Chapter 1. An Outline of Zimbabwe

1. Land and nature of Zimbabwe

(1) An outline of the land and the climate

Zimbabwe is a land-locked country in Southern Africa. The land area of 386,670 km^2 is almost the same as that of Japan. However, most of the other characters are quite different from those of Japan.

Plateau is the primary character of the land. A higher elevation extends from northeast to southwest. The land higher than 1,220 meters is called Highveld, the land between 1,250 and 915 Middleveld, and the land lower than this Lowveld. The eastern border with Mozambique which forms the eastern edge of the Southern African Plateau is a steep mountain range called Eastern Highland with the elevation of 2,500 meters.

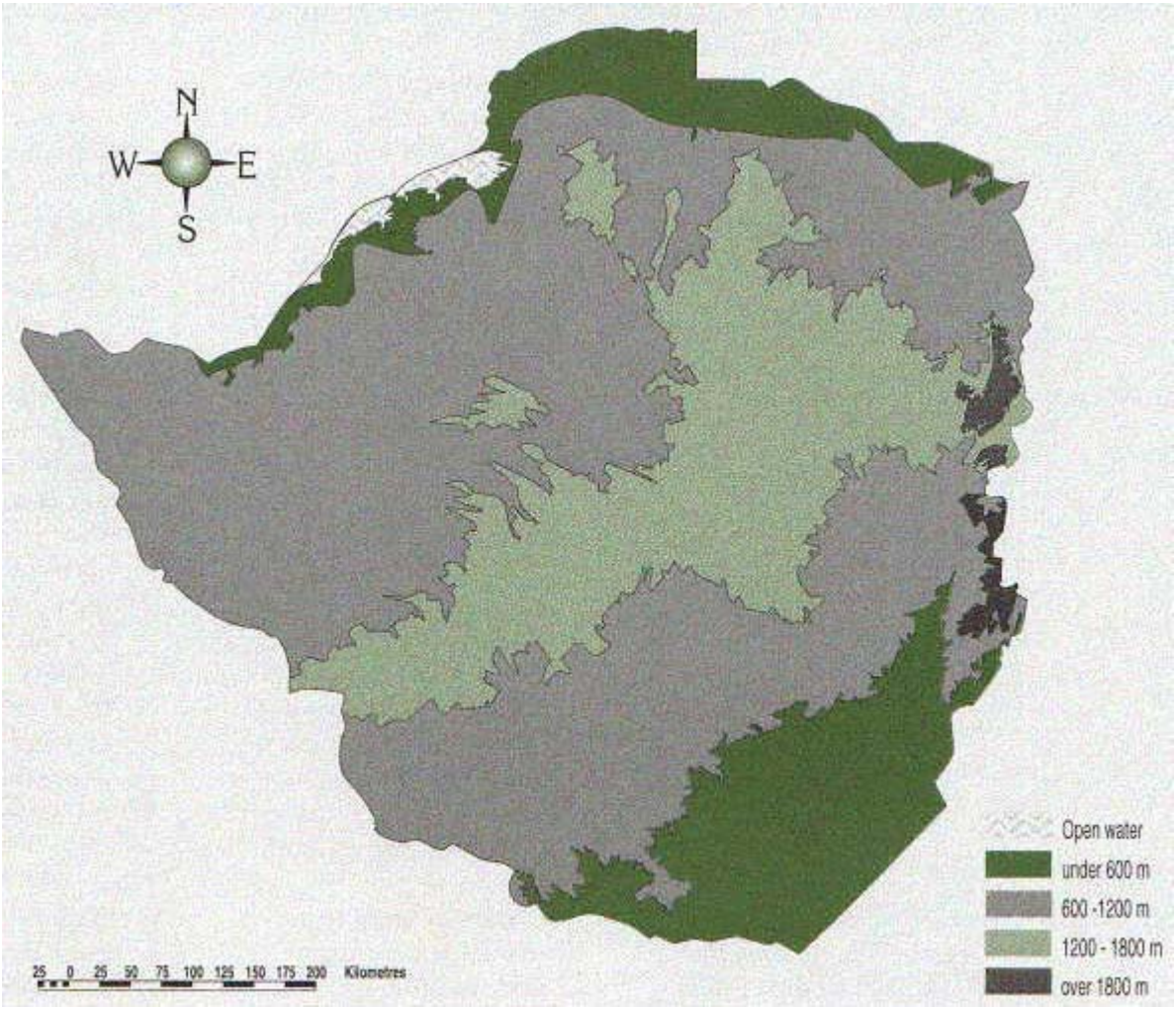

Fig. 1.1. Physiographic regions of Zimbabwe (Chenge, M., Sola, L., and Paleczny, D. (eds.), 1998: The State of Zimbabwe's Environment 1998, Ministry of Mines, Environment and Tourism)

Although the latitude is relatively low between 13 and 16 degrees south, the relatively

high elevation moderates the climate. The Eastern Highland receives the largest annual precipitation of 2,100 mm while Low Vield receives the smallest of 400 mm (African Development Bank, 1993).

There are dry and wet seasons. The dry season can be further divided into two (社団法人国際林業協力協会、1987:農林水産省委託 アフリカ地域食糧農業事情緊急調査報告書:ザンビア・ジンバブエ編):

(a) Hot and wet season (from late October or mid-November to late March)

This season is characterized by high humidity, daily highest temperature of 24-32 degrees and lowest of 14-20 degrees, which are suitable for cropping. More precipitation is received in December and January.

(b) Cool dry season (from April to early September)

This season is characterized by moderate and sunny weather. The daily highest temperature in July is 20-26 degrees and the lowest between 4-14 degrees. At the beginning of the season, it sometimes rains and the humidity is higher.

(c) Hot dry season (From mid-September to early November)

The hottest season. The daily highest temperature in October is 27-33 degrees and the lowest 14-20 degrees. The difference between the temperatures during day time and at night is large. The grasses on the dry plateau die.

Table 1.1. The climate at major cities

	City Altitude meters	Chirundu 400	Harare 1,473	Hwange 782	Kwekwe 1,180	Bulawayo 1,343	Chipinge 1,126	Beitbridge 306
Lowest temp-eratures ℃	January	27.3	20.8	26.4	22.6	21.7	21.2	27.4
	July	20.4	13.9	19.0	19.0	14.1	14.6	16.5
	Annual mean	25.7	18.6	24.7	24.7	19.2	18.7	23.1
Highest temp-eratures ℃	January	32.4	25.7	32.1	32.1	27.1	25.7	33.0
	July	28.9	21.0	27.3	27.3	21.0	19.8	24.9
	Annual mean	32.5	24.9	31.8	31.8	25.6	23.8	30.0
Precip-itation mm	January	162	216	147	147	134	230	195
	July	0	1	0	0	0	20	2
	Annual mean	606	863	591	591	589	1,116	298
No. of rainy days	January	14	19	16	16	12	14	10
	July	0	1	0	0	0	6	1
	Annual mean	57	92	68	68	63	111	36

(国際協力事業団、1992：ジンバブエ共和国橋梁改修及び建設計画事前調査報告書)

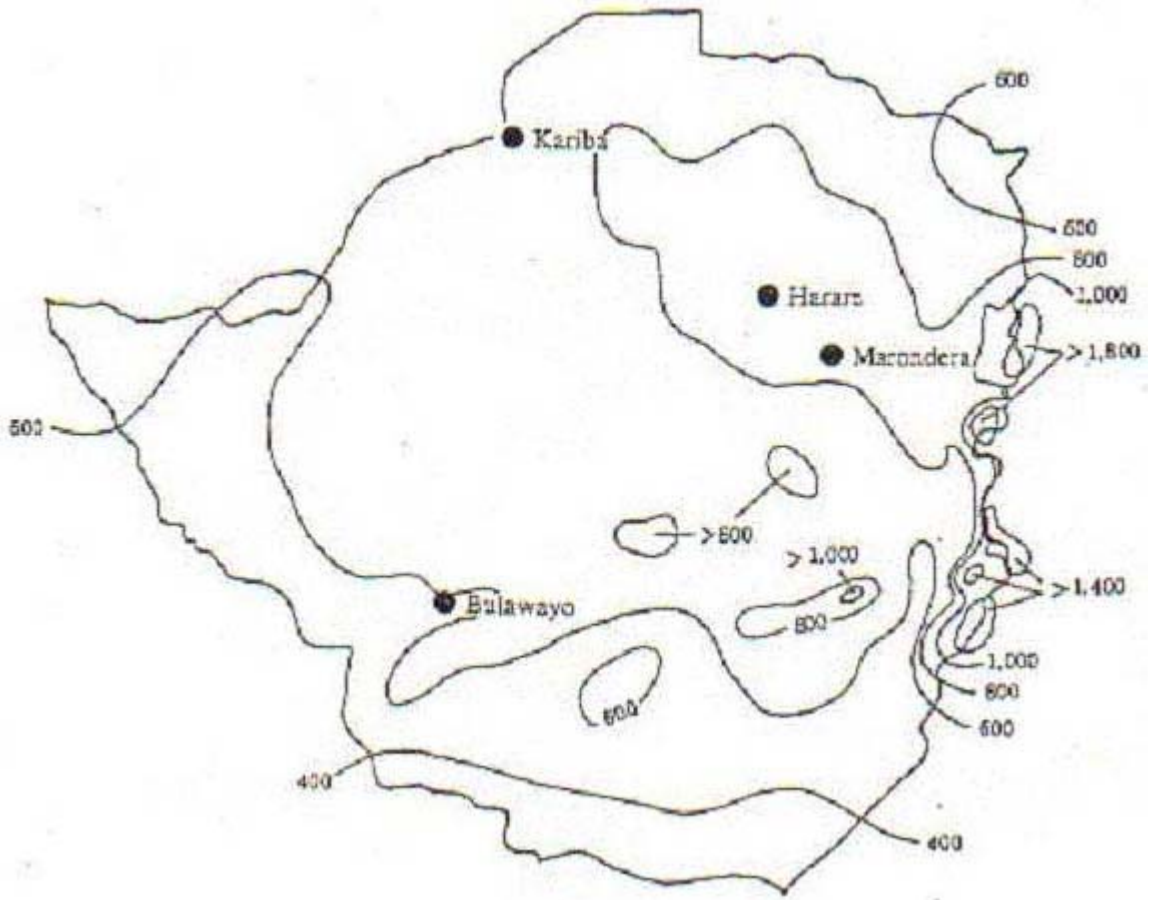

Fig. 1.2. Distribution of precipitation in Zimbabwe(運輸省・財団法人国際開発センター、1990：運輸省経済調査 アフリカ地域気象事業調査 総括編 各国編(セネガル・マリ・エチオピア・ジンバブエ))

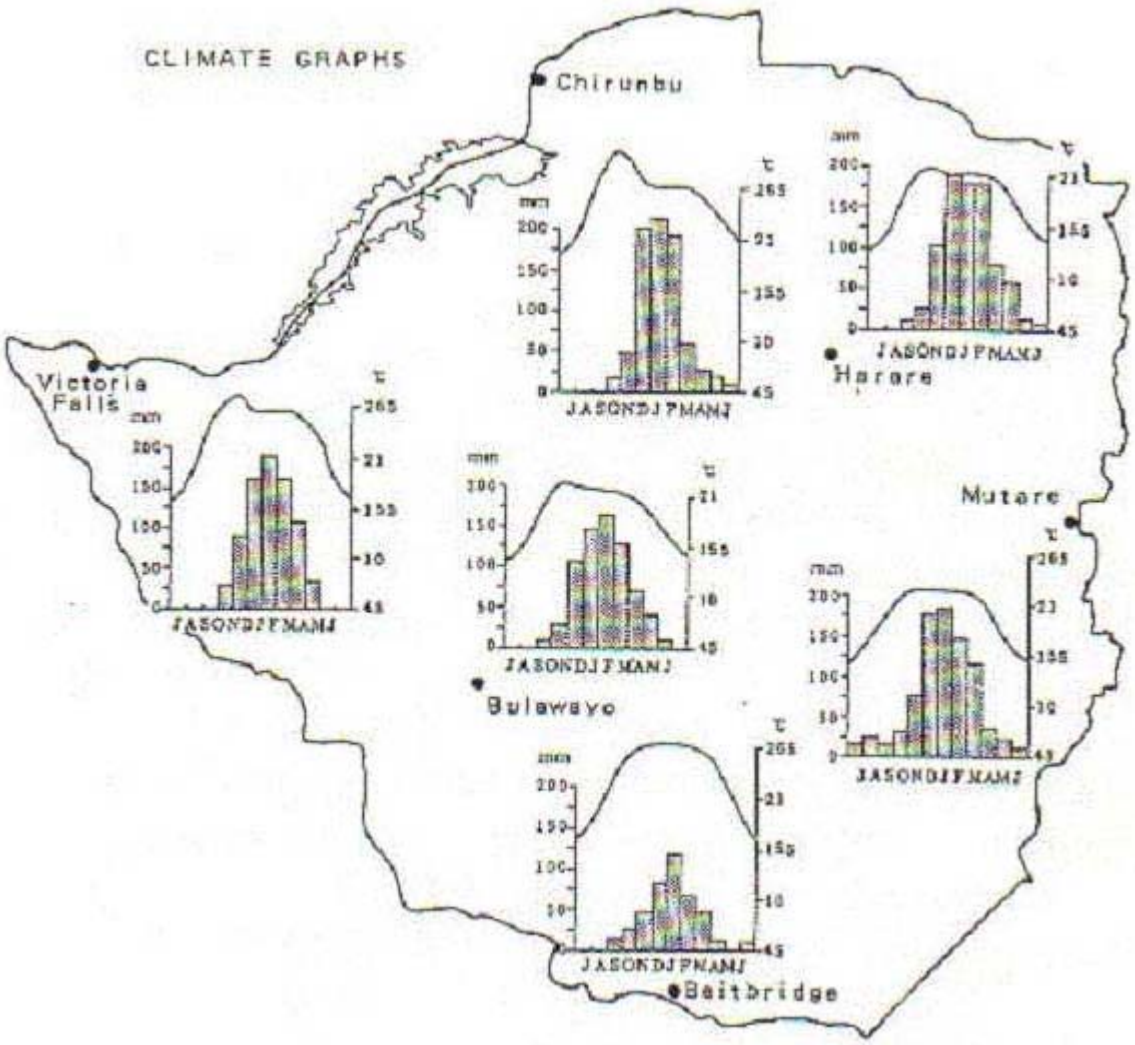

Fig. 1.3. Monthly temperatures and precipitation at major cities(国際協力事業団、1990:ジンバブエ共和国テレビ放送網整備計画基本設計調査報告書)

(2) Vegetation

While the State of Zimbabwe's Environment 1998 report (Chenge, Sola, and Paleczny, 1998) classifies the ecoregions into (a) Eastern Highlands, (b) Svai-Rimpopo, (c) Central, (d) Zambezi, (e) Open Water, and (d) Kalahari in much consideration of the hydrological regions and precipitation (Fig. 1.4), African Development Bank (1993) classifies the ecoregions into (a) Eastern Highlands, (b) Highveld, (c) Middleveld, and (d) Lowveld, primarily based on the topography and altitude. The latter classification is more traditional.

Native vegetation types include undifferentiated woodlands, scrub woodlands and dry deciduous forests, wooded grasslands and deciduous brushlands, and secondary grasslands. These vegetation types vary according to precipitation, temperature, and soil. In large areas of the country, native vegetation is restricted to protected areas and high elevations. Elsewhere, land use changes and degradation have either eliminated or altered native vegetation. (African Development Bank, 1993)

The Zimbabwe Woody Cover Map 1:1,000,000 derived from visual interpretation of

Landsat-TM data imagery of 1992 with extensive field checks and published by the Department of the Surveyor General in 1998, classifies the woody cover of Zimbabwe as follows:

Woody cover classes	% of the cover
Natural moist forest	0.03
Forest plantation	0.40
Woodland	53.20
Bushland	12.72
Wooded grassland	3.08
Grassland	1.76
Cultivation	27.47
Rock outcrops and mine dump	0.20
Settlement	0.36

The land cover categories by the Forest Commission used in the same research are shown in Table 1.2.

Table 1.2. Land cover categories for visual interpretation of Landsat Imagery by the Forest Commission (Chenge, Sola and Paleczny, 1998)

Land cover category	Definition and notes
Natural moist forest	Tree height > 15 m; canopy cover > 80 %
Plantations	Areas planted with exotic tree species
Woodland	Tree height 5 - 15 m; canopy cover 20 - 80 %
Bushland	Tree height 1 - 5 m; canopy cover 20 - 80 %
Wooded grassland	Tree height 1 - 15 m; canopy cover 2 - 20 %
Grassland	Tree canopy cover < 2 %
Cultivated land	Includes disturbed and fallow lands
Rock outcrops	Large areas of exposed rock with little or no plan cover
Water bodies	Surface area of large dams
Settlements	Areas of human habitation, most urban areas

According to the Map, natural moist forests and forest plantations are seen in the Eastern Highlands only. A majority of the cultivated lands are found at higher elevations, i.e. in the Highvled. A majority of the wooded grasslands and grasslands are found on the southwestern slopes of the Highveld. Extensive bushlands are found in the southern Lowveld and western Kalahari area, both of which are semi-arid. However, bushlands are also found in the western Highveld surrounding Bulawayo and in a part of Middleveld surrounding Masvingo. These locations indicate a different type of bushlands from those in the semi-arid areas. Extensive woodlands are seen at the lower altitude along the Zambezi Valley, in northwestern Middleveld, and in higher Lowveld in the south. The Map also shows that the vegetation of the protected areas are well preserved even in the regions where cultivated areas are dominant.

The result of this relatively large-scaled mapping is different from more traditional and small-scaled vegetation mapping, particularly in the western Highveld, such as the one shown in the State of the Environment 1998 report (Fig. 1.5). On the other hand, the ecoregions used in the State of the Environment report (Fig. 1.4) is relatively consistent with the Zimbabwe Woody Cover Map 1:1,000,000, particularly with regard to the Kalahari ecoregion and the bushlands in the semi-arid closed basin of the seasonal Makarikari Salt Lake in Botswana.

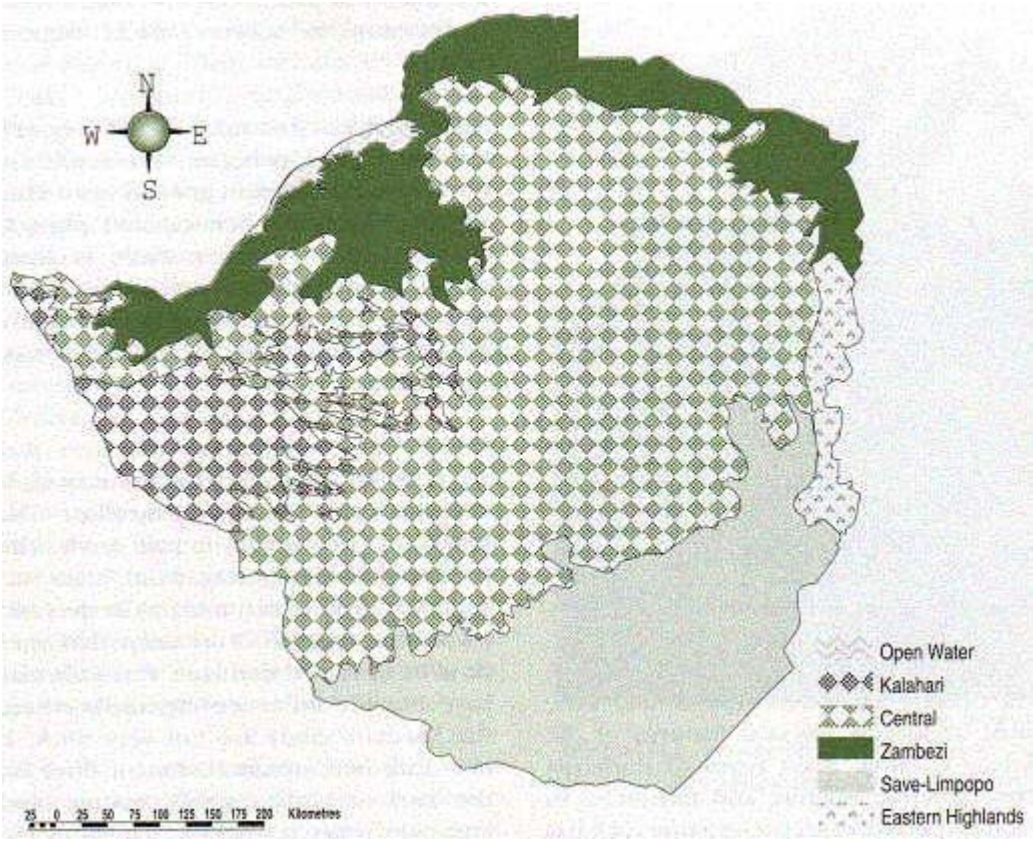

Fig. 1.4. Ecoregions of Zimbabwe (Chenge, Sola and Paleczny, 1998)

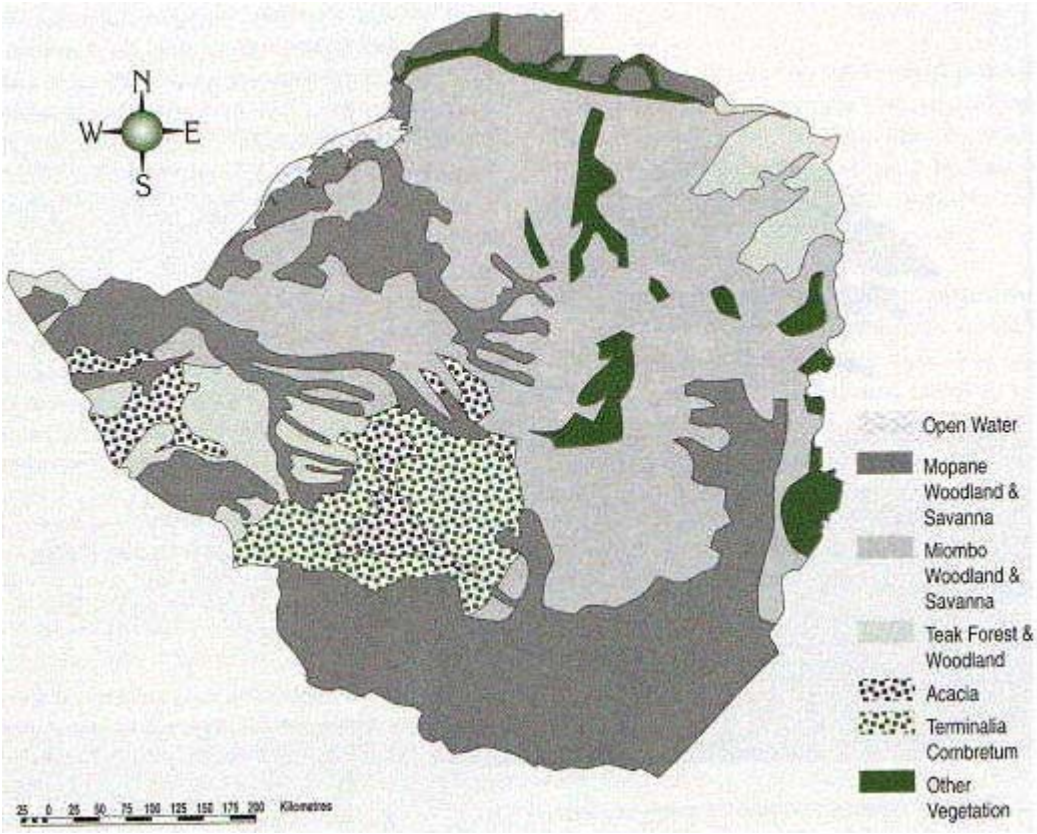

Fig. 1.5. Major woody vegetation types of Zimbabwe (Chenge, Sola and Paleczny, 1998)

(3) Hydrology

Zimbabwe's hydrological regime is divided by the hill extending from the northeast to southwest at 1,200 - 1,500 meters in altitude into the Zambezi system in the north and Sabi and Limpopo system in the south. The Zambezi system is further divided into three subsystems. The narrow belt along the eastern border is independent from the two systems. (See Table 1.3 and Figs. 1.6 and 1.7.)

Because most precipitation occurs during the wet season, most rivers except Zambezi, Limpopo and Sabi Rivers dry up in three to four months after the end of the wet season. The volume of the annual run-off for the total land area is 20 billion m^3, which is 7.5 % of the average precipitation. When Zambezi and Limpopo Rivers are excluded, the total run-off becomes 8 billion m^3, reducing the proportion to the total precipitation to 3 %. (社団法人国際建設技術協会、1987年:ジンバブエ国ブラワヨ水資源開発計画情報収集調査報告書; African Development Bank, 1993: Country Environmental Profile: Zimbabwe)

Almost all the lakes of Zimbabwe are artificial. The total carrying capacity of the approximately 8,000 reservoirs of the country amounts to five billion m^3. However, only 94 of the 8,000 dams are higher than fifteen meters. There is a tendency that larger dams are situated in commercial farm lands while smaller dams are in communal lands. (African Development Bank, 1993: Country Environmental Profile: Zimbabwe)

Table 1.3. Hydrological zones of Zimbabwe (Chenge, M., Sola, L., and Paleczny, D. (eds.), 1998: The State of Zimbabwe's Environment 1998, Ministry of Mines, Environment and Tourism)

Zone	Description	Area (km^2)	% of Zimbabwe's area
A	The northwestern area draining into the Gwayi River, and small rivers draining directly into Zambezi River. This zone includes rivers draining into the Nata River and eventually into the Mkgadikgadi System in Botswana.	102,560	26.7
B	The southwestern catchment area of of all rivers draining from Zimbabwe into the Limpopo River.	62,540	16.3
C	The northern catchment of rives such as Mupfure, Munyati, Sanyati and Manyame, draining into the Zambezi.	90,520	23.6
D	The Mazowe and Ruenya Rivers.	36,710	9.6
E	The Save-Runde catchment areas.	84,550	22.0
F	Rivers darining eastward formt the Eastern Highlands, and into Mozambique. The major rivers are the Pungwe, Gairezi and Budzi Rivers.	7,300	1.9
Total		384,180	100.1

(note) The total area drained excludes Lake Kariba. Rounding of numbers results in slightly varying percentages.

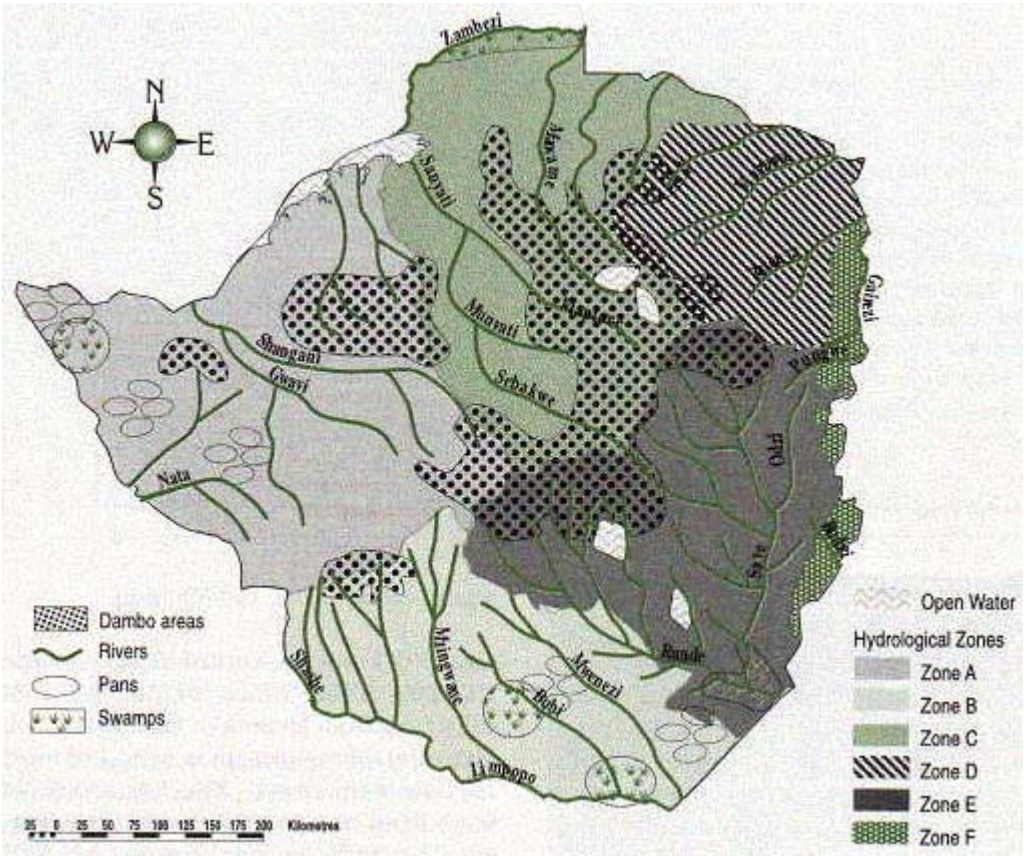

Fig. 1.6. Hydrological zones of Zimbabwe (Chenge, M., Sola, L., and Paleczny, D. (eds.), 1998: The State of Zimbabwe's Environment 1998, Ministry of Mines, Environment and Tourism)

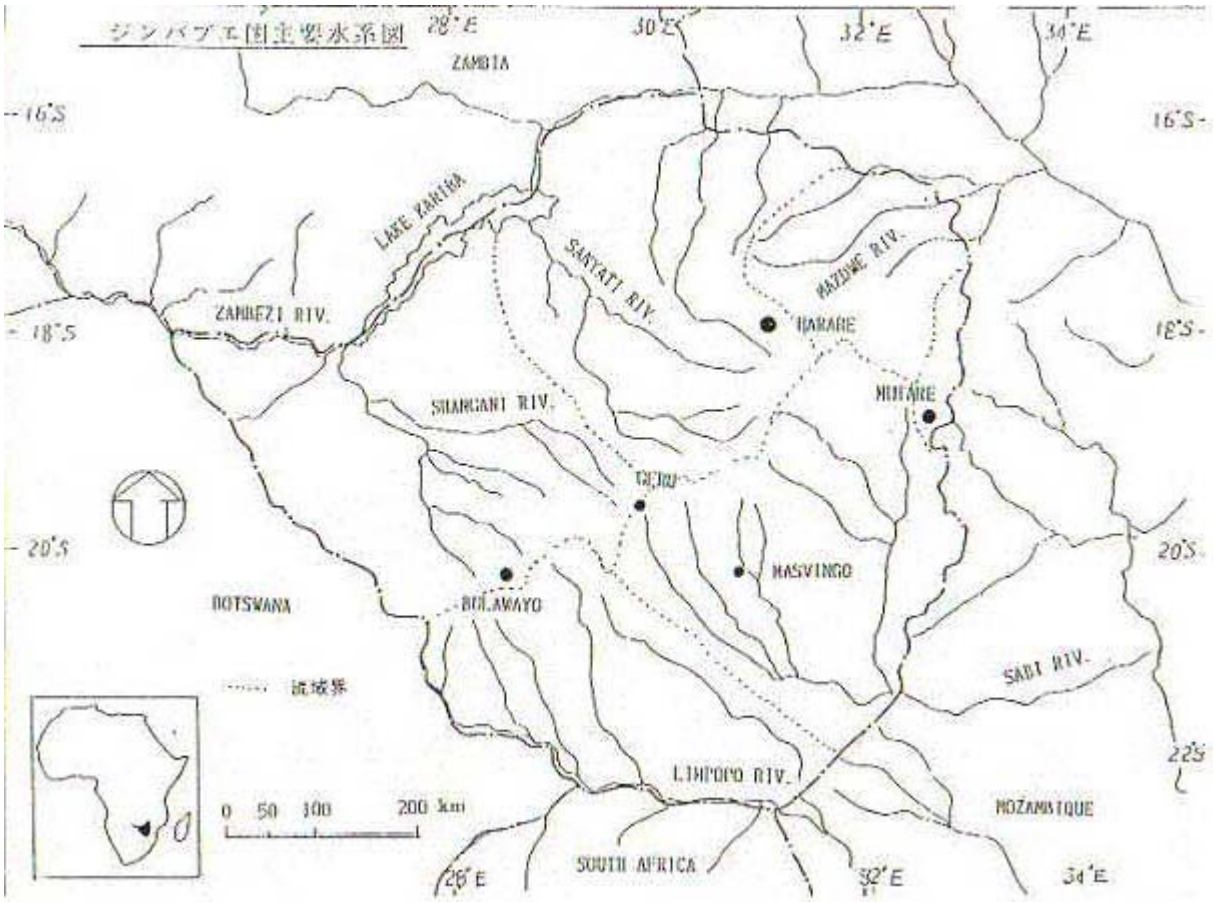

Fig. 1.7.　Major rivers of Zimbabwe (社)国際建設技術協会、1987：　ジンバブエ国ブラワヨ市水資源開発計画情報収集調査報告書、国際協力事業団）

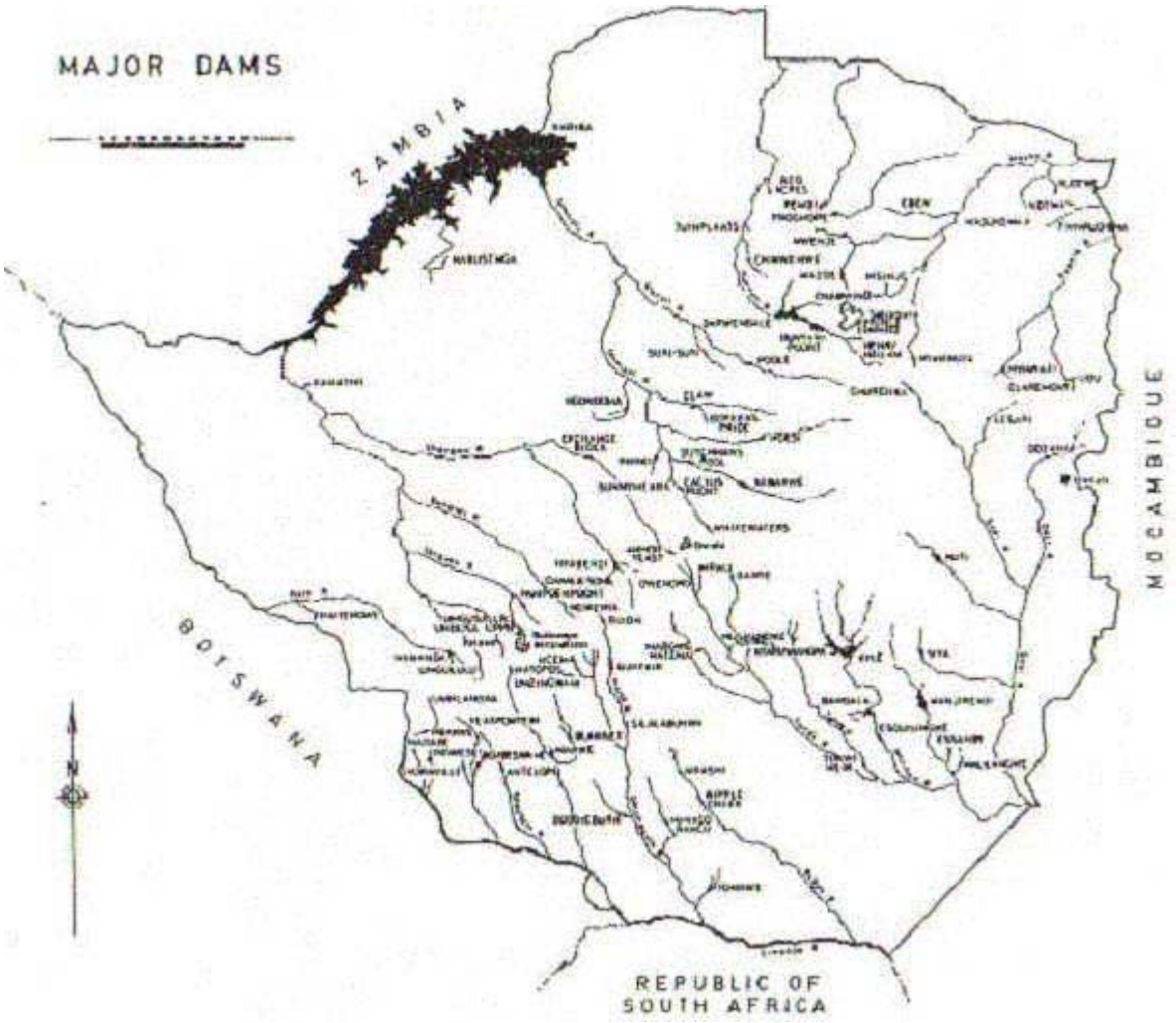

Fig. 1.8. Dams and reservoirs of Zimbabwe (社団法人日本プラント協会、1982:ジンバブエ国肥料プロジェクト発掘調査報告書)

Table 1.4. Run-off volumes from major hydrological systems((社)国際建設技術協会、1987：ジンバブエ国ブラワヨ市水資源開発計画情報収集調査報告書、国際協力事業団)

Hydrological system	Area (thousand km^2)	Annual run-off (m^3)	Specific run-off (m^3/sec/km^2)
Shgangani River	102.98	2,209	0.00068
Limpopo River	62.06	1,468	0.00075
Sanyani and Munyani Rivers	89.98	5,390	0.00190
Mazowe River	37.66	3,694	0.00311
Save River	82.05	5,799	0.00224
Eastern boarder system	7.08	1,504	0.00674

2. Political, governmental and socio-economic conditions

(1) An outline of Zimbabwe's politics and the government

When the Smith administration declared independence as Rhodesia in 1965, UK did not accept it because of the White minority's governance. In 1968 a resolution was adopted by the UN General Assembly to impose economic sanctions against Rhodesia and isolated

Rhodesia.

Only in 1980 the state officially became independent as Zimbabwe with administration by Whites and Blacks and with Robert Mugabe as the first Prime Minster. When the Commonwealth country became a republic in 1987, Prime Minister Mugabe assumed the first President. The president is both the chief of state and head of government.

With the significant majority of the ruling party due to the merger of the ruling Zimbabwe African National Union (ZANU) and Zimbabwe African People's Union (ZAPU) as Zimbabwe African National Union-Patriotic Front or ZANU-PF, the administration is quite stable. This stability led to the re-election of President Mugabe in 1990 and 1996.

A Land Expropriation Act of 1992 enabled the Government to expropriate lands owned by White large landholders at the price set by the Government in order to re-distribute the lands to the Black farmers who had been expelled from fertile lands during the colonial days. However, the resistance of the Commercial Farmers' Union (CFU) formed mainly by White large landholders has been persistent. In addition, the budget for the expropriation has not been sufficient. Because of these, progress has been limited.

With regard to diplomacy, Zimbabwe has been making efforts for strengthened close relations with neighbor countries under the non-alignment policy. President Mugabe has been demonstrating his international leadership for regional stability by mediation for the cease-fire in Mozambique and others. Zimbabwe was chaired the OAU in 1997. (Ministry of Foreign Affairs of Japan, 1998b: Japan's ODA 1998)

The primary administrative divisions are eight provinces and two cities with provincial status: Bulawayo City, Harare City, Manicaland, Mashonaland Central, Mashonaland East, Mashonaland West, Masvingo, Matabeleland North, Matabeleland South, and Midlands.

The Ministries are mostly responsible for political decision as secretariats of respective Ministers, while Departments are executive organs in individual sectors. It often happens that as Ministers change, the sectors individual Ministers are responsible for change and the Departments that belong to a Ministry change.

Table. 1.5. An outline of the country (Ministry of Foreign Affairs of Japan, 1997: Diplomatic Bluebook 1997, except *: http://www.afdb.org/: Zimbabwe Fact Sheet; **: CIA World Factbook 1998; ***: UNDP, 1998: Human Development Report 1998)

English name	Republic of Zimbabwe
Capital	Harare
Area	390 km^2
Population	1,1423 thousand**(July 1997 estimate) （Annual population growth 3.0%）
Major languages	English, Shona, Ndebele
Ethnic composition**	Shona 71 %; Ndeblele 16 %; other Blacks 11 %; Whites 1 %; Mixed and Asians 1 %
Major religions	Traditional, Christianity
Infant mortality ((1998 est.)**	61.75 deaths/1,000 live births
Adult literacy (1995)***	85.1 %
Life expectancy at birth 1995***	48.9
GNP	US$ 5.42 billion［US$ 490/person］(OECD/DAC category: Other Low Income Countries (per capita GNP <$765 in 1995))
Import to Japan	US$ 121 million (machinery for transportation, civil engineering machinery tires, etc.)
Export to Japan	US$ 163 million (nickel, ferrochromium, tabacco, asbestos, etc.)
Direct investment from Japan	US$ 3,536 thousand
Japanese residents	205

(2) Economic situation

Thanks to the wealth of mineral resources, the economic infrastructure has been relatively well developed in Zimbabwe. The economic structure is relatively well balanced among agriculture, industry and mining.

The efforts for elimination of the difference between the Blacks and Whites since the independence have achieved progress in the Black's education, primary health care and others. However, the recent years' drought and other unfavorable conditions have resulted in the economic growth rates lower than the population growth rates and increase in the unemployment rates, particularly those of the young. (Ministry of Foreign Affairs of Japan, 1998a)

With this background, the Government introduced liberal economic policies. In 1991, it launched an economic structural adjustment program with support from the World Bank and IMF. Liberalization of importation, reform of the foreign exchange policies, relaxation of various controls and management of finance have seen a progress. The second structural adjustment program, Zimbabwe Programme for Economic and Social Transformation (ZIMPREST) 1996-2000, is currently going on with a target of a net annual GDP growth at six per cent. The Program is particularly targeted at the following themes:

- Urgent restoration of macroeconomic stability (low inflation and interest rates, stable exchange rate);
- Facilitating the public and private savings and investment needed to attain growth;
- Pursuing economic empowerment and poverty alleviation by generating opportunities for employment and encouraging entrepreneurial initiative;

- Investing in human resources development; and
- Providing a safety net for the disadvantaged.

It also declares that it embraces initiatives to ensure socio-political stability by:

- improvements in the quality of democratic institutions;
- pursuit of good governance; and
- elimination of corruption.

The objectives and strategy are shown in a chart as reproduced as Fig. 1.9.

Table 1.6. Economic indicators (Ministry of Foreign Affairs of Japan, 1997: Japan's ODA 1997; Ministry of Foreign Affairs of Japan, 1998a: Japan's ODA 1998)

		1993	1994	1995	19969	Annual growth 85-95 mean	Annual growth 90-96 mean
Population (thousand)		10,638	11,002	11,011	11,248	2.8 %	2.4 %
Gross GNP	Total (US$ million)	5,756	5,424	5,933	6,815		
	Per capita (US$)	520	490	540	610	-0.6 %	-1.1 %
Current balance (US$ million)		-115.7	-424.9				
Consumer price index (1990＝100)		223.6	273.3	335.1			
External debt (US$ million)		3,329	3,539	3,741	5,005		
Currency exchange rate (Z$/US$ yearly mean)		0.1545	0.1227	0.1155	0.1008		

Table 1.7. GDP composition by sector (estimates for 1993) (CIA, 1998: World Factbook 1998)

Sector	%
Agriculture	18.3
Industry	35.3
Services	46.4

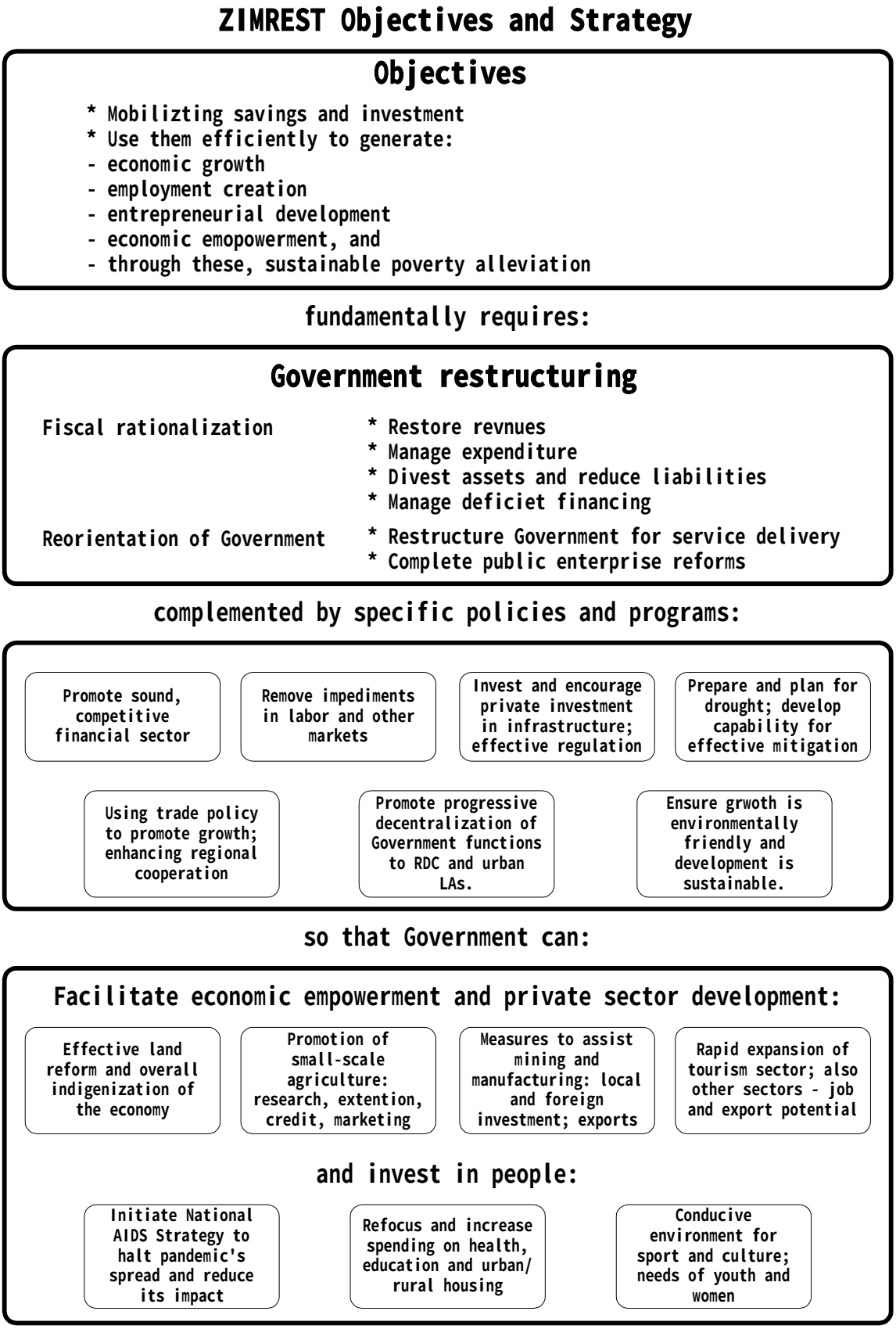

Fig. 1.9. The objectives and strategy of the second economic structural adjustment program of Zimbabwe 1996-2000

27 % of the population are engaged in agriculture. The share of agricultural products in the export amounts to 25 %. While mining shares only 5 % in the GDP and employment, minerals and metals share 20 % in the export. The major mineral resources are coal, chromium, asbestos, gold, nickel, copper, iron, vanadium, lithium, tin and platinum.

The major products from the mineral industries are coal, clay, various metal and non-metal minerals. Those from the industry are copper, iron, nickel, tin, wood products, cement, chemicals, fertilizer, clothing and footwear, foodstuffs and beverages. The major agricultural products are corn, cotton, tabacco, wheat, coffee, sugar cane, peanut, cattle, sheep, goat and pigs.

The major export commodities are agricultural products (38 %; Particularly tabaccos' share is so high as 28 %.), manufactured products (34 %), gold (12 %), textiles (4 %), and ferrochrome (7 %). The major destinations of the export are South Africa (12 %), UK (12 %), Germany (6 %), and Japan (5 %). The total export value is US$ 2.5 billion. (The figures are estimates for 1995.)

The major import commodities are machinery and transportation equipment (41 %), other manufactures (24 %), chemicals (13 %), and fuels (10%). The major partners for the importation are South Africa (38 %), UK (9 %), US (5 %), and Japan (5%). The total import value is US$ 2.2. billion. (The figures are estimates for 1996.)

The unemployment rate is said to be at least 45 % in 1994.

A fiscal year starts on 1 July and ends on 30 June of the following year.
(CIA, 1998: World Factbook 1998)

Closely associated with colonial legacies, land is unequally distributed in across farming sectors, resulting in various issues for development, sustainable use, management and conservation of land resources. The current land distribution in Zimbabwe is estimated as follows (Chenge, M., Sola, L., and Paleczny, D. (eds.), 1998: The State of Zimbabwe's Environment 1998, Ministry of Mines, Environment and Tourism):

4,000 large-scale commercial farmers	11.2 million ha	(2,200 ha /farmer)
10,000 small-scale commercial farmers	16.3 million ha	(123 ha /farmer)
1,000,000 communal area families	16.3 million ha	(16.3 ha /farmer)
60,000 resettlement families	3.3 million ha	
State farming sector	0.5 million ha	

It should be noted that 56 % of the total population of the country live in communal (51.74 %) and resettlement (4.08 %) areas.

3. Environmental Conservation in Zimbabwe

(1) Environmental problems in Zimbabwe

The State of Zimbabwe's Environment 1998 report (Chenge, M., Sola, L., and Paleczny, D. (eds.), 1998) lists the following as the major environmental issues confronting the country:

- Growing poverty and its attendant problems of resource over-exploitation;
- Land degradation due to both human activities and natural phenomena, and the

impact these have on food security;
- Continued loss of forests due to overexploitation;
- Conservation of biodiversity to minimize losses as a result of human activities; and
- Threat of alien species such as the water hyacinth in some of the country's water bodies.

The present distribution of population, which is a legacy from the colonial era, has had major environmental consequences. Large-scale commercial farmers occupy most of the fertile highlands, while the majority of the population lives in the less productive communal areas. The communal lands, which encompass almost half of the country's land area, suffer from severe environmental degradation such as overgrazing, deforestation and soil erosion. The unregulated establishment of mines has created large waste dumps, and runoff from these has contaminated soil and water bodies. However, compared to other countries in the region, urban sanitation is much less problematique, although the migration from rural areas to urban centers has led to overcrowding. The country's rich wildlife resources have been well managed. A number of innovations, which have promoted sustainable utilization of wildlife, could serve as a model for other countries. There is no lack of environmental legislation per se, but existing regulations are fragmented and difficult to enforce. Environmental awareness is generally high. (African Development Bank, 1993: Country Environmental Profile: Zimbabwe)

The major causes of the environmental problems in Communal Lands are enlarged croplands, increased needs for firewoods and construction materials, and fire. Trees have been cut for expansion of farmlands also in small-scale commercial agricultural lands and large-scale commercial agricultural lands. The deforestation caused for firewoods is much associated with the uneaven distribution of woody resources in the country. As a whole country, sufficient amount of resources for firewoods are available. (国際協力事業団農林水産開発調査部農業開発調査課、1994：ジンバブエ国ムニャティ川下流域農業開発計画事前調査報告書)

Table 1.8. Changes in woody cover between 1985 and 1992 (Chenge, M., Sola, L., and Paleczny, D. (eds.), 1998: The State of Zimbabwe's Environment 1998, Ministry of Mines, Environment and Tourism)

Forest Commission (1996)		Millington and Townsend (1989)		% change /year (uniform, based on 1985 figures)
Wood cover class	Extent (ha)	Woody biomass class	Extent (ha)	
Natural forest and woodland	20,808,959	B, C, D, H, I	25,612,300	- 2.7
Bushland	4,974,130	K	9,165,600	- 6.5
Wooded grassland	1,240,762	N	665,300	+ 11.6
Plantation	155,853	No data	No data	No data
Total	27,143,704	Total	35,443,200	- 3.3

Siltation of rivers and lakes, particularly of reservoirs, which is a result of soil erosion, is a serious problem in Zimbabwe. More than half of the reservoirs are said to have reduced their carrying capacities to a half or less of their original capacities and the average life length of reservoirs is said to be 10 - 15 years. (国際協力事業団農林水産開発調査部農業開発調査課、1994：ジンバブエ国ムニャティ川下流域農業開発計画事前調査報告書) Tables 1.9 and 1.10 show the extents of the siltation and soil erosion in the country.

Table 1.9. Extent of siltation of small dams in conmunal lands, small-scale farming and resettlement areas Chenge, M., Sola, L., and Paleczny, D. (eds.), 1998: The State of Zimbabwe's Environment 1998, Ministry of Mines, Environment and Tourism

Province	No. of dams	Average % of siltation
Mashonaland East	40	24.8
Milands	259	35.0
Manicaland	118	34.7
Mashonaland Central	130	34.0
Msvingo	109	61.9

Table 1.10. Extent of soil erosion (%) by land tenure class in Zimbabwe (Chenge, M., Sola, L., and Paleczny, D. (eds.), 1998: The State of Zimbabwe's Environment 1998, Ministry of Mines, Environment and Tourism)

Erosion class	Communal land	Commercial agricultural land	Other	Zimbabwe total
No erosion	7.2	14.7	55.5	17.2
Very limited	29.7	64.7	40.4	45.7
Limited	20.3	15.9	3.2	16.0
Moderate	19.6	3.4	0.6	10.2
Extensive	11.3	1.2	0.3	5.6
Very extensive	11.9	0.1	0.0	5.3

The rapid growth of Water Hyacinth in many reservoirs is also a matter of concern in Zimbabwe. The first occurrence of Water Hyacinth is said to be in Manyame River and Mukuvisi Rivers, one of the former's tributaries, in the 1930s. The plant's growing areas rapidly expanded between 1941 and 1943, leading in 1943 to the Government's designation of the species as a Noxious Weed in accordance with the Noxious Weeds Act of 1926. According to the national surveys by the then Ministry of Natural Resources and Ministry of the Environment and Tourism, Water Hyacinth is now extensively growing also in Nyadiri River in addition to Manyame River. It is also found in Macheke and a few other Rivers as well as Lake Mutirikwe. (小島貞夫・川崎保夫・村井英臣、1990：専門家総合報告書、国際協力事業団(国際協力事業団国際協力総合研修所(編)開発途上国技術情報データシート1996年度:ジンバブエ(2/2)所収)) The author of this report saw small water hyacinths also in Lake Kariba. This lake also faces to a much less extent a problem of macrophytes as shown in table 1.11.

Table 1.11. Biodiversity trends of macrophytes on Lake Kariba (Chenge, M., Sola, L., and Paleczny, D. (eds.), 1998: The State of Zimbabwe's Environment 1998, Ministry of Mines, Environment and Tourism)

1959	Population explosion of marcophytes and floating Kariba Weed, Water Lettuce, Bladderwort and Duckweed
1960	Appearance of Coontail, Cat-tail and Bulrush
1962	22 % of the Lake surface was covered by Kariba Weed
1962-66	Two species of pondweed occupied depth of up to four meters while Coontail first appeared in areas not occupied by Kariba Weed and Oxygen Plant.
1969	Wild Celery first appeared.
1971	First record of Bushy Pondweed

Because many of such areas suffering from rapid growth of Water Hyacinth are protected areas, the Department of National Parks and Wildlife has been making efforts to cope

with the plant by manual, mechanical and chemical controls. Due to the rapidness of the growth, the mechanical control has not been able to achieve significant effects. The mechanical control has not been applied on a sustainable manner primarily due to the cots of the machinery. The chemical control by spraying 2, 4-D or gyphosate has been able to effectively suppress the growth of the plant. However, there is a controversy of the side effects and long-term effectiveness of this method. There is a concern about the effects of dioxyns which 2, 4-D results in on humans and ecosystems. There is also a concern about the decomposition of Water Hyacinth in the water which further enriches the water. The Depart itself is concern about these side effects and long-term effects. However, in the current situation where the proposed biological control by beetles that eat Water Hyacinth has not yet been proved to be feasible, the Department is still relying much on the chemical control.

The primary causes of such water pollution are waste water from industrial and domestic sources and soil erosion. As mentioned above, mining is also causing water pollution in some areas.

Because reservoirs are the primary source of water for urban areas, which are mostly uphill in Zimbabwe, there is a serious concern about the pollution of the water, particularly about the pollution caused by waste water. The reservoirs that are water sources for urban areas are usually receive the waste water from the urban areas in the upstream and provides water for the same urban areas. This is particularly a concern in Harare which consumes almost 40 % of the total consumption of the urban areas of Zimbabwe as shown in Table 1. .

The primary problem with the waste water from urban areas is the insufficient treatment of the waste water. As shown in Table 1.13, the capacities of many of the existing treatment facilities are no longer sufficient. And the conditions of many of the facilities are not good. Combination of these results in unfavorable quality of effluents from the facilities.

One critical problem to cope with the problem of water pollution is lack of sufficient information of the water quality. Of the reservoirs, certain information is available for Lakes Kariba, Chivero and Mutiriwke only.

Table 1.12. Water consumption for urban centers (Chenge, M., Sola, L., and Paleczny, D. (eds.), 1998: The State of Zimbabwe's Environment 1998, Ministry of Mines, Environment and Tourism)

Urban area	Water consumption (million m^3 /year)
Bindura	12
Bulawayo	60
Chegutu	6
Chinhoyi	10
Chirezi, Triangle	4
Gweru	20
Harare, Chitungwiza, Norton, Ruwa	155
Hwange	40
Kadoma	14
Kariba	3
Karoi	3
Kwekwe, Redcliff	35
Mrondera	4
Mashava	3
Masvingo	12
Mhangura	2
Mutare	12
Rusape	2
Shurugwi	1
Zvishavane	6
Total	404

Table 1.13. Status of sewage of treatment plants in Zimbabwe (Chenge, M., Sola, L., and Paleczny, D. (eds.), 1998: The State of Zimbabwe's Environment 1998, Ministry of Mines, Environment and Tourism)

Name	Type of plant	Design capacity (m^3 /day)	Present volumes (m^3 /day)	Quality of effluent [1]	Disposal method	Condition of plant [2]
Mashonaland Central						
Bindura						
Showground Ponds	Oxidation pond				Discharge into Mazowe River Tributary	Poor
Golf course and town - Chipandze Road Ponds	Oxidation pond				Discharged into Nyanpandula River	Real bad state
Chipandza Ponds	Oxidation Ponds				Discharge into stream	Poorly maintained
Farm Ponds	Oxidation Ponds				Irrigation of pastures	Well maintained
Trojan Nickel Mine: Bindura	Oxidation pond				Irrigation of pastures	Poor housekeeping
Chiwarizo Ponds	Oxidation pond				Discharged into Nyanpandula River	
Z.R.P. Ponds	Oxidation pond					
Mazowe Rural Council						
Glendale	Oxidation pond				Irrigation of gum plantation	Well maintained
Concession	Oxidation pond				Irrigation of gum plantation	Maintenance not too good
Harare						
Ferle Sewage Works	Activated sludge	108,000	120,000	Fair	Discharge into stream	Average
Crowborough Sewage Works	Activated sludge			Fair	Discharge into stream	Average
Mabvuku/Tafara	Oxidation pond			Fair	Discharge into stream	Average
Marlbourgh	Oxidation pond					
Hatcliffe	Activated sludge			Fair	Irrigation of pastures	Average
Norton Town Council	Oxidation pond			Poor	Irrigation of pastures	Poor
Zengeza Township	Oxidation pond			Poor	Irrigation of pastures	Poorly maintained
						Mashonaland West
Chinhoyi Municipality	Conventional Bio Filters			Average	Irrigation of pastures	Poorly maintained
Chegutu Municipality	Oxidation pond			Average	Irrigation of pastures	Well maintained
Kadoma Municipality					Discharge into stream	Average state
Kariba Township				Poor	Discharge into stream	Average state

Karoi	Oxidation pond			Average	Irrigation of pastures	good
Midlands						
Gweru City Council	Activated sludge			Average	Irrigation of pastures	Average
Kwekwe Municipality	Oxidation pond					
Redcliff Town	Oxidation pond			Poor	Discharge into streams	Poorly maintained
Shurugwi (ZIMASCO)	Oxidation pond			Poor	Discharge into streams	Poor
Zvishavane						
Mandava Sewage Work	Oxidation pond			Very poor	Discharge into river	Overloaded, poor housekeeping
Mabula Sewage Works	Conventional Bio Filters			Very poor	Discharge into river	Overloaded, poor housekeeping
Matabeleland South						
Beitbridge (Panda Mine)	Oxidation pond			Very poor	Discharge into river	Poor
Esigodini (Essexvale Township)	Oxidation pond					Proposed in 1974
Filabusi (Conese Mine)	Oxidation pond					
Gwanda	Oxidation pond			Poor	Discharge into river	Overloaded
Plumtree	Oxidation pond			Poor	Irrigation of pastures	Average maintenance
Matabeleland North						
Bulawayo						
Eselby Farm plant No. 1	Conventional Bio Filters		3,170	Good	Irrigation of pastures	Fairly maintained
Eselby Farm plant No. 2	Conventional Bio Filters		5,790	Poor	Irrigation of pastures	Average
Eselby Farm plant No. 3	Activated sludge	11,000	9, 140	Good		Good
Luveve plant	Conventional Bio Filters	2,300	4,000	Average	Irrigation of parks	Average
Magwegwe North plant	Oxidation pond		3,937	Poor	Gum plantation/ irrigation of sorgum	Poor
Thorngroove plant	Conventional Bio Filters	14,500	8,735	Good	Watering parks	Good
Southern Areas plant	Activated sludge		7,000	Poor	Discharge into stream	Poor
Waterford plant	Conventional Bio Filters	96	70-90	Good	Watering parks	Good
Hwange Local Board						
Boabab	Activated sludge					

Mpumalanga	Activated sludge					
Hwange Power Stantion - ZESA						
Station treatment plant						
Ingagula treatment plant						
Vicgoria Falls Municipality	Oxidation pond					
Wankie Colliery						
No. 1 treatment plant	Conventional Bio Filters			Poor	Discharge into stream/ irrigate lawns	Poor maintenance
No. 2 treatment plant	Conventional Bio Filters			Poor	Discharge into stream	Good housekeeping
No. 3 treatment plant	Conventional Bio Filters			Poor	Irrigate sports fields	Poor maintenance
Manicaland						
Chipinge	Oxidation pond					
Conemara Township (Nyanga)	Oxidation pond			Poor	Irrigate bananas	Poor
Mutare Municipality	Activated sludge	23,700	25,000	Average	Irrigation of gum plantation	Average
Nyanga Township	Oxidation pond			Average	Irrigation of gum plantation	Good
Nyazura Township	Oxidation pond			Poor	Irrigation of gum plantation	Poor
Rusape Township	Oxidation pond			Poor	Irrigate golf course	Poor housekeeping
Masvingo						
Chiredzi Township	Oxidation pond			Poor	Irrigation of pastures	Poor housekeeping
Gaths Mine	Activated sludge		1,320	Average	Irrigate eucalyptus	Fair
Hippo Valley Estates	Oxidation pond			Average	Irrigation of pastures	Good
Mashava Township (Bere)	Oxidation pond			Poor	Irrigation of pastures	Average
Masvingo Municipality (old)	Conventional Bio Filters	7,500			Irrigation of pastures	Average
Masvingo Municipality (new)	Activated sludge				Discharge into stream	Under construction
Triangle Ltd.	Oxidation pond			Poor		

[1]. Note on the quality of effluent:
Poor: Most parameters do not meet the standards.
Average: More than half the parameters meet the standards.
Good: All the parameters meet the standards.

[2]. Condition of the plant:
Poor: Maintenance is non-existent. Plant just run down.
Average: Some maintenance of plant done. House keeping generally average.
Good: Well maintained plant with good housekeeping.
(Original source: Ministry of Resources and Water Development)

Table 1.14. An outline of Lake Kariba (UNEP and ILEC, 1988-1992: Data of World Lake Environments)

Latitude	17-20' S	Longitude	27-50'
Altitude	485 m	Surface area	5,400 km²
Maximum depth	78 m	Mean depth	31 m
Annual fluctuation of the depth	(controlled) 2.5 m	Water volume	160,000 million m³
Residence time of water	3 years	Coast length	2,164 km
Catchment area	663,000 km²	Mixing type	Monomictic
Solar radiation	23.9 MJ/m2/day	Hours of sunshine	2,920 hours/year
Freezing period	None	Fish catch	11,000 t/year
N load	t/year	P load	t/year
Land use in the basin		Natural landscape	%
Agricultural land	%	Others	%
Toxic Contamination		Siltation	Serious

Table 1.15. An outline of Lake Chivero (UNEP and ILEC, 1988-1992: Data of World Lake Environments)

Latitude	17-05' S	Longitude	30-05' E
Altitude	1,363.6 m	Surface area	26 km²
Maximum depth	27.4 m	Mean depth	9.4 m
Annual fluctuation of the depth	(controlled) 4.3 m	Water volume	250 million m³
Residence time of water	Unknown	Coast length	74 km
Catchment area	2,227 km²	Mixing type	Monomictic
Solar radiation	22.1 MJ/m2/day	Hours of sunshine	2,884 hours/year
Freezing period	None	Fish catch	87.3 t/year
N load	190 t/year	P load	80 t/year
Land use in the basin		Natural landscape	67.6 %
Agricultural land	23 %	Others	9.4 %
Toxic Contamination	Not serious		

Table 1.16. An outline of Lake Mutirikwe (MSSL-WCMC-UNEP Lake and Catchment Area Conservation Database (Internet: http://www.wcmc.org.uk/dynamic/lcdb/) except: *: from FAO、1990:Source Book for the Inland Fishery Resources of Africa, vol. 1)

Latitude	20-14' S	Longitude	31-00' E
Altitude*	1,035	Surface area*	91.05 km2
Maximum depth*	56.1	Mean depth*	15.7
Annual fluctuation of the depth		Water volume*	1,425 m2
Residence time of water	Unknown	Coast length	
Catchment area*	3,989 km2	Mixing type	
Solar radiation		Hours of sunshine	
Freezing period	None	Fish catch*	180 t/year
N load		P load	
Land use in the basin		Natural landscape	
Agricultural land		Others	
Toxic Contamination			

The change in the ecosystems by 31 exotic fish species introduced by angling societies (Chenge, M., Sola, L., and Paleczny, D. (eds.), 1998) is also a matter of concern at many reservoirs. Introduced species into Lake Kariba, which is relativey well studied, include Nile Tilapia, Greenhead Bream and Purpleface Largemouth. Here interbreeding between the native Kariba Bream and Nile Tilapia has been reported, although the whole impacts by the introduced species on the ecosystem are not known. The introduced species into Lake Chivero includes Common Carp, Largemouth Bass, Green Happy, Greenhead Bream and Redbreasted Bream.

Table 1.17. Fish catch records at Lake Kariba (Chenge, M., Sola, L., and Paleczny, D. (eds.), 1998: The State of Zimbabwe's Environment 1998, Ministry of Mines, Environment and Tourism)

Species	% catch in Zimbabwe (1995)	% catch in Zimbabwe (1994)	% catch in Zambia (1994)
Redbreast Tilapia	2.0	2.2	8.3
Green Happy	11.0	5.1	23.8
Purple Largemouth	1.0	1.0	7.3
Kariba Bream	11.0	36.2	6.0
Sharptooth Catfish	4.0	8.4	8.4
Bottle Nose	8.0	10.6	8.9
Root-Bottelneus	3.0	2.8	16.1
Tigerfish	38.0	24.2	1.2
Imberi	-	-	5.2
Chessa	-	1.0	0.7
Manyame Labeo	17.0	6.5	9.1
Squiker	-	-	2.2
Others	5.0	2.2	-

Table 1.18. Fish catch records for Lake Chivero, Lake Mutiriwi and Darwendale Dam (Chenge, M., Sola, L., and Paleczny, D. (eds.), 1998: The State of Zimbabwe's Environment 1998, Ministry of Mines, Environment and Tourism)

Species	% composition, Lake Chivero	% composition, Lake Mutirikwi	% composition, Darwendale Dam
Greenhead Tilapia	73.3	1.2	9.1
Redbreast Tilapia	8.6	79.6	28.0
Manyame Labeo	7.3	-	23.7
Sharptooth Catfish	5.8	7.2	27.8
Banded Tilapia	0.2	-	1.2
Tigerfish	0.1	-	5.3
Mozambique Tilapia	0.2	2.9	0.2
Alestes	0.1	-	0.1
Largemouth Bass	-	6.7	-
Robust Bream	-	2.4	-
Bottle Nose	-	-	0.1
Small Bream	0.1	-	-

Although air quality is monitored by the City of Harare every 48 hours during weekdays and 72 hours over weekends through its network of observation stations, comprehensive data and analysis to characterize the problems and human health impacts are lacking. The average concentration for suspended particular matter at 45 $\mu g/m^3$ is below the

WHO standard at 60 μg/m^3 in 1997. The figures have stabilized in the 1990s. On the other hand, sulfur dioxide has been increasing and the current levels in major cities surpass the WHO standard at 60 μg/m^3. In Harare the annual average concentration of 27 μg/m^3 in 1987 rose to 105.0 μg/m3 in 1997. The concentrations of nitrogen dioxide are also rising. In Harare the annual average of 26.31 μg/m3 for the whole city in 1995 rose to 31.60 in 1996. (Chenge, M., Sola, L., and Paleczny, D. (eds.), 1998: The State of Zimbabwe's Environment 1998, Ministry of Mines, Environment and Tourism)

(2) Law

Table 1.19 lists the environmental legislation in Zimbabwe. Although they cover various areas, there is no comprehensive umbrella law that provides for a common basis for all the environmental laws. (国際協力事業団農林水産開発調査部農業開発調査課、1994：ジンバブエ国ムニャティ川下流域農業開発計画事前調査報告書)、African Development Bank, 1993: Country Environmental Profile: Zimbabwe、小島貞夫・川崎保夫・村井英臣、1990：専門家総合報告書、国際協力事業団(国際協力事業団国際協力総合研修所(編)開発途上国技術情報データシート1996年度:ジンバブエ(2/2)所収), Chenge, M., Sola, L., and Paleczny, D. (eds.), 1998: The State of Zimbabwe's Environment 1998, Ministry of Mines, Environment and Tourism)

Table 1.19. Environmental legislation and responsible ministries (Chenge, M., Sola, L., and Paleczny, D. (eds.), 1998: The State of Zimbabwe's Environment 1998, Ministry of Mines, Environment and Tourism)

Legislation	Responsible ministry
Natural Resources Act, 1941	Ministry of Mines, Environment and Tourism
Mines and Minerals Act	Ministry of Mines, Environment and Tourism
Atmospheric Pollution Prevention Act, 1971	Ministry of Health and Child Welfare
Water Act,1976	Ministry of Rural Resources and Water Development
Forest Act, 1949, 1981 (amendment)	Ministry of Mines, Environment and Tourism
Fertilizer, Farm Feeds and Remedies Act	Ministry of Lands and Agriculture
Communal Land Forest Produce Act, 1982	Ministry of Mines, Environment and Tourism
Hazardous Substances and Articles Act, 1977	Ministry of Health and Child Welfare
Trapping of Animals (Control) Act, 1973	Ministry of Mines, Environment and Tourism
Parks and Wildlife Act, 1975	Ministry of Mines, Environment and Tourism
Regional Town and Country Planning Act, 1976	Ministry of Local Government and National Housing
Rural District Councils Act, 1988	Ministry of Local Government and National Housing
Land Acquisition Act	Ministry of Lands and Agriculture
Agricultural Land Settlement Act	Ministry of Lands and Agriculture
Agricultural Development Authority Act	Ministry of Lands and Agriculture
Communal Land Act, 1982	Ministry of Local Government and National Housing
Plant Pests and Diseases Act	Ministry of Lands and Agriculture
Noxious Weeds Act, 1926	Ministry of Lands and Agriculture
Prevention of Cruelty to Animals Act	Ministry of Mines, Environment and Tourism

The Natural Resources Act is the most important enactment for the environmental conservation in Zimbabwe. However, it is not fully applicable to communal lands which cover approximately a half of the land of the country because it regulates the natural resources management through land tenureship. This type of limitation of applicability to communal lands is common to many legislations. (African Development Bank, 1993:

Country Environmental Profile: Zimbabwe)

The superiority of the Mines and Minerals Act is said to be problematique. Once a mining right is established, no other land use, including agriculture, is excluded without any compensation. (African Development Bank, 1993: Country Environmental Profile: Zimbabwe)

The Government is capable of monitoring of natural resources. However, its capacity for the monitoring of air and water is insufficient. This lack of the basis of information of the current environmental situation results in the insufficient implementation of Hazardous Substances, Atmospheric Pollution Prevention and Water Acts. Exception clauses and incompatibility among individual laws also affects effective implementation. (African Development Bank, 1993: Country Environmental Profile: Zimbabwe)

Public participation is characteristic to the Zimbabwean environmental laws, particularly to natural resources management laws. Communal Area Management Program for Indigenous Resources (CAMPFIRE) is famous as a success in sustainable wildlife management, integrating rational management of wildlife by local communities and reimbursement of the revenue that the wildlife management produces.

Approximately 54,050 km^2 of 390,757 km^2 of the total land of Zimbabwe, i.e. 13.8 % of the country, are protected areas. These areas include many reservoirs.

Preparations for a new Water Act have been going on. It is proposed that with the following aims, the new Act controls discharge of pollutants with reduced need for prosecution, incentives for effective waste water treatment, financing for the Pollution Control Branch, and progressive improvement in standards (Chenge, M., Sola, L., and Paleczny, D. (eds.), 1998: The State of Zimbabwe's Environment 1998, Ministry of Mines, Environment and Tourism):

- The release of any matter into natural water should be controlled through the issuance of permits;
- The permit will specify the monitoring and reporting requirements of the discharger;
- There should be an administrative charge for the issuance of permits to cover the costs of policing compliance with the conditions of such permits;
- An appeal will not suspend the implementation of an administrative decision;
- Polluter may be required to remedy the effects of the pollution;
- Additional levies will be charged according to the quality of the effluent with increased charges for poorer quality of effluent;
- Levies raised from discharge of poor quality effluent will be used for environmental restoration and research; and
- Local authorities have certain delegated powers to control pollution.

The principles of this approach as shown in Fig. 1.10 are as follows:

- All agencies, authorities and private individuals wishing to discharge any liquid into a natural water body, whether directly or indirectly, should have a permit issued by the Pollution Control Branch (PCB);
- There is an administration charge for the permit but a scale of charges will be established which increases with the decrease in effluent discharge quality, penalizing polluters and encouraging improvement in effluent quality;

- The discharging agency has to submit periodic reports on the quality of the effluent, removing the burden of inspection from the PCB and placing it on the discharge agency; and
- The PCB checks the accuracy of the reports, conducts random tests and imposes penalties for non-compliance where necessary.

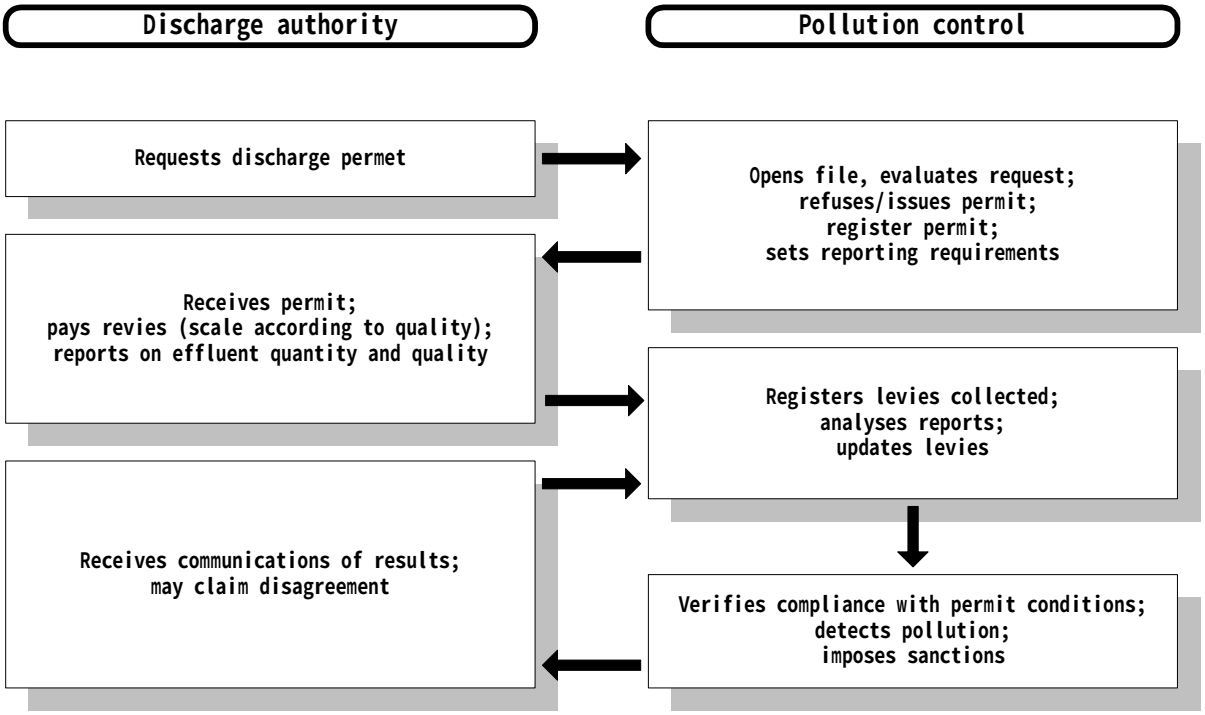

Fig. 1.10. Roles and responsibilities related to discharge permits as proposed for a new Water Act (Chenge, M., Sola, L., and Paleczny, D. (eds.), 1998: The State of Zimbabwe's Environment 1998, Ministry of Mines, Environment and Tourism)

Table 1.20. National parks and other protected areas of Zimbabwe (Chenge, M., Sola, L., and Paleczny, D. (eds.), 1998: The State of Zimbabwe's Environment 1998, Ministry of Mines, Environment and Tourism)

Protected aras	Area (thousand ha)
National Parks	
Chimanimani	17.1
Chizarira	191.0
Gonarezhou	505.3
Hwange	1,65.1
Kazuma Pan	31.3
Mana Pools	219.6
Matopos	42.4
Matusadona	140.7
Nyanga	33.0
Victoria Falls	2.3
Zambezi	56.0
Subtotal	*2,703.8*
Other Protected Areas	
Safari Areas	2,367.0
Recreational Parks	308.6
Botanical Reserves	7.0
Botanical Gardens	0.5
Sanctuaries	18.6
Subtotal	*2,701.7*
Grand total	**5,405.5**

(3) Environmental impact assessment

There is not specific law for environmental impact assessment in Zimbabwe. However, in 1994, the Minister of Environment and Tourism announced an Environmental Impact Assessment Policy with the aims to ensure that development projects likely to have significant environmental consequences receive both meaningful environmental planning by their proponents and through review by Government before they are allowed to proceed.

In order to facilitate compliance with the Policy by Government agencies, project developers and the general public, Environmental Impact Assessment Guidelines were prepared and published in 1997 with support from Canada. They are applicable to all types of projects. The Guidelines are composed by one General Guidelines and sectoral supplemental Policies for (a) Mining and Quarrying, (b) Forestry, (c) Agriculture, (d) Transport, (e) Energy, (f) Water, (g) Urban Infrastructure, (h) Tourism and (i) Waste Management.

The EIA Policy is administered by the Ministry of Mines, Environment and Tourism with technical assistance by the Department of Natural Resources. It applies to both public and private sector development activities. The responsibility for producing EIA reports, which are required in accordance with the potential impacts as illustrated in Fig. 1.11, rests with the developer.

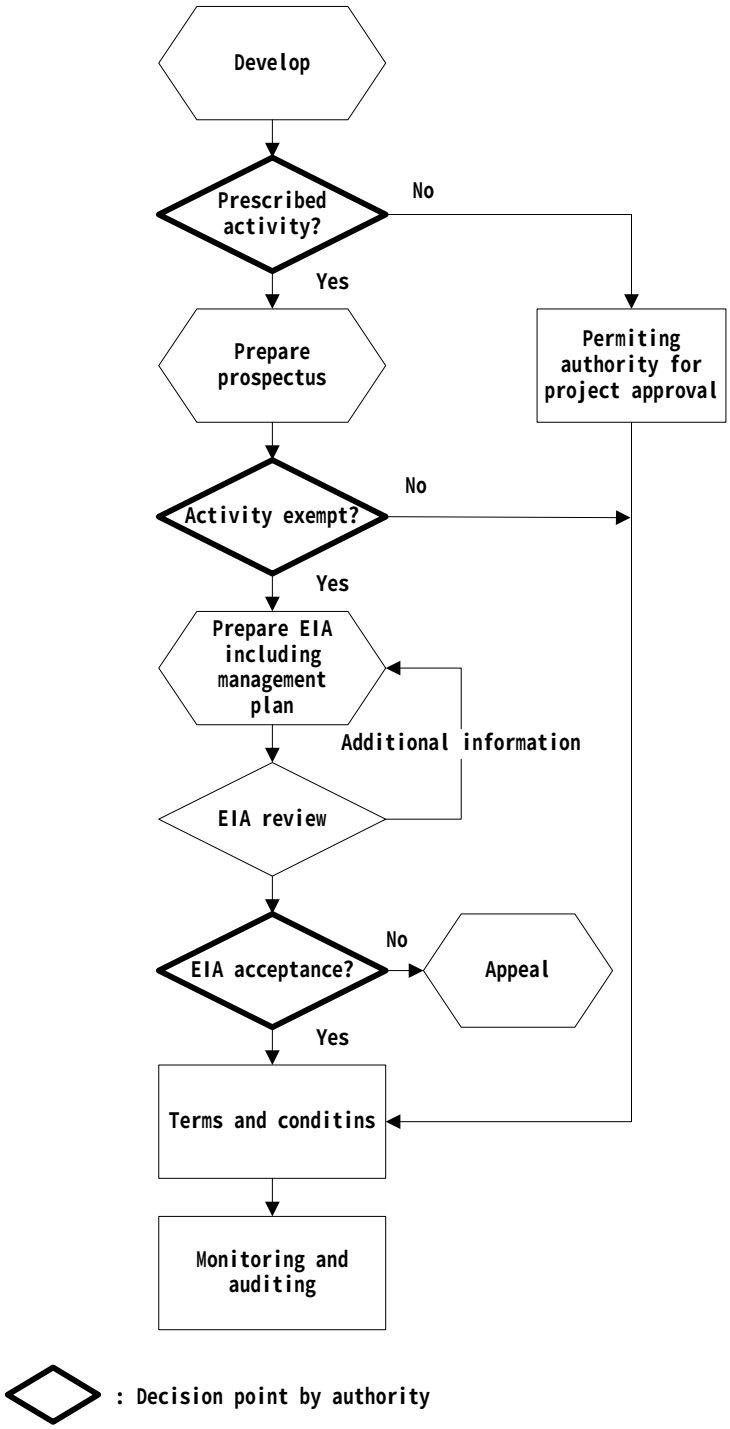

Fig. 1.11. The EIA process in Zimbabwe (Ministry of Mines, Environment and Tourism, 1997: Environmental Impact Assessment Guidelines)

(4) Government agencies

Table 1.19 shows the ministries responsible for the environment in accordance with legal provisions.

Currently it is the Ministry of Mines, Environment and Tourism that is responsible for the environment. The Department of Natural Resources in the Ministry is responsible for general environmental matters, including promotion of improvement of the quality of

the environment, provision of information about the current state of the quality of the environment, and environmental impact assessment. The responsibilities for environmental monitoring were dispersed in other departments. The budgets were not sufficient, either. Although, due to these, the Department was not able to fully perform its role for general environmental protection, it has been gradually strengthened as a full environmental department.

The Department of National Parks and Wildlife is responsible for the management of wildlife in general and the protected areas which cover many of the critical ecosystems, including those in major reservoirs of the country. For water resources, the Department is responsible not only for the aquatic ecosystems but also for the quality of the water in the protected areas.

The Natural Resources Board under the Ministry established in accordance with the Natural Resources Act of 1941 is responsible for making basic policies on natural resources management. Here the "natural resources" include (a) soil, waters and minerals, (b) animal, bird and fish life, (c) trees, grasses and other vegetation, (d) springs, vleis, sponges, reed-beds, marshes, swamps and public streams, and (e) landscapes and scenery (Article 2 of the Act).

The Forest Commission under the Ministry is responsible for the management of State Forests and the protection of private forests, including compulsory afforestation of private land after cutting of trees, in accordance with the Forest Act of 1949.

The Ministry of Health and Child Welfare is responsible for the health aspects of the environment, including the air pollution, water supply and sanitation.

The Ministry of Rural Resources and Water Development, particularly its Department of Water Development, is responsible for rivers, streams and underground water in accordance with the Water Act of 1976. The Act covers not only development of water resources as planned by the Ministry for each basin but also water pollution control, combined irrigation schemes, and safety of dams and large dams. Local authorities are also responsible for prevention of pollution of water in accordance with the Act.

Control of agricultural chemicals such as pesticides and such plants regarded as noxious weeds is the responsibility of the Ministry of Lands and Agriculture.

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