THE MUPFURE CATCHMENT

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1 Description of the Study Catchment

The Mupfure River stretches for about 224 kilometres from 31^{o} 15′E, 18^{o} 22′S at its source up to 29^{o} 25′ E, 17^{o}30′S at the confluence with Sanyati River (Fig1). The catchment area covers 11 866 square kilometres. The source of Mupfure River is located along the central watershed of Zimbabwe in the Chiota Communal Lands. The Department of Water Development has divided Zimbabwe into six hydrological zones, A to F, and the Mupfure River falls within Hydrological Zone C which comprises areas drained by the Sanyati and Manyame Rivers, and ultimately draining into the Zambezi River. The Mupfure catchment has been sub-divided into 4 hydrological sub-zones which are CUF1, CUF2, CUF3 and CUF4 (Fig 2).

Sub-zone CUF4 is found on the upper part of the catchment, and the major rivers occurring in this part are Muda, Mtsike, Nyachidzi, Marirangwe, and Nyonda Rivers. Sub-zone CUF3 stretches from downstream of Beatrice to the Mupfure Seruwe confluence. The major rivers occurring in this region are Doronanga, Nyundo, Nyakondowe, Nyangweni, and Chirundazi Rivers. The Lower Mupfure Catchment area is drained by the Washanje, Susuji, Chakari, and Nyabongwe Rivers.

Figure 1: **The Mupfure Catchment**

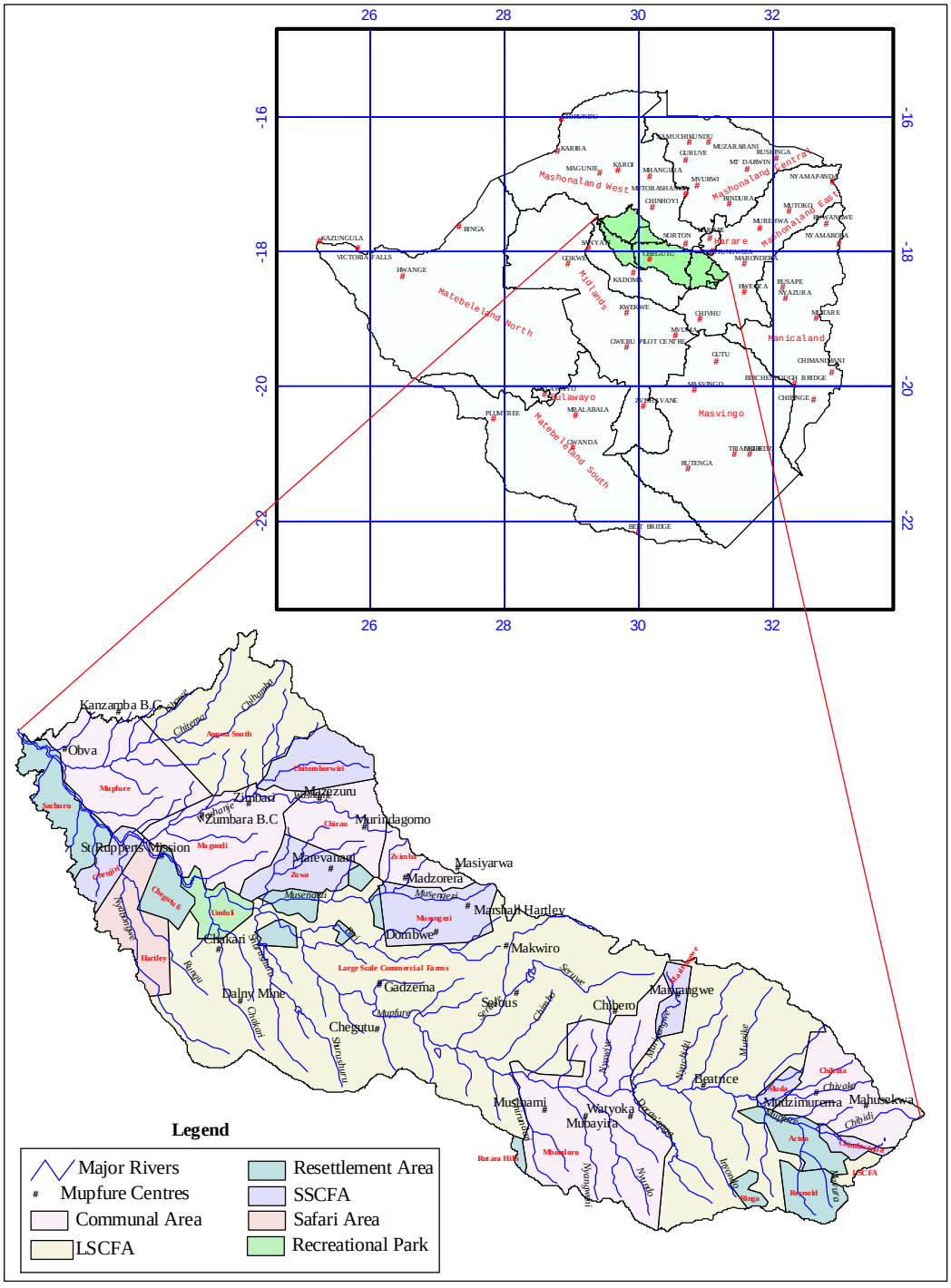
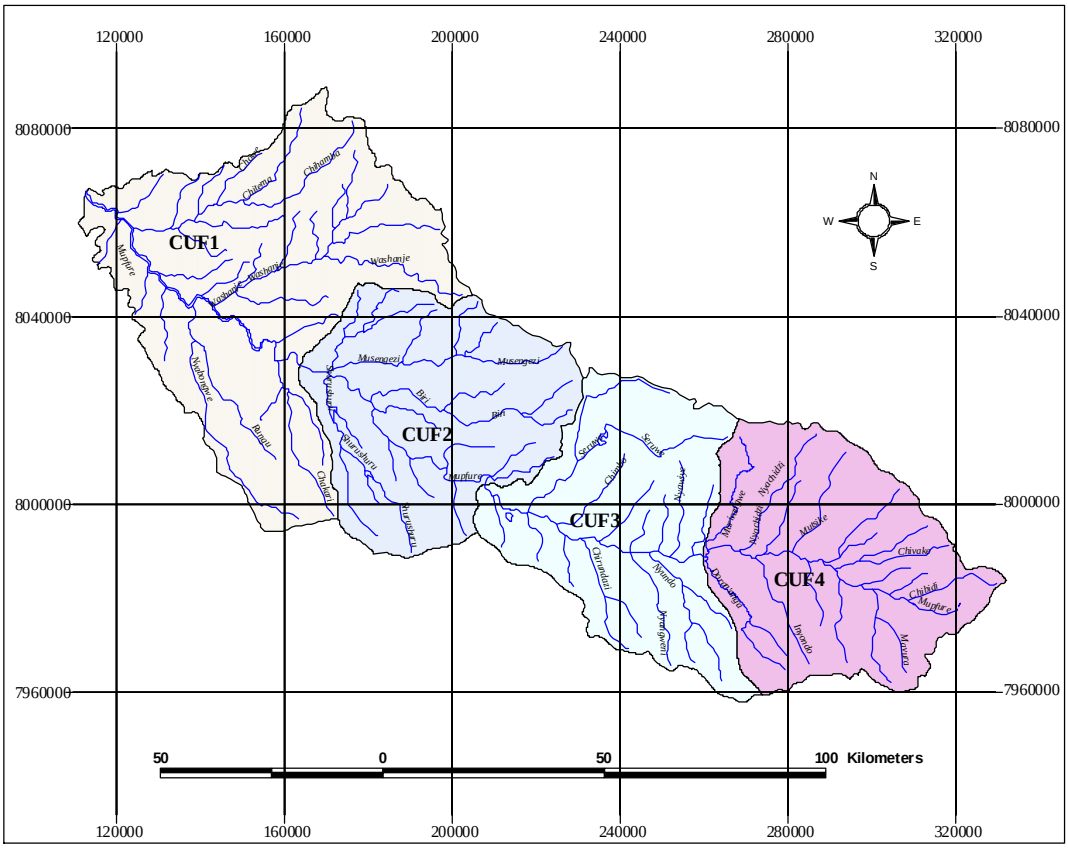


Figure 2: **The Mupfure Hydrological Sub-zones**



2 Geology and Relief

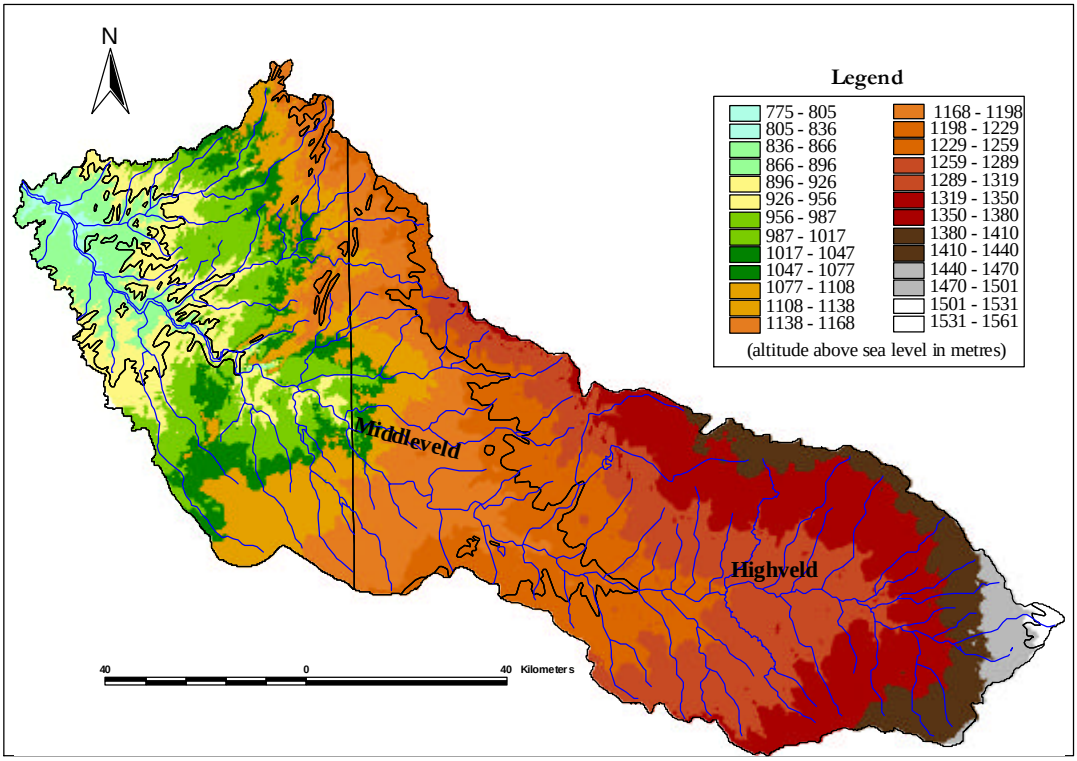
There are two major relief regions within the Mupfure Catchment which are the highveld and the middleveld (Fig 3). The highveld which consists of land with altitude from 1 200 metres to 1 560 metres above sea level and occurs mostly in the mid to upper parts of the catchment. The middleveld has altitude ranging from 900 to 1 100 metres and this occurs mostly on the lower part of the catchment.

The middleveld stretches from Chegutu to the confluence of Mupfure and Sanyati river ranging in height from 900 metres to about 1 100 metres above sea level. The mid and upper Mupfure catchment are characterised by slopes which range from 0° to 2° with the exception of river banks especially along the Mupfure River. The average slope values along the Mupfure River are in the range of 2.5° to 3.2°. The maximum slopes along the river are 3.4°. Thus more than 90% of the mid and upper Mupfure catchment is characterised by slopes less than 2°. This covers the following areas: Chiota, Beatrice, Mhondoro, Chegutu, Musengezi, and up to Chegutu.

The Selous and the Makwiro area the slopes range from 3° to a maximum of 10°. This is in areas mainly along the Great Dyke. South of Selous the slopes are moderately steep with the steepness gradually decreasing from 9° to 3°. In the Lower Mupfure Catchment area there are steep slopes ranging from 9° to over 15°. The Susuji River which drains part of the Magodi Communal Lands on the right bank of the Mupfure River is characterised by rugged terrain. The average slopes along this river are around 19'' degrees. One of the prominent relief features of this area is the Cheka-Wakasunga-Bete Ridge, which has a NNE-SSW alignment. Slopes along this ridge range from 9° to 30°. Moderately steep slopes of around 9° occur along river valleys such as those of Nyundo and Nyangweni Rivers.

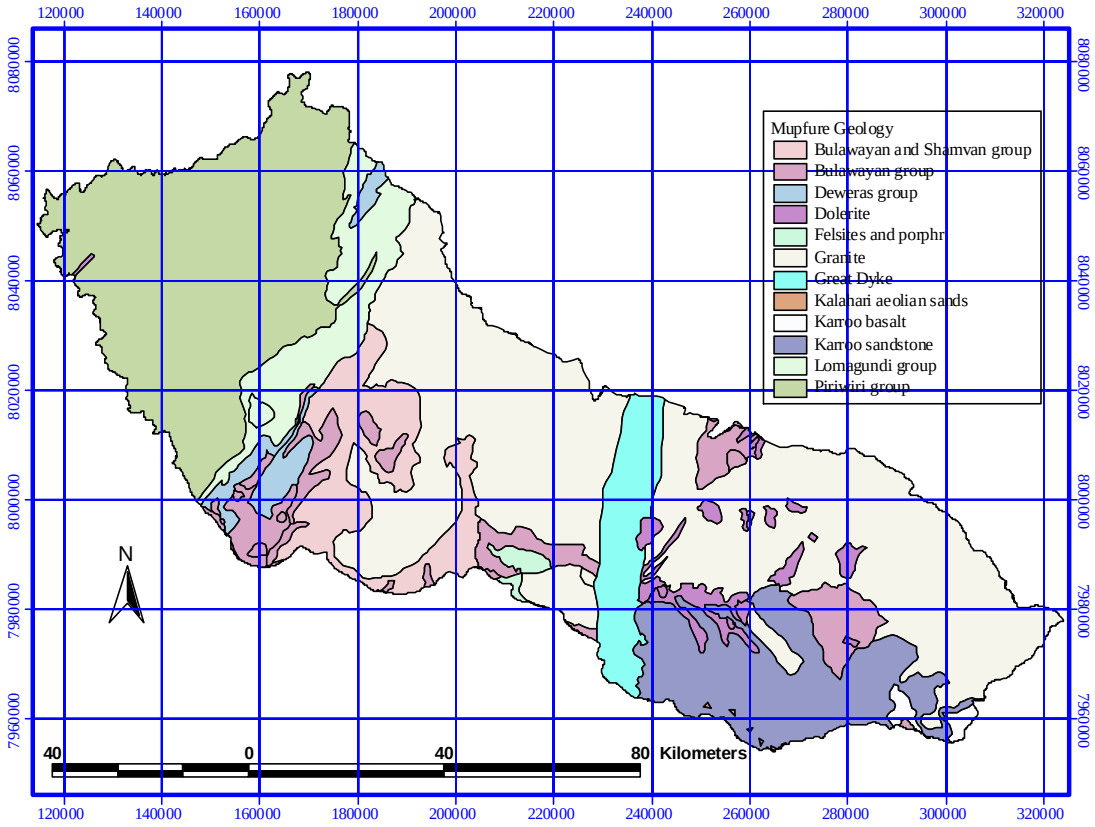
The upper catchment and parts of the mid catchment have numerous dambos occurring within them. These are seasonally waterlogged bottomlands. Dambos in the commercial farms are found in nearly their natural state with limited degradation. This is because the farms have been subjected to limited and controlled grazing pressure, have little or no cultivation and there are numerous dams that help maintain the water table. On the other hand, in communal areas dambos have been subjected to heavy pressure from humans and livestock, have been overgrazed, cropped and trampled. As such most of the dambos are degraded and eroded. Dambos as such are more common around areas such as Mahusekwa and Mudzimurema centres in the upper catchment and around Kutama and in Zvimba Communal Lands in the lower catchment and are characterised by cultivation (vegetable gardens) and livestock grazing in these communal areas.

Figure 3 Relief of the Mupfure Catchment



The major geological formations found in the Mupfure Catchment include the Greenstone Belt, granitoids, Great Dyke rocks, the Lomagundi and the Piriwiri Group of rocks (Fig 4). The Greenstone Belt (early precambrian) comprises metasediments, metavolcanics, and ultramafic lavas that cover about 38% of the catchment. These occur around Beatrice and in the south-western part of the catchment around Chegutu, Golden Valley, and Chakari (Fig 4). The granitoid group of rocks include granites and gneisses of various ages, and these cover about 39% of the catchment. They occur mostly in Chiota, Mhondoro, Selous, Musengezi and Zvimba Communal Lands. One of the prominent geological features of this catchment is the Great Dyke which is a secondary tectonic feature that runs north-south across the catchment. This dyke is rich in minerals such as chromite, platinum, nickel, asbestos, and magnesite. The Lomagundi and the Piriwiri groups of rocks (mid precambrian) consist of dolomites and phyllites which occur mostly in the north-western part.

Figure 4: Geology of the Mupfure Catchment



3 Soils

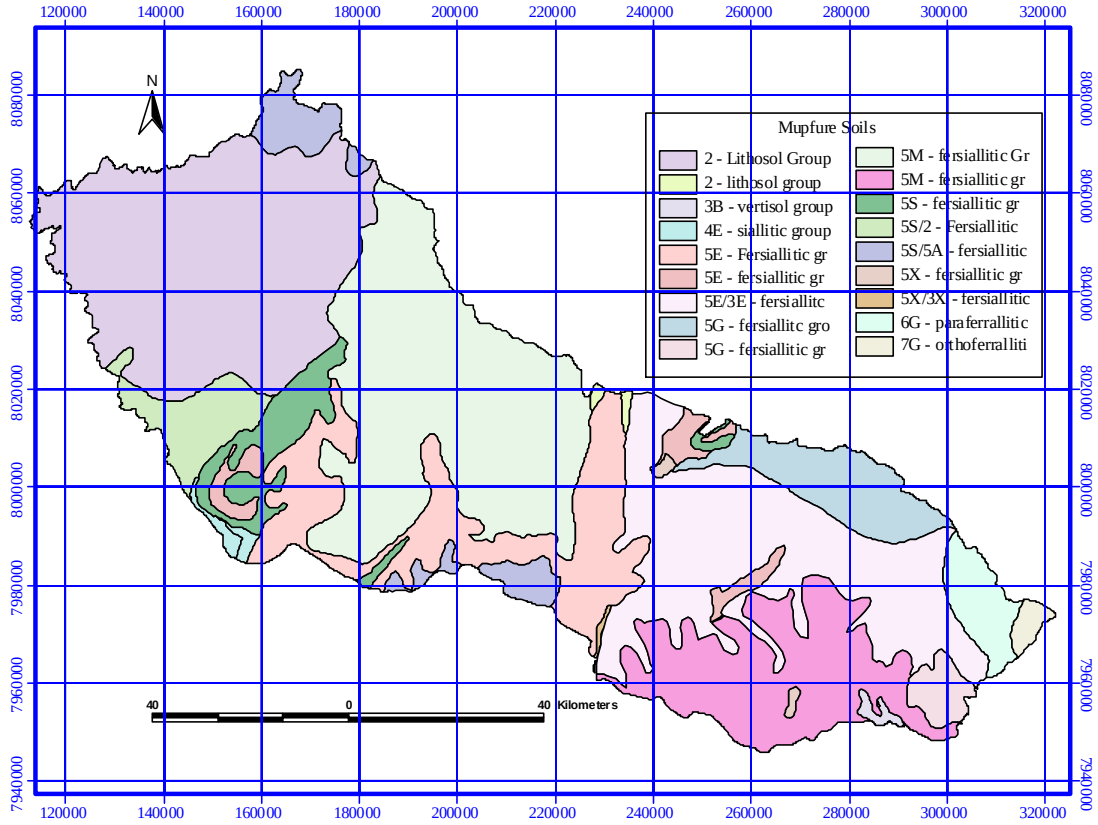
The Mupfure Catchment is composed mainly of the following soil groups: the fersiallitic, vertisol, lithosol, paraferrrallitic, othoferrallitic, and the lithosol groups. According to Thompson (1965) in Nyamapfene (1991) the soil classification system used in Zimbabwe as developed by Thompson (1965) is composed of four taxonomic levels namely the order, the group, the family, and the series. The lithosol group as found in the Mupfure Catchment belongs to the amorphic order which is reserved for those soils in which a low degree of profile development is a characteristic. The vertisol group belongs to the calcimorphic order, which is characterised by soils that are ralatively unleached and generally have large reserves of weatherable minerals with high base saturation and clay fractions predominantly active. This results in cohesive soils because of the clay content of the soils. The fersiallitic, orthoferralliti, and the paraferrallitic groups belong to the kaolinitic order, which is characterised by moderately to strongly leached soils.

The lithosol group of soils includes all soils with a depth less than or equal to 25 centimetres. They occur generally extensively on flat areas in low rainfall areas, particularly those areas underlain by rock which is relatively resistant to weathering. In the Mupfure Catchment these occur in the lower catchment area (Fig 5). On the other hand, most of the vertisols are moderately deep, generally ranging in depth from about 80 centimetres to a metre or just slightly more than a metre. These are found in a small portion in the upper catchment area south of the Mupfure River. The clay content in all Zimbabwean vertisols is high (well over 60%), and as such are often subject to hydromophy.

The fersiallitic group of soils all tend to be acidic with those derived from siliceous parent materials being more acidic than those from mafic materials. The main soil forming processes have been the

accumulation of clay and to a significant extent, the accumulation of sesquioxides and leaching of bases. In the catchment area the fersiallitic group of soils are mainly confined in the mid catchment area. The paraferrallitic soils of Zimbabwe are almost exclusively derived in situ from granite parent rock and are predominantly sandy hence relatively highly leached in high rainfall areas (mean annual precipitation greater than 800 millimetres). These are predominant in the upper catchment are and they have at least 5 % weatherable minerals present in the system. The orthoferrallitic group of soils occur in the upper catchment have profiles which are normally very deep being not less than two metres in depth and exhibit a very fine crumb structure which is weakly developed. The soils are largely the result of deep weathering of the underlying rock followed by intense leaching of bases in high rainfall areas. Porosity is very high and the soils have relatively high clay content. Most of the soils are highly coloured due to the high oxide content and their extremely good internal drainage. Figure 5 shows the distribution of soil types in the Mupfure Catchment:

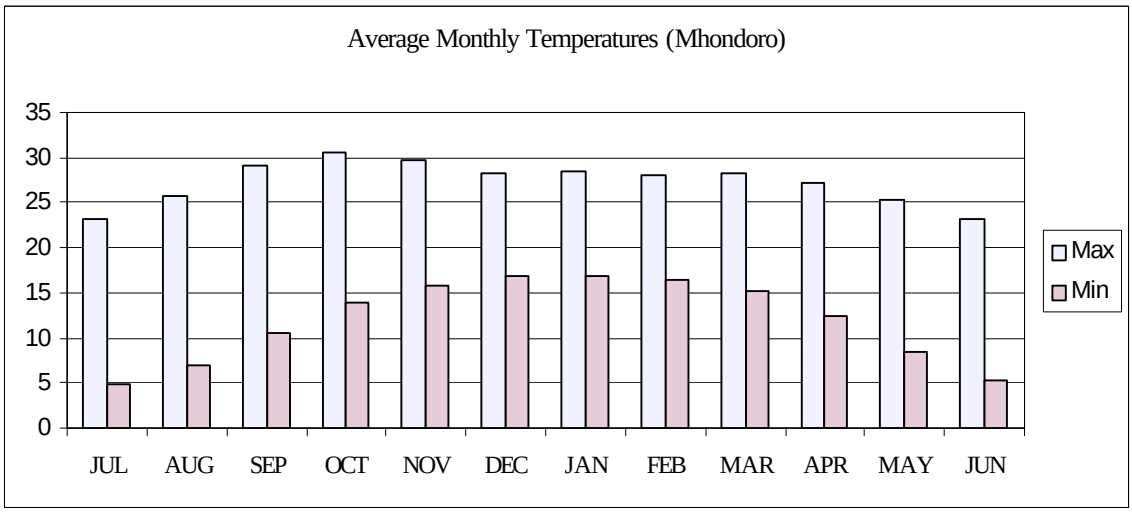
Figure 5 Soils of the Mupfure Catchment



4 Temperatures

Fig 6 shows the variation in maximum and minimum temperatures throughout the year. The highest temperatures are experienced during the September to November period. The May to early August period is considered to be the cool season during which relatively low temperatures occur. Frost does occasionally occur in some parts of the catchment.

Figure 6: Monthly Temperature Variations



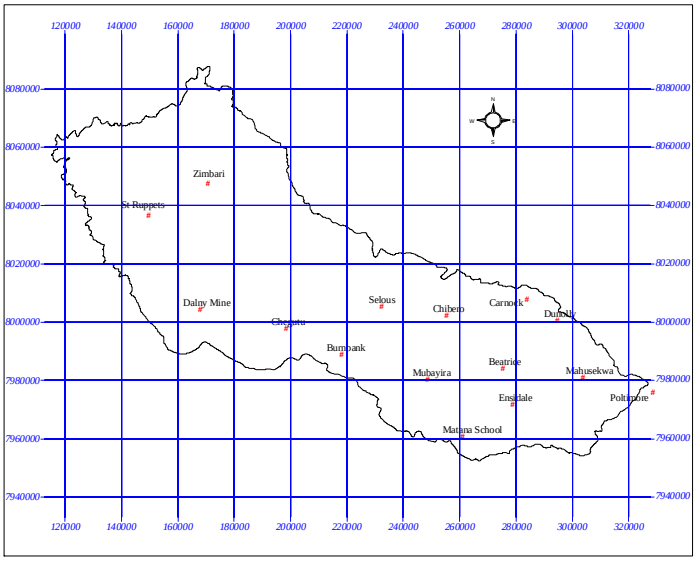
5 Rainfall

There are 14 rainfall stations within the Mupfure Catchment (Fig 7). The density of these stations varies from 1 rain gauge per 266 sq km in the lower part of the catchment to 1 gauge per 46 sq. km in the upper catchment (Table 1)

Table 1: Density of Rain gauges in the Mupfure Catchment

Zone	Area (km^2)	Number of Rainfall Stations	Rain gauge Density (gauges per km^2)
CUF1	403.53	3	135
CUF2	265.81	1	266
CUF3	251.65	5	50
CUF4	276.50	6	46

Figure 7 The location of rainfall stations in the Mupfure Catchment



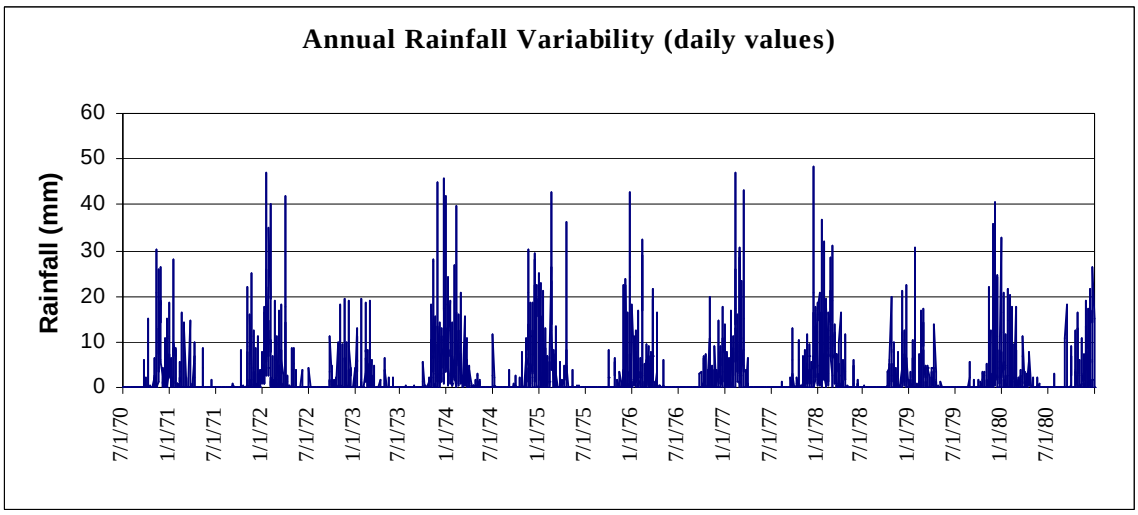
Rainfall increases in general from the west to the east with increase in altitude. Parts of the lower catchment receive about 670 mm of rainfall per year (Table 2). This increases to about 700 mm in the middle part of the catchment. The highest rainfall occurs in north-eastern parts which get about 800 mm per year.

Table 2 Rainfall stations in the Mupfure Catchment

Station	Period	Mean Annual Rainfall (mm)
Beatrice	1949/50-93/94	709
Burnbank	1949/50-93/94	687
Chegutu	1909/10-95/96	748
Chibero	1959/60-94/95	717
Dalny Mine	1949/50-94/95	727
Dunolly	1933/34-86/87	751
Mahusekwa	1949/50-86/87	736
Matana School	1954/55-86/87	724
Mubayira	1962/63-94/95	731
Selous	1971/72-95/96	747
St Ruppets	1971/72-94/95	746
Zimbari	1964/65-94/95	670
Ensidale	1970/71-96/97	615
Carnock	1970/71-96/97	784
Poltimore	1979/80-95/96	718

Rainfall varies greatly from one year to another, and the coefficient of variation of annual rainfall is as high as 30%. Fig 8 shows the considerable variability in the annual rainfall at Beatrice. During the rainy season which stretches from mid-November to March, rainfall often occurs in the form of 10 to 15 day wet spells that are followed by dry spells of similar duration. The rain comes mostly in the form of convective thunderstorms. The rest of the year from May to early November is dry (Fig 8).

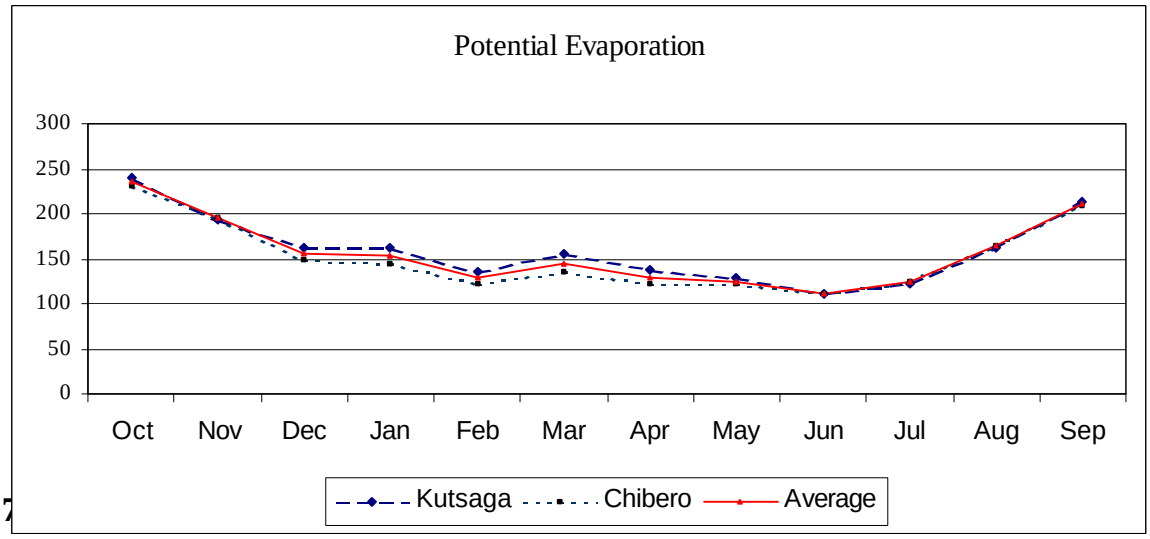
Figure 8 Annual Rainfall Variability.



6 Reference Potential Evaporation

There is only one station at which evaporation is measured within the Mupfure catchment. This is at Chibero. The other station close to the study area is Kutsaga Tobacco Research Station just outside Harare. Fig 9 shows the mean monthly evaporation rates measured using an A-pan. This shows that evaporation rates are considerably high ranging from 150 to 250 mm per month. The average annual evaporation rates vary from about 1900 mm in the lower parts of the catchment to 1800 mm in the upper part of the catchment.

Figure 9 Monthly Pan Evaporation



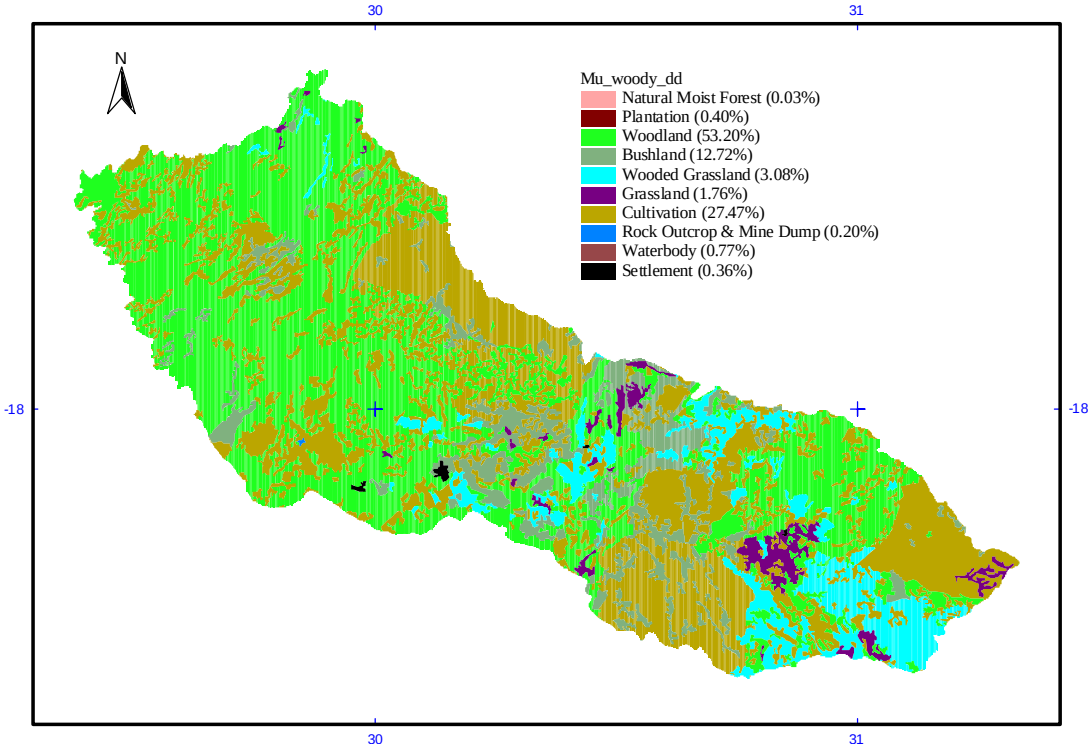
The various types of land cover occurring within the Mupfure Catchment were determined from a classification of a Landsat TM image of April 1998. The dominant land cover are woodlands that occupy 53% of the catchment. This is followed by cultivated lands that cover 27% of the area. Areas under bush cover 13% (Fig 10 and Table 3)

Table 3 Land cover types in the Mupfure Catchment area.

Landuse Types	% Of Area Covered
Woodland	53.20
Cultivation	27.47
Bushland	12.72
Grassland	1.76
Water bodies	1.77
Plantations	0.40
Settlements	0.36
Rock outcrops and Mine dumps	0.20
Natural Moist Forest	0.03

Most of the woodlands occur in areas under large and small scale commercial farming such as the Selous, Gadzema and Msengezi in the mid catchment, and Angwa South and Chitomborwizi in the lower catchment area. Cultivated areas commonly occur in communal areas.

Figure 10 Types of Land Cover Occurring within the Mupfure Catchment



8 Land Classes

There are three major land classes occurring within the study area, and these are communal areas, small scale commercial farming areas, and large scale commercial farming areas. Table 4shows the area covered by the various land classes.

Table 4 Major Land Uses in the Mupfure Catchment

Land Tenure	**Name**	8.1.1.1.1.1.1 Area in km2
Communal Area	Chihota	430
Communal Area	Chirau	328
Communal Area	Magondi	514
Communal Area	Mhondoro	1115
Communal Area	Mupfure	619
Communal Area	Zvimba	149
LSCFA	Angwa South	759
LSCFA	Large Scale Commercia l Farms	5195
Recreational Park	Umfuli	143
Resettlement Area	Acton	154
Resettlement Area	Chegutu 6	125

Resettlement Area	Musengezi	163
Resettlement Area	Reynold	144
Resettlement Area	Ringa	38
Resettlement Area	Rutara Hills	17
Resettlement Area	Sachuru	253
Safari Area	Hartley	301
SSCFA	Chenjiri	133
SSCFA	Chimbwanda	54
SSCFA	Chitomborwizi	250
SSCFA	Marirangwe	90
SSCFA	Muda	49
SSCFA	Musengezi	321
SSCFA	Zowa	212

9 Cropping Practices

The major crops cultivated in communal areas are maize, groundnuts, sunflowers, cotton and sorghum. Within communal lands cultivated lands are tilled using mostly ox drawn ploughs which loosen the soil to a depth of about 15 to 20 cm. On the other hand, in the commercial farming areas tractors are used in the ploughing or disking of the land. These loosen the soil to a maximum depth of around 30 to 45 cm. The major crops grown in large scale commercial farming are tobacco (flue cured) and maize. Irrigation of tobacco is undertaken in order to supplement rainfall. Irrigation of winter wheat is also undertaken in large scale commercial farming areas. In the small-scale commercial farming areas there is a mixture of both tobacco (barley - air cured), cotton and maize farming. Most of the crops in these areas are dependent on the rainfall received during the rainy season.

Most of the maize is planted by the 15th of November but sometimes planting goes on up to the 25th of December in the communal areas. Harvesting of maize is usually done 5 to 6 months later depending on the crop variety. In the lower rainfall areas sorghum is usually planted with the first rains and it takes about 60 days to flower and is harvested 3 to 4 months later when it dries. Groundnuts are also planted with more or less the first rains and takes 110 to 150 days to mature, harvesting of which is done 4 to 5 months after planting. As for cotton, land has to be ready for planting by the middle of October since it has a long growing season of 180 to 280 days. Thinning has to be done before November and harvesting normally takes place for 12 to 16 weeks in March up to July or August.

It is estimated that 26 600 hectares of land is under irrigation in all the large scale commercial farming areas, while 113 hectares are under small holder irrigation schemes. The existing small holder irrigation schemes are Hamilton Mills, Johannadale, Madzongwe, Shamrock, and Mahusekwa. The estimated water usage for irrigation is 266000 ML for the large scale commercial farming area, and 1130 ML for small holder irrigation schemes. The total amount of water granted to water rights belonging to LSCFA is 223 856 ML. The proportion of irrigated land under different crops are shown in Table 5 below.

Table 5 Proportion (%) of Irrigated Land Under Different Crops.

Crop	Beatrice North	Norton	Gadzema	Selous	Suri Suri	Mupfure
Maize	17	12	6	11	27	10
Wheat	1	0	0	20	11	0
Tobacco	21	21	31	26	2	53
Cotton	0	0	32	5	23	0
Soya bean	0	42	15	11	28	0
Others	60	25	16	27	9	37

Total	100	100	100	100	100	100

Tobacco occupies the greatest proportion of land under irrigation. However, irrigation of tobacco is mostly required during the establishment of tobacco seedlings in the early summer period.

10 Runoff

There are nine flow-measuring stations along the Mupfure River and these are equipped with automatic recorders (Fig 11). Table 6 below shows the stations and their catchment areas.

Table 6 River Flow Measuring Stations

Code	Location	Catchment Area (sq km)	Period of Record
C12	Twyford Weir	5180	1950/51-95/96
C65	Upper Seigneury U/S	4140	1964/65-95/96
C44	Lower Seigneury D/S	-----	1988/89-94/95
C67	Maynard Weir U/S	3650	1966/67-95/96
C70	Beatrice	1215	1969/70-95/96
C78	Johannadale	8240	1990/91-94/95
C107	Mahusekwa D/S	129	1989/90-95/96
C108	Mahusekwa D/S	122	1989/90-95/96
C84	Copper Queen	12100	1990/91-95/96

Runoff is highly seasonal as is characteristic of most rivers in Zimbabwe. Flows start to increase in late November. High flows are experienced during the December to February period. Afterwards flows decrease, and most rivers dry up during the July to November period (Fig 12). The duration of periods with zero flows varies from 70 to 155 days per year along the Mupfure River. Runoff is highly variable, and the coefficient of variation being 130% at Beatrice The mean annual runoff varies from 103 mm in the upper part to 50 mm in the lower part of the Mupfure Catchment.

Fig 11 The location of the flow measuring stations

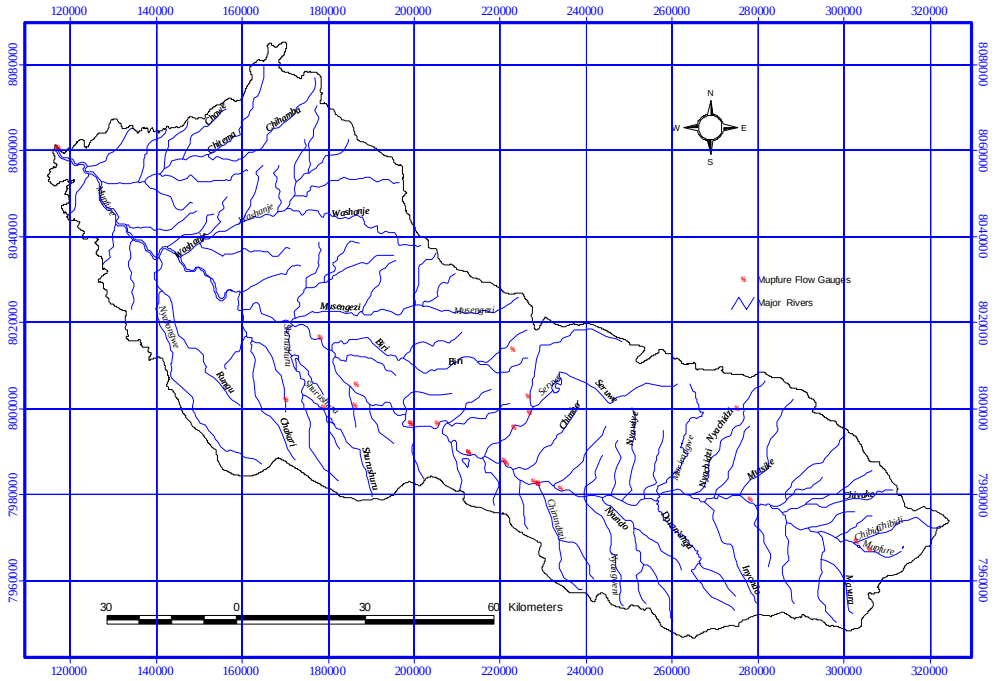
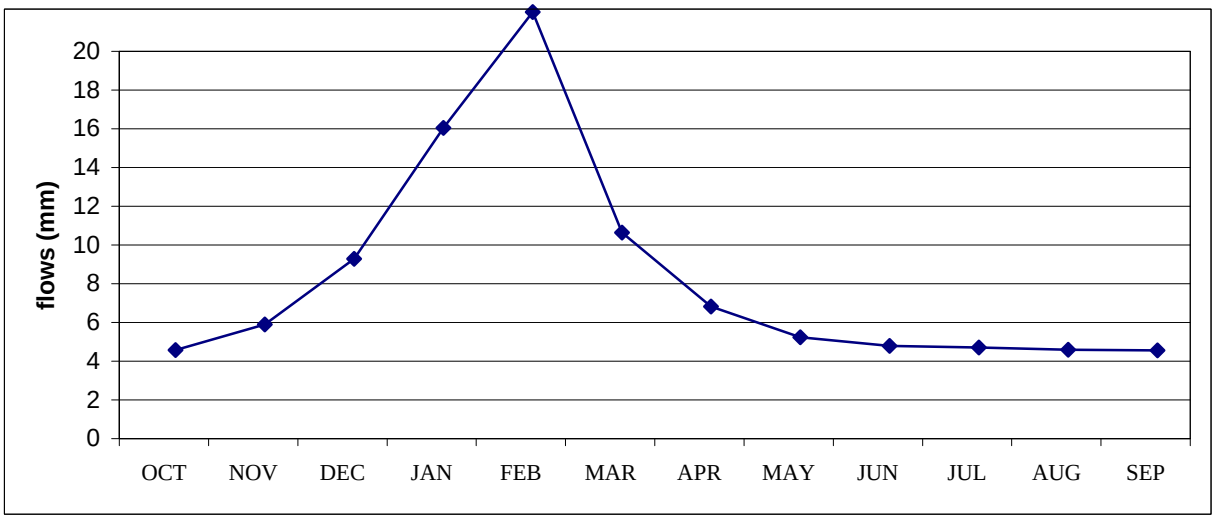


Fig 12 Mean Monthly Flows at C70



11 Water Consumption

There are no records of the amount of water consumed for domestic purposes in communal areas. An estimate of this consumption can be made using the size of the population within the Mupfure Catchment. The 1992 Census found that there were about 350 000 people within this catchment. If it is assumed that the average water consumption is 25 litres per capita per day, then the amount of water used for domestic purposes is about 3 million cubic metres per year.

The amount of water consumed for urban, industrial, and mining (UIM) purposes can be estimated form the records of the Department of Water Development. Table 7 below shows the amount of water consumed at various centres that are supplied with water by this department.

Table 7 Water Consumption at Main Centres

Centre	Water Source	Total Water Consumption (ml/year)
Beatrice	Borehole + River	148
Chakari	Borehole	38
Changafuma	Chegutu Town	35
Chibero College	Borehole + Dam	136
Chegutu	Dams	600
Ensidale	Borehole	28
Gadzema	Borehole	14
Kamhonda Clinic	Borehole	6
Kinzamba	Borehole	2
Mahusekwa	Dam	54
Msengezi Secondary School	Borehole	44
Msengezi Ressettlement Scheme	Borehole	3
Mubayira	Borehole	124
Selous	Borehole	34
Ringa	Borehole	16

12 Water Rights

According to the legislation in Zimbabwe, anybody who wishes to user water for non-domestic purposes has to be granted a water right or permit to do so. This requirement is also applicable to towns, mines, missions, and similar institutions that abstract and distribute water to residents for domestic purposes. The amount of water allocated to water right holders can be used as an indicator of the amount of water being used. This has its limitation in that water right holders do not always utilize their full allocations, and some may illegally exceed these allocations. Table 8 shows the number of water rights and volumes of water that have been allocated to various types of water users within the Mupfure Catchment.

Table 8 Amount of water allocated to various Sectors

CUF1					
	Number of Water Rights		Amount of Water Commitment (ML)		Total Commitment (ML)
	Storage	Abstraction	Storage	Abstraction	
LSCFA	12	11	9293	1360	10653
Communal Areas	0	5	0	220	220
Mines	1	0	1409	0	1409
Government	0	0	0	0	0
Roads	0	0	0	0	0
Total	13	16	10702	1580	12282
CUF2					
LSCFA	150	82	77221	21791	99012
Communal Areas	0	0	0	0	0
Mines	0	2	0	68	68
Government	6	2	11840	11205	23045
Roads	0	2	0	0	0
Total	156	88	89061	33064	122125
CUF3					

LSCFA	77	57	61371	8210	69581
Communal Areas	3	2	571	62	633
Mines	0	1	0	6	6
Government	5	0	12032	0	120032
Roads	0	6	0	6	6
Total	85	66	73979	8284	82263
CUF4					
LSCFA	92	82	34641	9969	44610
Communal Areas	0	0	0	0	0
Mines	0	0	0	0	0
Government	0	0	0	0	0
Roads	0	14	0	0	14
Total	92	96	34641	9983	44624

Source: Mazvimavi (1998)

The large scale commercial farming sector (LSCFA) have most of the water allocated to water right holders. Government also has substantial amounts of water allocated to it, which is used mostly for water supply to the town of Chegutu.

13 References

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