



NETHERLANDS CLIMATE CHANGE ASSISTANCE PROGRAMME (NCAP)  
IN TANZANIA

Analysis of Technical and Policy Options for Adaptation to  
Consequences of Climate Change for Tanzania  
Rufiji Background report

by

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## 1. BACKGROUND INFORMATION

The Project on Technical and Policy Options for Adaptation to Consequences of Climate Change for Tanzania under the auspices of the Netherlands Climate Assistance Program (NCAP) is aimed at making analyses of technical and policy options for adaptation to consequences of climate change (adaptation policy) in Tanzania, the case study of Rufiji area. This project is looking into the assessment of the capacity of adaptation to climate change impact at community (local level in Rufiji area) in order to come up with a range of low cost, technically uncomplicated, accessible adaptations. Before going deep in the objective of the study, the team thought that it was important to have an overview of the existing interventions, which could be an entry point for the study.

### 1.2 Rufiji Flood Plain Master Plan and Delta 2003-2013

The Mater plan was prepared for the Rufiji Environment Management Project (REMP) with the help of researchers and mangers in various institutions who gave their views regarding research in the lower Rufiji. The Rufiji District Council implements the REMP with technical assistance from IUCN. In the development of this research strategy, a participatory approach was followed in which government agencies and scientists from various institutions were consulted for their views on the area. A series of interactive workshops were held aimed at determining high priority management issues and the information needs required to address those issues (Ochieng, 2002).

The Master plan goal is to provide the Rufiji District, the national and international scientific community, the inhabitants of the Rufiji floodplain, delta, woodlands and forests and the development partners with a coherent research programme aimed at the understanding of the physical, biological and social processes that drive the functioning of its vital ecosystems. The approach preferred is holistic, thematic rather than the traditional sectoral, single disciplinary style.

According to Ochieng (2002), the research strategy developed clearly shows that the environmental issues facing the Rufiji District management are a holistic character, exhibiting complex interactions between geographical (the Rufiji River Basin), the physical (soils, hydrology, climate, nutrients, etc), trophic (fauna and flora) and human dimensions (farmers, forest harvesters, hunters, fisher folks, livestock keepers and tourists) as well as the possible effects of management interventions. The master plan has therefore been organised following a thematic approach. There are four themes, with each theme covering a range of issues or sub-themes that should be addressed by research and monitoring. The themes are classified into short (1-2 years), medium (2-5years), and long-term (5 years on wards) research and monitoring.

The **short term phase** involves an assessment of the status, health and emerging issues. Here the general baseline information to gain an overview of issues identified should be gathered. The **medium term phase** covers the causes of impact/ threats and trends identified in the short-term phase and it includes monitoring of selected indicators/key parameters. It is the diagnosis of causes in which issues or resource-specific surveys and observations will concentrate on causes-effect relationship. The **long-term phase** involves the understanding of interrelationships, linkages and trends of a similar scale as the medium term, but intensive levels from which data

for prediction and modelling can be derived. It is the diagnosis of interaction and forecasting in which intensive monitoring and research is done to determine specific mechanisms of interaction needed to build a cause-effect model. Even the introduction of the NCAP in the Rufiji District took on board some of the good ideas from the master plan as an entry point.

### 1.3 Rural water supply

Although the amount of water a human being uses in developing countries like Tanzania is small (54 litres/day) relative to that in developed countries like North America (500 litres), without water, it is not possible for a human being to live even one day without water. Hydrologists are worried that by year 2020, some of the countries, particularly those south of the Sahara, will reach to a point of absolutely having no water, because of droughts in some areas.

Tanzania's renewable water resources amount to about 80km<sup>3</sup> per year, of which 30km<sup>3</sup> is ground water. Lakes cover about 7% of the total land. About 50% of the surface run off water is derived from the main rivers flowing directly to the Indian Ocean and the remaining 50% is divided into surface water drainage into the main internal drainage basins which have no outlet to sea. Even then due to variation in topography, rainfall pattern and climate, there is great variability in the amount of water available for different parts of the country. About one third of the country receives less than 800mm of rainfall per annum. These are semi arid areas of Tanzania. Tanzania also experiences a long dry season normally extending from June to October. This affects the amount of water that flows in rivers and reservoirs.

The administration of water supply systems in Tanzania falls into two categories namely rural water supply and urban water supply. The concepts of rural water supply equally apply to peri-urban areas. Rural water supply systems are generally simple and small and they are based on the Tanzanian Temporary Water Quality Standards (Kashaigili et al.2003). The rural water supply coverage of 42% is mainly obtained from springs, lakes and streams and shallow wells. This coverage does not take into count the quality of water supplied. In addition, many schemes are either partially or completely non-operational. On the other hand, urban water supply (mainly referring to municipal water systems) coverage has been estimated at 80%. In general, the existing water pumping systems and treatment plants are working under their installed capacities and are producing water of low quality due to old age. Besides, considerable water losses resulting from leakages in the distribution systems are as high as 30-40% in most of the towns (Kashaigili et al.2003).

According to National Bureau of Statistics (NBS, 1997), in 1996, about 56% of Rufiji District was covered with clean water in rural areas and 45% in urban areas. Therefore, the distribution of rural type of water supply was 25%-water dams, 28%-water wells and 47%-pumped water schemes in the district. In 1996 also there were 33 piped water schemes, of which 9 were functioning; 37-water pumping machine, of which 15 were functioning; 28-deep wells, of which 18 were functioning; 152 shallow wells (open), of which 123 were functioning and 27 wells with hand pumps (covered), of which 13 were functioning (Table 1).

Table 1: Showing distribution of piped water schemes in Rufiji District in 1996.

Attributes	Total Schemes	No. of Schemes functioning	Total Water Pumping Machines	No. of Pumping machines functioning
Piped water schemes	33	9	37	15
Deep wells	28	18	-	-
Shallow wells-open	152	123	-	-
Wells with hand pump	27	13	-	-

Source: NBS, 1997.

Also Ako (2001) revealed that ground water availability Rufiji District was controlled by hydro-geological characteristics of the project area and that the recharge rates were estimated to be 4-5 [l/s in lowland and 1-4 [l/s on upper areas during dry seasons. On the other hand, in the south-western part of the district the re-charge rate was relatively lower (0-1 [l/s). It is suggested that ground water over-extraction could be one of the possible impacts from the Rural Water Supply and Sanitation Project. However, the impact was not expected to occur due to small volume of water extracted for domestic purpose.

With respect to ground water quality, it is indicated that most of the boreholes and shallow wells in Rufiji area contained saline water and that the salinity levels usually increased during dry seasons. However, no bacteriological contamination has been found in water from boreholes. Nevertheless, it is suggested that it would be important to conduct water quality analysis for all boreholes and shallow wells to ensure that there were no bacteriological contaminants from pit latrines and grave- yards.

#### 1.4. Health

For several decades now, Tanzania like most other countries in sub-Saharan Africa, faced with the dual burden of a crisis in public health and a grave shortage of resources with which to address this escalating, interlocking web of problems. The health challenges confronting most of Africa have been well publicized: high on the list are the spread of deadly diseases and problems such as malaria, HIV/AIDS, tuberculosis, malnutrition, and anemia. Apart from their impacts on human lives, these devastating epidemics are enhanced by conditions of poverty. Poor citizens are caught, in effect, in a vicious cycle: while their poverty makes them more vulnerable to the effects of illness and less able to afford proper treatment, succumbing to sickness in turn reduces their already-meagre capacity to generate income.

Both aspects of this cycle can be seen as factors in the national context in Tanzania. While it has struggled with the onslaught of infectious diseases, high rates of child mortality, and widespread disability, Tanzania (one of the poorest countries in the world, with an annual per capita income of US \$280) has until recently only been able to allot roughly US \$68 per person annually to health care (**Table 2** ). By comparison, according to Conference Board of Canada (2004) figures, Canada spends an annual US \$2 809 per capita on health care, while annual per capita health care expenditures in the United States total US \$4 819.

Among the epidemics is Malaria. It is major public health problem in Tanzania and increasing trends have been observed in the last two decades. A significant consequence of repeated malaria infections in high transmission areas is anaemia in very young children. The control of malaria in Tanzania includes both preventive and curative strategies. On the preventive side insecticide treated bed nets (ITNs) are a promising tool. ITNs have been shown to be effective in reducing

malaria morbidity and mortality in controlled trials. Large-scale implementation of the technology is currently being initiated in many African countries (Abdalla, 2000). On the other hand, Mwangeni et al. (2002) using mortality of children under five years of age (infant, child and under five mortality) and the household ownership of bed nets as indicators of health status, revealed that (**Table 3**) infant mortality rate declined with increase in the socio-economic status of the household. The author further indicated that the children in the poorest households were about 5% more likely to die at infancy than those in the better off household.

With respect to wealth and poverty, Mbila and Senkondo (2001) established that there were no sign of excessive wealth or poverty. The mean calculated asset index was 1876.88 compared to the survey area which averaged 3330.38 indicating that average wealth of Ndundunyikaza was slightly more than 50% of the average wealth in the survey area of Rufiji Flood Plain and Delta. On the other hand, the mean calculated asset index for Muyuyu Njia Nne was 2563.7 compared to the survey are average of 3330.38 indicating that the average wealth of Muyuyu Njia Nne was more than 70% of the average wealth in the survey area of Rufiji Flood Plain and Delta (Mbila and Senkondo, 2001).

In Morogoro and Rufiji rural areas, District Health Management Teams (DHMTs) through Tanzania Environmental Health Intervention Project (TEHIP) raised per capita public spending on health to US \$12 annually and this lead to a 25% decline in the burden of disease. In Rufiji and Morogoro, for example, child mortality fell by over 40% in the 5 years following the introduction of evidence-based planning. In the same period, the death rate for Rufiji adolescents and adults between 15 and 60 years old declined by 18%.

Through DHMTs in each of the country's 123 councils, the Ministry of Health felt that devolving planning and management authority to local teams-composed of members with complementary skills and multiple areas of expertise would lead to policies and administrative practices that better suited local needs and conditions. DHMTs, for example, could allocate budgets, on the basis of prevailing local mortality rates than moving automatically in step with national health priorities.

The author reported that in the two districts, annual budgets were recasted to address the local burden of disease and that the funds were targeted on more selective list of health interventions in proportion to the impact of specific diseases. The author further reported that the resulting improvements in the health picture in those districts had dramatic encouraging implications. They confirm that many deaths that currently occur in developing countries were preventable and showed that health personnel had the knowledge to deliver better quality health care without waiting for additional expenditure or the design of new drugs and vaccines.

Table 2. A profile of selected health-relevant indicators for Tanzania

Indicator	Statistic	Indicator	Statistics
Population	34.4 million	Child <5 mortality	165 per 1000 live births
Urban/rural population ratio	34:66	Maternal mortality	5.3 per 1000 live births
Gross national income	US \$280 per capita	Life expectancy at birth	44 years
Health spending	US \$11.37 per capita	Low birth weight	13% <2500g
Inflation	19% per year	Child <5 underweight	29% (moderate and severe)
Adult literacy	84% of males 67% of females	Child labour	32% of 15 year olds
Total fertility	5.2 children per woman	Primary school enrolment	47% of the required age group
Infant mortality	104 per 1 000 live births	Poverty head count	36% below US \$1 per day
Inequity ratios of poorest to least poor quintiles for			
- Health outcomes (mortality)	Av. 1.7 x worse in poorest	Access to oral rehydration	21% of children with diarrhoea
Access to improved drinking water	68% of population	HIV/AIDS prevalence	7.6% of 15-49 year olds

**Source:** Developed from *Fixing Health System*)

Table 3: Infant mortality by socio-economic status

Quintile	Infant Person Years Observed (PYOs)	Infant Death	Infant Mortality Rate/1000 PYOs
1 <sup>st</sup> (Poorest)	835.5	91	108.9
2 <sup>nd</sup>	830.6	83	99.9
3 <sup>rd</sup>	843.3	69	81.8
4 <sup>th</sup>	828.7	69	83.3
5 <sup>th</sup> (Less Poor)	862.3	62	71.9
Poorest –Less poor Ratio			1.51
Concentration index			-0.0816

**Source:** Mwageni, et al. (2002).

## 1.5 Agriculture and Food security

*Agriculture:* Farming activities are the major economic pursuits around Rufiji flood plains with the cultivation of crops such as paddy, maize and various types of vegetables and fruits. Seasonal floods control these activities. People who live and farm in some floodplains move to higher lands during the floods and return to the valleys during the cultivation season. In fact some people, like those in the lower Rufiji floodplain, have developed a 'two homes' system. They live in one house during the cultivation season and the other during the flood season. This type of settlement pattern has traditionally enabled the peasants to cultivate two types of crops. Some crops are planted when the areas are still wet but the water level is falling (flood recession agriculture). The use of such seasonal floodplains allows the planting of a range of crops; paddy is planted in standing water as the water level falls, while quick growing crops (such as cucumber and tomato) are planted later in damp soil.

In this way, flood plains of this type influence not only settlement patterns but economic activities as well (**Table 4**). The people adapt themselves to the seasons and organize their various activities accordingly. The disadvantage of this type of settlement pattern is that people cannot build permanent houses but must move their habitation between the floodplain and the uplands. It was on this basis that in the 1970s, at the peak of the implementation of 'Ujamaa' programmes, the people in the Rufiji floodplain were moved by force to the uplands for their own safety.

Faced with modern market forces, both in crop markets, capital markets, labour markets and property markets, this low labour productivity represents a new kind of risk which became more pronounced towards the end of the 20th century and the beginning of the 21st century. If risks are likely to be absorbed by others than the peasants, e.g. financial markets, farming strategies with higher labour productivity will most probably win over the traditional ones. Also, the continued robustness of the agricultural system itself depends on a number of conditions that have to be fulfilled. They are mostly related to the micro-environmental knowledge among the peasant population and especially the dynamic aspects of this (Sandberg, 2004)

Table 4: Agricultural Activities Calendar in Rufiji Flood Plain

Month	Water Status	Agricultural Activities	Crop conditions
November	Low water	Plant Maize on high river banks	Good crop if low flood
		Start preparing rice fields	Avoid labour bottlenecks
		Harvest and market cotton	Mlau- system
		Harvest and market mango fruits	
December	Low water	Harvest maize from low clays	Mlau system
		Preparing rice fields continue	Avoid labour bottlenecks
		Plant Maize on high river banks	Good crop if low flood
		Harvest and market mango fruits	-
January	Low water	Plant Rice, fast/slow > high/low	Right variety in right place
February	Rising	Rice is growing	-

	water		
March	Raising water	Rice growing	Good crop if medium flood
		Harvesting maize from river banks	Needs dry spells to ripen
April	Flood peaks	Rice grows	Tolerates medium floods
		Plant maize on highest places	As flood recedes
		Plant Cowpeas on highest places	As flood recedes
June	Flood recedes	Plant maize on <i>Mbaragilwa</i>	As flood recedes
		Plant Cotton on <i>Kitope</i>	As flood recedes
		Harvest rice	Labour peaks
July	Floods recedes	Harvest and market rice	-
		Plant Cotton on lowest clays	-
August	Lower water	Harvest maize from high places	-
September	Lower water	Plant maize on lowest clays	-
October	Lower water	Harvest cow-peas	-
		Start harvesting cotton	-

**Source:** Developed from Sandberg (2003).

*Food security:* Food security in Tanzania has been of great concern because geographically the country falls in the region of food and environmental problems. Food security is defined as "...A country and people are food secure when their food system operates in such a way as to remove the fear that there will not be enough to eat. In particular, food security will be achieved when the poor and the vulnerable, particularly women and children and those living in marginal areas, have secure access to the food they want (Mascarenhas, (2000). FAO (2001) in the Special Programme for Food Security (SPFS) launched in 1996, showed that by working with farmers' groups in demonstration plots and by investing in low-cost irrigation structures which are built and maintained by water users' associations, as well as through the introduction of oxen for ploughing and increasing farmers' access to the tools and technologies they need, the results have been more than encouraging. The programme showed that yields of rained rice increased from 12 to 21 bags per acre (2.7 metric tonnes to 4.7 metric tonnes per hectare) and even in low rainfall years, average yields in the demonstration plots were 25 to 30 percent higher than in the control plots. To complement these improvements in crop production, the SPFS has also been successful in introducing and improving livestock raising (FAO, 2001).

The strategy of increasing the food production in Tanzania by land expansion and earnings in export-oriented agriculture, in 1980s, has not helped the country and communities to achieve food security objectives. Nutritional and health status indicators, suggest also high food insecurity. The per capita caloric availability for the region is 1950 calories per day which is less than the international minimum standard for an adequate diet of 2100 calories and much less than the standard for the an adequate diet of 2400 calories per day. Malnutrition is also a cause of up to 80% of maternal deaths. The regional infant mortality rate is 99 deaths per 1000 people and malnutrition accounts for more than one third of infant and child deaths (Ngusaru, 2000).

The farmers involved in crop production in Rufiji District still use indigenous ploughing methods that are the use of a hoe and a stick for planting. With these tools it is not possible to cultivate a large area. This explains why a small proportion of the available land is used for crop production. Consequently the output from these farms is also relatively small. This situation coupled with a

variation in weather conditions; food security is at stake in the district.

## 1.6 Natural Resources

The Rufiji basin has about 92 forest reserves covering an area of 22,933 km<sup>2</sup> about 13% of total land surface of the basin area. These reserves cover Matombo area in Morogoro and highlands of Iringa and Mbeya Regions. The reserves comprise 4,480 km<sup>2</sup> and 18,720 km<sup>2</sup> protection and production reserves respectively. The protection reserves are important for regulation of water supplies in the catchment as well as timber and other forest products. On the other hand, the production reserves are specifically intended for timber production in the basin. Important tree species in the reserves include Mpingo tree (*Dulbergia melanoxyton*), Mninga (*Pterocarpus angolensis*) and Mvule (*Melicia excelsa*). These trees are important for timber and calving production.

The exploitable timber products in the basin are estimated to be 929,000 m<sup>3</sup> of which one third is mahogany. Rufiji Basin also holds a fairly balanced tourism potential for what is considered as a 'southern tourism circuit' with major links to the Islands of Mafia and Zanzibar. The circuit links it with the mainland's Coastal beaches and historical centres of Kilwa and Bagamoyo. Of the greatest attraction are the Ruangwa and Salous game reserves and two Mikumi and Ruaha National parks. These tourism attraction areas have a high concentration of game animals- elephants, buffaloes, lions, warthogs, ducks, guinea fowls, crocodiles, and hippopotamus at cetra.

Ikwiriri and other areas in Rufiji District, in the Coast Region are threatened by indiscriminate logging and if this proceeds unchecked the area will be turned into a desert. At least 10 trucks laden with logs leave the area every hour. Loggers can cut down as many trees as they wish, after paying a paltry 7500/- licence fee. The booming trade seems to benefit outsiders, mostly 'investors' of Somali and Chinese origin and wealthy Tanzanians. Although five percent levy, (375/-), is charged on each licence, the amount is too small to generate revenue from the natural resources. Since the loggers targeted trees 60-100 years old including *Milletius*, *Afromosia*, and *Angolesis*, these species were on the verge of extinction.

## 1.7 Gender issues

Gender is social relationships built by respective society. The relationships are usually built through socialization immediately the child comes to the world. The boys are socialized to a masculine behaviour of ownership, management and control while a girl is socialized to a feminine behaviour of submissiveness and other specific tasks related to reproductive roles. The society therefore forms the standard for a woman and that of a man. Doing otherwise one is seen as abnormal. 'Jando and Unyago' are the famous traditional institutions where socialization for males and females takes place. Gender is an analytical concept that helps to make us aware of the needs, interest and concerns of different social groups (Mjema, 2001 and Northern, 2003). Women are responsible for child bearing, pregnancy, delivery and breast feeding (physical roles) in addition to the productive roles (controlling resources). In Rufiji communities men do fishing for sale while women deal with small fishes 'uduvi' basically for food consumption.

Mjema (2001) reports that 25% women seats given to women in village government were very small to ensure effective women's participation in issues of concern to them. The workshop noted that there was an urgent need of increasing women representation as it was in Jaja Village where women had 50% of the seats.

## **1.8 Poverty**

According to the World Bank (World Bank, 1993) more than half of Tanzania's households are classified as poor and there are considerable inequalities between rich and poor and between rural and urban areas (like Dar es Salaam). The wealthiest 20 percent of Tanzanians controlled 45.5 percent of total income, while the poorest 20 percent controlled only 6 percent in 1993. Poverty is especially a rural phenomenon. On the average a rural Tanzania spends the equivalent of US \$193 while an urban Tanzanian (in DSM) spends on average US \$587. About 70% of the households live in rural areas and about 92 % of all the poor households, involved in subsistence agriculture, live in rural areas (World Bank, 1993 and PRSP, 2000). Also income varies with agro-ecological zones. Tanzanians who live in intensive agricultural systems (coffee, banana and dairy systems of the North and coffee, maize and legume systems of the Southern highlands) are relatively well-off compared to the agro-pastoralist zones of the semi arid central plains and the cash and cassava areas of South (World Bank, 1993).

A number of factors are associated with the distribution of income and poverty in rural areas in Tanzania. Households in rural areas who grow cash crops (37%) are better off than in rural areas whose households grow and sell only food crops. About 20% of the households used input, though in the lowest expenditure quintile (11%). There is a need to improve input supply, infrastructures (rural roads) and subsidise input prices). Besides, access to credit from financial institutions such the banks is limited for low income households who have little or no acceptable collateral and this has been responsible for the current poverty situation in Tanzania (World Bank, 1993 and MOAC, 1998).

## **1.8 Climate change in Tanzania:**

Climate Change is real and will affect climatic factors and concentrations of (carbon dioxide (CO<sub>2</sub>)) in the atmosphere and the timing of extreme/critical threshold events relative to crop development. The IPCC reports suggest that global mean temperatures will increase by  $1.0 \pm 3-5^0$  between 1990 and 2100, with a best estimate of  $2^0$  C. Increase in temperatures is likely to affect health, food security and social economic conditions all over the world. In Africa, due to deterioration in terms of trade, inappropriate policies, high population growth rates and lack of significant investment, highly variable climate conditions will render the continent most vulnerable to impact of projected changes in climate. According to Mwandosya, Nyenzi and Luhanga (1998) Tanzania, is predicted to warm by 2 - 4 C° by 2100. Rainfall is predicted to decrease by 0 – 20 percent in the inner parts of the country. In contrast, rainfall may increase by 25-50 percent in the northeast, southeast and the Lake Victoria basin. Changes in the mean temperature, rainfall patterns and rainfall variability are likely to prolong dry seasons and to increase the severity of periodic droughts. This will be pronounced in the interior part of the country which will experience higher temperature increases and reduced rainfall. The northeast, southeast and the Lake Victoria basin will be less exposed to droughts but they are likely to experience more frequent and severe flooding.

Average maize yield is predicted to decrease 33 percent by 2075 if CO<sub>2</sub> concentrations will double and temperature increase by 2-4 degrees. Maize yields may decrease 80 percent in the Tabora-Dodoma region (Mwandosya et al., 1998).

Tanzania's water resources will experience varied climate change impacts. Some watercourses such as the Rufiji are predicted to have slightly increased water flows but the Ruvu and the Pangani are predicted to have reduced water flows. While the predicted annual flow changes are only about 5-10 percent, water flows are going to become more seasonal. Predicted minimum flows in the dry season are less than half of the present ones in Ruvu and Pangani and predicted peak flow in rainy season about twice the present one for the Rufiji (Mwandosya et al., 1998). Higher peak flows contribute to floods, which adversely affect human settlements and health. Lower minimum flows will in turn impact the use of water for power generation, irrigation and public water supply. This is of national concern as the Ruvu supplies an important proportion of water for Dar es Salaam and the power plants on the Great Ruaha, together with those on the Pangani River, provide the backbone of national hydroelectric generating capacity. Changes in rainfall and evaporation may also affect groundwater levels. Groundwater levels may increase in places where rainfall increases and soil is permeable but is likely to decrease elsewhere. More frequent floods will destroy infrastructure, buildings and belongings in the floodplains (Mwandosya, et al., 1998).

Warming, flooding and increased rainfall increase the spread and incidence of insect-borne diseases such as malaria. Draughts will impact all settlements, requiring more time for water collection and resulting in reduced water use. This impairs hygiene and contributes to the spreading and increased incidence of all contagious diseases (Mwandosya et al., 1998).

### **1.10 Environmental protection**

Since 1998, Rufiji Environment Management Project (REMP-MUMARU) has promoted wise use and conservation of the forests, woodlands and wetlands of the Rufiji delta and floodplain. Several of the villages with which the group works are adjacent to the Selous Game Reserve - a UNESCO World Heritage Site. Working with district authorities, communities, and other stakeholders, REMP has developed environmental management plans at district and village levels. This work has gone hand in hand with awareness raising and the training of communities in sustainable fisheries and beekeeping and in tree propagation and planting, but with no climate change in mind until recent after the introduction of the NCAP in Rufiji area.

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