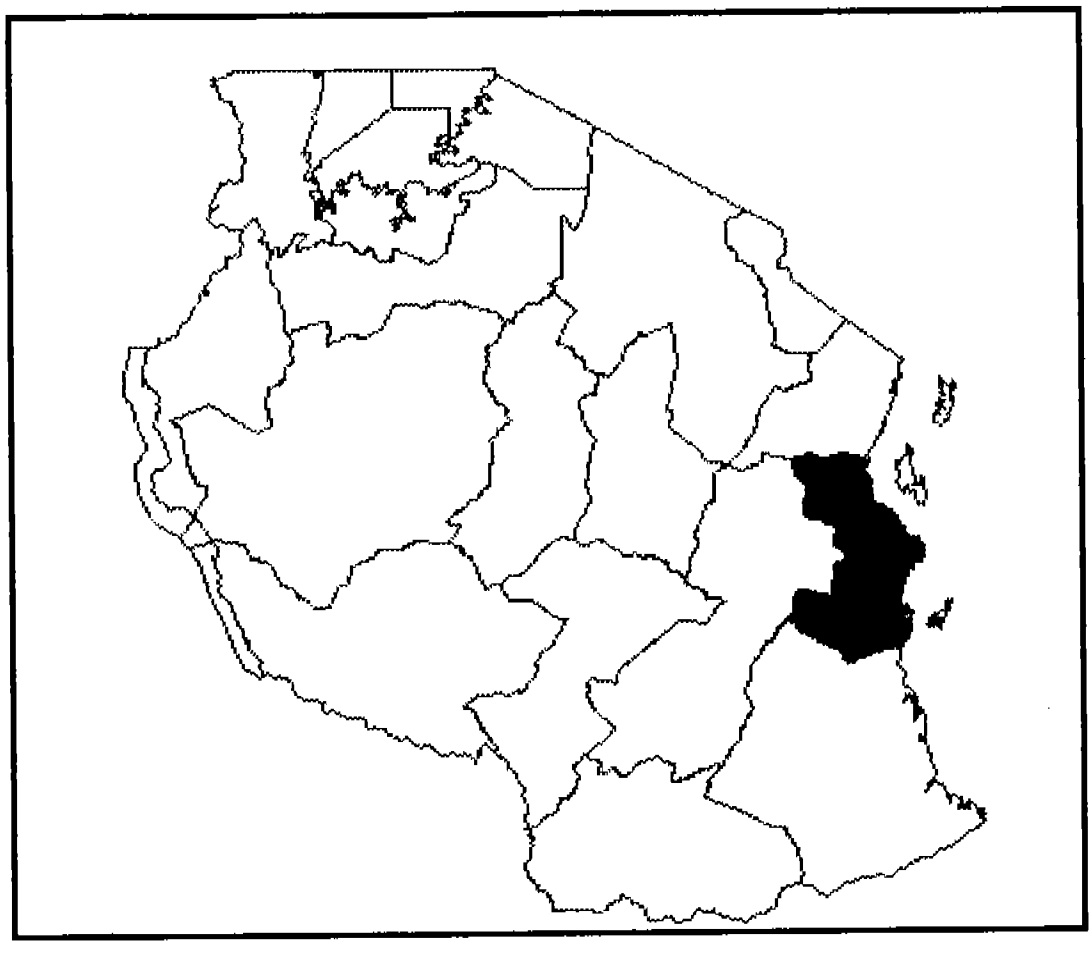
AN ENVIRONMENTAL PROFILE

FOR

COAST REGION, TANZANIA



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ENVIRONMENTAL PROFILE OF THE COAST (PWANI) REGION

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PART I: OVERVIEW OF THE ENVIRONMENT IN COAST REGION, TANZANIA

CHAPTER ONE

1. PHYSICAL ASPECTS OF THE NATURAL RESOURCE BASE

1.1 LOCATION

The region borders Tanga Region to the North, Morogoro to the West, Lindi to South and, to the East the Dar es Salaam Region and the Indian Ocean.

Table 1-1 Area and population according to district

District	Area (sq. km)	1996	1997	1998	1999	2000
Bagamoyo	9,842	209,180	214,068	219,071	224,190	229,429
Kibaha	1,812	94,661	96,381	98,131	99,913	101,728
Kisarawe	6,896	232,318	237,724	243,255	248,914	254,706
Rufiji	13,339	169,462	171,508	173,578	175,674	177,794
Mafia	518	43,456	44,959	46,514	48,122	49,787
Total	32,407	749,077	764,639	780,548	796,814	813,444

Source: Health statistics abstract, 1997

1.2 GENERAL OVERVIEW OF CLIMATE

INTRODUCTION

Coast region is one of the regions located on the eastern flank of the country and bordering with the Indian ocean. The region engulfs the Dar es Salaam region which is also the Capital city. Along the coast area the region spans from 5.91°S to 8.23°S. The northern most part of the region is 5.54°S and the Southern most part of the region is 8.51°S. The region spans from38.89°E to 39.53°E. The altitude varies from sea level to 1000m. The region experiences bimodal rainfall pattern with March to May rainfall which is termed as Masika or long rains and Vuli rains in the months of October to December.

The rains are controlled by the apparent movement of the sun. The area of greatest heating and therefore lowest pressure occurs where the sun is roughly overhead and this is termed as heat trough or equatorial trough or the Inter-Tropical Convergence Zone (ITCZ).

The start of the rainy season is associated with northward and southward movement of the equatorial trough. The southern movement is associated with the short rains and the northward movement is associated with long rains. The strength of the convergence is determined by the strength of either northeast or south monsoon winds which normally carry a lot of moisture from the ocean. The short rains are generally erratic and they are unrealiable in terms of amount and distribution. During the rainy season, some of the rain is convectional in nature and some is advective. Since the coast region is close to the coast, then most of the clouds which form over the Indian Ocean are advected to the land by the monsoon winds.

The period June to September is generally dry except on few occassions when the area receives rain from the ocean due to its proximity being near a large water body.

1.3 AGRO-ECOLOGICAL ZONES

There are two agro-ecological zones in the Coast Region: Coast zone and Alluvial plains.

1.3.1 COAST ZONE

All of the region, except the Rufiji basin, is in this zone.

Zone is characterised with infertile sands on gently rolling uplands and fertile clays on uplands and river flood plains. Generally the altitude is less than 300 m above the sea level. Rainfall in the zone is bimodal, varying fro 750 - 1200 mm per year.

There are two growing seasons: October - December, and March - June, (during short rains). The key subsistence crop in this zone is cassava, grown at places where maize is too risky. Conditions are also suitable for cashew and coconut cultivation, the traditional cash-crop. Land is not scarce, and fallowing and shifting cultivation are practised, within limits imposed by continuos access to the cashew and coconut stands.

Intensification is limited by climate and access to markets. Low prices for cashews and coconuts have caused smallholders to diversify into sesame and groundnuts. Where irrigation and markets are available, vegetables are also grown.

Cashew-nut production has been revitalised because of improved access to export markets and the availability of treatment for the powdery mildew disease.

The zone is characterised with coastal thicket or bushland with relict forest. The implication of having such kind of vegetation is an indication that either previously the area was a coast forest and through human activity it has been transformed into bushland

by cutting down the vegetation; or areas which were formerly farmlands have been abandoned to develop into secondary vegetation. Among the most important species found here include *Manilkara sulcata, Albizia petersiana, Dalbergia melanoxylon, Scorodophloeus fischeri* and *Xylotheca tettensis.*

In valleys and depressions the vegetation is of marshland. They form a good site for cultivation of rice, and the places are found in association with characteristic vegetation such as *Typha sp.* and some ferns.

The is also mixed woodland vegetation. The vegetation is more or less the same as in coastal thicket or bushland with relict forest, with exception that shrubs here are few and woodland trees such as *Albizia* spp., *Combretum* spp. and *Brachystegia* dominate. In some areas particularly between Kibiti and Ikwiriri it is not uncommon to see *Sterculia achliebenii* as emergent among the woodland species.

The soils in this zone are Aerosols or ferruginous tropical soils on sandy parent materials which occur in upland areas.

The Aerosols can further be categorised as:

(i) **Red and Brown sands**

In freely drained areas, the soils have a coarse, sandy texture, with colour varying from yellowish red to pale brown. The soils are weak structurally and therefore have low water holding capacity and drain very quickly. This category of soil support an open woodland vegetation, and may also support dry forest particularly *Cynometra manilkara* forest as a consequence of low phosphate content of the soils.

(ii) **Black Sandy Clays**

These occur in poorly drained, extensive depression areas and major valleys; and are of heavier texture. They are flooded in the wet season and become very hard and dry in the dry season. In some of these depressions, rice cultivation is practised and where no such practice is done, wooded grassland vegetation dominates.

(iii) **Superficial White buff Sands**

This has good drainage and mottles at the lower part of the B-horizon, and normally wet subsoil. These are typical soils mined for construction purposes.

(iv) **Pale sandy soils**

These are most typical of the coastal plain and plateau which are both away from ridges and which are nevertheless not liable to excessive water-logging. In Kisarawe district where this soil is more extensive, the vegetation includes species such as *Baphia kirkii.*

(v) **Beach Sand**

Areas with substrate of almost sand-bar type accumulation of beach sand such as Kisiju and are geologically very unstable.

(vi) Depending on the proportion of sand, clay and silt, different localities have different types of soils: e.g.

(a) Muhoro which is not reached by floods has either sandy or heavy clay [loamy sand] with imperfect drainage, and become water-logged during the rains

(b) Nyamwange has sandy loam which has good drainage.

(c) Vikindu which has clay bound sands and gravel and therefore good drainage.

1.3.2 Rufiji Basin Alluvial Plains

The basin covers an area of 68,500 km^2 and lies between latitudes 5° 32' South and 10° 44' South, and between longitudes 33° 32' East and 39° 25' East, with varying topographic and climate conditions. The entire flood plain covers 118,000 hectare, of these 80,000 hectares were classified as suitable for farming.

It is a wide mangrove swamp delta. Alluvial soils; sandy upstream and loamy downstream are found in the flood plain. Rainfall in the basin is unimodal, often inadequate 800 - 1200 mm per year. The growing season is December - April.

Vegetation is flood plain grassland, dominated by reeds *Phragmites* and *Panicum maximum*. This is an excellent site for paddy cultivation and very few scattered tree species such as mango, *Acacia zarrwbarica, Sclerocarya caffra,* and *Kigelia africana* thrive in this black cotton soils. Also found in association with the flood plain grasses is the legume *Sesbania sesban*.

The soils in the flood plain are vertisols or black cotton soils which are characteristic of water logged areas such as Rufiji basin, and scattered swamps.

The soils of the flood plain can be divided into the following categories:

(i) Coarse sands on river beds which are not used for cultivation because they have a very low moisture retention capacity and are infertile.

(ii) Sandy loams of river banks, locally known as "mbaragwila". These are fertile and easily tilled. Because of their excellent physical properties; good water - holding capacity, well drained; they are intensely used for agriculture, based on rotation and inter-cropping of rice, cotton and maize.

(iii) When the river floods, fine silt is deposited in standing water, in the depressions behind the levees. The clays of these depression areas ("finyanzi") retain moisture well but can suffer from poor drainage. They are comparatively more difficult to cultivate, being compact and slightly sticky. However, other areas within the flood plain have combinations of these soils e.g. "mbaragwila" over coarse sand, clay over coarse sand, clay over "mbaragwila" etc. These are collectively referred to as "composite" soils.

(iv) Saline soil in the seaward of the delta support mangroves, salt marsh or re vegetation. The grassland and bare areas have pH 5.0 - 5.2. It has w agricultural potential, but local people do grow rice.

1.4 Drainage

The Coast Region is drained by Rufiji river (the largest), Ruvu 'B' river, Wami river and smaller rivers like Muhoro, Ruboi and Luhule rivers.

The rivers discharge their waters into the Indian Ocean.

CHAPTER TWO

2. LAND USE

Various types of land use exit in coast region, such as agriculture, forestry, growing-land requirements and human settlements. The region has a total of 32,407 square kilometres.

2.1 Forest and Game Reserves

Being on Coast agro-ecological zone (zone I), the forests are those classified as coastal forests. Most of these forests have been completely cleared like the Mkuranga sacred forest grove, and turned into farmlands, some of which have later been abandoned to develop into coastal bushland.

By 1990 there were a total of 286,297.9 hectares of managed forest in Coast Region. Of these, 242,417.9 were productive and 43,880.0 hectare protective.

Local authority managed 87,988.0 hectare of productive forest. It managed no protective forest.

The Kiomo/Zaroninge Forest Reserve (19,335.0 ha) in Bagamoyo District served also as a Game Reserve.

Afforestation in Coast Region saw a total of 576 hectares planted with trees in the Ruvu Afforestation Project between 1965 - 1984. Softwood covered 433 hectares while hardwood covered the remaining 143 hectares. The project covered 0.7% of the total area planted under the National Afforestation Project (79,249 ha).

2.1.1 Village Afforestation Programme

The programme was designed and launched in 1967/70 with the objectives of planting and growing as many trees as possible by individuals, schools, industries and village communities through people participation.

The following tables estimate the trees planted under the programme.

Table 2-1 Areas and classification of managed forests by 1990

Region	Area in Hectares		
	Productive	Protective	Total (HA)
Coast (Pwani)	242,417.9	43,880.0	286,297.9

Source: Forest Division Data Bank, Gazzetment index.

Table 2-2 Areas of local authority managed forestry by 1990

Region	Forest type productive (HA)	Protective (HA)
Coast (Pwani)	87,988.0	-

Source: Forest and Bee-keeping Division Index.

Table 2-3 National Afforestation project (in hectares)

Region	Project	Year planting		Area planted	
			Soft-woods	Hard-wood	Total
Coast (Pwani)	Ruvu	1965 - 1984	433	143	576

Source: Ministry of Lands Natural Resources and Tourism, Forest Division 1984.

Table 2-4 Village forestry tree planting from 1975 - 1990 (hectares) - Coast Region

Planted									Proposed					Planted	
1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
-	-	-	148	233	70	56	303	151	97	116	139	NO RECORD	NO RECORD	-	62

NB: Planting Space at 2.5m x 2.5m = 1,600 trees/hectare

Source: Forest Division Annual Reports.

The forest reserves in the region include Vikindu, Kisiju, Kiwengoma, Kazimzumbwi, Mchungu , Kikale and Pugu forest reserves.

2.1.2 Vikindu forest reserve

It is a highly disturbed forest located 17 km South of Dar es Salaam. The Dar es Salaam / Kilwa main road passes directly through the 4,486 hectares forest. The majority of the forested area has been extensively logged and re-planted with exotic trees such as *Eucalyptus* and *Cassia siamea*. Some of the indigenous trees and shrubs remaining along the rivers and water courses are removed by the local people for timber, poles and charcoal. About 86,000 sacks of charcoal are estimated to find their way to Dar es Salaam market from Vikindu and nearly villages every month.

Some important medicinal plants in Vikindu forest include *Parinari curatellifolia, Secamone parvifolia, Uapaca kirkii, Voacanga* spp., *Cissampelos pareira* and *Clerodendrum* spp.

Vikindu forest is important in having some endemic plants species such as *Warbargia elongata* and the rare *Tristema schliebenii*.

2.1.3 Kisiju forest Reserve

The Kisiju forest reserve have an area of 2 km^2. Ninety two species of plants have been recorded in this forest, with no endemic taxa, but probably with two rare species i.e. *Xylopia spp.* and *Oxyanthus spp.*

2.1.4 Kiwengoma forest Reserve

The reserve which is 10 to 25 km^2 is located on the Matumbi massif. The vegetation of the forest is secondary having been cleared and cultivated over the past 100 years. The forest canopy is dominated by *Khaya senegalensis, Scorodophloeus fischeri* and *Milicia excelsa*. There are some endemic taxa in this forest which include *Tessmannia densiflora, Baikiae ghesquiereana* and the African violet *Saintpaulia ionatha*.

2.1.5 Rufiji Mangrove Forest

The most notable location in Tanzania with respect to mangroves is the Rufiji. The Rufiji Delta is the largest area of mangrove vegetation in Tanzania as well as in East Africa. The area is covered by 1022 sq. km of immense forests of great economic, ecological and conservational importance, but is under threat due to environmental changes and uncontrolled exploitation by man. The river splits into nine main channels, interconnected by numerous minor ones to form an intricate and dynamic delta system with entire islands consisting of pristine mangrove forests. The Rufiji Delta contains, crocodiles, hippos, blue monkeys, three species of kingfishers, fish eagles, herons and numerous species of migrating animals . The local economy is fuelled by the mangroves

and the ecosystem they support. The pools around the forests provide excellent breeding grounds for fish, shellfish and, in particular, prawn/shrimps which fill the traps of local fishermen and the nets of offshore commercial trawlers. Around 80 percent of Tanzanian's prawns come from this area.

The mangrove products have been used for over 200 years in a sustainable way, but demand from the increasing population and the pressure for commercial exploitation threatens to outstrip the supply of seedlings from natural re-colonisation.

Rufiji requires special attention, because of its size , its ecological importance, its economic importance , and the pressure to clear mangroves for agriculture , especially rice cultivation (with high use of DDT and other pesticides reported). Many fishermen depend on the Rufiji Delta. Prawn fishing is a major commercial activity involving both artisanal and industrial fisheries.

Any management plan for the Delta must seek to help local development and win popular support, especially as policing is made very difficult by the complex network of channels. As part of the management plan, a core forest/marine nature reserve could be defined, perhaps encompassing some key prawn and fish breeding grounds and a few of the 46 tiny island (of which 16 are inhabited). The Delta should be the subject of a relatively long and intensive study and therefore the inventory project should take on a second specialist to be based full-time in Rufiji, working under the direction of the project leader.

The parastatal Rufiji Basin Development Authority (RUBADA) has hitherto concentrated its attention on the Stiegler's Gorge area but the delta also comes within its scope. It should also participate in the Rufiji mangrove study.

In parts of Tanzania where villages are reasonably spaced along the coast, there may be good potential for involving villagers in mangrove management. The FBD could give a particular village exclusive rights to use a stretch of coastline (or island) and involve the village in drawing up the management plan for the mangrove and marking the zones for utilisation etc. The villagers would then be responsible for carrying out the plan, including helping to protect the mangrove area from exploitation by outsiders. Such an approach is much more feasible for mangrove than for most forests (especially closed moist forest), because regeneration is relatively reliable and villages are aware that mangroves are important for their fisheries.

Mangrove management needs to be integrated with management of other coastal resources, including corals, fisheries, shellfish etc. At the national level this may best be done through NEMC, which has been working on integrated coastal management nationally.

There is considerable experience of mangrove management in other parts of the world and much could be gained from improving links with chosen institutions.
Implementation of the mangrove management plan will require further training and material support.

2.1.6 The Selous Game Reserve

Selous game Reserve is the biggest game reserve in the country. It encompasses several regions including Coast Region. This area is rich in both flora and fauna.

In 1905 the German Colonial Government began creating some small game reserves. The tract between the Msolwa-Kilombero-Ulanga-Ruaha rivers in the western Selous and most of the northern sector between Mgeta river in the north and the Rufiji in the south were already game reserves. Hunting was also forbidden in two other areas towards Liwale. This makes them some of the first wildlife sanctuaries in Africa.

All these game reserves are said to have presented by Kaiser Wilhelm as a wedding anniversary gift to his wife. This is probably the explanation as to why the local people called these game reserves "*shamba la bibi*" meaning "fields of the lady".

The greater part of the northern sector of the Selous which is earmarked for photographic tourism and one of the most beautiful areas in the whole ecosystem, lies in the Coast Region.

The Ecosystem

The Selous Game Reserve is one of the largest areas set aside for wildlife preservation anywhere in the world covering approximately 50,000 sq. kilometres. It is part of the Selous ecosystem totalling 75,000 sq. kilometres and including Mikumi National Park and others uninhabited areas in the north; the Kilombero Game Controlled Area in the west; other sparsely populated areas towards Kilwa in the east and towards Dar es Salaam in the north-east. Parts of the ecosystem are extensive *miombo* woodland areas which provide a range for migrating elephants and extend beyond the reserve's border towards Songea in the south-west, towards Tunduru in the south, and as far as Liwale in the south-east.

Three quarters of the reserve consists of *miombo* woodland where the dominant trees are *Brachystegia, Julbernardia globiflora, Isoberlinia, Pterocarpus angolensis and Combretum.* The eastern part of the reserve is mainly grassy woodland with *Terminalia* species.

The tourist sector of the reserve north of the Rufiji River contains all the various forms of vegetation to be found in the ecosystem. *Miombo* woodland covers the ridges of the mountains around Beho Beho and Stiegler`s Gorge; also there are open woodlands with *Terminalia spinosa* trees, hardpan and short grassy plains with seasonally flooded "mbugas". These "mbugas", or "black cotton soil" patches, present a problem for every motorist during the rains. The savannahs provide grazing and browes and support a wide range of wildlife, in particular a wildebeest and other species of antelope in great numbers. The number of wild ungulates these savannahs can support is higher than the relative numbers of domestic livestock the same area would support because wild animals make more efficient use of the range, without having a detrimental effect on the environmental. In addition to *miombo,* open woodlands and savannah, another type of vegetation occurs here in the form of riverine forests with dense thickets. The wide meandering Rufiji River with its lakes and swamplands interlaced with a myriad of

channels is ecologically one of the most important habitats in the whole of eastern Africa.

Here the characteristics *Borassus* Palms grow in grows along the river reaching up to 25 metres tall.
They need a great deal of water to survive and they often die off if the ground water level drops. This Rufiji riverine habitat also supports an abundance of wildlife such as elephants, hippos, crocodiles, birds, and plains game.

The *miombo* woodland is adapted to long dry seasons and the trees grow in relatively poor and infertile soils. The average rainfall ranges from about 750 mm in the east to 1300 mm in the west. The rains fall from December to may, with a drier spell during January and February. Most of the area is unsuitable for cultivation and should man attempt to develop the land for agricultural purposes then sadly the inevitable end result would be desertification.

The *miombo* is a woodland formation which has been shaped over hundreds of years by annual fires either occurring naturally or lit by honey gatherers and hunters. During the dry season one can get the impression that the whole of the Selous is burning. Areas burnt early soon sprout new grass and then the ungulates move in. Areas burnt late may only start to regenerate in the rainy season. Tree growth is also hindered by these annual fires.

These are differing arguments as to how one should view these fires. Some people see the fires as destructive to vegetation, especially to trees, and wildlife, in particular small animals, and all attempts should be made to extinguish the fires. Others argue that the fires are started by the administration itself with the feeling that it is better to have an early " cold " fire which is not so destructive as a late fire occurring naturally when it is hotter and the grass drier. In the Selous there is unfortunately no efficient fire management at present. Even if the fires are regarded as a natural part of the miombo ecosystem there is too few game scouts to play an active role in fire management in this vast wilderness.

Another important inhabitant of the *miombo* woodlands is the tsetse fly. Although this is harmless to wildlife, it carries deadly disease for domestic livestock. The fly has discouraged human settlements and livestock in the reserve thereby leaving a vast reservoir where wildlife could survive

Tanganyika became a British Protectorate after the war and the existing four protected areas were expanded. The conglomerate was named "Selous" in 1922 in memory of the great explorer who felt there.

During the 1930's and 1940's the administration of the Tanganyika Protectorate, in its fight against endemic sleeping sickness, moved the people away from fly-infected areas. Then the easiest way to prevent them from moving back to the infertile wilderness was to add these areas to the already existing game reserves. Outside the reserve up to three thousand elephants were shot every year because of their habit of destroying crops in the adjacent farms. The policy at that time was to protect the wildlife within the reserve but

animals ranging outside were not given any protective status. After independence, the government of the United Republic of Tanzania extended some protective areas and created a considerable number of new ones. In the "Arusha Manifesto" of 1962 the government outlined its policy.

Consequently some new areas in the south were added to the Selous, mainly to provide a large enough range where elephants could roam freely without too much conflict with villages. In 1975, one section of the Selous was annexed to Mikumi National Park and at about the same time, the Tazara Railway was constructed through the northern sector of Selous.

During the early 1980`s some parts of the Selous were prospected for oil and this was carried out without doe consideration being given to the ecological impact of such activities. As a result some major ecological damage was caused by cutting extensive seismic lines through areas of previously untouched wilderness. These lines still facilitate poachers and give them easy access, sometimes even by vehicle into remote parts of the reserve. As a result of heavy poaching activity, black rhinos have all but disappeared from the reserve and elephant numbers have been reduced by almost two thirds.

The Selous game reserve was declared a 'WORLD HERITAGE SITE' by the United Nations in 1982.

Management of the reserve and conservation

The Selous game reserve is administered by the Wildlife Division of the Ministry of Natural Resources and Tourism. The administrative headquarters is at Matambwe in the northern sector Selous. A total of 500 game scouts and technical and administrative personnel are posted in the reserve. Their main task is to patrol the area and prevent poachers from entering the reserve. It is virtually impossible for this relatively small number of game scouts to patrol such a vast area efficiently. During the rainy season, most of the roads are impassable and the only way to move around is on foot. Other activities of the Wildlife Division include monitoring of the game populations, development and maintenance of the necessary infrastructures such as roads, airstrips, game scout stations and outposts. The main income for the reserve is derived from hunting safaris. This hunting is carried out on a sustainable basis and only a small fraction of the population growth is harvested. Without the income from safari hunting, the reserve could not generate enough funds for management and conservation. Areas designated for safari hunting are in a different parts of the Selous from the areas for photographic tourism.

So far, the rural population bordering the Selous has not felt any direct benefit from the reserve. Presently, programmes are underway to give them a share in the income of the reserve as well as responsibility in the management of the buffer zones surrounding the Selous Game Reserve. It is hoped that this will lead to a reduction in poaching. Nowadays, wildlife conservation cannot be practised without the support of the people living in or near the conservation areas, but only through them.

A note on Poaching

There is no legal ivory trade in Tanzania. All ivory products offered for sale by street vendors or in shops come from poached or in shops come from poached elephants. By buying illegal wildlife products, one contributes to poaching and run the risk of heavy penalties.

2.1.7 Pugu Forest Reserve

Pugu Forest Reserve is located in Kisarawe District in Coast Region between 6° 52' and 6° 56' S and 39° 02' and 39° 07' E. It has an area of 2,410 hectares. This forest is 25 kilometres south-west of Dar es Salaam City.

Pugu Forest is one of the Coastal Forests. The Coastal Forests are divided into two groups. The first group comprises the *Mangrove Forests* which are found along the inter-tidal zone of the Indian Ocean. The second group is composed of *dry land Forests*. *Dry land* Forests are scattered along the coastal belt. They are remnants of larger forests which existed in the coastal areas. Pugu Forest Reserve is a *Dry Land Forest* type. Up to 15 plant species were noted to be endemic or nearly endemic to the reserve. Four rare plant species recorded in Pugu Forest Reserve are only found there and Kenya's coastal forests.

2.1.7.1 Pugu Forest History

Originally Pugu Forest Reserve extended to the present Dar es Salaam International Airport 40 years ago. It was known as Mogo forest. In 1965 Mogo forest was de-gazetted by the government and human activities like Charcoal burning, pole acquisition, pitsawing, establishment of new settlements, fire wood, encroachment for agriculture practices was allowed to continue.

The activities contributed to the reduction of the original Mogo forest cover and animal species distinction. For example: Mogo was the only site which was known for the monotypic genus *Stephonostema stenocarpum*. By allowing human activities this plant was highly disturbed. The 1994 inventory, shows the forest is remaining with only 10 kilometres of vegetation cover.

The ownership of Pugu Forest Reserve is under the Central Government. Pugu Forest Reserve was gazetted in 1954.

Drainage

The main river in the Msimbazi which flows through Pugu Forest Reserve to the Indian Ocean. This river starts far south-west of the Pugu Forest Reserve from Ruvu South Forest Reserve. Another river is Mabizi which starts at the northern side of the Pugu Forest Reserve near Mabizi village. The Mabizi river flows through the forest and later join Msimbazi river. Nyamaronda and Mabizi are seasonal rivers. These two rivers have a number of tributaries which dry up during dry seasons. There is a reservoir in the south-east of the forest.

Soil types

It has a topsoil which is very fertile and underlying kaolin minerals. Pugu Forest Reserve soils are those of rock type, gravel, loam, sand and red greenish clay. Siltstone and coarse grit in some places and red brown lateric soils. Over 90% of soil type found in Pugu Forest Reserve is loam type. The analysis made on few of the most dominant tree species indicated in appendix 6 shows where each individual species is found and the soil type. Very few plots were found to have sand gravel or clay soil types.
The pH is neutral basic.

2.1.7.2 Vegetation types

There are variety of vegetation types in Pugu Forest Reserve which is related to the variation of topography. These include distinct wet valley bottom, dry ridge-top and intermediate valley side.

Pugu forest is a catchment forest, streams from Pugu hills supply water in Dar es Salaam and then to the Indian Ocean.

According to the 1994 inventory, Pugu Forest is divided into four main types of vegetation:

(i) The **Open forest** which is 185.56 hectares. Open forest vegetation type contains less tree species and shrubs due to human damage like cutting trees for charcoal burning, fuel wood, pole and wood carving.

(ii) **Closed forest** which is 1575.47 hectares is mostly covered by natural plant species. Closed forest was very rich in natural vegetation cover. In other words it was a dense forest with less disturbances, During field visit for ground truthing it was noted that, even in closed forest areas which before used to be very dense now they have been destroyed by charcoal makers. Looking at them from far away they seem to be closed forest areas.

(iii) **Grassland** which include light shrubs 201.34 hectares. Areas covered with grass are those which had been most affected by human activities like those around the forest edge, and those near the railway line and roads passing through the forest. The railway line which runs in the northern side of Pugu Forest Reserve had created a 50 metres wide strip which is now bushed grassland. Other areas are those falling in charcoal burning points, Kaolin, Brick and tiles factory, school area , army is located in the forest, Tanzania Peoples Defence Force (TPDF). The removal of species which are good for timber, pole, and charcoal burning, and thus living immature species.
It was also noted that sometimes other areas have grasses just because tree species can not grow there due to soil types, human disturbances, topography and climatic variation factors.

(iv) **Plantation** is 398.63 hectares covered by exotic plant species like *Eucalyptus* and cassia spp. Here it should be noted that the area covered by plantations now, was covered by natural vegetation.. Later this area was cleared and exotic tree species was planted.

In general the vegetation cover is very much disturbed and at the moment the remaining canopy is dominated by *Manilkara sulkata, Diospyros* sp. *nov, Diospyros verrucosa, Lecaniodiscus sp nov. Diospyros sp. nov* is a new tree species which was identified during the forest iventory 1994.

2.1.7.3 Regeneration

The bushland dominance disturbs regeneration on some stumps of timber trees e.g. *Brachylaena huilensis, Milicia excelsa, Millettia usaramensis, Manilkara sulcata* which ate the species commonly cut for charcoal, building poles and timber in the middle of the forest reserve. These areas had pioneer species e.g. *Eragiostis liliaris*, Cucurbit, Congza trema.

Dominant and lest frequent tree species were judged by the relative densities of individual species.

2.1.8 Other Forest and Game Reserves

Other forest and game reserves such as Saadani in the region are similarly rich in biodiversity, though they also face the same threat of unauthorised harvests.

2.2 Cultivated Land

The region has 319,000 hectares of land suitable for annual crops. These were 117,849 small farms in the region in 1989/90. The total area planted to annuals is 167,000 hectare, equivalent to 52% of the Gross Suitable Area (excluding reserves).

2.3 Other land Uses

Other types of land use exist, like grazing-land requirements derived from various types of livestock present in the region, and land for human settlement.

2.4 Land Tenure

There are some 118,000 small holder farms in the region, with 112,000 hectares planted with annual crops.

The large farms have a total area of 105,333 hectares. The source of small farmers' claim to tenure of the land they cultivate is due in large measure to traditional mechanisms which include inheritance, allocation by the village elders, and investment in clearing.

2.5 Deforestation

This is a big problem in this region as it is in the country as a whole. But this problem is peculiar here as compared in other regions. Dar es Salaam (the biggest commercial city in the country having the highest number of immigrants from other regions) is surrounded by this region.

The majority of Dar es Salaam residents depend on wood fuel for their cooking. This has put much pressure on the forests in the nearby Coast Region. Charcoal making is a major source of income in the region . This charcoal finds its way to Dar es Salaam where there is good market for it.

2.6 *Remedy*

The Government had established Ruvu National Afforestation Project between 1965 and 1984 for softwood and hardwood. They were 433 hectares of softwood and 143 hectares of hardwood making a total of 576 hectares. This project was started to cater for timber poles and wood-fuel as the natural forests were being exploited for construction timber and other uses.

Village Afforestation programme which were launched in 1967 with the aim of planting and growing as many trees as possible by individuals, institutions and village communities through peoples participation should be encouraged. This programme was also meant to improve wood productivity in the rural areas in order to alleviate the fuel-wood and environment degradation problems.

Agro-forestry a system of inter-cropping trees with other crops is another important component in the programme.

CHAPTER THREE

3. SOCIO - ECONOMIC ASPECTS

3.1 *Population*

The 1988 census gives the following figures for the population of the Coast Region and its districts:

Total Population:	**628,015 (2.8% of the Nation)**
Male population:	**309,751 (2.7% of the Nation)**
Female population:	**328,264 (2.8% of the Nation)**
Average household size	**4.9 (5.2 for the Nation)**
Annual average Population growth:	**2.1% (2.8% for the Nation)**

The ethnic composition of the Coast Region is quite varied. But the dominant culture is that of Wazaramo, predominating in Kisarawe and Kibaha, the Wandengereko and Warufiji in Rufiji, and the Wakwere and Wazigua in Bagamoyo.

While the Wazaramo and Wandengereko are traditionally matrilineal, the Warufiji are said to be traditionally patrilineal with loose clan organisation.

But there has been so much interaction between people of the coast throughout the centuries of maritime trade that certain distinctions have been blurred.

A common characteristic of people of the coastal belt is their view towards marriage. It has been noted that marriages are considered loose unions between the partners which can be broken more easily than in other communities. Polygamy is also an accepted feature of the communities (although this is not peculiar to coastal people).

The general adherence to the Islamic religion among the majority of the coast people gives them another point of common reference, even though in actual practice, Islam is intermixed quite freely with the ethnic cultural traditions which exist in a given community.

It is important to note that the majority of people who remain in the rural areas are older people and the women who do most of the cultivation. It is a general feature that the young people as soon as they finish schooling leave home to try luck in Dar es Salaam. Tables 3-1 to 3-2 Women aged 15 - 49 years give further details on Coast Region's population.

The total population for the latest nine (9) years in Coast region are as follows:

Table 3-1 Population

1988	1989	1990	1991	1992	1993	1994	1995	1996
636,482	648,887	661,476	674,250	687,210	700,355	713,686	727,204	740,908

Source: Planning Commission

Table 3-2 Women aged 15 - 49 years for the year

District	1995	1996	1997	1998	1999	2000
Bagamoyo	45,926	46,99	48,098	49,222	50,372	51,549
Kibaha	20,957	21,338	21,725	22,120	22,522	23,931
Kisarawe	47,543	48,650	49,781	50,940	52,125	53,338
Rufiji	35,659	36,089	36,525	36,966	37,412	37,864
Mafia	9,629	9,962	10,307	10,663	11,032	11,414
Total	159,714	163,038	166,436	169,910	173,462	177,095

Source: Health statistics abstract, 1997

3.2 Education

The problems with education are not substantially different from other areas in the country, but there are some additional facts which are specific to the Region.

(i) The region has a long time tradition of Koran education and quite a number of people (especially in the middle and older age groups) are literate in Arabic Script. It was compulsory for all children, in particular boys, to attend *Madrasa*, Koranic schools.

(ii) Because of (i) the campaign for compulsory secular education did not take-off as quickly as in other areas. In early years of UPE, there was a marked tendency for parents to withdraw children from schools at the slightest pretext, but especially girls, when they reached puberty to confine them according to custom and marry them off.

Many primary and secondary schools have been built by the Government and less have been built by self-help efforts.

Tables 3-3 to 3-4 give some data on education in the Coast Region.

Below are some details of the number of primary schools in Coast Region.

Table 3-3 Number of primary schools

	1989	1990	1991	1992	1993	1994	1995
Number of primary school (public)	377	382	385	388	391	389	391
Total enrolment in Public primary school	82	86	89	89	96	89	102

Source: Statistics abstract, 1997

Table 3-4 Girls enrollment in public primary school and as percentage to total enrollment

'(000)					Percentage (%)				
1991	1992	1993	1994	1995	1991	1992	1993	1994	1995
44	43	47	48	49	49	48	49	48	48

Source: Statistics abstract, 1995

3.3 Health

The health sector in the region face problems not very much different from the rest of the nation. Thus, although the health posts and dispensaries are there, the unavailability of trained personnel and medical supplies persist. The few medical facilities operated by NGOs and religious organisations are not sufficient to cater for the whole population, and some of these charge fees which are too high for the ordinary person. This is especially true of maternity services, and the high rate of infant and maternal mortality has become like a well rehearsed song in Tanzania.

Tables 3-5 to 3-37 unveil the health situation on the region.

HEALTH FACILITIES

Number of hospitals in coast region is six (6) in which four (4) are owned by the government, one (1) by voluntary and one (1) by parastatal. So no hospital in coast region is owned by private sector.

Also in this region there are some fourteen (14) government health centres and 172 dispensaries, 117 owned by government, 18 by voluntary, 9 by parastatal and 28 by private.This is clearly shown in table 3-5

Table 3-5 Owners of health facilities

	Government	Voluntary	Parastatal	Private	Total
Number of Hospitals	4	1	1	-	6
Number of Health centres	14	-	-	-	14
Number of Dispensaries	117	18	9	28	172

Source: Health Statistics Abstract 1997

Table 3-6 Population per health facility and number of health facilities per 10,000 population in Coast Region

Population estimate, 1995	Number of health facilities	Estimated population per health facilities	Number of health facilities per 10,000 population
772,662	192	4,024	25

Source: Health Statistics Abstract 1997

Table 3-7 Number of beds in hospitals and health centres

	Government	Voluntary	Parastatal	Private	Total
Hospitals	411	55	138	-	604
Health Centres	191	-	-	-	191

Source: Health Statistics Abstract 1997

Table 3-8 Number of population per bed in Coast Region

Population 1995	Number of beds	Population per bed
737,178	795	927

Source: Health statistics abstract 1997

Table 3-9 Reported number of cases during the year 1995 in Coast Region

CH	RB	R.F	TY	PL	MN	A.P	N.T	ME
0	1	0	0	0	0	0	0	0

Abbreviations: CH - Cholera RB - Rabies R.F - Relapsing Fever
TY - Typhoid PL - Plague MN - Meningitis
A.P - Acute Polio N.T - Neonatal Tetan ME - Measles

* - Data Unrealistic

Source: Health Statistical Abstract 1997

Table 3-10 Distribution of communicable disease cases and distribution of death caused by it 1994 - 1995

Distribution of	**Cholera**		**Plague**		**Meningitis**		**Dysentery**		**Rabies**	
	1994	1995	1994	1995	1994	1995	1994	1995	1994	1995
Communicable Disease Cases	0	0	0	0	0	14	2,250	304	0	87
Death Caused by Communicable Cases	0	0	0	0	0	3	23	8	0	1

Source: Health Statistical Abstract 1997

Table 3-11 Infectious Diseases Week Ending (IDWE) reports Ministry of Health in Coast Region for the year 1996

Malaria		**Cholera**		**CSM**		**Dog Bites**		**Typhoid**		**Dysentery**		**Diarrhoea**		**Measles**		**Polio**		**Plague**	
C	D	C	D	C	D	C	D	C	D	C	D	C	D	C	D	C	D	C	D
1,705	-	1	-	-	-	4	-	-	-	-	-	312	-	60	-	-	-	-	-

Abbreviation: C - Cases D - Deaths

Source: Health Statistical Abstract 1997

Table 3-12 Reported cases of measles in Coast Region

Number of cases		
1992	1993	1994
238	702	98

Source: Health Statistical Abstract 1997

Table 3-13 Cumulative aids cases for the year (1991 - 1996) in Coast Region

1991	1992	1993	1994	1995	1996
1,676	2,215	2,740	3,023	3,238	3,373

Source: Health Statistical Abstract 1997

In this region (Coast) many people being affected by AIDS more than other diseases such as Cholera, Malaria, Diarrhoea etc.; since 1990 - 1996. Also the number of people who are affected and die by other diseases is low.

Table 3-14 Rate of aids per 100,000 population based on the cumulative cases in Coast Region

Years								
1992			1993			1996		
Population	Rate	Rank	Population	Rate	Rank	Population	Rate	Rank
693,924	189	4	708,650	206	4	756,056	446	4

Source: Health Statistical Abstract 1997

Table 3-15 Smear positive pulmonary tuberculosis and leprosy case detection rate per 100,000 in Coast Region

	Tuberculosis rates		Leprosy rates	
1992	1993	1994	1992	1993
58	78	958	11.0	17.0

Source: Health statistics Abstract, 1997

Table 3-16 Smear positive cases of pulmonary tuberculosis in Coast Region and age group for the year 1993

Age group							
0 - 14	15 - 24	25 - 34	35 - 44	45 - 54	55 - 64	65+	Total
15	124	170	110	81	35	15	550

Source: Health Statistics Abstract, 1997

Table 3-17 New cases for relapses of tuberculosis and rate of smear positive by sex and year

1993			1994		
Male	**Female**	**Total**	**Male**	**Female**	**Total**
316	234	550	563	395	958

Source: Health Statistics Abstract, 1997

Table 3-18 New cases for relapses of leprosy by age group in Coast Region for the year 1993

Age groups							
0 - 14	15 - 24	25 - 34	35 - 44	45 - 54	55 - 64	65+	Total
8	11	24	20	11	12	9	95

Source: Health Statistics Abstract, 1997

Table 3-19 Reported newly diagnosed smear positive pulmonary tuberculosis patients in Coast Region by age group and sex for 1994 - 1995

	Age group and sex																				
	0 - 14			15 - 24			25 - 34			35 - 44			45 - 54			55 - 64			65+		
	M	F	M+F	M	F	M+F	M	F	M+F	M	F	M+F	M	F	M+F	M	F	M+F	M	F	M+F
Reported newly diagnosed smear positive pulmonary tuberculosis patients of Coast region by Age Group and Sex for the year 1994	3	5	8	62	47	109	115	101	216	86	47	133	49	26	75	21	14	35	16	1	17
Reported newly diagnosed smear positive pulmonary tuberculosis patients of Coast region by Age Group and Sex for the year 1995	3	5	8	65	57	122	132	79	211	92	36	128	54	23	77	25	12	37	20	6	26

Source: Health Statistics Abstract, 1997

Table 3-20 Number and percent of notified newly diagnosed tuberculosis patient (all types) in Coast Region during 1995

Pulmonary Tuberculosis						Extra Pulmonary		Total
AFB+	%	Relapse	%	AFB-	%	Tuberculosis	%	
609	68	29	3	119	13	141	16	898

Source: Health Statistics Abstract, 1997

Table 3-21 Number and percent of notified newly diagnosed tuberculosis patients (all types) in Coast Region during 1996

Pulmonary Tuberculosis						Extra Pulmonary Tuberculosis		Total
AFB+NEW	%	Relapse	%	AFB-	%	Cases	%	
671	63	29	3	217	20	155	14	1,072

Source: Health Statistics Abstract, 1997

Table 3-22 New cases for relapse of tuberculosis and rate of smear positive by sex and year in Coast

Male	Female	Total	Rate smear positive per 100,000	
			1992	1993
316	234	550	74	75

Source: Health statistics Abstract, 1997

Table 3-23 Frequency distribution of newly diagnosed leprosy patients by age, sex for the year 1995

	Age group and sex																				
	0 - 14			15 - 24			25 - 34			35 - 44			45 - 54			55 - 64			65+		
	M	F	M+F	M	F	M+F	M	F	M+F	M	F	M+F	M	F	M+F	M	F	M+F	M	F	M+F
PB	6	1	7	1	3	4	10	1	11	5	4	9	10	9	19	6	2	8	3	1	4
MB	1	0	1	4	1	5	4	6	10	4	4	8	8	3	11	4	1	5	0	0	0

Source: Health Statistics Abstract, 1997

Table 3-24 Annual return of attendance for oral health care by sex and age for 1993 and 1995

Year	Male	Female	Total	Children	Adult
Attendance 1993	8,591	9,451	18,042	8,481	9,561
Attendance 1995	5,339	7,121	12,460	6,877	5,603

Source: Health Statistics Abstract, 1997

Table 3-25 Annual return of diagnosis for oral health care in Coast Region and type of disease for 1993 and 1995

Year	Carves	Perio	Trauma	Neop	Others	Referra	Total
Diagnosis for 1993	9,453	577	62	4	1,082	30	11,208
Diagnosis for 1995	11,918	547	51	5	545	135	13,066

Source: Health Statistics Abstract, 1997

Table 3-26 Annual return for treatment for oral health care in coast by type of treatment for 1993 and 1995

Year	Ext	Cons	Pros	Others	Surg	Ohi	Scal
Treatment for 1993	9,306	433	24	820	32	9,882	-
Treatment for 1995	11,417	187	-	478	25	-	11

Source: Health Statistics Abstract, 1997

Table 3-27 Annual returns for emergency oral health care for the year 1995

Attendance				Diagnosis				Treatment		
Sex		Age in Years		Caries	Perio	Trauma	Others	Extract	Others	Referral
Male	Female	<15	15+							
2,582	3,040	974	4,648	5,134	354	22	238	5,572	130	26

Source: Health Statistics Abstract, 1997

Table 3-28 Annual average current + required rates of motality decline

Rate of decline	For IMR	Rate of decline	For U5 MR
Current	Required	Current	Required
0.7	5.4	0.8	6.9

Source: Health Statistics Abstracts, 1997

Table 3-29 Maternal mortality rate by region (Coast) for four consecutive years (1992 - 1995)

MMR			
1992	1993	1994	1995
209	111	70	187

Source: Health Statistical Abstract 1997

Table 3-30 Life and death

	1978	1988		
Case	Total	Total	Male	Female
Life expectancy at birth on Coast region by sex for 1978 and 1988	47	48	46	51
Crude Death rate in Coast region	16.9	16.1	16.9	15.4

Source: Health Statistical Abstract 1997

Table 3-31 Number of health facilities reported with family planning facilities and contraceptive consumption for 1995

Health Facility reported	Health Facility with family planning	Contraceptive consumption					
		Oral pill	Injections	Iucds	Condoms	Foam Tab	Diaphragms
130	105	6,342	2,257	6	5,356	1,162	0

Source: Health Statistical Abstract 1997

Table 3-32 Maternity and delivery room tabulations for reported births for 1995

District target	Reported district target	Estimate coverage reporting	Reported live births at H.F by TBA	Reported % of birth attended
8,283	1,449	17%	333	23%

Source: Health Statistical Abstract 1997

Table 3-33 Maternity and delivery room tabulations for delivery information for 1995

Delivery information						**Abort**
BBA	**Normal**	**Vacuum**	**CS**	**Others**	**Totals**	**Outcome**
91	674	0	7	16	788	13

Source: Health Statistical Abstract 1997

Table 3-34 Maternity and delivery room tabulation for mother information for 1995

Post partum haemorg	Retained placenta	3rd Degree tear	All other complications	Death
11	7	11	13	7

Source: Health Statistical Abstract 1997

Table 3-35 Maternity and delivery room tabulation 1995

Case	**Live births total**	**Live births <2.5 Kg**	**Still births**	**Live births died**
Maternity and delivery room Tabulation for single Birth information	752	39	19	1
Maternity and delivery room Tabulation for Multiple birth information	35	-	0	0

Source: Health Statistical Abstract 1997

Table 3-36 The immunization programme in Coast Region for 1995-1996

Year	Health Facility number	Health Facility with 1MM	Vaccine consumption				
			Bcg	Polio	Dpt	Measles	Tetanus
1995	130	130	549	1,053	914	545	852
1996	-	-	-	-	-	-	-

Source: Health Statistical Abstract 1997

Table 3-37 The immunization programme reported coverage for children < 1 for the year 1995

BCG		DPT3		Measles	
Percent %	No. Vacc TPR	Percent %	No. Vacc. TPR	Percent %	No. Vacc TPR
83	1,468	69	1,468	71	1,468

Abbreviation: Vacc/TPR = Number of Vaccination per Target Population of Reporting Health Facilities.

Source: Health Statistical Abstract 1997.

3.4 *Agriculture*

The majority of the people in the region are engaged in agriculture. The most total comes to 93% of all people above the age 15. This includes most of the people listed in the 1988 census data as "not employed", because many people do not think agriculture is "work"! (The other 7% are engaged in small scale trading and casual labour, professional people including technicians and teachers; craftsmen and machine operators. clerks and administrators in that order).

The agricultural activities varies generally into the two agro-ecological zones in the region.

3.4.1 Agriculture in Uplands

The cultivation is dependent on soil fertility, and the soils are known to be poor. Furthermore, agriculture depends on rainfall, and the rainfall varies considerably from one area to other. There are two main rain seasons: Short rains with a peak in November (*Vuli*), and Long rains with a peak in April (*Masika*). But rainfall can be quite unreliable, and periods of drought are not uncommon.

Vermin seems to be serious problem as far as farmers are concerned. The most common and widespread are baboons, monkeys, wild pigs and birds (in particular quelea quelea).

The presence of vermins has two major consequences; destroying crops and thus wasting people's efforts; and also diverting labour from actual productive activities because people have to spend a lot of their time guarding their crops.

The crops grown include cashew nuts, cassava and upland rice. Other crops are coconut palms, sesame, sweet potatoes, maize, sorghum and citrus fruits.

3.4.2 Agriculture in the Floodplain

Agriculture system in lower Rufiji is dependent on natural flooding than a direct rainfall, so that rains in the upper part of the Rufiji basin are very important to the local community.

In essence, the agricultural system of the flood plain consists of two cultivation periods which do overlap *Masika* ("flush irrigation period) which takes advantage of the December / January rains and natural flooding of the Rufiji river; and *Mlao*, the flood recession cultivation period.

Under this system, a wide range of crops are grown to include 32 varieties of rice, maize and cotton. The choice among the different varieties of rice which is the main food crop and cash crop throughout the valley depends on drought and salt tolerance capability, and also on its quality and yield.

In the delta, maize (grown all the year round), pulses, pumpkins, and sweet potatoes, as well as some rice are the main food crops.

The agricultural labour peak is in October when cotton is being harvested and marketed while at the same time fields are being prepared for the new season. The second peak is in May - June when rice harvests conflict with the after-flood (Mlao) planting maize and cotton.

This agricultural year consists of three phases;

(i) The short rains (October - January); preparation of rice fields; early maize is planted and harvested;
(ii) Flood season (February - May); rice growing;

(iii) Mlao season (June - October); harvest and marketing of rice; planting of cotton and food crops on wet soil.

Table 3-38 to 3-39 Distribution of major agricultural implements in Coast Region for 1989/90 give details on agriculture in the region.

AGRICULTURE

Table 3-38 Area, production and yield per hectare of principal crops

Crops		1985/86	1986/87	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93+
Maize	A	21.97	NA	17.35	15.98	13.19	10.60	17.58	18.70
	P	31.22	NA	26.03	11.95	29.48	9.20	7.21	17.10
	Y	1,421	NA	1,500	748	2,235	808	410	914
Sorghum	A	4.33	NA	7.13	5.29	11.56	3.20	3.17	6.00
	P	4.31	NA	3.55	3.18	15.05	7.90	2.32	6.60
	Y	995	NA	498	601	1,302	2,469	732	1,100
Paddy	A	31.66	31.66	28.45	27.03	26.41	15.60	10.53	18.10
	P	46.06	39.00	41.25	39.19	25.20	18.80	8.89	18.10
	Y	1,455	1,232	1,450	1,450	954	1,205	844	1,000
Cassava	A	43.57	NA	46.19	39.26	59.00	37.30	35.86	59.30
	P	305.52	NA	323.33	265.13	115.10	93.20	93.24	154.30
	Y	7,012	NA	7,000	6,753	1,951	2,499	2,600	2,602
Sweet Potatoes	A	NA	NA	NA	NA	NA	NA	0.58	2.50
	P	NA	NA	NA	NA	NA	NA	0.76	3.20
	Y	NA	NA	NA	NA	NA	NA	1,299	1,280
Pulses	A	NA	NA	6.70	7.29	2.80	1.10	0.85	2.50
	P	NA	NA	2.68	2.65	1.90	0.40	0.34	1.20
	Y	NA	NA	400	364	679	364	400	480

KEY: A - Area ('000' hectare)
P - Production ('000' Metric tons)
Y - Yield per hectare (Kilograms)
NA - Not available at the time of compilation of the booklet

Source: Agriculture and Livestock Sector 1986/87 - 1991/92

Table 3-39 Area, production and yield per hectare of principal crops

Crops		1985/86	1986/87	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93+
Oil seeds & Oil nuts	A	1.91	1.91	1.91	2.29	NA	NA		
	P	0.16	0.16	0.16	1.47	NA	NA		
Banana plantains	A	1.00	1.00	1.04	NA	3.15	3.20	4.85	5.40
	P	19.00	15.96	15.96	NA	16.80	3.20	14.54	16.10
	Y	19,000	15.960	15,346	NA	5,342	1,000	3,000	2,981
Cashew nuts (Raw)	P	4.23	5.10	4.00	2.15	3.54	5.72	5.50	

Key: A - Area ('000' hectare)
P - Production ('000' Metric tons)
Y - Yield per hectare (Kilograms)
NA - Not available at the time of compilation of the booklet

Source: Agriculture and Livestock Sector 1986/87 - 1991/92.

Table 3-40 Area, production and yield per hectare of principal crops (sisal) in Coast Region

Crops		1985/86	1986/87	1987/88	1988/89	1989/90	1990/91
Sisal	IMM	0.22	0.46	0.32	0.55	0.59	0.58
	MA	1.28	0.99	1.25	0.72	1.76	1.76
	TOL	1.50	1.45	1.57	1.27	2.35	2.34
	P	1.04	0.75	0.84	0.86	0.86	0.79
	Y	693	5.17	535	677	850	850

Key: IMM - Immature
MA - Mature
TOL - Total
P - Production ('000 Metric tons)
Y - Yield per hectare (Kilograms)

Source: Agriculture and Livestock Sector 1986/87 - 1991/92

NAFCO FARMS

Table 3-41 Area production and yield/hectare of different cereals in Ruvu (Coast Region) for paddy

Year	Area	Production	Yield
1984/85	278	556	2.00
1985/86	415	1,572	3.80
1987/88	372	817	2.20
1988/89	142	439	3.09
1989/90	87	261	3.00
1990/91	135	253	1.87

Area - Hectares
Production - Metric tons
Yield - Kilograms

Source: Agriculture and Livestock Sector 1986/87 - 1991/92

MARKET PRODUCTION, IMPORTS AND EXPORTS OF AGRICULTURAL COMMODITIES

Table 3-42 Purchases of crops by NMC/cooperatives in coast region for 1985/86 - 1991/92 (quantity in metric tons)

Crops	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91	1991/92
Maize	0	0	0	1,501	1,501	0	0
Paddy	65	0	0	0	0	0	0
Beans	0	0	0	0	0	0	0
Sorghum	0	0	5	0	0	0	0
Wheat	0	0	0	0	0	0	0
Cassava	0	0	0	0	0	0	0

Source: Agriculture and Livestock Sector 1986/87 - 1991/92

Table 3-43 Purchases of millet by cooperatives in Coast Region

Type	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93+
Finger Millet	0	0	0	0	0	0
Bul-Rush	190	0	0	0	0	0

Source: Agriculture and Livestock Sector 1986/87 - 1991/92

Table 3-44 Purchases of crops by GAPEX/cooperatives in Coast Region for 1985/86 - 1991/92 (quantity in metric tons)

Crops	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91
Groundnuts	0	0	0	0		
Sesame	73	0	83	155	26	37
Sunflower	0	0	7	10	1	0
Castor Seeds	0	0	0	0	0	0
Soya Beans	0	0	0	0		
Cardamon	0	0	0	0		

Source: Agriculture and Livestock Sector 1986/87 - 1991/92

Table 3-45 Fertilizer distribution in Coast Region 1985 - 1991 (in metric tons)

1985	1986	1987	1988	1989	1990
1,612	827	1,046	1,119	923	1,176

This data is a combined one (Mean Coast and Dar es Salaam Region)

Source: Agriculture and Livestock Sector 1986/87 - 1991/92.

Table 3-46 Distribution of selected fertiliser (tonne)

Fertiliser	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Sulphate of Ammonia	245	379	606	482	438	310	286	595	265	474
Calcium Ammonium Nitrate	729	11	109	8	54	105	315	25	43	36
Triple Super Phosphate	293	166	293	160	409	116	124	191	183	146
Urea	58	84	44	115	143	100	164	169	265	315

Source: Agriculture Statistics 1989

Table 3-47 Seed distribution in Coast Region by crops

Year	Maize	Sorghum	Wheat	Paddy
1985/86	21	3	-	-
1987/88	67.7	12.5	-	3.6
1989/90	68.2	0.3	-	4.4

Source: Agriculture and Livestock Sector 1986/87 - 1991/92

DISTRIBUTION OF MAJOR AGRICULTURAL IMPLEMENTS 1989/90

In the region some implements were not distributed such as Ox-Harrow, Ox-Ridger and Treck chains.

The implements which were distributed by UFI in the region are Hand hoes, Machetes.

Table 3-48 Distribution of major agricultural implements in Coast Region for 1989/90

Hand Hoes ('000)	Machetes ('000)	Axes ('000)	Shovels ('000)	Pick axes ('000)
660	1,536	0	0	0

Source: Agriculture and Livestock Sector 1986/87 - 1991/92

3.4.3 *Livestock Keeping*

The livestock keeping in the region is not advanced, and there are a few number of keepers of livestock in the region. For instance, the 1994 livestock census showed 1,336 keepers of all types of cattle, and as little as only two persons who keep working cattle only.

Table 3-53 to 3-54 detail the performance of the livestock sector in the region.

Table 3-49 Number of livestock keepers in Coast Region (1984 livestock census)

All types of cattle	Working cattle	Indigenous cattle	Dairy cattle	Beef cattle
1,336	2	1,597	23	8

Source: Agriculture and Livestock Sector 1986/87 - 1991/92

Table 3-50 Number of livestock keepers in Coast Region (1984 livestock census)

Sheep ('000)	Goats ('000)	Indigenous pigs ('000)	Exotic pigs ('000)	Donkeys ('000)	Chicken ('000)
411	1,851	0	15	251	47,236

Source: Agriculture and Livestock Sector 1986/87 - 1991/92

Table 3-51 Number of villages and independent farms keeping livestock (1984 livestock census)

Cattle only	Other livestock
118	400

Source: Agriculture and Livestock Sector 1986/87 - 1991/92

Table 3-52 Estimated cattle population, off take, surplus and deficit in Coast Region 1989

Human total ('000)	Cattle total ('000)	Cattle off take ('000)	Beef produced ('000 Kg)	Beef consumed ('000 Kg)	Cattle surplus ('000)	Cattle deficit ('000)
651.63	91.01	8.92	1,248.68	4,385.46	N/A	22.41

Key: N/A - Not Available

Source: Agriculture and Livestock Sector 1986/87 - 1991/92

Table 3-53 Abattoirs and slaughter slabs in Coast Region 1981,1991 And 1992

Abattoirs	Slaughter Slabs	Abattoirs	Slaughter Slabs	Abattoirs	Slaughter Slabs	Narco
1981		1991		1992		
8	11	8	11	7	13	1

Source: Agriculture and Livestock Sector 1986/87 - 1991/92

Table 3-54 Estimated number of cattle ('000) 1986 - 1992

Estimate of	**1984**	**% Change 1985 - 90**	**% Change 1991-2000**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**
Cattle Numbers	87.9	1.25	0.975	90	91.0	92.0	93.0	93.9	95.1	96.4
Indigenous Cattle Numbers	79.9	0.80	0.83	81.4	82.1	82.7	83.3	83.8	84.7	85.6
Dairy Cattle Numbers	2.2	8.25	10	2.7	3.0	3.3	3.6	4.0	4.3	4.6
Beef Cattle Numbers	5.8	1	1	5.9	5.9	6.0	6.0	6.1	6.2	6.2
Goat Numbers	18.7	⇦ 0 . 97 ⇨ (1985 - 2000)		19.0	19.2	19.3	19.5	19.6	19.7	10.4
Sheep Numbers	4.9	0.00	-	4.9	4.9	4.9	4.9	4.9	4.9	4.9

The actual 1984 Livestock Census.

Source: Agriculture and Livestock Sector 1986/87 - 1991/92

Table 3-55 Collection of hides, sheep skins and goat skins 1986 - 1991/92

Collection of	1986	1987	1988/89*	1989/90	1990/91	1991/92
Hide Number	N/A	6,281	3,900	86,577	91,586	N/A
Sheep Skins	N/A	1	N/A	38	N/A	N/A
Goat Skins	N/A	8	N/A	98	5	N/A

Key: * - Changed to Financial Year
N/A - Regions not responding

Source: Agriculture and Livestock Sector 1986/87 - 1991/92

Table 3-56 Production of hides and skins 1991/92 in Coast Region

Cattle	Goats	Sheep
4,617	1,440	17

Source: Agriculture and Livestock Sector 1986/87 - 1991/92

Table 3-57 Purchases of hides and skins 1991/92

Cattle	Value Tshs	Goats	Value Tshs	Sheep	Value Tshs
3,800	3,800,000	375	65,000	24	2,400

Source: Agriculture and Livestock Sector 1986/87 - 1991/92

Table 3-58 Livestock (cattle) vaccinations against diseases 1986 - 1991/92

Disease	1986	1987	1988/89*	1989/90	1990/91	1991/92
Anthrax	N/A	1,302	N/A	N/A	N/A	N/A
Black quarter	N/A	2,761	N/A	N/A	N/A	N/A
Rinderpest	51,474	68,560	39,072	N/A	N/A	N/A
Foot and mouth (fmd)	5,693	N/A	N/A	N/A	555	N/A

Key: *- Start of change of Financial Year
N/A - Not Available

Source: Agriculture and Livestock Sector 1986/87 - 1991/92.

3.5 Power Supply

The major source of energy for household in both urban and rural areas in the region as is for the whole country is wood-fuel (i.e. fuel-wood and charcoal). In urban areas, electricity from the national grid system is utilised for industrial, commercial and domestic activities. Presently, this power is hydrogenated from Kidatu and Mtera stations.

3.6 Water

Water supply is a chronic problem both in rural and urban areas. For rural areas, most households get their water supply from wells within and outside their vicinity. For example, in Kisarawe rural, only 0.4% and 2% of the households get their tap water from inside and outside their blocks respectively, while 22% and 75% get well-water from within and outside their vicinities. In most cases, the well water as well as tap water is not necessarily safe and clean because some wells are traditional shallow and unprotected.

PART II COAST REGION'S MAIN ENVIRONMENTAL ISSUES AND IMPLICATIONS FOR DEVELOPMENT

CHAPTER FOUR

4. COAST REGION'S MAIN ENVIRONMENTAL ISSUES AND IMPLICATIONS FOR DEVELOPMENT

4.1 RUFIJI BASIN DEVELOPMENT

The Rufiji basin covers an area of 68,500 km^2 and lies between latitudes 5° 32' South and 10°44' South, and between longitudes 33° 32' East and 39°25' East, with varying topographic and climate conditions.

Three main tributaries from the mountains form the Rufiji river. These are the Great Ruaha which contributes 43.3% Kilombero 22.5% and Luwegu 14.8%.

The bankful conditions are fulfilled when river stream-flow reaches a value between 200 and 2500 m^3/s. At level below 1000 and 1600m^3/s, the flood spill over the levees in only a few places.

The river transport and deposit to the lower Rufiji some 17 million tons of reddish-brown sediment annually, composed mainly of alluvial clay and sand.

Historically, Rufiji has had important trade relations with the outside world, like Kilwa. As early as the Middle Ages, Rufiji was part of the East African - Arab trade network, exporting such items as ivory, wax and gum copal. In the 17th century, Rufiji became an important exporter of agricultural produce to Zanzibar. There also existed a lucrative trade in mangrove poles to the Middle East which continued to the middle of this country. All of this trade was carried on over sea using local or foreign dhows and vessels.

The basin has a big potential for agricultural, hydropower and shrimp farming potential. The Rufiji Basin Development Authority, RUBADA, was formed as the managerial body of the basin.

Various development schemes have been attempted, such as a rice-growing scheme, and the fishery of the flood plain, which involves the use of gillnets in the area as fish are isolated with the drying up of the flood plain.

Some other development schemes caused much controversy. For instance a proposed dam at Stiegler's Gorge in the Selous Game Reserve caused much controversy. Much of the initial concern over possible negative below impoundment effects of the proposed hydropower dam was dissipated when construction of the dam did not receive funding.

Elsewhere, flood plains in Africa have received considerable attention, often in connection with hydroelectric dams and their effects. It has been found extremely difficult to imitate natural flooding by controlled water releases from hydropower dams, and usually, the fishing of the flood plain downstream from the dam suffer, despite attempts to model and predict needed releases.

Recently, again much controversy has evolved over the development of the Rufiji Delta for shrimp farming. It was said the project will have big environmental impact of the fragile delta ecosystem. The impacts include clearing of mangrove forests, involuntary resettlement of indigenous populations, and salinisation of the soil. The Environmental Impact Assessment of the project disapproved it, though the cabinet gave it greenlight, EIA not withstanding. The project is yet to take off, and the controversy is still there.

4.2 KAZIMZUMBWI FOREST RESERVE CONSERVATION

Kazimzumbwi forest reserve at the border of Kisarawe district and Ilala district (Dar es Salaam) was established by government in 1954. Its conservation has attracted a lot of public controversy.

4.2.1 Invaded or Not?

The South border of the forest reserve caused much of the trouble. The government notice (GN) establishing the forest reserve described the South border, as starting from a beacon near village of Maguruwe, a line is drawn generally westwards, passing near the village of Nzasa where there is another beacon, and go further westwards, crossing Mnyonde river ending on a beacon at Mnyundo hill.

Trouble started when the forestry authorities in 1994 decided to force Nzasa villages out of their village, allegedly for being in Kazimzumbwi forest reserve. In fracas that ensued one person was killed and another maimed. Several villages were charged for invading the forest reserve and fined.

One of them appealed to the High court, which ruled in his favour after the forestry officials failed to produce evidence to prove that Nzasa village is part of the reserve.

Following his victory, the area saw influx of more people, especially from Dar es Salaam, who felt more trees for cultivation in the disputed area.

Forestry Officers invited district and regional leaders to help dislodge the villagers. The Dar es Salaam Regional Commissioner visited the area and ordered out the villagers in a month period if at all were inside the reserve. None moved, after the authorities failed to show the reserve's beacons, in October, 1996.

The next visit was in May, 1997. A national leader gave the villagers three months to vacate the area. A government notice empowering the Coast Region , Regional Commissioner (RC) to deal squarely with invaders of the forest reserve was out in week's time.

The villagers all the same did not move out, maintaining they are out of the reserve. When three months grace period expired, authorities threatened to use the riot police (FFU) to drive the invaders out. However, no FFU was sent, and villagers went on with their farming activities.

The villagers maintain that they are outside the forest reserve, and whatever the allegations, no-one is going to forcefully remove them from what they consider their traditional land. They point out that the village is in Ilala district, Dar es Salaam Region. Their version of the story have it that the 1954 forest borders demarcated in the government notice does not include the village into forest reserve, a fact they say they are ready to bring to the attention of courts of law.

The forest reserve of Kazimzumbwi is degraded at an alarming rate, the Kisarawe forest officials says. Who do the damage? It is apparently not clear. The authorities point accusing fingers to Nzasa villagers, while at the same time the villagers accuse the reserve officials for plotting to grab their farming land which is outside the reserve, leaving the reserve at the mercy of organised loggers.

4.2.2 Solution to the Problem

The most feasible solution of the Kazimzumbwi-Nzasa dispute is community participation. The villagers and the forest officials should together mark the reserve border and ensure the village and the reserve co-exist for mutual benefit. Any use of force should always be avoided. If the village co-existed with the reserve for over 40 years, it can do the same for the rest. The authorities must always stick to the rule of law when handling the Kazimzumbwi Forest Reserve - Nzasa village issue.

The Kazimzumbwi forest reserve is rich in biodiversity, both of fauna and flora. Among its many endemic and rare species, is the East African Akalt bird.

4.3 CONCLUSION

- Kazimzumbwi Forest Reserve has been seriously encroached.
- Environmentalists are of the opinion that the Rufiji Prawns Project if excuted will cause an environmental concern. Resettling of people will be another problem.
- Deforestation is a problem in this region due to felling of trees for charcoal making and poles as a building material. A good number of poles is used as a support for construction work in Dar es Salaam.
- Education level is very low in the region.

4.4 RECOMMENDATIONS

- There should be a clear demarcation for the Kazimzumbwi Forest Reserve
- The people living along the Rufiji delta be given more time to discuss on the Rufiji Prawns Project. It would be to the advantage of the people of the area and the country as a whole if we re-visit the professional's advice.
- Construction companies are to be advised to make use of reusable materials such as iron bars for their construction work..

CHAPTER FIVE

5. CLIMATE PROFILE OF COAST REGION

INTRODUCTION

Coast region is one of the regions located on the eastern flank of the country and bordering with the Indian ocean. The region engulfs the Dar es Salaam region which is also the Capital city. Along the coast area the region spans between 5.°S to 9°S. The northern most part of the region is around 6°S and the southern most part of the region is 9°S. The region spans from 38.°E to 40°E. The altitude varies from sea level to 1000m. The region experiences bimodal rainfall pattern with March to May rainfall which is termed as Masika or long rains and Vuli rains in the months of October to December.

The rains are controlled by the apparent movement of the sun. The area of greatest heating and therefore lowest pressure occurs where the sun is roughly overhead and this is termed as heat trough or equatorial trough or the Inter-Tropical Convergence Zone (ITCZ).

The start of the rainy season is associated with northward and southward movement of the equatorial trough. The southern movement is associated with the short rains and the northward movement is associated with long rains. The strength of the convergence is determined by the strength of either northeast or south monsoon winds which normally carry a lot of moisture from the ocean. The short rains are generally erratic and they are unreliable in terms of amount and distribution. During the rainy season, some of the rain is convectional in nature and some is advective. Since the coast region is close to the coast, then most of the clouds which form over the Indian Ocean are advected to the land by the monsoon winds.

The period June to September is generally dry except on few occasions when the area receives advected rain from the ocean.

5.1 SUMMARY FROM THE ANALYSIS

5.2 METHODOLOGY

5.2.1 RAINFALL

Time Series Analysis was performed to determine the annual rainfall, short rain and long rain trends of this Region using the few selected stations with data ranging from 1960 to 1996. These five stations were selected because of the continuity on the part of its data for a number of years and locality. Mean annual and seasonal rainfall data was used. Missing data (though few) were replaced by long term mean of that station.

5.2.2 *Annual Rainfall Time Series:*

For annual rainfall time series analysis, Mandera Mission shows a slight decreasing trend while Kisarawe had slight decreasing trend from the early sixties to mid-seventies and then an increasing trend. Other stations showed an oscillatory trends with some marked peaks . However, some stations had either few data or it was discrete. These were either modified (by interpolation/extrapolation) or left out.

5.2.3 *(March-May) Rainfall*

Kisarawe shows an increasing trend from the period 1986 to 1996. The remaining stations were showing oscillatory trends.

5.2.4 *(October-December) Rainfall*

Most stations generally show variable trends.;

5.3 *TEMPERATURE*

As for temperature, Mafia is the only station used for the time series analysis. Other stations do not have continuous data for this parameter. Kibaha Agrometeorological station , however , could not be used as it has data for a very short duration for someone to make a meaningful analysis.

As described above, a time series analysis was used for long term mean annual rainfall, short rains (October to December), long rains (March to May) and temperature. Other parameters are mean monthly sunshine hours, wind speed (knots), humidity (%) and mean monthly radiation Rd (mj/**2)

5.4 List of Stations:

Bagamoyo Agriculture Office

Bagamoyo Salt Works

Mandera Mission

Lugoba

Chalinze Mission

Ubena Prison

Ruvu Farm

Kibaha Meteorological Station

Kisarawe Agriculture Office

Mkuranga NCDP

Mafia

Utete

Muhoro

Stieglers Gorge

Appendix 1

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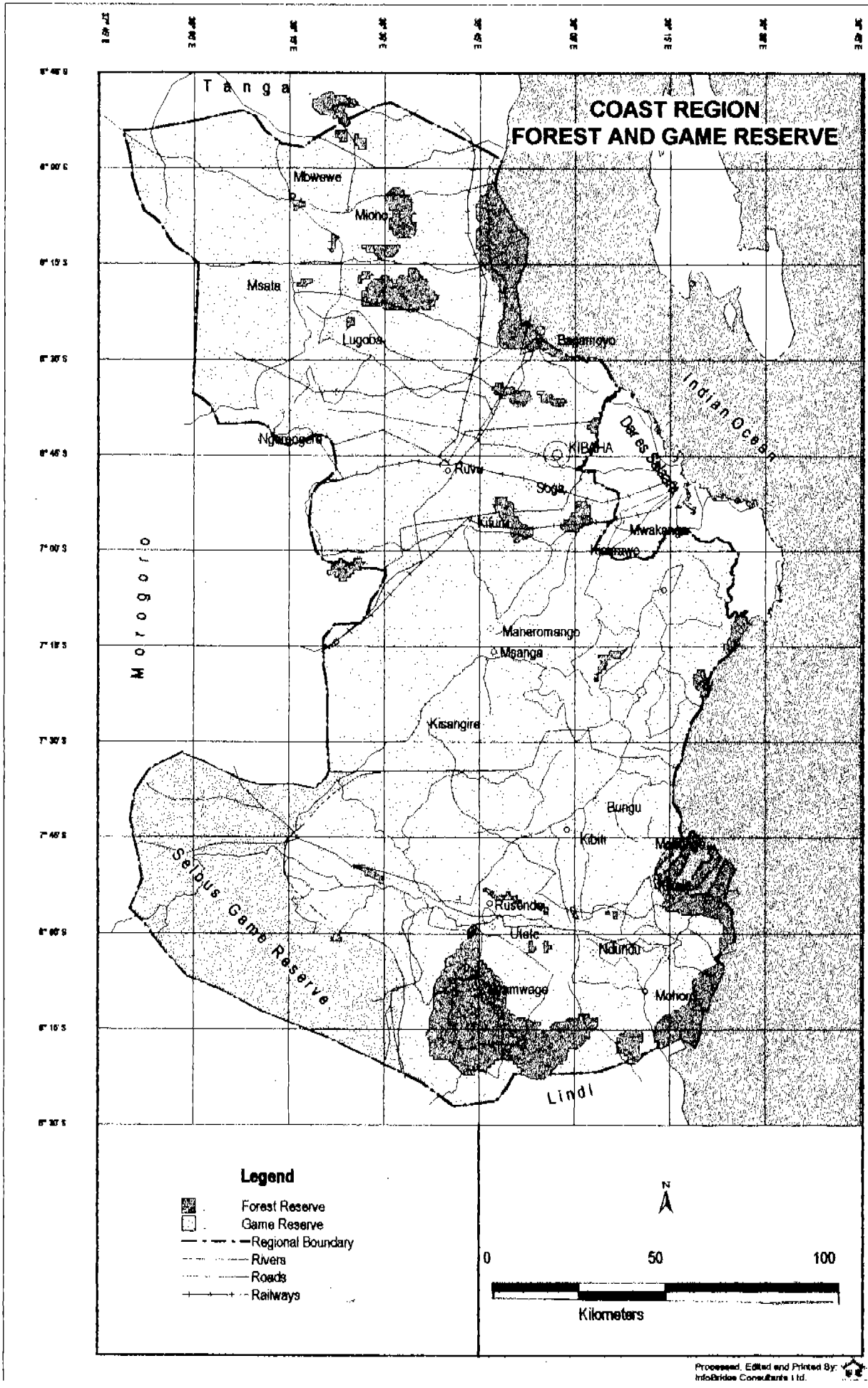
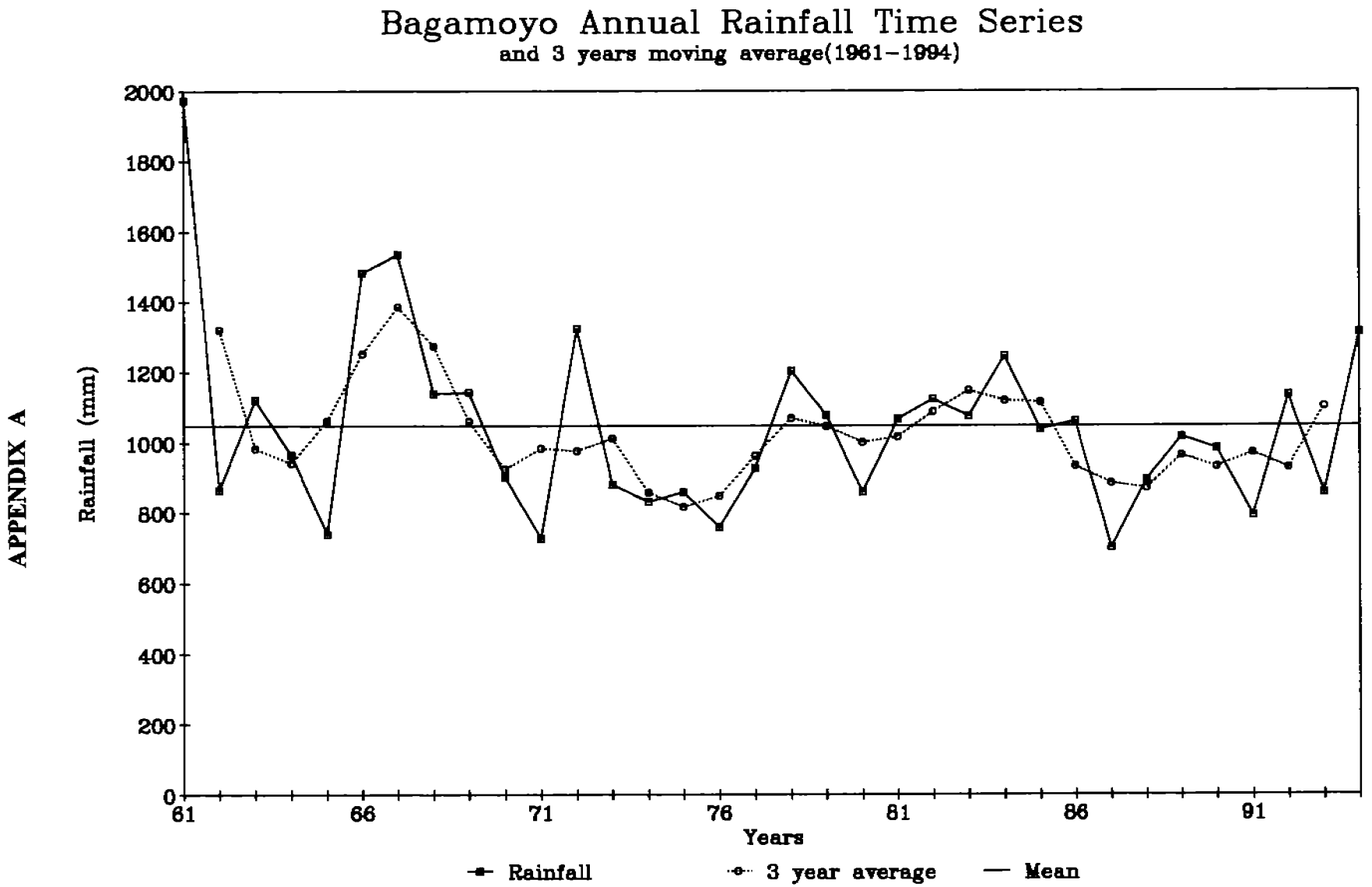
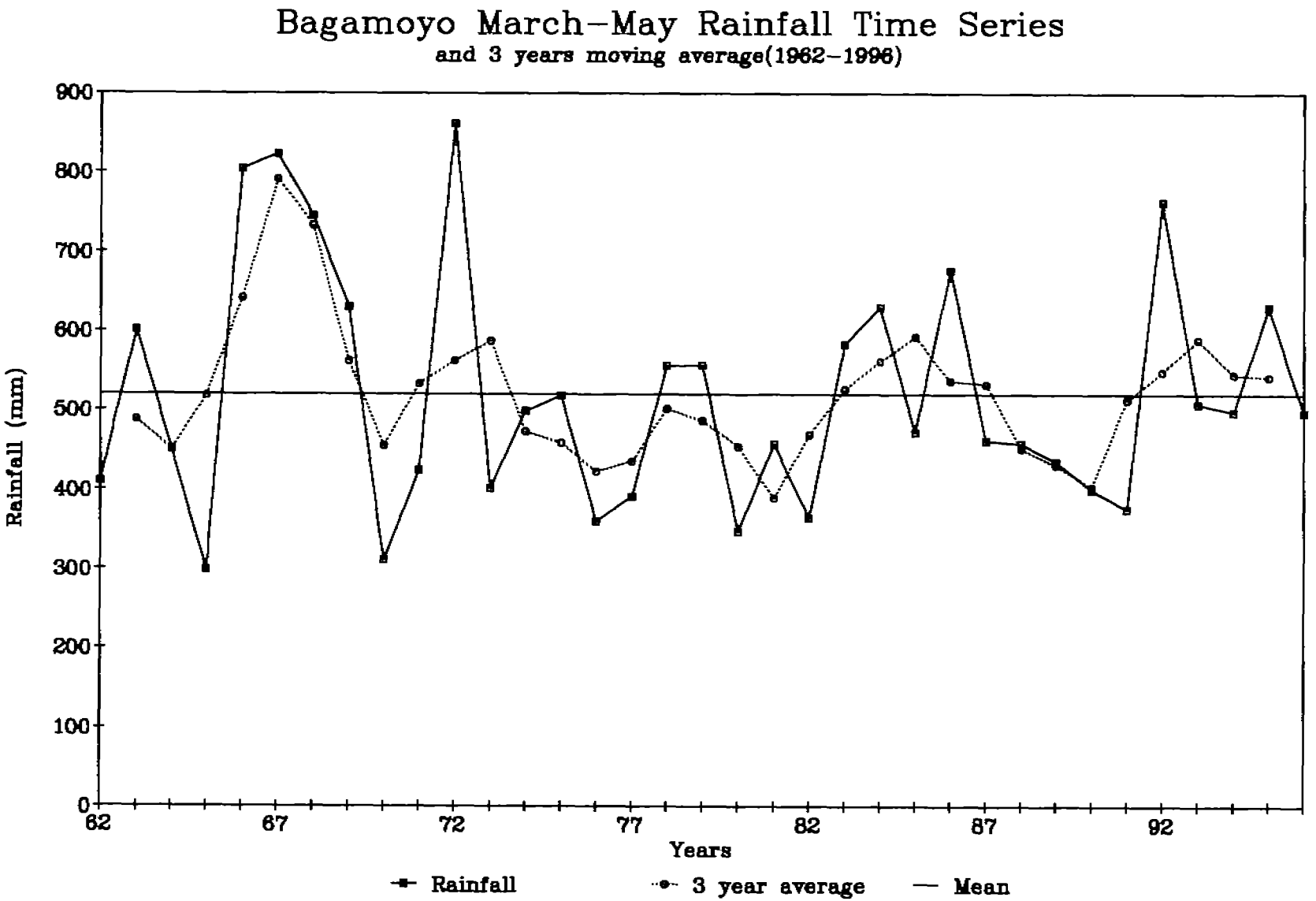

COAST REGION
FOREST AND GAME RESERVE
Tanga
Mkwewe
Mkono
Msata
Lugoba
Bagamoyo
Indian Ocean
Dar es Salaam
KIBAHA
Ruvu
Soga
Kiluvya
Mwakanga
Maneromango
Mgeta
Kisangire
Bungu
Kibiti
Mkongo
Selbus Game Reserve
Rusenda
Utete
Ndundu
Mohoro
Lindi
Morogoro
Legend
Forest Reserve
Game Reserve
Regional Boundary
Rivers
Roads
Railways
N
0
50
100
Kilometers
Processed, Edited and Printed By:
InfoBridge Consultants Ltd.

APPENDIX A


Bagamoyo Annual Rainfall Time Series
and 3 years moving average(1961-1994)
Rainfall (mm)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
61
66
71
76
81
86
91
Years
Rainfall
3 year average
Mean

APPENDIX B


Bagamoyo March–May Rainfall Time Series
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Rainfall (mm)
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800
700
600
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0
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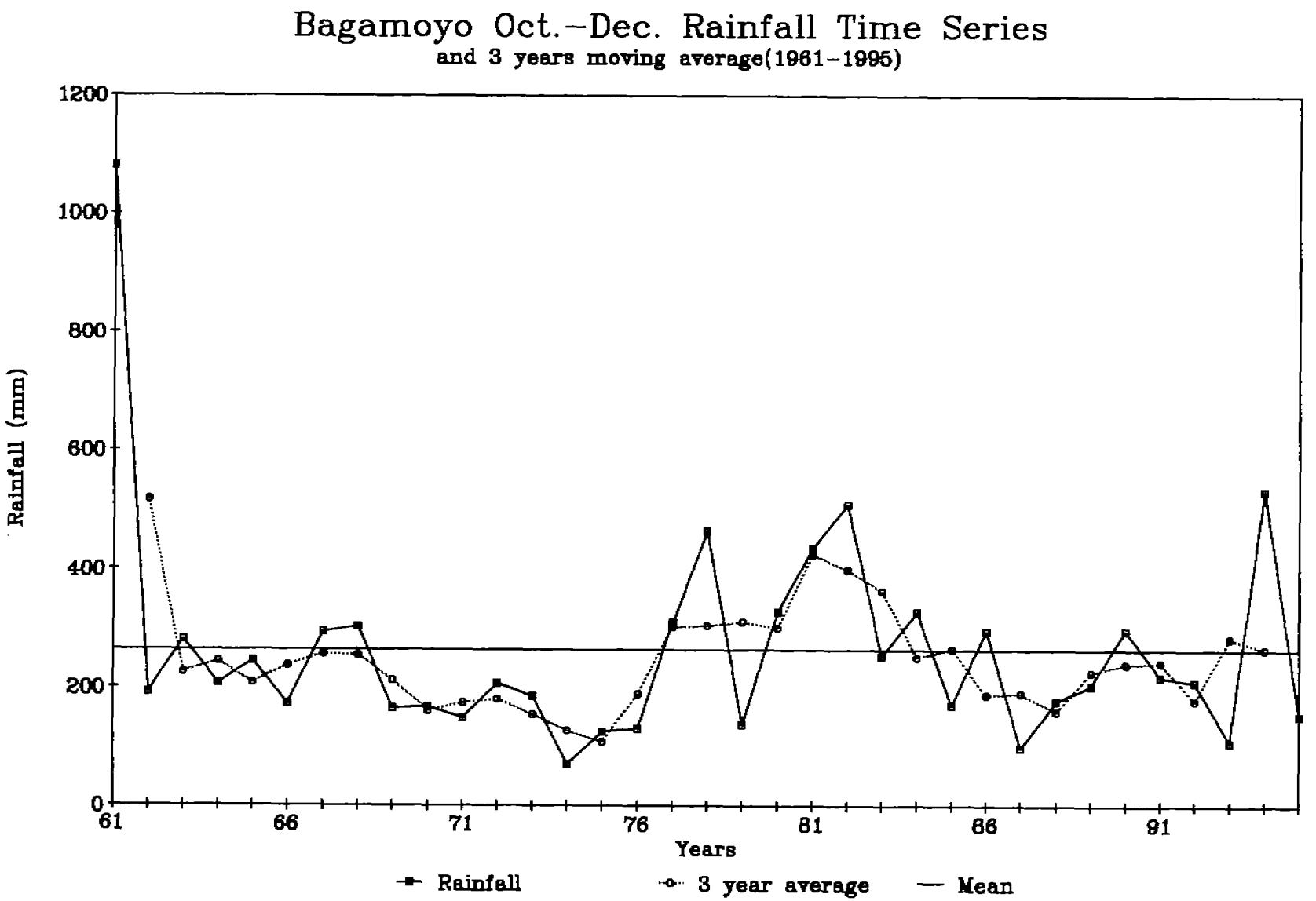
67
72
77
82
87
92
Years
Rainfall
3 year average
Mean

APPENDIX C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Rainfall (mm)
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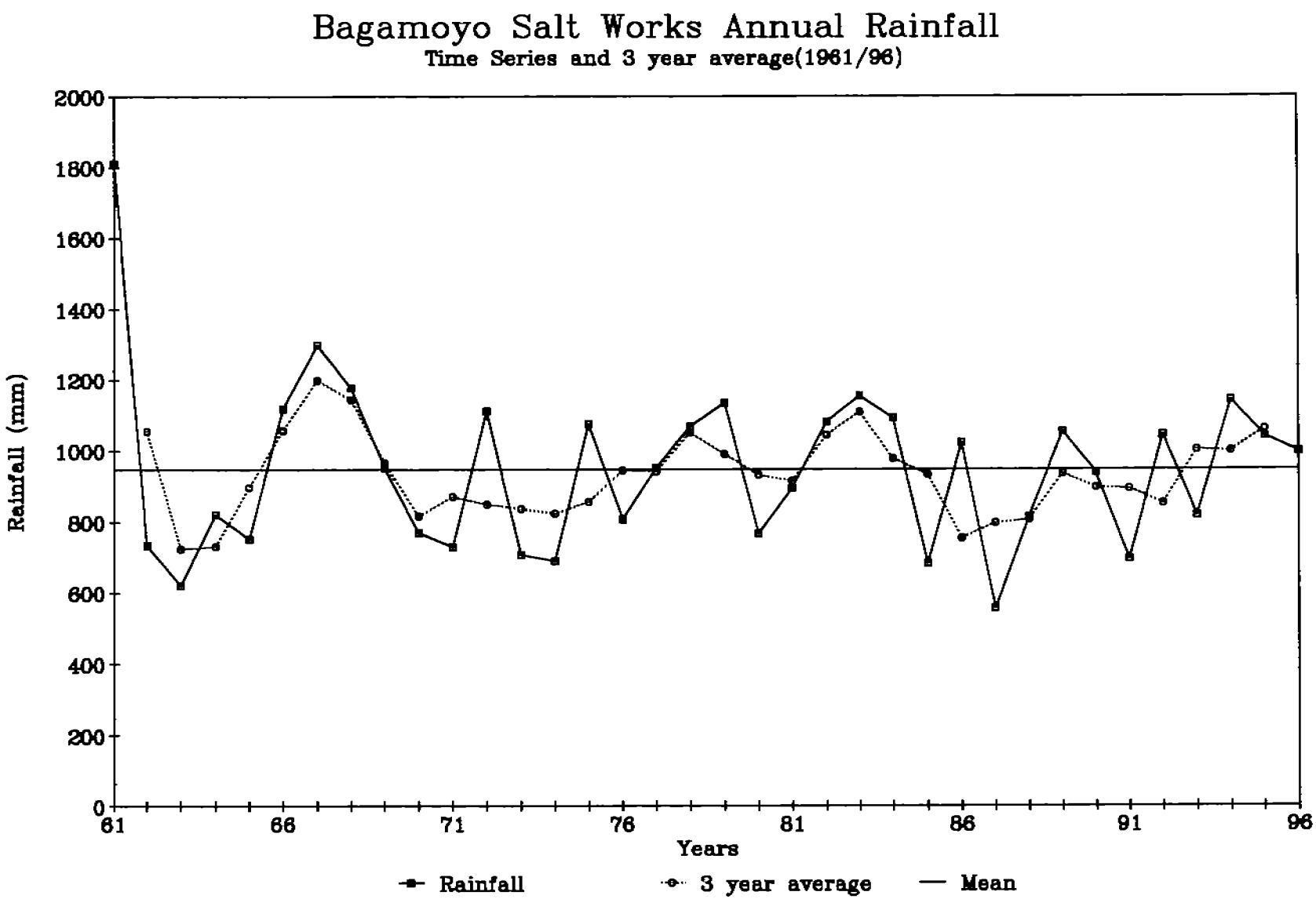
1000
800
600
400
200
0
61
66
71
76
81
86
91
Years
Rainfall
3 year average
Mean

APPENDIX D


Bagamoyo Salt Works Annual Rainfall
Time Series and 3 year average(1961/96)
Rainfall (mm)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
61
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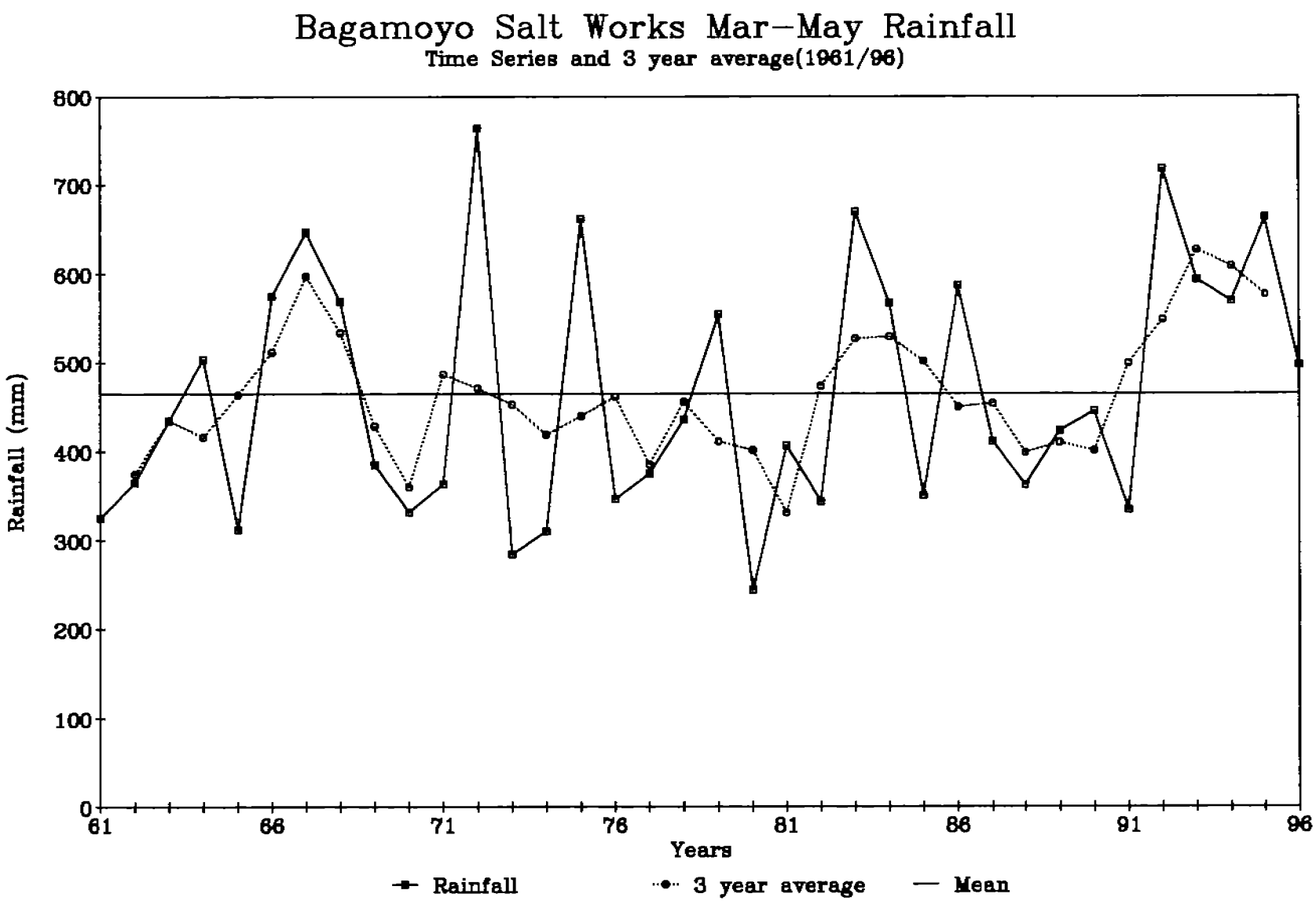
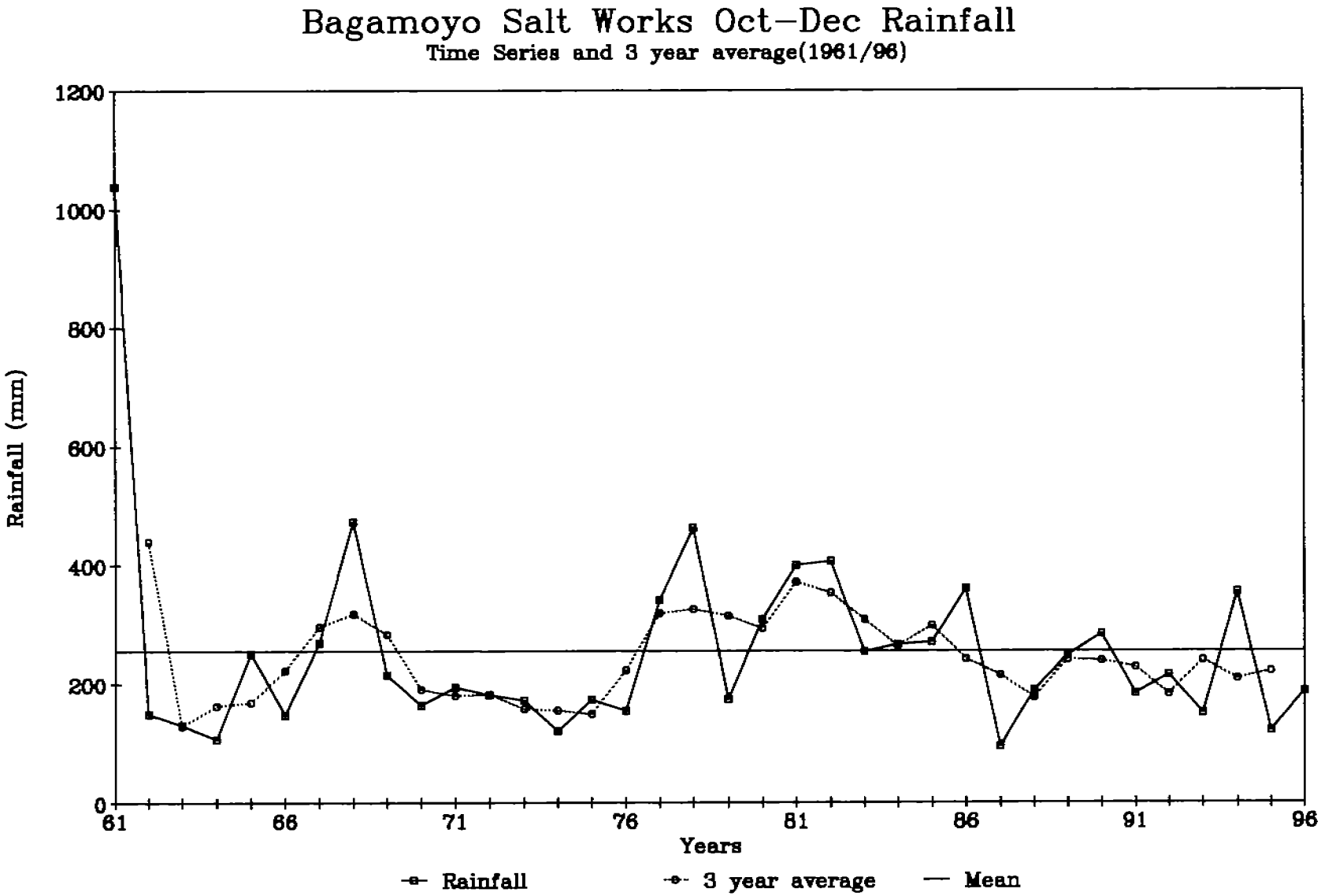
71
76
81
86
91
96
Years
Rainfall
3 year average
Mean

APPENDIX E


Bagamoyo Salt Works Mar–May Rainfall
Time Series and 3 year average(1961/96)
Rainfall (mm)
800
700
600
500
400
300
200
100
0
61
66
71
76
81
86
91
96
Years
Rainfall
3 year average
Mean

APPENDIX F


Bagamoyo Salt Works Oct–Dec Rainfall
Time Series and 3 year average(1961/96)
Rainfall (mm)
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1000
800
600
400
200
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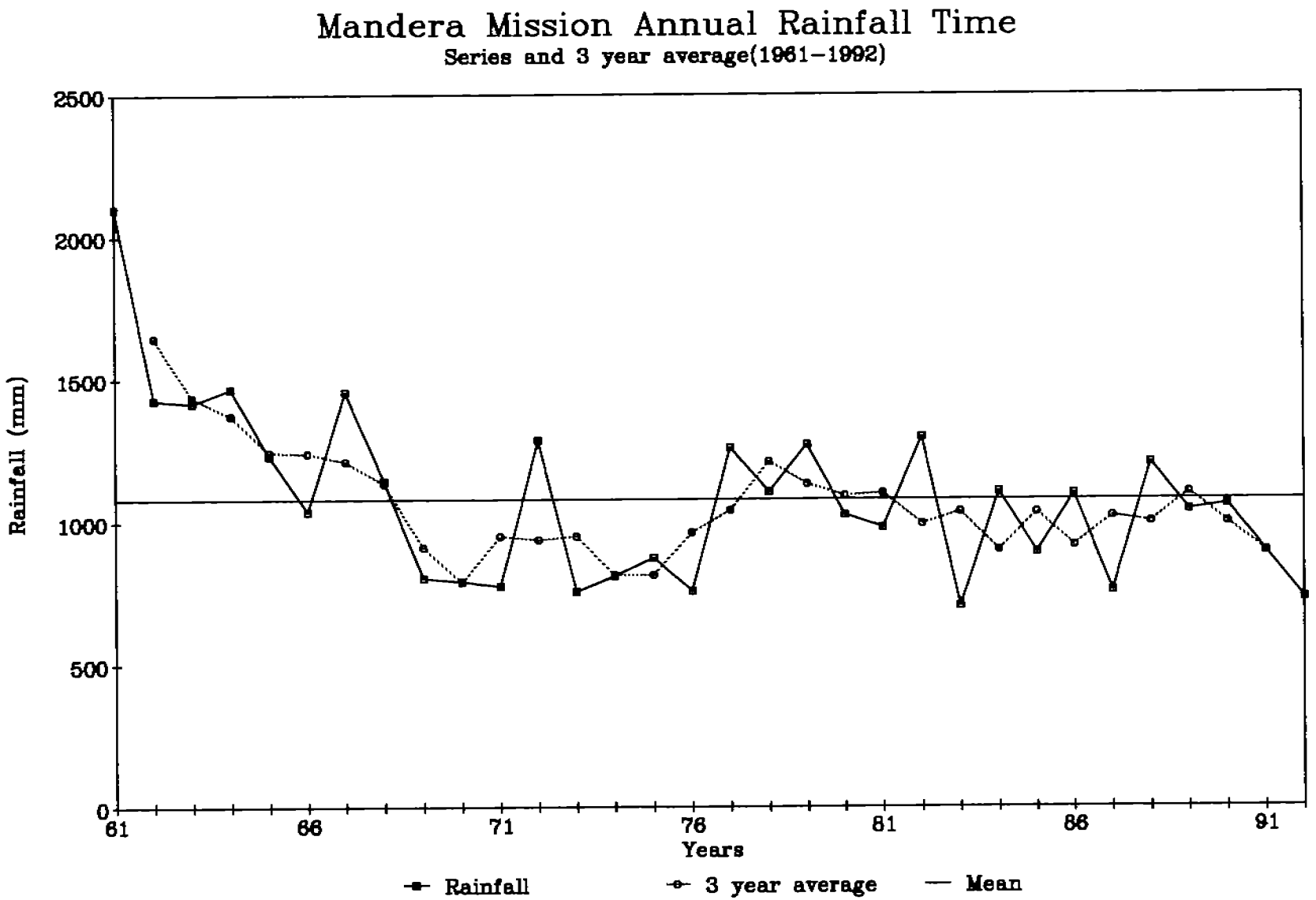
61
66
71
76
81
86
91
96
Years
Rainfall
3 year average
Mean

APPENDIX G


Mandera Mission Annual Rainfall Time
Series and 3 year average(1961-1992)
Rainfall (mm)
2500
2000
1500
1000
500
0
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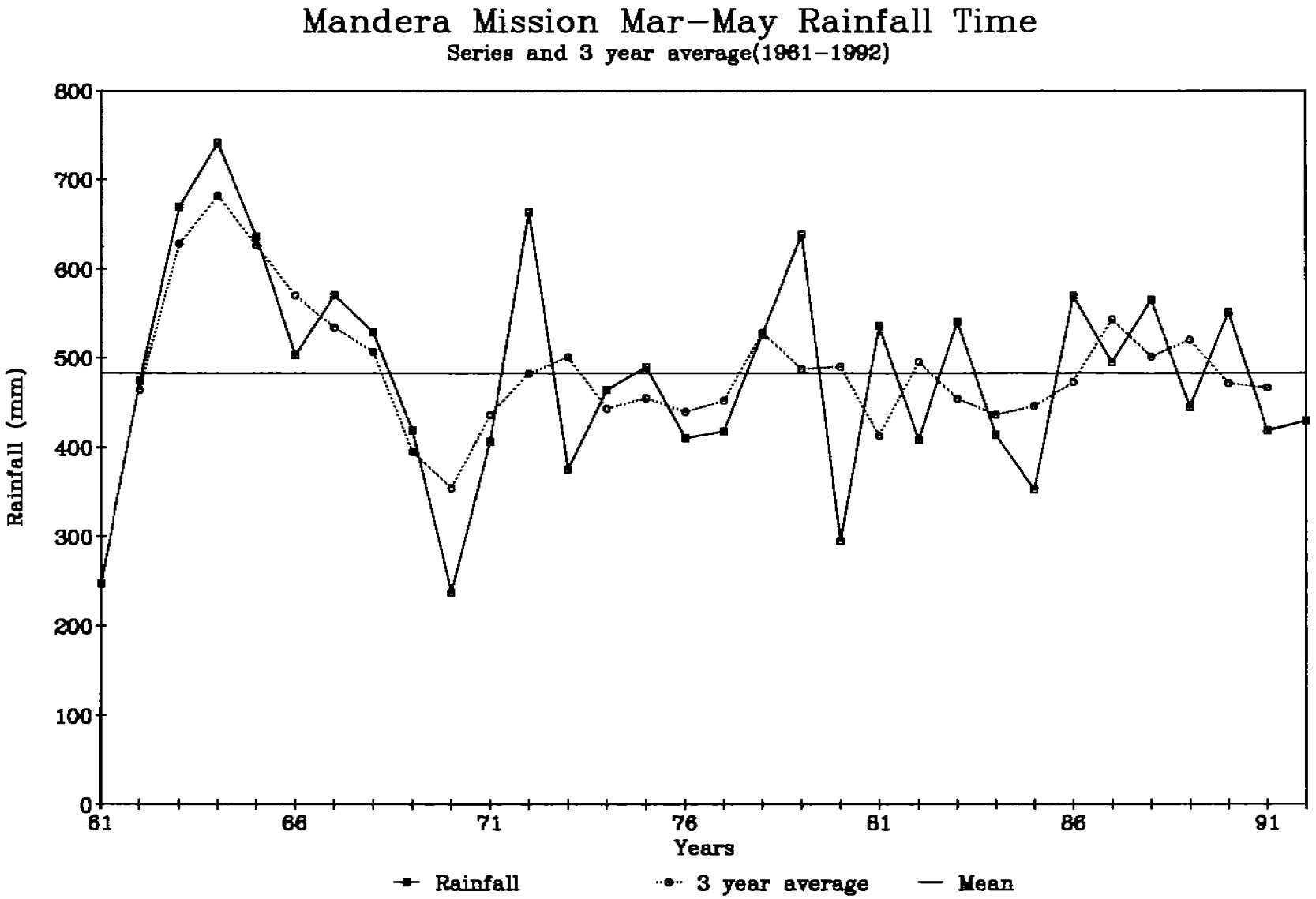
66
71
76
81
86
91
Years
Rainfall
3 year average
Mean

APPENDIX H


Mandera Mission Mar–May Rainfall Time
Series and 3 year average(1961–1992)
Rainfall (mm)
800
700
600
500
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300
200
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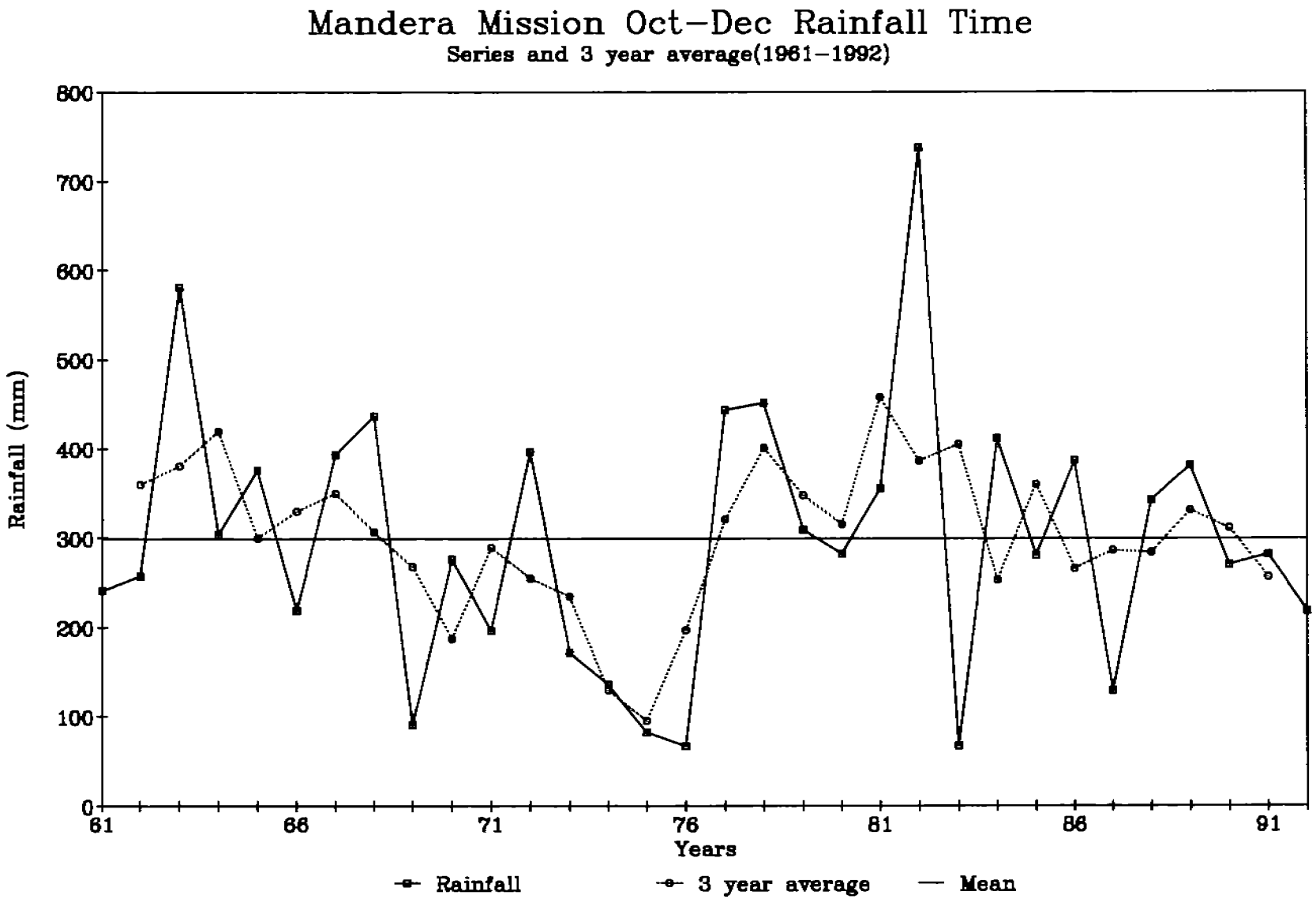
0
61
66
71
76
81
86
91
Years
Rainfall
3 year average
Mean

APPENDIX I


Mandera Mission Oct–Dec Rainfall Time
Series and 3 year average(1961–1992)
Rainfall (mm)
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700
600
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200
100
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61
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71
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81
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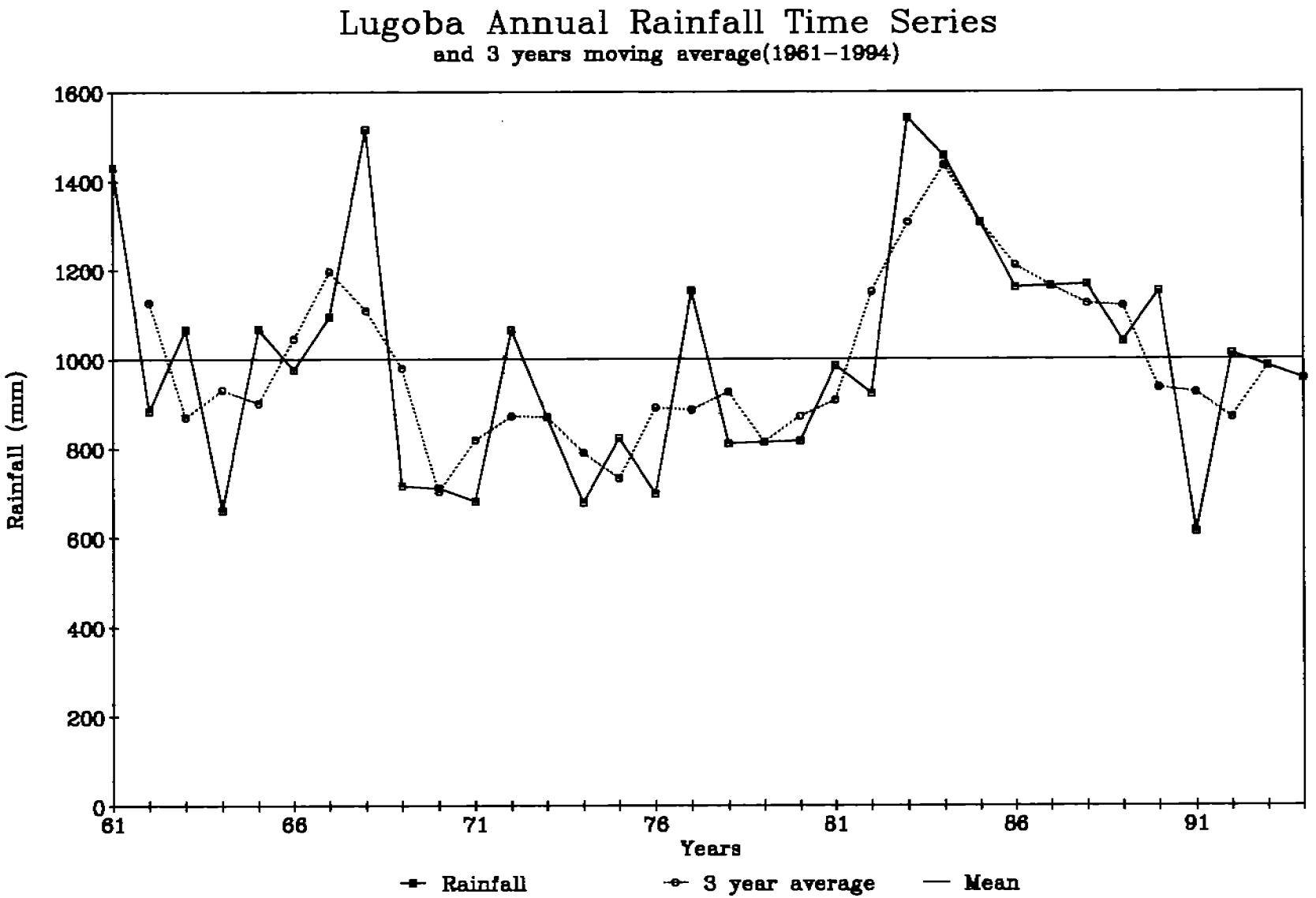
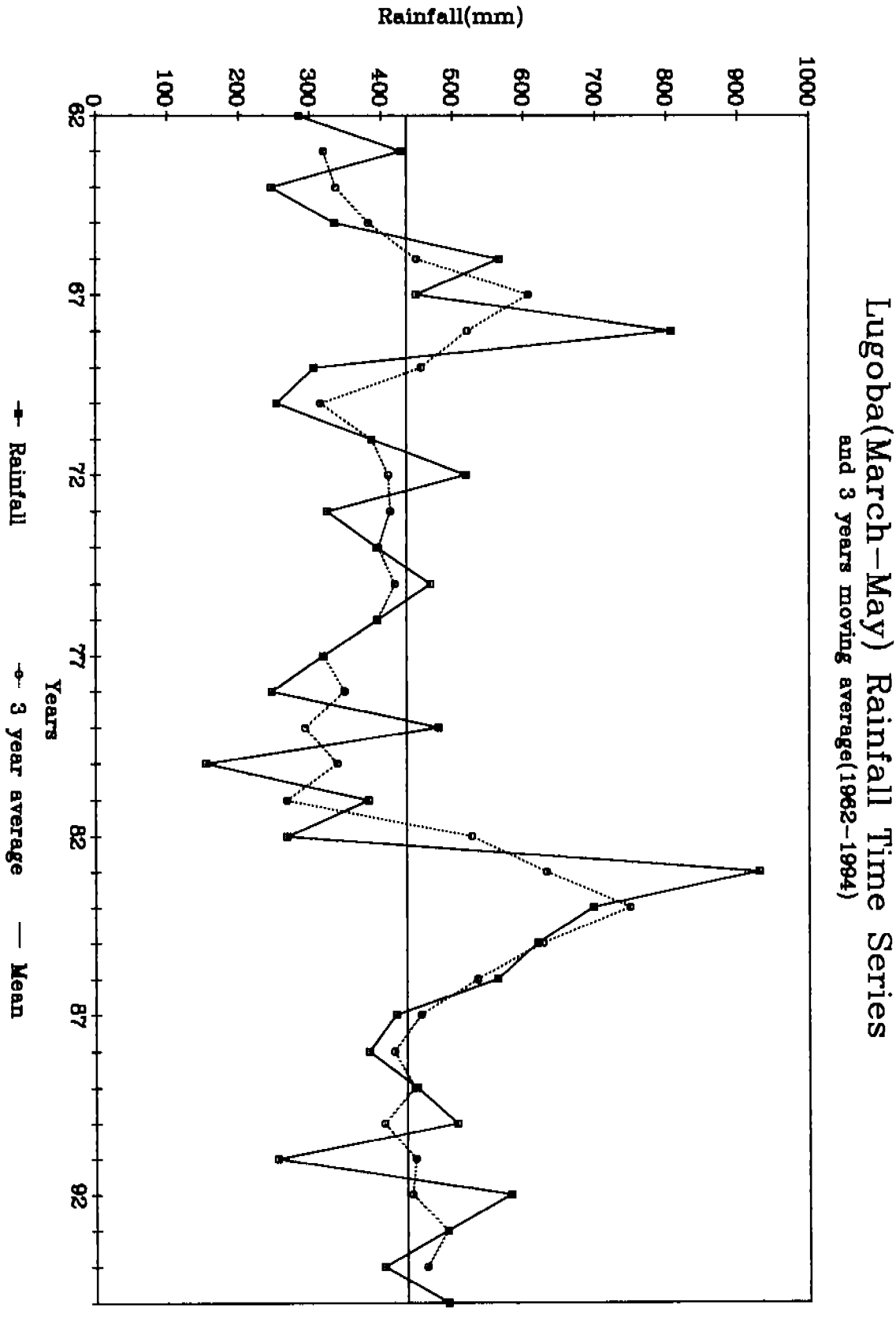
91
Years
Rainfall
3 year average
Mean

APPENDIX J


Lugoba Annual Rainfall Time Series
and 3 years moving average(1961-1994)
Rainfall (mm)
1600
1400
1200
1000
800
600
400
200
0
61
66
71
76
81
86
91
Years
Rainfall
3 year average
Mean

APPENDIX K


Lugoba(March-May) Rainfall Time Series
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Rainfall(mm)
0
100
200
300
400
500
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700
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900
1000
62
67
72
77
82
87
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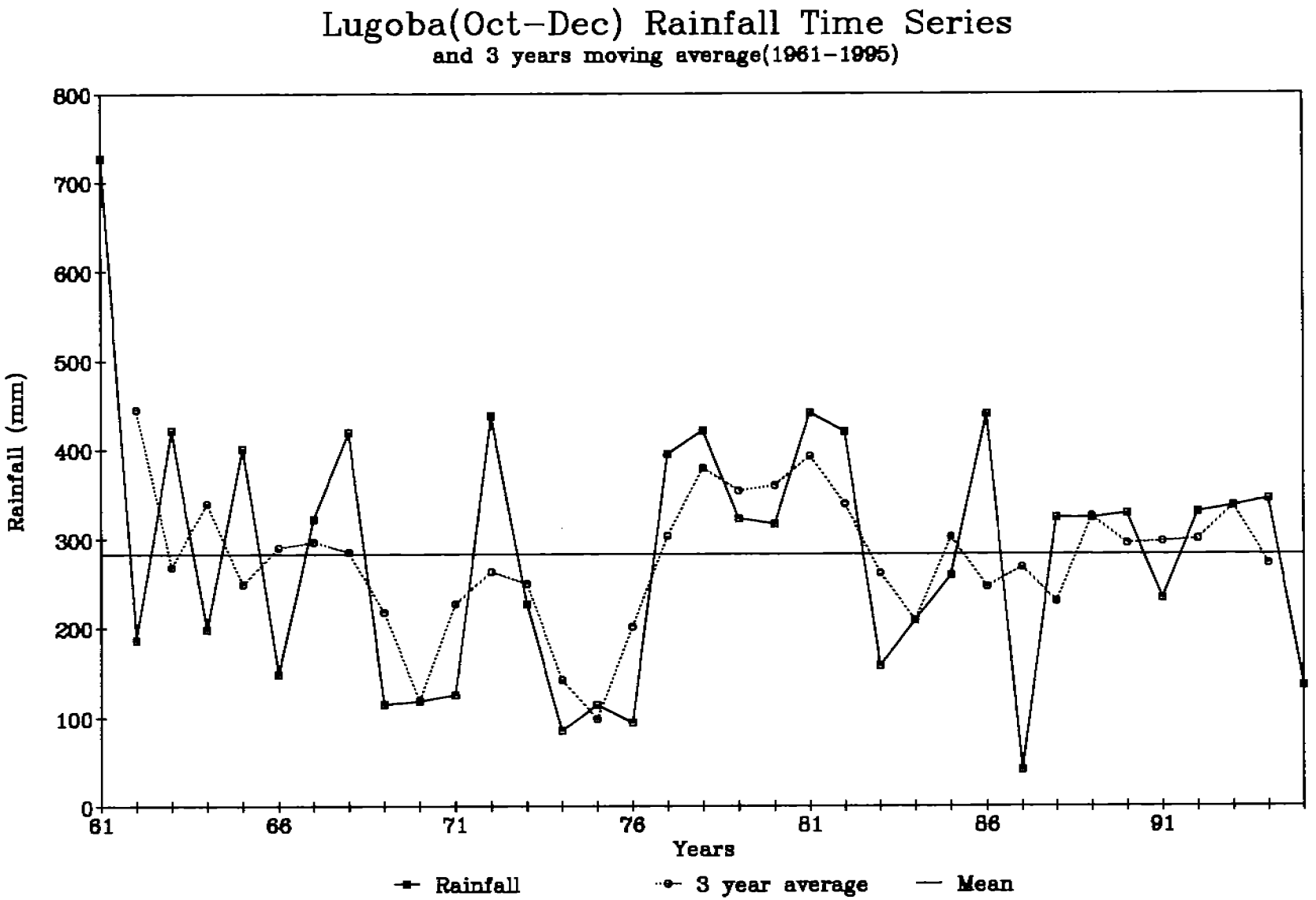
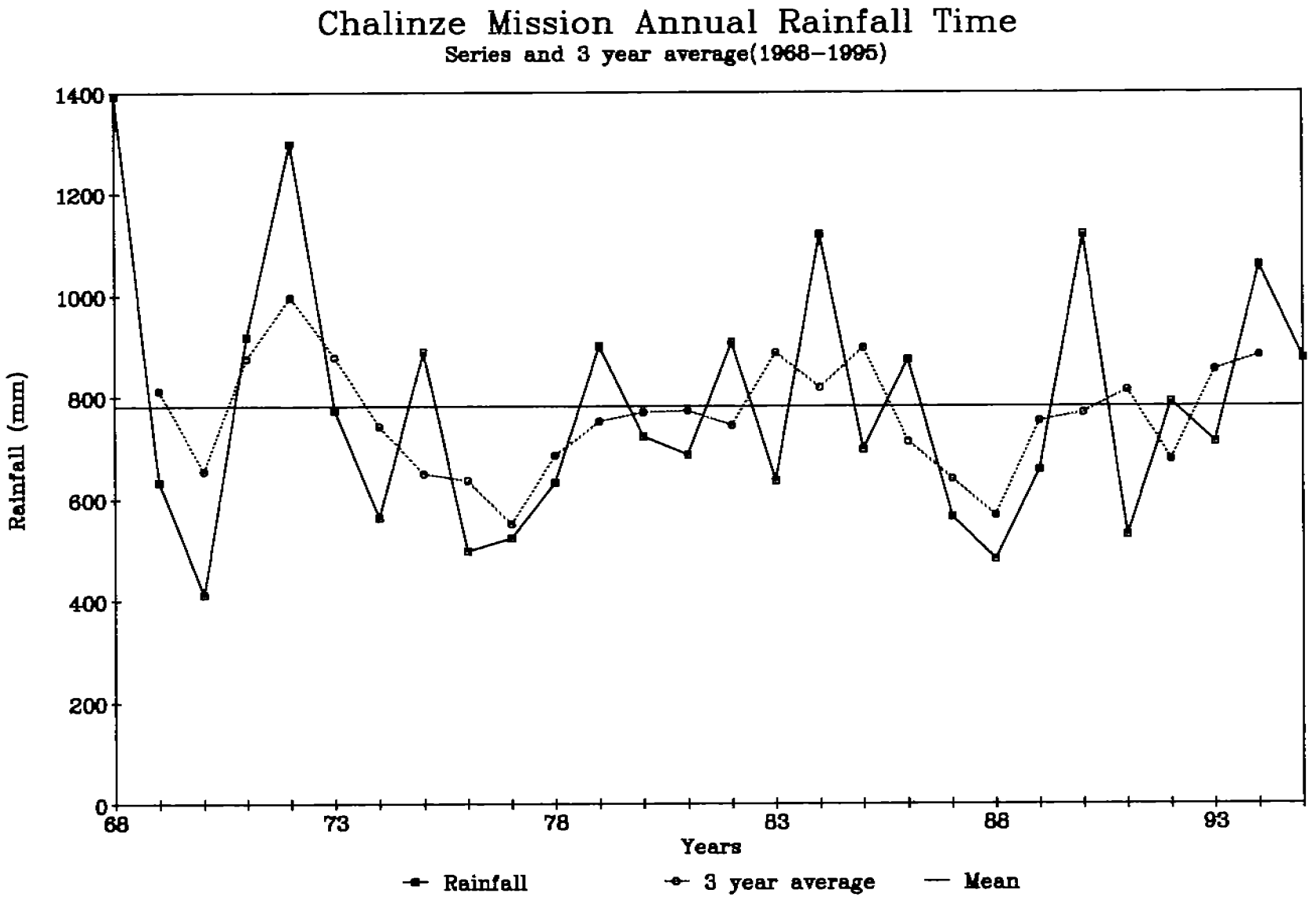
Years
Rainfall
3 year average
Mean

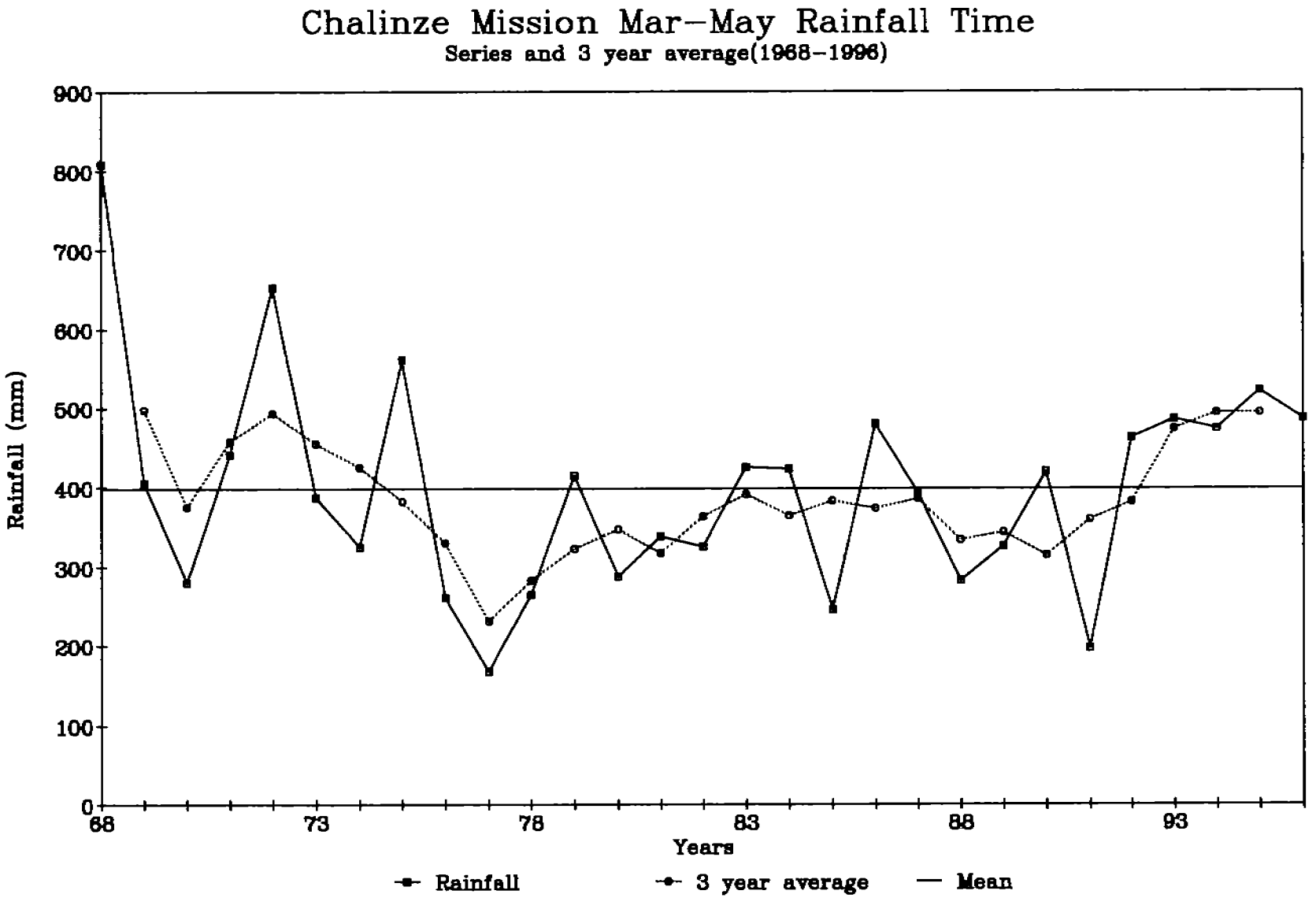
APPENDIX L


Lugoba(Oct–Dec) Rainfall Time Series
and 3 years moving average(1961–1995)
Rainfall (mm)
800
700
600
500
400
300
200
100
0
61
66
71
76
81
86
91
Years
Rainfall
3 year average
Mean

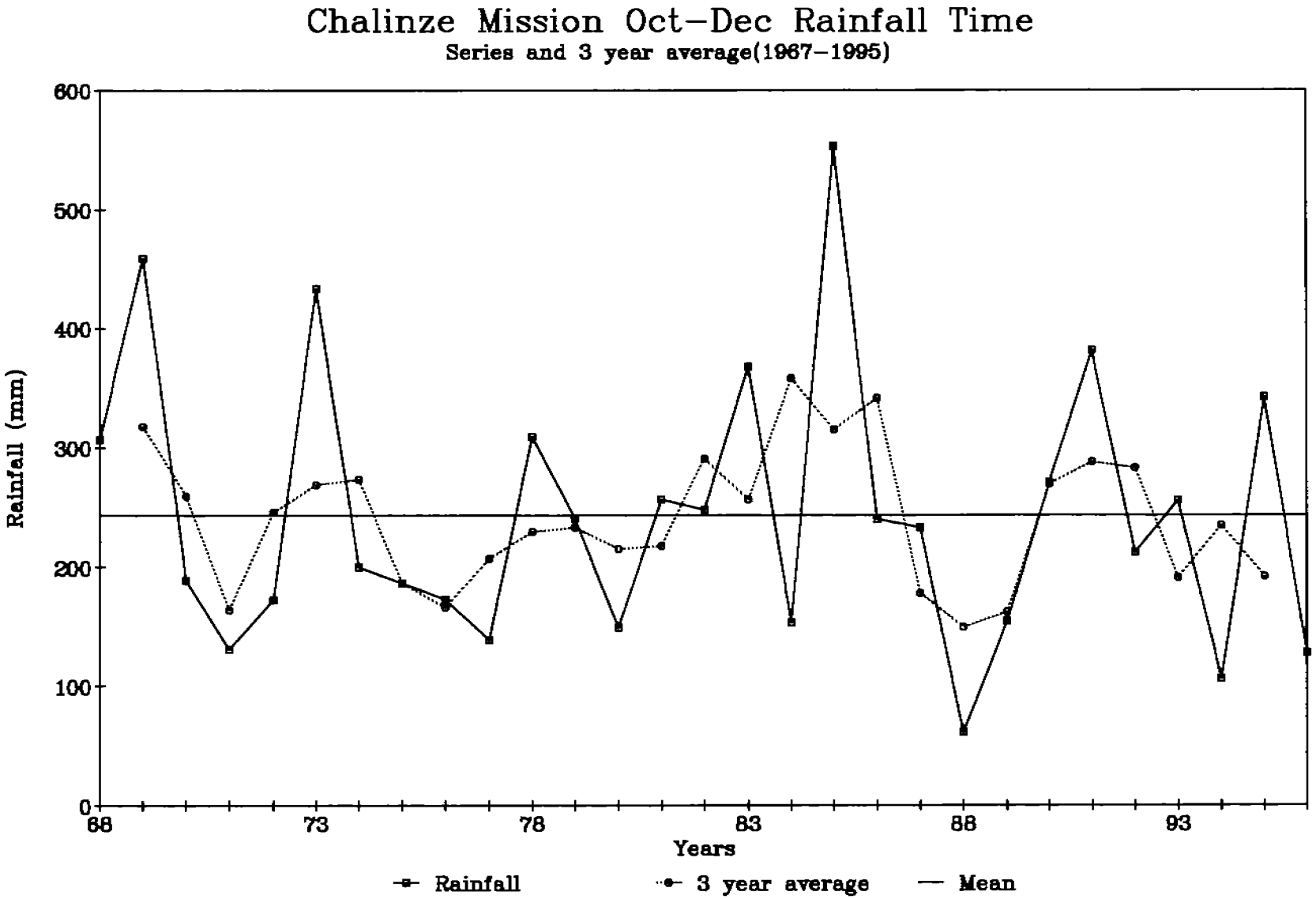
APPENDIX M


Chalinze Mission Annual Rainfall Time
Series and 3 year average(1968-1995)
Rainfall (mm)
1400
1200
1000
800
600
400
200
0
68
73
78
83
88
93
Years
Rainfall
3 year average
Mean

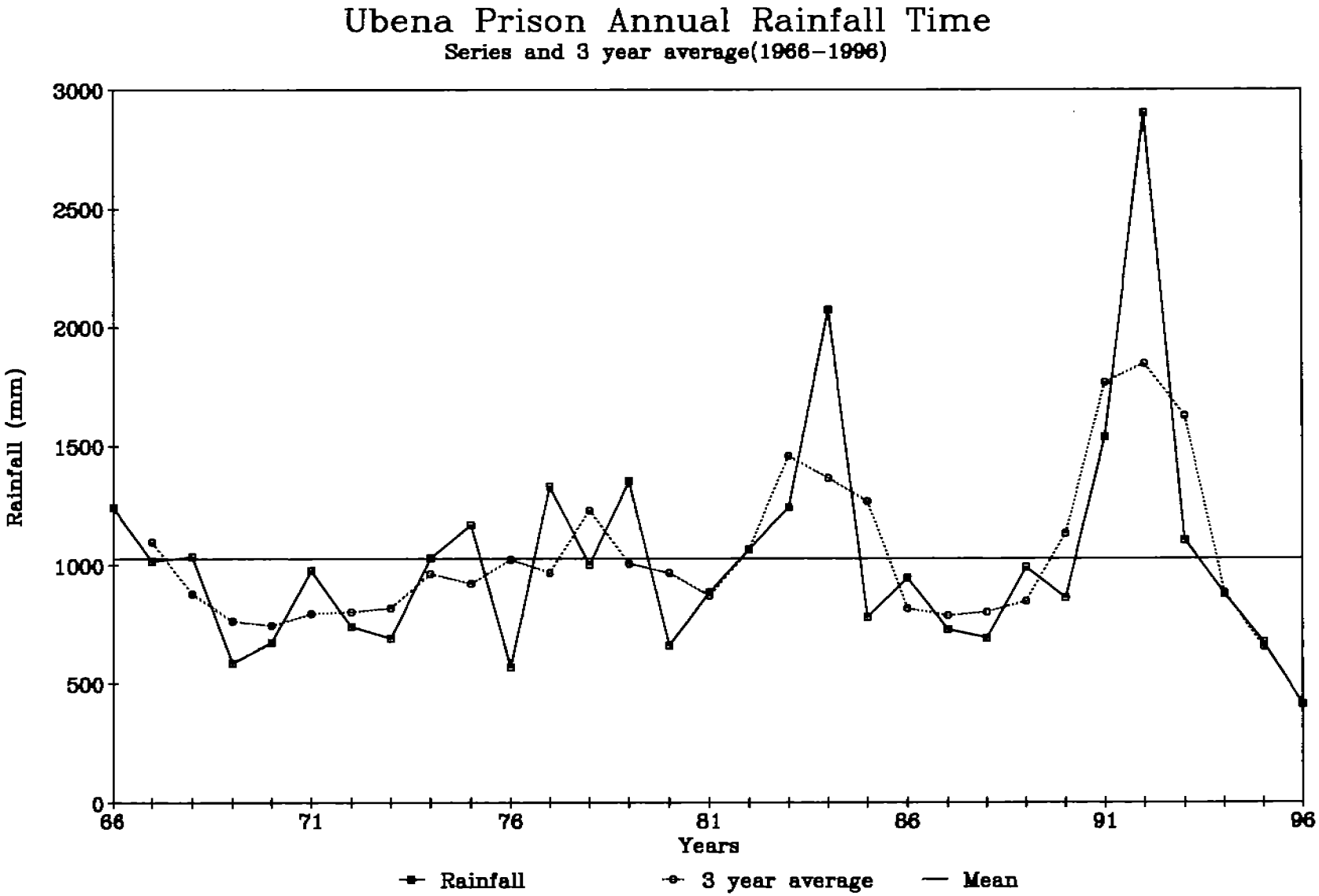
APPENDIX N


Chalinze Mission Mar–May Rainfall Time
Series and 3 year average(1968–1996)
Rainfall (mm)
900
800
700
600
500
400
300
200
100
0
68
73
78
83
88
93
Years
Rainfall
3 year average
Mean

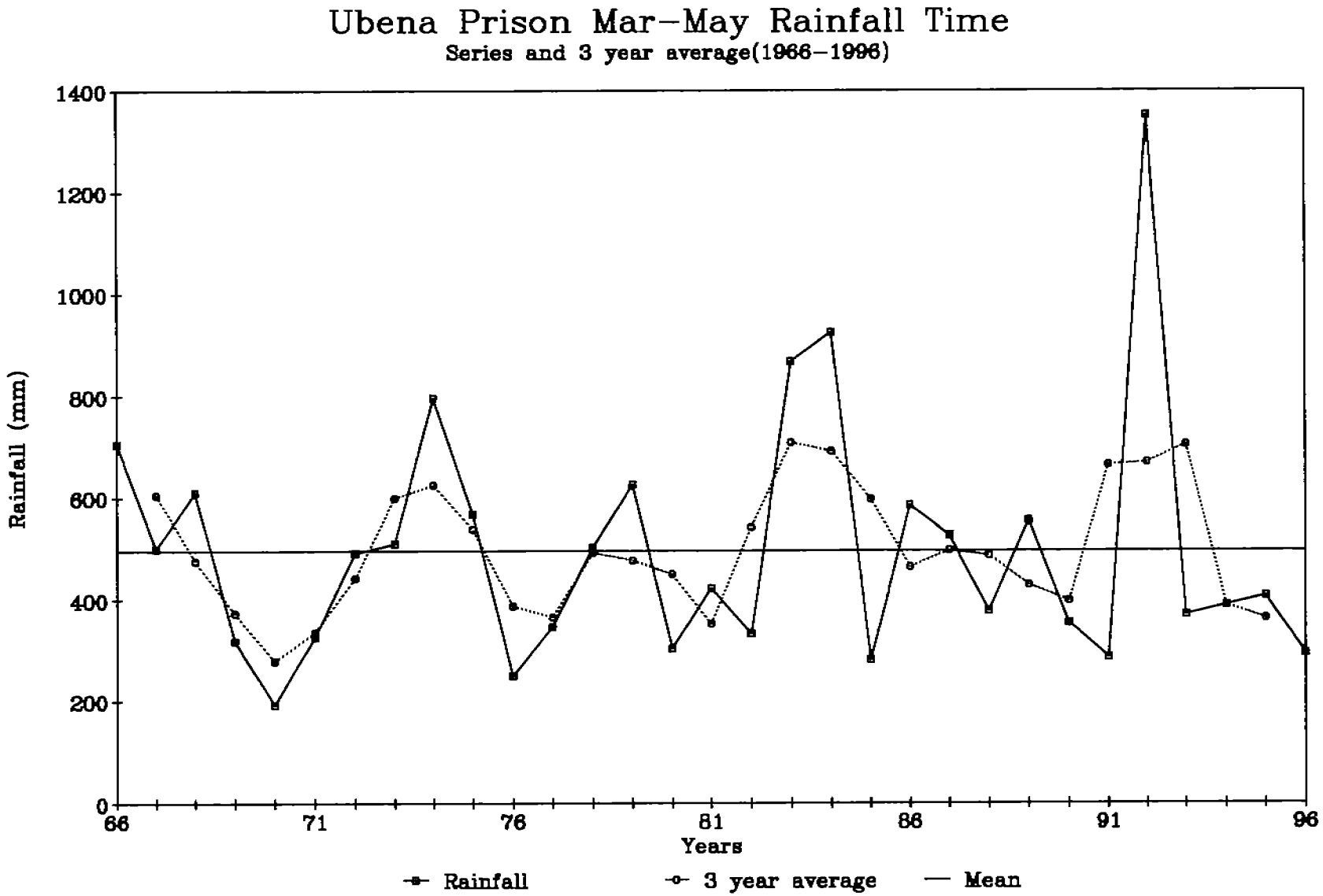
APPENDIX O


Chalinze Mission Oct–Dec Rainfall Time
Series and 3 year average(1967–1995)
Rainfall (mm)
600
500
400
300
200
100
0
68
73
78
83
88
93
Years
Rainfall
3 year average
Mean

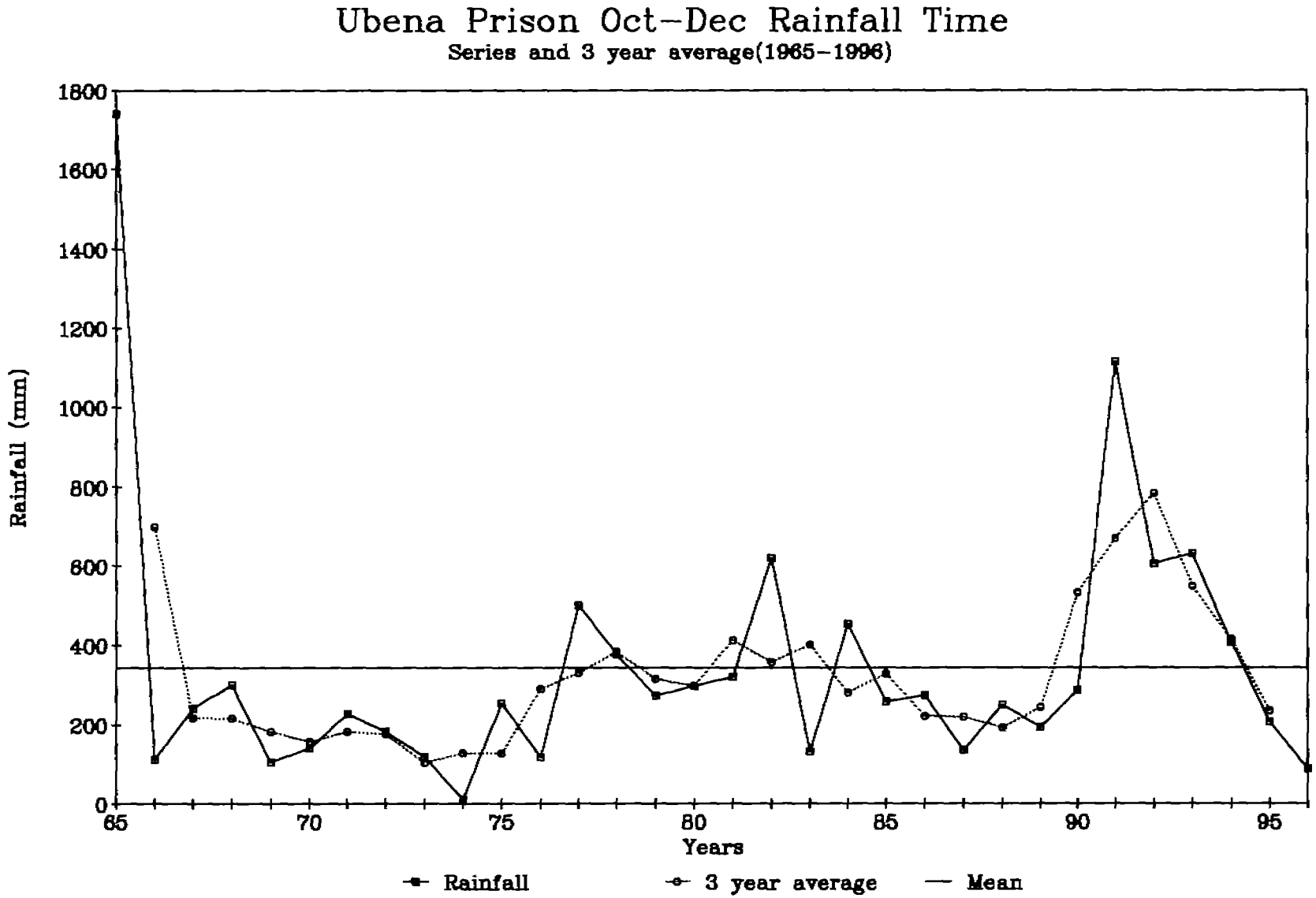
APPENDIX P


Ubena Prison Annual Rainfall Time
Series and 3 year average(1966-1996)
Rainfall (mm)
3000
2500
2000
1500
1000
500
0
66
71
76
81
86
91
96
Years
Rainfall
3 year average
Mean

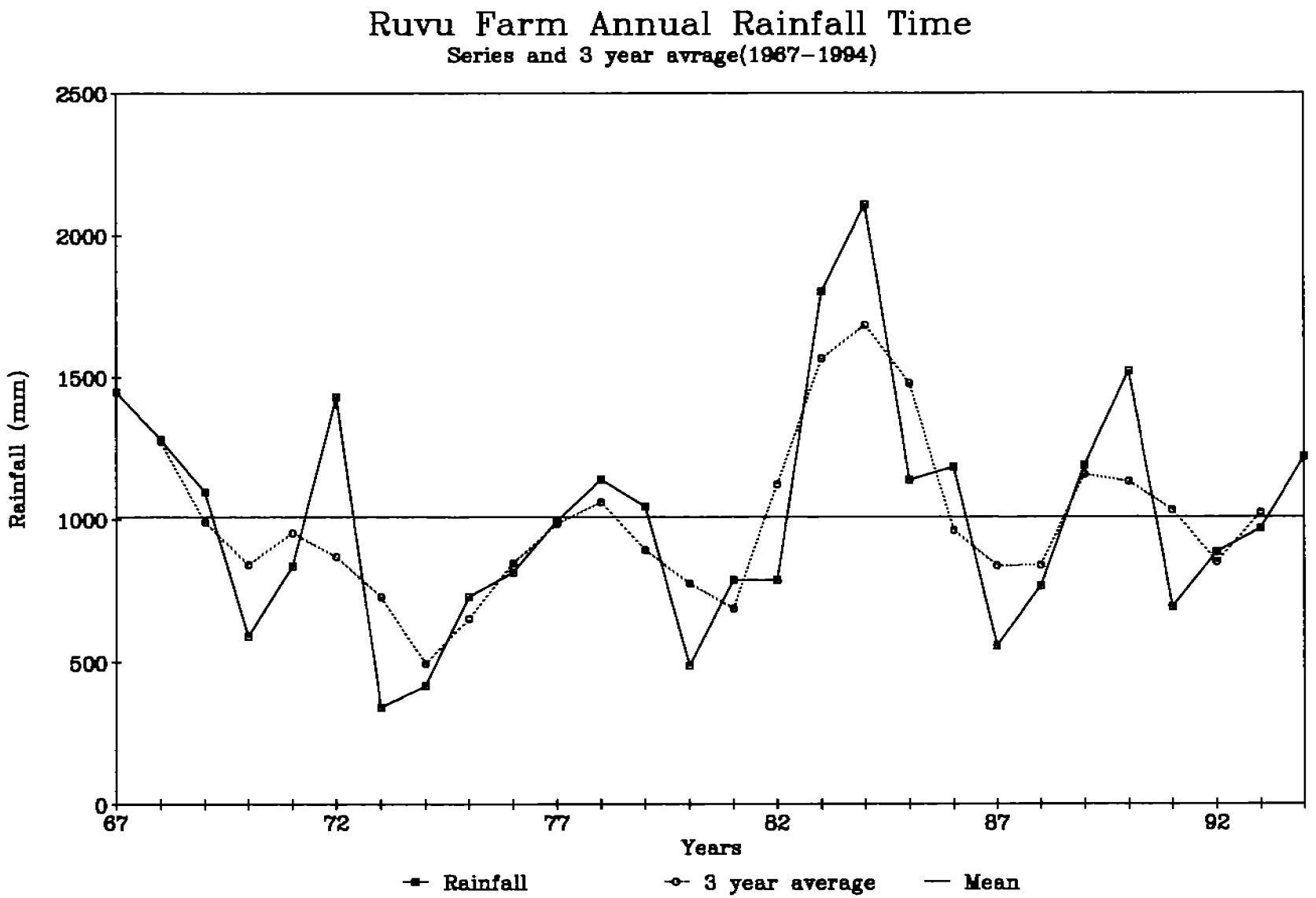
APPENDIX Q


Ubena Prison Mar-May Rainfall Time
Series and 3 year average(1966-1996)
Rainfall (mm)
1400
1200
1000
800
600
400
200
0
66
71
76
81
86
91
96
Years
Rainfall
3 year average
Mean

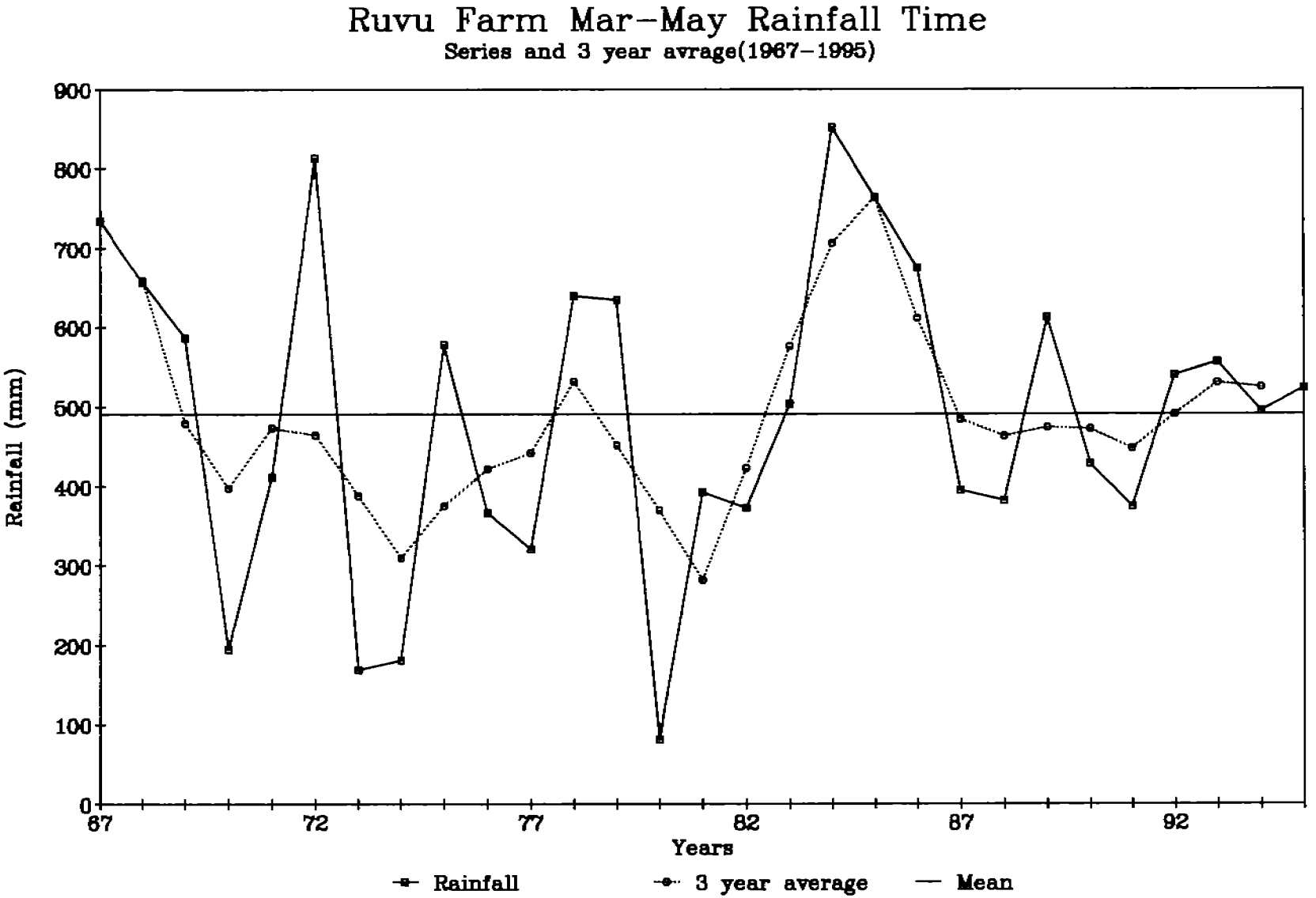
APPENDIX R


Ubena Prison Oct-Dec Rainfall Time
Series and 3 year average(1965-1996)
Rainfall (mm)
1800
1600
1400
1200
1000
800
600
400
200
0
65
70
75
80
85
90
95
Years
Rainfall
3 year average
Mean

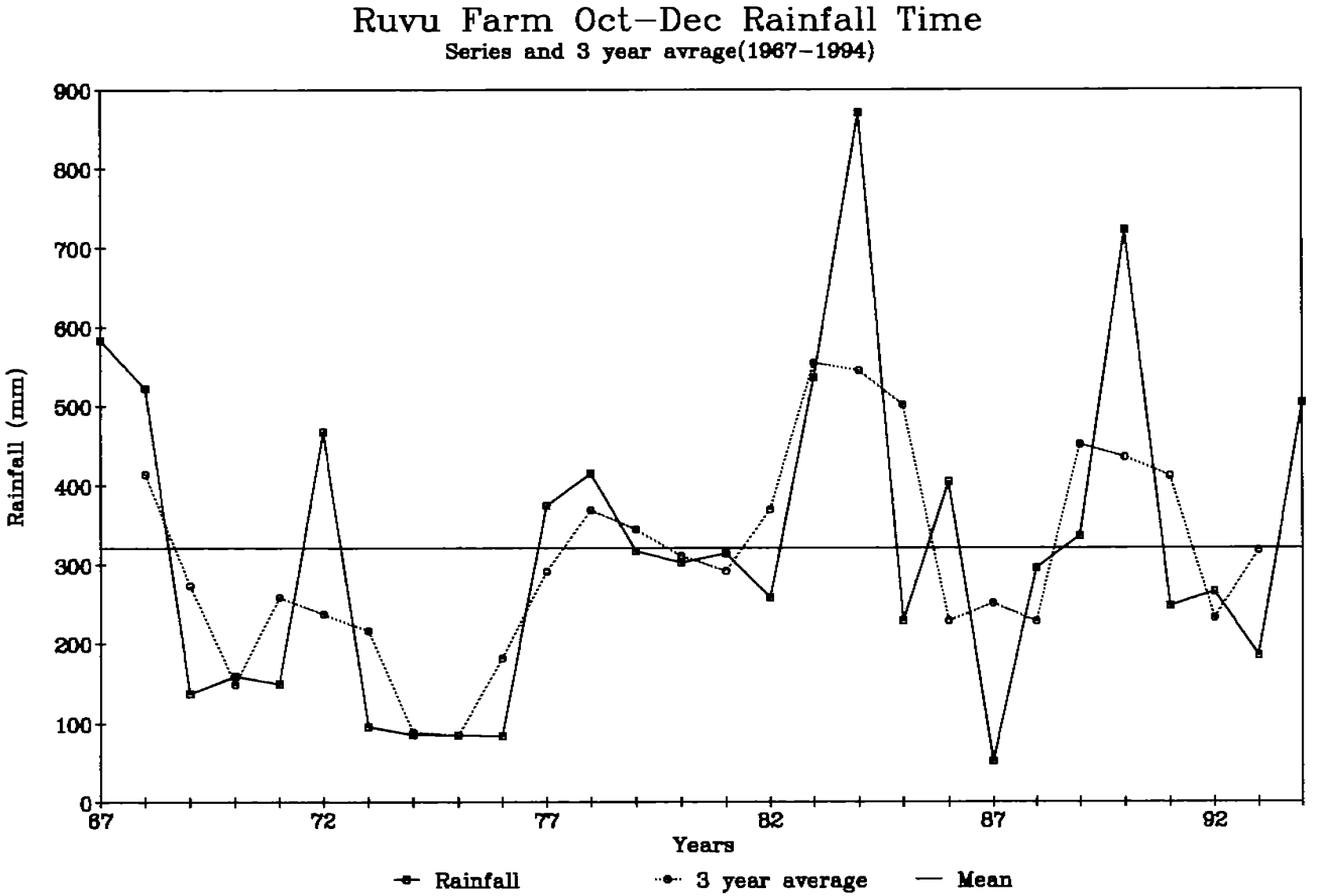
APPENDIX S


Ruvu Farm Annual Rainfall Time
Series and 3 year avrage(1967-1994)
Rainfall (mm)
2500
2000
1500
1000
500
0
67
72
77
82
87
92
Years
Rainfall
3 year average
Mean

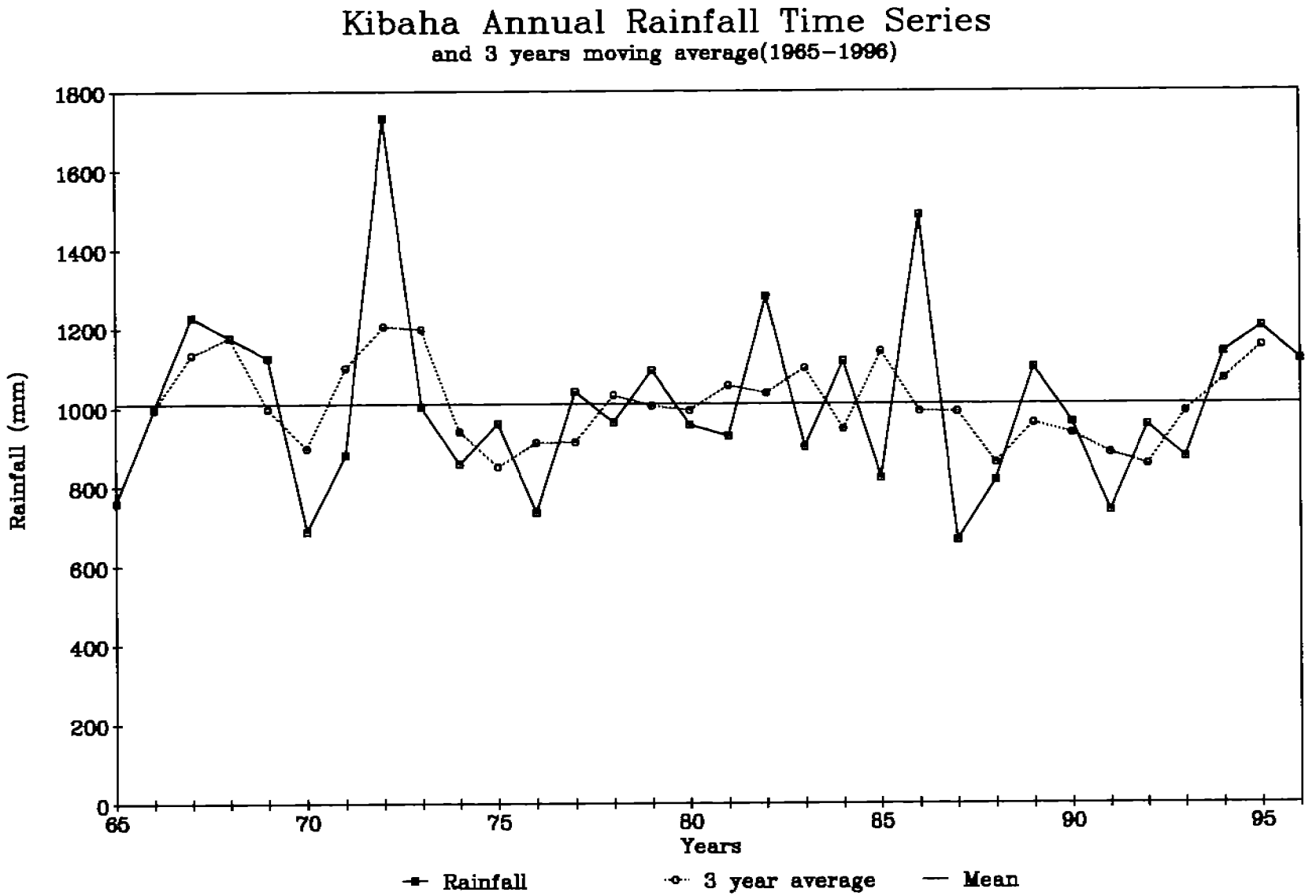
APPENDIX T


Ruvu Farm Mar-May Rainfall Time
Series and 3 year avrage(1967-1995)
Rainfall (mm)
900
800
700
600
500
400
300
200
100
0
67
72
77
82
87
92
Years
Rainfall
3 year average
Mean

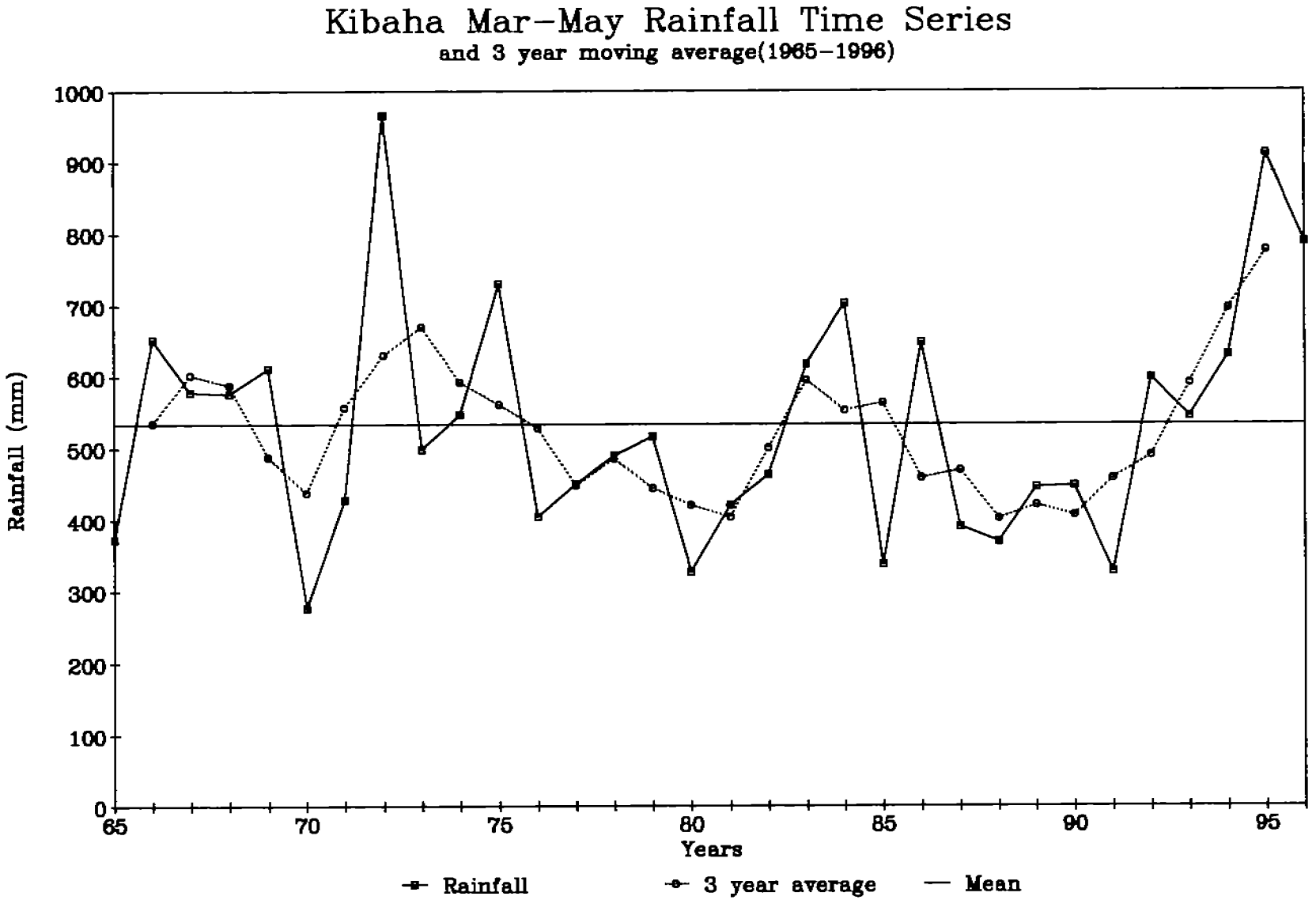
APPENDIX U


Ruvu Farm Oct–Dec Rainfall Time
Series and 3 year avrage(1967–1994)
Rainfall (mm)
900
800
700
600
500
400
300
200
100
0
67
72
77
82
87
92
Years
Rainfall
3 year average
Mean

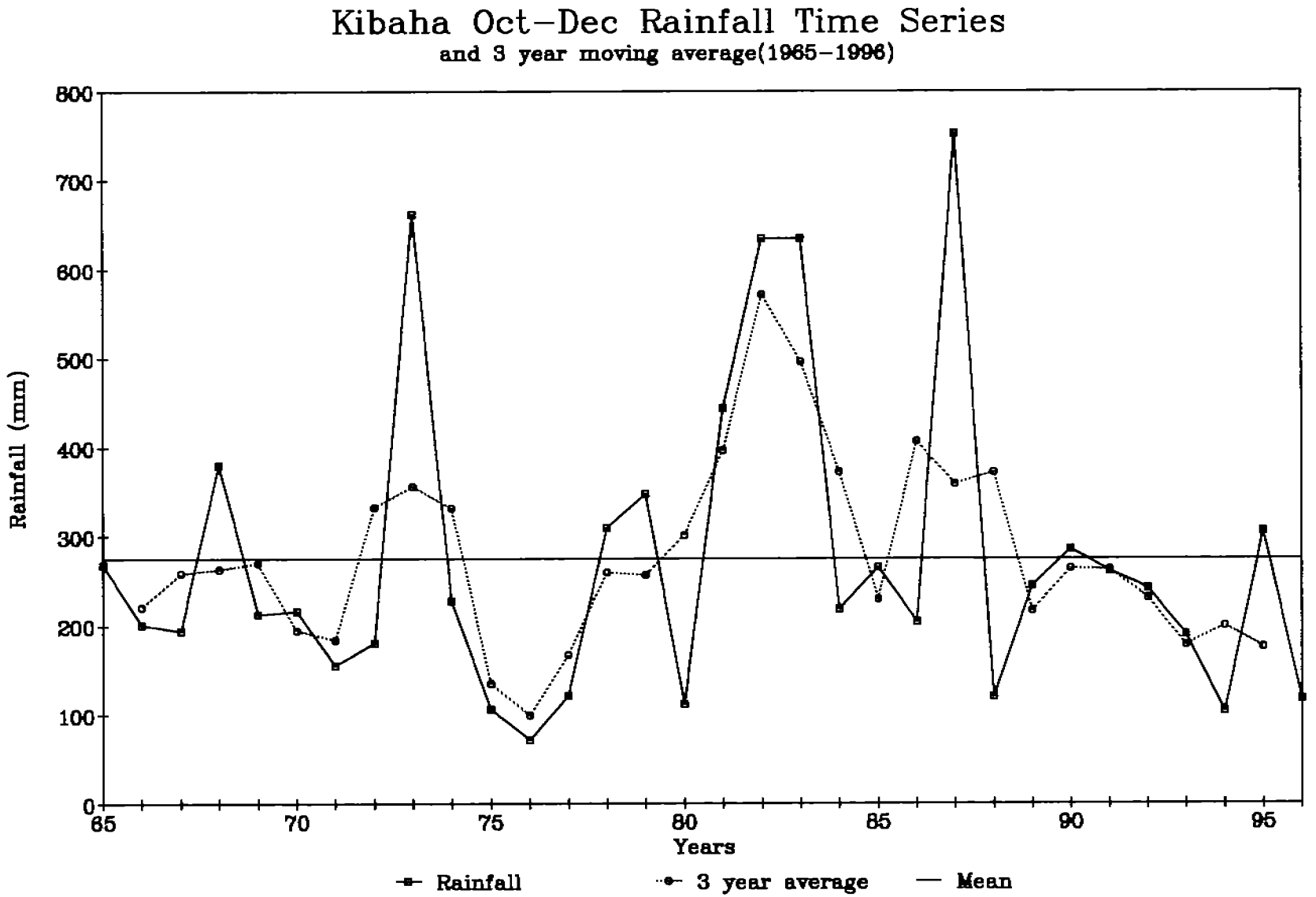
APPENDIX V


Kibaha Annual Rainfall Time Series
and 3 years moving average(1965-1996)
Rainfall (mm)
1800
1600
1400
1200
1000
800
600
400
200
0
65
70
75
80
85
90
95
Years
Rainfall
3 year average
Mean

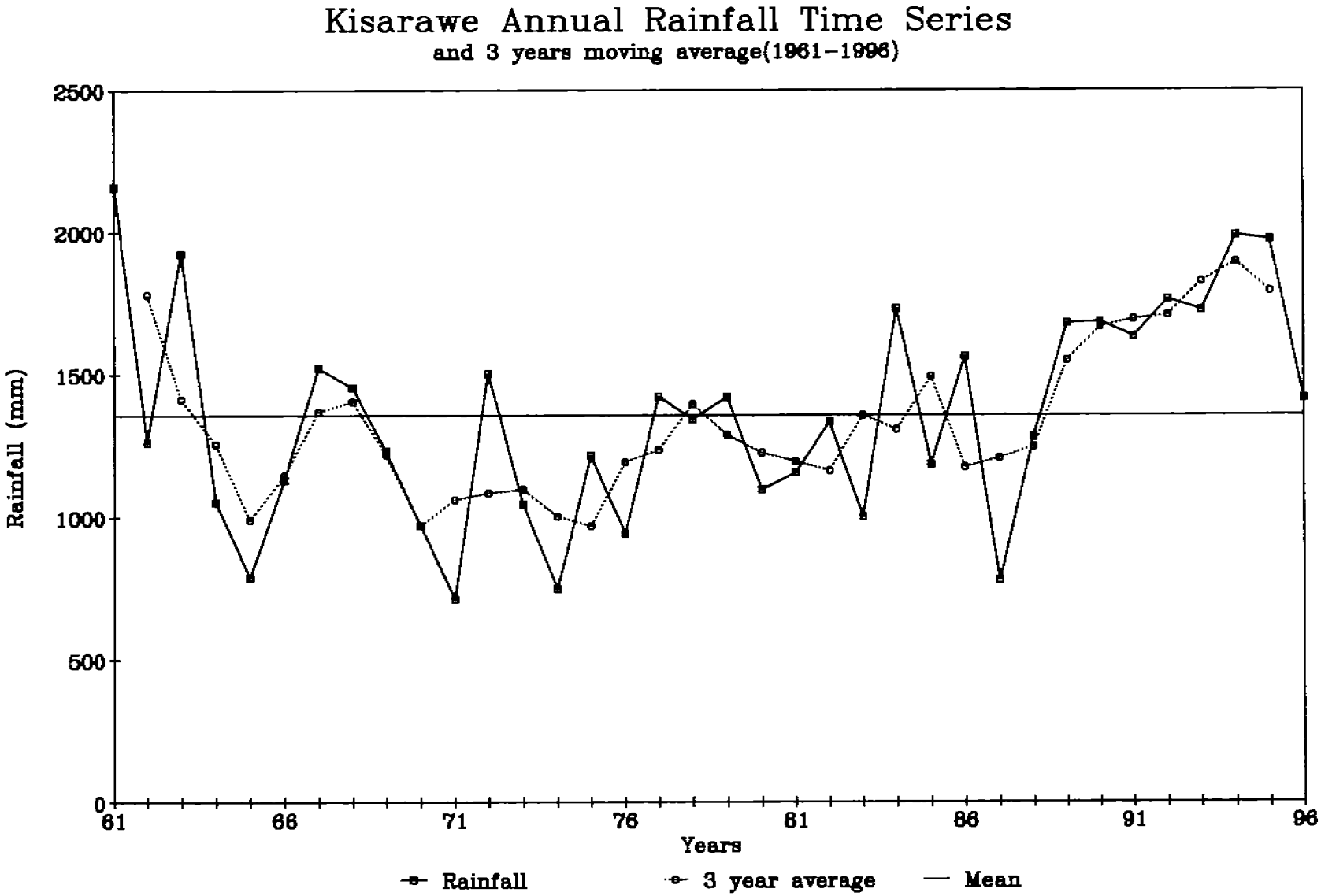
APPENDIX W


Kibaha Mar–May Rainfall Time Series
and 3 year moving average(1965–1996)
Rainfall (mm)
1000
900
800
700
600
500
400
300
200
100
0
65
70
75
80
85
90
95
Years
Rainfall
3 year average
Mean

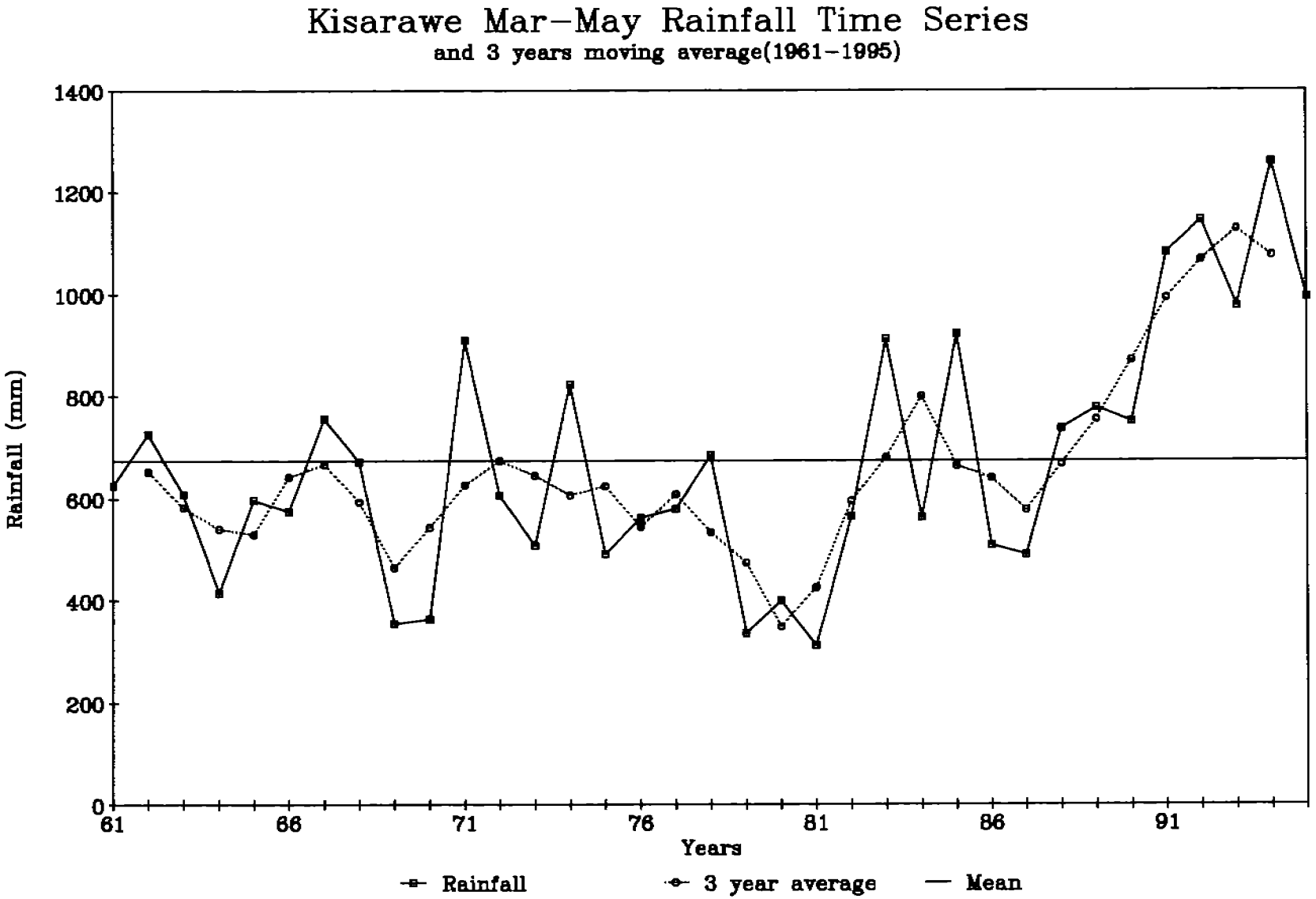
APPENDIX X


Kibaha Oct–Dec Rainfall Time Series
and 3 year moving average(1965–1996)
Rainfall (mm)
800
700
600
500
400
300
200
100
0
65
70
75
80
85
90
95
Years
Rainfall
3 year average
Mean

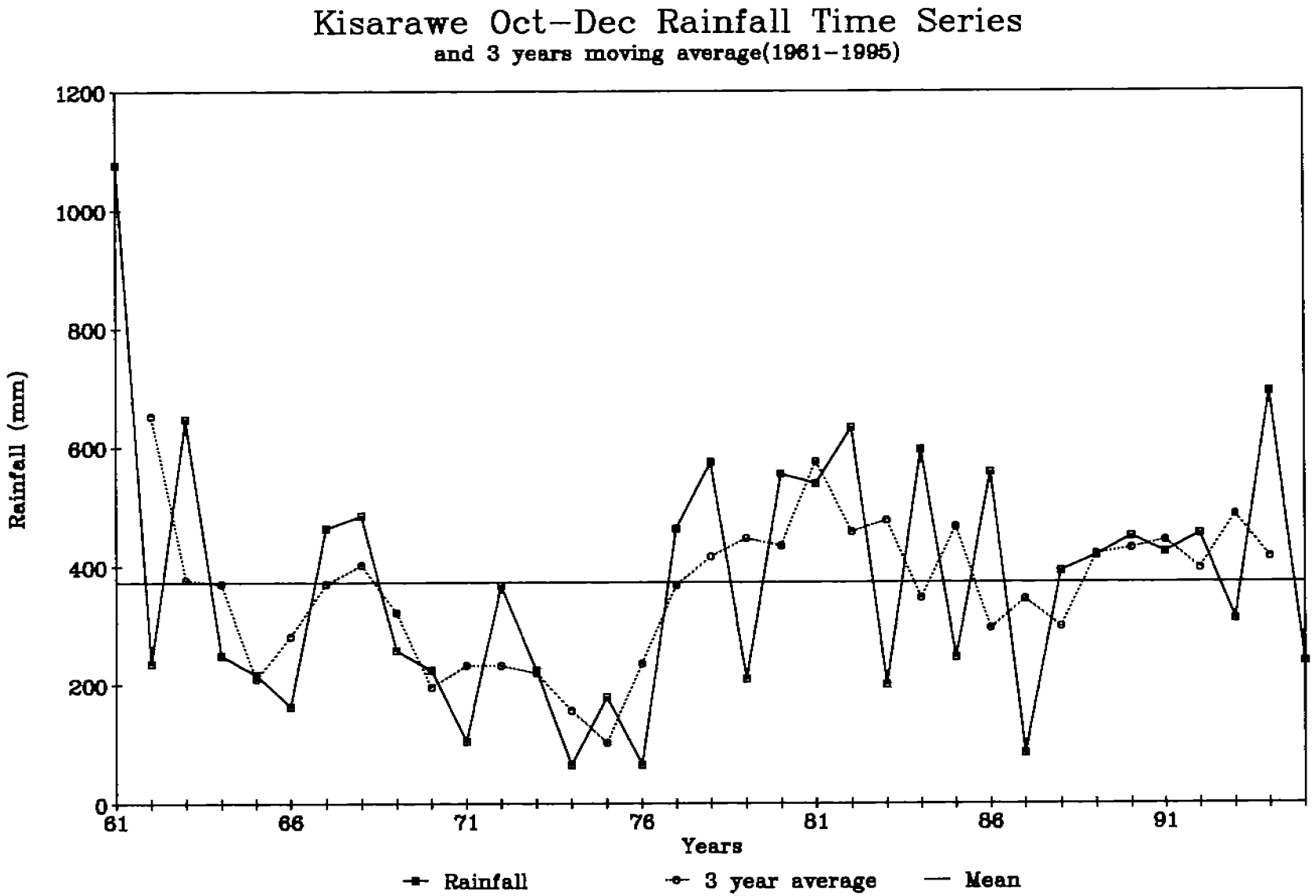
APPENDIX Y


Kisarawe Annual Rainfall Time Series
and 3 years moving average(1961-1996)
Rainfall (mm)
2500
2000
1500
1000
500
0
61
66
71
76
81
86
91
96
Years
Rainfall
3 year average
Mean

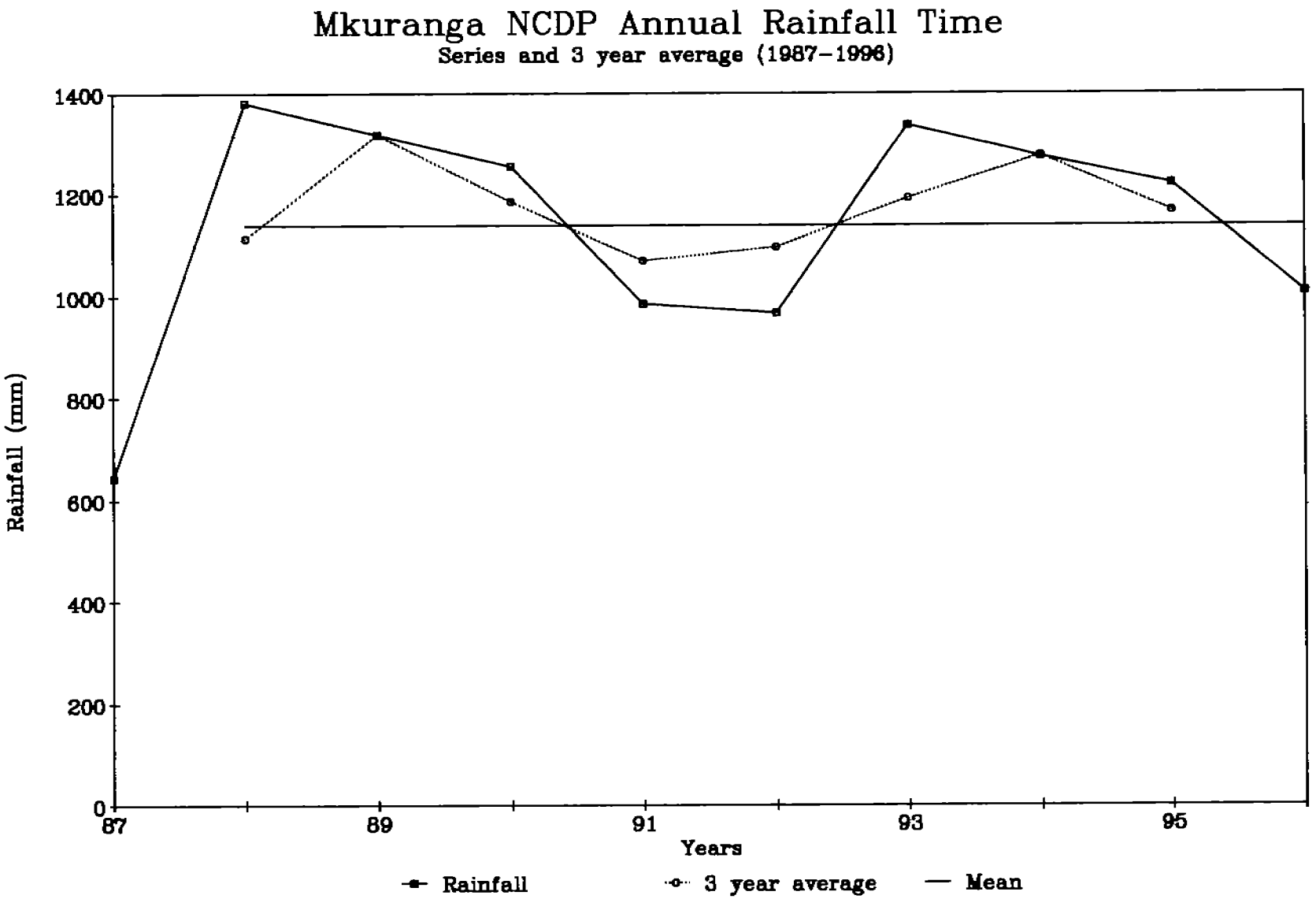
APPENDIX Z


Kisarawe Mar-May Rainfall Time Series
and 3 years moving average(1961-1995)
Rainfall (mm)
1400
1200
1000
800
600
400
200
0
61
66
71
76
81
86
91
Years
Rainfall
3 year average
Mean

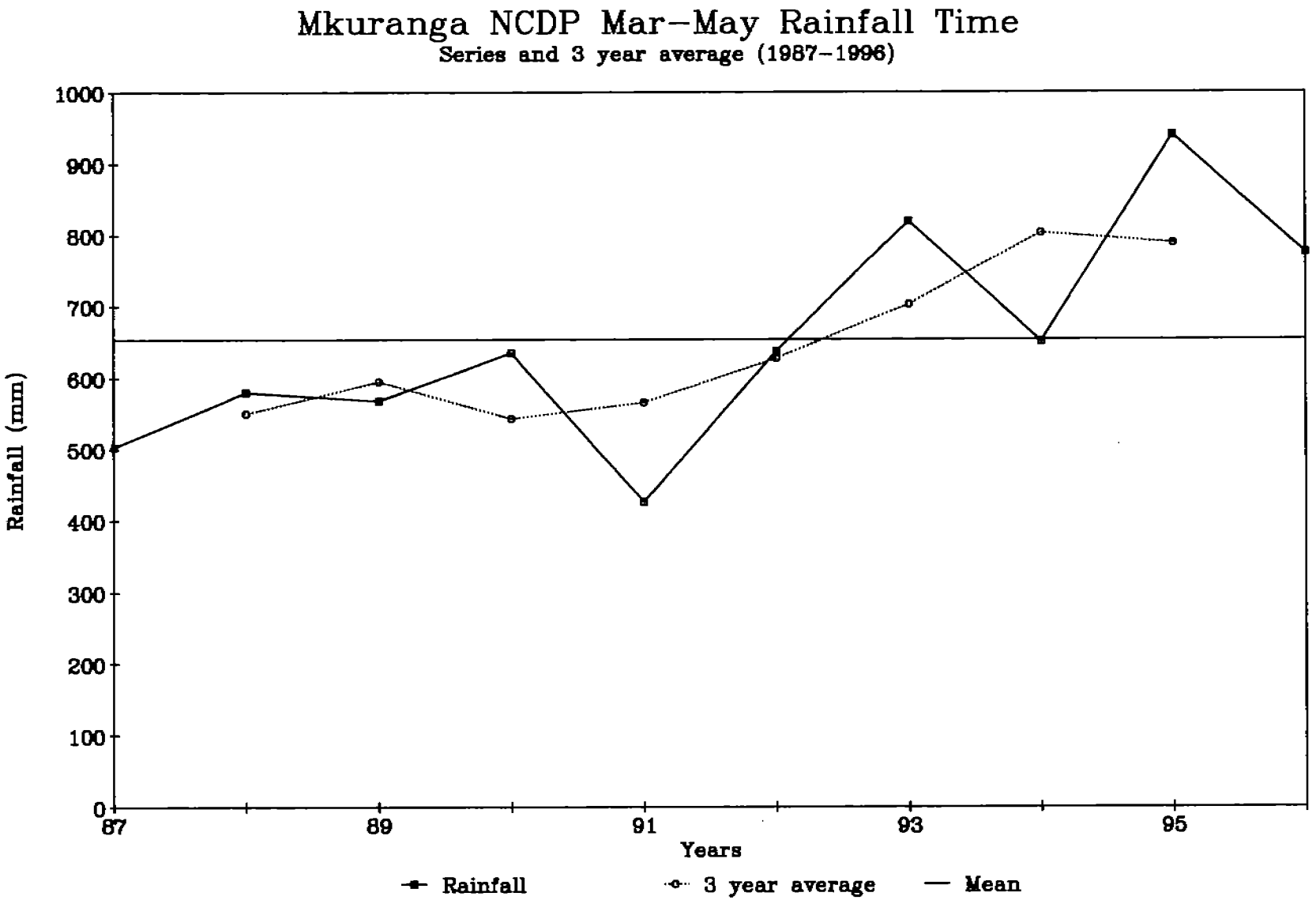
APPENDIX ZA


Kisarawe Oct-Dec Rainfall Time Series
and 3 years moving average(1961-1995)
Rainfall (mm)
1200
1000
800
600
400
200
0
61
66
71
76
81
86
91
Years
Rainfall
3 year average
Mean

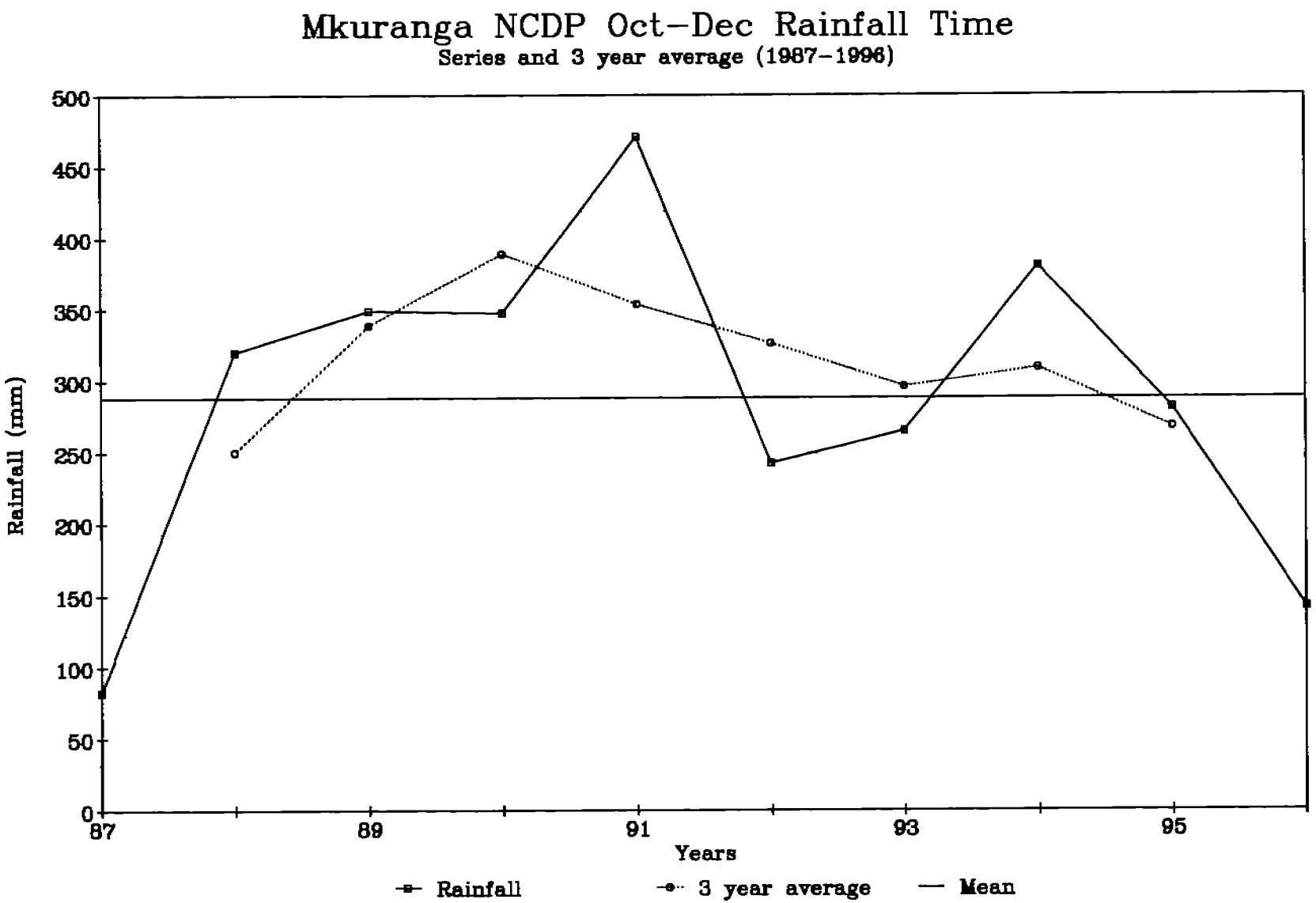
APPENDIX ZB


Mkuranga NCDP Annual Rainfall Time
Series and 3 year average (1987-1996)
Rainfall (mm)
1400
1200
1000
800
600
400
200
0
87
89
91
93
95
Years
Rainfall
3 year average
Mean

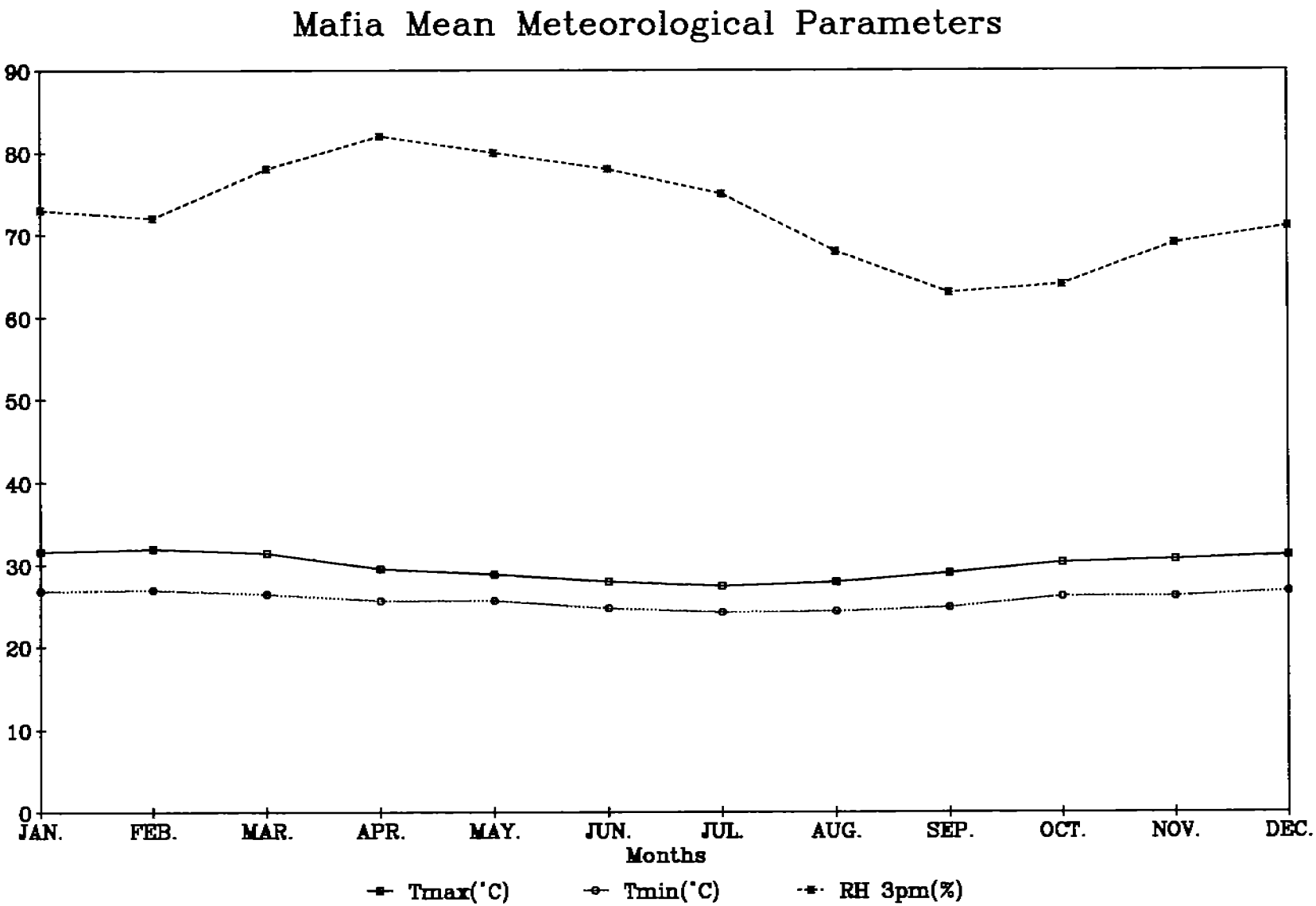
APPENDIX ZC


Mkuranga NCDP Mar–May Rainfall Time
Series and 3 year average (1987–1996)
Rainfall (mm)
1000
900
800
700
600
500
400
300
200
100
0
87
89
91
93
95
Years
Rainfall
3 year average
Mean

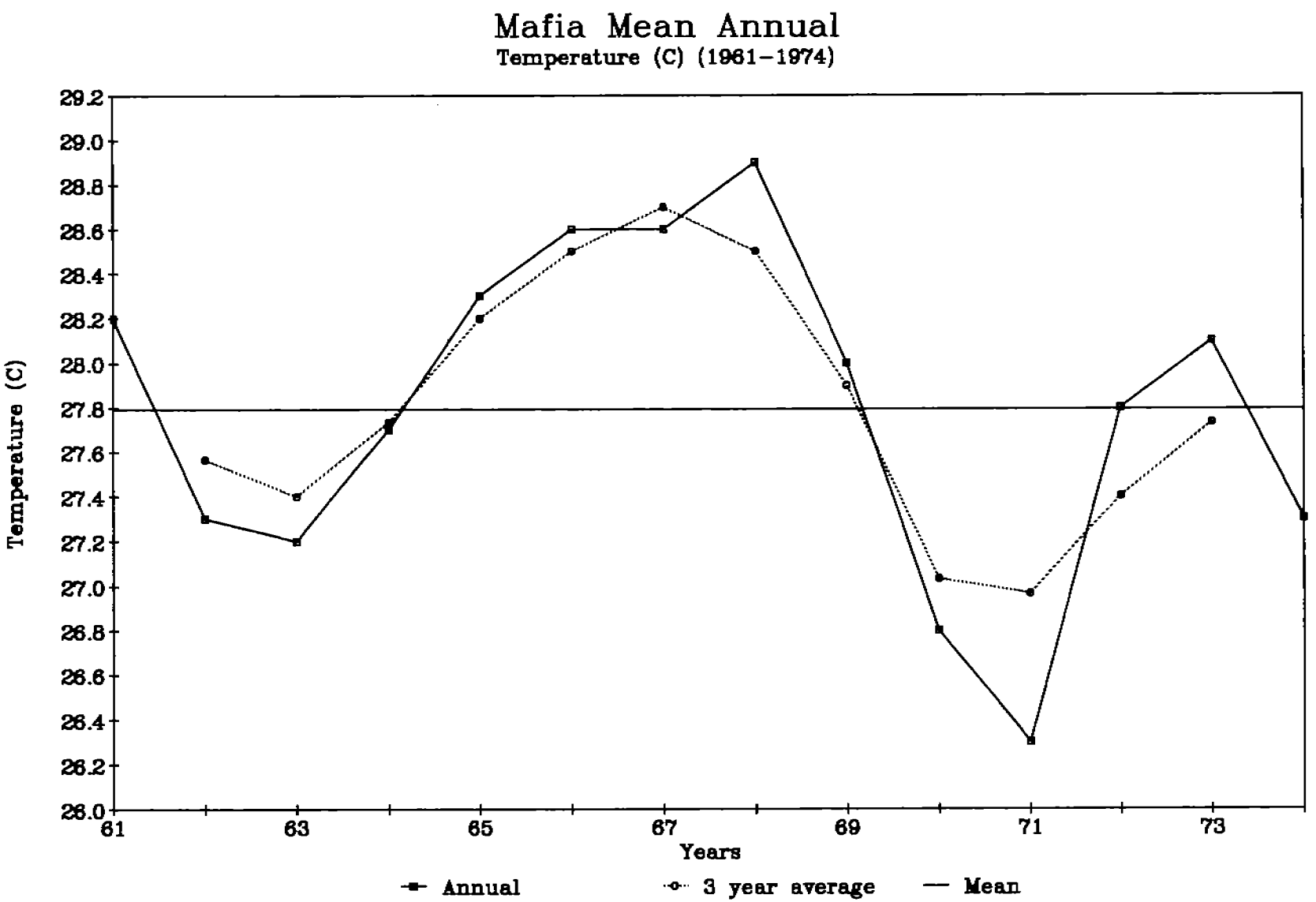
APPENDIX ZD


Mkuranga NCDP Oct–Dec Rainfall Time
Series and 3 year average (1987–1996)
Rainfall (mm)
500
450
400
350
300
250
200
150
100
50
0
87
89
91
93
95
Years
Rainfall
3 year average
Mean

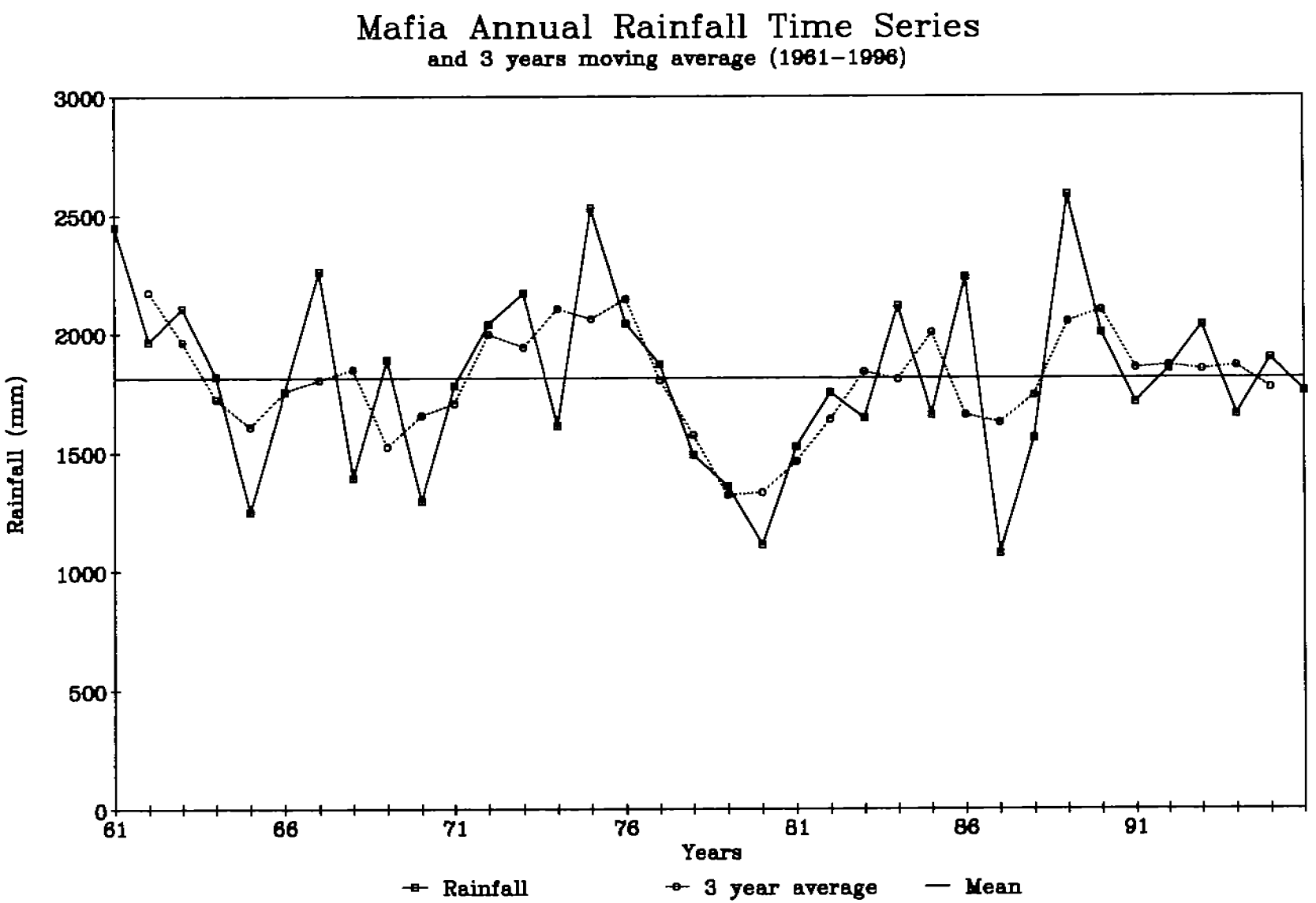
APPENDIX ZE


Mafia Mean Meteorological Parameters
90
80
70
60
50
40
30
20
10
0
JAN.
FEB.
MAR.
APR.
MAY.
JUN.
JUL.
AUG.
SEP.
OCT.
NOV.
DEC.
Months
Tmax(°C)
Tmin(°C)
RH 3pm(%)

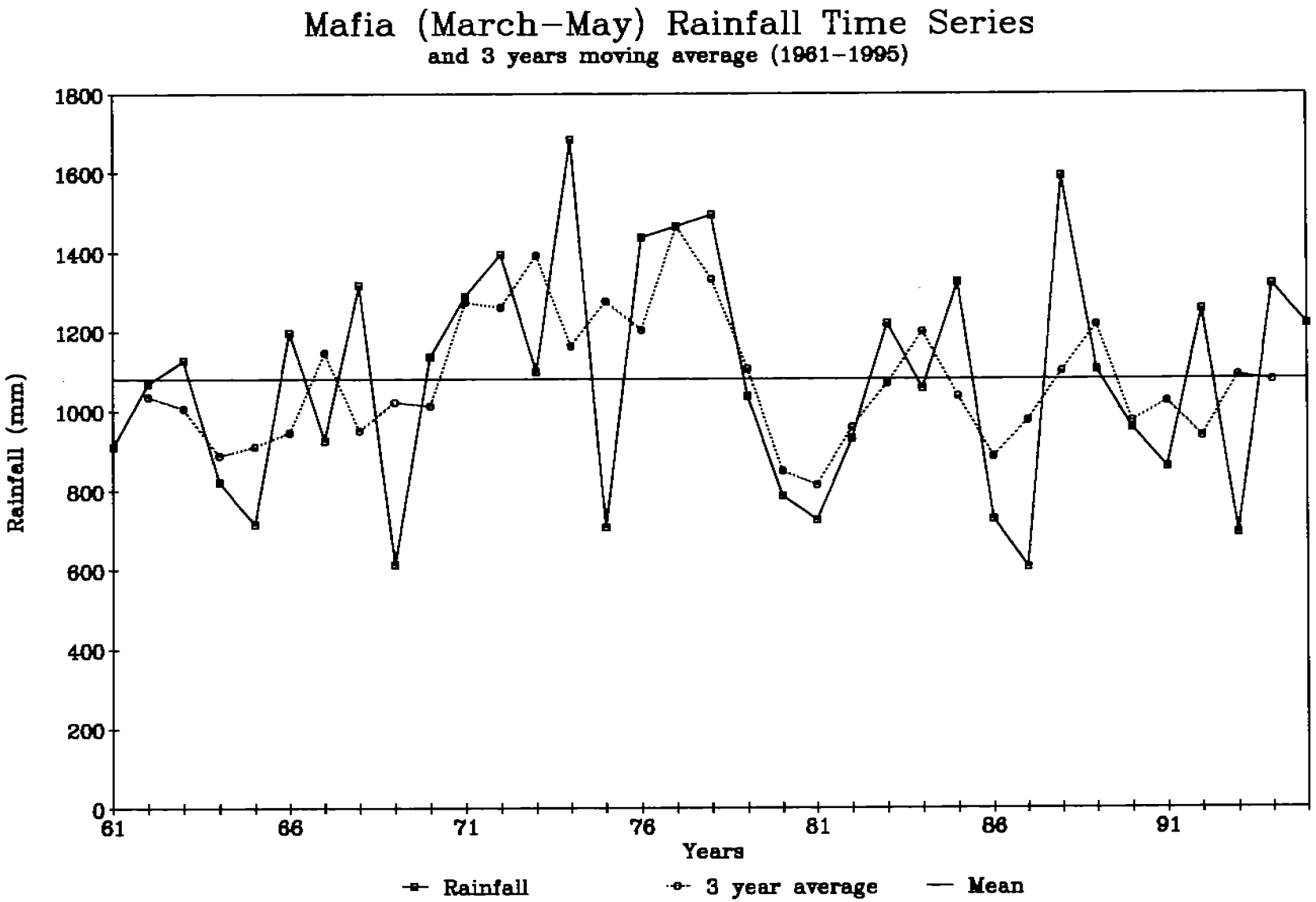
APPENDIX ZF


Mafia Mean Annual
Temperature (C) (1961-1974)
Temperature (C)
29.2
29.0
28.8
28.6
28.4
28.2
28.0
27.8
27.6
27.4
27.2
27.0
26.8
26.6
26.4
26.2
26.0
61
63
65
67
69
71
73
Years
Annual
3 year average
Mean

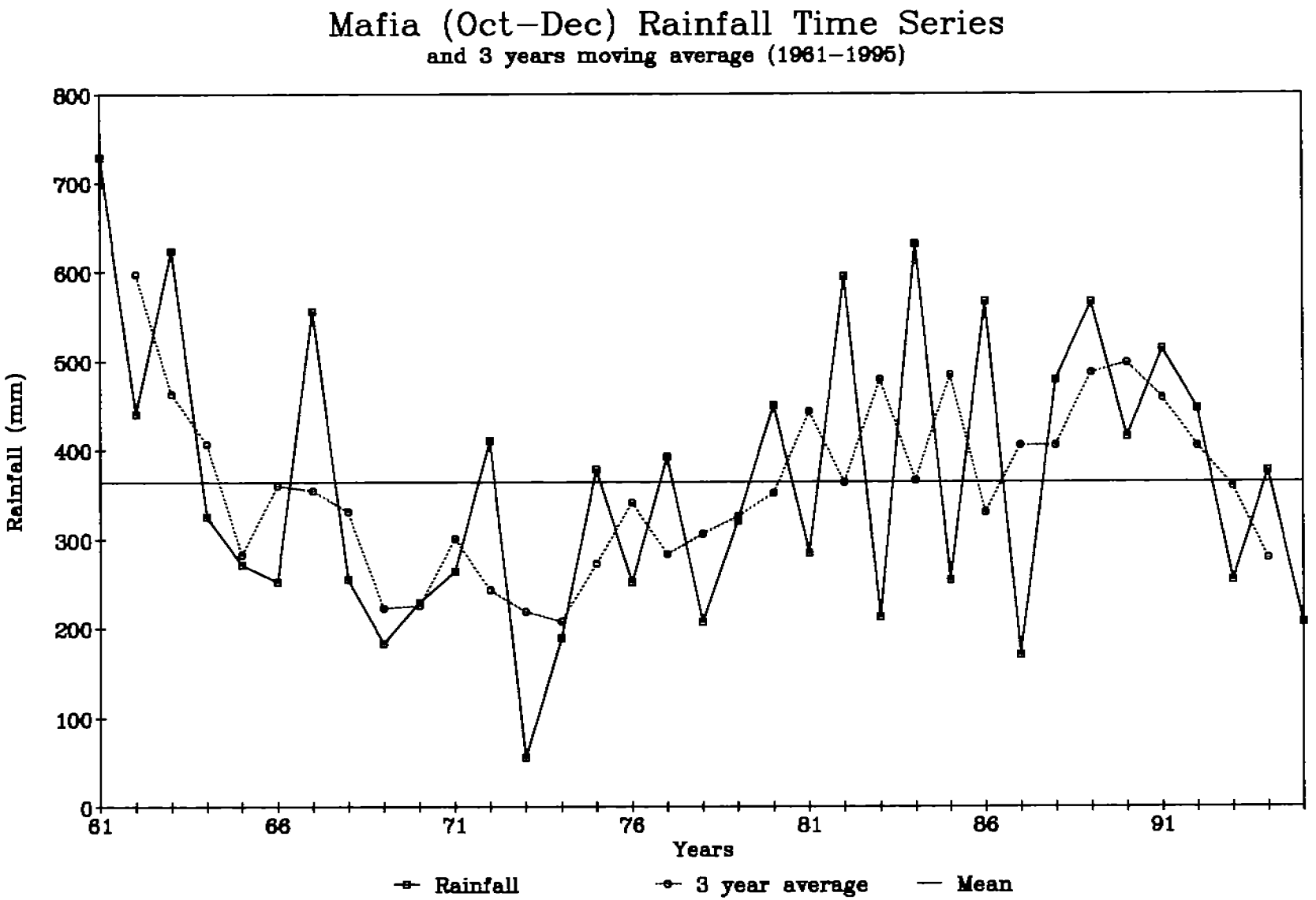
APPENDIX ZG


Mafia Annual Rainfall Time Series
and 3 years moving average (1961-1996)
Rainfall (mm)
3000
2500
2000
1500
1000
500
0
61
66
71
76
81
86
91
Years
Rainfall
3 year average
Mean

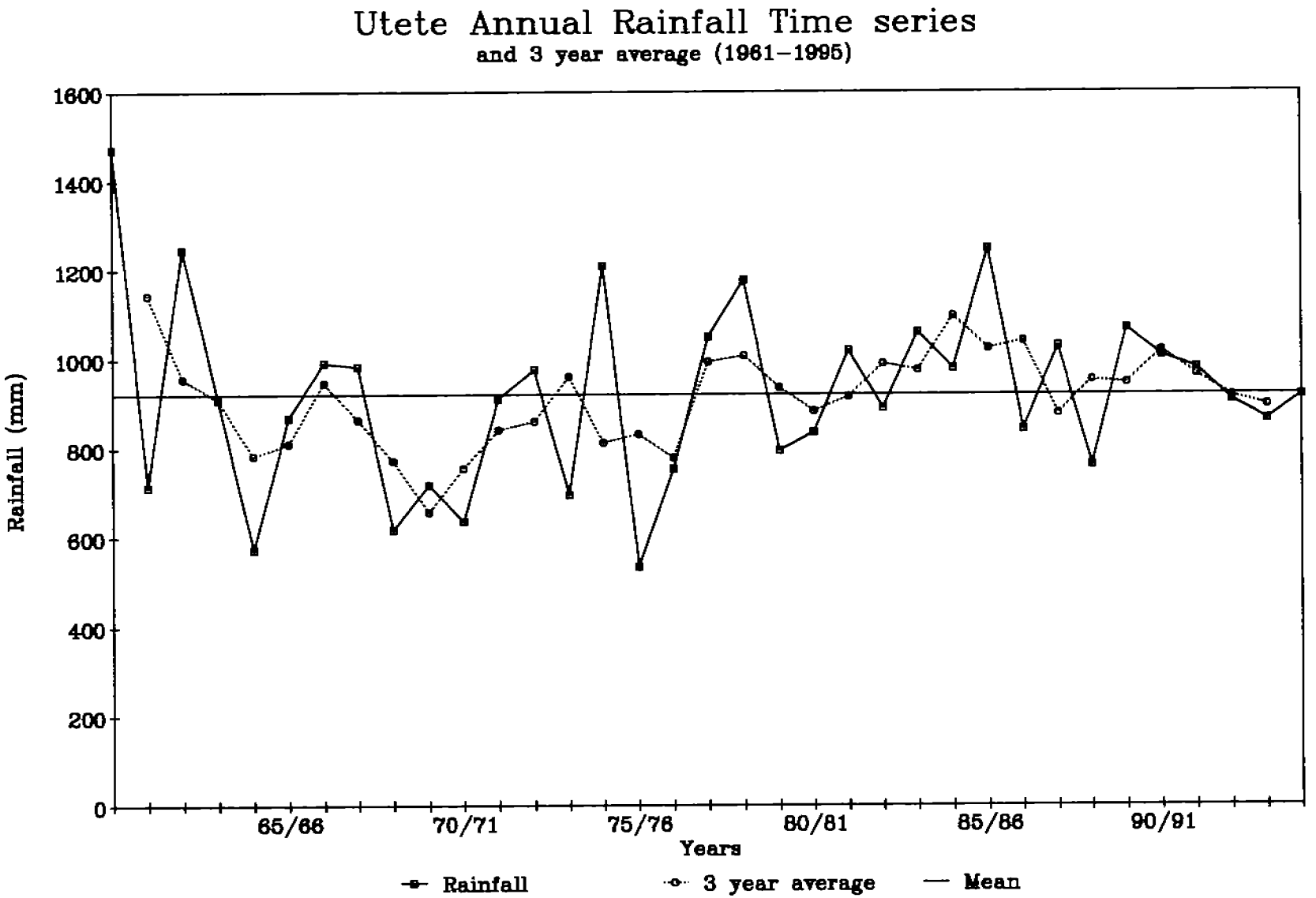
APPENDIX ZH


Mafia (March–May) Rainfall Time Series
and 3 years moving average (1961–1995)
Rainfall (mm)
1800
1600
1400
1200
1000
800
600
400
200
0
61
66
71
76
81
86
91
Years
Rainfall
3 year average
Mean

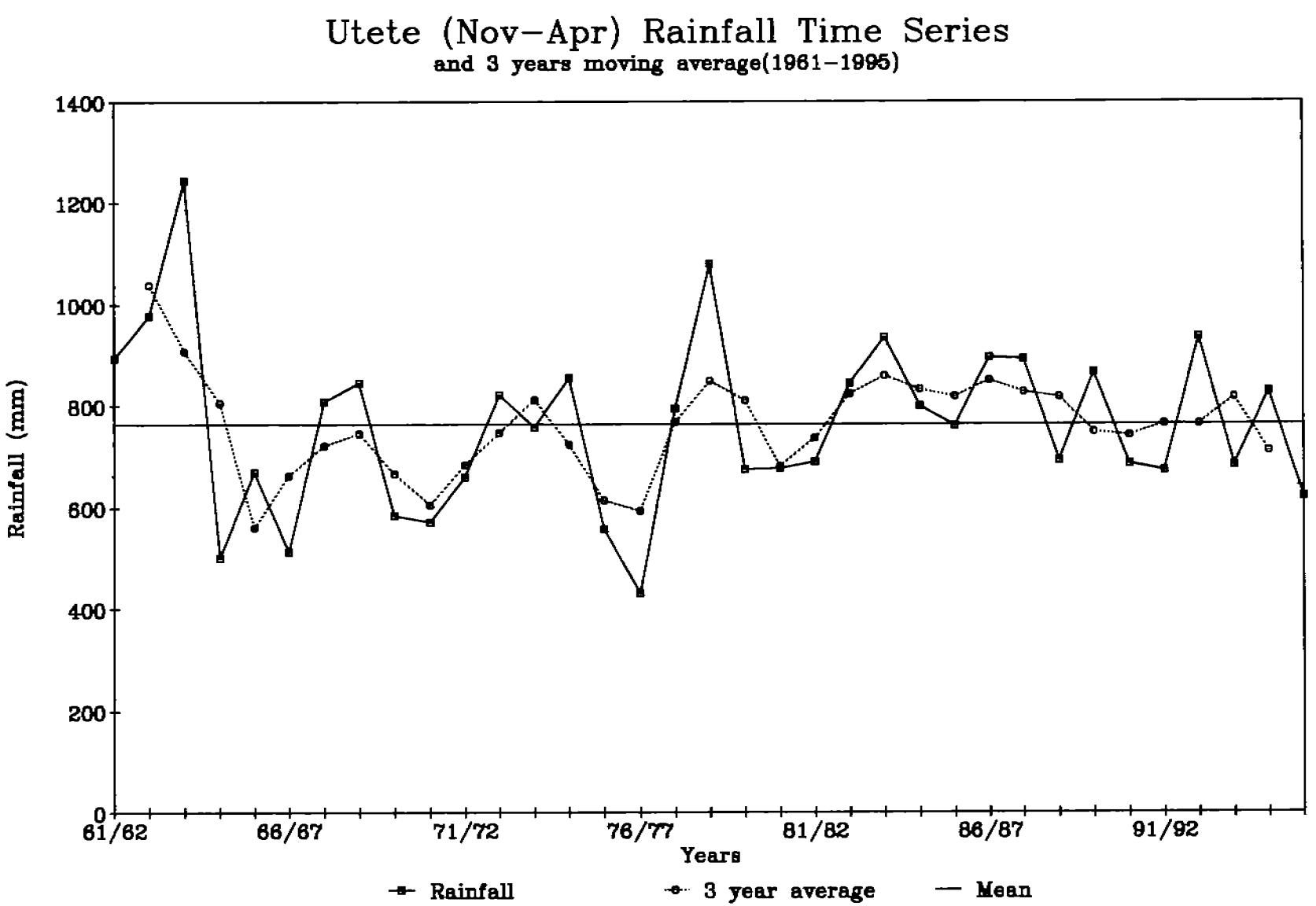
APPENDIX ZI


Mafia (Oct–Dec) Rainfall Time Series
and 3 years moving average (1961–1995)
Rainfall (mm)
800
700
600
500
400
300
200
100
0
61
66
71
76
81
86
91
Years
Rainfall
3 year average
Mean

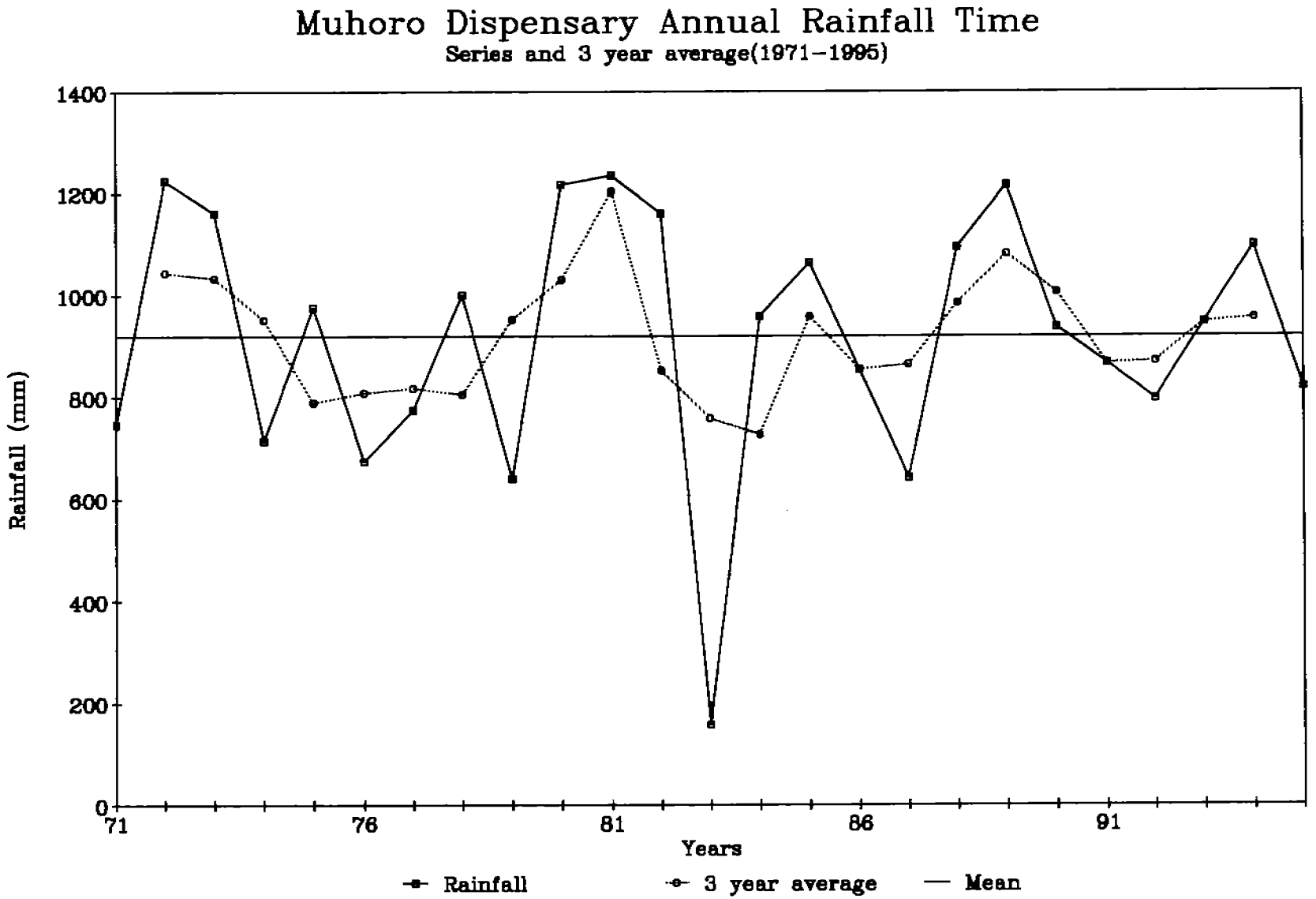
APPENDIX ZJ


Utete Annual Rainfall Time series
and 3 year average (1961–1995)
Rainfall (mm)
1600
1400
1200
1000
800
600
400
200
0
65/66
70/71
75/76
80/81
85/86
90/91
Years
Rainfall
3 year average
Mean

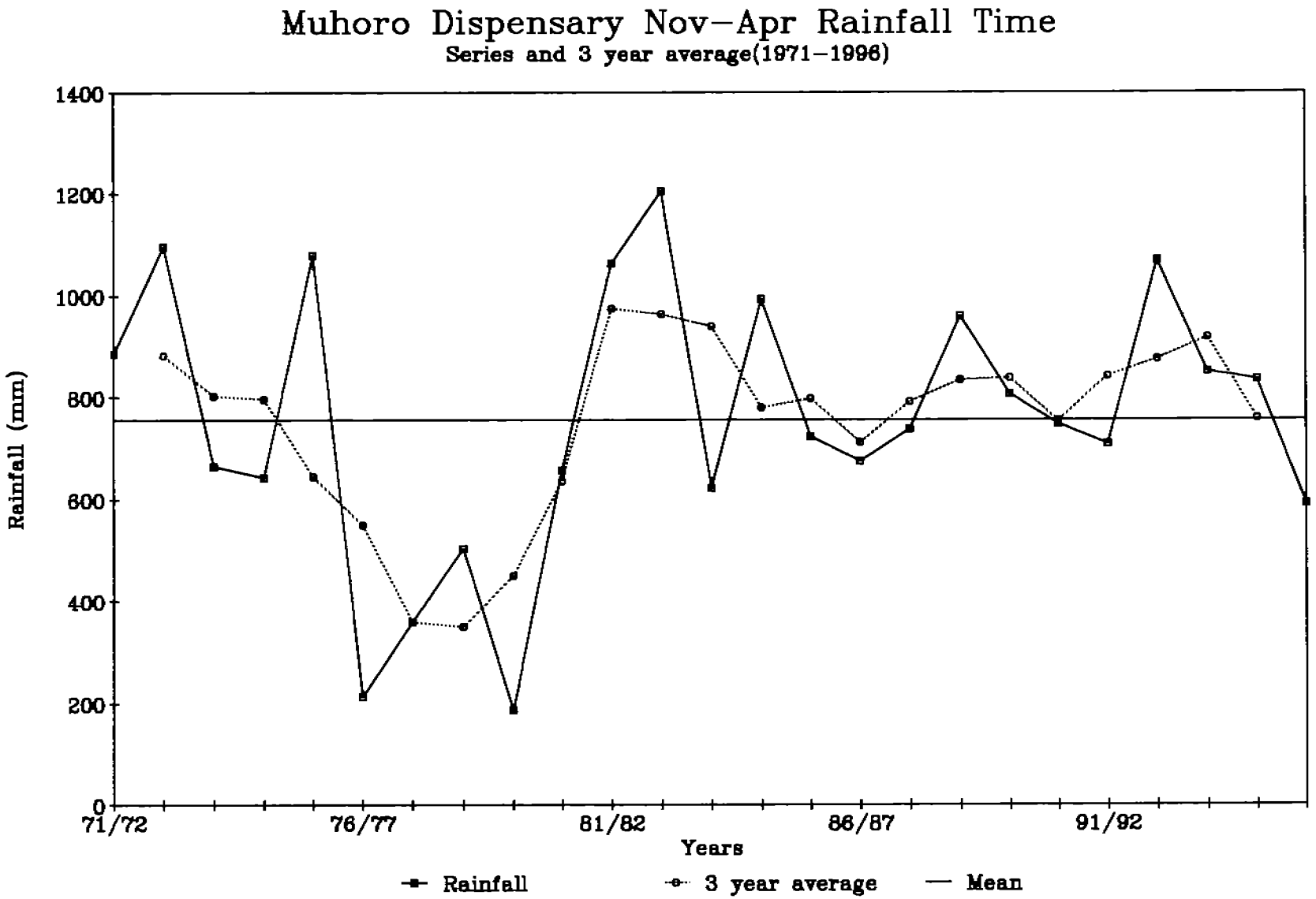
APPENDIX ZK


Utete (Nov–Apr) Rainfall Time Series
and 3 years moving average(1961–1995)
Rainfall (mm)
1400
1200
1000
800
600
400
200
0
61/62
66/67
71/72
76/77
81/82
86/87
91/92
Years
Rainfall
3 year average
Mean

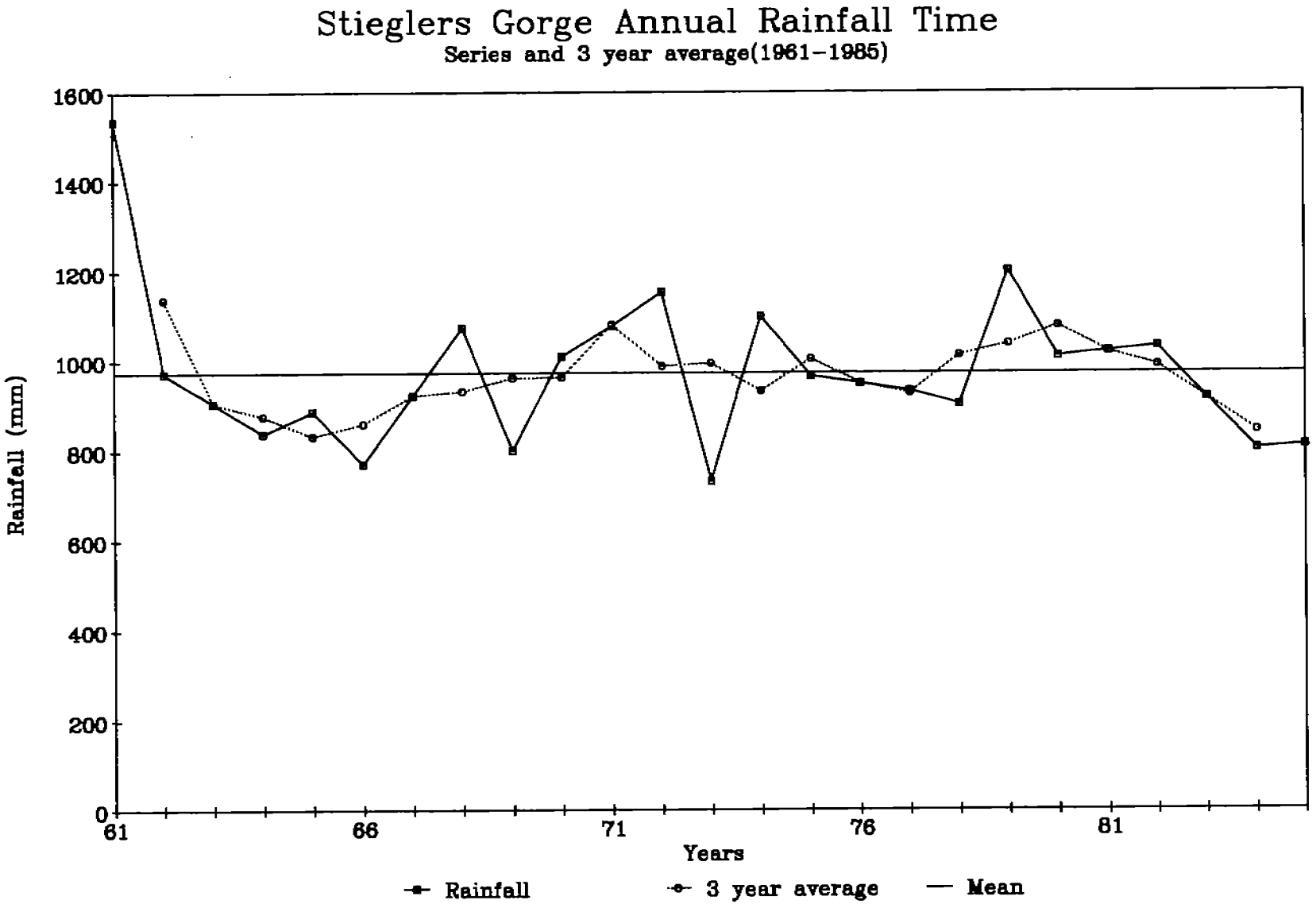
APPENDIX ZL


Muhoro Dispensary Annual Rainfall Time
Series and 3 year average(1971-1995)
Rainfall (mm)
1400
1200
1000
800
600
400
200
0
71
76
81
86
91
Years
Rainfall
3 year average
Mean

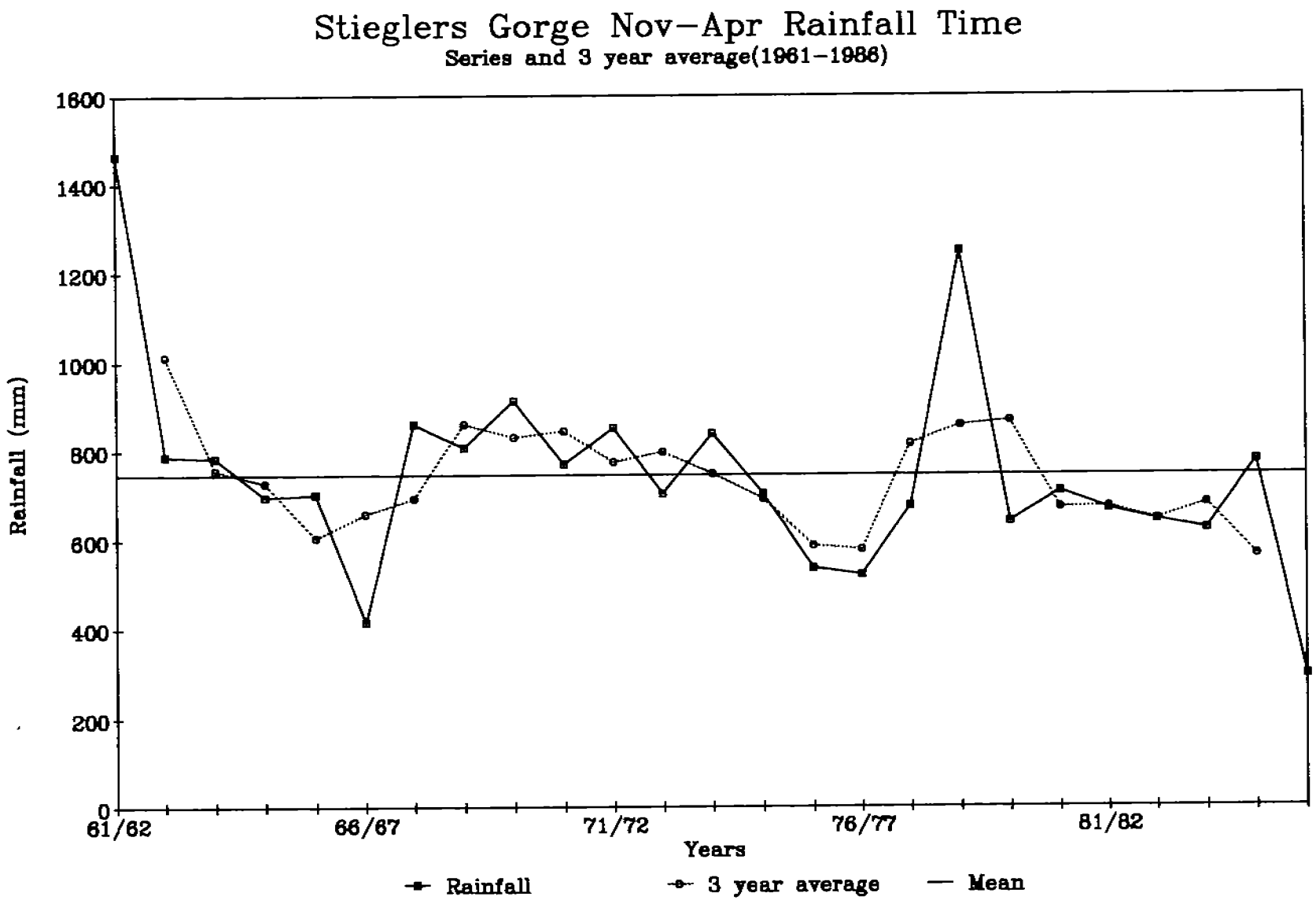
APPENDIX ZM


Muhoro Dispensary Nov–Apr Rainfall Time
Series and 3 year average(1971–1996)
Rainfall (mm)
1400
1200
1000
800
600
400
200
0
71/72
76/77
81/82
86/87
91/92
Years
Rainfall
3 year average
Mean

APPENDIX ZN


Stieglers Gorge Annual Rainfall Time
Series and 3 year average(1961-1985)
Rainfall (mm)
1600
1400
1200
1000
800
600
400
200
0
61
66
71
76
81
Years
Rainfall
3 year average
Mean

APPENDIX ZO


Stieglers Gorge Nov–Apr Rainfall Time
Series and 3 year average(1961–1986)
Rainfall (mm)
1600
1400
1200
1000
800
600
400
200
0
61/62
66/67
71/72
76/77
81/82
Years
Rainfall
3 year average
Mean