IMPACT OF THE FLOOD HAZARD

THE ECONOMY AND ECOLOGY

A CASE STUDY

OF

LINDI AND MTWARA REGIONS

National Environment Management
Council Research Team

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ACKNOWLEDGEMENT

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EXECUTIVE SUMMARY

In April 1990 flood hazards occurred in Lindi and Mtwara regions which are located in the south-eastern end of Tanzania. The flood devastated areas include the Makonde Escarpment and the adjoining floodplains which are underlain by unconsolidated sandstones and alluvium respectively. Given a humid tropical climate, proximity to the sea and subject to the South-east monsoons, cyclone development in the Indian Ocean could have triggered the catastrophic weather event.

It was found out that these floods were predominantly a result of the heavy rainfall and that geological formations as well as man's economic activities aggravated the problem.

The disastrous floods were characterized by landslides, slip scars, inundation of farms, destruction of buildings, roads, water, power and telecommunication systems and to cap it all by loss of lives of both people and livestock resulting in poverty, hunger and degradation of the environment.

It is in this light that both short and long term programmes that are trans-sectoral and multi-ministerial have been proposed to combat flood hazards. Emphasis in the whole strategy, however, is placed on the need for land-use planning and development.

INTRODUCTION

This report is a contribution to the study of the impact of the 1990 April flood hazards on the environment as well as on the socio-economic activities of the people in Lindi and Mtwara regions. In essence a flood refers to the inundation of normally dry land resulting from the temporary rising and overflowing of a body of water such as a river, a lake or sea. According to UNDRO (1977), however, floods do not in themselves constitute disaster until they strike at human lives property and services.

Following the 1990 long rains of January to December, unprecedented floods occured in April in the Southern regions of Lindi and Mtwara. As a sequel to the heavy rainfall, the Makonde Escarpment was so waterlogged and saturated with rain water that landslides occurred along the western rims of the escarpment. The landslides were characterised by the shifting of heavy rocks and lumps of soil/mud together with the vegetation covering them, all of which were swept down-stream by the floodwaters along river valleys, finally draining into Lukuledi river and other smaller streams flowing into the Indian Ocean.

The heavy loads of rocks and tree trunks carried by the flood waters led to the attrition of the river channels, thereby deepening and widening them and uprooting and damaging vegetation, including trees, shrubs and crops. Other losses include residential houses, schools, dispensaries, and infrastructure such as roads, bridges, water-

other community facilities. Some small streams were filled up with flood waters and some created new courses and swept accross plains and crop fields. The heavy tree trunks and rock boulders were deposited along the floodplains as observed at Ndanda and Mwena Villages in Masasi District (Photo 1). The finer sand silt and clay were swept further downstream to be deposited preferentially in thick layers along the lowest parts of the floodplains thereby covering and devastating farms which were planted with various crops such as paddy and maize. It is pathelic to record that 18 people were killed in Masasi district, Mtwara regions.

The objectives of this study are as follows:

i) determine the root causes and effects of the floods to present and future production and availability of food and income from cash crops;

ii) find out the effects of floods to sources of drinking and domestically used water.

iii) determine the level of decline of health facilities and resurgence of new health risks due to the recent flooding,

iv) appraise the current land use in view of the land use conflicts resulting from flooding

v) draw up recommendations with the view of finding short and long term solutions to the flood hazards, and

vi) devise a programme to prepare flood prone communities on how to deal with flood emergency.

In order to attain the above objectives a field reconnaissance survey was carried out in the area between November 22nd and December 10th 1990. By using an open-ended questionnaire, interviews were conducted with government officials from village to regional level with more a detailed dialogue with peasant farmers was carried out. Reference to data from secondary sources was also made.

ENVIRONMENTAL SETTING OF THE REGIONS

Location: Mtwara and Lindi regions are located in the southeastern end of Tanzania bordering Mozambique to the south and the Indian Ocean to the east. (Figure 1). In coordinate terms, the two regions lie between parallels 8° 2'S. and 10°5'S. and longitude 36°.5'E and 40°E. (Figure 1).

Geology and Geomorphology: The two regions are underlain by basement complex rocks that are covered with a deep mantle of deeply weathered sedimentary rocks and soils. (Finnwater 1977). Unconsolidated sandstones cover a large area. The deposits found along the coastal strip are marine in origin while those inland are terrestrial. These terrestrial sandstones are covered by between 5-30 metres of unconsolidated sands.

The Makonde plateau, the biggest in the area rises gradually from the low coastal plain to an altitude of between 600 and 900 metres above mean sea level (M.S.L.). Its eastern part is edged by very steep arc shaped escarpments that are caused by erosion (Photo1).

To the north of the Lukuledi valley and west of Lindi, lies the smaller Rondo plateau with an average altitude of about 600 metres and rises to a maximum of 900 metres above M.S.L. forming a south facing arch.

The dominant structural trend of the basement area varies between NNW-NNE with a steep, in places vertical dip. Most of the falt zones are very small. Intensive folding is often associated with falting. Signs of this strong movement are today indicated by the topography of the ground level as reflected by the non-channelised floods.

The area is drained by the Ruvuma river and her tributeries that form the boundary with Mozambique for about 675km. Other rivers draining the regions include the Mbwemkuru, the Mlundi, the Mavuji, the Lukuledi, the Mambi and the Mbuo.

Catstrophic floods in the two regions occured in the Lukuledi, the Mambi and the Mbuo river basins. For a comprehensive analysis of the flood refer to the Flood Probe Teem Report 1990. Given the geologic and geomorphic situation of the area, it is highly probable that the three rivers draining the Makonde plateau would be subject to flooding in the event of heavy precipitation.

limate: With a humid tropical climate, the area falls into two istinct zones namely the coastal belt and the inland belt. eing further south of the Equator and under the influence of the outh-east Monsoon the area experiences a marked drop in humidity d temperature tha, say, Dar es Salaam.

The average climatic conditions are shown in Table 1.

Table 1

Temperature and rainfall conditions in Selected Stations

	Attitude (m)	Temperature Max °C	Min. °C	x°C	x Annual Rainfall (mm)
Mtwara	370	30.7	21.2	25.9	1159
Lindi	133	30.5	21.7	26.1	-926
Nachingwea	1525	30.3	18.8	24.5	926

Source: Economic Report on Mtwara Region, BRALUP 1971 pp.2

According to the records at Chidya Secondary School weather station in Masasi District, rainfall around the Makonde Escarpment on 3rd and 4th April, 1990 was 119mm. Other stations recorded rainfall as follows:- Ndanda Bwawani 400mm, Rukohe 90mm, Mwena 149mm, Ndikwa 80mm, Chikundi 110mm. and Masasi Town 5.5mm.

It is estimated that the areal average was 300mm of rain in hours or an average intensity of 12.5mm/hr. It is most likely, therefore that the floods were caused the heavy rainfall which was converted to surface runoff. Prior to this heavy downpour there was a statement from the Directorate of Georological in Dar es salaam that they had observed a weather cyclone in the Indian Ocean moving [illegible]

which Mtwara and Lindi are located. Weather cyclone influences rainfall pattern hence this could be taken as a reason for substantiating the kind of rainfall experienced that resulted into the disasterous floods.

Soils: The soils in the area are strongly influenced by way of their genesis by geology and geomorphology (Johnson and Tiacks 1969). They are predominantly derived from unconsolidated sancstone parent materials (Photo 2). The major soil types are:

Soils derived from alluvium:

These are either heavy textured or light textured soils found in areas that are no longer flooded as well as those still receiving deposition. They reflect the highest agricultural potential albeit packets of saline soils. Due to the flat terrain these soils have greatly suffered from the flood hazard.

Soils developed from deep unconsolidated sands:

These soils are derived from both terrestrial and marine leposits inland and along the coast respectively. They are haracterized by law quantities of weatherable minerals and the exture ranges from coarse to five pasticles whilst the structure aries from single grain to massive and structureless. These oils have a low agricultural potential given the low level echnology in the area.

Soils derived from gneiss rocks

This large and important group of soils consists of those derived from gneiss rocks of the basement complex. These are predominantly very deep soils and in some places they are seldon more than one metre deep. These soils may be correlated to the Oxisols (USDA 1975) by having loose, structureless surface horizon that becomes hard and caps after wetting and drying, with iron concretions (oxic) where impeded drainage occurs. Given the contemporary technology employed by the peasant farmers these soils have a medium potential for agriculture.

Shallow Soils on Escarpments

These soils are subject to severe erosion due to very steep gradient. The natural fertility of these soils varies with the nature of the parent material. By and large the soils have been left under forest cover.

Vegetation and Land-Use

The vegetation pattern very much reflects the topography and climate of the area. The coastal plain is characterized by mangrove swamps, and scrub bush. The main type of agricultural land use is subsistance farming based on coconut trees, cassava and paddy.

The inland belt is dominated by open miombo woodland with perennial grass understrong. Whilst Brachystegia woodland dominates the deep well drained soils, Terminalia woodland is found on moderately well drained alkalic

odland occurs on shallow soils in low rainfall areas . The jor agricultural land use is subsistance farming based on shewnuts, cassava, sorghum, rice and maize.

In both belts, shifting cultivation of annual crops is still ing practised in some sites as reflected by a regrowth of shland thicket. The introduction of the villagization ogramme that lead to 'commercialize' fallow and permanent ltivation on the fragile escarpment soilscapes may have ntributed to the catastrophic floods.

pulation and Settlement

There are 1.5 million people in Mtwara and Lindi region of ich more than 80% live in villages. Over half of the total pulation live in Mtwara, Nachingwea, Masasi and Lindi stricts, which altogether cover only a fifth (1/5) of the gional area. The regional population growth rate is 1.8% (1988 nsus).

This rural population was organised into Ujamaa villages tablished in 1975, as nucleated settlements. This resulted to concentration of people especially on the makonde escarpment ich led to overcultivation and deforestation around the ttlements. This has been one of the major causes for land gradation and subsequent decline in agricultural production the gions has experienced for the past 10 years.

Mtwara and Lindi regions suffer from the problem of nucleated population distribution and indeed settlement patterns. Concentrations of people and to some extent livestock characterize Masasi and Nachingwea districts while Mtwara and Lindi areas are sparsely settled. There is also a poor distribution pattern within the villages in relation to Land. Settlements are centralised leaving much land underutilized in the periphery due to the distance friction factor.

As a result a number of land use related problems have emerged and these include:

- Land degradation in villages caused by centinous farming on the same plots.

- Shortage of fuelwood and water due to over exploitation of the resources within easy each of settlements.

Due to these problems regional authorities have since 1984, initiated a Village Rectification Programme the aimed at raising agricultural production. The programme still continues but it is hampered by limited resources.

CAUSES OF THE FLOODS

In order to reconstruct the root causes of the Lindi-Mtwara floods, use must made of the contemporary responses' (field evidence) to the factory and processes emanating from the floods and landslides.

Field evidence reveals the following:

i) river floods which occured as rivers discharged high flows over their banks as observed loaded with huge trees and bolders along the floodway.

ii) non-channelised flash floods following faults and slope gradient as characterized by deposited trees with their barks peeled off as well as bolders and pebbles along the floodway.

iii) Lakeshore floods as observed around the inundated zone.

iv) landslides-rock earth and litter as observed on the denuded escarpments as well as in areas of deposition.

v) The collapse of the HEP plant at Ndanda Mission may have aggravated the flood disaster.

vi) Extensive cultivation of the pediment based on commercialized fallow contributed significantly to surface runoff.

On the basis of the available field evidence it may be pothesized that the floods may have been caused by a complex mbination/interaction of rainfall, soil, underlying parent terial and slope (gravity).

heavy storm concentrated in the escarpment over a short period of time might have been the precursor.

If this is so, it follows logically, therefore, that the oil-water-gravity model (Conacher and Dalrymple 1977) may be pplied in this case to explain the catenary `revolution' that ccured in Lindi-Mtwara regions culminating into flood hazards.

Starting from the interfluve, which acted as a water-parting ivide, the incoming heavy precipitation reduced the water etention capacity of the permeable polypedons. Composed of consolidated parent rock materials, and located on a very steep mber of the catena the rock-soil-water materials on the terfluve moved by gravity downslope trigering of a sequence of tastrophic process of erosion and deposition.

Some downslope members of the catena have been subjected to ension cultivation under villagization rendering the soils sceptible to erosion under heavy storms.

People interviewed reported that the landslides and indeed floods were caused by a volcanic eruption in the escarpment. reported of a booming sound during the night of 4th April). One may speculate that the ensuing downslope movement of solidated rocks-boulders, pebbles and runoff caused by their weight after saturation and subsequently knocking each other against uprooted trees, may have produced the thunderous roar h was heard miles away

By the same token, those local inhabitants that thought God was engered by rampant vices and had decided to punish them by ending life on earth (the night was reportedly very dark) drew their conclusion out of fear of the terrible roar.

Today Environment and land use practices ~~today~~ have changed dramatically from the insitu bush fallow pattern based on a 6-9 year fallow period with a 3 year cropping cycle described in the 1940's and 50's. This cultivation pattern based on a fallow gave rise to "Makonde" thicket, which was then cleared for the cultivation of crops over 3 years before being fallowed again.

Population increase has also reduced this fallow period on cultivable land given the technological stagnation in agriculture. With the pressure on land close to village sites, Makonde Thicket has been extensively cleared, although in some remoter locations as land use has ceased, vegetation regeneration has continued unimpeded. As a result soil fertility, already inherently low, is decreasing even further. The potential range of crops and yields is being reduced and the ecological system modified. Villagers within and around the escarpment have always been getting the supplies of firewood and poles from the forest within the area. The overutilisation of resources in the area has caused decreased infiltration capacity of rain water and therefore unregulated water supplies. Surface run off which accentuates soil erosion and descreases discharge of important springs in the area especially during the dry season has been reported. (Finnwater 1977).

It suffices to conclude that the Lindi-Mtwara floods were a result of the heavy precipitation experienced within a short time falling on a fragile landscape.

THE IMPACT OF FLOODS ON THE ECONOMY AND ECOLOGY OF MTWARA AND LINDI REGIONS

Residential Areas:

This category of land use includes residential houses, crop granaries or stores, latrines, livestock sheds and other household facilities which were damaged, temporarily submerged or affected in any other way by the floods. A total of 4390 buildings were damaged by the floods, affecting about 140,000 people. the main damage on buildings was the collapsing of walls, most of which are constructed of wooden poles and mud or mud bricks which were not strong enough to resist the impact of the flood waters, rocks and other debris which were swept down across the affected settlements.

Since the flood waters from the Makonde Escarpment were swept down during the night, the affected people had taken no precaution to transfer their household items such as cooking and eating utensils, clothes, beddings, stored foodstuffs and livestock to other areas away from the floodplains. As a result of flooding some of those items were either swept away and got lost or were damaged by the flood water. Many respondents (82%) interviewed reported that they lost some chicken, clothes, stored foodstuffs, especially rice, peas and dried cassava as well as cooking and eating utensils.

Seven villages located on the foothills of the Makonde Escarpment in Msasi district, namely Mkolopola, Miwale, majembe.

Mkang'u, Rukohe, Mkungu and Mwena were most adversely affected by floods as evidence by the extensive damage of their residential buildings and farms. The Regional and District Authorities assisted the affected villagers to voluntarily resettle in other areas which are located on higher ground and not liable to be affected by floods in future. (Photo 3)

The most adversely affected villagers were transferred from Mkolopola, Miwale, Majembe, Nkang'u, Rukohe, Mkungu and Mwena and resettled in Namwanga, Msikisi, Songambele (Newala District), Nanganga, Msikisi, Chimemena and Likwachu (Lindi District) villages respectively. Others were resettled in Kilimahewa, Longa, Nakadi, Chochelo, Mtakuja and Cheleweni villages within Lindi Region. New residential and agricultural puts were demarcated and allocated to the new settlers in the resettlement areas. masasi District demarcated 2417 plots while Mtwara District demarcated 954 plots.

The impact of the floods on land use pattern in the villages which were deserted was that it changed from mixed pattern of residential buildings, farms, grazing areas, schools and community facilities and turned to regenerated vegetation such as bushes and shrubs or fallow and in future some of those areas would be forested or woodlands. On the other hand, the land use pattern in the areas where the transferred villagers were resettled changed more markedly in response to the new developments, including establishment of temporary huts, tents and the clearing of existing natural vegetation or

crops such as cashewnuts in order to give room for the construction of new residential houses, schools, health facilities, shops, godowns and other community facilities to cater for the resettled population.

Some villagers were resettled on higher ground within their villages and were only allowed to cultivate seasonal crops in their old farms after the floods had subsided but they were restricted from constructing permanent residential houses in the vacated areas. A total of 3579 families with 14,509 people were relocated from the affected flood plains and resettled in new and environmentally safer areas.

Details on the number of households and population which was resettled due to floods in Mtwara and Lindi regions are shown in Appendix I.

Cultivated crops/Farms:

The onset of the 1990 in Mtwara and Lindi regions saw the crop calendar in the middle of the farming season when farmers had planted their crops, mainly paddy, maize, cassava, peas, millet and sorghum. Most of those crops therefore were not yet mature or ripe for harvesting and were thus completely destroyed. A total of 12,492 hectares of various crops in Masasi District, 938 hectares in Mtwara District and 696 hectares in Newala District were destroyed by floods. The survey conducted in Masasi, Mtwara and Lindi districts revealed that the floods destroyed between 1 and 5 hectares of various crops per

household.

Some crops were uprooted and carried downstream by the flood water and others were crushed and destroyed due to the impact of the fast flowing flood water, mud, rocks, tree trunks and other debris which were thrown accross the crop fields in the affected flood plains. The rice fields which are mostly located in the lower parts of the floodplains were most adversely affected because they were either inundated or swept away by the flood water.

The destruction of cultivated crops and stored foodstuffs had a severe impact on food supply in the affected areas which experienced a serious food shortage, thus necessitating the supply of relief food to supplement the little food which was not destroyed by floods. The interviewees confirmed that there was general under-nourishment in many households a couple of months after the floods.

About 45,459 people in Mtwara and Lindi regions whose crops and foodstuffs were destroyed by floods needed relief aid, mainly food, (including maize and cassava flour, beans, cooking oil, peas, rice, sorghum, millet, sugar, salt, powdered milk and dates) in addition to building materials (cement, corrugated iron sheets, tents, spades), agricultural inputs (such as seeds and implements namely hoes, pangas/ matchets), as well as clothes, beddings, cooking utensils and crockery.

The demand for the above flood relief items and those which

were supplied by the government, local and international relief and donor agencies such as Red Cross Society are shown in Appendix II.

Roads and Related Infrstructure:

The floods caused extensive damage to long sections of road surface and washed away ot damaged six bridges on Mtwara-Mingoyo-Masasi road (200 km) and two bridges on Mtwara-Newala-Masasi road (205 km) (Photo 4). Secondary and feeder roads which were also damaged by floods include Mpapura-Chemchem Road (Mtwara District), Mkwiti-Nanihonga and Nkwiti-Likolombe (Newala District) and Lukuledi-Nambwawala, Masasi-Msikisi, Namatutwe-Chiwale, Mlingula-Mkowele-Nanyindwa, mandiwa-Mumbaka roads (Masasi District). A total of 104 culverts along major roads were also damaged or swept away by the floods and needed replacement and the damaged sections of the roads called for rehabiiitation. Stretches of 227 kilometres of roads needed major reconstruction using graders and 20 kilometres of roads had to be regravelled.

The extent of damage caused by floods on each of the most adversely affected roads was as follows:-

Mtwara-Mingoyo Road (DST):

A total of 2.2.km of road surface was washed away by floods. Three bridges, including Mbuo bridge (30 metre span), Mpapura bridge (30 metre span) and Mkwaya bridge (70 metre span) were completely washed away. Also 16 culverts of 1.2 metre and 1.8

metre diameter were washed away.

Mingoyo-Masasi Road (DST):

A total of 2km. of road, three main bridges, including Nangoo (70 metre span), Nyangao (67 metre span) and Liloya (30 metre span) were damaged and washed away by floods and 34 culverts were also awshed away and needed to be rainstalled.

Mtwara-Newala-Masasi-Lukuledi (Gravel):

Two bridges, namely Namuamba bridge and Mwiti bridge were damaged and washed away by floods. Two culverts of 1.2 metre diameter had to be reinstalled at Nanyamba and a temporary drift was provided at Mwiti. other 52 culverts were also washed away by floods and needed to be reinstalled in order to make the road passable.

The total cost of reconstruction of all the above-mentioned roads was estimated to be shs. 79,850,000/=.

The major adverse effects of the damaged roads (caused by floods) on the population was that some villages were cut off for a period ranging from three days, a few weeks to several months and in a some areas essential services, such as dispensaries, schools and shops were inaccessible. Supplies of food and other consumer goods therefore could not be transported from Dar es Salaam, Lindi, Mtwara and Songea to reach such villages and settlements.

Water Supply

These floods damaged 5 water supply systems at Mwena, Mwiti, Luchemo/Mkalemba, Luchewa and Mbwinji in Mtwara region. The sources of the water supply system were washed away and the pumping station at Luchewa was also destroyed. The estimated loss in terms of reconstruction costs of the damaged water supply systems was put at shs. 63 million for Mwena, shs. 5.8 million for Mwiti, shs. 42 million for Luputu and shs. 8 million for Mbwinji.

Six shallow wells in Utende, nakada, Chekeleni and Mbuo villages within Mtwara District and 13 shallow wells in Masasi District were destroyed either by being filled up with mud or collapsing due to the floods. Following this episode, the population in the affected villages had to resort to unsafe surface water supplies such as rivers, streams and ponds before the damaged boreholes were rehabilitated or new ones constructed.

The dam at Ndanda Mission was completely washed away and the electric generators downstream were totally damaged.

Most of the newly resettled areas had no organised water supply systems, so the government had to construct shallow wells in order to supply water to the resettled population. Those short term shallow wells were estimated to cost about shs. 26 million.

In some of the new resettlement areas such as Mkang'u village the constructed shallow wells were found to contain saline water hence the people were forced to use unsafe surface

such as streams for domestic purposes.

Schools and Related Facilities:

Primary school buildings, including classrooms, offices, latrines and teacher's residential houses as well as school gardens and playgrounds at Mwena, Chisegu, Namatunu, Nkangu and Mkolopola villages in Masasi District were also damaged. The buildings and related infrastructure in those villages were so devastated that they had to be abandoned and relocated to new settlement areas and construction is now going on, along with other public facilities. In the meantime, the pupils have to attend school in neighbouring villages or temporary huts and teachers are being provided with temporary accomodation in tents. School buildings and related facilities in other 8 primary schools in Masasi District were slightly damaged by floods and needed minor repairs to attain habitable conditions.

The floods therefore disrupted normal school routines and pupils' attendance was characterised by absenteesm or late arrival at school due to long walking distances under flood conditions.

A public library located at Mwena village which had been serving about 20,000 people in Mwena ward was also extensively damaged by floods and had to be relocated too.

Health Facilities

Most health infrastructure and other facilities, including dispensaries, rural health centres and hospitals were not

adversely affected by floods except two dispensaries in Masasi District whose buildings and related infrastructure were wrecked.

The main problem with regard to the provision of health services during the flood period however was the inaccessibility of existing health facilities from several villages or residential areas. In most cases inaccessibility lasted for between three days and two weeks because of damaged roads and bridges including footpaths, which were under flood water.

Furthermore, the breakdown of transport infrastructure also hindered smooth transportation of medicines and other medical supplies from Lindi and Mtwara regional headquarters to respective district hospitals, rural health centres, dispensaries and village health posts scattered throughout the flooded areas.

The new resettlement areas which were established as a result of the floods had no organised health facility of any kind. The people who had been resettled there therefore had to depend on mobile health services and temporary. First Aid Boxes which were provided by the Government and Voluntary organizations such as the Red Cross Society during the initial period of constructing new health facilities. Those who needed hospital treatment to travel on foot or by bicycle to existing health facilities in neighbouring villages while others went to higher order centres such as Ndanda Mission Hospital.

The newly resettled population was also more exposed to diseases

vectors namely mosquiotoes and flies as,they lived in temporary huts and tents and had scanty clothing and beddings whilst using temporary pit latrines. Due to lack of reliable and safe potable water supply in those settlements, they were also susceptible to bacterial and fungal gastronic diseases.

Disease vectors, particularly mosquitoes and snails, with their associated diseases (malaria, elephantiasis, schistosomiasis, etc) already prevalent in Mtwara and lindi regions even before the floods, increased considerably, as result of the floods. The intensification of the problem was a response to extensive areas being covered with water for several weeks, thereby providing a conducive habitat for reproduction and development of the disease vectors.

Godowns:

Four village-owned godowns, each with a capacity of storing 300 tons of agricultural produce and inputs were damaged by floods in Nakada, Mkwajuni, Lyoya and Muungano villages in Mtwara District. One godown at Likolombe village in Newala District as well as 7 godowns located at Mkolopola, Miwale, Majembe, Mkang'u, Rukohe, Mkungu and Mwena villages in Masasi District were also extensively damaged by floods and had to be relocated and new ones constructed in new resettlement areas.

Forests and Afforestation in Mtwara and Lindi Regions

Afforestation in these two regions has been undertaken by villagers and the general public

effort to meet future demands for fuelwood and small wood products as well as to maintain a sound vegetation cover. However, the government has been providing free tree seedlings and constant technical advice. Field implementation strategies can broadly be divided into four streams namely individual tree planting, schools and institutions, communal woodlots and Forest department demonstration plots.

Very little noticeable success in the implementation of village afforestation on a self-reliance basis has been achieved in communal farms and schools. This was due to lack of follow up and supervision from the nursery management. Also seedlings were not enough to cope with the increasing demand.

An appreciable degree of success has been observed in the sphere of individual tree planting especially fruit trees around houses and farm boundaries.

Some of the problems experienced were as follows:

(i) Poor tending of communal woodlots.

This has caused a significant failure in these regions i.e. once trees are planted very little followup in tending is made.

(ii) Weeding

woodlots as this operation requires high labour input, which is mostly used in agricultural crops. Some villagers believe that trees do not require weeding as they are usually seen growing naturally in the wild.

(iii) Lack of Transport:

Lack of transport facilities has significantly hindered the effectiveness of the forest workers involved in village afforestation programmes throughout the regions. All districts visited by our mission do not have even bicycles allocated to forestry.

(iv) Poor Initial Planning:

Poor initial planning on how to implement and control effectively village afforestation programmes from nursery stage to rotation age has contributed significantly to failures in village afforestation. Large nursery stocks have been raised year after year without first ascertaining some of the crucial factors which influence the success of the programme such as:-

i) villagers willingness and capability to plant.

ii) Selection of the right-species which can sustain the climate of soil conditions.

Inadequate of manpower and lack of appropriate technology have also been a set back in this endevour.

(v) Inadequate funds and hence shortage of polypots have also contributed to the dismal performance of the executing team.

CONCLUSION AND RECOMMENDATIONS:

From the analysis of the existing data, field observation as well as information gathered from various respondents who were interviewed by the study Team in Mtwara and Lindi regions, it can be concluded that the adverse environmental effects of floods, as characterised by devastation of natural forests, and cultivated crops as well as extensive destruction of houses, roads, and other public facilities was due to the exceptionally heavy rain which fell continuously from 3rd to 5th April, 1990. The impact of that rainfall could not be sustained by the rocks and soils on the steep slopes of the Makonde Escarpments due to their loose structure and the steep terrain which contributed to the momentous movement of the flood water and the landslides down-hill along a series of river valleys.

It should be noted that the extent and gravity of the damage caused by those floods could have been reduced considerably or more easily controlled if there had been effective land use planning and development in the affected areas. Such preventive and ameliorative measures include the protection of the easily erodable soils capes, particularly on steep slopes and escarpments as well as along river/streams valleys. Other measures include conserving the natural vegetation, afforestation as well as prohibition or strict control of intensive land uses such as crop cultivation leading to devegetation.

Furthermore judicious and rational utilization of each parcel of land on the basis of scientifically assessed suitability eg. for agriculture, grazing, residential, forestry, public facilities, etc should be encouraged. By the same token unsuitable areas liable to be flooded should be free from any permanent settlement and land use developments which could be adversely affected by floods.

On the basis of the above conclusions, we propose the following recommendations:-

(a) Short-term Activities:

We fully support the various rescue operations and other flood disaster relief activities that were urgently undertaken by various governmental and non-governmental agencies in response to the floods which occurres in Mtwara and Lindi regions in early April, 1990.

Following the onset of the floods, the Government of Tanzania at national, regional, district and village levels as well as local and international organizations, including Swiss Disaster Relief, TEXACO, the red Cross Society, Church organizations such as MBESA and foreign governmental development and donor agencies such as FINNIDA and USAID responded by providing short-term flood relief aid to the flood victims in Mtwara and Lindi regions. The flood relief aid included the supply and distribution of foodstuffs, tents, beddings, clothes, household utensils, building materials, road construction equipments and materials, medicines, farm implements and seeds.

Government personnel, funds and equipments were mobilised mainly from the Prime Minister's office, the Ministry of Works and the tanzania People's Defence Forces for undertaking repairs and rehabilitation of damaged roads as well as laying of Bailey bridges, water supply systems (boreholes and shallow wells), construction of godowns,m and other public facilities, especially in the new areas where the people who were moved from flood prone areas were resettled.

The short-term food aid and other flood relief supplies were planned to be provided until April, 1991 when it was expected that agricultural production would have picked up, especially after harvesting their crops planted during 1990/91 rainy season. It was hoped that this would have enabled the flood victims to satisfy most of their subsistence needs.

However, the above-mentioned flood relief activities should be supplemented with short-term environmental conservation activities. Reclamation efforts should be directed to afforestation of the steep escarpments and hillsides which were left bare due to landlides as well as along the large gullies that resulted from the impact of the floods. The Encroachment of human activities on such areas as the upper slopes of the Makonde Escarpment, catchment forests and other fragile areas which are easily prone to soil erosion should be checked and strictly controlled.

There should also be strict monitoring and control in the flood prone lowlands/flood plains from where the population has been moved in order to ensure that no new permanent settlements and development are established devoid of conservation. Those measures are necessary so as to control further soil erosion and general environmental degradation in the flood affected areas while long-term environmental conservation and flood control measures are being planned.

The above mentioned short-term measures, though well co-ordinated and supervised, were undertaken hastily and mostly on a rather ad hoc planning basis. They should, therefore, be followed by well-planned longterm programmes to ensure quick and accurate disaster relief coordination as proposed by Rugumamu (1989).

(b) LongTerm Programmes:

In order to prevent future reoccurrence of flood disasters, it is recommended that the following long-term action oriented programmes should be undertaken:-

i) Preparation of Comprehensive Land Use Plans:

he government should prepare comprehensive long-term land use lans, including Regional Physical development Plans for Mtwara nd Lindi regions as well as detailed District and Village Land se Plans to be implemented by the respective authorities. These lans should be prepared by an inter-disciplinary team of lanners from the regional and district government departments

of Lands (Town Planning and Surveying), Agriculture, Livestock Development, Forestry, Water, health, Works and Community Development, in close collaboration with the leaders and the target population in the respective planning areas.

This trans-sectoral and interministerial team should be provided with adequate gear including funds, transport, camping and field equipments required to facilitate their work.

The preparation of comprehensive land use plans would involve the assessment of land suitability in the whole planning area, on the basis of which, different areas of land would be demarcated and proposed to be put to the most optimal use. Thus, areas which would be identified as being prone to flooding would be demarcated and proposals would be made to relocate from those areas all permanent settlements and other facilities which are liable to be adversely affected by floods.

Those flood-prone areas would be used for livestock grazing during the dry season and cultivation of suitable annual crops such as paddy with environmental conservation measures.

ii) Land Surveying and Allocation:

n order to facilitate the implementation of the land use roposals put forward in the various land use plans, they should e followed by surveying and fixing of boundary marks/beacons on lots earnmarked for various uses. The surveyed plots should nen be allocated to relevant land users/developers en

individual farmers/households, village Councils, District Councils, Cooperative Unions, Public and Private Organizations, etc. for effective development on sustainable basis.

(iii) Provision of Long-Term Land Titles/Leases:

The approved Survey Plans that would be prepared from the surveying and mapping exercise should be utilised to prepare deed plans and Certificates of Occupancy which should finally be issued to developers on long term leases (33,66 or 99 years).

The Certificate of Occupancy for each category of land use should spell out development conditions which require the relevant land users to ensure proper environmental conservation measures on their land so as to protect it against soil erosion and prevent any adverse effects in the end of future floods.

(iv) Soil-water and Forest Conservation Programmes:

Long-term plans should aim at the conservation of natural forests and afforestation programmes in proposed areas based on the land use plans should be carried out. Efforts should be directed to the protection of water catchments, soil conservation on steep slopes/escarpments and river valleys. Woodlands and forest plantation for provision of fuelwood, timber, building poles, fencekeeping and general aesthetic purposes should be sustainable exploited.

Since the presence of adequate forest cover is crucial in controlling soil erosion and other related

floods, afforestation programmes should be intensified and facilitated throughout Mtwara and Lindi regions. it should be categorically stated that the Government should provide adequate funds, transport and manpower for establishing tree nurseries, distribution of tree seedlings and provision of forest extension education and advice to farmers, schools, hospitals and other public institutions. These target groups should be encouraged to provide their labour and other inputs in planting and taking care of their woodlots on self-help basis.

(v) Enforcement of Environmental Conservation and Land Use Laws and By-Laws:

The natural and plantation forests/woodlands which are located in critically important areas with regard to flood control, such as the upper slopes of the makonde Escarpment. Other forest areas which would be identified by the Local Authorities (District and Village Councils) and those which would be proposed in the various land use plans should be conserved and their use strictly controlled by the relevant authorities, through the by-laws formulated by the people. When effectively enforced, people based legal measures would go a long way to ensure long term environmental conservation and prevention of adverse effects of floods in the event of future occurrence. This is a bottom-up approach to environmental conservation in rural areas.

(vi) Establishment of Flood Monitoring and Early Warning System

Most of the adverse effects of floods in residential areas such

as the loss or damage of household items, livestock, stored foodstuffs as well as the loss of human lives would be considerably reduced or avoided if the population in the flood prone areas are provided with reliable weather information and are forewarned to take preventive measures against any impeding floods. Whether such floods are due to heavy rainfall, cyclones, typhoons, eathquakes, etc early warning is primary. Hence, in order to ensure that such information is recorded/collected, analysed and made readily available to the target population when required, the government should prepare long term plans to identify suitable areas for establishing weather monitoring stations, with equipment for collecting and diseminating information relating to floods and related disasters. This should be done in phases, depending on the availability of funds, especially foreign exchange for purchasing the required technical weather recording and monitoring equipment as well as training and recruitment of staff to run those weather stations.

(vii) Provision of Environmental Education:

The government should intensify and expand the provision of environmental education to the general public and specific target groups in Mtwara and Lindi Regions in particular and other areas in general on the appropriate ways and means of preventing and controlling adverse effects of floods as discussed in the foregoing sections above.

This should be done through inclusion of environmental issues related to flooding in the syllabis of primary and secondary

schools as well as adult education programmes. These educational programmes should be supplemented with mass media programmes through the radio, newspapers, magazines, pamphlets and posters. Environmental education with specific reference to floods should also be disseminated through public lectures, seminars, workshops, video, cinema and theatre arts. because learning is a linfe-long process, this programme should be flexible depending on developments in Science and Technology.

Implementation of the above programmes will minimize loss of life and damages and timely organization and facilitation of effective relief and rehabilitation. The sum total of all these programmes may be referred to as disaster preparedness right from the local level through district and regional to the national level.

We would finally wish to advance that our next research agenda be directed towards drawing up a detailed plan of action to combat flood hazards. The plan should show specific activities to be carried out over a set period of time as well as the resources required for their implementation.

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APPENDIX 1:

VILLAGES WHICH WERE RELOCATED AND RESETTLED DUE TO FLOODS IN MTWARA AND LINDI REGIONS, APRIL, 1990:

DISTRICT	RELOCATED VILLAGE	NO. OF HOUSEHOLDS	POPULATION	RECEIVING/ RESETTLE-MENT VILLAGE	DISTANCE FROM RELOCATED VILLAGE (KM)
MASASI	1. Mkangu	165	988	Nanganga(Mkada)	110
	2. Milumia	132	308	Nambawala	117
	3. Mpanyani	64	211	Nambawala	117
	4. Ruhoke	161	944	Msikisi	88
	5. Sautimoja	149	923	Likwachu(Lindi Region).	60
	6. Miwale	46	211	Msikisi	64
	7. Mkungu	273	777	Chimemena	5
	8. Mwena	792	1616	Likwachu (Lindi Region).	8
	9. Mkolopola	212	439	Namwaga	1
	10. Majembe	181	1819	Songambele/Senjela	4
	11. Mkundi	142	364	Mkululu/Mbugo	10
	12. Mkululu (Commercial area)				
	SUB-TOTAL	2417	9298		
MTWARA	1. Mkwajuni	165	751	Near Likonde	5
	2. Lyowa	216	995	Malohi	4
	3. Muungano	23	150	School area	-(Same neighbourhood).
	4. Mbuo	83	519	Namome	1
	5. Nakada	244	980	Mlimani	0.1
	SUB-TOTAL	751	3395		
NEWALA	1. Likolombe	217	1070	elevated part of Likolombe	2
	2. Lochunu (Lukungu and Chikalule neighbourhood	194	746	Namihonga neighbourhood	6
	SUB-TOTAL	411	1816		
	GRAND TOTAL	3579	14,509		

Source: Regional Commissioner's Office, Mtwara, SEPTEMBER, 1990

APPENDIX II:

FLOOD RELIEF AID REQUIREMENTS, SUPPLY AND DISTRIBUTION IN MTWARA REGION, APRIL-22ND SEPTEMBER, 1990

TYPE OF FLOOD RELIEF AID	TOTAL AID REQUIREMENTS	AMOUNT SUPPLIED RECEIVED	AMOUNT DISTRIBUTED (PER DISTRICT		
			MASASI	MTWARA	NEWALA
(a)	(b)	(c)	(d)	(e)	(f)
TENTS	2000	208	111	69	28
CLOTHING:	232 BALES				
-Assorted canvas sheets		317	159	114	44
-Collarless shirts/ Nguabi (pcs).	15	15	8	5	2
-Gents' canvas sheets		268	136	91	41
-Blankets (pcs)		236	121	81	34
-Children's canvas sheets.		62	30	20	12
-Children's suits/ Chipukizi		327	170	113	44
-Ladies' canvas sheets.		97	50	33	14
-Khanga (pairs)		12	8	3	1
-Vitenge (pairs)		7	3	3	1
-Assorted textiles (bales)		108	55	38	15
-Bedsheets		193	94	64	25
FOODSTUFFS:					
-Assorted cereals	4,500tons	-	-	-	-
-Cassava/Maize		2068.64	1330.56	615.080	123
-Maize flour (bags)		228	54	161	14
-White rice(sacks)		753	547	150	56
-Sorghum (sacks)		23	15	4	4
-millet		5	3	2	-
-Dates (ctns)		1368	711	468	189
-Dates (sacks)	57	57	-	57	-
-Cooking oil(tins)		416	218	147	51
-Unhulled rice (sacks)		58	58	-	-
-Powdered milk(ctns)		202	57	106	39
-Sugar (sacks)		476	60	410	6
-Tea leaves(pkts)		29	15	10	4
-Salt (kg)		5250	4952	2085	13
-Canned food-stuffs (ctns)		2514	1307	380	327
-Assorted legumes (tons)	450 tons	643.32	435.6	187.35	20.37
-Peas (sacks)		13	-	9	4