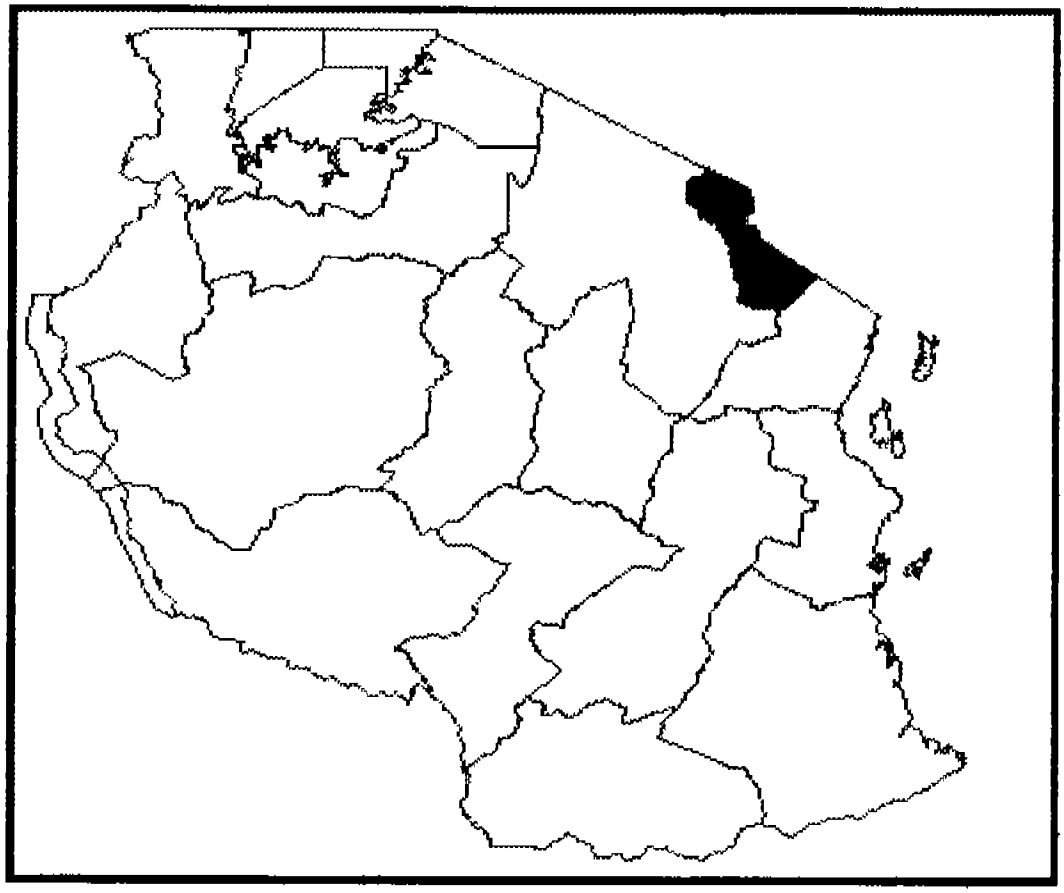
AN ENVIRONMENTAL PROFILE

FOR

KILIMANJARO REGION, TANZANIA



PRODUCED BY:

ENVIRONMENTAL IFORMATION
CENTRE OF THE NATIONAL
ENVIRONMENT MANAGEMENT COUNCIL

ENVIRONMENTAL PROFILE OF KILIMANJARO

TABLE OF CONTENTS

1. PHYSICAL ASPECTS OF THE NATURAL RESOURCES BASE 1

1.1 LOCATION 1

1.2 PHYSIOGRAPHY, RELIEF AND DRAINAGE 2

1.3 GEOLOGY 3

1.4 VEGETATION TYPES 3

1.5 AGRO - ECONOMIC ZONES OF KILIMANJARO 9

2. LAND USE 11

2.1 MAIN LAND USES 11

2.2 CONTROLLED AREAS 11

2.2.1 The Kilimanjaro National Park 11

2.2.2 Mount Kilimanjaro Game Reserve 11

2.2.3 Game Controlled Areas (GCAs) 12

2.3 GRAZING LAND 12

2.4 AGRICULTURAL LANDS 13

2.5 URBAN LAND USE 13

2.6 TOURISM 13

2.6.1 Tourism in Kilimanjaro 13

2.6.2 Some problems facing tourism in Kilimanjaro 14

2.7 MANUFACTURING AND MINING 14

2.7.1 Manufacturing 14

2.7.2 Mining 15

3. SOCIO-ECONOMIC ASPECTS 16

3.1 POPULATION 16

3.1.1 Population Distribution 16

3.2 EDUCATION 18

3.3 HEALTH 20

3.4 TRANSPORT 27

3.5 WATER SUPPLIES 28

3.6 ECONOMIC ACTIVITIES 30

3.6.1 CULTIVATION 30

3.6.2 LIVESTOCK 31

3.6.3 Livestock Composition 31

3.6.4 Animal Production *31*
3.6.5 Livestock development problems *32*
3.6.6 Beekeeping *34*
3.6.7 Beekeeping Production *34*
3.7 FISHERIES 35
3.7.1 Fishing in Kilimanjaro *35*
3.7.2 Fish farming *35*
3.7.3 Fish Production *35*
4. ENVIRONMENTAL ISSUES **36**
4.1 MOUNT KILIMANJARO FORESTS DEGRADATION 36
4.2 MOSHI WASTEWATER MANAGEMENT 37
5. CLIMATIC PROFILE OF KILIMANJARO REGION **39**
5.1 INTRODUCTION 39
5.2 ANALYSIS 39
5.3 ANNUAL RAINFALL TIME SERIES 40
5.4 TEMPERATURE 40
5.5 METHODOLOGY 40
5.6 LIST OF STATIONS 41
6. CLIMATIC PROFILE OF KILIMANJARO REGION **43**

LIST OF TABLES

TABLE 1-1 ADMINISTRATIVE DIVISIONS IN KILIMANJARO REGION 1994 1

TABLE 1-2 AREA (SQ. KM) AND POPULATION DENSITY IN KILIMANJARO REGION, 1988 2

TABLE 2-1: CROP ACREAGE OF THE MAJOR FOOD CROPS IN KILIMANJARO REGION (1990/91) 13

TABLE 2-2 INDUSTRIES IN KILIMANJARO 15

TABLE 2-3 DISTRIBUTION OF INDUSTRIES IN KILIMANJARO 15

TABLE 3-1 SHOWS POPULATION PROJECTIONS BETWEEN THE YEAR1996 TO THE YEAR 2000. IT ALSO SHOWS THE POPULATION PROJECTIONS OF CHILDREN UNDER 1 YEAR, UNDER 5 YEARS AND WOMEN AGED BETWEEN 15-49 YEARS OF AGE PER DISTRICT. 16

TABLE 3-1 POPULATION PROJECTIONS 17

TABLE 3-2 KILIMANJARO RURAL POPULATION DENSITY IN 1967, 1978, AND 1988 18

TABLE 3-3 FACTS ON REGION 18

TABLE 3-4 ENROLMENT IN PUBLIC PRIMARY SCHOOLS BY DISTRICT, SEX AND CLASS, 1991. 19

TABLE 3-5: SHOWS THE ENROLMENT IN PUBLIC PRIMARY SCHOOLS BETWEEN 1987-1991 20

TABLE 3-6 HOSPITAL BY OWNERSHIP, 1996 21

TABLE 3-7 HEALTH CENTRES BY OWNERSHIP, 1996 21

TABLE 3-8 DISPENSARIES BY OWNERSHIP, 1996 21

TABLE 3-9 POPULATION PER HEALTH FACILITY 22

TABLE 3-10 NUMBER OF BEDS IN HOSPITALS 22

TABLE 3-11 NUMBER OF BEDS IN HEALTH CENTRES 22

TABLE 3-12 POPULATION PER BED 22

TABLE 3-13 DISTRIBUTION OF COMMUNICABLE DOSEASES CASES, 1994 AND 1995 22

TABLE 3-14 DISTRIBUTION OF DEATHS CAUSED BY COMMUNICABLE DISEASES, 1994 AND 1995 23

TABLE 3-15 REPORTED CASES OF MEASLES. 1992 - 1994 23

TABLE 3-16 COMMUNICATIVE AIDS CASES (1991 - 1996) 23

TABLE 3-17 RATE OF AIDS PER 100,000 POPULATION BASED ON THE BASED COMMULATIVE CASES 23

TABLE 3-18 SMEAR POSITIVE PULMONARY TUBERCULOSIS AND LEPROSY CASE DETECTION RATE PER 100,000 24

TABLE 3-19 ANNUAL RETURN OF ATTENDANCE FOR ORAL HEALTH CARE BY SEX AND AGE FOR 1993 AND 1995 24

TABLE 3-20 LIFE EXPECTACY AT BOTH, 1978 AND 1988 24

TABLE 3-21 CRUDE DEALTH RATE 24

TABLE 3-22 FAMILY PLANNING TABULATION ON THE NUMBER OF HEALTH FACILITYREPORTED,WITH FAMILY PLANNING FACILITIES AND COUNTERCEPTIVE CONSUMPTION, 1996 25

TABLE 3-23 FAMILY PLANNING FOR NEW ACCEPTORS, CURRENT USERS STERILIZATION, 1996 25

TABLE 3-24 IMMUNISATIONS PROGRAMME, 1996 25

TABLE 3-25 IMMUNIZATION COVERAGE FOR CHILDREN UNDER 1, 1996 25

TABLE 3-26 INFECTIOUS DISEASES WEEK ENDING (IDWE) REPORTS TO MINISTRY OF HEALTH, 1996 26

TABLE 3-27 ROAD NETWORK IN KILIMANJARO REGION (KMS) BY TYPE OF ROAD AND SURFACE, 1992 27

TABLE 3-28 NEWLY REGISTERED MOTOR VEHICLES IN KILIMANJARO REGION 1991-1992/93 27

TABLE 3-29 HOUSEHOLDS BY DISTRICT AND TYPE OF WATER SUPPLY IN KILIMANJARO REGION, 1988 28

TABLE 3-30 HOUSEHOLDS BY DISTRICT AND TYPE OF WATER SUPPLY IN KILIMANJARO REGION, 1988 PERCENTAGE DISTRIBUTION 28

TABLE 3-31 STATUS OF WATER SUPPLY SCHEMES COVERAGE IN KILIMANJARO REGION (RURAL AREAS), 1991 29

TABLE 3-32: HOUSEHOLDS BY DISTRICT AND TYPE OF TOILET IN KILIMANJARO REGION 1988 29

TABLE 3-33 PRODUCTION AND ACREAGE OF MAJOR FOOD CROPS IN KILIMANJARO REGION (TONNES), 1990 / 91 30

TABLE 3-34: SALES OF CASH CROPS BY KIND OF CASH CROP IN KILIMANJARO REGION 1986/87 - 1990/91 ('000 KGS) 30

TABLE 3-35 KILIMANJARO LIVESTOCK POPULATION AND DISTRIBUTION BY DISTRICT, 1984 CENSUS. 31

TABLE 3-36 HIDES AND SKINS PRODUCTION IN KILIMANJARO REGION, 198632

TABLE 3-37 DISTRIBUTION OF HIVES IN KILIMANJARO REGION, 1987 34

LIST OF APPENDICES

Appendix 1.....**42**

Bibliography

Appendix 2.....**43**

Climatic Profiles of Kilimanjaro Region

ACKNOWLEDGEMENTS

The National Environment Management Council would like to express its appreciation to UNDP for its support with financial assistance which led the realization of this document which was prepared as part of Environmental Information System (EIS) Project for Tanzania. It made possible the extensive data collection, validation, processing and compilation of information within the region itself and from sectoral headquarters in Dar es Salaam.

Special thanks go to:

Robert Kihunsi, Senior Lecturer at University College for Lands and Architectural Studies (UCLAS) for his initial research and provision of baseline data;

Mohamed R Matitu, Principal Meteorologist with the Directorate of Meteorology for providing climatic profiles.

Authorities in Kilimanjaro Region for co-operating with the consultants in providing information and data. We also extend our sincere gratitude to the experts in the region for availing the valuable information and data which resulted into realization of the report.

Numerous institution which contributed up-to-date information or provided pointers as to where it could be accessed, within thin category:

The Bureau of Statistics, Ministry of Health and Directorate of Meteorology in Dar es Salaam made notable contributions in data acquisition and analysis.

MARCH 1998

PART I: OVERVIEW OF THE ENVIRONMENT IN THE KILIMANJARO REGION, TANZANIA.

CHAPTER ONE

1. PHYSICAL ASPECTS OF THE NATURAL RESOURCES BASE

1.1 LOCATION

Kilimanjaro region is located on the north-eastern part of Mainland Tanzania, just south of the equator. It borders Kenya to the North, Tanga region to the east, and Arusha region to the west.

There are four agro-economic zones in Tanzania, whereas the Kilimanjaro region lies in zone IV, i.e. mostly highland area.

Table 1-1 Administrative divisions in Kilimanjaro region 1994

District	No. of divisions	No. of wards	No. of villages
Rombo	5	10	55
Mwanga	4	16	53
Same	8	24	65
Moshi R	4	27	148
Hai	4	11	61
Moshi U	2	16	0
Total	**25**	**104**	**382**

Source: Regional Development Director's office

Total surface area is 13,309 square kilometres. About 23% is cultivated land, 33% grazing land while 35% is arid land, including the Kilimanjaro mountain.

The altitude of the Region ranges from 600 metres in the lowlands up to 5895 metres above the sea level at the highest peak of Mt. Kilimanjaro. The majority of the population is settled between 1000 and 1800m above the sea level.

Table 1-2 Area (sq. Km) and population density in Kilimanjaro Region, 1988

District	Land area sq. kms	Population Density (persons per sq. km)
Rombo	1,482	136
Mwanga	2,170	45
Same	5,730	30
Moshi R	1,529	224
Hai	2,369	84
Moshi U	29	3,339
Total	**13,309**	**83**

Source: Regional Development Director's office

Note: population density = number of population divided by area

1.2 PHYSIOGRAPHY, RELIEF AND DRAINAGE

Kilimanjaro Region has got two main physiograghic units, the mountain block and the relatively undulating flat area. The mountain block is composed of the Kilimanjaro Mountain and its footslopes.

The general physiography of this area resembles that of many dormant volcanoes in other parts of the world. Kilimanjaro has had three main peaks. The Shira plateau is the denuded remnant of the oldest eruptive centre and has been largely covered by lavas from Kibo. Mawenzi peak, 5150m is the next oldest and most precipitous, while snow-capped Kibo, 5895m, is the highest point in the continent of Africa

At lower altitudes the slopes are gentle (0° - 5°) with a relatively shallow depth of volcanic rocks overlying the Achean Basement Complex. Above 1200m on the south and above about 1400m on the east, however, the slopes steepen greatly and often exceed 15° even in cultivated areas. Slopes in excess of 25° are mostly restricted to river valleys or to the steeply sloping ash cones. In the highrainfall area of Old Moshi-Kilema, rivers have cut more deeply into the ash than into the similar soils in the drier areas of Kibong'oto and Keni. Slopes increase most regularly in the Lyamungo-Uru area on the south where the lava flows have been fairly uniform and little faulted. On the east, fault lines are more common and have caused the formation of steep escarpments especially in Mkuu.

The main rivers draining the southern slopes are the Kikafu, Weruweru, Karanga and Rau to the west of Old Moshi, while the Himo and Dagana drain the Kilema-marangu-Mwika area. From Mwika to Keni most streams are semi-permanent. However, the lavas of the East side again throw up other almost permanent rivers, namely the Marue and Lume, while the Mashima and Tarakea carry much water during the rains but are dry most of the year. The majority of these rivers drain southwards into the Kikuletwa and thence into Pangani River System. The Lume and Marue, however, join and form the Lumi which flows East of the North Pare mountains int Lake Jipe.

1.3 GEOLOGY

The oldest rocks with extensive expossure in the Kilimanjaro mountain are the lavas from Mawenzi. Most of the rocks found in the area are basic in character and are rich in calcium and magnesium-containing minerals such as andesine, labradorile, anorthite, vite and augite.

1.4 VEGETATION TYPES

A. Wooded grasslands

1. *Medium-height Hyparrhenia-Panicum / Combretum acacia Wooded Grassland (largely cropped with maize, beans or finger-millet)*

This occupies extensive areas of the lower slopes of the mountain bordering the Mombasa-Moshi road. Rainfall is usually less than 1000mm and altitudes below 1200m. The soils are not very deep and may be stony. The combination of low rainfall, high temperatures and freely drained soils means that fairly drought-resistant species survive best. *Hyparrhenia dissolute* and *Panicum maximum* are the most obvious grasses, but others occurrring include *Aristida spp., Sorghum verticilliflorum, Panicum coleratum, Eragrostia sp., Cenchrus ciliaris, Dgitaria spp., Chloris gayana* and *Cynodon dactylon. As altitude increases, the Combretum* species occurs, among which *Combretum gueinzii* is more common on shallower soils. *Croton macrostachys* (*Mfurufuru*) also occurs. Maize, beans, finger millet, castor and sisal have largely replaced the indigeneous vegetation. Grass is also extensively cut for fodder.

2. ***Tall Hyparrhemia-Panicum / Croton-Combretum-Rauvolfia Wooded Grassland (mostly replaced by maize, beans, millet and some bananas)***

This type occurs on the upper part of the plains in kilema, Marangu, Mwika and Mkuu. *Hyparrhenia dissoluta* and *Panicum maximum* are agfain the most common grasses, but while Combretum ssp. are still common, small trees of *Croton macrostachys* and *Rauvolfia caffra* and even some *Albizzia schimperiana* also occur. Other trees include Acacia tortilis and *A. polyacantha*. The grasses *Hyparrhenia filipendula, Digitaria sp., Aristida sp., Heteropogon contortus* and *Rhyncheletrum* repens are also common. The rainfall is greater than for Type 1, but probably does not exceed 1125 mm on average. Besides maize, beans and millet, bananas cassava and even small areas of coffee have replaced the indigenous vegetation. Both grazing and the cutting of grass for fodder are practised.

3. ***Medium Height Hyparhenia-Cynodon/Acacia Tortilis Seasonally Waterlgged Wooded Grassland (usually grazed)***

This type covers most of the seasonal water courses on both the south and east sides of the mountain. Besides *Acacia tortilis, A. polyacantha, A. seyal, A. mellifera* and *A. stulmannii* may also occur. *Hyparrhenia rufa* commonly occurs but where the soils are more moist and grazed, *Cynodon dactylon* and *C. plectostachyus* are more common. These seasonal gently sloping watercourses are used for grazing, but some areas are planted with arable crops including maize, beans and vegetables.

4. ***Medium Height Hyparrhenia-Themeda/Acacia Polyacantha Wooded Grassland (largely cultivated with maize, beans and pyrethrum)***

Within the survey area this type is restricted to the altitudes of 1500-1800 m in Useri where the soil is of fluvioglacial origin and dark brown in colour. Rainfall rarely exceeds 900 mm annually. The *Acacias* are more common along the drainage lines. Other species which may occur include *Rauvolfia caffra* and *Croton macrostachys* while *Cupressus lusitanica* and *Grevillea robusta* have been planted extensively. Besides *Hyparrhenis filipendula, H. hirta* and *Themada triandra, Setaria sphacelata, Digitaria sp., erogrostis sp.* and *Chloris gayana* also occur. Much of this type is being cultivated with maize, beans, finger millet and castor, while at the higher elevations pyrethrum and Irish potatoes are grown. Pastures are both grazed and cut so that there is little grass left to burn.

B. Bushed Grassland

5. *Medium-height Aristida-Heteropogon/Acacia-Combretum Bushed Grassland (chiefly grazed, some maize, beans, finger millet and sorghum)*

This extends over much of the lower areas on the east side of the mountain from Himo to Useri. Rainfall rarely exceeds 750 mm and may be below 500 mm where *Acacia* species are more common. Besides *Aristida adscensionis* and *Heteropogon contortus, Eragrostis superba, Chloris roxburghiana, Themeda triantra, Rhycheletrum repens, Panicum coloratum, Pennisetum mezianum, Digitaria scalarum, Cynodon dactylon and Cenchrus ciliaris occur.* The *Combretum* species are usually small and tend to be replaced by *Acacia mellifera, A. stuhlmannii, A. drepanalobium* and *A. nilotica* in the drier areas. Occasional taller trees of *A. tortilis* also occur where this type merges into Wooded Grassland.

The basal cover of the grasslands here is rarely more than 40 percent and in areas of overgrazing, frequently much less. Soil erosion, therefore, commonly occurs.

6. *Medium-height Hyparrhenia-Heteropogon/Combretum-Acacia Bushed Grassland (grazed, tarely cultivated, frequently burnt)*

This type restricted to the volcanic ash and scoria cones in the drier areas which occur in the lower Kirua-Keni area. *Hyparrhenia filipendula* is common while *H. dissoluta* is less so. Besides *Heteropogon contortus, Aristida adscensionis, Sporobolus fimbriatus* and *Cenchrus ciliaris* occur. *Combretum guineense* is common while dwarf *Acacia stuhlmannii, A. nilotica* and *A. mellifera* are also found. Because of the excessively drained soils and steep slopes this area is rarely cultivated and often subjected to fires.

C. Woodlands

7. *Acacia/Commiphora Bushland (rarely cultivated, often overgrazed)*

These areas are restricted to steeply sloping or eroded lands with rainfalls of under 900 mm. With the cutting of grass for fodder and the grazing of many areas of Wooded Grassland and Bushed Grassland, however, fire is much less common than formerly. Conseqduently the area of Bushland has tended to increase in recent years and there are considerable tracts of country which now contain dwarf bushes notably of *Acacia mellifera, A. stuhlmannii, A. drepanalobium* and *Commiphora sp.*, with occasional taller trees of *Acacia tortilis*. Some of the areas supporting bushland are very stony while others are on relatively deep soils. All, however, tend to have a poor ground cover of grasses brought about either by overgrazing or erosion, the latter depending very much on the former. Among the grasses found in this type are *Aristida adscensionis, Chloris roxburghiana, Digitaria scalarum, Cynodon dactylon, Erogrostis sp., Harpachne schimperi* and *Rhyncheletrum repens.*

D. Woodlands

8. *Albizzia/Croton/Rauvolfia Woodland (largely replaced by coffee, bananas and maize)*

This type forms a narrow belt on the more undulating topography just above the plains on the southern slopes. On the east of the mountain it is more extensive and occurs at higher altitudes. The common trees are *Albizzia schimperiana, A. petersiana, Croton macrostachys* and *Rauvolfia caffra*. Trees of these species in this woodland type rarely exceed 12 m in height, and 8-10 m would be more normal. Other species present include *Trema orientalis, Cordia holstii, Ficus sp., Mimusops sp.*, and *Lantana salviifolia*. The grasses which are common in cultivated areas include Hyparrhenia spp., especially *H. hirta, Eragrostis superba, Aristida Digitaria scalarum, D. diagonalis, Heteropogon contortus, Panicum maximum, Sporobolus pyramidalis* and *Rhyncheletrum repens.*

Coffee has replaced this type to a considerable extent and usually requires some irrigation for high yields. Areas of maize, beans, bananas, *Grevillea robusta* and *Eucalyptus sp.* have also displaced much of the original woodland.

9. *Acacia abyssinica Woodland (mainly cropped with maize, pyrethrum and potatoes)*

This distinctive type occurs only in the north east of the survey area above 1500 m in Useri. It is characterised by well-grown (up to 18 m) tall trees of *Acacia abyssinica. A. polyacantha* is found at the lower altitudes. Other trees found are *Albizzia schimperiana, A. petersiana, Rauvolfia caffra* and *Croton macrostachys*. Among the grasses are *Digitaria sp., Themeda triandra, Eragrostis tenuifolia, E. curvula* and *Hyparrhenia hirta.* Though some coffee is grown in this area, maize, beans, pyrethrum and Irish potatoes are more common.

E. Forests

10. *Albizzia/Rauvolfia Medium Altitude Forest (now mostly coffee and bananas)*

On the southern slopes of the mountain, the most extensive area of former forested land belongs to this type. Here it is most widespread within the altitudinal ranges of 100-700 m. To the east it is much less extensive and is replaced largely by *Albizzia/Rauvolfia* Woodland. The difference between these two type depends largely on the presence or absence of lianes, the size of the trees and the associated tree species. Besides the common *Albizia spp., Rauvolfia caffra* and *Croton macrostachys, Newtonia buchananii, Macaranga Kilimandscharica, Fauria saligna, Olea welwitchii, Ficus capensis* and *Teclea viridis* occur. Many of the trees on this type have been replaced by coffee and bananas which together make up the dominant vegetation in the area shown on the map. In addition there are small areas of pasture in which the grasses *Pennisetum clandestinum, Eragrostis curvula Sporobolus pyramidalis, Digitaria spp.* and Cyperus spp. are found sometimes with the clovers *Trifolium semipilosum* and *T. usambarensis.* Other prevalent species are the hedge plant *Dracen a stevoneri var. kilimandscharica, Pteridium aquilinum* (bracken), *Veronica sp.* and *Lantana salviifolia*. Maize, beans, yams, sweet potatoes and sugar cane are also grown but the area covered by these crops is much less than that by coffee and bananas.

11. ***Lowland Riverine Forest***

At the lower elevations this is the only type of forest to be found. It fringes most of the permanent watercourses, being widest where there are alluvial fans, as exemplified in the Rau Forest to the south east of Moshi. The small area of this type has not been studied closely, but the vegetation is composed of very mixed species including *Cordyla africana* with lianes. While most of the big trees remain, much of the undergrowth of such species as *Veronica* and *Lantana* has been cleared and coffee, sugar cane or vegetables are frequently seen.

12. ***High Altitude Ocotea/Podocarpus Rain Forest***

Here, *Ocotea* and *Podocarpus* species are the trees of greatest economic importance through seldom the most common. The type occupies most of the land above 1700 m on the southern slopes but is rare north of Mkuu on the east side (Wood, 1965). While there is a considerable overlap of species, there is a greater tendency for *Ocotea usambarensis*, the East African Camphor wood, to occur on the ash derived soils (Steel, 1963) while Podocarpus milanjianus seems to be more common on the less freely drained lava-derived soils. On this basis the high altitude rain forest is tentatively divided into two sub-types: the Ocotea Rain Forest and the Podocarpus Rain Forest.

12A. ***High Altitude Ocotea Rain Forest***

The following species commonly occur in this forest on volcanic ash and in the cultivated areas formerly under forest on ash. *Conopharyngia usambarensis, Syzgium guineense, Olea hochstetteri, Macaranga Kilimandscharica, Agauria salicifolia, Myria salicifolia, M. meyerjohannis, Hagenia abyssinica, Landolhpis kilimkandjarica, Cassia didymototrya, Dodonea viscosa, Newtonia buchanani, Podocarpus mileangianus, Fagaropsis angolensis, Dombeya mastersii, Parinari holstii, Kigelia aethiopica* and *Rauvolfia caffra* have also been noted together with rather poor specimens of *Albizzia spp.* Among the grasses are *Digitaria sp., Eragrostis spp., Sporobolus pyramidalis, Hyparrhenia hirta, Cyperus spp.* and particularly in areas cleared from forest, *Fimbristylis diphylla* and *Rhyncheletrum repens.* In cultivated areas both coffee and bananas are poor. Yams, sweet potatoes and Irish potatoes are also grown.

12B. ***Podocarpus High altitude forest***

At the lower altitudes *Podocarpus milanjianus* is the most common species of Podocarpus but above 3400 m this is replaced by *P. gracilior* (Wood, 1965). Other species in this sub-type on the Masia complex which have not already been noted on the ash-derived soils of Old Moshi include *Trichelia roka, Mimusops sp., Ilex mitis, Rapanea rhododendroides, Eckebergia rueppellania, Xymolos monspora,* and *Olea africana* while the common grasses include *Pennisetum clandestimum, Eragrostis spp., Sporobolus pyramidalis, S. pellucidus* and *Exotheca abyssinica.*

13. ***High Altitude Dry Forest***

On the eastern side of the mountain the forest contains many of the same species as in the South Kilimanjaro Rain Forests. Trees are shorter, however, and in the drier northeast section rarely exceed 12 m. Species occuring in the Useri Forest include *Macaranga kilimanjarica, Conopharyngia usambarensis, Olea africana, O. chryophylla and Xymalos monosphora, Agauria salicifolia, Hagenia abyssinica, Podocarpus milanjianus, Cassipourea malosana, Eckebergia ruepelliana, Galiniera coffeoides, Ocotea usambarensis* and *Euclea divinorum.* An even drier type of forest exists on the northern slopes of the mountain in which *Juniperus procea* and *Olea spp.* are common. Among the grasses occuring in the cleared part of this eastern forest type are *Pennisetum clandestinum, Hyparrhenia hirta, Eragrostis sp., Sporobolus pyramidalis* and *Digitaria sp.* The areas cleared from this Dry Forest for a number of years do not support very good crops. Coffee, bananas and annual crops are poor and even bracken does not grow very vigorously.

14. ***Upland Eragrostis/Fimbrystillis Grassland***

This area is mostly the Useri Glades, but considerable areas of secondary grassland also occur in patches on the upper cultivation slopes of the area shown as Upland Dry Forest. The most common plants are *Erangrostis spp.* especially *E. tenuifolia, Hyparrhenis hirta,* Exotheca abyssinica, Cyperus spp. and Fimbristylis diphylla. Among the non-graminae which are scattered throughout this type are *Artemesia afra, Myrica meyerijohanis, Agauria salicifolia* and *Pteridium. Pennisetum clandestinum* is common on cattle tracks where there is higher fertility. It is perhaps significant that the glades on Kilimanjaro are mostly in relatively low rainfall areas having prolonged dry periods. Frequent fires and grazing are also factors perpetuating the absence of forest in the glades. However, shallow acid soils sometimes with imperfect drainage are considered a more fundamental reason than fire or grazing for the existence of the Useri Glades although undoubtedly these help to tip the balance in favour of grassland. The reason for the shallow soil of the Useri glades may date back to the Ice Age and periglacial phenomena, but the present soils are much different fro the neighbouring soils on steeper slopes which support forst (see Uhini Series). Furthermore, the pattern of the glades is too regular for their formation to be ascribed simply to grazing, burning or cultivation. It reflects very much the topography and geomorphology of the area as both the soil and vegetation maps show.

1.5 AGRO - ECONOMIC ZONES OF KILIMANJARO

There are two main agro-economic zones in Kilimanjaro region.

ZONE 1: Densely Populated Mountain Blocks

These are mountainous areas with high rainfall and dense population. Coffee is the main cash crop and, in most cases, banana the main food crop. Shortage of land, soil erosion and the need to reduce the dependence on coffee are major problems.

The zone includes the slopes of Pare mountains and the volcanic Kilimanjaro Mountain, one of the main coffee - producing areas in the country, where small - holder dairying is being developed as an alternative to coffee.

Average annual rainfall ranges from 100 to 1500 to 2000mm on Kilimanjaro slopes, and 650 - 1000 in Pare mountains. Dominant vegetation in the zone is forest. Soil erosion is moderate to severe, whereas there is a negligible tsetse flies problem. Population is very dense (over 100 persons per sq. km), major tribes being Chagga on Kilimanjaro slopes, and Pare on Pare mountains. Settlement pattern is of dispersed (individual) households, with medium social cohesion.

Land tenure is permanent whereby occupants have rights to cultivate on permanent basis. The rights are inherited, and in some cases sold due to land shortage. The average area cultivated annually per household, including land under perennial crops is small (0.5 to 2 ha). The soil is fertile, enhanced with high applications of animal manure. Double cropping is negligible to low, with the flat tillage.

Other crops of importance in the zone are pyrethrum, cardamon, maize and beans.

Zone 2: Less Densely Populated Flat Land

This zone comprises the driest parts of the region in which animal husbandry is the major, or in a few cases, the only activity.

Most of the inhabitants cultivate little or no land, own large herds of cattle and other livestock and practice seasonal or continuous migration, although in some parts there are also some permanent farmers.

The marginal areas bordering Masailand, are used by both Masai pastoralists and permanent mixed farmers. The latter tend to have large farms and practice modern methods of cultivation, sometimes using irrigation. The crops grown vary, but paddy is common.

Topography is one of flat to undulating land with average annual rainfall ranging from 400 - 600mm to 500 - 800 mm.

Predominant vegetation is grass and bush with moderate soil erosion and negligible tsetse flies problem.

Population density is medium (30 - 49 per sq. km) to low (15 - 20 per sq. km), major tribes being Chagga and Pare. Settlement pattern is dispersed (individual) households, with small dusters of houses in some cases, having medium social cohesion. The land tenure is permanent, and there is no shortage of cultivable land.

The average area cultivated annually per household including land under perennial crops ranges from small (0.5 - 2ha) to medium (2 - 3ha), though there is much variation in farm size. Cash crops are negligible on a large scale, but few farmers cultivate cotton, oilseed and maize.

Food crops are maize, beans, cassava and paddy. Generally double - cropping practice is low in the zone, through highly practised in flood plains.

The soil is fertile, whereby the farmers apply flat village and little animal manure or artificial fertilisers.

CHAPTER TWO

2. LAND USE

2.1 MAIN LAND USES

The main land uses in Kilimanjaro Region include the protected areas, rangelands, farms, water bodies and the settlement areas.

2.2 CONTROLLED AREAS

2.2.1 The Kilimanjaro National Park

Gazetted in 1973, the Kilimanjaro National Park covers 756 sq. Km, equivalent to 19.8% of area gazetted as National Park in the Northern Zone.

It is 48 km from Moshi town, along a tarmaced road to Marangu, the major gate for climbers. Most of the park is above 3,000 above the sea level, where major vegetation is the heath which gives way to a desert and eventually the two peaks - snow capped Kibo and Mawenzi.

Mountaineering is the major tourist activity in the park, though there are viable mammal and bird populations in the lower parts of the park.

National parks are set aside for protection of wildlife and its habitat. Tourist use is the primary and a major use of wildlife and National park. Development is limited to that which facilitates visitor use and management of the park. Availability of the wildlife and other aesthetical features, and viability of the ecosystem to sustain tourism, are important criteria when deciding to make an area a National Park.

2.2.2 Mount Kilimanjaro Game Reserve

Game reserves are set aside for conservation of wildlife and its habitat in as natural a condition as possible. No development is permitted in a game reserve. Thus, settlements and other infrastructure are not allowed.

Roads and a few houses may be constructed only to facilitate wildlife management in a game reserve. Little tourism take place in game reserves. However, use by training institutions and for research purposes is allowed. Hunting, mainly tourist hunting, may also be done. Conditions are always imposed on every permit / licence issued so as to ensure least alteration or damage to the environment. The objective being to impose more or less "total protection" of the environs.

Mount Kilimanjaro Game Reserve is also a forest reserve. It covers some 900 sq. Km. It is found in the lower slopes of Mt. Kilimanjaro and most of the mountain is forest. 89 sq. Km of the forest has been felled to establish exotic forest on the west and north-east of the Reserve. All around its boundary it is touched by cultivation mainly of banana plantations. Part of its northern boundary is shared with the international border with Kenya.

2.2.3 Game Controlled Areas (GCAs)

A game controlled area is one in which only wildlife is protected. Human activities and development may be carried out as long as they don't cause harm or molest the wildlife in the area. The aim of their gazettement is to make a preparatory stage for subsequent rise to higher conservation status as discussed earlier. They are also supposed to work as buffer zones to higher conservation status.

Some GCAs, though shown on the map, are already destroyed and no longer worth the use for wildlife conservation, e.g. Ruvu-Same, Kalimawe and Sanya-Lelatema.

2.3 Grazing land

The available data puts the total grazing land in Kilimanjaro to be 426,000 hector.

The region for this purpose may broadly be divided into two categories, viz. Rangelands *per se,* and other grazing lands in highlands with crop agriculture potential where agricultural crops go hand in hand with livestock keeping. Rangelands, are often marginal arid lands with low and erratic rain where extensive grazing is common. This type of land is characterised by being open with scattered acacia tree species. In some areas these rangelands are a closed complex of *Acacia commiphora,* bushlands in Mwanga and Same districts which extends to Mbulu and Hanang districts through Kiteto district in Arusha region, and to Korogwe and Handeni districts to the coastal plain, punctuated in some areas by *Hyparrhemia parcum* wooded grassland, *Gretovia cornocerpoides* and *Combretum parmifolium* bushlands.

In most cases carrying capacities on the assumption of 4.5 hector per AU, is exceeded. This figure is commonly used as the key to proper stocking rates in these places. Cases of overstocking are evident in several areas, particularly the Sanya plains, Mwanga and Same.

Other grazing lands are mainly high agricultural potential areas, and the upland most forest zone 1000m above sea level. They include the coffee-banana areas of Kilimanjaro and Pare.

Grazing in these areas is very intensive and more often animals are kept indoors and stall-fed. Open grazing is limited due to high human population which is actively involved in crop agriculture. The soil in these areas is more fertile, and rainfall reliable than their adjacent lowlands. Livestock stocking rates are very high ranging from 0 - 9.5 hector per AU.

2.4 Agricultural Lands

Agricultural lands are spread all over the Kilimanjaro region. They include both small and large scale farming. Table 2-1 shows the area used for farming activities in the region.

Table 2-1: Crop acreage of the major food crops in Kilimanjaro Region (1990/91)

Crops	Hectares
Maize	69,361
Wheat	2,272
Sorghum	568
Paddy	5,766
Beans	33,988
Irish Potatoes	2,380
Sweet Potatoes	6,150
Cassava	5,660
Sunflower	1,828

Source: Table G.2 Kilimanjaro Regional Statistical Abstract, 1993

2.5 Urban Land use

Kilimanjaro region has got over 20 urban centres, the largest being Moshi. Others are Same, Mwanga, Mkuu, Sanya Juu, Hai, Himo, Machame, Ndungu, Mashati, Marangu, Gonja, etc.

2.6 Tourism

2.6.1 Tourism in Kilimanjaro

One of the attractions is the Kilimanjaro mountain. With the height of 5895m above the sea level, the Kilimanjaro is the highest mountain in Africa. The major attractions being the peaks, and to a less extent, the wild animals e.g. Baboons and monkeys.

Plants also form another attraction to the tourists. The Rau Forest conserves rare species of trees, e.g. Ostigma "*Msoo*". This specie is only found in Rau forest in the whole world. The largest "*Mvule*" in the country being found in this forest. Lack of publicity had hindered the visit of more tourists. The regional authorities were working on it.

A remarkable grave, too long for a single man exists in Rombo. There is a legend that a Rombo Chief who was extraordinarily tall was buried in that grave. It has attracted several tourists.

The Mweka caves which were used for hiding during war-times has also attracted a number of tourists.

2.6.2 Some problems facing tourism in Kilimanjaro

Communication

Unreliable and costly air-transport frustrates tourists who happen to have tight programmes. This stems out from numerous cancellation of local flights resulting into unnecessary delays.

Equipment

Mountaineering gears in the mountain sites are sometimes badly worn out and requiring replenishment. Replenishment may take time owing to various factors.

Honesty

Lack of honesty among the staff and proprietors of a few tourist facilities leads t creation of bad reputation.

Lack of reputable standard accommodation places also hamper the tourism sector in the region.

2.7 Manufacturing and Mining

2.7.1 Manufacturing

Kilimanjaro region, which is relatively small with notable land scarcity, has had moderate sugar and sisal estates, together with coffee farms. These influenced establishment of industries, including of sugar refining, sisal desiccating, coffee pulping and curing.

Industries in Kilimanjaro region are widely distributed.

Table 2-2 Industries in Kilimanjaro

Year	1978	1983	1988
Industries	117	133	94

Source: The June 1988 publication of "Hali ya Uchumi wa Taifa, Mwaka 1987"

Table 2-3 Distribution of Industries in Kilimanjaro

Moshi (U)	Moshi (R)	Rombo	Mwanga	Same	Hai
33.3	8.6	23.1	8.5	12.8	13.7

Source: The June 1988 publication of "Hali ya Uchumi wa Taifa, Mwaka 1987"

2.7.2 Mining

Majority of people involved in the mining sector in Kilimanjaro region are small-scale miners. Mining sector is faced with several problems. General problems include lack of financial and capital inputs for procuring machinery and equipment, transport infrastructure and facilities, and the lack of effective mining promotion in the general development programme.

CHAPTER THREE

3. SOCIO-ECONOMIC ASPECTS

3.1 POPULATION

Total population according to 1988 data was 1,108,699. The 1997 projections stands at 1,337,532. About 84.6% of the population is settled in the rural areas. Average population density is estimated to be 88.5 persons per sq. Km. Actual densities are as high as 700 people per sq. Km in the zone between 1,100 to 1800 metres above the sea level. While young children (both sex) consist of 31.3 % of the total population, old people, 55 years and above, consist of 20.1% of whom only 1. 6 live in urban areas.

Table 3-1 shows population projections between the year1996 to the year 2000. It also shows the population projections of children under 1 year, under 5 years and women aged between 15-49 years of age per district.

The population in Kilimanjaro region increased at an average of annual growth rate of 2.0% betwen 1978 and 1988. The growth rate was lower than the estimated national rate of 3.4% mainly due to emigration.

3.1.1 Population Distribution

The population density in Kilimanjaro vary from district to district.

The mostly populated rural areas which according to the 1978 census, had a population of more than 200 persons per square kilometre are Mkuu, Mashati, Usseri, Tarakea, Machame, East Vunjo, East Hai, and Central Hai divisions.

Most of the above mentioned divisions have a critical land shortage due to increasing population pressure and consequently become the main areas of out- migration.

Table 3-2 Kilimanjaro rural population density in 1967, 1978, and 1988

District	Total land area(sq. km)	Available land area(sq. km)	Population density (person/sq. km of available land.)1967		
			1967	**1978**	**1988**
Rombo	572	572	220	276	337
Hai	1,516	1,516	74	114	132
Same	5,872	3,906	25	34	44
Mwanga	1,677	1,625	32	46	60
Moshi Rural	1,169	1,169	214	267	293
Moshi Rural	N.A	N.A	N.A	N.A	N.A
Total	10,806	8,788	74	103	125

Excluding Forest reserve, Game reserves, National parks.

N.A= Not Applicable.

3.2 EDUCATION

Kilimanjaro region has got a number of different types of education facilities. This includes the primary, secondary and technical schools. Table 3-3 shows total enrolment, the number of qualified teachers, strams, pupils / school average and pupil / stream average.

Table 3-3 Facts on region

Facts	1987	1988	1989	1990	1991
Number of schools	696	691	692	703	701
Total enrolment ('000)	211	213	216	223	231
Number of qualified teachers	7,024	7,109	7,543	7,555	7,976
Number of streams	5,713	5,830	5,866	5,998	6,495
Pupils/School, average	304	308	314	317	320
Pupils per stream, average	37	37	37	37	36

Source: Table M.3, Kilimanjaro Regional Statistical Abstract, 1993

Table 3-4 Enrolment in public primary schools by district, sex and class, 1991.

District	Class	I	II	III	IV	V	VI	VII	Total
	Gender								
Rombo	Boys	3,495	3,183	4,608	2,927	2,698	2,302	1,999	21,212
	Girls	3,558	3,273	4,469	3,138	2,741	2,406	2,199	21,784
	Total	**7,053**	**6,456**	**9,077**	**6,065**	**5,439**	**4,708**	**4,198**	**42,996**
Mwanga	Boys	2,346	1,855	1,549	1,807	1,521	1,657	1,269	12,004
	Girls	2,095	1,845	1,579	1,712	1,535	1,575	1,242	11,583
	Total	**4,441**	**3,700**	**3,128**	**3,519**	**3,056**	**3,232**	**2,511**	**23,587**
Same	Boys	3,567	2,955	2,542	2,954	2,291	2,365	2,080	18,754
	Girls	3,259	2,826	2,605	2,777	2,450	2,387	2,023	18,327
	Total	**6,826**	**5,781**	**5,147**	**5,731**	**4,741**	**4,752**	**4,103**	**37,081**
Moshi (R)	Boys	6,098	5,588	5,151	5,332	4,793	4,457	4,264	35,683
	Girls	6,148	5,576	5,038	5,350	4,786	4,492	4,738	36,128
	Total	**12,246**	**11,164**	**10,189**	**10,682**	**9,579**	**8,949**	**9,002**	**71,811**
Hai	Boys	3,757	3,077	2,717	3,096	2,702	2,359	2,396	20,104
	Girls	3,484	2,979	2,724	2,976	2,665	2,384	2,564	19,776
	Total	**7,241**	**6,056**	**5,441**	**6,072**	**5,367**	**4,743**	**4,960**	**39,880**
******	Boys								
	Girls	1,803	1,366	970	1,199	883	761	834	7,816
	Total	**3,560**	**2,654**	**1,833**	**2,480**	**1,698**	**1,486**	**1,632**	**153,430**
Moshi (U)	Boys	21,020	17,946	17,430	17,697	14,820	13,865	12,506	115,284
	Girls	20,347	17,865	17,385	17,152	15060	14,005	13,600	115,414
	Total	**41,367**	**35,811**	**34,815**	**34,849**	**29,880**	**27,870**	**26,106**	**230,698**

Source: Table M.2, Kilimanjaro Regional Statistical Abstract, 1993

Key: (R) Rural

(U) Urban

Table 3-5 Shows the enrolment in public primary schools between 1987-1991

Gender ('000)	Year	Class						
		I	II	III	IV	V	VI	VII
Boys	1987	19	16	15	16	13	14	12
	1988	18	18	16	16	14	12	12
	1989	19	17	16	15	14	12	12
	1990	19	18	18	18	15	14	11
	1991	21	18	18	18	15	14	12
Girls	1987	19	16	16	16	13	13	13
	1988	18	18	15	15	15	13	13
	1989	18	18	17	16	14	14	13
	1990	18	18	17	17	14	14	14
	1991	20	18	17	17	15	14	14
Total	1987	38	32	31	32	26	27	25
	1988	36	36	31	31	29	25	25
	1989	37	35	33	31	28	28	24
	1990	37	36	35	34	28	28	25
	1991	41	36	35	35	30	28	26

Source: Table M.1, Kilimanjaro Regional Statistical Abstract, 1993

3.3 Health

Kilimanjaro region is adequately covered with different types of health facilities compared with other regions in the country. In 1996 it had 16 hospitals, 18 health centres and 361 dispensaries. Tables 3-7, 3-8 and 3-9 show the ownership of the facilities. The estimated number of health facilities per 10,000 people is 2.9, while the national figure is 1.7. *See* Table 3-10

The number of beds in hospitals is 1900, in dispensaries it is 389. The population per bed in Kilimanjaro region is 680, while the national figure is 882. *See* Table 3-11 , 3-12 and 3-13 respectively.

The common communicable diseases are cholera, plague, meningitis, dysentry and rabies. Table 3-14 and 3-15 gives some details of these diseases.

AIDS is a sensitive problem in the region. Table 3-16 and 3-17 show the cases of AIDS in the region between 1991 and 1996. Table 3-18 shows the Tuberculosis and leprosy detection and per 100,000 people.

Oral health care facilities are also available in Kilimanjaro region. Table 3-19 shows the attendance for oral health-care between 1993 and 1995.

The life expectancy in Kilimanjaro region was estimated to be 59 and the crude death rate was 10.2 in 1988. Tables 3-20 and 3-21 show the changes between 1978 and 1988.

Family planning and immunisation programmes are practiced in the region. Table 3-22 to 3-23 shows the data of these programmes.

There are a number of infectious diseases in the region. Table shows the cases and deaths of the common diseases.

Table 3-6 Hospital by ownership, 1996

	Government	Voluntary	Parastatal	Private	Total
Kilimanjaro	5	7	4	-	16
Mainland	81	81	17	45	224

Source: Health Statistics Abstract, Table 1.3.2, 1997

Table 3-7 Health Centres by ownership, 1996

	Government	Voluntary	Parastatal	Private	Total
Kilimanjaro	17	1	-	-	18
Mainland	284	43	6	11	344

Source: Table 1.3.3 Health Statistics Abstract, 1997

Table 3-8 Dispensaries by ownership, 1996

	Government	Voluntary	Parastatal	Private	Total
Kilimanjaro	131	74	24	132	361
Mainland	2,512	724	260	780	4,276

Source: Table 1.3.4 Health Statistics Abstract, 1997

Table 3-9 Population per health facility

	Population Estimate, 1995	Number of Health facilities	Estimated population per Health Facility	Number of Health Facilities per 10,000 population
Kilimanjaro	1,357,699	395	3,437	2.9
Mainland	29,264,815	4,844	6,041	1.7

Source: Table 1.3.5 Health Statistics Abstract 1997

Table 3-10 Number of beds in hospitals

	Government	Voluntary	Parastatal	Private	Total
Kilimanjaro	730	1,079	91	-	1900
Mainland	11,831	11,644	2,249	110	25,834

Source: Table 1.4.1 Health Statistics Abstract

Table 3-11 Number of beds in Health Centres

	Government	Voluntary	Parastatal	Private	Total
Kilimanjaro	344	45	-	-	389
Mainland	5,651	183	18	-	5,852

Source: Table 1.4.2 Health Statistics Abstract

Table 3-12 Population per bed

	Population 1995	Number of bed	Population per bed
Kilimanjaro	1,556,928	2,289	680
Mainland	27,941,103	31,686	882

Source: Table 1.4.4 Health Statistics Abstract

Table 3-13 Distribution of communicable doseases cases, 1994 and 1995

	Cholera		Plague		Meningitis		Dysentery		Rabies	
	1994	1995	1994	1995	1994	1995	1994	1995	1994	1995
Kilimanjaro	1,038	0	0	0	31	207	2,391	711	331	379
Mainland	5,013	2,220	547	833	2,228	27,94	28,896	107,558	1981	1932

Source: Table 2.1.18, Health Statistics Abstract, 1997

Table 3-14 Distribution of deaths caused by communicable diseases, 1994 and 1995

	Cholera		Plague		Meningitis		Dysentery		Rabies	
	1994	1995	1994	1995	1994	1995	1994	1995	1994	1995
Kilimanjaro	82	0	0	0	10	4	24	19	4	3
Mainland	467	263	47	74	274	305	404	116	39	24

Source: Table 2.2.19, Health Statistics Abstract, 1997

Table 3-15 Reported cases of measles, 1992 - 1994

	1992	1993	1994
Kilimanjaro	188	2,128	46
Mainland	13,015	15,635	3,558

Source: Table 2.1.20 Health Statistics, Abstract, 1997

Table 3-16 Communicative AIDS cases (1991 - 1996)

	1991	1992	1993	1994	1995	1996
Kilimanjaro	2,060	3,707	4,699	5,119	5,513	5,991
Mainland	44,195	60,066	73,572	79,445	83,351	88,467

Source: Table 2.1.21, Health Statistics Abstract, 1997

Table 3-17 Rate of AIDS per 100,000 population based on the based commulative cases

1992			1993			1996		
Population	**Rate**	**Rank**	**Population**	**Rate**	**Rank**	**Population**	**Rate**	**Rank**
1,205,853	144	6	1,231,444	185	5	1,325,231	215	15

Source: Table 2.1.22, Health Statistics Abstract, 1997

Table 3-18 Smear positive pulmonary Tuberculosis and Leprosy case detection rate per 100,000

	TB			Leprosy	
	1992	1993	1994	1992	1993
Kilimanjaro	27	39	1273	1.9	1.6
Mainland	48	57	1719	13	11

Source: Table 2.1.25, Health Statistics Abstract, 1997

Table 3-19 Annual return of attendance for oral health care by sex and age for 1993 and 1995

	Attendance 1993					Attendance 1995				
	Male	**Female**	**Total**	**Children**	**Adult**	**Male**	**Female**	**Total**	**Children**	**Adult**
Kilimanjaro	10,032	10,972	21,004	4,462	16,542	6,845	7,689	14,534	3,139	11,395
Mainland	108,424	136,421	245,845	57,910	187,935	90,704	114,786	205,490	54,640	150,870

Source: Table 2.3.1, Health Statistics Abstract

Table 3-20 Life expectacy at both, 1978 and 1988

	1978	1988		
	Total	**Male**	**Female**	**Total**
Kilimanjaro	58	57	62	59
Mainland	44	49	51	50

Source: Table 3.1.5, Health Statistics Abstract

Table 3-21 Crude Dealth Rate

	1978	1988		
	Total	**Male**	**Female**	**Total**
Kilimanjaro	10.2	12.2	8.5	10.2
Mainland	19.1	15.9	13.5	14.7

Source: Table 3.1.6, Health Statistics Abstract

Table 3-22 Family Planning tabulation on the number of health facilityreported,with family planning facilities and counterceptive consumption, 1996

		Contraceptive Consumption					
Health facility reported	**Heath facility with family planning**	**Oral pill**	**Injections**	**IUCDs**	**Condoms**	**Foam Tab**	**Diaphragns**
210	126	0	14,076	604	30,542	1,954	0

Source: Table 5.1.3, Health Statistics Abstract

Table 3-23 Family Planning for new acceptors, current users sterilization, 1996

	Rep. Target Women 15 - 44	**New acceptors**		**Current users**			
		Number	**Rate**	**Number**	**rate**	**Male**	**Female**
Kilimanjaro	107,413	5,408	5%	10,324	10%	0	215

Source: Table 5.1.4: Health Statistics Abstract

Table 3-24 Immunisations Programme, 1996

Health facility number	**Health facility with immunization service**	**Vaccine Cunsumption**				
		BCG	Polio	DPT	Measles	Tetanus
210	130	2,564	11,366	13,508	3,762	4,095

Source: Table 5.5.5, Health Statistics Abstract

Table 3-25 Immunization Coverage for Children under 1, 1996

BCG		**DPT 3**		**Measles**	
Percent	**No. Vacc/TPR**	**Percent**	**No. Vacc/tpr**	**Percent**	**No. Vacc/TPR**
34	17,546	36	17,546	43	17,546

No. Vacc/TPR = Number of Vaccination per Target Population of reporting Health Facilities

Source: Table 5.3.4, Health Statistics Abstract

Table 3-26 Infectious Diseases Week Ending (IDWE) reports to Ministry of Health, 1996

	Malaria		Cholera		CSM		Dosbites		Typhoid		Dysentry		Diarrhoea		Measles		Polio		Plague	
	Cases	Deaths	Cases	Deaths	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases
Kilimanjaro	7,976	47	40	1	41	2	563	-	56	-	408	7	1,775	7	157	-	-	-	-	-
Mainland	427,319	1,217	433	138	2,149	344	6,476	42	4,924	21	16,006	259	93,157	175	1,910	3	0	0	947	78

Source: Table 2.1.17 Health Statistics Abstract, 1997

3.4 TRANSPORT

Kilimanjaro has got road density of 8.96 km / 100 km^2, primary and secondary roads. There are nine railway stations in Kilimanjaro region, in a railway line. The main airdrome is the Kilimanjaro International Airport (KIA), and Moshi airport. KIA has modern facilities and a 3,600 runway, capable of handling any type of aircraft. Moshi airport is mostly used by non-commercial and charter air traffic. Other transport systems of bicycles, animals and animal-drawn carts are also used. The bicycle is used both in rural and urban areas. Postal and telecommunication facilities available in the region include post-offices, postal agencies, telephone, telex, radio-call and E-mail services. Table 3-27 show the details of road network by surface type.

Table 3-27 Road network in Kilimanjaro region (kms) by type of road and surface, 1992

Type of road	Surface		
	Tarmac (kms)	Gravel (kms)	Total (kms)
Trunk roads	230	177	407
Regional roads	66	147	213

Source: Table K.1, Kilimanjaro Regional Statistical Abstract, 1993.

Each year, different kinds of motor vehicles are registered. Table 3-28 hows the type and number of motor vehicles registered between 1991 and 1993.

Table 3-28 Newly registered motor vehicles in Kilimanjaro region 1991-1992/93

Vehicles by type	Vehicle type		
	1991	**1992**	**1993**
Automobiles	70	121	80
Lorries	10	28	7
Buses	6	6	7
Tractors	9	7	21
Motorbikes	51	37	24
Other	19	23	18
Total	165	272	157

Note: Lorries include trailers, tankers, etc.

Source: Table K.2, Kilimanjaro Regional Statistical Abstract, 1993

3.5 Water Supplies

Kilimanjaro Region is served with a number of water supply systems, both in rural and in urban areas. Table 3-29 shows the number of households in 1988 by district served with piped, well and other types of water sources. Table 3-30 shows the same data in percentage. Table 3-31 shows the water scheme coverage in rural areas in 1991.

Table 3-29 Households by district and type of water supply in Kilimanjaro Region, 1988

District	Piped water		Well water		Other supply		Not stated	Total
	within	outside	within	outside	within	outside		
Rombo	11234	15057	390	2740	1788	4421	18	35648
Mwanga	469	5847	2180	3061	1817	3112	0	16486
Same	3467	9342	4849	5681	658	6335	5	30337
Moshi Rural	12424	27389	816	1049	3875	17957	30	63540
Hai	3240	9397	2464	1482	4015	16715	5	37318
Moshi Urban	6798	14923	92	136	4	682	8	22643
Region's Total	**37632**	**81955**	**10791**	**14149**	**12157**	**49222**	**66**	**205972**

Source: Table C.13.1, Kilimanjaro Regional statistical abstract, 1993

Note . " within/outside" means within ' outside compound

Table 3-30 Households by district and type of water supply in Kilimanjaro Region, 1988 percentage distribution

District	Piped water		Well water		Other supply		Total
Rombo	within	outside	within	outside	within	outside	100
Mwanga	2.8	35.5	13.2	18.6	11.0	18.9	100
Same	11.4	30.8	16.0	18.7	2.2	20.9	100
Moshi Rural	19.6	43.1	1.3	1.7	6.1	28.3	100
Hai	8.7	25.2	6.6	4.0	10.8	44.8	100
Moshi Urban	30.0	65.9	0.4	0.6	0.0	3.0	100
Region's Total	**18.3**	**39.8**	**5.2**	**6.9**	**5.9**	**23.9**	**100**

Source: Table C.13.2, Kilimanjaro Regional statistical abstract, 1993

Note . " within / outside" means within ' outside compound.

Table 3-31 Status of water supply schemes coverage in Kilimanjaro Region (rural areas), 1991

District	Population served within 400m	No. Of villages with water supply scheme	No of villages without service
Rombo	128,200	30	25
Mwanga	65,700	28	25
Same	97,500	31	34
Hai	129,970	37	24
Moshi Rural	275,520	91	57
Total	**448,920**	**217**	**165**

Source: Table C.14, Kilimanjaro Regional statistical abstract, 1993

Table 3-32: Households by district and type of toilet in Kilimanjaro Region 1988

District	Type of Latrine				Total
	Flush inside	Toilet outside /shared	Pit latrine	None/not stated	
Rombo	429	126	34,070	1,029	35,654
Mwanga	113	89	15,175	1,107	16,484
Same	215	197	27,797	2,126	30,335
Moshi Rural	1,459	2,179	57,582	2,319	63,519
Hai	387	343	34,234	2,353	37,317
Moshi Urban	4,487	3,847	13,949	360	22,643
Region's total	**7,090**	**6,781**	**182,807**	**9,294**	**205,952**

Source: Table C.15.1, Kilimanjaro Regional statistical abstract, 1993

3.6 ECONOMIC ACTIVITIES

3.6.1 CULTIVATION

Cultivation is still the main economic activity in the region. the food crops grown include maize, wheat, sorghum, paddy, beans, Irish potatoes, sweet potatoes and cassava. The cash crops grown include cotton, cardamon, coffee, wheat and sunflower. Table 3-33 and 3-34 give some details on the food and the cash crops.

Table 3-33 Production and acreage of major food crops in Kilimanjaro Region (tonnes), 1990 / 91

Crops	Production (tonnes)	Hectares
Maize	86,000	69, 361
Wheat	4,500	22,72
Sorghum	600	568
Paddy	26,000	5,766
Beans	31,000	33,988
Irish Potatoes	22,000	2,380
Sweet Potatoes	59,000	6,150
Cassava	11,000	5,660
Sunflower	2,400	1,828

Source: table G.2, Kilimanjaro Regional Statistical Abstract, 1993

Table 3-34: Sales of cash crops by kind of cash crop in Kilimanjaro Region 1986/87 - 1990/91 ('000 kgs)

	year				
Crops	1986/87	1987/88	1988/89	1989/90	1990/91
Cotton	445	513	346	569	569
Cardamon	48.5	5.24	6	10	11
Coffee	16,500	1,9526	1,9520	16,580	16,584
Wheat	1,250	1,250	895	1,275	4,510
Sunflower	265	336	615	1,870	1,524

Source: Table G.3, Kilimanjaro Regional Statistical Abstract, 1993

3.6.2 LIVESTOCK

In 1984 country had a livestock population of 13.5 million herd of cattle, 10 million goats, 150, 000 asses and 22 million chicken and ducks (Livestock Census, 1984).

According to FAO statistics, 35 million hector were under permanent pastures. FAO findings indicate that in spite of this abundant grazing land, wide distribution of livestock is limited in that 60% of cattle, sheep and goats are kept on 3.5 million hector or a mere 10% of the land.

Table 3-35 Kilimanjaro livestock population and distribution by district, 1984 census.

Livestock Classes						
District	Cattle	Goats	Sheep	Donkeys	Horses	Total A U
Hai	87,838	58,939	42,608	1,682	47	74,741.2
Moshi	105,291	115,242	52,572	174	35	96,745.4
Rombo	48,749	167,300	64,993	-	-	75,707.0
Mwanga	61,390	41,576	23,303	136	-	49,948.8
Same	112,737	29,319	45,920	3,518	-	96,207.0
Total	416,105	462,376	229,396	5,510	82	393,349.4

Source Regional Livestock Development Office, Kilimanjaro.

3.6.3 Livestock Composition

The Kilimanjaro region had a total of 393,349 animal units (AU), including 416,005 cattle, 462,376 goats, 229,396 sheep, 5,510 donkeys and 82 horses, in 1984. In 1991/91 there were 431, 000 cattle, 237,000 sheep and 458,000 goats.

3.6.4 Animal Production

The region has diverse ecological conditions which give rise to a wide range of livestock keeping systems. They range from stall- feeding (zero-grazing) and intensively raised livestock by small holders in more favourable locations of the high-altitude, high-rainfall areas to extensive herding where low and erratic rainfall precludes agriculture.

The production both in quantity and quality is low. Productivity of individual animals and herds is relatively poor. Factors which have been identified to contribute the low productivity are related to the very nature of the indigenous livestock kept. The animals are known to be late maturing, with long calving intervals and high calf-mortalities. Parastatal and big private ranches, and dairy farms in the other hand, are the production units which gives the best results. These are the well managed establishments which maintain high standards of animal husbandry, including disease control, animal nutrition and record keeping.

Small holder dairy farmers who intensively rear their animals under zero-grazing system are progressively becoming important milk producers. These do keep grade animals and pure exotic breeds which are replacing low-milk producing indigenous Zebu.

Hides and Skins

Exact figures on the production of hides and skins in the region are not available. In particular, those produced in villages are collected by unauthorised traders and disappear mysteriously unrecorded. Reliable figures, therefore, are those obtained from official abattoirs and slaughter slabs.

Table 3-36 Hides and skins production in Kilimanjaro Region, 1986

Cattle	Sheep	Goat
39,771	3,611	13,750

Source Regional Livestock Development Office, Kilimanjaro.

Dairying has high popularity in the region, perhaps more than elsewhere in the country. The region is leading in having the highest number of dairy cattle in the country. It is estimated that about 50% of the country's total dairy herd is raised in this region.

There were 68,096 animals in Kilimanjaro in 1984, most of which being kept by small holders under zero-grazing system - a common feature of animal husbandry in the coffee-banana highland Of Mt. Kilimanjaro. Over 72% of these dairy animals are in Moshi (both Urban and Rural), Hai and Rombo districts.

3.6.5 Livestock development problems

Grazing land

Grazing land scarcity may be singled out to be the prominent problem, particularly in the high agricultural crop potential areas of Kilimanjaro. The situation is more tense in the districts of Moshi, Hai and Rombo. The districts of Mwanga and Same have this problem more pronounced in the highlands of the Pare range of mountains and their immediate lowlands.

In these areas, there is virtually no open land for grazing, and as such, livestock, mainly cattle, are subjected to stall-feeding (zero-grazing). Small stocks are usually tethered along footpaths and roads.

The established fact is that increased human population as discussed earlier has led to sub-dividing of the already limited land among members of a family into smaller fields, for agricultural crops production, thus leaving no areas for grazing.

The case is rather different in lowlands, again, because of the increased human population in these highlands, surplus population has moved into, and acquired large portions of the land formally grazingland, for agriculture. These phenomenon has led to a reduction of grazing land due to agriculture expansion, relegating livestock keeping to lower, potential higher-risk marginal areas. Almost always this situation is brought about by poorly-planned expansion of agriculture into grazing land.

Pasture and Water

Pastures, both in quantity and quality in most parts, especially in the lowlands, as always is the case, are subjected to seasonal variations, much in response to wet-dry seasons.

Animal Diseases

Notorious and prevalent diseases documented and which pose a threat in almost all the districts in Kilimanjaro are East-Coast Fever (ECF) and other tick-borne diseases, interval parasites and trypanosomiasis, which is transmitted by the tse tse flies.

Tse tse flies problem in the region is significantly felt in Mwanga and Same districts.

Other diseases of a sporadic nature include foot and month disease (FMD), mastitis, Black quarter, Anthrax rabies, malignant catarrhal fever, Haemorrhagic scephicaemia, Rinderpest, contagious Bovine Pleuropnoumonia (CBPP), Tuberculosis (TB), and Brucellosis.

Inadequate Veterinary Services

The crucial aspects are veterinary drugs, equipment and infrastructure. Regional and district authorities complain about the inadequacy of drugs and equipment. The few and irregularly supplied items, coupled with inefficient distribution at field level has been a problem of major concern in all districts. Curative as well as prophylactic drugs are difficult to get. The available drugs are expensive for most of the livestock owners to buy. As a result, most dips do not operate. Dip testing centres (DTCS) are inoperative for lack of chemicals and reagents used for dip wash analysis. Consequently, control of ticks through dipping is less effective than is expected, because most dips are understrength. It has been observed that about 20% of the dips do not function, for the lack of water, especially in dry seasons. Other dips are damaged and require renovation works.

3.6.6 Beekeeping

Distribution of vegetation and hives

There are natural forests and agricultural crops in Kilimanjaro which attract bees. The natural forests attracting bees include the Acacia trees found in Mwanga and Same districts.

Agricultural crops which attract bees include sisal, coffee, banana and beans.

Beehives are of two types; traditional and modern, whose distribution is as given in table 3-37

Table 3-37 Distribution of hives in Kilimanjaro Region, 1987

District	Traditional hives	Modern hives	Total
Moshi rural	10,135	115	10,250
Hai	67,207	394	67,601
Rombo	384	6	390
Mwanga	60,000	110	60,110
Same	16,550	38	16,588
Total	**154,276**	**663**	**154,939**

A traditional or local hive can be described as a primitive (unimproved) item or equipment for keeping a bee colony for the production of honey and beeswax. This type of hive can be made of bark, log, pot, gourd or reeds. Log hives are common in Kilimanjaro.

A modern hive is an improved (modernised) item or equipment for a careful keeping of a colony-production of honey and beeswax.

3.6.7 Beekeeping Production

Beekeeping methods

Two methods used are:

- Traditional Beekeeping (using traditional hives)
- Modern Beekeeping (using modern hives)

Traditional Beekeeping in Kilimanjaro is practised on a much larger scale than the modern Beekeeping.

Bee products

These include honey, beeswax and propolis. However, the exploitation of propolis is on a very small scale.

3.7 Fisheries

3.7.1 Fishing in Kilimanjaro

Traditionally, the people of Kilimanjaro region are not fishermen; hence fishing activities are less important in the region's economy.

All the fishing activities in Kilimanjaro region are carried out in freshwater habitats.

The freshwater bodies include Nyumba ya Mungu dam, Kalimawe, Mworoworo, Dindara and small lakes such as Jipe and Challa, and river Kikuletwa and Ruvu.

Most of the freshwater bodies fluctuates seasonally, and are alkaline in nature.

The most common species include *Tilapia* spp. (*Perege*), *Clarias* spp. (*Kambale*), *Oreochromis* spp. (*Perege*), etc.

There are a variety of fishing gears used in the freshwater bodies, among which are Gill nets (*Nyavu*), Traps (*Dema*), and Hard-line rods and hooks (*Mishipi*).

3.7.2 Fish farming

In the past, fish farming was regarded as sport fishing run by foreigners in the cold waters of Kilimanjaro region. Trout fishing was the most common one and was too expensive to be run.

Conventional fish farming is a recent venture in the region and has been properly managed. There are about 106 fish ponds in the region, the main fish cultured being *Areochromis niloticus* (Nilp Tilapia).

3.7.3 Fish Production

Fish Processing

Most of the fish handling and processing are done traditionally, modern equipment being rarely applied and modern equipment scarce.

Icing, chilling, or freezing facilities are located in Moshi and at Nyumba ya Mungu. Such preservatory or storage facilities re completely absent or broken down in rural and remote areas where fish is most abundant. The common traditional fish processing methods include smoking, frying, sun-drying, baking on open fires, etc.

Fish Marketing

A big portion of fresh and processed fish is consumed in the urban areas where the demand for fish is higher.

PART II KILIMANJARO MAIN ENVIRONMENTAL ISSUES AND THEIR IMPLICATIONS FOR DEVELOPMENT

CHAPTER FOUR

4. ENVIRONMENTAL ISSUES

4.1 Mount Kilimanjaro forests degradation

Mount Kilimanjaro forests are disappearing at an alarming rate, the sole culprit being the forest fires. The fire which broke out in 04th September, 1997, for instance, consumed what KINAPA (the Kilimanjaro National Park Authority) estimates to be 1.09 square kilometres of bush and forest, representing 10900 hectors of forest cover when it was put out in the third week of September.. The fire started at the Machame hut where tourists normally camp briefly before proceeding with their journey It then spread to Shira plateau, on the western side and Umbwe slopes on the eastern side. It reached as high as 12,000 feet above the sea level.

There was a serious fire outbreak earlier in January 1997, ravaging thousands of hectors of forest cover. It caused a lot of damage before mother nature intervened - heavy rains started two months later and mercifully put off the fire.

The fire is depleting the forest resources and scare tourists, leading to a downward spiral in the tourist business.

The regional authorities attribute the cause of recurrent outbreak of forest fires to outdated methods of burning and clearing farms: the traditional way meant to scare away the dangerous animals and insects in an area before cultivation. The blame is also shouldered on the crude honey-harvesting methods employing fire, as well as on the tourists and porters who carelessly throw away burning cigarette remains as they climb the mountain.

Some residents, on the contrary, attribute that the frequent fire outbreaks are caused by some acts of sabotage. The residents say some of them, especially the pastoralists, are angered by the government decision to confiscate their livestock caught grazing in the KINAPA area.

KINAPA management say about 62 herds of cattle were confiscated in the 1997 June-September period, though residents put the number at more than 1,000. Such decisions might have prompted the wrath of the resident , who in anger resorted to sabotage by setting the forest reserves ablaze.

On the other hand, some other residents point accusing fingers on foreigners or people acting at the orders of a foreign power. The saboteurs allegedly mingle with genuine tourists to conceal their evil intentions, making it a custom for the fires to start near tourist tracks.

The encroachment of the forest reserves by agriculturists also worsen the situation. For instance, a local daily reported the decimation of the Rongai forest reserve due to agricultural activities, apparently permitted by the reserve authorities.

The outcome of this molestation of forest cover have already been felt by the Kilimanjaro residents. All the rivers and some other water sources in the Rombo district natural forest were reportedly dry by early October, 1997 following the encroachment of the agriculturists. The residents experienced an unprecedented drought, when even the perennial rivers dried. At Tarakea-Kamdawi, for example, the Ushululu water source dried completely. The Kilimanjaro mountain snow could not be seen from Rombo, whereas banana, coffee and other trees especially at Tarakea , Usseri and Mashati divisions wilted. The drought at the Rongai forest may also be attributed to the planting of *eucalyptus* trees.

4.2 Moshi Wastewater Management

Moshi town, the regional headquarters and the only sewered town in the Kilimanjaro region, face a big problem of proper management of wastewater. Handling of wastewater is a headache to residents, reaaching to nightmarish propotions.

The situation is compounded by the fact that the wastewaster disposal system is in shambles. Earlier regarded as the most efficient, the Moshi sewage treatment plant is now unable to handle the wastewater form the municipality.

It is reported that the plant is able to treat only 50 percent of wastewater. The rest is being flushed into Rau river untreated.

The plant, construction of which was completed in 1962 and was supposed to be extended in three phases, uses a biofilter plant to treat the wastewater.

The completed part was designed to serve 12,000 residents with a capacity of processing about 1,500 cubic metres of wastewater per day.

Presently, the plant is handling up to 15,000 cubic metres of wastewater per day, more than ten times its designed capacity.

The plant has become extensively dilapidated, particularly at the sludge pumping station and stone-filter mechanism .

The residents in the neighbourhood say lack of equipment has reduced the plant to a health hazard. A number of infectious diseases in the area have been attributed to mishandling of waste at the plant.

The plant becomes increasingly a burden to the Moshi Municipal authorities, as about 18 million Tshs is being spent annually for operation and maintainance of the plant, whereas about 400 million Tshs are requred for major rehabilitation of the plant.

It is proposed to construct wastewater stabilisation ponds as the alternative to the existing plant. The stabilisation ponds project is poised to cost about 1.45 billion. The World Bank, through the Urban Sector Engineering Project has agreed to fund the programme.

CHAPTER FIVE

5. CLIMATIC PROFILE OF KILIMANJARO REGION

5.1 INTRODUCTION

The Region has two rain seasons which are short and long rains. The short rains are commonly known as Vuli rains and the long rains are known as Masika rains. The short rains are normally received during the months of October – December. These rains are generally unrealiable in terms of their onset ceassation and their effective and their effective impact on crops. The long rains are normally reliable and they fall during the months of March – May. All the rain seasons are associated with the southward and northward movement of the ITCZ (Inter tropical Convergence Zone0 which is rain generating mechanism due to the convergence of the southeast and northeast monsoons over the region. The short rains are experienced when the ITCZ is moving soutwards and the long rains are received when the ITCZ is moving northwards.

The period June to October is a generally dry period, but on few occassions rainfall can be experienced over high grounds due to orographic effects. On years when the short rains fail, water supply becomes a problem to both animals and plants and as a result becomes a common phenomena. Cold temperatures are normally experienced during June to August when we have the south east monsoons.

The south eastern part of the region which covers the lower part of Same District is generally dry with mean annual rainfall ranging from 300 mm to 800 mm. The high grounds are normally wetter with mean annual rainfall ranging from 800 mm to 2500 mm.

The aim of this data presentation is to identify climatic change and environmental implications on the status of soil quality, agricultural activities, ground and surface water etc.

5.2 ANALYSIS

The analysis was based on climatological data obtained from the Directorate of Meteorology Dar es Salaam. Monthly rainfall for at least 30 years covering the period 1960 to 1990 was selected from 5 stations in the region. The stations were selected on the basis of the availability of complete data set.

Long term monthly and annual averages were computed for all the selected stations. Comparison between actual and mean monthly rainfall for the period (1960-1990) was computed in order to check for the deviation from normal. The results were plotted on linear graph. The graphs indicated that the annual rainfall over this region is oscillator in nature but with a general trend of decrease since late sixties.

Descriptive time series analysis was carried out for the five stations. Three point moving average was applied to smooth the original annual time series so that trends and other patterns can easily be observed. In support of the rainfall data, other meteorological variables were also taken into consideration in order to broaden the picture. The included parameters were mean maximum and minimum temperature, radiation, sunshine hours, relative humidity and wind speed at 1500 local time from all the selected stations.

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 9though few) were replaced by long term mean of that station.

5.3 Annual Rainfall Time Series

For annual rainfall time series analysis, most stations show oscillatory pattern.

(March-May) Rainfall

Variable pattern has been observed in almost all stations.

(October-December) Rainfall

Oscillatory pattern has been observed in most stations.

5.4 TEMPERATURE

There were oscillatory in nature.

5.5 METHODOLOGY

As for temperature, KIA, Moshi, Same and Lyamungu stations were used.

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

5.6 List of Stations

Moshi Meteorological Station

Same Meteorological Station

Lyamungu Agromet Station

KIA Meteorological Office

Rombo District Office

Appendix 1

BIBLIOGRAPHY

[1] Bureau of Statistics, (1994), Kilimanjaro Regional Statistical Abstract 1993, Dar es Salaam.

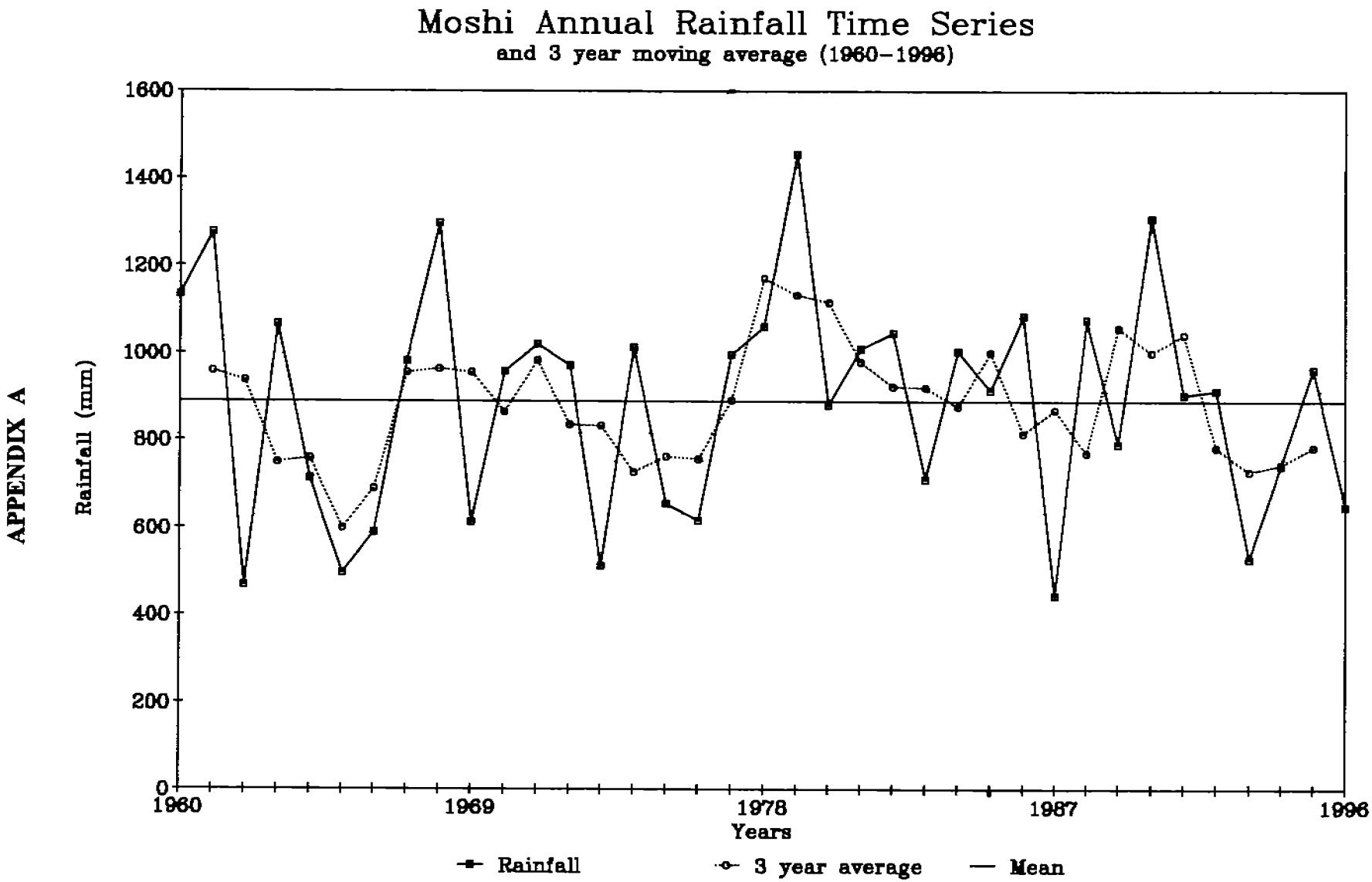
[2]. Ministry of Health, (1997), Health Statistics Abstract, 1997, Dar es Salaam

Appendix 2

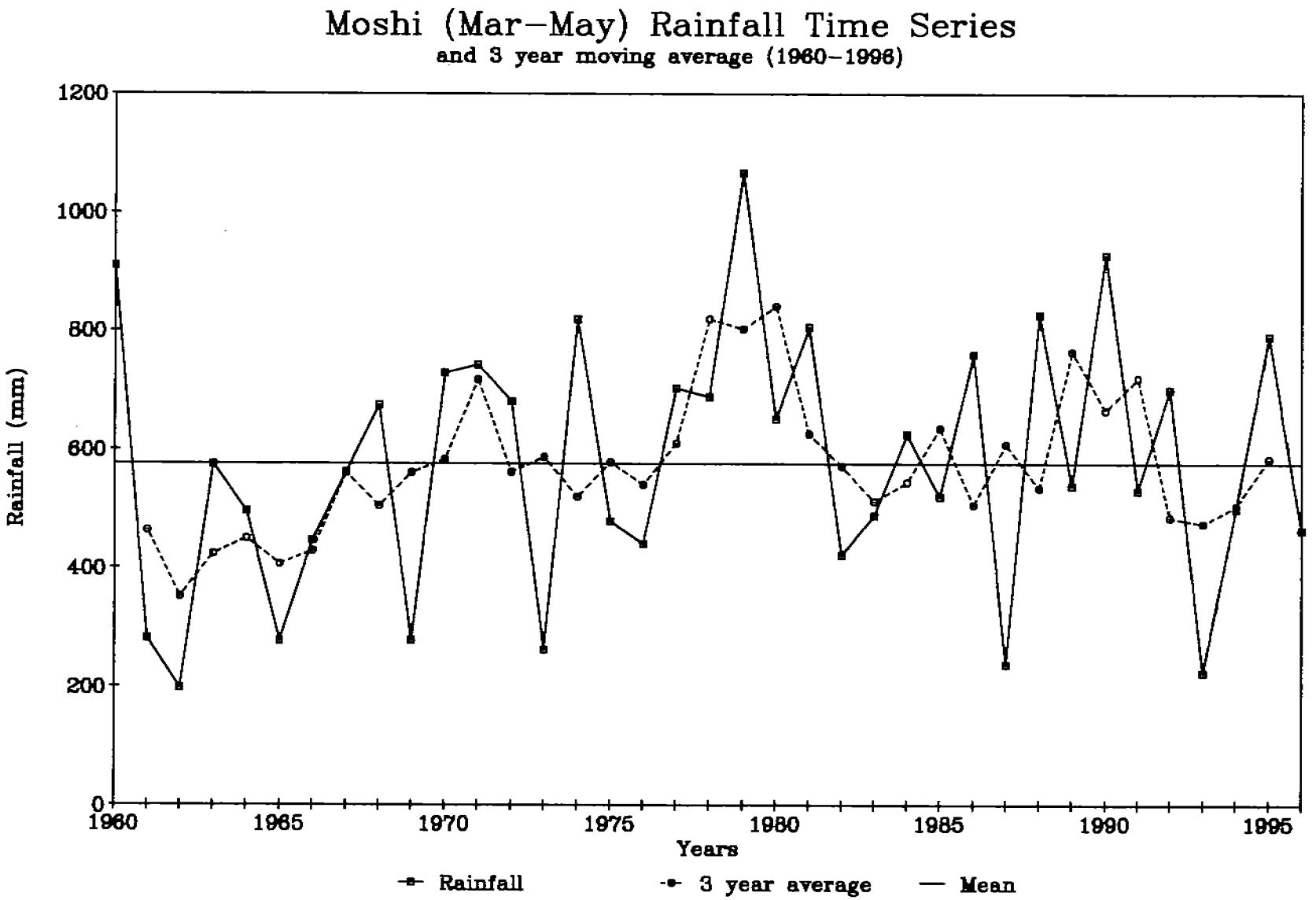
6. CLIMATIC PROFILE OF KILIMANJARO REGION

Appendix A -	Moshi Annual Rainfall Time Series
Appendix B -	Moshi (March-May) Rainfall Time Series
Appendix C -	Moshi (October-December) Rainfall Time Series
Appendix D -	Moshi Mean Annual Temperature Time Series
Appendix E -	Moshi Mean Meteorological Parameters
Appendix F -	Same Annual Rainfall Time Series
Appendix G -	Same (March-May) Rainfall Time Series
Appendix H -	Same (October-December) Rainfall Time Series
Appendix I -	Same Mean Annual Temperature Time Series
Appendix J -	Same Mean Meteorological Parameters
Appendix K -	Lyamungu Annual Rainfall Time Series
Appendix L -	Lyamungu (March-May) Rainfall Time Series
Appendix M -	Lyamungu (October-December) Rainfall Time Series
Appendix N -	Lyamungu Mean Annual Temperature Time Series
Appendix O -	Kilimanjaro Annual Rainfall Time Series
Appendix P -	Kilimanjaro (March-May) Rainfall Time Series
Appendix Q -	Kilimanjaro (October-December) Rainfall Time Series
Appendix R -	Kilimanjaro Mean Annual Temperature Time Series
Appendix S -	Kilimanjaro Mean Meteorological Parameters
Appendix T -	Rombo Annual Rainfall Time Series
Appendix U -	Rombo (March-May) Rainfall Time Series
Appendix V -	Rombo (October-December) Rainfall Time Series

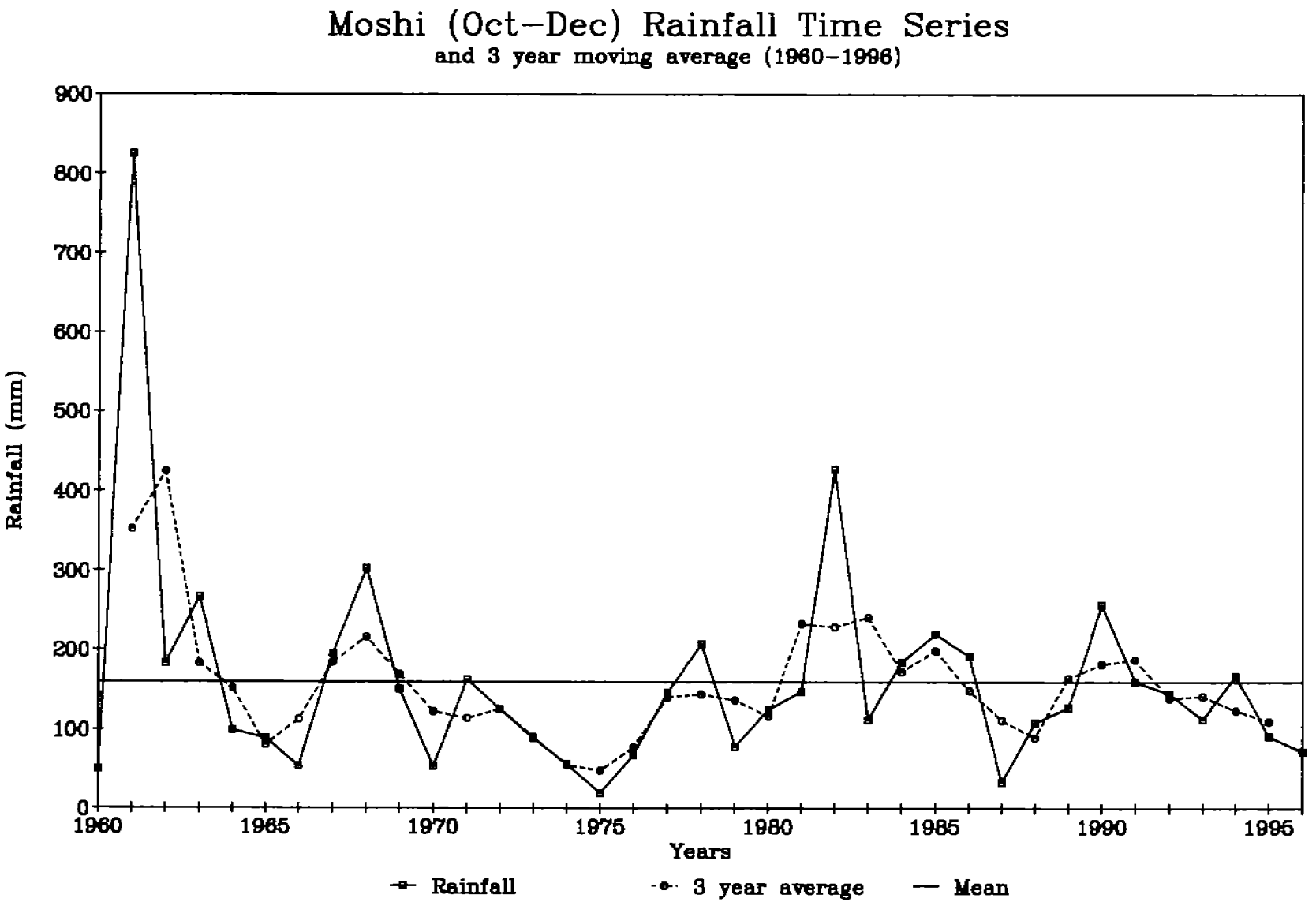
APPENDIX A


Moshi Annual Rainfall Time Series
and 3 year moving average (1960–1996)
Rainfall (mm)
1600
1400
1200
1000
800
600
400
200
0
1960
1969
1978
1987
1996
Years
Rainfall
3 year average
Mean

APPENDIX B


Moshi (Mar–May) Rainfall Time Series
and 3 year moving average (1960–1996)
Rainfall (mm)
1200
1000
800
600
400
200
0
1960
1965
1970
1975
1980
1985
1990
1995
Years
Rainfall
3 year average
Mean

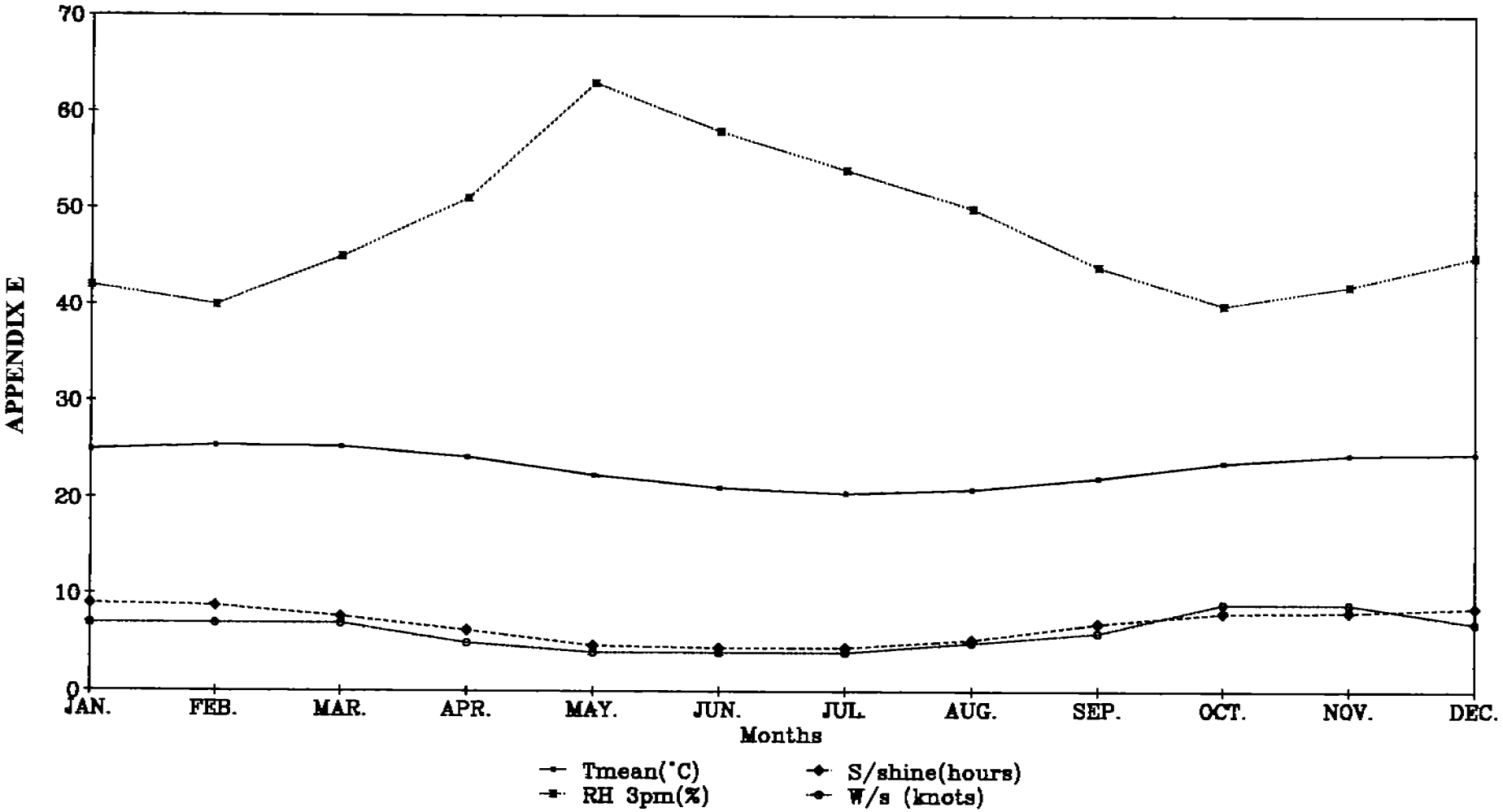
APPENDIX C


Moshi (Oct–Dec) Rainfall Time Series
and 3 year moving average (1960–1996)
Rainfall (mm)
900
800
700
600
500
400
300
200
100
0
1960
1965
1970
1975
1980
1985
1990
1995
Years
Rainfall
3 year average
Mean

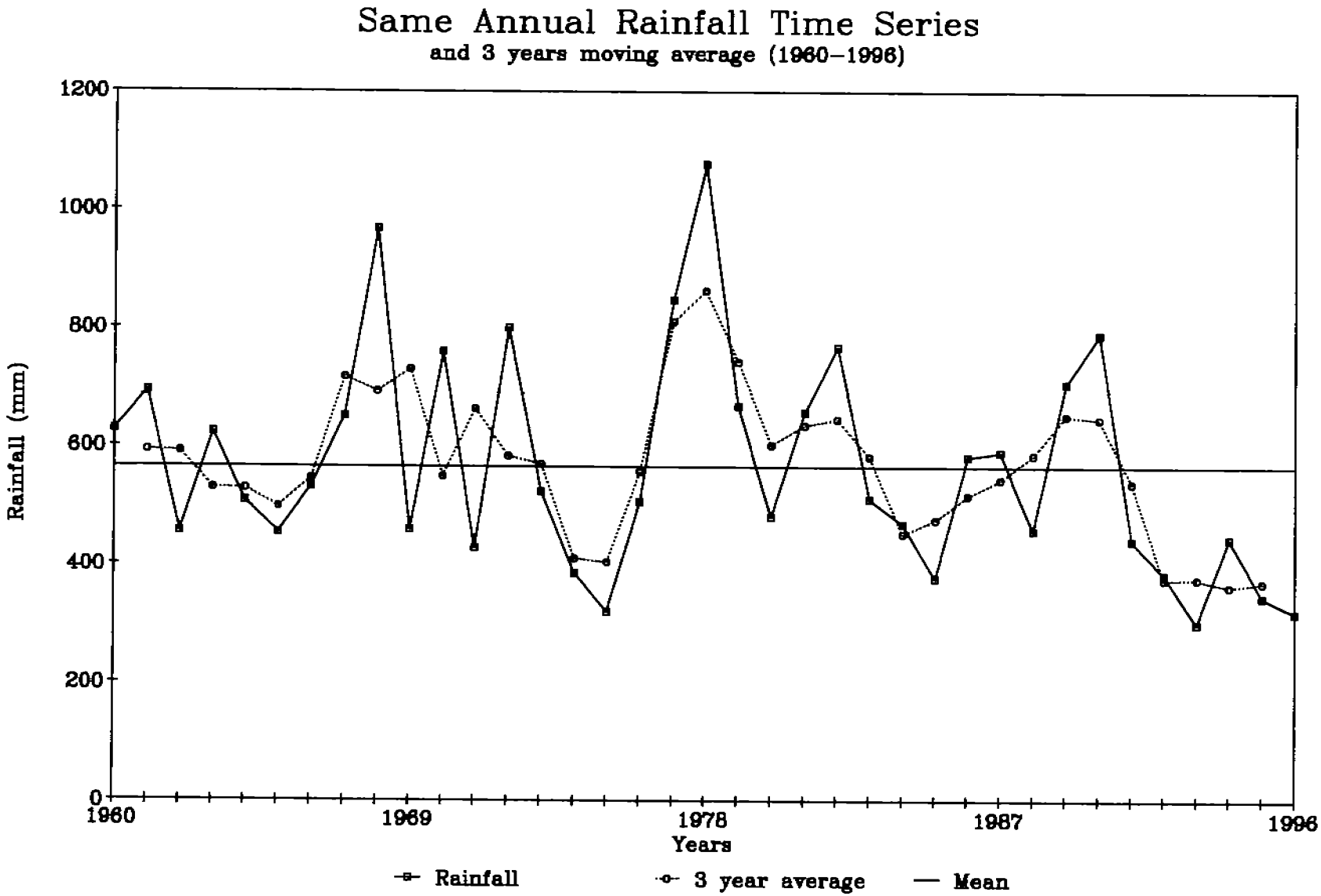
APPENDIX E

Moshi Mean Meteorological

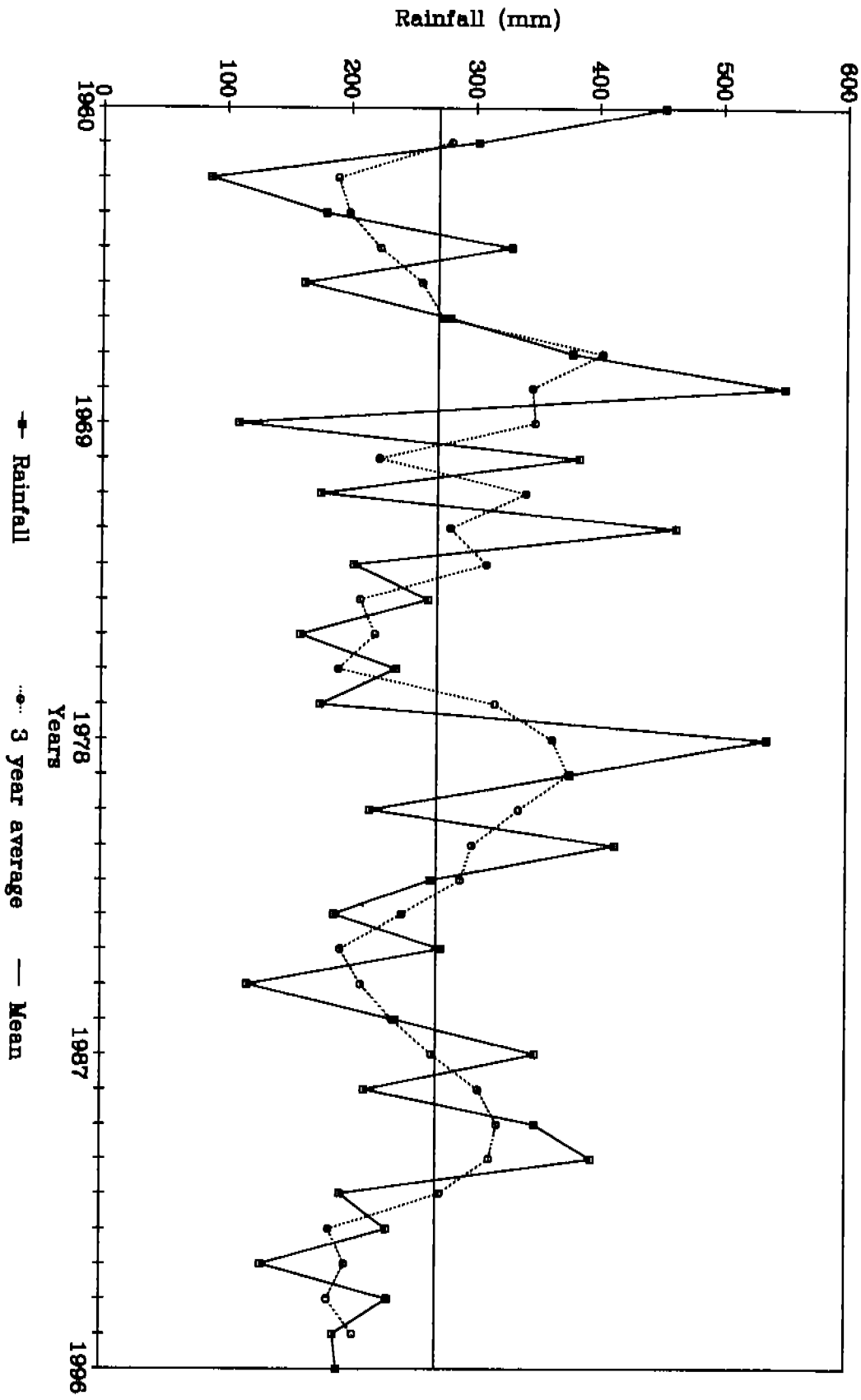
Parameters



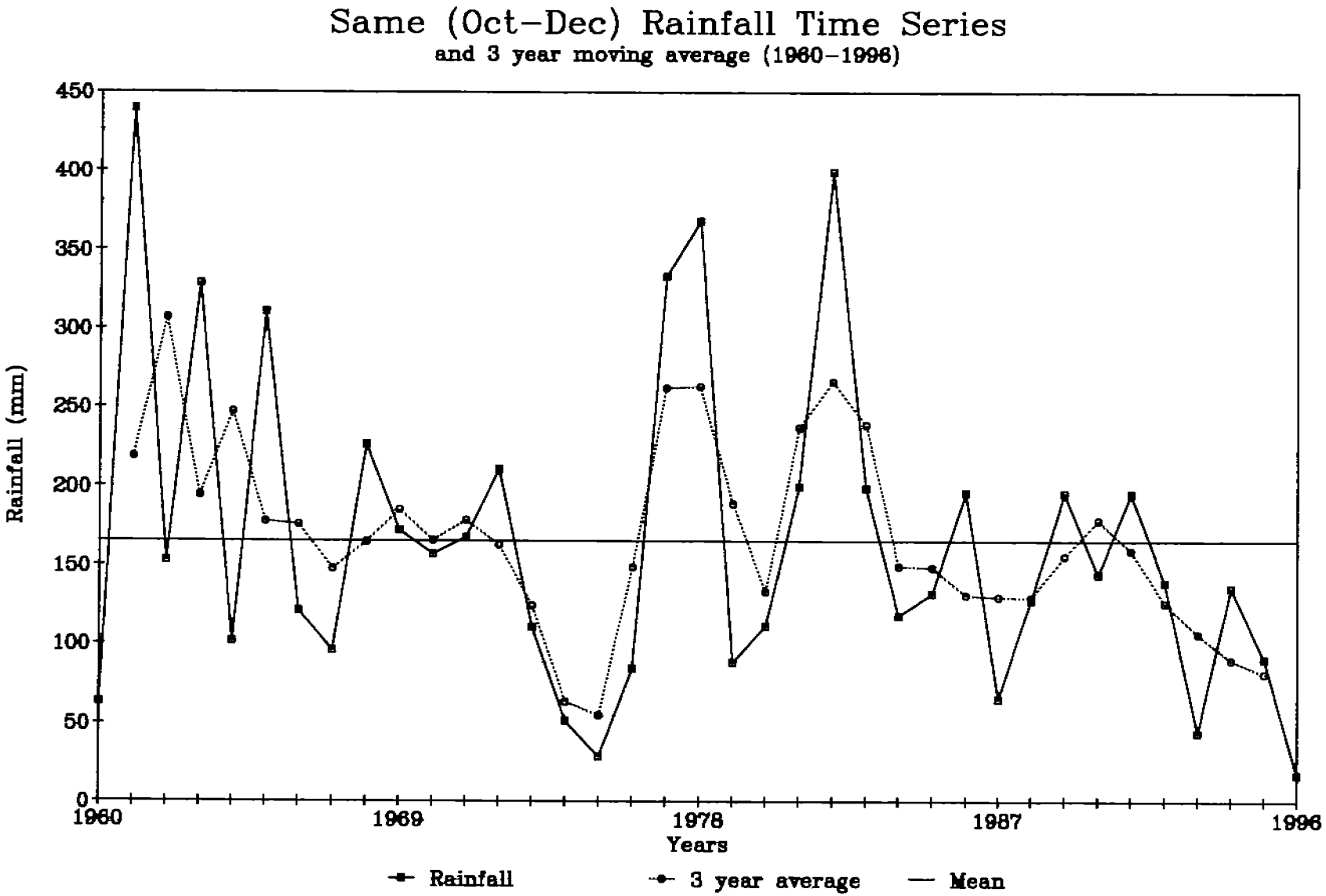
APPENDIX F


Same Annual Rainfall Time Series
and 3 years moving average (1960–1996)
Rainfall (mm)
1200
1000
800
600
400
200
0
1960
1969
1978
1987
1996
Years
Rainfall
3 year average
Mean

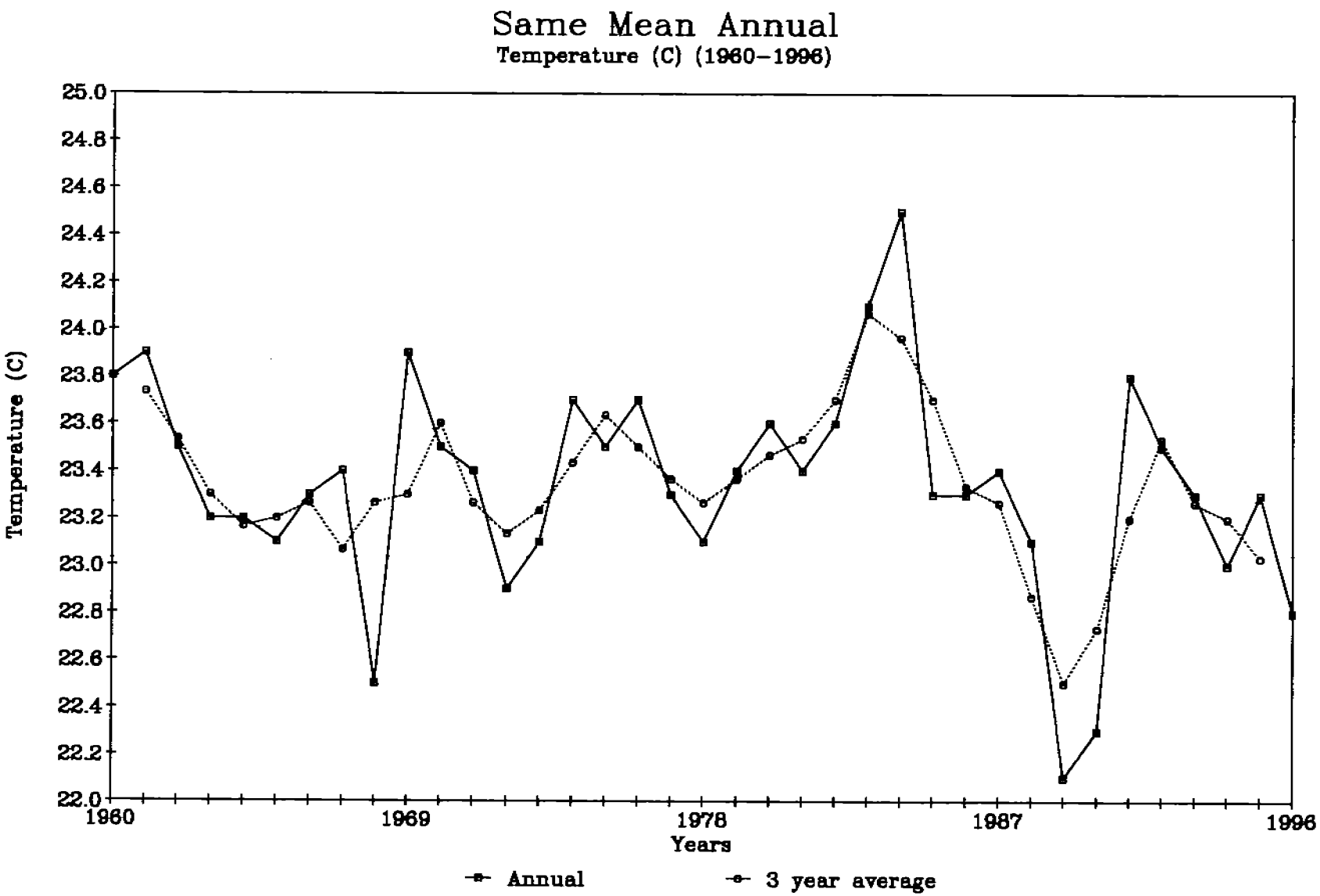
APPENDIX G


Same (Mar–May) Rainfall Time Series
and 3 year moving average (1960–1986)
Rainfall (mm)
0
100
200
300
400
500
600
1960
1969
1978
1987
1996
Years
Rainfall
3 year average
Mean

APPENDIX H

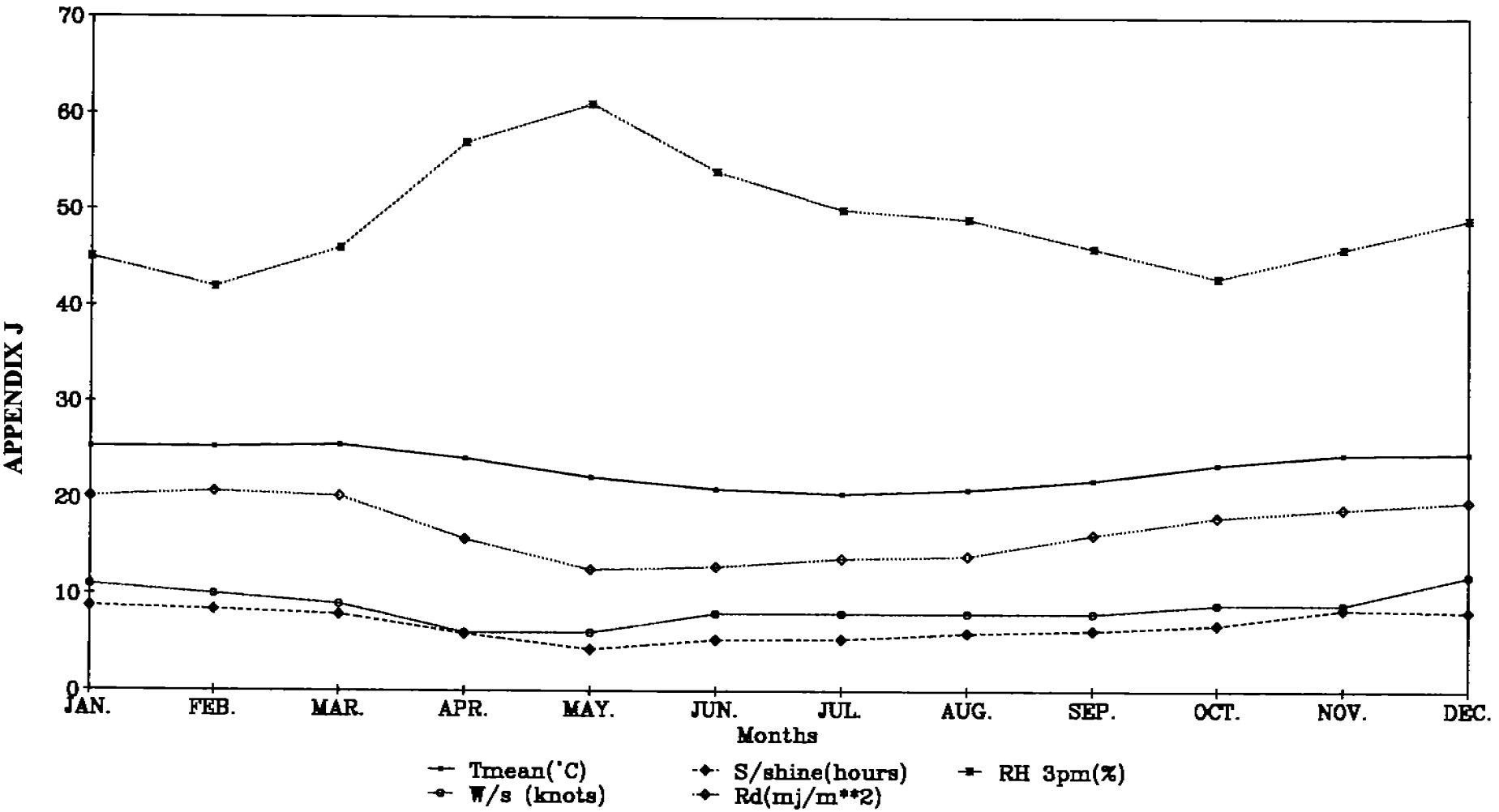

Same (Oct–Dec) Rainfall Time Series
and 3 year moving average (1960–1996)
Rainfall (mm)
450
400
350
300
250
200
150
100
50
0
1960
1969
1978
1987
1996
Years
Rainfall
3 year average
Mean

APPENDIX I

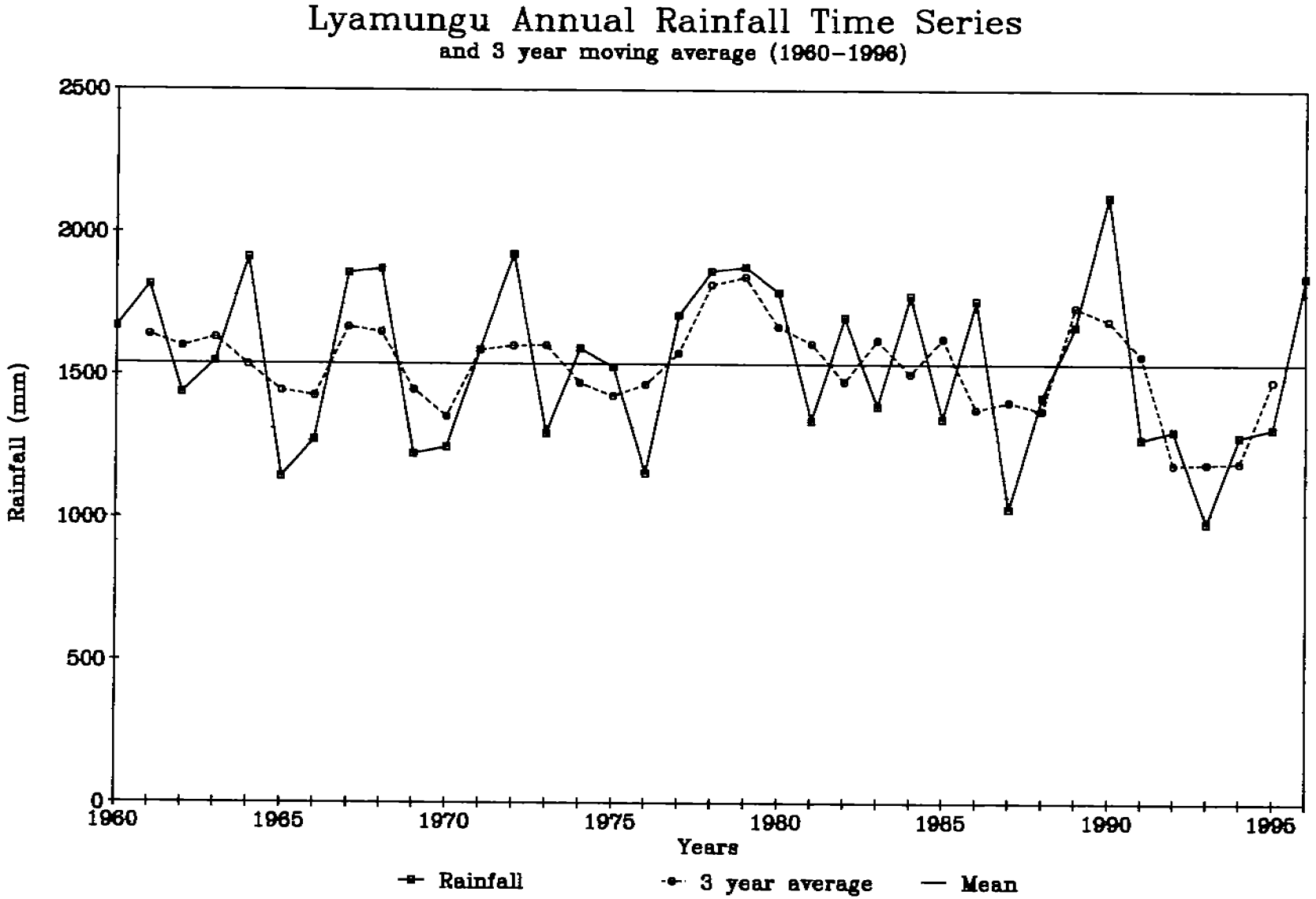

Same Mean Annual
Temperature (C) (1960-1996)
Temperature (C)
25.0
24.8
24.6
24.4
24.2
24.0
23.8
23.6
23.4
23.2
23.0
22.8
22.6
22.4
22.2
22.0
1960
1969
1978
1987
1996
Years
Annual
3 year average

APPENDIX J

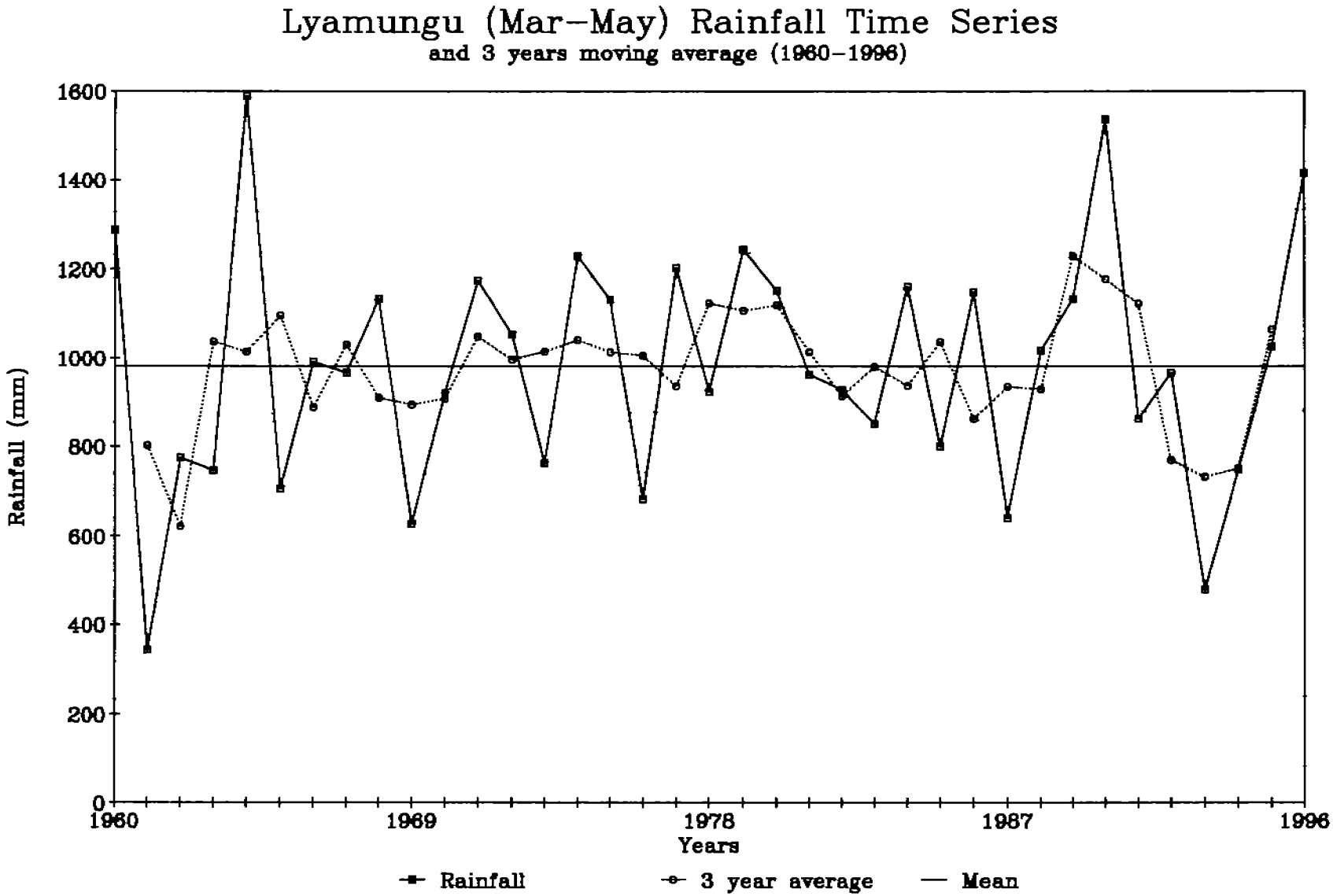
Same Mean Meteorological Parameters



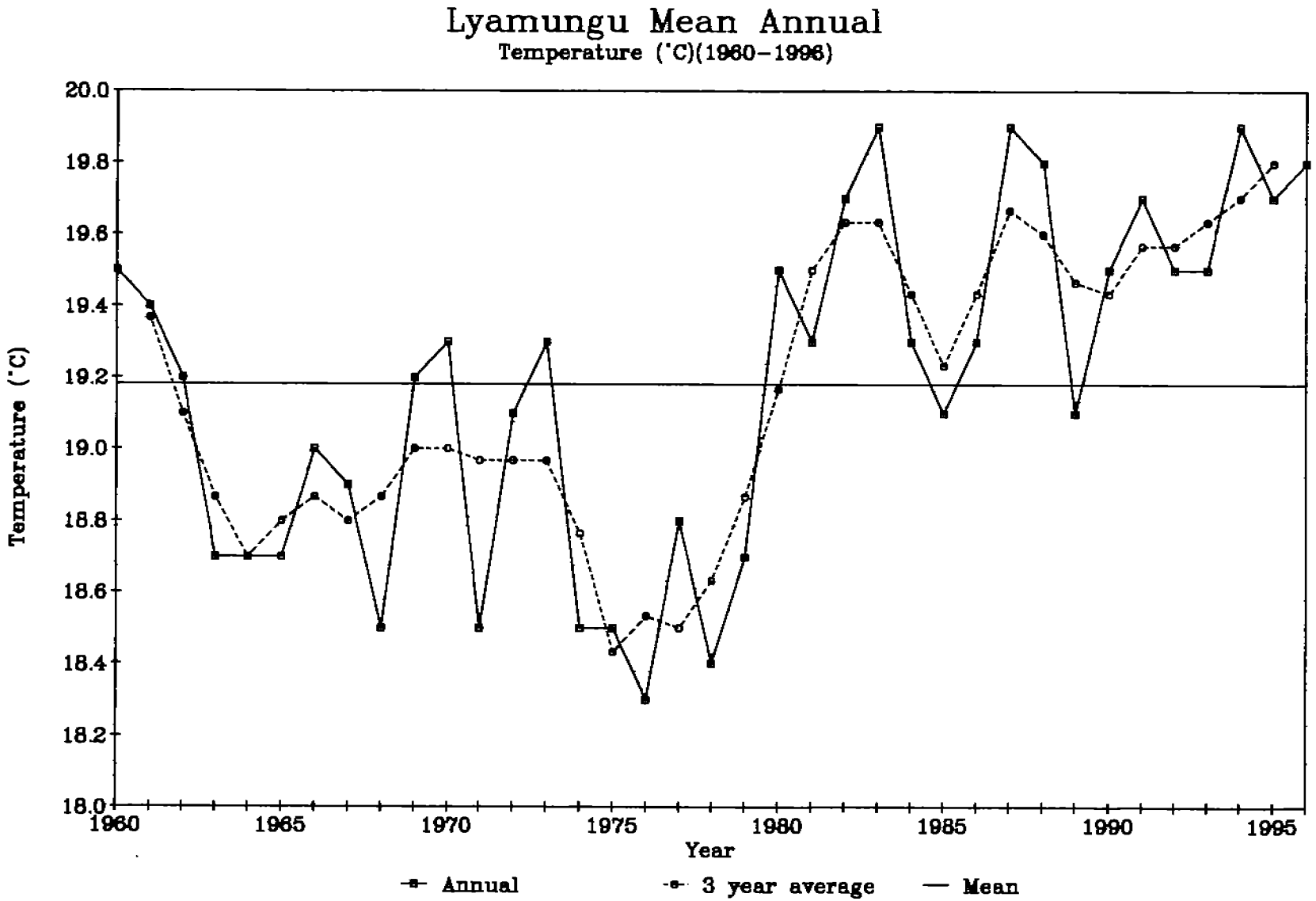
APPENDIX K


Lyamungu Annual Rainfall Time Series
and 3 year moving average (1960-1996)
Rainfall (mm)
2500
2000
1500
1000
500
0
1960
1965
1970
1975
1980
1985
1990
1995
Years
Rainfall
3 year average
Mean

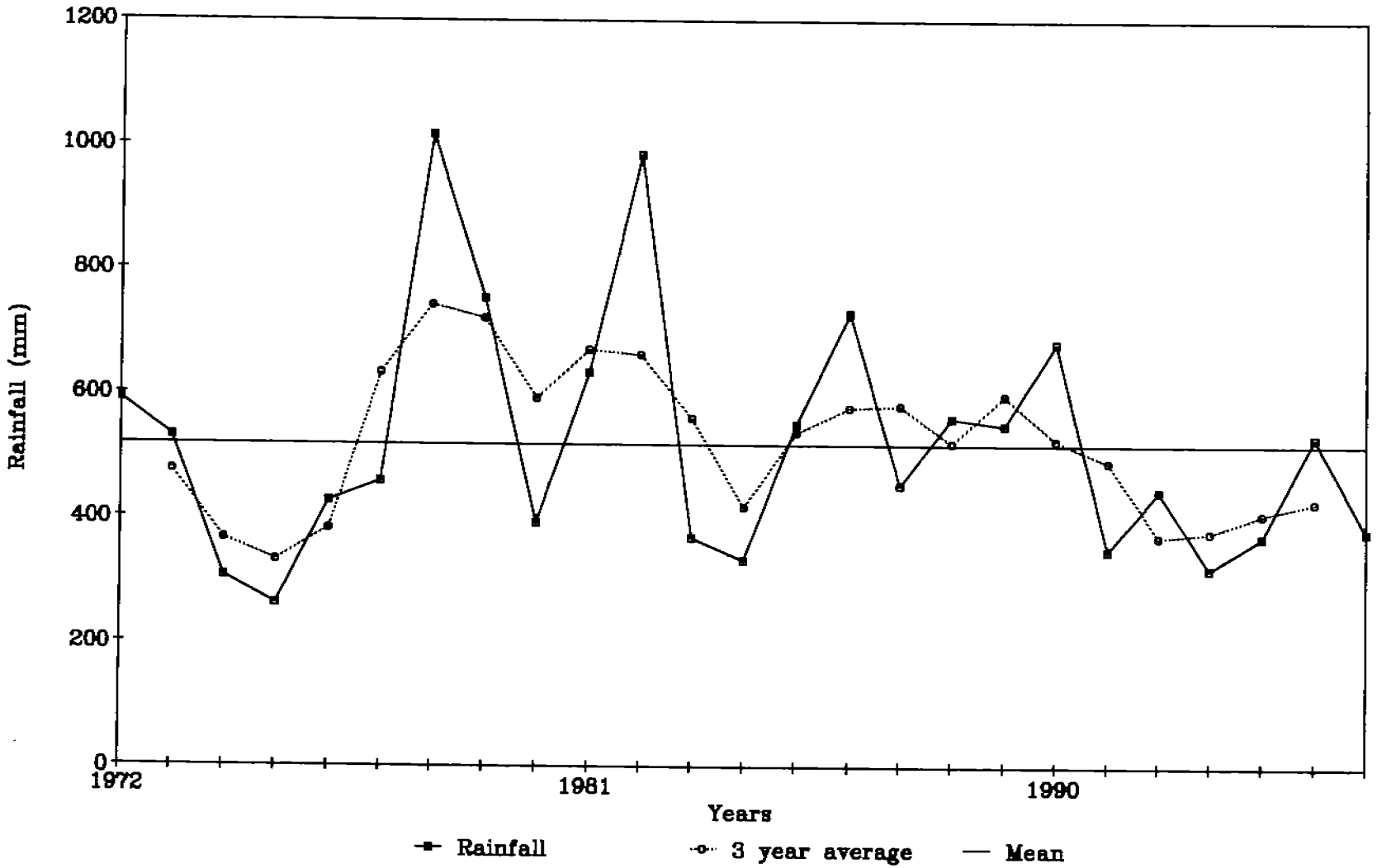
APPENDIX L


Lyamungu (Mar–May) Rainfall Time Series
and 3 years moving average (1960–1996)
Rainfall (mm)
1600
1400
1200
1000
800
600
400
200
0
1960
1969
1978
1987
1996
Years
Rainfall
3 year average
Mean

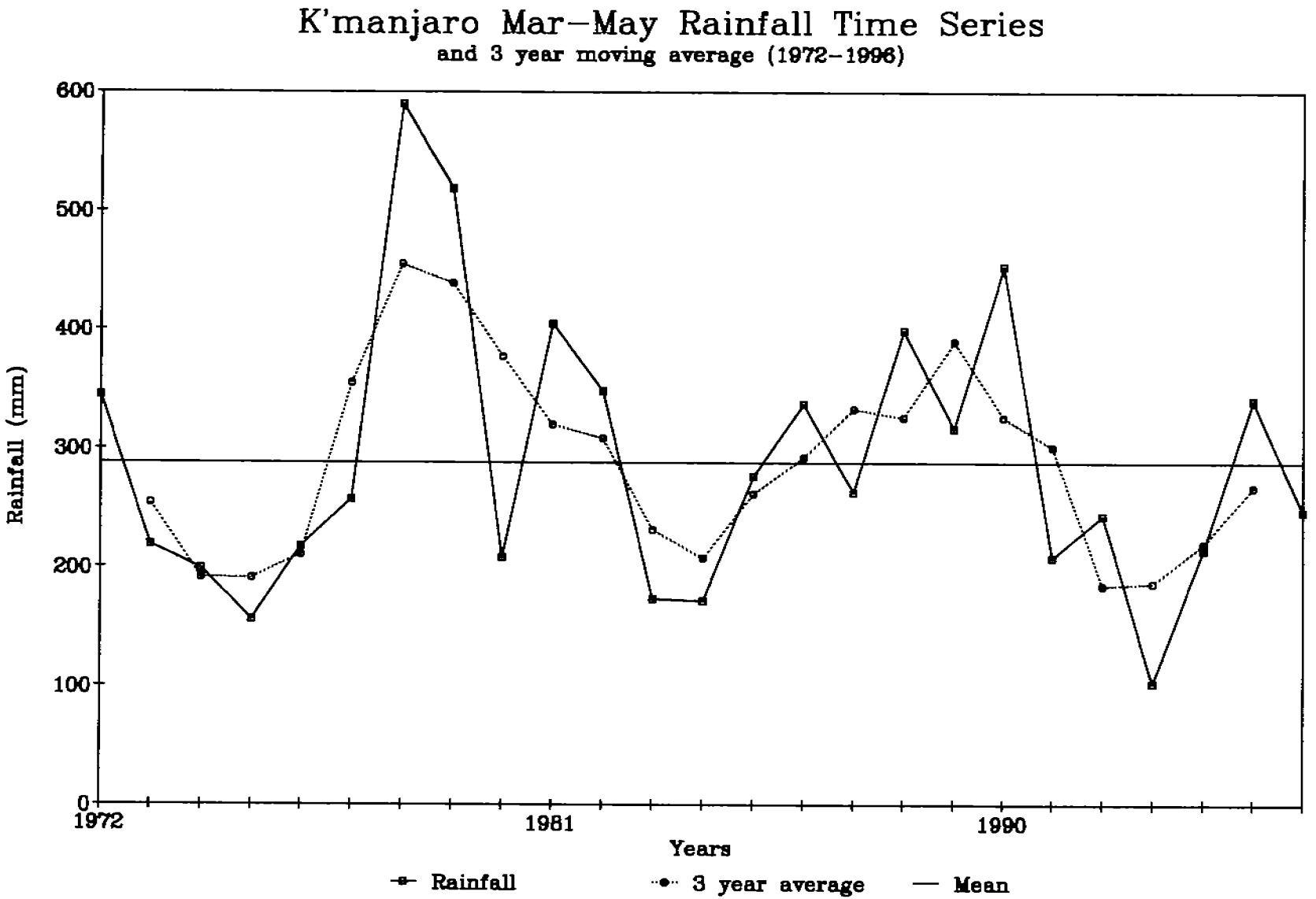
APPENDIX N


Lyamungu Mean Annual
Temperature (°C)(1960-1996)
Temperature (°C)
20.0
19.8
19.6
19.4
19.2
19.0
18.8
18.6
18.4
18.2
18.0
1960
1965
1970
1975
1980
1985
1990
1995
Year
Annual
3 year average
Mean

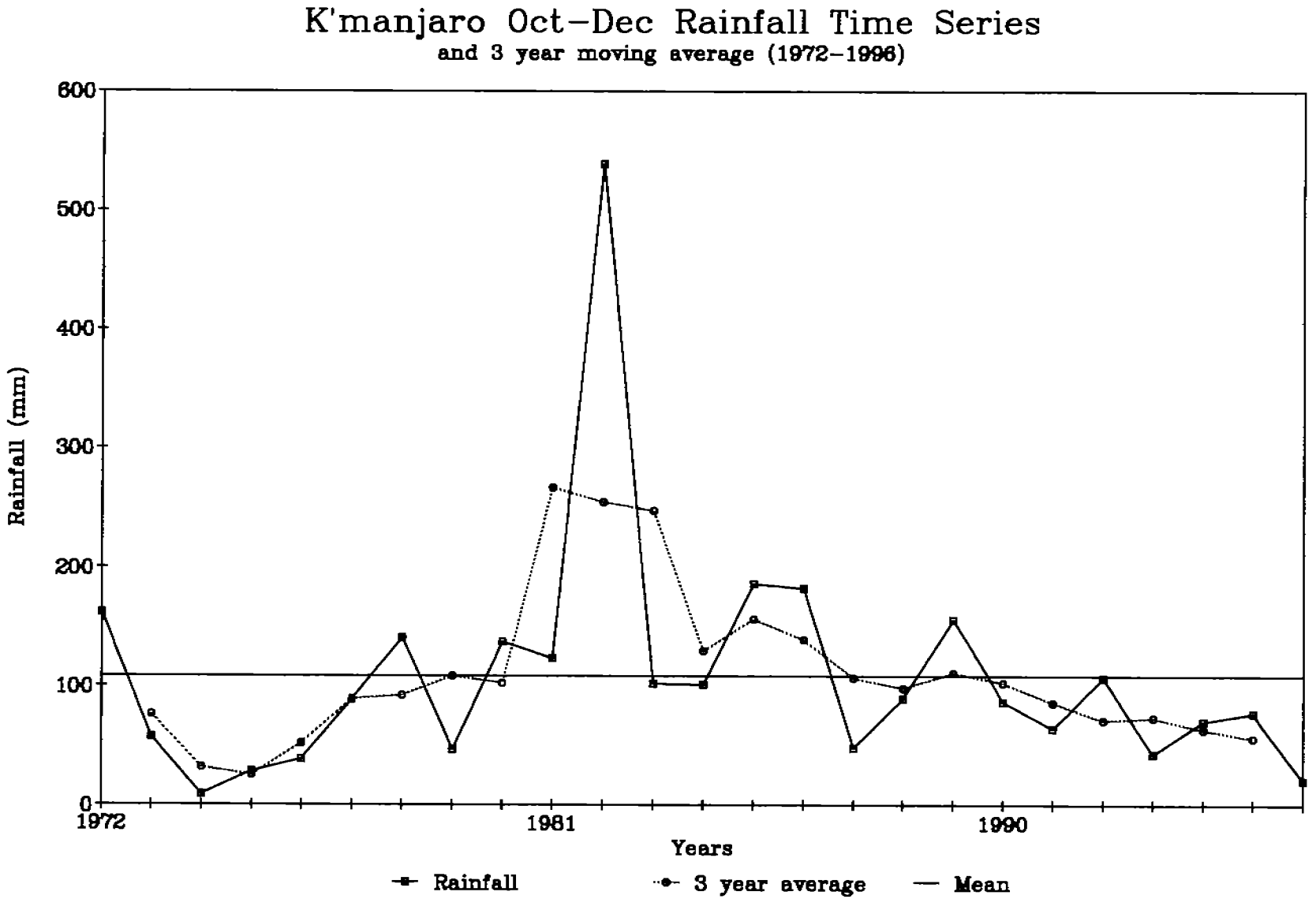
APPENDIX O


Kilimanjaro Annual Rainfall Time Series
and 3 years moving average (1972–1996)
Rainfall (mm)
1200
1000
800
600
400
200
0
1972
1981
1990
Years
Rainfall
3 year average
Mean

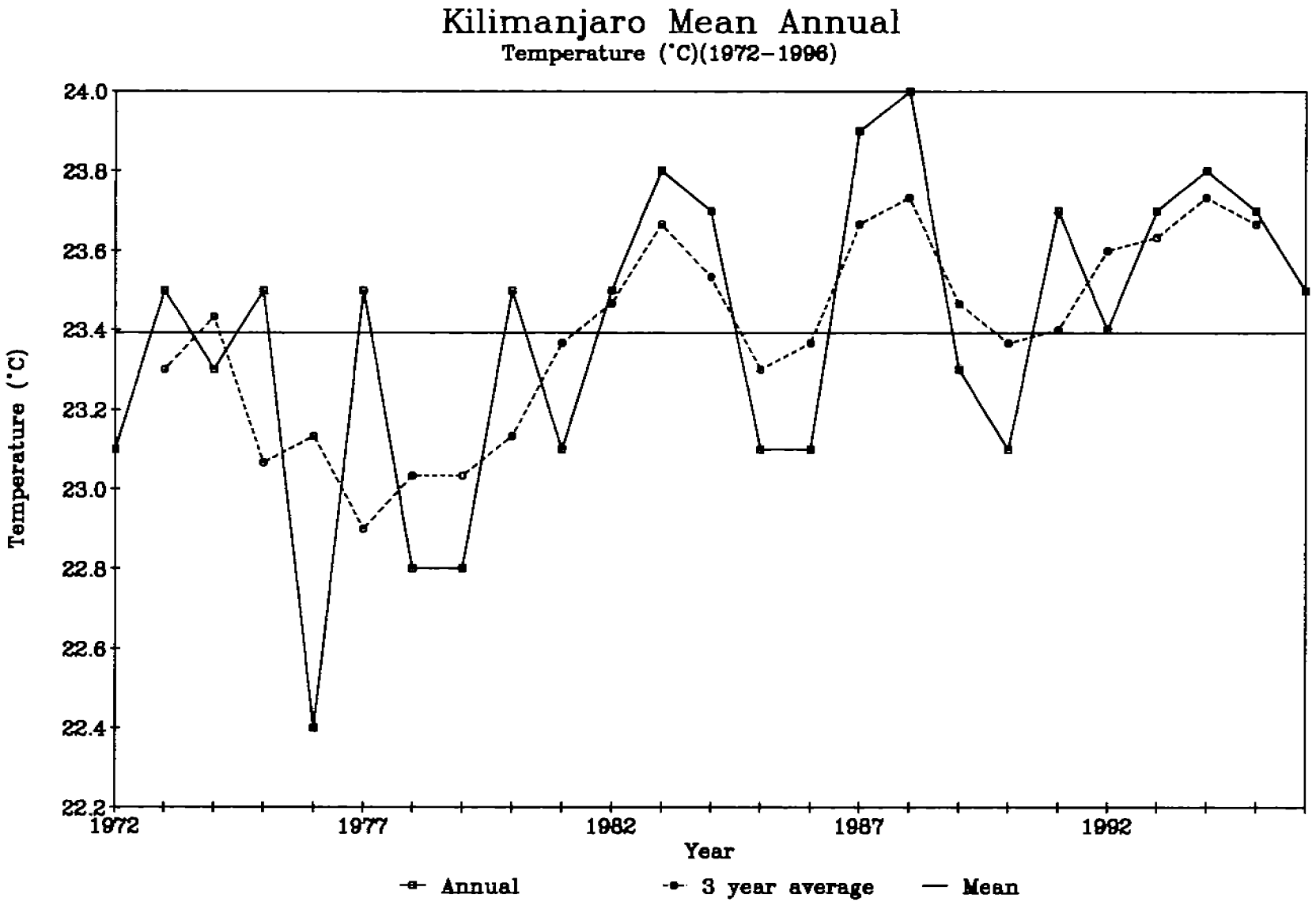
APPENDIX P


K'manjaro Mar–May Rainfall Time Series
and 3 year moving average (1972–1996)
Rainfall (mm)
600
500
400
300
200
100
0
1972
1981
1990
Years
Rainfall
3 year average
Mean

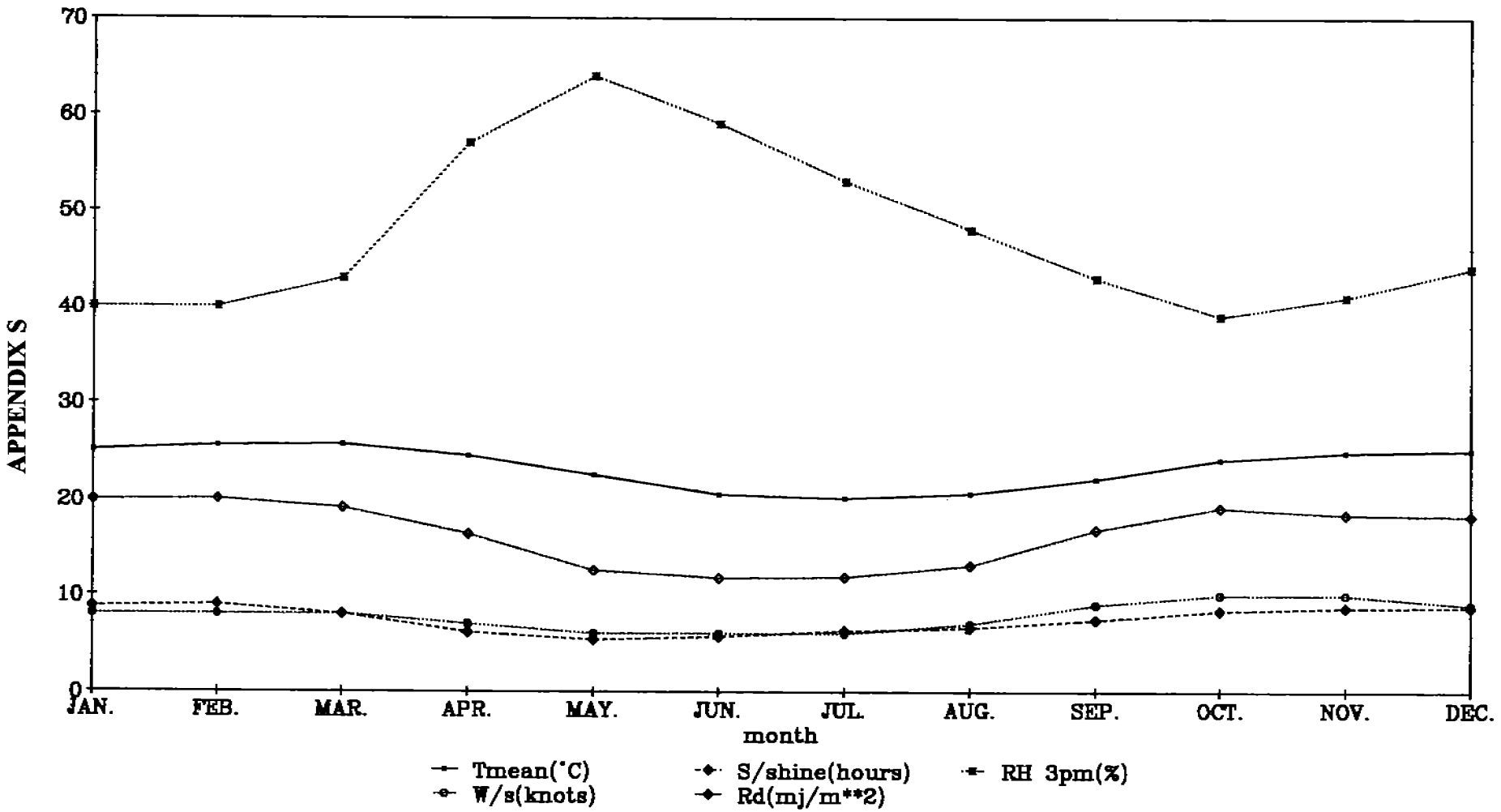
APPENDIX Q


K'manjaro Oct–Dec Rainfall Time Series
and 3 year moving average (1972–1996)
Rainfall (mm)
600
500
400
300
200
100
0
1972
1981
1990
Years
Rainfall
3 year average
Mean

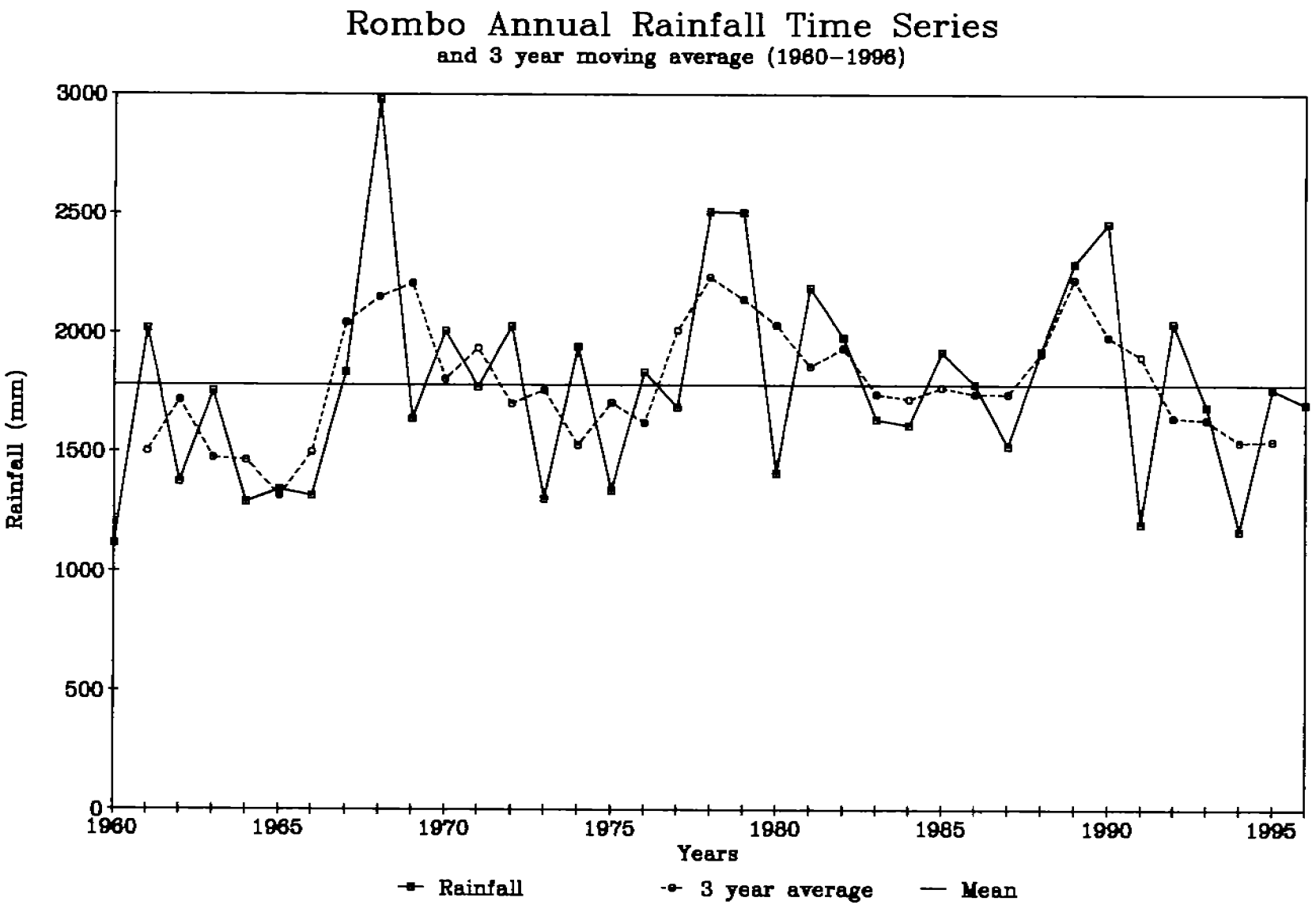
APPENDIX R


Kilimanjaro Mean Annual
Temperature (°C)(1972-1996)
Temperature (°C)
24.0
23.8
23.6
23.4
23.2
23.0
22.8
22.6
22.4
22.2
1972
1977
1982
1987
1992
Year
Annual
3 year average
Mean

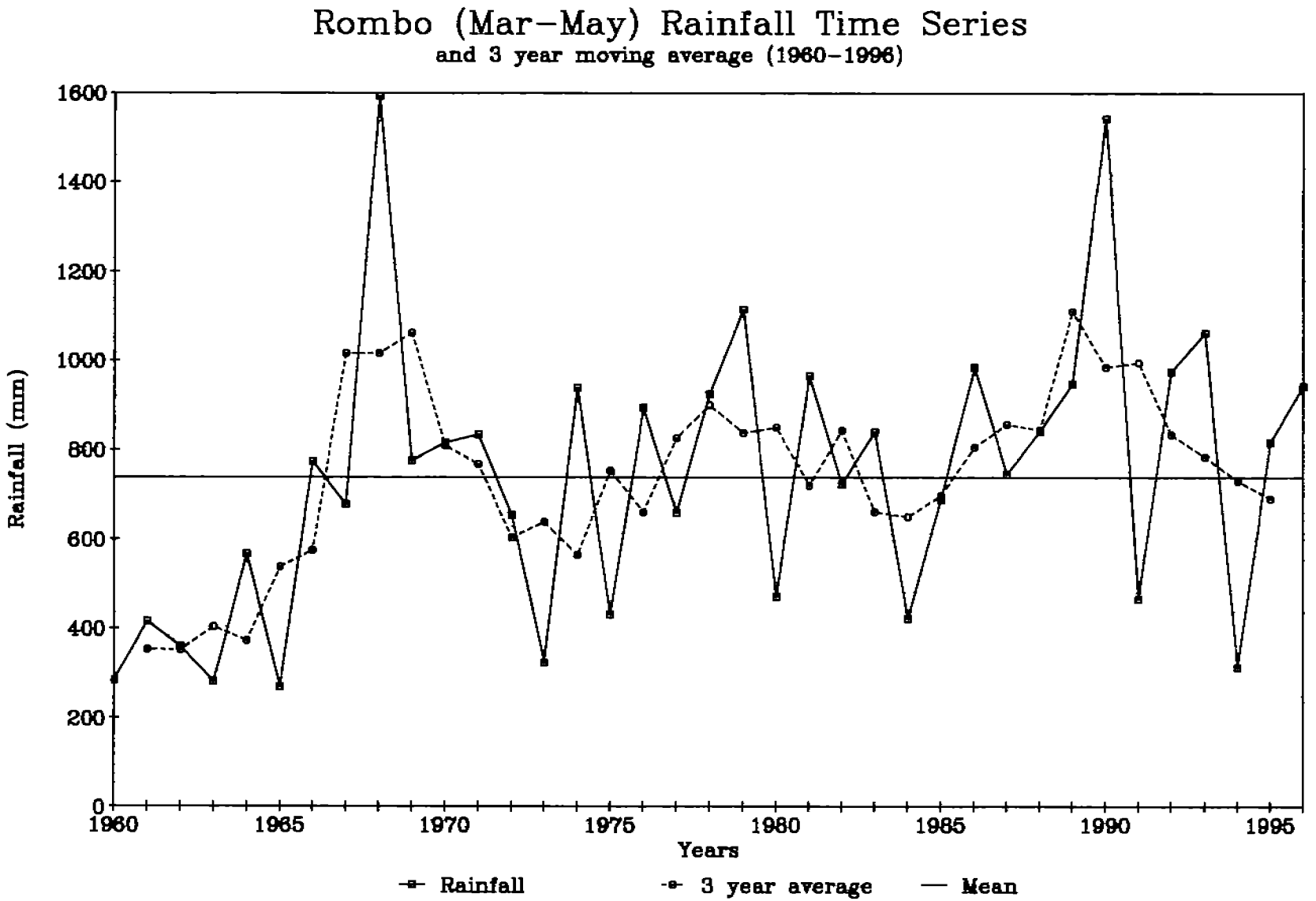
APPENDIX S


Kilimanjaro Mean
Meteorological Parameters
70
60
50
40
30
20
10
0
JAN.
FEB.
MAR.
APR.
MAY.
JUN.
JUL.
AUG.
SEP.
OCT.
NOV.
DEC.
month
Tmean(°C)
W/s(knots)
S/shine(hours)
Rd(mj/m**2)
RH 3pm(%)

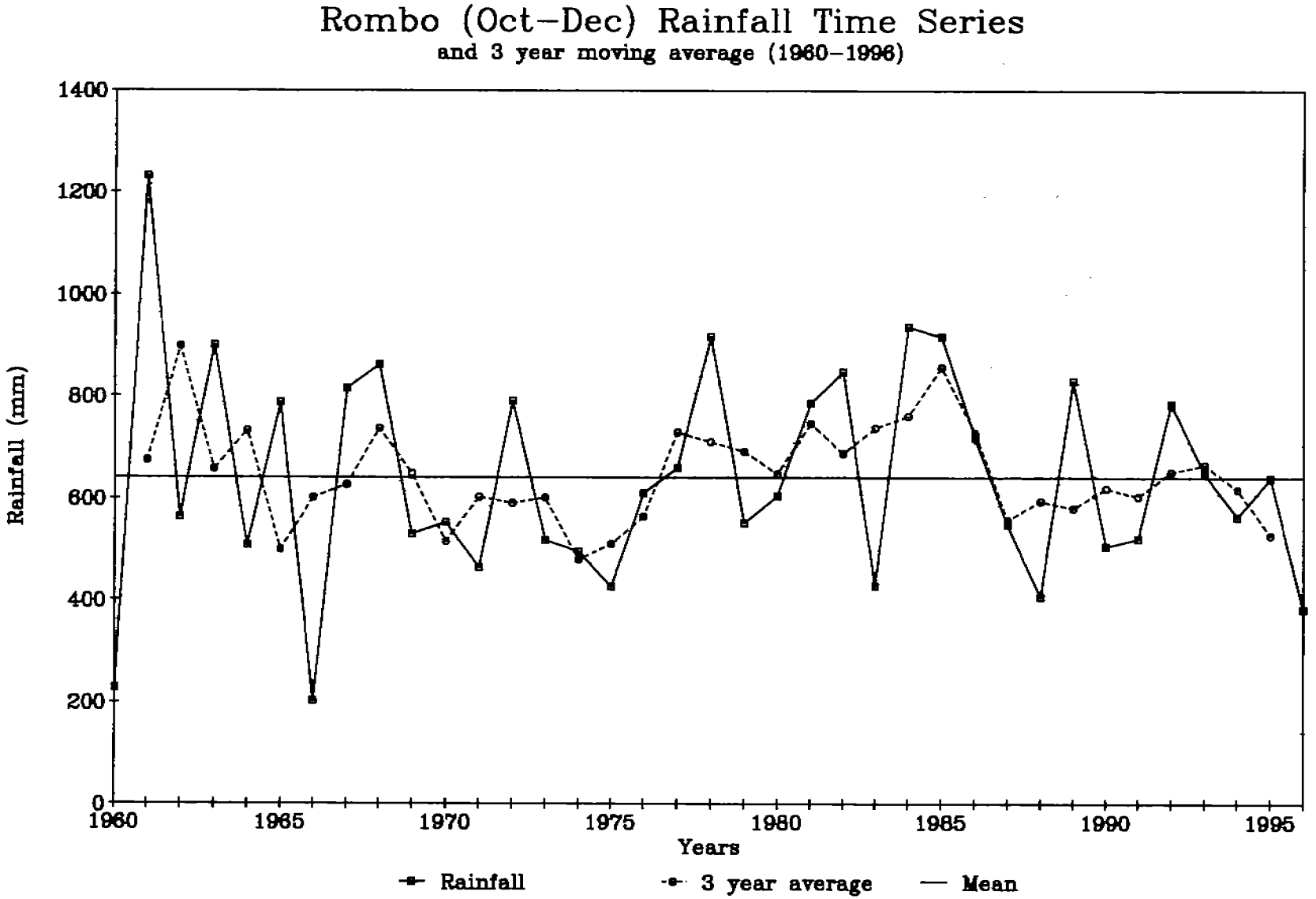
APPENDIX T


Rombo Annual Rainfall Time Series
and 3 year moving average (1960–1996)
Rainfall (mm)
3000
2500
2000
1500
1000
500
0
1960
1965
1970
1975
1980
1985
1990
1995
Years
Rainfall
3 year average
Mean

APPENDIX U


Rombo (Mar–May) Rainfall Time Series
and 3 year moving average (1960–1996)
Rainfall (mm)
1600
1400
1200
1000
800
600
400
200
0
1960
1965
1970
1975
1980
1985
1990
1995
Years
Rainfall
3 year average
Mean

APPENDIX V


Rombo (Oct–Dec) Rainfall Time Series
and 3 year moving average (1960–1996)
Rainfall (mm)
1400
1200
1000
800
600
400
200
0
1960
1965
1970
1975
1980
1985
1990
1995
Years
Rainfall
3 year average
Mean