general, the Rufiji District was selected in mid 1990's for a major health survey. As will be elaborated later, the situation has not changed much (GoT MH 2002). Malaria is still the major problem and despite some reduction the "under five" is still high (**Latest IMR)**

2.0 The Natural Wealth Contested.

From a national perspective, there is no shortage of conspicuous resources in the district: the largest mangrove forest in Eastern Africa, borders – the Selous Game Park, one of the worlds largest Game Reserve. The river and the swamps are an important source of inland fisheries. But when the river with its heavy burden of detritus meets the delta and the sea, a new and additional very productive environment is created both on the land and the sea. The diurnal and annual mixing of the riverine and marine waters and the mangroves become the spawning and nursery grounds for various types of fish, as well as for the crustaceans: lobsters, shrimps and prawns. These were available in subsistence and commercial quantities.

By the 1990's the delta became a contested area between the indigenous people practicing subsistence livelihoods and commercial fishing interests. There was an attempt by a foreign firm supported by the Government of Tanzania to clear a significant part of the mangrove forest and establish one of Tanzania's most ambitious aquaculture farm. The annual output, it was tooted by the commercial enterprise, would make prawns the most important export of Tanzania. Yet, there was little discussions about the risks involved and for that matter the environmental and social costs to be borne by the local people.

With the policy shifts dictated by structural adjustment programmes, there is a subtle and not so subtle shift for the government to disengage itself from directly getting involved with development including decreasing attention paid to planning, a push for the greater involvement of the private sector. There is a vacuum in the country that is being rapidly replaced by the process of globalization – great ascendancy in the role of market forces undue emphasis on foreign aid and the use of capital. There is no compromise to getting

the macro-economics right even if the massive inequalities between segment are glaringly obvious. While acknowledging that the poverty of people is the greatest challenge there is still an obsessive faith in the trickle down theory.

2.1 Putting Human Beings at The Centre of Development.

For some years, as a reaction to the notion that development was just a matter of solving the technical problems and alarmed by the paucity of socio-economic data and the neglect of ecological consideration a massive research effort was initiated at the BRALUP/IRA of the University of Dar es Salaam[3] in the mid 1970's.

The most important thing that emerged from these studies is that after generation the people of the Rufiji District had learnt to survive in an environment that was not always benign. For centuries, the people have adapted to a changing environmental situations and their livelihood incorporates important mitigating elements. There has been little appreciation about the indigenous and local knowledge of the people. Therefore the NAPA study must include this very important perspective. **IK**

Several studies indicate that there was an attempt by the people to sustainably use the various ecological niches. For instance, the use of mangrove poles both for local construction and for export to parts of Muscat, Oman and other parts of the Persian Gulf has also gone on for centuries. Indeed, there is new archeological evidence to suggest that there was trade dating back to the Greco-Roman Period.[4] By using local knowledge, the people cultivate a variety of crops able to withstand the floods and drought, to use different woods for house construction, furniture etc. Local inhabitants also developed skills and crafts for building canoes, boats and ocean crossing dhows. More importantly the "Warufiji" learnt how to adjust to macro and micro level environmental variations. All these are opportunities for research on climate change to put people's will, skills and knowledge to adjust at the centre.

2.2 The Biggest Contemporary Challenge Is Poverty

The biggest contemporary challenge at a national and international level is the task and responsibility of reducing the existing poverty levels and ensuring that there is real development for the majority of people in Tanzania. This requires that the situation be examined in a local, national and international context. Currently it should be noted that:

- through various household budget surveys for expenditures and incomes and using health, education and water supply statistics a composite picture emerges but this is only valid at a regional level. There are no comparable statistics at a district level especially for expenditures.

[3] The research started in 1970 and went on in the mid 1980's. After about 16 years of existence, the multidisciplinary, Bureau of Resource Assessment and Land Use Planning (BRALUP), was upgraded to a full fledged Institute of Resource Assessment. More than 39 research report in one form or another exist !

[4] Personal Communication: Professor Felix Chami, Archaeology Department, University of Dar es Salaam.

- Within the regions there is considerable variation so it is critical to get information at the sub-regional level[5].
- Another limitation is that the environmental indicators linking livelihood and poverty are in the process of being developed[6].

However, when all is said and done, and measured by the conventional indicators of development, the Rufiji District still remains of the poorest of the 130 districts in Tanzania (See Box 1). Harsh as this conclusion maybe, it epitomizes the development of Tanzania. Potentially huge resources, the showpiece of the IFI's reform policies to put Africa on the development track, a paragon of virtuous peace and with a GDP annually growing impressively. Yet, Tanzania is still the poorest country in the world and the majority of people continue to be in the caught in the quagmire of poverty.

Box 1 Some Salient Features of Poverty In Rufiji
"We are all poor here"

Poverty is rampant: The sample was limited and covered 54 households in four villages. The refrain, "We are all poor here" reflects a reality. Un-captured was the reality that poverty has many dimension. Only 5 households (HHs) had incomes that were above an assumed 500,000 Tsh per annum and which would put them above the national poverty line. Yet, more than half, 57% of the (HHs) had a surplus income over expenditure. Expenditures varied greatly and could be investments – purchase of canoe, construction material, fishing equipment etc

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Incomes differ widely, by location, gender, education: Incomes for those living in the delta (1,471,524 Tsh) are higher than those in the flood plains (631,995 Tsh); male headed HHs averaged 1,392 compared to 482,350 for female HHs. Incomes for those who have completed primary education (1,740,363 Tsh) is three times higher than those without (506,317 Tsh)

Agriculture is not important as a source of income: Out of a sample of 1590 adults, more than 85% were involved in agriculture. However, it was always combined with fishing (45%); palm weaving (26%); salt making (10%); business (7%). Despite the high involvement with agriculture it was not necessarily, the activity that gave them most of the income.

There is still food insecurity: For various reasons HHs experience food shortages and have to buy food. The distant location of the fields is the main problem. .

Source: Hogan et, al. (2000)

[5] There has been a marked improvement in the level of information on Poverty in Tanzania. According to the Poverty and Human Development Report 2002, future reports will begin to focus at the sub-Regional level.

[6] Based on the initiatives of the Vice President's Office, there is a good chance that the sustainable use of natural resources and the value added to them, will be one of the indicators to monitor efforts to get out of poverty

The profile presented in Box 1, would probably be different when compared to other agro-economic areas. Importantly, though is meeting the challenges of poverty in a district well endowed with natural resources. In the context of a climate changing scenario, it requires that new insights be explored to increase the capacity of the inhabitants to benefit more from the natural resources in a sustainable way. Asymmetrical use of the considerable resources will destroy the livelihood of the inhabitants and increase the risk of malnutrition and disease. More than that, the forests of Rufiji District extending into the Ulugurus form a major carbon sink in Tanzania and therefore in national and global interests should be better used. This requires a better and balanced analysis of the existing use of natural resources.

Within the above limitation, every effort will be made to reflect the true situation in Rufiji. Specific sectors studies will be used especially when it comes to the exploitation of the environment and natural resources by the people. This also means that additional field work will have to be used to supplement and verify that intended policies and their implementation will realistically enable people to have an improved quality of life.

3.0 The People - Resource Issues.

Basically the people in Rufiji to a very great extent rely on the considerable degree of natural resources endowment for their livelihood. In recent years new problems have begun to emerge that threaten the livelihoods of the people. The basis of the exploitation of natural resources and their livelihood is to a very large extent is influenced by local and indigenous knowledge. It is the juxtaposition of these two elements (use of natural resources using traditional and IK) that requires that researchers appreciate and recognizes that there is need to pay careful attention to the livelihood perspective which differs considerably from the natural resource management perspective. These differences are summarized in Figure 1

The tendency for most of the past plans for the Rufiji District have been to tilt the emphasis in one or another formal sector (eg such sectors like Hydro Electric Power, aquaculture, commercial logging). With such a sectoral bias towards the natural resources there is little inclination to consider weighing the full economic, ecological and the social cost of resource use on local people.

The impact of this bias on the livelihood of the local people can be catastrophic to their immediate wellbeing, culture and development. This is not a theoretical statement. The Evidence from other parts of Africa all point to the need for considering both sides of the equation.[7] The people of Rufiji are not immune, from having to face serious problems

[7] The best example is probably from the Niger Delta which is rich in hydrocarbon resources. Communities which once had sustainable livelihoods, had their fishing grounds and agriculture ruined, their institutions and leadership killed or evicted and the pace of development of the infrastructure almost made stagnant. Billions of dollars worth of petroleum were extracted increasing the profits to the oil companies, some which went to the national coffers and subsequently which was simply siphoned off.

arising from the support of one interest group or sector without considering the interests of the local people[8]. As the area gets exposed and opened up the pressure to change is going to increase many-fold.

Figure 1

Comparison Between
Livelihood & Natural Resources Management Perspectives

	Livelihood Perspectives		NRM Perspectives
1	Focus is on local people, their knowledge and skills and their livelihood strategies		Focus is on the natural resource, their production potential, use and or conservation.
2	A holistic approach in the use of natural resources that is incorporated in the livelihood strategies of the local people.		Narrow focus and the link between the different life supporting systems is not fully appreciated
3	Dynamic and subtle in adaptation and mitigation efforts. In the Rufiji Basin there are more than 20 varieties of rice. In the delta the rice variety with long stalks can "ride" the floods. The *mlau* form of agriculture enables peasants to make use of sub-surface moisture when the floods ebb.		Can demand the massive alteration of the life supporting systems and is seldom sustainable. Construction of the Stiglers Dam would have altered the upstream ecosystem and submerged vegetation, downstream, the reduced flow of fresh water would lead to the incursion of salt water
4	Builds on peoples understanding, skills and knowledge of their environment and resources.		Relies on external knowledge and technologies and puts heavy emphasis on capital and specialists.
5	Custom and tradition pays attention to "macro-micro" linkages. At the the macro level the Warufiji are conscious of floods but realize their beneficial impact.		Pays most attention to macro level policy issues and less attention to the outcomes on local people.
6	More equitable use of resources and less differentiation among people.		Greater differentiation among people and use of resources can be destructive

Source: Derived from FAO

Justifying The Sustainable Livelihood Approach

Communities dwelling in the Rufiji District have used the natural resources of the area for centuries and in the process adapted themselves to annual, medium and long term

[8] Granting of the concession to clear the mangroves and establish aquaculture farms in the Rufiji Delta would probably have the same consequences on the local people as the fate suffered by Ogoni people of the Niger

changes. In some years as a result of very heavy rainfall in the highlands of the Rufiji Basin, its occurrence significantly different from the norm have all resulted in floods above the normal. At the same time, the predicted devastation due to anthropogenic factors has really not materialized[9].

Using the livelihood approach enables us to see trends on how people have adapted to changes under difficult circumstances. Therefore it is imperative that we consider the following:

> **"…..** They challenge us to find ways of amplifying the voice of the poor. They demand longer timeframes, capable of meeting the demands of development initiatives that are flexible and dynamic enough to respond to people's needs. These issues challenge the way that development agencies are structured, the way they work and the skills that agency personnel require….." Carney 2003

There is another related element that requires attention. Although there is a tendency to treat the Rufiji District as a homogenous area, the reality is far more intricate and complex. The general division of flood plains and delta is not enough. On an agro-economic base there are five basic longitudinal divisions with the low plateau which is not differentiated between the north and south. The breakdown is as follows:

1. Coastal Littoral
    a) N Coast: more independent older migrants, tidal marsh for pasture etc
    b) South Coast: much older settlements, tradition of trade, export of rice, coconut, Jaja, Mbwera build on gongo lands.
2. Inner Delta
    a) North Delta: Densely peopled, fertile, possibility of getting 2 rice crops pa.
    b) South Delta: generally fewer people and more isolated
3. Flood Plain
    a) Northern Flood Plains: Much larger than southern side, many people resettled, agricultural problems because of distance to fields; improved transport has helped.
    b) Southern Flood Plains: tends to be cut off, agriculture still a problem
4. Coastal Hills
    a) Northern Hills: Some of the larger settlements, opportunities for trade, markets more accessible;
    b) Southern Hills: isolated and fewer people
5. Lower Valley
    a) North: Settlements strung along northern bank
    b) South: isolated,
6. Low plateau – Undifferentiated - Miombo Woodlands:

[9] In the 1940's administrators were quick to point out about a catastrophe in the making because of the misuse of land in the Uluguru and other mountains. Savile (1945). See the critique in Temple (1973)

4.0 The Population Profile

The trends of population growth and distribution are very different for Rufiji compared to the national average. The district population growth has been very sluggish. Consequently in the case of Rufiji, even after more than 50 years, the population has not even doubled from the base in 1948 (See Table 2). In addition to the disease factor, there may be two historical reasons for this low population.[10] In contrast to the population of Tanzania has doubled after about every 21 years. From the base year 1948, it tripled in 1988 and has almost increased threefold by 2002. The population density of the district has similarly not altered much but has somehow managed to double from 7 to 14 persons per square km.

Table 2
Some Comparisons in Population Characteristic Between National & Rufiji District

Year		1948	1957	1967	1978	1988	2002
Total Population M =million	D N	105,250 7.7 M	118,865 8.8 M	121,024 11.9 M	135,432 17.0 M	152,316 22.5 M	203,102 34.4 M
District Density National Density	D N	7..2 14	7.8 19	8.3 25	9.4	10.5 26	14 38
Annual Growth Rate District	D N	0.4 1.8	0.2 3.1	0.7 2.5	1.0 2.8	 2.8	 2.9

4.1 Interventions, Population Re-Distribution and Natural Resources.

Internally within the district there is a great disparity in population density. In the delta wards, adjacent to the sea, densities can be in excess of 100 per square kilometer (pskm). In contrast there are very large areas towards the Selous Game Reserve that are almost devoid of population partly because of the presence of tsetse flies. However, the over all density for the district is only 14 pskm. By comparison, the national population density has moved to 38 pskm.

Population has also been redistributed in a major way since the late 1960's. Following the floods, most of the people from the flood plain but not the delta were concentrated in villages and there was an attempt to lay the basic infrastructure. The concentration of roads especially in the north bank, around this period created a few major nodes and this was enhanced with the north to south road from Dar es Salaam and the completion of the Mkapa Bridge. Settlements like Ikwiriri and Kibiti which have large populations now function as towns. The old fort and the district headquarter, located on the south bank is almost isolated despite the newly completed bridge.

[10] Slave trading activities was one factor, the other was the Maji Maji uprising in 1906 and the scorch to earth policy of the German colonial power which left thousands dead from disease and starvation.

The people of the district commonly called "Warufiji" are not homogenous but are differentiated on historical/cultural, linguistic and ethnic lines.

4.2 The Impact of Intervention

During the 2002 National Population Census it had a population of 203,102 inhabitants. Although its population density is among the lowest for any district in Tanzania, nevertheless the population is unevenly distributed. In six wards the population is for census reasons regarded as having an urban (Utete Town, District Capital) or "mixed" populations. This census terminology implies that not all people are agriculturalists and some are involved in trade, processing or in occupations other than farming. The six wards have over 45% of the population. (See Table 3) There are big clusters or population nodes: one is north of the delta and a triangular patch in the southern part of the delta, there is a string of villages on the north bank and similarly along the road to Dar es Salaam. Both Kibiti and Ikwiriri are important junction centres and nearly have a fifth of the population.. The District capital, Utete located in the southern bank, is an isolated service town. However, away from the low lying delta extensive sections of the district, especially in the south are without any permanent settlements.

Table 3 Salient Features of the Recent Population of Rufiji District

Total Population	203,102
Population in wards (7) regarded as urban or mixed	106,174
Females	104,704
Males	98,398
Population Density per sq kms	14
Total Number of villages	94
Total Number of hamlets	385
Number of Wards	19
Population in Urban & Mixed Wards (Total Number 6)	92,738
Population in wards regarded as rural (13 wards)	110,364

5.0 The Natural Resource Base of The Rufiji District

In the Coast Region, Rufiji being one of the six districts, out of a total forested area of 2,436, 839 ha some 330,144 are reserved and the remaining 2,106,695 ha falls under open public forests. At a general level most of Rufiji District is forested. In the northern part of the delta, between 1989-99, about 1,700 ha of mangrove forests were cleared to make room for rice cultivation (Anon 2002). The land cleared in subsequent years has almost doubled. Rufiji has a total area of 14,471 skm, out of which some 1,230 skm is occupied by the river.

5.1 The Forests of Rufiji

The distinct threefold distribution of forests in the Rufiji District is easy to describe. The Coastal Forest type covers most of the district except for the intrusion of the miombo woodland that is located in the south west of the district. Mirroring the miombo but on the opposite eastern side and covering a much larger area of some 50,000 hectares are the single largest stand of mangrove forests.

Belatedly it was discovered that the coastal forest are part of the ancient forests uniquely of national and global importance and related to the rich biodiversity of the Eastern Arc Mountains. To conserve the Coastal forest, the Central Government has set aside 13 protected areas or Forest Reserves with a total area of 150,000 ha; three other reserves have been given to the jurisdiction of the District Councils. All mangrove forests are gazetted as Forest Reserves. Few of the forest reserves are still intact, several are so small that their real value is open to doubt.

The total protected area is about 14% and this leaves the rest of the forests as unreserved or public lands. This amounts to 1,081,510 ha out of a total of 1,231,930 ha under forest. There is a marked contrast in some these public lands. In some areas, which have been fired for the initial agriculture purposes and subsequently after a few years abandoned there is no doubt about some land and vegetation degradation having taken place. The secondary vegetation which has succeeded is poor in comparison and is not as diverse as the original one. In other areas, a combination of mango and cashew trees as well as shrubs and thickets gives an impression of a forested area.

5.2 Forests and Livelihoods

The livelihood of the people in the Rufiji since time immemorial has depended a great deal on the forests both directly (See Table 4) and indirectly. The indirect value of the various forests is both of local and global significance. Locally the forests form distinct ecosystems enabling the shore line and banks to be protected, changing the chemical composition of water to enable other life forms to thrive, fixing nitrogen and maintaining soil fertility and effectively changing the micro-climate to add diversity of fauna and flora. The East African coast would be quite arid and not as productive in fisheries without the influence and the impact of the Rufiji and other smaller rivers.

The impact of the Rufiji District at a national level is deceptively complex because of the two magnets of attraction. One is based on Dar es Salaam and the other is the century's old connection with Zanzibar[11] and consequently the informal links with the latter tend to dominate. The direct links with Dar es Salaam which started more than 40 years ago have become more intensive in recent years and is all based on the increasing domestic energy needs of the vary large majority of the nearly three million people living in the city. As the suburbs of the city spread and previous sources of construction timber, wood and charcoal were built over or exhausted, the Rufiji district became the main source of

[11] At the height of the trade in the Rufiji District, apart from mangrove poles needed for Zanzibar and for the desert Kingdoms in the Persian Gulf, there was trade in salt, dried fish, skins, ivory, gum copal and frankinsense. Over 2000 dhows called annually.

supply. In the six coastal districts around Rufiji District out of a total of 12, 692 and 10,160 cubic metres of round wood licensed for extraction in 2000 and 2001, respectively, over 75% originated from the Rufiji District (Milledge, & Kaale 2003).

Table 4
Direct Uses of Forest Products

	Main Category	Specific Uses
	House construction	Vertical poles and lattices for walls, doors and windows including frames, roof frames and thatch, special houses on raised platforms to withstand floods or as lookout posts to guard agricultural fields.
	Furniture	Tables, chairs, beds and ropes to make mattress holders Mats,
	Transport	Small and large canoes from a single bole, out riggers, boats and dhows from planks, masts, oars, bailers etc
	Crop protection	Fences to keep off vermin, stockades, surface and pit traps for large animals, bows and arrows and spears, snares, sap for trapping birds, fishing traps and floats of various kinds, wood for beehives, .
	Foods	Collected and wild foods especially during times of drought and floods, but also including those collected routinely such as honey, mushroom, wild fruits, roots and tubers.
	Medicines	It is estimated that there are about 70,000 traditional healers and herbalists in Tanzania compared to 2000 University trained doctors. The full range of plants used has not been fully documented.
	Utensils	Grain bins, coconut graters, ladles, mortar and pestles
	Cultural	Variety of drums and xylophones and other musical instruments, such as the *kayamba – or reed box rattles,* carvings and crafts, grave markers, dyes, toys Ornamental and scented plants,
	Energy	Firewood and charcoal; specific wood for smoking fish; wood for converting brine into salt, .

In the process of liberalization and globalization, the hardwoods from the coastal forest have become major export commodities partly because of the ease of export both undertaken legally and illegally. Periodically, the Ministry of Tourism and Natural Resources becomes agitated that logs and timber products are in the harbour ready for being exported. Yet in several cases licenses were issued, the items were not easy to conceal and they managed to pass through several check-points.

5.3 Mangroves and Livelihood

Semesi in her contribution on mangroves noted that while the main threat was mainly brought about by human beings, in the context of this study on climate change she specifically noted that:

> "The predicted sea level rise due to global warming may flood present mangrove areas. They would however, be expected to colonize new land, the extent of which would depend on local topography." (Semesi 1991)

The statement recognizes the problem but is very pragmatic in its outlook. Therefore, not surprisingly, the more than 3,000 ha of mangrove forest lost in the Rufiji since the Semesi study was done, are not the consequence of climate change but are mainly the result of the opening up of new land for rice production. In this environment new pests emerge, such as crabs, that attack the emerging rice plants. The careless and excessive use of pesticide that follows tends to pollute the productive ecosystem (Personal Communication 2004).

Although the Semesi study on mangrove management is still invaluable and other major studies, such as the various reports from the Rufiji Environment Management Project (REMP) and the Coastal Zone Management Plan have been undertaken there have been difficulties in implementation and this has been at the core of the problem of chronic poverty in the Coastal areas in Tanzania.

Thus, fifteen years down the line while there is little evidence of sea level rise; from the data available, the main threat to the mangroves are predictable because of human interventions. This is the one area where a better understanding between decision makers involved in policy making, implementation and monitoring should work with the different communities. But there are pre-conditions that have to be observed.

5.3.1 Meeting Some Pre-conditions For Sustainable Development of the Mangroves

One of the major difficulties in the management of the mangrove forests is that they require much more inter-sectoral institutional cooperation especially between those involved in marine resources on the one hand and terrestrial resources on the other. This requires both specialists and people who can work jointly.

Secondly, after dozens of workshops, seminars and very many volumes of reports, it is time that there be a meeting ground for this scientific knowledge and ethno science or local people's knowledge. Such an understanding would greatly reduce the conflicts of interests that presently exists. This also requires a greater degree of transparency than has been the case so far.

Thirdly, the mangrove forests in the Rufiji after years of neglect require special attention for several reasons including:

- The fact that mangroves have a invaluable role in protecting erosive damage from marine action.

- their complexity. For instance in the Rufiji District there were 474 mangrove compartment listed, they varied in composition and size. Some were no more than a couple of hectares while 4 others were with over 1000 ha each and there were dozens that were more than a 100 ha (See Semesi Appendix 1)
- The huge impact they have locally on the livelihood of the people particularly on fishing communities. This means that communities living in the south eastern part of Rufiji, where the major part of mangrove forests are located, are a world apart from villagers living in the northern bank of the river and who are in the coastal forests.[12]
- Because of their influence on the productivity of valuable the marine resource of a commercial and none commercial value.
- See Box of elaboration below

6.0 The Coping Mechanisms of the "Warufiji"

As has been said earlier the Warufiji are far from being a homogenous group. The coping mechanisms are influenced by their own culture and their response to the environment and natural resources. However, in recent years the extraneous factors, both commercial and social have begun to play an even more important role in bringing change to the area. The majority of "Warufiji" have become merely bystanders as logs from the forest, mangroves from the tidal areas and fish from the platforms are licensed off to "investors"! Past arguments about conservation, biodiversity and sustainable development have been quietly forgotten by the bureaucrats. This is the time to examine the coping mechanisms of the different stakeholders in Rufiji.

6.1 Coping Mechanisms Among the Fishing Folks

In the delta there are three very distinct livelihood groups and coping mechanisms associated with them. They practice sophisticated but in a sense simple practices that micro-manage the natural resources and the environment for sustainable use, emphasize on returns to labour and food security. They are all based on maximizing different aspects of water and hydrology. But choices still have to be made and such divisions are not easy. The threats to their livelihood are more external than due to ecological factors.

Villages facing the sea are more concerned with fisheries but there is some agriculture. There are several such villages and small settlements, including Mchungu, Kiomboi, Kibanjo Nyamisati, Jaja and Pombwe (Maghimbi 2001). While the physical features around a village may differ in detail most of these villages have a platform which is more than a kilometer wide, which may be backed by low cliffs, bays and creeks. During diurnal high tides the platform is covered by the sea which recedes when the tide water flows back. Stake traps, about a metre high, triangular in shape, with the fence forming an apex, pointing to the sea and the exposed unfenced side backing the shore are placed on these platforms.

[12] This means that CEEST in future will have to pay more attention to the sampling frame which will have partly to be based on ecological considerations.

The tides are of a semi-diurnal pattern each with two high and two low tides per day. In addition, depending on the phase of the moon there are spring tides which rise to 3.5m and the neap tides measuring 2.5 m.(UNEP 2001). This is well summarized by the following observation:

> Tides not only influence ecological processes in the coastal water but also play an important role in socio-economic activities of the coastal communities. In most of the coastal communities tides determine among other things: the fishing period, type of fishing gears to be used and the market time.

6.1.1 Constraints Facing The Fishing Communities

There are three major constraints facing the fishing communities especially those concerned with prawn fishing. First, even without global warming there is the *el nino* or southern oscillation (ENSO) effect which are uniquely occur in cycles of 2- 9 years. Seasonal aberrations that are caused by the warming of the sea and suppression of the nutrient rich upsurges in the Pacific bring changes in the weather pattern in East Africa. The most severe *el nino* event in recent years started with a drought that reduced the HEP capacity and during 1997/98 it was followed by torrential rains which caused widespread flooding and disrupted and damaged transportation. One estimate is that Tanzania lost over a billion dollars brought about by the two features. It is not known how much the fishing communities suffered in that period.

Secondly, should there be global warming this will have an impact on the fisher. During the South East Monsoon, the south equatorial current brings relatively cool waters from the Pacific to the Tanzanian coast. Conversely during the North East Monsoon, the south equatorial current gets much warmer water from the north. Global warming would result in ice melt in the Southern Ocean and this could result in sea water rise. At the same time higher temperatures could disrupt the pattern of floods, result in less rain in the southern highlands and this would mean less water in the Rufiji..

The third and biggest threat is more immediate and depends on Government policy. Fishers[13] in the Rufiji are not undertaken as a small scale artisanal pursuit rather they are being pursued as a commercial activity. There are three types of prawn fishing by trawlers: in the ocean and by artisanal fishers on the platform and in the delta. Foreign trawlers, much smaller than those operating in the open seas, are able to get in the shallow waters and the creeks and compete with the local fishers. The later operate in canoes and simply cannot compete with the equipment, infrastructure, and the number of workers in this small trawlers. (Maghimbi 2002, Gibbons 1998). The fishers had assumed that they would be allowed to practice their livelihood without the unfair competition from the trawlers. There are concerns about over fishing because of the intensity from trawlers and the likelihood of damage to the delicately balanced ecosystem of the creek and delta.

[13] Fishers, include both men and women. This is not an academic distinction, for some reason, the Rufiji fishers have a very high percentage of women compared and in contrast to the Tanga, Pangani and Bagamoyo coast.

More than anything else this is a policy matter. There is a growing feeling that the trawlers are paying a license fee that is simply not commensurate with the haul of prawns and other fish. A lot can be done to get the fishers out of poverty[14]

7.0 Coping Mechanisms Among the Delta Mouth Dwellers

The communities living in settlements in the delta, refused to be resettled by the government during the floods in 1960 and subsequently in 1968.. Even during the days of plantations and slavery experienced by neighbouring communities like those living in Mbwera, Jaja, communities living in the northern part of the delta worked independently on their plots of land around the family head.

The micro ecology determines the extent to which the tidal influence of the sea and salinity could be minimized. An uncanny ability of some peasants to evaluate the soils and their productivity, a deep understanding of what biodiversity could achieve were all part of the armory of coping with the water logged delta. Not only this, but aware that tsetse were absent in the delta, they could also keep cattle and also have manure both as a fertilizer but to offset the influence of salinity. Most peasants were conscious that although the rainfall was adequate, more than 1000mm per annum, it was adequate but unreliable. The people relied more on the floods which occurred every two to three years; for they not only flushed out the saline intrusions but were responsible for sustaining and rejuvenating the soil fertility. Correct timing and the right rice variety could ensure a good harvest[15]. The choice of growing a specific rice variety was quite a sophisticated exercise that tried to balance several variables related to ecological conditions, and socio-economic variables.

8.0 Copping With Floods

The negative consequences of the Rufiji floods have received the foremost attention. Box 2 highlights some of the main features. There is no doubt that when floods are very late, or very early and prolonged they immediately become destructive.

On the whole people living in the floods plains have managed to adapt their livelihoods to the normal flood regime[16]. It is the floods, which enables the people to have a relatively secure livelihood provided they adhere to certain precautions:

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[14] Many fisher complain about the difficulty of getting ice, have appropriately designed cooling boxes, equipment and markets.

[15] There were at least 9 local varieties of rice and 14 others listed by Sandberg in 1974. In fieldwork conducted in 1998 in the neighbouring district of Mkuranga, the *afaa, kilombero & Bora Kupata,* were being sold by shopkeepers at a differential price

[16] Has the construction of the Mkapa Bridge reduced the concerns of flooding in the Lower Rufiji? Worth discussing and seeing contingency allowances made in the design of the bridge.

For example where and how they build their homes, what variety of crops and in what sequence they are grown etc

Build the chronology!

Relate to impact of flooding: In the 1960's highest level was 21.77 ft in 1969 and 18.97 ft in 1968 at Gauging Station IK4 Utete.

The 1968 floods in the Rufiji led to the first of the two major "Operations" followed by the drought led resettlement in Dodoma. However, the resettlement left most of the delta villages and hamlets almost intact. Administrators tended to ignore the copping mechanisms of the peasants and ignored the sustainable year round and multiple productivity of the environment.

Implications of Floods

Negative consequences are foremost. But work on adjustment aspects and coping mechanisms of people. Floods replenish the natural productivity especially of the delta. Higher flood levels generally meant higher yields especially of cotton (Muhema 1972).

(To be continued)

Completed but has technical hitch 18

RUFIJI: Local Rice Varieties and Characteristics										
Local Rice Varieties	Growth Period	Growing Time	Hill or Valley	Preferred soil	Taste	Output – rice /paddy ratio	Price cents/kg	Flood Resistance	Drought Resistance	Saline Resistance
Afaa		6	V					M	H	L
Kilombero		6	V					H	H	L
Bora Kupata		3	H		P			L	M	L
Sene		3	D							H
Nyati										

Managing micro-environment in the Rufiji: Droughts, Floods, Pests and Vermin

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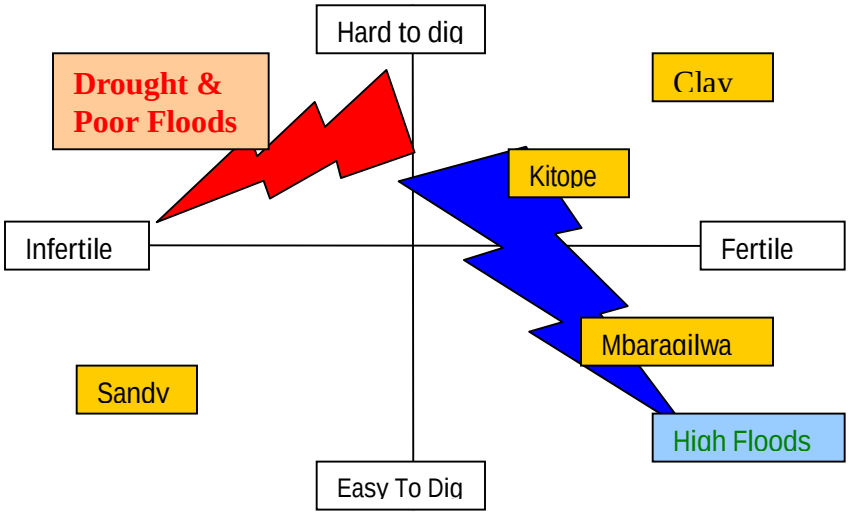
8.1 Coping Mechanisms among the Communities in the Flood Plains

While both in the delta and in the flood plains the peasants try to maximize the returns from the flood, the impact of the floods is not always the same. Two related types of indigenous irrigation systems prevail in the Rufiji; the first is the flush irrigation and the second is the *"mlau"* or dry season irrigation. Both have a strong water/soil inter-relationship. Diagrammatically this is represented in figure 2. The most productive soils are known as *mbaragilwa*

Figure 2: Relationship between Floods, Hardness of Soils & Fertility



8.2 Indigenous Flush Irrigation Systems

In the flood plains the peasants have to maximize the positive impact of the floods with their labour. Without the floods the ground in many places, except the infertile sandy areas, is very difficult to work upon. Hoes have to be large to be able to turn the soils over and reach the moisture level – the smaller hoes, more easily available and used by women simply cannot penetrate deep enough. Apart from making the soils easy to work upon, they have two other advantages. First, floods tend to clean up the fields of dead and other vegetation and take it wards the ocean. Secondly, floods deposit silt and generally replenish the fertility of the soils and redistribute soil particles in a more discernible pattern.

After the dry season the land is burnt to clear the vegetation before it is tilled with a hoe. This is heavy work even for healthy persons, it takes about three weeks to clear about an acre. Timing is critical, in August and September, the slack time there is surplus labour but if land is cleared too early, it has to be prepared again. In the delta flood plain cleaning has to wait until the dry season cotton and cowpeas have been harvested.

8.3 "Mlau" – Dry Season or Recessional Irrigation

Whereas people can have little control over the floods, the *mlau system,* gives the people even more control over the environment. Peasants have discovered through experience that as the floods recede it is still possible to get a crop by growing plants or varieties of crops whose roots follow the receding water. For instance cotton has a deep root system as has maize and some rice varieties have stalks which grow long enough to be above normal floods, others do not require as much water etc (See Table). Sandberg basing his research on Marsland (1938) as his source, notes that there are 4 different kinds of micro environments suitable for *mlau* cultivation. These are:

1. Areas flooded by the river and where rich deposits of silt have taken place and the surface of the ground has fractured and ready for cultivation. The subsoil moisture remains sufficiently high to grow crops like maize, cotton and cow peas (*Kunde)*
2. Areas not subjected to surface flooding but the moisture infiltrates from the high water of the river through a highly permeable layer of sandy loam sitting on an impermeable layer of clay.
3. Low laying banks near the mouth of the delta periodically flooded with fresh water that is piled by the high tide;
4. Depressions with a layer of semi-permeable sub soils which are inundated by heavy rains (*(nchacha land).* However to be effective they require additional rains during the growing season.

It will be noted that in the first three situations, the height of the flood is a decisive factor. The higher the flood level, the larger is the area that is soaked and cleared of vegetation and therefore available for cultivation. If the flood is too short and late, like the 1974 one, it destroys the crops and is not able to penetrate and soak the clay soils for later use by plants. The strategy for the farmers is to have a variety and a mixture of micro-environments as close to the river or its distributaries (Sandberg, Cook). In this pursuit, it is not surprising that the settlements are band-like strung along the river and its tributaries.

9.0 Additional Observations on Adapting to Micro-Environments.

In the flood plains there are three additional features which require comments because of the part they play in extending the amount and the availability of fresh water, which in turn affects the flora and fauna and also to the possibility of land use.

1. ***Gongo* lands:** these are literally islands which remain above the flood level. There are various types of *gongo* lands depending on formation. The soils are either sandy or heavy clay which become water logged during the rains and gradually dry up. If the latter soil type predominates then rice can be cultivated but because they do not benefit from floods the productivity is low and cultivation depends on the rain fall. Generally such land is not preferred. However, some of the old settlements such as Jaja, Mbwere, Kiongoroni and Mbwere. Some of the largest coconut plantations are found in these land islands.

2. **Lakes & Ponds:** Dotted all over the flood plains and even on the higher grounds of the banks are lakes, ponds and marsh lands. The meandering nature of the river

particularly in the delta creates ox-bow lakes and narrow elongated ponds marking the course of a wet season tributary. Apart from providing freshwater they also contain fish and allow the cultivation of home gardens. When the water surface is colonized by reeds these become important items in the craft industry (mats, baskets).

3. **The Saline Tidal Flats**: there are extensive areas particularly on the eastern side when the Rufiji takes a southern course. Such lands tend to be colonized by mangroves and over time with sediment laden flood waters, they can be cultivated with saline tolerant rice varieties.

9.1 Adaptation of Cultivation in the Miombo Woodlands

The density of population is very low in both the north and south banks. Cultivation is almost entirely seasonal in nature. Keeping of cattle and livestock is a problem because of tsetse flies. Their proximity to the Game Controlled Area means that there is the additional hazard from wildlife. Although some upland rice is grown, for the most part the cropping pattern is different, with cassava, millet and now maize becoming more common. In addition a substantial part of the diet comes from collected and gathered foods.

9.2 Adaptation of Cultivation On The Terraces

The resettlement programme since the late 1960's initially resulted in the concentration of people in some of the largest *Ujamaa Villages*. Some of these villages have now been subdivided. This resettlement away from the flood plains required major adjustments. The character of these villages has changed significantly and compared to the past can no longer be regarded as agricultural villages. Even in the census, the population is regarded as "Mixed" implying that they have both rural and urban features. To summarize:

- Households no longer rely on a single economic activity. More than 45 economic activities,
- Largest number still involved in agriculture but income slowly being eroded
- However, villages in the delta many times better off than those in the terraces.
- The highest incomes are from those involved in fishing activities (+700,000 pa); followed by agriculture (<200,000); business/trade (>100,000)

10.0 Coping With Health

Bantje's study is still significant because it relates seasonality + birth-weights and by implication survival of mother and child. Note the following:

- Birth weights are lowest during the wet season because of the intensity of agricultural labor and the declining amount of food available;
- LBW are most consistent in February and June and these months correspond to the stressful period of planting and awaiting for the harvest;
- During periods of reduced activity, for instance during floods or after harvest, there is a gain of weight;

What are the policy recommendations from these findings and sentinel studies?

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Appendix 1
Completed After Getting Processed Data From CEEST

1) Future Trends

For many people in Rufiji, the risks are mostly agriculturally related. If rainfall decreases there will be pressure to move in the hills …This will further threaten the biodiversity. **But is this true?**

2) Climate Change Is Not A Big Issue In the Development of the Rufiji

The biggest threat to the people of Rufiji is **NOT** climate change! People can adapt to climate change as they have done for centuries. (Candidate for 4th Dragon & Butterfly Episode .- Preferably at International Conference)

3) But Pay Attention To Agricultural Change

The agriculture in the Rufiji Delta and flood plain is the most diversified and on the whole very sustainable. Has agriculture changed in Rufiji ?
What has changed and what is the same?
Survey may have to be supplemented by additional field work
How do you upgrade the subsistence livelihood?
Standard Agric surveys … miss a lot (Extend REPOA Study To Rufiji)

In the Final Version - Update cost and benefits at community, national and global level. I need more recent figures on which to base my calculations (Will MNR&T release data).

The basic argument: For a short time clear cutting mangrove may substantially increase the "national coffers"; is the fraction given to the local community enough?

(Recruit fishermen in forestry projects, just like Maasai in Drylands of Tanzania)..
INCORPORATE FISHING PAPER – Nobody else is doing it

4) Work In Progress towards final report

Context of Climate Change in Tanzania outline Brief: A few estimates exist about the impact of climate change in Tanzania. (Parry M 1990; Mwandosya Nyensi & Luhanga 1998)**;** URT – VPO 2003). A 0.5 m rise and 1.0 m rise of the sea level would flood about 250, 490 skm of country respectively. The economic loss would be the greatest around Dar es Salaam estimated to be in the region of 200 billion and in the short run the mangroves of the Rufiji Delta would suffer extensively. The real wakeup call was the experience of the tsunami in 2004).

Assessment and Trends of Interventions and the way Forward

There have been several interventions in the Rufiji: eg Resettlement (Turok)

Assessment of POLICIES