3.4 Agriculture and Livestock

3.4.1 Present Status of Agriculture

(1) Natural Conditions

Zambian agriculture is greatly depend on rainfall, and rainfed agriculture is widely practised across the whole country. Consequently, the agriculture is planned by the expected amount of rain. Therefore, the agriculture of Zambia can be clearly divided into three agro-ecological zones depending on the amount of annual rainfall as summarised in the following Table 3-25 and Figure 3-9.

Table 3-25 Agro-ecological Zones of Zambia

Agro-ecological Zones	Annual Rainfall (mm)	Approximate Extension of Zone
Zone-III	1,000 - 1,400	North-Western, Copperbelt, Luapula and Northern Province, and northern part of Central Province
Zone-II	800 - 1,000	Northern half of Western and Southern Provinces, Almost all of Central Province, western part of Lusaka Province, and Eastern Province except narrow band of Zone-I
Zone-I	700 - 800	Southern half of Western and Southern Provinces, Eastern half of Lusaka Province, and narrow band along the Luangwa River in Eastern Province

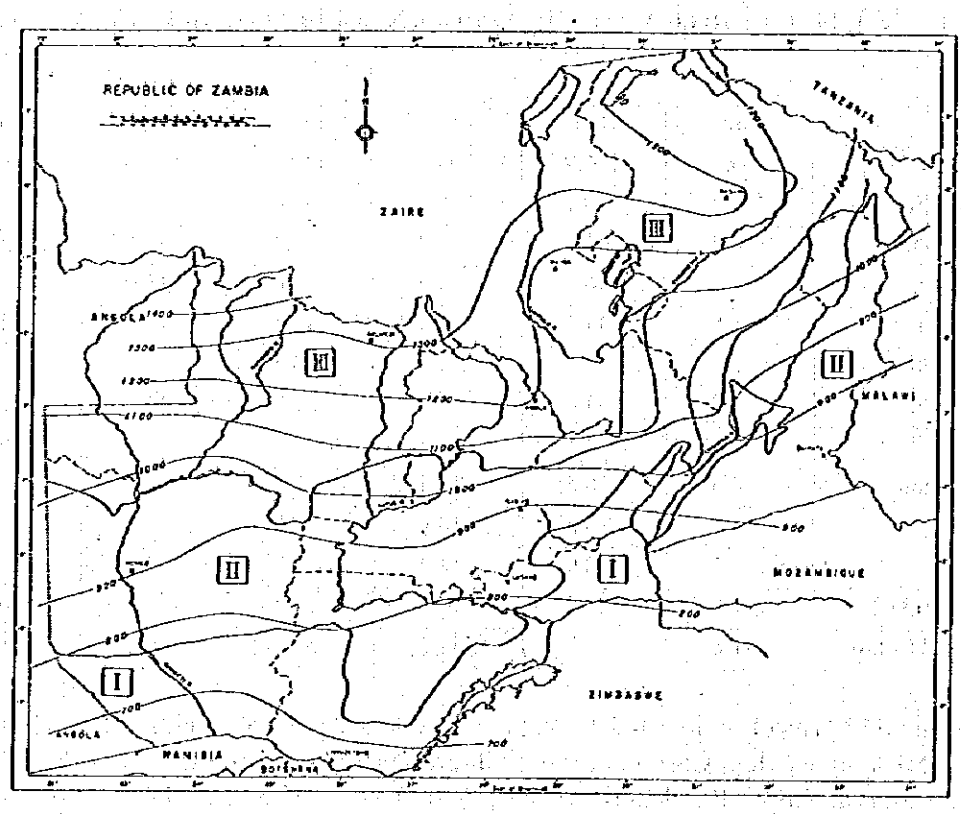


Figure 3-9 Agro-Ecological Zones and Isohyet in Zambia

Rainfall distribution of respective agro-ecological zones has almost same tendency of the rainfall that is concentrating from November to March. Monthly mean temperature ranges from 15 °C to 16 °C in July to 24 °C to 25 °C in October through Zambia, Annual mean temperature is around 21 °C through all zones and is quite suitable for cropping condition. General meteorology of Agro-ecological Zones can be tabulated as in Table 3-26.

Table 3-26 General Meteorology of Agro-ecological Zones

Agro-Ecological Zone			Season and Month												Annual
Selected Station	Meteorological Factors	Unit	Hot Dry Season			Rainy Season					Cool Dry Season				
			Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	
III	Rainfall	(mm)	3.0	32.8	121.1	300.3	295.0	241.2	164.3	43.0	3.6	0.6	0.1	0.4	1,205.4
Ndola	Temp(Mean)	(°C)	22.2	23.8	23.3	22.2	22.0	22.0	22.1	21.1	19.0	16.6	16.5	18.9	20.8
	Temp(Max)	(°C)	30.7	31.4	29.6	27.2	26.7	27.0	27.6	27.7	26.8	25.2	25.2	27.6	31.4
	Temp(Min)	(°C)	13.7	16.2	17.1	17.2	17.1	16.5	16.5	14.5	11.1	8.1	7.8	10.2	7.8
	Evaporation	(mm)	226.3	230.5	177.5	129.8	118.4	109.0	130.6	133.8	141.1	135.2	154.2	189.5	1,875.9
II	Rainfall	(mm)	0.7	20.8	88.5	244.5	225.1	177.9	98.0	25.7	4.4	0.1	0.0	0.1	885.8
Kabwe	Temp(Mean)	(°C)	22.3	24.2	23.8	22.5	22.2	22.3	21.9	20.6	18.6	18.4	16.1	18.5	21.0
	Temp(Max)	(°C)	29.9	31.2	30.0	27.4	27.1	27.2	27.1	26.7	25.5	23.7	23.5	26.2	31.2
	Temp(Min)	(°C)	14.6	17.1	17.7	17.5	17.3	17.4	16.6	14.5	11.6	13.2	8.7	10.8	8.7
	Evaporation	(mm)	268.7	294.5	222.0	155.9	142.5	129.3	151.0	160.9	159.4	145.2	164.2	217.3	2,210.9
I	Rainfall	(mm)	4.0	32.6	69.6	144.8	149.3	150.7	89.5	25.2	1.7	0.4	0.0	0.2	668.0
Sesheke	Temp(Mean)	(°C)	22.4	25.7	25.7	24.9	24.7	24.4	24.0	22.0	18.5	15.4	15.1	18.0	21.7
	Temp(Max)	(°C)	33.2	34.2	32.7	31.0	30.7	30.2	30.7	30.0	28.3	26.1	26.2	29.3	34.2
	Temp(Min)	(°C)	11.6	17.2	18.7	18.9	18.8	18.5	17.4	14.2	8.8	5.4	4.3	6.7	4.3
	Evaporation	(mm)	245.6	308.9	257.3	177.4	148.8	138.4	177.5	167.0	141.2	155.2	156.2	197.9	2,271.4

Land use was investigated and studied based on the Land Use Map and on its land use categories. Total national land counts as 75,185,000 ha, in which agricultural land shares a large area as 16,352,000ha or 21.7%. However, shifting cultivation shares the largest portion in agricultural land. Actual planted area was 1,363,000 ha in 1993. It is equivalent to only 12% of agricultural land. The categories and acreage of land use are summarised as follows :

Summary of Present Land Use

to Agriculture	Total Land	Agri. Land	Non-Agri Land	Non-agricultural Land				
				Reserved Forest	Non-reserved Forest	Total forest	Lake/ Swamp	Flood Plain
Area (1,000ha)	75,185	16,352	58,833	10,980	37,657	48,637	2,100	7,990
Ratio	100%	21.7%	78.3%	14.6%	50.1%	64.7%	2.8%	10.6%

The agricultural lands are classified into seven categories by the cultivation methods or agricultural purposes. As shown below, shifting axe/hoe cultivation (Chitemene) shares almost half of the agricultural land. Shifting cultivation prevails in the northern region of Zambia as in Northern, Central, North-western and Luapula provinces.

Categories	Agricultural land (1,000 ha)
- Shifting Axe/Hoe Cultivation	7,809 (48%)
- Semipermanent Ox/Tractor Cultivation	834 (5%)
- Fishing/Semipermanent Hoe Cultivation	333 (2%)
- Semipermanent Hoe/Ox Cultivation	2,314 (14%)
- Semicommercial Farms/Ranches	2,613 (16%)
- Private Commercial Farms/Ranches	1,238 (8%)
- Government Agricultural Project	1,212 (7%)
Total	16,353(100%)

Prevailing soil series are counted at 19 series in Zambia. Out of 19 soil series, 10 soil series are suitable for agricultural cultivation, extending in a large area of over 70% in the country as

shown below. However, those suitable soil series are to be further evaluated and classified into three classes of "Land Classification" by the productivity of crops resulted by the chemical and physical properties and the depth of soils.

Soils	Acreage (1,000 ha)	
1) Suitable soil for agriculture		
- Upland crops	48,590	(66%)
- Paddy rice	3,553	(5%)
Sub-total	52,143	(71%)
2) Need soil improvement	4,053	(5%)
3) Unsuitable soil	17,909	(24%)
National Total	74,106	(100%)

The most problem restrictions of soils in Zambia are acidity and excessive drainability. Such soils are classified into class-III, while class-I soil ensures high productivity of crops and class-II soil also produces reasonable productivity by farming practices. Acid soils are prevailing in the northern region as Luapula and Northern provinces, and excessive drainability is found in the Kalahari sand (or white sand) in Western Province. Class-III soils are to be excluded from suitable soil for cultivation. In this study, careful study has been given to identify the distribution of class-I and class-II soils in the country. The results of the study are shown in Table 3-27. As shown in Table 3-27, it is found that the suitable soils classified into I and II extend in the northern region as 20 times of present planted area in North-western Province, and 11 times and 8 times in Luapula and Northern Provinces respectively. From the aspect of total potential of cultivable area, the northern provinces have an almost same potential area of granary provinces as Southern, Central and Eastern Provinces.

Table 3-27 Present Planted Area and Potential Cultivable Area

Lusaka	Copper-belt	Central	N/ Western	Western	South-ern	Luapula	Northern	Eastern	Zambia
Planted Area in 1993 (ha)									
38,580	50,346	247,365	39,715	109,972	280,129	72,622	151,383	362,751	1,352,863
Potential Cultivable Area (ha) (class-I, II)									
104,422	303,100	1,356,162	814,779	1,041,280	935,997	832,785	1,225,692	1,234,268	7,848,485
Ratio to Planted Area									
2.7	6.0	5.5	20.5	9.5	3.3	11.5	8.1	3.4	5.8

(2) Socioeconomic Background of Agriculture

Agriculture of Zambia in the national economy shared about 27.7% of gross domestic products in 1993, and 17.2% in average since 1985. Although the gross value added (GVA) of agriculture fluctuated by year, its growth rate was 2.3% in average since 1985. Agriculture is composed of four major sectors, namely crops, livestock, fishery and forestry sectors. Gross value added (GVA) of agriculture, that is gross earning of agriculture products minus production cost, was estimated for each sector as shown in the Table 3-28.

Table 3-28 Gross Value Added of Agriculture Sector in 1993

Sector	GVA	
	Amount (M'K)	Share (%)
1. Agriculture	236,221	78.9
- Crops	(177,607)	(59.2)
- Livestock	(45,614)	(15.3)
- Wildlife	(13,000)	(4.4)
2. Fishery	14,082	4.7
3. Forestry	48,979	16.4
Total	299,282	100.0

Crop GVA shares the largest composition of about 60% of total agricultural gross value added.

Actual planted area in 1990 was around 1,154,000 ha with average cultivated area per household of 2.22 ha, and national total of agricultural households in same year was 520,520. The largest farming size is 5.78 ha in Southern Province, and Luapula and North-Western are particularly much less than national average as 0.63 ha and 0.8 ha, respectively. In general, agricultural land is leased to Zambians or non-Zambians for agricultural purposes through the land alienation procedure. There are two types of land tenure system in Zambia that are the Traditional Land System and the State Land System. The traditional land system is composed of the Reserved and the Trust Lands. In State land, District Councils proceeds the administrative works to evaluate the land utilisation plan of the applicants and to lease the agriculture lands to the applicants who want to conduct cultivation.

Annual import and export of agricultural commodities were K16.8 billion and K 6.8 billion respectively in total average of 1991 and 1992, and they shared 17.1% of national total import and 6.8% of national total export. Import of cereals shared the largest portion of about 7% of national total import, followed by fertilisers of 2.5% and textile yarn of 2.3%. Export of agricultural commodities is around 40% of import of agricultural commodities in Kwacha values. Textile yarn shared the largest portion of exports corresponding to 2.0% of total national export, followed by sugar, oilseeds etc. Zambia imported grains almost constantly around 200,000 tons annually in average since 1981. Maize shared the largest amount (159,000 tons) in import of grains, followed by wheat (41,000 tons) and rice (3,700 tons) in the same period. The export of maize of about 68,000 tons was achieved in 1993 as a first experience since 1981 due to good harvest by preferable weather conditions.

Economic producer prices of wheat and rice were K244,750/ton and K238,700/ton, while their producer prices were K242,000/ton and K187,500/ton respectively in 1994. The rice is competitive with imported rice, while wheat is little hard to compete with imported wheat.

According to the annual expenditure of non-metropolitan area, average expenditure was about K600,000/year/household. Gross earning of maize is estimated at K197,000/ha in 1993 price. In case their gross income is produced only by crops, it will be necessary to cultivate at least 3.0 ha of maize.

(3) Crops

Rainfed agriculture is predominant in Zambia and most crops are grown under rainfed conditions. Consequently, rainfed crops are planted depending on start of rainfall and relying on rainfall, which starts generally in November and continues to March for five months. Rainfed crops are generally planted in November and harvested in April to May. However, yields of rainfed crops are easily affected by rainfall amount and distribution in drought year. On the other hand, winter crops like wheat, winter vegetables and perennial crops like sugarcane and tree crops have to be irrigated because of scarce or almost no rainfall in winter season.

When rain starts, sowing of maize and millet starts early November, and followed by pulse crops and oil crops like mixed beans, soybeans, groundnuts, sunflower and seed cotton in December. Sowing of maize continues to late December, because planting area of maize shares the largest acreage of about 60% of total planted area or around 820,000 ha in 1993.

Planted area and crop production of the country were 1,363,000ha and 2,821,000tons in 1993. The composition of crops is summarised as follows;

Table 3-29 Planted Area and Crop Production in 1993

Crops	Planted Acreage		Production	
	(ha)	(%)	(1,000 ton)	(%)
Cereal Crops	954,000	(70.0)	1,892	(67.1)
Starchy Crops	109,500	(8.0)	236	(8.4)
Sugar Crops	13,000	(1.0)	140	(5.0)
Pulse Crops	38,500	(2.8)	23	(0.8)
Ail Crops	214,700	(15.8)	136	(4.8)
Tobacco	6,900	(0.5)	7	(0.2)
Vegetables	11,700	(0.9)	233	(8.3)
Tree Crops	14,500	(1.1)	154	(5.5)
Flower	250	(0.0)	-	(-)
Total	1,362,800	(100.0)	2,821	(100.0)

Crop-wise planted area in 1993 is tabulated in the Table 3-30, and also typical cropping calendar is illustrated in Figure 3-10.

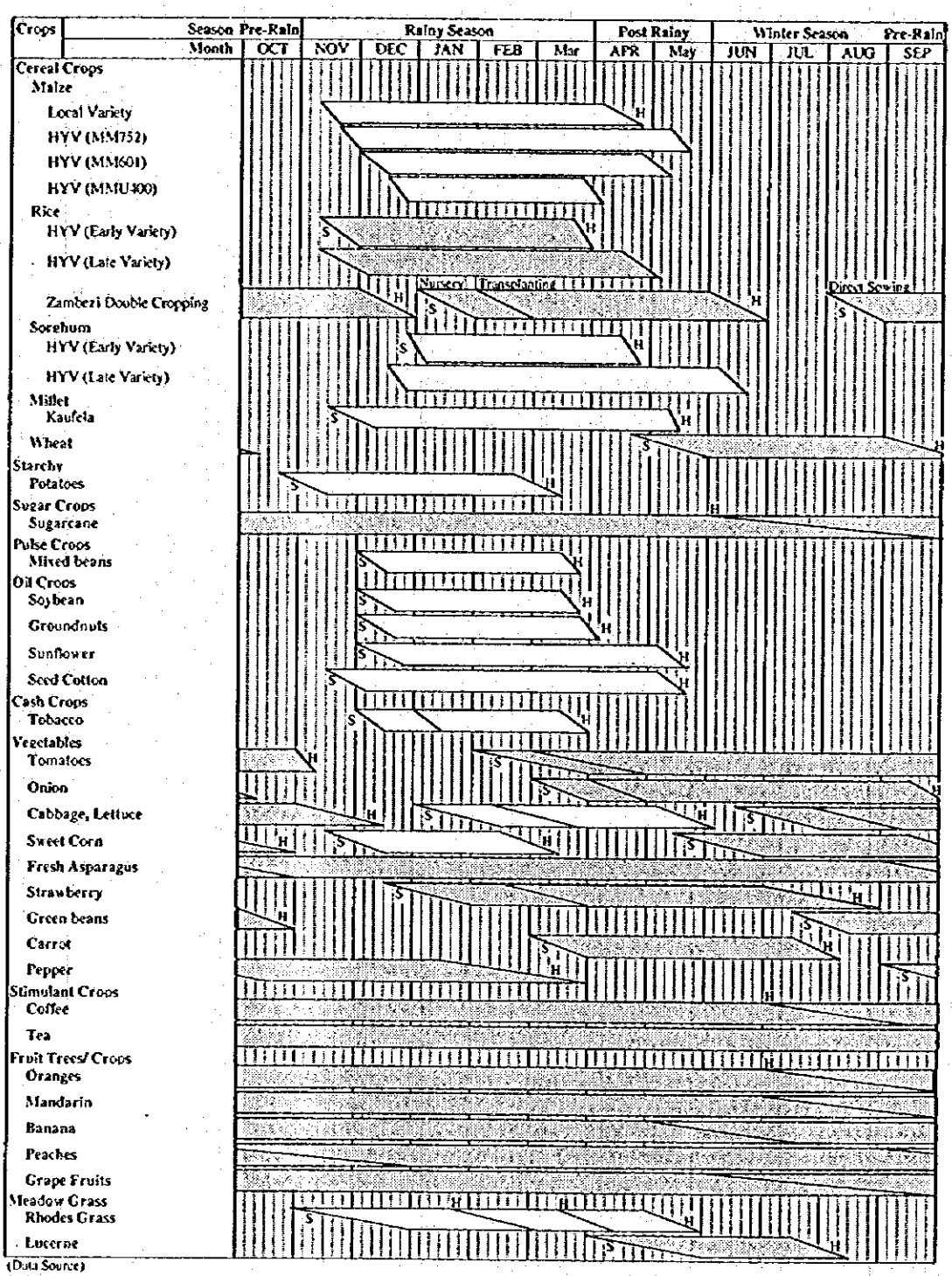
Production of cereal crops reached 1,892,000 tons in 1993, and maize production accounts 1,736,000 tons. Maize is predominant among crops. Maize was planted on 820,000 ha in 1993, which is equivalent to 60% of total planted area. Among provinces, maize is planted at largest extent in Eastern Province, and followed by Southern and Central Provinces. Cassava follows maize in its planted area (8%), followed by groundnuts (6%), seed cotton (5.6%), millet (4%), and sorghum (3.5%) as shown in Table 3-30. Wheat, rice and tobacco are less than 1% of total planted area.

Yields of maize are largely affected by weather conditions such as droughts that are more severe in the southern region and more moderate in the northern region. National average yield of maize is 1.84 tons/ha. Among provinces, Central Province realises the highest yield as 2.53 tons/ha, and followed by Northern, Copperbelt and Luapula. On the other hand,

Table 3-30 Planted Area by Provinces and Crops in 1993

(Unit: ha)

	Lusaka	Copper-belt	Central	N/Wes-tern	Western	Southern	Luapula	Northern	Eastern	Zambia
Maize	24,981	30,343	152,091	17,742	46,062	203,431	15,197	50,439	280,110	820,396
	3.0%	3.7%	18.5%	2.2%	5.6%	24.8%	1.9%	6.1%	34.1%	60.2%
Sorghum	2,275	3,497	7,195	5,458	10,892	6,963	1,502	2,621	7,389	47,792
	4.8%	7.3%	15.1%	11.4%	22.8%	14.6%	3.1%	5.5%	15.5%	3.5%
Millet	3	163	3,467	910	15,149	2,513	8,466	18,259	5,878	54,808
	0.0%	0.3%	6.3%	1.7%	27.6%	4.6%	15.4%	33.3%	10.7%	4.0%
Rice	18	33	40	772	7,217	0	403	3,727	1,501	13,711
(Extensive)	0.1%	0.2%	0.3%	5.6%	52.6%	0.0%	2.9%	27.2%	10.9%	1.0%
Irrigated	3,327	2,978	2,585	0	0	4,616	0	0	150	13,656
Wheat	24.4%	21.8%	18.9%	0.0%	0.0%	33.8%	0.0%	0.0%	1.1%	1.0%
Rainfed	0	2,400	419	0	0	0	0	865	2	3,686
Wheat	0.0%	65.1%	11.4%	0.0%	0.0%	0.0%	0.0%	23.5%	0.1%	0.3%
Cassava	0	733	1,672	10,640	26,965	0	35,318	32,431	53	107,812
	0.0%	0.7%	1.6%	9.9%	25.0%	0.0%	32.8%	30.1%	0.0%	7.9%
Potatoes	800	210	600	0	0	60	0	0	0	1,670
(estimated)	47.9%	12.6%	35.9%	0.0%	0.0%	3.6%	0.0%	0.0%	0.0%	0.1%
Sugarcane	0	0	0	0	0	13000	0	0	0	13,000
	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	1.0%
Mixed	50	651	1,770	2,406	1,094	107	3,245	27,054	2,112	38,489
Beans	0.1%	1.7%	4.6%	6.3%	2.8%	0.3%	8.4%	70.3%	5.5%	2.8%
Soybeans	1,387	2,429	7,931	153	18	4,872	60	137	2,877	19,864
	7.0%	12.2%	39.9%	0.8%	0.1%	24.5%	0.3%	0.7%	14.5%	1.5%
Groundnuts	915	2,033	17,682	1,060	2,371	8,454	7,304	9,742	32,903	82,464
(R)	1.1%	2.5%	21.4%	1.3%	2.9%	10.3%	8.9%	11.8%	39.9%	6.0%
Sunflower	562	78	10,860	102	4	20,171	29	46	4,047	35,899
	1.6%	0.2%	30.3%	0.3%	0.0%	56.2%	0.1%	0.1%	11.3%	2.6%
Seed	3,185	301	37,158	0	103	13,744	0	0	22,001	76,492
Cotton	4.2%	0.4%	48.6%	0.0%	0.1%	18.0%	0.0%	0.0%	28.8%	5.6%
Tobacco(V)	0	0	1,727	0	97	1,152	0	4	578	3,558
	0.0%	0.0%	48.5%	0.0%	2.7%	32.4%	0.0%	0.1%	16.2%	0.3%
Tobacco(B)	119	157	156	2	0	27	0	0	2,927	3,388
	3.5%	4.6%	4.6%	0.1%	0.0%	0.8%	0.0%	0.0%	86.4%	0.2%
Vegetables	1,736	3,493	2,263	255	0	594	695	2,415	212	11,663
	14.9%	29.9%	19.4%	2.2%	0.0%	5.1%	6.0%	20.7%	1.8%	0.9%
Coffee	22	1,057	349	215	0	485	403	3,643	11	6,185
	0.4%	17.1%	5.6%	3.5%	0.0%	7.8%	6.5%	58.9%	0.2%	0.5%
Tea	0	0	0	0	0	0	140	0	0	140
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%
Orange	336	1,684	1,315	42	0	462	578	2,631	107	7,155
	4.7%	23.5%	18.4%	0.6%	0.0%	6.5%	8.1%	36.8%	1.5%	0.5%
Banana	44	46	13	10	0	72	320	453	17	975
	4.5%	4.7%	1.3%	1.0%	0.0%	7.4%	32.8%	46.5%	1.7%	0.1%
Flower	209	36	0	0	0	0	3	1	0	249
	83.9%	14.5%	0.0%	0.0%	0.0%	0.0%	1.2%	0.4%	0.0%	0.0%
Total	39,969	52,322	249,293	39,767	109,972	280,723	73,663	154,468	362,875	1,363,052
	2.9%	3.8%	18.3%	2.9%	8.1%	20.6%	5.4%	11.3%	26.6%	100%



(Data Source)
Crops:Horticulture Section, MAFF
A Handbook for Agricultural Extension, 1991-92 Eastern, Western and Luapula Provinces, DOA, MAFF
(Note)
1) Season divided by Meteorology of Zambia, June 1981, ZMD
2) S: Sowing, T: Transplanting, H: Harvesting, Nursery: Raising of Seedling
3) Mainly rainfed Mainly irrigated

Figure 3-10 Cropping Calendar

Western Province produces only 0.97 ton/ha yield, which is equivalent to almost half yield of national average. Average provincial yield of maize can be summarised as follows;

Table 3-31 Average Yield of Maize

Province	Yield (ton/ ha)
Lusaka	1.69
Copperbelt	2.09
Central	2.53
N. Western	1.72
Western	0.97
Southern	1.97
Luapula	2.08
Northern	2.19
Eastern	1.41
Zambia average	1.84
Target in 2005	2.24
Target in 2015	2.44

(4) Present Status of Irrigation

Irrigation development in Zambia has started recently, and been implemented since early 1960's as governmental or commercial projects. Irrigated area has reached to 53 thousand ha by 1993, and accounts 3.2% of the total planted area. Annual increase in irrigated area is 3,100 ha and corresponds to 5.5% of annual increase in planted area.

Total Irrigated Area:	53,020 ha
Commercial Farms:	30,750 ha (58%)
Government Irrigation Projects:	22,270 ha (42%)

Table 3-32 shows the irrigated area in dry season in 1993 in Zambia. Irrigated area is concentrated to Southern provinces as 36.3% and followed by Copperbelt and Northern as 17.5% and 17.2% respectively. Western province is the most behind in irrigation development.

Table 3-32 Present Irrigated Area by Province

Province	Irrigation in Dry Season (ha)		Water ($1000m^3$ /day)	Wheat (ha)	Sugar cane (ha)	Coffee (ha)	Tea (ha)	Citrus Fruits (ha)	Banana (ha)	Vegeta bles (ha)	Flowe rs (ha)
10 Lusaka	5,674	10.7%	490	3,327	0	22	0	336	44	1,736	209
20 Copperbelt	9,294	17.5%	803	2,978	0	1,057	0	1,684	46	3,493	36
30 Central	6,525	12.3%	564	2,585	0	349	0	1,315	13	2,263	0
40 N/Western	522	1.0%	45	0	0	215	0	42	10	255	0
50 Western	0	0.0%	0	0	0	0	0	0	0	0	0
60 Southern	19,229	36.3%	1,661	4,616	13,000	485	0	462	72	594	0
70 Luapula	2,139	4.0%	185	0	0	403	140	578	320	695	3
80 Northern	9,143	17.2%	790	0	0	3,643	0	2,631	453	2,415	1
90 Eastern	497	0.9%	43	150	0	11	0	107	17	212	0
Zambia	53,023	100.0%	4,581	13,656	13,000	6,185	140	7,155	975	11,663	249
	100.0%			25.8%	24.5%	11.7%	0.3%	13.5%	1.8%	22.0%	0.5%

(Note) Irrigated area is estimated by Water Right Survey 1994. (Irrigated area as of 1993)

(5) Agricultural Policy by the MAFF

Agricultural policy of the Ministry is published in "Statement of Agricultural Policy" reviewed in 1993 and "Agricultural Sector Investment Programme (ASIP)" formulated in 1994. ASIP shows concrete implementation programmes for the execution of the policy contained in the Statement during the first stage, from 1995 to 1999, of the period covered in the Statement. Investment programmes for the next stage will be formulated in the future. The Statement and ASIP raise the following objectives:

< Major Objectives in "Statement of Agricultural Policy" >

- to ensure national and regional food security
- to generate income and employment through full utilisation of local conditions
- to insure that existing agricultural resources (land, water, air) is maintained and improved upon
- to contribute to sustainable industrial development
- to expand the contribution to the national balance of payment with expansion of export

< Major Short Term Objectives Agriculture Sector Investment Programme (ASIP) >

1) Agricultural Policy and Food Security
   - Donor aid will decrease gradually and terminate at the end of five years, and self-financing and management will be required afterwards.
   - ASIP must be sustainable using only GRZ resources after this period.
   - A growth rate of 6% in agricultural GDP must be achieved while reducing GRZ expenditure on the sector to not more than 1.5% of total GDP.
   - Food Security Agency will be created for storage of 2.5 million bags (225,000t) of cereals

2) Irrigation Policy
   - to strengthen the institutional capacity of the Irrigation Engineering Section (IES) to provide effective services and training to farmers.
   - to proceed with the rehabilitation or completion of the existing nine Smallholder Irrigation Schemes (267ha)

3) Mechanisation Policy
   Mechanisation will be planned based on the exploitation of ox power, aiming at expansion of draught system and mechanised agriculture with the establishment of mechanisation centres. Improvement of draught system in the southern region will be a main target in short term, while long term target will focus on introduction of draught system in northern region, where hoe cultivation still prevails.

4) Fishery Promotion
   Fishery will be promoted to encourage fish consumption up to 12 kg/person/year, which has decreased to 8.61 kg/person/year.

5) Product Development for Export
   The ASIP proposes an institution that will co-ordinate the activities of collecting production and marketing information for farmer groups. It is also proposed that this institution will investigate the feasibility studies for exportable crops including new products. Following crops are nominated as product for export.:

- Tobacco: demands are stable, and exports have not yet peaked.
- Flowers: dominant market is Europe, earning highest export amount among non-traditional agricultural exports. Zambia has ideal weather conditions for growing flowers.
- Cotton: textile export showing steady increases over the last three years.
- Oilseeds: groundnuts and soybeans are showing increases, castor oil and sesame oil are currently being developed.
- Horticultural Products: declined in 1992, but still remain a challenge to capture the outside market.
- Livestock and Livestock Products: declining since 1989 due to decrease of exportable products caused by diseases.
- Beverages: Coffee and tea farmers have been discouraged by falling price of unprocessed coffee on the world market. However, locally processed coffee and tea could displace imported processed coffee brands - domestic consumption of Zambian coffee and tea is still low.

(6) Donor Assisted Agricultural Project

Donors have assisted 159 agricultural projects on several sectors since 1970s. Sweden and Netherlands are major donors, assisting the agricultural projects of Zambia. Japan has assisted 9 agricultural projects since late 1980s. Following agricultural projects have been assisted by Japan:

Agricultural Projects assisted by Japan

Name of Project	Subjects
1. Mazabuka Traditional Farm Development	Improvement of traditional livestock.
2. Fish Hatchery Project	Strengthening fry supply.
3. Kaunga Rural Development Project	Irrigation project (100 ha)
4. Kanakantapa Agricultural Village Development	Irrigation project (30 ha)
5. Agricultural Verification Study for Rice	Rice verification in Zambezi F.P.
6. Mongu Rural Development Study	F/S based on above verification results.
7. Veterinary Medicine Research Study	Veterinary research for livestock.
8. Forest Resources Management Study	Conservation and protection of teak.
9. Dam Construction and Machinery for LDS	Small dams for irrigation.

(Note) F.P.: Flood plan, F/S: Feasibility Study

3.4.2 Present Status of Livestock

(1) Population and Production of Livestock

It is estimated that 2,669,000 head of cattle, 592,000 sheep and goats, 303,000 pigs, and 7,920,000 poultry were bred in the country in 1990.

Table 3-33 Number of Livestock and Share by Province in 1990

Province	Cattle		Sheep/Goats		Pigs		Poultry	
Lusaka	87,647	3.3%	13,407	2.3%	10,321	3.4%	1,582,000	20.0%
Copperbelt	74,374	2.8%	16,504	2.8%	21,186	7.0%	1,219,000	15.4%
Central	503,512	18.9%	47,597	8.0%	19,842	6.5%	987,000	12.5%
N/Western	59,340	2.2%	9,918	1.7%	4,732	1.6%	219,000	2.8%
Western	546,957	20.5%	8,368	1.4%	4,667	1.5%	388,000	4.9%
Southern	1,052,795	39.5%	274,228	46.3%	73,473	24.2%	1,337,000	16.9%
Luapula	12,186	0.5%	29,900	5.0%	3,019	1.0%	326,000	4.1%
Northern	107,821	4.0%	31,875	5.4%	8,318	2.7%	855,000	10.8%
Eastern	223,880	8.4%	160,359	27.1%	157,855	52.0%	1,008,000	12.7%
Zambia	2,668,512	100.0%	592,156	100.0%	303,413	100.0%	7,921,000	100.0%
Sector	Traditional	Conmercial	Traditional	Commercial	Traditional	Commercial	Traditional	Commercial
Lusaka	37,647	50,000	11,619	1,788	5,137	5,184	339,000	1,243,000
Copperbelt	18,250	56,124	5,964	10,540	9,089	12,097	301,000	918,000
Central	322,732	180,780	34,431	13,166	7,969	11,873	441,000	546,000
N/Western	56,462	2,878	9,918		4,732		219,000	0
Western	546,957		8,368		4,667		388,000	0
Southern	866,378	186,417	261,207	13,021	70,363	3,110	1,246,000	91,000
Luapula	10,031	2,155	29,812	88	2,988	31	326,000	0
Northern	96,437	11,384	30,265	1,610	7,853	465	822,000	33,000
Eastern	222,586	1,294	160,359		157,855		1,008,000	0
Zambia	2,177,480	491,032	551,943	40,213	270,653	32,760	5,090,000	2,831,000
Ratio	82%	18%	93%	7%	89%	11%	64%	36%

(Note) Poultry: estimated by data from 1982 to 1990, due to no sufficient data.

Southern, Central, Eastern and Western Provinces are predominant in cattle breeding and have a share of about 80% of the total number of cattle. Cattle are the most important livestock in Zambia, provide essential food products and contribute to draught power and manure for cultivation.

Cattle slaughtering rate estimated by DOA is about 6% in traditional sector, equivalent to 132,000 head per annum, and around 17 - 18% in commercial sector or 84,000 head per year. There is no exact data for traditional sector, because livestock of traditional sector is slaughtered mainly in local sites not in official butchery. Table 3-34 shows the slaughtering in official butchery for 11 years from 1980 to 1990. Average annual slaughtering are 107,924 head of cattle, 28,500 pigs, 2,742 goats, 1,051 sheep, and about 6,600,000 poultry. However, slaughtering was rapidly increased in 1990 for all livestock.

Table 3-34 Livestock Slaughtering in National Basis

Year	Cattle	Pigs	Goats	Sheep	Poultry	Eggs (*2)
1980	92,358	47,894	511	100	(*1)	(1,000eggs)
1981	100,052	37,748	547	29		
1982	82,856	31,157	1,454	29	11,160,796	105,485
1983	99,219	30,068	816	660	45,035	46,934
1984	106,492	30,314	1,279	1,166	5,832,710	44,418
1985	100,047	18,387	1,563	805	5,651,482	53,237
1986	85,875	17,344	1,205	651	6,505,841	74,359
1987	81,679	15,395	810	1,047	7,195,508	85,332
1988	116,041	18,466	1,086	858	9,828,026	128,503
1989	92,218	14,644	741	210		
1990	230,330	52,086	20,149	6,007		
Ave.	107,924	28,500	2,742	1,051	6,602,771	76,895
S.D.	23,731	10,594	3,165	922	2,393,148	25,324
Max	230,330	52,086	20,149	6,007	11,160,796	128,503
Min	81,679	14,644	511	29	45,035	44,418
S.D./Ave.	22.0%	37.2%	115.4%	87.7%	36.2%	32.9%

(Data Source)
1) 1980-89: Agricultural Statistics Bulletin 1989/90
2) 1990 : Livestock Population 1990-91, Statistics Section, MAFF
3) Poultry & Eggs: Agricultural and Pastoral Production (Commercial) 1981-82 to 1987-88
(Note)
*1: Cockerels and Broilers sold only by Commercial Farms.
*2: Eggs sold only by Commercial Farms.

Average meat consumption of the nation can be calculated as 3.69 kg / capita / year using the figure of meat production given by public slaughterers. As shown in Table 3-35, consumption by urban population is computed as 14.2 kg / person for meat, 1.8 kg / person for eggs and 13.7 litres / person for milk. This assumes that rural consumption is satisfied by subsistence production.

Table 3-35 Production and Per Capita Consumption of Meat, Eggs and Milk

Year	Meat Production (unit: tons)								National Popu.	Meat, Egg and Milk Consumption													
										Consumption for Nation (kg/capita/year)									Consumption by Urban Population (kg/capita/year)				
	Bovine Meat	Pig Meat	Goat Meat	Mutton Meat	Poultry Meat	Total Meat	Eggs	Milk (10^3 lit.)	(million)	Bovine	Pig	Goat	Mutton	Total[1]	Poultry	Total[2]	Eggs	Milk	Total[1]	Poultry	Total[2]	Eggs	Milk (lit.)
1980	16,163	3,353	7	1		19,524			5.66	2.86	0.59	0.00	0.00	3.45				(lit.)	9.15				
1981	17,509	2,642	8	0		20,159			5.81	3.09	0.47	0.00	0.00	3.56					9.44				
1982	14,500	2,181	20	0	20,089	16,701	5,274	30,319	5.97	2.56	0.39	0.00	0.00	2.95	3.55	6.50	0.93	5.36	7.82	9.42	17.24	2.47	14.22
1983	17,363	2,105	11	9	81	19,488	2,347	22,688	6.13	3.07	0.37	0.00	0.00	3.44	0.01	3.45	0.41	4.01	9.12	0.03	9.15	1.09	10.64
1984	18,636	2,122	18	16	10,499	20,792	2,221	28,161	6.29	3.29	0.37	0.00	0.00	3.66	1.85	5.51	0.39	4.98	9.71	4.91	14.62	1.03	13.21
1985	17,508	1,287	22	11	10,173	18,828	2,662	35,646	6.46	3.09	0.23	0.00	0.00	3.32	1.80	5.12	0.47	6.30	8.81	4.77	13.58	1.25	16.71
1986	15,028	1,214	17	9	11,711	16,268	3,718	24,989	6.64	2.66	0.21	0.00	0.00	2.87	2.07	4.94	0.66	4.42	7.61	5.49	13.10	1.75	11.72
1987	14,294	1,078	11	15	12,952	15,398	4,267	27,955	6.82	2.53	0.19	0.00	0.00	2.72	2.29	5.01	0.75	4.94	7.21	6.07	13.28	1.99	13.1
1988	20,307	1,293	15	12	17,690	21,627	6,425	34,808	7.00	3.59	0.23	0.00	0.00	3.82	3.13	6.95	1.14	6.15	10.13	8.3	18.43	3.02	16.31
1989	16,138	1,025	10	3		17,176			7.19	2.85	0.18	0.00	0.00	3.03					8.04				
1990	40,308	3,646	282	84		44,320			7.38	7.12	0.64	0.05	0.01	7.82					20.74				
Ave.	18,887	1,995	38	15	11,885	20,935	3,845	29,224	6.49	3.34	0.35	0.00	0.00	3.69	2.10	5.35	0.68	5.17	9.80	5.57	14.20	1.80	13.70
S.D.	4,153	742	44	13	4,307	4,378	1,266	3,743	0.47	0.73	0.13	0.01	0.00	0.77	0.76	0.83	0.22	0.66	2.05	2.02	2.20	0.59	1.75
Max.	40,308	3,646	282	84	20,089	44,320	6,425	35,646	7.38	7.12	0.64	0.05	0.01	7.82	3.55	6.95	1.14	6.30	20.74	9.42	18.43	3.02	16.71
Min.	14,294	1,025	7	0	81	15,398	2,221	22,688	5.66	2.53	0.18	0.00	0.00	2.72	0.01	3.45	0.39	4.01	7.21	0.03	9.15	1.03	10.64
S.D./A	22.0%	37.2%	115.8%	86.7%	36.2%	20.9%	32.9%	12.8%	7.2%	21.9%	0.30			3.84	1.95	15.5%	32.4%	13%	21%	36%	16%	33%	13%

(Data Source)

This table derived using slaughtering data and Poultry and Milk Production by following References. (Appendix G)

(1) Slaughtering: Agricultural Statistic Bulletin (1980-89), MAFF Statistics Section (1990), and (2) Poultry and Eggs: Agricultural Pastoral Production (Commercial Farms)

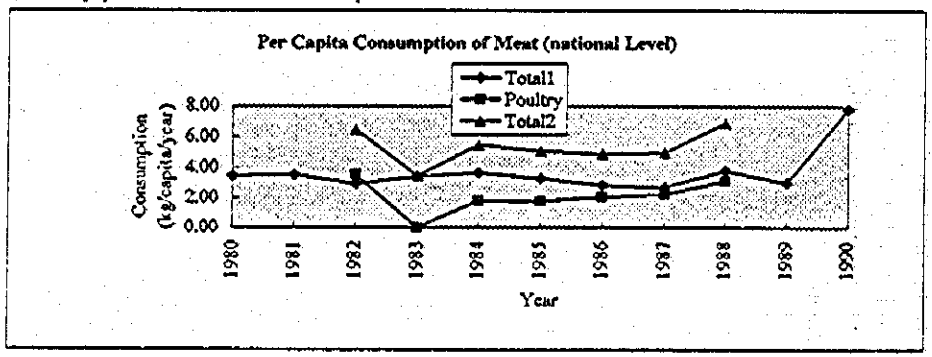
(Notes)

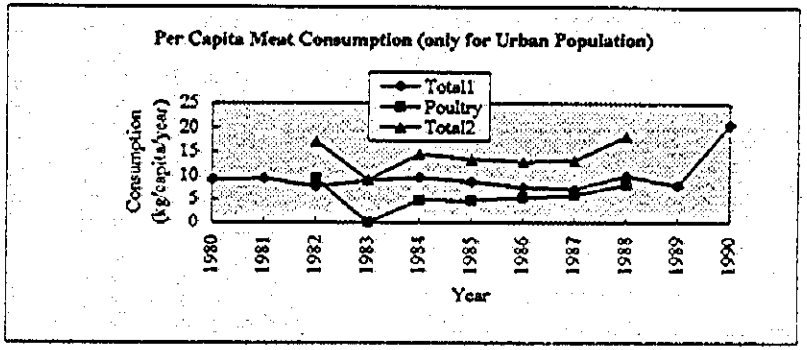
1) Beef cattle: 175 kg/head, Pigs: 70 kg/head, Sheep/Goats: 14 kg/head, Poultry: 1.8 kg/bird, (Eggs: 1kg/20 eggs)

2) Total1: Meat Consumption excluding Poultry. 3) Total2: Meat Consumption including Poultry.

4) The number of slaughtering shows the officially registered number slathered in cold storage companies or private butcheries. illegal slaughtering are not known.

5) Urban population is 37.7% of National Population.





(2) Grazing and Feed Supply

<Grazing>

The flood plain area extending over the country as a whole covers an area of 7,990,000 ha area of which as much as 80% of the total is estimated to be natural vegetation. Assuming the feeding ratio as 2 ha per head, the area holds a capacity able to breed as many as 3,196,000 head of cattle. As to the cattle grazing, 854,000 heads could be raised on the basis of 5 ha area per head under utilisation of 50% of agricultural land (8,543,450 ha). In dry season, residuals such as straws/leaves of maize, paddy, wheat and millet are used for feed supply. Depending on the available residuals, it is able to breed 859,000 heads of cattle on 0.82 ha per head with 80% utilisation in dry season. Total present natural breeding capacity is estimated at 4,909,000 heads of cattle in the country as shown in Table 3-36. However, such potential of natural breeding capacity is not equally distributed in the provinces. As shown in the table, cattle number already reached over grazing stage in Southern Province, where the cattle number exceeds about 140,000 heads than adequate number.

Table 3-36 Present Status of Grazing and Over Grazing in Zambia

Province	Lusaka	Copper-belt	Central	N/ Western	Western	Southern	Luapula	Northern	Eastern	Total
Available Feeding by Agricultural Land except Shifting Cultivation Area										
Agricultural Land (ha)	339,666	225,602	1,142,704	503,494	1,457,169	1,963,977	687,620	542,097	1,681,121	8,543,450
Capability of breed (*1)	34,000	23,000	114,000	50,000	146,000	196,000	69,000	54,000	168,000	854,000
Available Feeding by Staple Crops Field										
Staple Crop Land (ha)	26,948	29,466	114,052	23,830	62,245	252,268	30,757	64,369	276,306	880,241
Maize, Sorghum, Millet	26,893	29,407	113,957	23,642	58,439	252,268	30,264	60,946	274,797	870,613
Rice Extensive	55	59	95	188	3,806	0	493	3,423	1,509	9,628
Capability to breed (*2)	26,000	29,000	111,000	23,000	61,000	246,000	30,000	63,000	270,000	859,000
Available Feeding by Natural Vegetation										
Floodplain Area (ha)	254,114	273,381	970,164	1,066,878	2,392,184	1,179,752	165,047	1,648,743	39,600	7,989,863
Capability to breed (*3)	102,000	109,000	388,000	427,000	957,000	472,000	66,000	659,000	16,000	3,196,000
Capability to breed (heads)	162,000	161,000	613,000	500,000	1,164,000	914,000	165,000	776,000	454,000	4,909,000
Cattle Number in 1990						<over grazing>				
	87,647	74,374	503,512	59,340	546,957	1,052,793	12,186	107,821	223,880	2,668,512

(Note) *1) Utilisation (50%), 5 ha/head, *2) Utilisation (80%), 0.82 ha/head, *3) Utilisation (80%), 2 ha/head

<Concentrated Feed>

Concentrated feed is utilised in commercial sector for breeding their livestock. However, concentrated feed is seldom utilised in traditional sector. Therefore, the requirement of concentrated feed is estimated only for livestock of commercial sector. Table 3-37 shows the average requirement of concentrated feed from 1985 to 1991.

Table 3-37 Number of Livestock and Concentrated Feed Demand in Commercial Sector

Description	No. of livestock	Feed requirement (tons/year)
Cattle	448,424	491,027
Pigs	28,266	28,888
Sheep/Goat	38,218	4,185
Poultry	2,607,269	95,165
Total		619,265
Available By-Product		290,049
Deficit of feed by By-Product		329,216

Total concentrated feed amount to about 619,000 tons of which 290,000 tons are covered by by-product of crops, that is corresponding to 47 % of total requirement. Consequently, 290,000 tons or 53 % of total requirement has to be prepared by grain.

(3) Water Consumption of Livestock

Unit water requirement of livestock is as shown in following Table. Cattle consumes 40 lit./day, pigs consume around 20 to 35 lit/day, sheep/goats consume 20 to 29 lit/day, and poultry consumes 0.2 lit./day of water.

Table 3-38 Unit Water Requirement of Livestock (Unit:lit./head/day)

	Beef/Cattle		Pigs Breeding		Sheep/Goats		Poultry Breeding	
Breeding System	T/Farm	C/Farm	T/Farm	C/Farm	T/Farm	C/Farm	T/Farm	C/Farm
Major Water Source	S/W, G/W	G/W	S/W, G/W	G/W	S/W, G/W	G/W	S/W, G/W	G/W
Water Use								
- Dipping Water	0.7 *1	0.7 *2				0.7 *2		
- Drinking Water	40.0 *1	40.0 *1	20.0 *1	20.0 *1	20.0 *1	20.0 *1	0.20 *1	0.20 *1
- Cleaning Water				15.0 *3		8.0 *2		
Total	40.7	40.7	20.0	35.0	20.0	28.7	0.20	0.20

*1: Animal Husbandry Section, MAFF *2: Observation of Commercial Livestock Farm.
*3 Agricultural Techniques Handbook 1985 (Japan)
(Note) 1) C/Farm: Commercial Farm, T/Farm: Traditional Farm
2) G/W: Groundwater, S/W: Surface water

Depending on above unit water requirement of livestock, provincial unit water requirement can be estimated by the ratio of commercial and traditional livestock number. Table 3-39 shows the unit water requirement taking the ratio of both sectors.

Table 3-39 Unit Water Requirement of Livestock by Province (Unit: per head)

Province	Cattle		Sheep/ Goats		Pigs		Poultry	
	(lit./day)	(m^3/yr)	(lit./day)	(m^3/yr)	(lit./day)	(m^3/yr)	(lit./day)	(m^3/yr)
Lusaka	40.7	14.9	21.2	7.74	27.5	10.04	0.2	0.073
Copperbelt	40.7	14.9	25.6	9.34	28.6	10.44	0.2	0.073
Central	40.7	14.9	22.4	8.18	29.0	10.59	0.2	0.073
N/Western	40.7	14.9	20.0	7.30	20.0	7.30	0.2	0.073
Western	40.7	14.9	20.0	7.30	20.0	7.30	0.2	0.073
Southern	40.7	14.9	20.4	7.45	20.6	7.52	0.2	0.073
Luapula	40.7	14.9	20.0	7.30	20.2	7.37	0.2	0.073
Northern	40.7	14.9	20.4	7.45	20.8	7.59	0.2	0.073
Eastern	40.7	14.9	20.0	7.30	20.0	7.30	0.2	0.073
Zambia	40.7	14.9	20.6	7.52	21.6	7.88	0.2	0.073

Depending upon the above unit water requirement, total water requirement of livestock is estimated at about 129,000 m3/day at present.

Table 3-40 Number of Livestock and Water Requirement in 1990

Province	Cattle		Sheep/ Goats		Pigs		Poultry		Total
	(head)	(m^3/day)	(head)	(m^3/day)	(head)	(m^3/day)	(head)	(m^3/day)	(m^3/day)
Lusaka	87,647	3,567	13,407	284	10,321	284	1,582,000	316	4,451
Copperbelt	74,374	3,027	16,504	423	21,186	606	1,219,000	244	4,300
Central	503,512	20,493	47,597	1,066	19,842	575	987,000	197	22,331
N/Western	59,340	2,415	9,918	198	4,732	95	219,000	44	2,752
Western	546,957	22,261	8,368	167	4,667	93	388,000	78	22,599
Southern	1,052,795	42,849	274,228	5,594	73,473	1,514	1,337,000	267	50,224
Luapula	12,186	496	29,900	598	3,019	61	326,000	65	1,220
Northern	107,821	4,388	31,875	650	8,318	173	855,000	171	5,382
Eastern	223,880	9,112	160,359	3,207	157,855	3,157	1,008,000	202	15,678
Zambia	2,668,512	108,608	592,156	12,187	303,413	6,558	7,921,000	1,584	128,937

3.4.3 Food Balance

(1) Feed Balance of Livestock

Concentrated feed is generally supplied from the by-product of crops. Table 3-41. shows the balance of supply and demand. The balance analysis has been given for 7 years from 1985 to 1991, because livestock data are only available for 7 years. The requirement has been estimated only for livestock of commercial sector considering present condition, that concentrated feed is seldom applied in the traditional sector. As shown in the table, the supply of by-products is not enough to meet to the required concentrated feed. Annual deficit is about 329,000 tons, and it has to be made up by grain.

Table 3-41 Feed Balance of Livestock and Grain Requirement

Year		1985	1986	1987	1988	1989	1990	1991	Average
Number of Livestock of Commercial Sector									
Cattle		393,135	412,792	433,432	475,024	487,516	491,032	446,052	448,426
Pigs		21,559	23,715	26,087	28,694	32,139	32,760	32,910	28,266
Sheep/Goat		32,196	35,417	39,958	42,863	31,240	40,213	45,642	38,218
Poultry		2,567,636	1,228,046	2,150,163	4,006,112	2,400,629	3,291,026	2,607,269	2,607,269
Feed Requirement as Concentrated Sort (tons/year)									
Cattle	3.0	430,483	452,007	474,608	520,151	533,830	537,680	488,427	491,027
Pigs	2.8	22,033	24,237	26,661	29,325	32,846	33,481	33,634	28,888
Sheep/Goat	0.3	3,525	3,878	4,375	4,693	3,421	4,403	4,998	4,185
Poultry	0.1	93,719	44,824	78,481	146,223	87,623	120,122	95,165	95,165
Total		549,760	524,946	584,125	700,392	657,720	695,686	622,224	619,265
Available Amount of By-Product (tons)									
(Table 3-37)		246,041	262,279	242,541	389,948	367,651	257,873	264,011	290,049
Deficit of Feed by By-Product (tons)									
		303,719	262,667	341,584	310,444	290,069	437,813	358,213	329,216

(Notes)
1) Feed as concentrated sort only for livestock of Commercial Sector.
2) Feed requirement is estimated based on per head requirement and number of livestock

(2) Regional Balance of Staple Crops

Regional balance of staple crops is studied as of 1990. Maize, millet, sorghum, rice and wheat are selected as grain, and cassava is also included as one of staple crops. Cassava is an important crop in the northern provinces and Western Province.

Surplus production of staple crops are observed in four provinces, Central, Southern, Northern and Eastern Province as shown in Table 3-42. Other five provinces are deficit in balance, and importing staple crops from former four provinces. Southern Province produces the maximum surplus, and Central and Eastern Provinces are following. Copperbelt Province is the most deficit province among five deficit provinces, which imports over 150,000 tons per year. Deficit of food is much mitigated to about 9,000 tons by cassava in North-western and Luapula Provinces. However much deficit still remains at about 30,000 tons in Western Province, although cassava is counted.

Table 3-42 Present Regional Balance of Staple Crops (As of 1990)

Province	Food Demand		Production		Balance with Food		Balance with Feed	
	Population	Demand (tons)	Grain (tons)	Cassava (tons)	with Grain (tons)	Incl. Cassava (tons)	Requirement (tons)	Total Balance (tons)
Lusaka	987,106	157,937	83,732	0	-74,205	-74,205	not analysed on provincial basis	
Copperbelt	1,427,528	228,404	75,801	354	-152,603	-152,603		
Central	720,628	115,300	362,562	741	247,262	248,003		
N/Western	387,554	62,009	39,795	12,838	-22,214	-9,376		
Western	606,813	97,090	61,565	6,153	-35,434	-29,281		
Southern	907,150	145,144	421,117	31	275,973	275,004		
Luapula	525,160	84,026	47,269	27,279	-36,757	-9,478		
Northern	855,177	136,828	172,886	27,598	36,058	63,656		
Eastern	965,968	154,555	397,802	45	243,247	243,292		
Zambia	7,383,084	1,181,293	1,662,620	75,039	481,327	556,366	584,409	-28,043

(Note)
1) Food demand is based on per capita consumption of 160 kg/year.
2) Cassava production is equivalent weight by calorie with maize. (1/3 of maize)

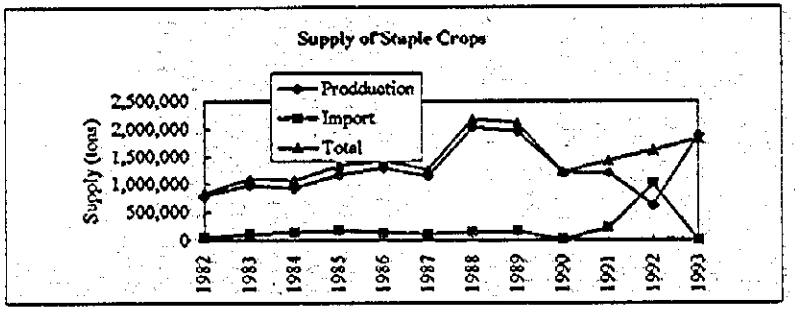
National total deficit is estimated at about 28,000 tons when feed and other requirement are counted.

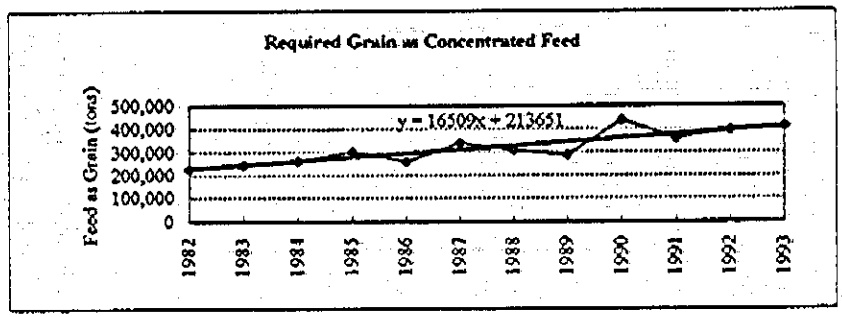
(3) Present Food Balance and Per Capita Consumption of Staple Crops

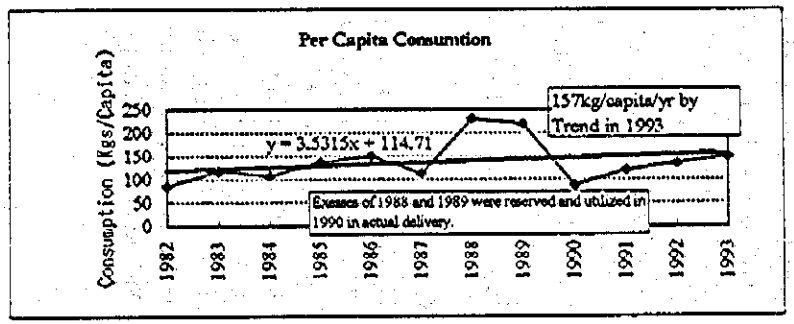
Taking a deficit of feed supply to livestock into account, food balance of staple crops has been analysed from 1982 to 1993 as shown in Table 3-43. As shown in the table, cereals (mostly maize) are imported almost every year except 1990. Average annual import was about 210,000 tons including the heavy import from 1992 to 1993 caused by the severe drought in 1992. Excluding 1992 and 1993, average annual import was only 83,000 tons. Under above conditions, balance is analysed including losses, seed reservation and other purposes. As calculated in trend analysis in Table 3-43, per capita consumption is estimated at 157 kg/year. According to the information of the Food Security, MAFF, per capita consumption is decreasing in amount recently due to liberalisation of food market. Taking this situation into account, per capita consumption is considered to be 160 kg/year.

Table 3-37 Present Food Balance and Per Capita Consumption of Staple Crops in Zambia

Year		1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	Average	S.D	S.D/Ave
Population (million)		5.97	6.13	6.29	6.46	6.64	6.82	7.00	7.19	7.38	7.58	7.77	7.97			
1. Production *1	(tons)	786,286	986,626	922,972	1,173,253	1,298,458	1,155,602	2,039,789	1,964,343	1,206,687	1,216,130	610,416	1,890,607	1,270,931	443,448	34.9%
2. Import *2	(tons)	58,359	111,600	145,912	165,432	132,363	103,286	146,149	148,420	17,934	216,000	1,003,791	0	187,437	253,159	135.1%
3. Export *2	(tons)	0	0	0	0	0	0	0	0	0	0	0	68,000	5,667	18,794	331.6%
Total (1+2-3)	(tons)	844,645	1,098,226	1,068,884	1,338,685	1,430,821	1,258,888	2,185,938	2,112,763	1,224,621	1,432,130	1,614,207	1,822,607	1,452,701	396,066	27.3%
4. Feed Requirement 1)	(tons)	230,160	246,669	263,178	303,719	262,667	341,584	310,444	290,069	437,813	358,213	395,250	411,759	320,960	65,252	20.3%
5. Seed (2%) 2)	(tons)	15,726	19,733	18,459	23,465	25,969	23,112	40,796	39,287	24,134	24,323	12,208	37,812	25,419	8,869	34.9%
6. Losses (5%) 3)	(tons)	42,232	54,911	53,444	66,934	71,541	62,944	109,297	105,638	61,231	71,607	80,710	91,130	72,635	19,803	27.3%
7. Processing (5%) 3)	(tons)	42,232	54,911	53,444	66,934	71,541	62,944	109,297	105,638	61,231	71,607	80,710	91,130	72,635	19,803	27.3%
Total (4 to 7)	(tons)	330,350	376,224	388,525	461,052	431,718	490,584	569,834	540,632	584,409	525,750	568,878	631,831	491,649	90,553	18.4%
Available for Consumption	(tons)	514,295	722,002	680,359	877,633	999,103	768,304	1,616,104	1,572,131	640,212	906,380	1,045,329	1,190,776	961,052	335,335	34.9%
Per Capita Consumption	**(kg/Capita)**	**86**	**118**	**108**	**136**	**150**	**113**	**231**	**219**	**87**	**120**	**135**	**149**	**138**	**44**	**31.9%**







(Note)
1) Feed requirement for 1982-84 and 1992-93 is interpolated.
2) Annual stock is not considered in supply in this table.
Therefore, annual supply fluctuates significantly.

3.4.4 Agricultural Development

(1) Proposal of Long Term Agricultural Development Plan

Agricultural development plan is proposed, corresponding to the three scenarios set in the socioeconomic framework, based on the present conditions and programmes expressed in ASIP. Water resources development plan for the agricultural sector is formulated according to the proposed agricultural development plan, as shown in Table 3-44.

Table 3-44 Agricultural Development Scenarios

	Present Status	Base Scenario - Agricultural Expansion	Base Scenario - Industrialisation	Conservative Scenario
Population (1000 persons)	7,969 (1993) (=100)	12,738 (160)	14,336 (180)	11,589 (145)
Annual Growth in Value Added of Agricultural Sector	Average 2.3% (1985-1993)	1994-2000: 6.0% afterwards: 3.0%	3.0% (constant)	1995-: 2.6% 2000-: 2.3% 2005-: 2.0% 2010-: 1.5%
value Added of Agricultural Sector - 2005 - 2015)	(299.3 billion K.) (=100)	 494.9 billion K. (165) 699.8 billion K. (234)	 439.6 billion K. (147) 616.4 billion K. (206)	 382.7 billion K. (128) 491.2 billion K. (164)

(2) Production of Crops

Rain fed agriculture will remain predominant even in the future, and most of maize and oil crop production will be obtained through rain fed cultivation. Wheat and rice cropping through irrigated farming will be complementary for stable production of cereals. In addition, irrigation will support the production of cash crops, such as vegetable and fruit, and of exported goods, such as coffee, sugar and flowers, in order to contribute to the improved balance of payments of the country and high growth in the Value Added of the sector. Expansion and enhancement of rain fed agriculture in the northern region, where rainfall is comparatively constant, will be necessary to achieve the stable agricultural production of the country. Of the three scenarios, the largest expansion of rain fed agriculture will be required to attain the target in the Base Scenario-Agricultural Expansion. In this scenario, prompt introduction of ox draught system in the northern region should be extensively encouraged.

< Staple Crops >

Self supply is assumed in all scenarios. Rain fed maize and irrigated wheat will be main crops. Consumption of staple crops is presumed to be 160 kg/capita/year, and wheat consumption is supposed to remain at 13 kg/capita/year, 8% of the total consumption. Even in the future, main part of the production should rely on rain fed agriculture. In Base Scenario-Agricultural Expansion, increased production will allow to ensure the targeted cereal reserve for three months (510 thousand tons), which will upgrade the food security against drought events, and for Zambia to become a cereal exporting country. In the other two scenarios, all of the products will be consumed domestically.

< Oil Crops >
Oil crops are ranked third of the agricultural products for export and are produced by rain fed agriculture. The market for these crops continues to look promising in the future. ASIP also emphasises the development of processing technology for vegetable oil production, assuming that demands increase. Production increase to two or three times the current volume can be projected by 2015.

< Vegetables >
Vegetables are the most suitable for cash earning. Current production has reached to the level to meet the supply of 65 kg/capita/year, and rapid consumption increase will not occur. Further, large scale export will be difficult. Current level of production is assumed to continue.

< Fruit >
Current consumption of fruit is 16 kg/capita/year, which corresponds to 30% of the consumption in developed countries (50 kg/capita/year). In the Base Scenario-Agricultural Expansion, where the largest increase of agricultural production is projected, production of fruit is planned to increase to meet a consumption level of 27 kg/capita/year.

< Coffee and Tea >
Coffee and tea plantation is expanding by 530 ha/year. Much endeavour is being made by entrepreneurs to marketing and exports of coffee and tea. Current expansion is assumed to continue in the Base Scenario-Agricultural Expansion. In the other scenarios, however, the production will grow at the same rate as that set for growth of total value added of agricultural sector in each scenario, considering possible risks in the future.

< Sugarcane >
Sugar is ranked second of the exported agricultural products. The complete process from plantation to exporting has been established by the sugar company. The plantation will be expanded from the current area of 13,000 ha to 21,000 ha by 2005, in accordance with projection of the production expansion planned by the company.

< New Products >
Flower growing and exports have been started recently mainly by commercial farmers. ASIP highlights expansion in the future. The markets for flowers are European countries, where stable and expanded supply with lower price in winter can be achieved from Zambia which enjoys summer at the same time. Therefore, production will increase to 10 times the present level in the Base Scenario-Agricultural Expansion. In the other scenarios, the production will grow at the same rate as that of total value added of the sector of each scenario, considering possible risks.

Under above considerations, trial study has been made to get target growth rate of the value added with satisfying the all requirements of livestock production, fishery production and grain production. Since said three productions are fixed by population scenarios because per capita consumption was set at 14.2kg/yr, 12kg/yr and 160kg/yr, adjustment has been made only by other crops than cereals. Table 3-45 shows the result of crop production, acreage and economic growth of agriculture for three agriculture development scenarios.

Total planted and irrigated areas are maximum in 2015 in case of Base Scenario-Agricultural Expansion of about 2,633,000ha and 114,000ha respectively. Base Scenario-Industrialisation follows the Base Scenario-Agricultural Expansion with the planted area of 2,343,000ha and the irrigated area of 107,000ha. The areas are minimum in Conservative Scenario with the planted area of 1,916,000ha and the irrigated area of 91,000ha. Present planted and irrigated areas are 1,363,000ha and 53,000ha respectively in 1993. Therefore, both areas of Base Scenario-Agricultural Expansion reach almost or over two times the present areas.

Table 3-45 Crop Production and Water Demand for Irrigation by Three Scenarios

	Current Status (1993)	Base Scenario - Agricultural Expansion	Base Scenario - Industrialisation	Conservative Scenario
< Crop Production >				
(1) staple Crops	1,894,000 ton	3,664,000 ton	3,383,000 ton	2,728,000 ton
(export)		510,000 ton	-	-
(wheat)	71,000 ton	166,000 ton	186,000 ton	151,000 ton
- domestic production	50 %	100 %	100 %	100 %
- Import	50 %	0 %	0 %	0 %
(2) Oil Crops	154,000 ton (=100)	462,000 ton (300)	385,000 ton (250)	323,000 ton (210)
(3) Vegetable	520,000 ton (65 kg/person/year)	855,000 ton (65 kg/person/year)	958,000 ton (65 kg/person/year)	775,000 ton (65 kg/person/year)
(4) Fruits	129,000 ton (16 kg/person/year)	348,000 ton (27 kg/person/year)	250,000 ton (17 kg/person/year)	202,000 ton (17 kg/person/year)
(5) Coffee & Tea	6,300 ha (=100)	18,240 ha (290)	12,000 ha (190)	9,600 ha (152)
(6) Sugar Cane	13,000 ha (=100)	21,000 ha (162)	21,000 ha (162)	21,000 ha (162)
(7) New Crops (flower)	250 ha (=100)	2,500 ha (1000)	500 ha (200)	380 ha (152)
< Total Planted Area >	1,363,000 ha (=100)	2,633,000 ha (193)	2,343,000 ha (172)	1,916,000 ha (141)
< Total Irrigated Area >	53,000 ha (=100)	114,000 ha (215)	107,000 ha (202)	91,000 ha (172)
<Newly Irrigated Area>	-	61,000 ha	54,000 ha	38,000 ha
< Additional Irrigation Water Demand >	-	5,282,000 m^3/day	4,680,000 m^3/day	3,242,000m^3/day

(3) Food Demands and Security

Food demand has been estimated for three scenarios. Per capita demand of staple crop is assumed at 160 kg/year based on actual food balance for 12 years from 1982 to 1993. Consumption of meat is considered at 14.2 kg/capita, that is the present consumption rate. The present meat consumption rate will be also applied for the future consumption in all scenarios.

Necessary production of staple crops are as shown in Table 3-46. Necessary production as minimum requirement of staple crops ranges from 2,728,000 tons/year for the Conservative Scenario to 3,664,000 tons/year for the Base Scenario-Agricultural Expansion in 2015. Production of staple crops has to be increased to 144% and 193% of the 1993 production for the above cases. In case of the Base Scenarios-Industrialisation, it is necessary to produce 3,383,000 tons/year, equivalent to 179% of the 1993 production of 1,894,000 tons.

<Reserves>
For security of food, 3 month reserve of grain will be planed in all cases of agricultural development plans. The amount of annual reserves are:

Base Scenario-Agricultural Expansion =	510,000 ton,
Base Scenario-Industrialisation =	573,000 ton,
Conservative Scenario =	464,000 ton

<Export of Grain (Maize)>
In case of Base Scenario-Agricultural Expansion, it is proposed to produce 510,000 tons of maize for export, which is the same amount of three month reserve. By the production of 510,000 tons of maize, total production of staple crops becomes 3,664,000 tons which includes 5% losses (26,000 tons) and 2% of seed (10,000 tons), adding to the target of 3,118,000 tons in total.

Table 3-46 Required Production of Staple Crops for Three Scenarios

Agricultural Plan	Base Scenario-Agri cultural Expansion		Base Scenario-Industrialisation		Conservative Scenario	
	2005	2015	2005	2015	2005	2015
Population (1,000)	10,465	12,738	10,994	14,336	10,025	11,589
Minimum Required Staple Crops (tons)						
Food Demand 1)	1,674,000	2,038,000	1,759,000	2,294,000	1,604,000	1,854,000
Feed Demand 2)	550,000	706,000	510,000	683,000	467,000	547,000
Losses 5%	126,000	156,000	129,000	169,000	118,000	136,000
Manufacturing 5%	126,000	156,000	129,000	169,000	118,000	136,000
Seed 2%	51,000	62,000	52,000	68,000	47,000	55,000
Total	2,527,000	3,118,000	2,579,000	3,383,000	2,354,000	2,728,000
Export	0	546,000	0	0	0	0
Grand Total	2,527,000	3,664,000	2,579,000	3,383,000	2,354,000	2,728,000

(Note)
1) Food requirement = 160 kg/capita/yr
2) Feed demand = Total Required Feed * 53% as grain.

(4) Necessary Countermeasures for Stabilising the Production

For producing the above requirement, the following factors are considered:
- Production of staple crops mostly depend on rainfed maize cultivation.
- The national production of staple crops fluctuates by 25% once in 5 years. If no irrigated cereals are increased, that is equivalent to 780,000 tons/year. In case of Base Scenario-Agricultural Expansion, irrigated wheat is expected to increase to 34,800 ha and expected to produce a stable yield of about 174,000 tons of grain. Therefore, reduction of production will be reduced to 606,000 tons, 225,000 tons will be secured by the national reserve for food security.

<Import of Maize>
- Balance of 381,000 tons will be imported from the world market, if no measures are taken.

<Expansion of Rainfed Cultivation in the Northern Regions>
- On the other hand, productivity of maize is stable in the northern provinces, such as Northern, Luapula and North-western Provinces. However, hoe cultivation is predominant

in these area, and total maize planted area of three provinces shares only 10% of national planted area. In these provinces, there are not enough number of oxen at present stage. The cultivation area per farmer is much less than that in Southern and Eastern Provinces. Therefore, it will be difficult to expand the planted area so rapidly with hoe cultivation in short period. In this study, it is recommended to expand cultivation area in the northern region with an rapid increase of oxen to meet necessary expansion of national planted area. As shown in the table below, agricultural population of northern three provinces are projected to decrease from 33% of national agricultural population in 1993 to 29% in 2015. Therefore, encouragement of oxen introduction is to be strongly proceeded for northern region.

Table 3-47 Projection of Economically Active Agricultural Population

(Unit:1,000)

Province	1990 Actual	Base Scenario-Agricultural expansion			Base Scenario-Industrialisation			Conservative Scenario		
	1990	1995	2005	2015	1995	2005	2015	1995	2005	2015
Lusaka	33	39.7	54.3	71.4	37.4	43.7	42.8	39.3	52.0	65.2
Copperbelt	61	70.3	92.4	117.3	70.2	93.8	123.3	69.9	88.6	105.9
Central	121	137.3	171.7	206.8	136.8	172.2	212.6	136.3	165.2	188.3
N/Western	77	85.3	101.8	118.5	83.9	97.4	107.1	84.8	97.7	107.9
Western	95	103.0	117.5	130.8	102.4	117.8	134.4	102.0	112.7	119.0
Southern	133	150.2	186.2	222.1	148.8	183.8	222.0	149.1	178.5	202.5
Luapula	110	119.4	137.2	152.5	118.3	134.8	149.6	118.6	131.2	138.6
Northern	182	197.6	227.3	251.3	195.8	223.3	248.7	196.2	217.4	228.1
Eastern	303	342.8	426.3	509.6	341.7	429.4	528.3	340.1	408.7	463.9
Zambia	1,115	1,245.6	1,514.7	1,780.3	1,235.3	1,496.2	1,768.8	1,236.3	1,452.0	1,619.4
Population of Northern Region (N/Western, Luapula, Northern)										
	369	402	466	522	398	456	505	400	446	475
Ratio to National Population										
	33%	32%	31%	29%	32%	30%	29%	32%	31%	29%

(5) Northern Expansion of Rainfed Agriculture

As stated above, for effective utilisation of resources of the country, it is essential to expand the rainfed agriculture in the northern region.

In this expansion plan, following targets are to be achieved for the national and the regional benefits:

- to mitigate fluctuation of staple crop production more or less the three month reserve for drought year once in five years.
- to increase planted area per household more than 1.8ha in the northern region, which supports the expenditure of agricultural household.

Table 3-48 shows the expansion plan for Base Scenario-Agricultural Expansion together with status of 1993. In this scenario, cultivation area increases to 2,633,000ha (193%) in 2015 from 1,363,000ha in 1993, and national average cultivation area per household increases to 3.1ha from 2.5ha. According the results of analysis, the cultivation area of northern three provinces (N/Western, Luapula and Northern) is increased from 268,000ha to 663,000ha by 2.47 times, while that of other 6 provinces is increased 1.69 times. In this plan, reduction of maize production can be reduced from 916,000ton (25% of targeted production of

3,664,000ton) to 580,000ton (16%), which still exceeds the three month reserve of 510,000ton by 70,000 ton, but excess is not large amount which is able to be managed by import. However, export is not able to achieve such drought year, but able to export 510,000ton annually in other years. Per household cultivation area is increased to 1.8ha from 0.9ha in N/Western Province, from 1.0ha in Luapula Province, and to 3.2ha from 1.7ha for Northern Province.

It is estimated the cultivable capacity per farmer of hoe cultivation, ox draught cultivation and mechanised cultivation at 0.30ha, 1.43ha and 3.51ha respectively. Base on this assumption, oxen number has to be increased from 9,000head in 1993 to 226,000head in 2015 by about 25 times in said three provinces.

For realising this northern expansion programme, increase of ox is an essential factor. Therefore, encouragement of ox expansion is to be strongly proceeded, and veterinary facilities and ox training centres are to be provided as well as extension work for promotion of cultivation in the northern region.

Table 3-48 Northern Expansion of Cultivated Area by Base Scenario-Agricultural Expansion

	Present (1993)											
	Cultivated	Cultivated	Wet	Planted	Cultivation Method							
	Area	Area Per	Season	Area	Hoe		Ox		Mechanized			
Province		Household	Planted	per	Cultivation		Cultivation		Cultivation			
		(ha/house)	Area	Famer								
	(ha)		(ha)	(ha)	(ha)		(ha)		(ha)			
Lusaka	39,969	2.7	36,400	1.3	5,906	(16 %)	16,027	(44 %)	14,518	(40 %)		
Copperbelt	52,372	2.0	46,200	0.9	12,104	(26 %)	4,213	(9 %)	29,835	(65 %)		
Central	249,293	4.6	244,800	2.4	5,618	(2 %)	93,050	(38 %)	146,248	(60 %)		
N/Western	39,767	0.9	29,000	0.5	17,309	(59 %)	5,177	(18 %)	6,669	(23 %)		
Western	109,972	2.2	82,900	1.1	5,113	(6 %)	77,813	(94 %)	0	(0 %)		
Southern	280,723	4.5	276,200	2.4	0	(0 %)	198,228	(72 %)	78,141	(28 %)		
Luapula	73,663	1.0	38,200	0.4	26,651	(78 %)	696	(2 %)	7,020	(20 %)		
Northern	154,468	1.7	120,800	0.8	36,416	(30 %)	6,967	(6 %)	77,220	(64 %)		
Eastern	362,875	2.6	362,300	1.5	51,726	(14 %)	93,849	(26 %)	216,703	(60 %)		
Zambia	1,363,052	2.5	1,236,800	1.3	160,843	(13 %)	496,020	(40 %)	576,354	(47 %)		
	Base Scenario-Agricultural Expansion (2015)											
Lusaka	79,368	2.8	70,974	1.3	6,764	(10 %)	35,672	(50 %)	28,537	(40 %)		
Copperbelt	105,121	2.3	105,121	1.1	6,827	(6 %)	30,325	(29 %)	67,969	(65 %)		
Central	375,740	4.4	363,843	2.2	0	(0 %)	145,538	(40 %)	218,308	(60 %)		
N/Western	94,607	1.8	87,495	1.0	11,412	(13 %)	55,969	(64 %)	20,114	(23 %)		
Western	131,145	2.1	124,135	1.2	12,740	(10 %)	111,395	(90 %)	0	(0 %)		
Southern	402,459	4.2	374,732	2.1	0	(0 %)	260,809	(70 %)	113,924	(30 %)		
Luapula	183,002	1.9	168,719	1.4	945	(1 %)	133,879	(79 %)	33,894	(20 %)		
Northern	384,914	3.2	368,581	1.9	0	(0 %)	132,689	(36 %)	235,891	(64 %)		
Eastern	734,474	3.3	732,473	1.9	0	(0 %)	292,989	(40 %)	439,483	(60 %)		
Zambia	2,510,244	3.1	2,396,075	1.7	38,688	(2 %)	1,199,265	(50 %)	1,158,120	(48 %)		

(6) Agricultural Development

(a) Value Added of Agricultural Sectors by Three Scenarios

Table 3-49 shows the value added of each sub-sector of agriculture by three scenarios. Total value added is maximum of about M'K 699,801 in 2015 in the Base Scenario-Agricultural expansion, and followed by the Base Scenario-Industrialisation and the Conservative Scenario.

Table 3-49 Value Added of Agricultural Sectors by Three Scenarios

	Year	1990	1993	1994	1995	2000	2005	2010	2015
Base Scenario-Agricultural Expansion									
Population	('1,000)	7,383	7,969	8,164	8,359	9,412	10,465	11,602	12,738
	Ratio	100	108	111	113	127	142	157	173
GVA Imposed to Agricultural Sector									
Imposed GVA Growth Rate (%)			52.1	6.0	6.0	6.0	3.0	3.0	3.0
GVA Growth Ratio to 1993			100.0	106.0	112.4	150.1	174.3	202.1	234.3
Agricultural GVA Plan (Gross Margin)									
Crops	(K million)		177,607	187,692	197,777	248,201	298,625	367,687	436,750
Livestock	(K million)		45,614	47,624	49,635	59,689	69,742	79,686	89,630
Wildlife	(K million)		13,000	13,390	13,806	16,276	17,830	19,637	21,730
Forestry	(K million)		48,979	51,918	55,053	73,665	85,371	98,987	114,758
Fishery	(K million)		14,082	15,410	15,047	19,023	23,352	29,780	36,934
Total GVA	(K million)		299,281	316,034	331,317	416,853	494,919	595,777	699,801
Growth Rate of GVA				5.6%	4.8%	4.7%	3.5%	3.8%	3.3%
Ratio to 1993			100.0	105.6	110.7	139.3	165.4	199.1	233.8
Increase of Irrigated Area (ha)							31,719		60,619
Base Scenario-Industrialisation									
	Year	1990	1993	1994	1995	2000	2005	2010	2015
Population	('1,000)	7,383	8,012	8,221	8,431	9,713	10,994	12,665	14,336
	Ratio	100	109	111	114	132	149	172	194
GVA Imposed to Agriculture									
Imposed GVA Growth Rate (%)			52.1	3.0	3.0	3.0	3.0	3.0	3.0
GVA Growth Ratio to 1993			100.0	103.0	106.0	122.6	141.9	164.2	189.9
Agricultural GVA Plan (Gross Margin)									
Crops	(K million)		177,607	183,813	190,018	221,045	252,072	301,098	350,124
Livestock	(K million)		45,614	48,486	51,359	65,724	80,088	98,810	117,532
Wildlife	(K million)		13,000	13,000	13,000	13,000	13,000	13,000	13,000
Forestry	(K million)		48,979	50,449	51,918	60,049	69,502	80,424	93,012
Fishery	(K million)		14,082	15,410	15,168	19,810	24,926	33,321	42,715
Total GVA	(K million)		299,281	311,158	321,463	379,627	439,587	526,653	616,382
Growth Rate of GVA				4.0%	3.3%	3.4%	3.0%	3.7%	3.2%
Ratio to 1993			100.0	104.0	107.4	126.8	146.9	176.0	206.0
Increase of Irrigated Area (ha)							28,589.0		54,139.0
Conservative Scenario									
	Year	1990	1993	1994	1995	2000	2005	2010	2015
Population	('1,000)	7,383	7,928	8,109	8,291	9,158	10,025	10,807	11,589
	Rate	100	107	110	112	124	136	146	157
Imposed GDP Growth to Agriculture									
Growth Rate (%)			52.1	2.6	2.6	2.3	2.0	1.7	1.5
Growth Ratio to 1993			100.0	102.6	105.2	117.6	129.7	141.3	152.1
Agricultural GVA Plan (Gross Margin)									
Crops	(K million)		177,607	180,922	184,237	200,810	217,384	253,332	289,279
Livestock	(K million)		45,614	47,377	49,140	57,956	66,771	74,233	81,695
Wildlife	(K million)		13,000	13,000	13,000	13,000	13,000	13,000	13,000
Forestry	(K million)		48,979	50,253	51,526	57,600	63,526	69,159	74,497
Fishery	(K million)		14,082	15,410	14,956	18,357	22,021	27,147	32,758
Total GVA	(K million)		299,281	306,961	312,859	347,723	382,702	436,870	491,219
Growth Rate of GVA				2.6%	1.9%	2.1%	1.9%	2.7%	2.4%
Ratio to 1993			100.0	102.6	104.5	116.2	127.9	146.0	164.1
Increase of Irrigated Area (ha)							16,889.0		37,789.0

(Note)

1) GVA of wildlife is estimated at 3.5% of Agricultural GVA K394 billion of 1993 (CSO), referring to Report No. 11570-ZA, World Bank.
2) Wildlife is assumed to increase at an half rate of Agricultural GVA.

(b) Scale of Farm Land to be planted

According to the Gross Domestic Product Plan set up for each scenario, farm land to be planted and proposed crops are estimated as following Table 3-50.

Table 3-50 Required Planted Area by Three Scenarios (Unit:ha)

Crops		Actual	Base Scenario - Agricultural Expansion		Base Scenario - Industrialisation		Conservative Scenario	
			2005	2015	2005	2015	2005	2015
Maize		820,396	1,138,000	1,332,000	1,024,200	1,218,600	944,500	984,800
Sorghum		47,792	79,000	96,800	71,100	88,600	65,600	71,600
Millet		54,808	120,000	157,000	108,000	143,600	99,600	116,100
Rice (Ext.)	(*)	13,711	17,500	22,100	19,600	24,800	15,900	20,100
Rice (Int.W.S.)	*	0	1,800	2,800	2,100	3,000	1,700	2,500
Rice (Int.D.S.)	(*)	0	900	1,400	1,050	1,500	850	1,250
R. Wheat		3,686	0	0	0	0	0	0
I. Wheat	*	13,656	24,000	33,200	26,900	37,200	21,800	30,200
Cereals		954,049	1,381,200	1,645,300	1,252,950	1,517,300	1,149,950	1,226,550
Cassava		107,812	135,400	171,600	152,500	193,200	123,000	155,900
Potatoes		1,670	2,500	3,400	2,800	3,900	2,300	3,100
Starchy		109,482	137,900	175,000	155,300	197,100	125,300	159,000
Sugarcane	*	13,000	21,000	21,000	21,000	21,000	21,000	21,000
Sugar crop		13,000	21,000	21,000	21,000	21,000	21,000	21,000
M. Beans		38,489	53,800	73,200	60,600	82,400	48,900	66,500
Pulse Crops		38,489	53,800	73,200	60,600	82,400	48,900	66,500
Soybean		19,864	68,900	94,900	26,500	29,200	21,200	29,200
Groundnuts (R)		68,808	299,000	517,400	115,000	123,200	97,400	130,400
Groundnuts (I)	(*)	13,656	24,000	33,200	26,900	37,200	21,800	30,200
Sunflower		35,899	0	0	0	0	0	0
Seed Cotton		76,492	68,000	0	68,000	90,000	54,400	72,000
Oilseed Crops		214,719	459,900	645,500	236,400	279,600	194,800	261,800
Tobacco(V)		3,558	5,000	6,200	4,000	5,000	3,200	4,000
Tobacco(B)		3,388	6,900	10,000	5,600	8,100	4,500	6,500
Tobacco		6,946	11,900	16,200	9,600	13,100	7,700	10,500
Tomatoes	*	6,000	6,900	9,800	7,700	11,000	6,300	8,900
Onion	*	1,000	1,100	1,700	1,300	1,900	1,000	1,500
Cabbage	*	3,000	3,400	4,900	3,900	5,500	3,100	4,500
Lettuce	*	663	800	1,100	900	1,200	700	1,000
Carrots	*	1,000	1,100	1,700	1,300	1,900	1,000	1,500
Vegetables		11,663	13,300	19,200	15,100	21,500	12,100	17,400
Coffee	*	6,184	12,000	18,000	7,900	11,800	6,300	9,500
Tea	*	140	190	240	130	160	100	130
Stimulant Crops		6,324	12,190	18,240	8,030	11,960	6,400	9,630
Orange	*	7,154	9,700	14,600	7,000	10,500	5,700	8,500
Banana	*	974	1,500	2,100	1,100	1,500	900	1,200
Fruits		8,128	11,200	16,700	8,100	12,000	6,600	9,700
Flower	*	250	1,250	2,500	380	500	310	380
New Crops		250	1,250	2,500	380	500	310	380
Total Planted Area		1,363,050	2,103,640	2,632,840	1,767,460	2,156,460	1,573,060	1,782,460
Irrigated Area (ha)		53,021	84,740	113,640	81,610	107,160	69,910	90,810
Incremental from 1993			31,719	60,619	28,589	54,139	16,889	37,789

1) *: Irrigated Crops 2) (*) : Irrigated but not counted in irrigated area. 3) Groundnuts(I): considered as supplemental irrigation crop before wheat. 4) Sunflower is considered to decrease its planting area due to decrease of price. 5) Seed cotton is also considered to decrease in ADP-1 due to lower income for farmers.

(c) Allocation of Irrigation Area by Provinces

As resulting in Table 3-50, irrigated lands are to be developed at about 61,000ha for Base Scenario-Agricultural Expansion, and 54,000ha for Base Scenario-Industrialisation and 38,000ha for Conservative Scenario respectively. On the other hand, potential irrigation areas are estimated at about 132,000ha in the country as shown in Table 3- 51. The locations of potential areas are shown in Figure 3-11. For appropriate allocation of said irrigated areas, following priorities have been considered:

< Priorities >

- Lower income regions. (Luapula, Western, North-Western, Northern)
- Lower yield region. (Western, Eastern, Lusaka, North-Western)
- Food unbalanced regions among Agriculture dominant provinces. (Western)
- High potential region on water resources. (Luapula, Southern, Central, N/Western, Northern, Western)

Based on above priorities, basic allocation ratio has been tabulated as shown in the Table 3-51.

Table 3-51 Potential Irrigation Area and Allocated Irrigation Projects

Province	Lusaka	Copperbelt	Central	N/Western	Western	Southern	Luapula	Northern	Eastern
Potential Irrigable Area (ha)									
132,461	3,010	10,260	15,570	15,260	13,410	23,148	33,555	13,829	4,419
Basic Allocation Ratio									
	2%	9%	4%	13%	23%	9%	30%	6%	4%
Allocation for 61,000ha based on Basic Allocation Ratio									
61,000	1,100	5,000	3,000	8,000	14,000	6,000	18,000	4,000	3,000
Existing Irrigation Projects									
ASIP Rehabilitation Project									
267	10	140	0	0	0	89	0	0	28
Existing Expansion Project									
16,484	1,900	4,200	0	290	10	8,450	1,144	490	0
New Irrigation Projects (in case Base Scenario - Agricultural expansion)									
Multipurpose Dam Project									
6,590	810	5,780	0	0	0	0	0	0	0
Irrigation Dam Project									
8,480	0	0	0	0	0	0	7,000	0	1,480
Run-of-river Project									
29,000	0	0	5,000	6,300	7,000	0	4,000	6,700	0
Total (ha) 60,821	2,720	10,120	5,000	6,590	7,010	8,539	12,144	7,190	1,508

In selection of irrigation project, first priority has been set on the ASIP Rehabilitation Project and the Existing Expansion Project. On the other hand, three multipurpose dams, namely Chongwe, Kafubu and Mutundu dams are selected as peri-urban irrigation projects which are able to produce valuable crops like vegetables. And, among remaining proposed dams, two dams namely Lufubu and Lundazi dams are selected from aspect of less cost and gravity conveyance system. Remaining projects are selected from run-of-river potential areas, to meet the basic allocation areas of provincial basis.

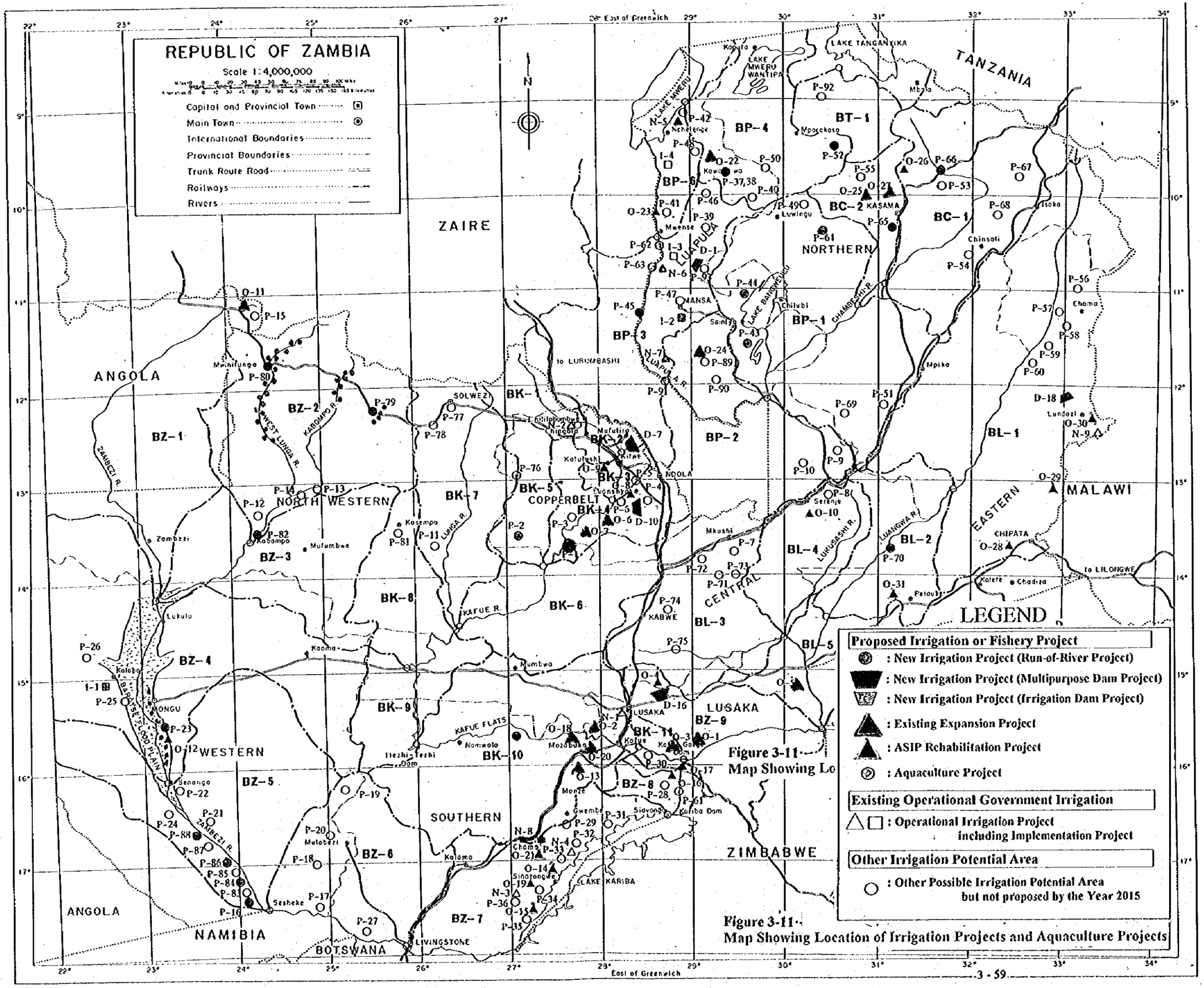


Figure 3-11 Map Showing Lo

Figure 3-11 Map Showing Location of Irrigation Projects and Aquaculture Projects

3.4.5 Livestock Development Plan

(1) Direction of Livestock Development

The cattle population increased from 1,730,000 in 1980 to 2,680,000 in 1989 at the high growth rate of 4.5%, but decreased to 2,540,000 in 1991. Traditional farmers owned about 2,178,000 head (82%) of cattle, and commercial farmers shared 491,000 head of cattle (18%) in 1990. Annual meat consumption per capita is 14.20kg (average for 1980-90 for urban population (figures for rural slaughtering are not known), of which poultry meat is 5.57kg. This consumption rate is the same as that of Japan in 1970, so that it is proposed to be maintained to the year 2015 at the same rate as national population growth.

Cattle number rapidly increased with a high growth rate from 1980 to 1989. However, cattle number decreased sharply after 1989, especially in Southern Province. The reason for the decrease is considered to be over-grazing in the Kafue Floodplain. Therefore, growth of cattle number should be much less than 4.5% per annum in the future.

Present per capita meat consumption level is considered to be a good rate, and this rate should be maintained in the future. To realise this per capita meat consumption rate (14.20 kg/year), it is necessary to increase the number of livestock at the same rate as the national population.

(2) Projection of Livestock Population

Livestock numbers are projected to grow at the same rate as national population growth, and will increase to 1.73 times the 1990 number for Base Scenario-Agricultural Expansion, 1.94 times for Base Scenario-Industrialisation, and 1.57 times for Conservative Scenario respectively. Table 3-52 shows the projected livestock numbers in 2005 and 2015 for each scenario.

Table 3-52 Projected Number of Livestock by Three Scenarios

		Base Scenario-Agricultural Expansion		Base Scenario-Industrialisation		Conservative Scenario	
	1990	2005	2015	2005	2015	2005	2015
Ratio of Growth	1.000	1.417	1.725	1.489	1.942	1.358	1.570
Livestock Number (1,000 head)							
Cattle	2,669	3,780	4,603	3,974	5,182	3,625	4,190
Sheep/Goats	592	839	1,021	881	1,150	804	929
Poultry	7,921	11,224	13,664	11,794	15,383	10,757	12,436

(Note) Ratio of Growth: following the projected growth ratio of the national population.

However, as shown in Table 3-36, in Southern province, the cattle number already exceeded the natural breeding capacity at 1990 year level. Therefore, it is necessary to solve the over-grazing in the Kafue floodplain to increase the livestock numbers.

(3) Livestock Development Plan

There are several alternatives to increase livestock numbers, particularly cattle numbers, by the year 2015.

Two alternative are considered to solve over-grazing in Southern Province, namely:

- to prepare irrigated meadow grass at about 116,000 ha for excess number of cattle of about1,060,000 head using Kafue water in the floodplain.
- to expand cattle in the northern region to mitigate over grazing in Southern Province.

However, necessary water of about 116 m^3/s for irrigation of the former plan is too heavy burden for the Kafue river. Consequently, northern expansion plan is selected for livestock development.
This direction is supported from a viewpoint of effective utilisation of resources of the country. Table 3-53 shows the expansion plan for the Base Scenario-Agricultural Expansion.

Table 3-53 Livestock Allocation Plan by Northern Expansion (Base Scenario-Agricultural Expansion)

			Lusaka	Copper-belt	Central	N/ Western	Western	Southern	Luapula	Northern	Eastern	Total
Breeding Capacity by Available Roughage												
Available Feeding by Agricultural Land except Shifting Cultivation Area												
Agricultural Land (ha)			339,666	225,602	1,142,704	503,494	1,457,169	1,963,977	687,620	542,097	1,681,121	8,543,450
Capability of breed	*1		34,000	23,000	114,000	50,000	146,000	196,000	69,000	54,000	168,000	854,000
Available Feeding by Staple Crops Field												
Staple Crop Land (ha)			53,639	68,850	197,376	74,740	107,025	270,700	112,150	240,210	486,210	1,610,900
Maize, Sorghum, Millet			53,600	68,800	197,300	73,500	92,400	270,700	111,500	234,200	483,800	1,585,800
Rice Extensive			39	50	76	1,240	11,625	0	650	6,010	2,410	22,100
Rice Intensive Wet S.			0	0	0	0	3,000	0	0	0	0	3,000
Capability to breed	*2		52,000	67,000	193,000	73,000	104,000	264,000	109,000	234,000	474,000	1,570,000
Available Feeding by Natural Vegetation												
Floodplain Area (ha)			254,814	273,381	970,164	1,066,878	2,392,184	1,179,752	165,047	1,648,743	39,600	7,989,863
Capability to breed	*3		102,000	109,000	388,000	427,000	957,000	472,000	66,000	659,000	16,000	3,196,000
Capability to breed (heads)			188,000	199,000	695,000	550,000	1,207,000	932,000	244,000	947,000	658,000	5,620,000
Projected Cattle Number												
Year 1990	1.000		87,647	74,374	503,512	59,340	546,957	1,052,795	12,186	107,821	223,880	2,668,512
Year 1995	1.132		99,000	84,000	570,000	67,000	619,000	1,192,000	14,000	122,000	253,000	3,020,000
Year 2000	1.275		112,000	95,000	642,000	76,000	697,000	1,347,000	16,000	137,000	285,000	3,402,000
Year 2005	1.417		124,000	105,000	713,000	84,000	775,000	1,492,000	17,000	153,000	317,000	3,780,000
Year 2010	1.571		138,000	117,000	791,000	93,000	859,000	1,654,000	19,000	169,000	352,000	4,192,000
Year 2015	1.725		151,000	128,000	869,000	102,000	944,000	1,816,000	21,000	186,000	386,000	4,603,000
Excess Number												
Year 1990 (Actual)			0	0	0	0	0	120,795	0	0	0	120,795
Year 1995			0	0	0	0	0	260,000	0	0	0	260,000
Year 2000			0	0	0	0	0	410,000	0	0	0	410,000
Year 2005			0	0	18,000	0	0	560,000	0	0	0	578,000
Year 2010			0	0	96,000	0	0	722,000	0	0	0	818,000
Year 2015			0	0	174,000	0	0	884,000	0	0	0	1,058,000
Allocation Plan by 2005												
Room for Allocation			64,000	94,000	0	466,000	432,000	0	227,000	794,000	341,000	2,418,000
Ratio of Room for Allocation			0.0265	0.0389	0.0000	0.1927	0.1787	0.0000	0.0939	0.3284	0.1410	1.0001
Allocation Number			15,000	22,000	0	111,000	103,000	0	54,000	190,000	81,000	576,000
Number in 2005			139,000	127,000	695,000	195,000	878,000	932,000	71,000	343,000	398,000	3,778,000
Allocation Plan by 2015												
Room for Allocation			37,000	71,000	0	448,000	263,000	0	223,000	761,000	272,000	2,075,000
Ratio of Room for Allocation			0.0178	0.0342	0.0000	0.2159	0.1267	0.0000	0.1075	0.3667	0.1311	1.0000
Allocation Number			19,000	36,000	0	228,000	134,000	0	114,000	388,000	139,000	1,058,000
Number in 2015			170,000	164,000	695,000	330,000	1,078,000	932,000	135,000	574,000	525,000	4,603,000
Planned Cattle Allocation												
Year 1990 (Actual)			87,647	74,374	503,512	59,340	546,957	1,052,795	12,186	107,821	223,880	2,668,512
Year 1995			105,000	92,000	567,000	105,000	657,000	1,013,000	32,000	186,000	282,000	3,039,000
Year 2000			122,000	109,000	631,000	150,000	768,000	972,000	51,000	265,000	340,000	3,408,000
Year 2005			139,000	127,000	695,000	195,000	878,000	932,000	71,000	343,000	398,000	3,778,000
Year 2010			155,000	146,000	695,000	263,000	978,000	932,000	103,000	459,000	462,000	4,193,000
Year 2015			170,000	164,000	695,000	330,000	1,078,000	932,000	135,000	574,000	525,000	4,603,000
Increase Rate from 1990												
Year 1990 (Actual)			1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Year 1995			1.20	1.24	1.13	1.77	1.20	0.96	2.63	1.73	1.26	1.14
Year 2000			1.39	1.47	1.25	2.53	1.40	0.92	4.19	2.46	1.52	1.28
Year 2005			1.59	1.71	1.38	3.29	1.61	0.89	5.83	3.18	1.78	1.42
Year 2010			1.77	1.96	1.38	4.43	1.79	0.89	8.45	4.26	2.06	1.57
Year 2015			1.94	2.21	1.38	5.56	1.97	0.89	11.08	5.32	2.35	1.72
Increase Number from 1990												
Year 2015			82,353	89,626	191,488	270,660	531,043	-120,795	122,814	466,179	301,120	1,934,488

(Note)
*1: Utilisation (50%), 5 ha/head
*2: Utilisation (80%), 0.82 ha/head
*3: Utilisation (80%), 2 ha/head

(4) Projected Number of Livestock and Provincial Allocation

In the same manner as Table 3-53, cattle has been allocated for other two scenarios. Table 3-54 shows the projected number of livestock that are allocated based on the potential of breeding capacity of each province.

Table 3-54(1) Number of Livestock projected for 2005

Number of heads in 1990

Province	Cattle		Sheep/ Goats		Pigs		Poultry	
Lusaka	87,647	3.3%	13,407	2.3%	10,321	3.4%	1,582,000	20.0%
Copperbelt	74,374	2.8%	16,504	2.8%	21,186	7.0%	1,219,000	15.4%
Central	503,512	18.9%	47,597	8.0%	19,842	6.5%	987,000	12.5%
N/Western	59,340	2.2%	9,918	1.7%	4,732	1.6%	219,000	2.8%
Western	546,957	20.5%	8,368	1.4%	4,667	1.5%	388,000	4.9%
Southern	1,052,795	39.5%	274,228	46.3%	73,473	24.2%	1,337,000	16.9%
Luapula	12,186	0.5%	29,900	5.0%	3,019	1.0%	326,000	4.1%
Northern	107,821	4.0%	31,875	5.4%	8,318	2.7%	855,000	10.8%
Eastern	223,880	8.4%	160,359	27.1%	157,855	52.0%	1,008,000	12.7%
Zambia	2,668,512	100.0%	592,156	100.0%	303,413	100.0%	7,921,000	100.0%

Base Scenario-Agricultural Expansion : 1.417 times of 1990

Province	Cattle		Sheep/ Goats		Pigs		Poultry	
Lusaka	139,000	3.7%	19,000	2.3%	15,000	3.5%	2,242,000	20.0%
Copperbelt	128,000	3.4%	23,000	2.7%	30,000	7.0%	1,727,000	15.4%
Central	683,000	18.1%	67,000	8.0%	28,000	6.5%	1,399,000	12.5%
N/Western	210,000	5.6%	14,000	1.7%	7,000	1.6%	310,000	2.8%
Western	890,000	23.6%	12,000	1.4%	7,000	1.6%	550,000	4.9%
Southern	916,000	24.2%	389,000	46.4%	104,000	24.1%	1,895,000	16.9%
Luapula	71,000	1.9%	42,000	5.0%	4,000	0.9%	462,000	4.1%
Northern	353,000	9.3%	45,000	5.4%	12,000	2.8%	1,212,000	10.8%
Eastern	389,000	10.3%	227,000	27.1%	224,000	52.0%	1,428,000	12.7%
Zambia	3,779,000	100.0%	838,000	100.0%	431,000	100.0%	11,225,000	100.0%

Base Scenario-Industrialisation : 1.489 times of 1990

Province	Cattle		Sheep/ Goats		Pigs		Poultry	
Lusaka	148,000	3.7%	20,000	2.3%	15,000	3.3%	2,356,000	20.0%
Copperbelt	137,000	3.4%	25,000	2.8%	32,000	7.1%	1,815,000	15.4%
Central	683,000	17.2%	71,000	8.0%	30,000	6.7%	1,470,000	12.5%
N/Western	242,000	6.1%	15,000	1.7%	7,000	1.6%	326,000	2.8%
Western	943,000	23.7%	12,000	1.4%	7,000	1.6%	578,000	4.9%
Southern	916,000	23.0%	408,000	46.3%	109,000	24.2%	1,991,000	16.9%
Luapula	84,000	2.1%	45,000	5.1%	4,000	0.9%	485,000	4.1%
Northern	405,000	10.2%	47,000	5.3%	12,000	2.7%	1,273,000	10.8%
Eastern	416,000	10.5%	239,000	27.1%	235,000	52.1%	1,501,000	12.7%
Zambia	3,974,000	100.0%	882,000	100.0%	451,000	100.0%	11,795,000	100.0%

Conservative Scenario : 1.358 times of 1990

Province	Cattle		Sheep/ Goats		Pigs		Poultry	
Lusaka	133,000	3.7%	18,000	2.2%	14,000	3.4%	2,148,000	20.0%
Copperbelt	121,000	3.3%	22,000	2.7%	29,000	7.1%	1,655,000	15.4%
Central	683,000	18.8%	65,000	8.1%	27,000	6.6%	1,340,000	12.5%
N/Western	186,000	5.1%	13,000	1.6%	6,000	1.5%	297,000	2.8%
Western	845,000	23.3%	11,000	1.4%	6,000	1.5%	527,000	4.9%
Southern	916,000	25.3%	372,000	46.3%	100,000	24.3%	1,816,000	16.9%
Luapula	62,000	1.7%	41,000	5.1%	4,000	1.0%	443,000	4.1%
Northern	313,000	8.6%	43,000	5.4%	11,000	2.7%	1,161,000	10.8%
Eastern	366,000	10.1%	218,000	27.1%	214,000	52.1%	1,369,000	12.7%
Zambia	3,625,000	100.0%	803,000	100.0%	411,000	100.0%	10,756,000	100.0%

(Note) Cattle number of Southern and Central Provinces is allocated to other provinces.

Table 3-54(2) Number of Livestock projected for 2015

Base Scenario-Agricultural Expansion : 1.725 times of 1990

Province	Cattle		Sheep/ Goats		Pigs		Poultry	
Lusaka	168,000	3.6%	23,000	2.3%	18,000	3.4%	2,729,000	20.0%
Copperbelt	163,000	3.5%	28,000	2.7%	37,000	7.1%	2,103,000	15.4%
Central	683,000	14.8%	82,000	8.0%	34,000	6.5%	1,703,000	12.5%
N/Western	359,000	7.8%	17,000	1.7%	8,000	1.5%	378,000	2.8%
Western	1,090,000	23.7%	14,000	1.4%	8,000	1.5%	669,000	4.9%
Southern	916,000	19.9%	473,000	46.3%	127,000	24.3%	2,306,000	16.9%
Luapula	133,000	2.9%	52,000	5.1%	5,000	1.0%	562,000	4.1%
Northern	592,000	12.9%	55,000	5.4%	14,000	2.7%	1,475,000	10.8%
Eastern	499,000	10.8%	277,000	27.1%	272,000	52.0%	1,739,000	12.7%
Zambia	4,603,000	100.0%	1,021,000	100.0%	523,000	100.0%	13,664,000	100.0%

Base Scenario-Industrialisation : 1.942 times of 1990

Province	Cattle		Sheep/ Goats		Pigs		Poultry	
Lusaka	179,000	3.5%	26,000	2.3%	20,000	3.4%	3,072,000	20.0%
Copperbelt	182,000	3.5%	32,000	2.8%	41,000	6.9%	2,367,000	15.4%
Central	683,000	13.2%	92,000	8.0%	39,000	6.6%	1,917,000	12.5%
N/Western	491,000	9.5%	19,000	1.7%	9,000	1.5%	425,000	2.8%
Western	1,179,000	22.8%	16,000	1.4%	9,000	1.5%	753,000	4.9%
Southern	916,000	17.7%	533,000	46.4%	143,000	24.2%	2,596,000	16.9%
Luapula	190,000	3.7%	58,000	5.0%	6,000	1.0%	633,000	4.1%
Northern	800,000	15.4%	62,000	5.4%	16,000	2.7%	1,660,000	10.8%
Eastern	562,000	10.8%	311,000	27.1%	307,000	52.0%	1,958,000	12.7%
Zambia	5,182,000	100.0%	1,149,000	100.0%	590,000	100.0%	15,381,000	100.0%

Conservative Scenario : 1.570 times of 1990

Province	Cattle		Sheep/ Goats		Pigs		Poultry	
Lusaka	155,000	3.7%	21,000	2.3%	16,000	3.4%	2,484,000	20.0%
Copperbelt	146,000	3.5%	26,000	2.8%	33,000	6.9%	1,914,000	15.4%
Central	683,000	16.3%	75,000	8.1%	31,000	6.5%	1,550,000	12.5%
N/Western	280,000	6.7%	16,000	1.7%	7,000	1.5%	344,000	2.8%
Western	998,000	23.8%	13,000	1.4%	7,000	1.5%	609,000	4.9%
Southern	916,000	21.9%	431,000	46.3%	115,000	24.2%	2,099,000	16.9%
Luapula	100,000	2.4%	47,000	5.0%	5,000	1.1%	512,000	4.1%
Northern	465,000	11.1%	50,000	5.4%	13,000	2.7%	1,342,000	10.8%
Eastern	446,000	10.6%	252,000	27.1%	248,000	52.2%	1,583,000	12.7%
Zambia	4,189,000	100.0%	931,000	100.0%	475,000	100.0%	12,437,000	100.0%

(Note) Cattle number of Southern and Central Provinces is allocated to other provinces.

(5) Water Consumption of Livestock

Depending on the number of livestock in each province (Table 3-54) and the unit water requirement (Table 3-39), total livestock water demand is estimated as shown in Table 3-55. The maximum water requirement reaches 250,000 m3/day for Base Scenario-Industrialisation, and minimum will be 202,000 m3/day for Conservative Scenario.

Table 3-55 Water Requirement of Livestock by Three Scenarios

Scenarios	Actual	Base Scenario-Agriculture Expansion		Base Scenario-Industrialisation		Conservative Scenario	
Province	1993 (m3/day)	2005 (m3/day)	2015 (m3/day)	2005 (m3/day)	2015 (m3/day)	2005 (m3/day)	2015 (m3/day)
Lusaka	4,451	6,921	8,367	7,332	9,000	6,610	7,691
Copperbelt	4,300	7,002	8,830	7,494	9,872	6,648	7,935
Central	22,331	30,391	30,962	30,552	31,373	30,305	30,687
N/Western	2,752	9,029	15,187	10,354	20,629	8,009	11,925
Western	22,599	36,713	44,937	38,876	48,636	34,837	41,141
Southern	50,224	47,738	50,007	48,247	51,619	47,293	48,862
Luapula	1,220	3,903	6,666	4,497	9,141	3,513	5,213
Northern	5,382	15,777	25,802	17,948	34,490	14,077	20,484
Eastern	15,678	25,138	31,637	26,711	35,625	23,810	28,469
Zambia	128,937	182,612	222,395	192,011	250,385	175,102	202,407

(6) Feed Projection of Livestock

Supply of roughage feed is met by the grazing system allocated as shown in Table 3-54 (1) and 3-54 (2). Regarding the concentrated feed, a requirement of about 700,000 tons/year of maize grain is estimated for Base Scenario - Agricultural Expansion by 2015.

Table 3-56 Required Concentrated Feed for Livestock

		Cattle	Pigs	Sheep/ Goats	Poultry
Number in 1990 *1		491,032	32,760	40,213	2,831,000
Projected Number of Livestock					
Base Scenario-Agricultural Expansion					
2005	1.529	751,000	50,000	61,000	4,329,000
2015	1.964	964,000	64,000	79,000	5,560,000
Base Scenario-Industrialisation					
2005	1.419	697,000	46,000	57,000	4,017,000
2015	1.899	932,000	62,000	76,000	5,376,000
Conservative Scenario					
2005	1.297	637,000	42,000	52,000	3,672,000
2015	1.521	747,000	50,000	61,000	4,306,000

Required Concentrated Feed

	(Unit Feed Requirement (kg/head/day) 3.0	2.8	0.3	0.1	Total	fed by By-Product (47%)	fed by Grain (53%)
Base Scenario-Agricultural Expansion							
2005 (t/year)	822,000	51,000	7,000	158,000	1,038,000	488,000	550,000
2015 (t/yr)	1,056,000	65,000	9,000	203,000	1,333,000	627,000	706,000
Base Scenario-Industrialisation							
2005 (t/year)	763,000	47,000	6,000	147,000	963,000	453,000	510,000
2015 (t/yr)	1,021,000	63,000	8,000	196,000	1,288,000	605,000	683,000
Conservative Scenario							
2005 (t/year)	698,000	43,000	6,000	134,000	881,000	414,000	467,000
2015 (t/yr)	818,000	51,000	7,000	157,000	1,033,000	486,000	547,000

(Note) 1) Availability of by-product (47%) is discussed inSection 3.4.2 (2).
2) Concentrated feed is considered to prepare only for commercial sector.

3.5 Hydroelectric Power Generation

3.5.1 Present Situation of Electric Power Supply and Demand

(1) Power Stations

In Zambia, electric power is supplied by Zambia Electricity Supply Corporation Ltd. (ZESCO). ZESCO currently supplies power through two systems; namely the interconnected system and various isolated systems. Also Zambia Consolidated Copper Mines (ZCCM) owns private power stations. The location of the existing power stations and transmission lines are illustrated in Figure 3-12.

<ZESCO South Service Areas>
Chipata, Choma, Kabwe, Kafue, Kaoma, Livingstone, Luangwa, Lukulu, Lundazi, Lusaka, Mazabuka, Mongu, Monze

<ZESCO North Service Areas>
Chingola, Chinsali, Kasama, Kitwe, Luanshya, Luwingu, Mansa, Mbala, Mpika, Mporokoso, Mufulira, Nakonde, Ndola, Serenje, Solwezi

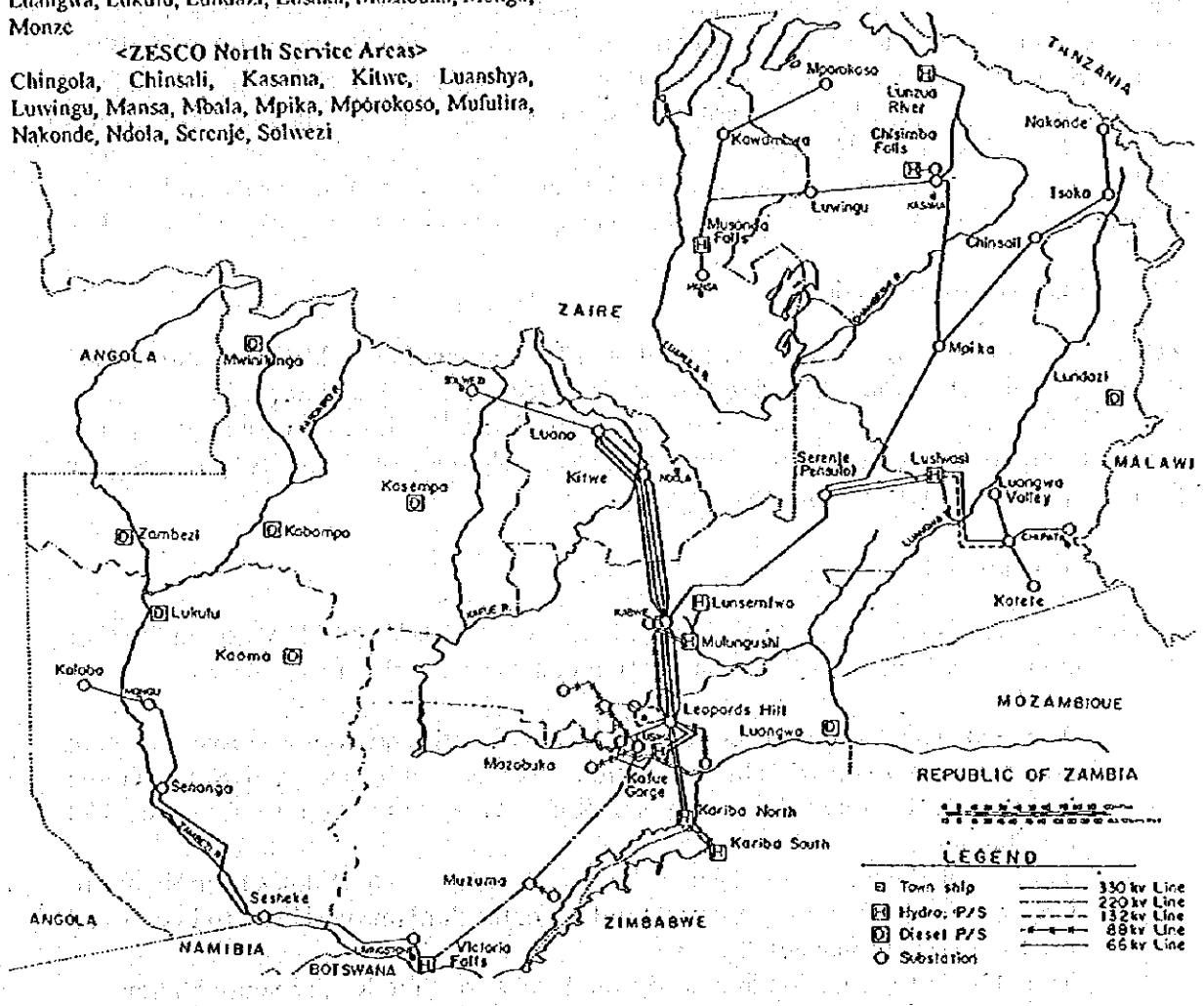


Figure 3-12 Power Stations and Transmission Lines

(a) ZESCO Interconnected System

The total installed capacity of the interconnected system is 1,623 MW but the total available capacity is 1,608 MW since Lusaka and Mongu Power Station are not used. The working power stations are the hydroelectric schemes such as Kariba North PS (600MW), Kafue Gorge PS (900MW) and Victoria Falls PS (108MW).

(b) ZESCO Isolated Systems

Isolated systems, not connected to the National Grid, cover the eastern part and the western part of Zambia. Until 1993, the eastern part was covered by two isolated systems: Lusiwasi and Northern System. In both systems all the working power stations are hydro-power schemes. Other areas are covered by isolated diesel stations. The Lusiwasi System has been supplied only by Lusiwasi Hydro-power Station with available capacity 12 MW. The Northern System has been supplied by three hydro power stations: Chishimba Falls, Lunzua River and Musonda Falls Stations, with total available capacity 11.75 MW. These stations were sometimes unable to meet the winter demand of the areas due to low river flow. In 1994, Serenje Substation Project (330/66 kV, 60 MVA) was completed to increase the capacity and to improve the reliability of power supply in Eastern, Northern and Luapula Provinces. By this project, the Lusiwasi and Northern Systems were connected to the interconnected system. Eight isolated diesel power stations with total available capacity of 4.21 MW still exist in Zambia. These diesel power stations are of small capacity and mostly very old and unreliable.

(c) ZCCM Power Stations

ZCCM own seven power stations. The total installed capacity is 138 MW. Gas turbine and thermal power stations in the Copperbelt are installed for emergency operation in case of electricity failure from the interconnected system. Two hydroelectric power stations in Kabwe are used only to supply the mines. If the mines have a shortage of electricity, power supply from the interconnected system is possible.

(2) Transmission

Seven voltage levels (330kV, 220kV, 132kV, 88kV, 66kV, 33kV and 11kV) are utilised for the existing transmission lines. The main transmission line networks are as follows:

- The two major hydropower stations, Kariba North and Kafue Gorge, are both connected to Leopards Hill Substation by two 330kV lines and Kafue Gorge additionally by one 330kV line via Kafue West Substation to Leopards Hill Substation.
- Three 330kV lines from Leopards Hill to Kabwe. Four 330kV lines from Kabwe to Copperbelt, two of these go straight to Luano, the third one via Kitwe to Luano, and the fourth one terminates at Kitwe.
- Two 330kV transmission lines lead from Kariba North to Kariba South Station.
- One 330kV line from Kabwe Substation to Serenje Substation. Since completion of Serenje 330/66kV Substation in 1994, Lusiwasi and Northern System are connected to the interconnected network.

(3) Electrical Energy Generation and Consumption

(a) Peak Generation and Demand

Figure 3-13 presents the variation of the annual peak generation at the power stations connected to the Interconnected System together with the peak demand in Zambia and the exports to both Zimbabwe and Zaire. Figure 3-14 presents the variations of the annual domestic peak demand.

< Peak Generation >

The total peak generation of power stations connected to the interconnected system in Zambia in 1992/93 was 1,433 MW. The sources of generation were as follows:

= Total Interconnected System	:	1,433 MW	98.4 %
- Kariba North Hydropower Station	:	(598 MW)	(41.1 %)
- Kafue Gorge Hydropower Station	:	(730 MW)	(50.1 %)
- Victoria Falls Hydropower Station	:	(105 MW)	(7.2 %)
= Total Isolated Systems	:	23 MW	1.6 %
- Hydropower station	:	(20 MW)	(1.4 %)
- Diesel Power station	:	(3 MW)	(0.2 %)
= Total in Zambia	:	1,456 MW	100 %

< Peak Demand >

The total peak demand of Zambia's interconnected system in 1992/93 was 1,433 MW. The proportions of demand were divided as follows:

- Domestic Use in Zambia	:	993 MW	70 %
- Exports to Zimbabwe	:	440 MW	30 %
- Exports to Zaire	:	0	0
< Total >	:	1,433 MW	100 %

The peak demand on the Zambian system 993 MW was divided between the bulk consumers in the following proportions:

- ZCCM Power Division	:	562 MW	57 %
- ZESCO South	:	293 MW	29 %
- ZESCO North	:	138 MW	14 %
< Total >	:	993 MW	100 %

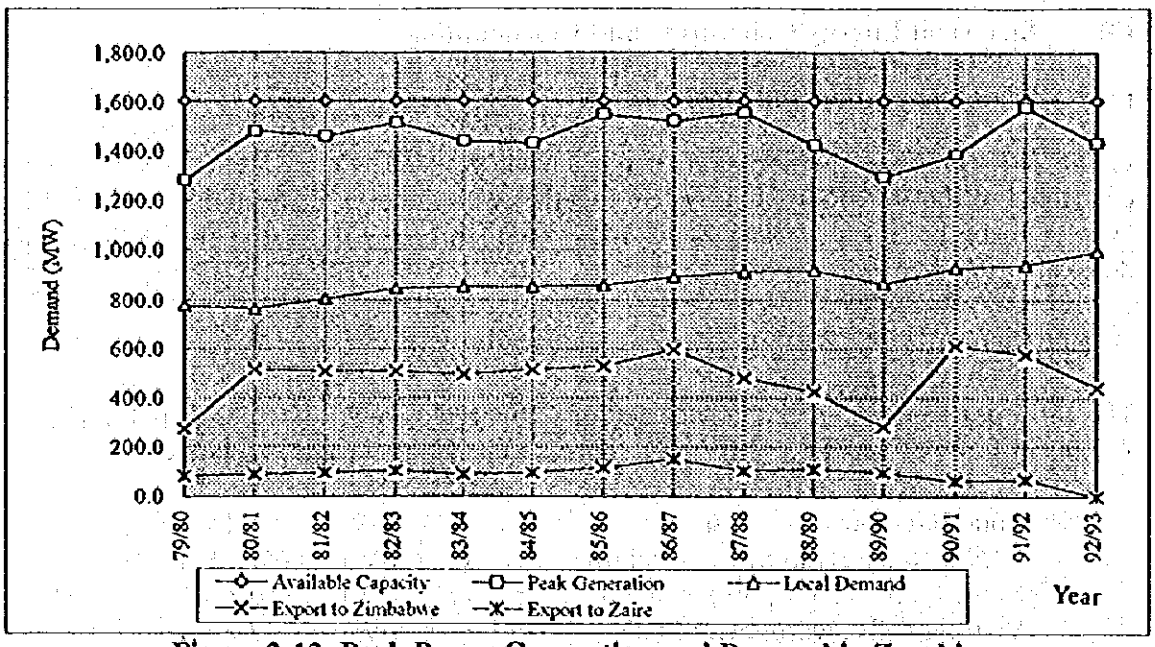


Figure 3-13 Peak Power Generation and Demand in Zambia

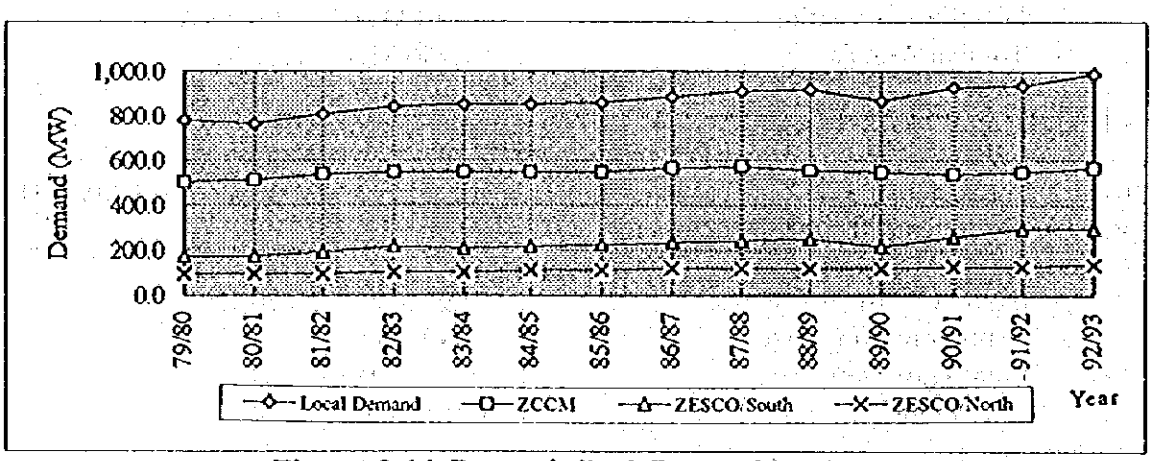


Figure 3-14 Domestic Peak Demand by User

(b) Generated Energy and Consumed Energy

< Energy Generated >

The total electrical energy generated by the Zambian power stations connected to the Interconnected System in 1992/93 was 6,850 GWh. The sources of generation were as follows.

= Total Interconnected System	:	6,400 GWh	99 %
- Kariba North Hydropower Station	:	(2,540 GWh)	(39 %)
- Kafue Gorge Hydropower Station	:	(3,211 GWh)	(50 %)
- Victoria Falls Hydropower Station	:	(649 GWh)	(10 %)
= Total Isolated System	:	63 GWh	1 %
- Hydropower Stations	:	(49 GWh)	(0.8 %)
- Diesel Power Stations	:	(14 GWh)	(0.2 %)
< Total >	:	6,463 GWh	100 %

< Energy Consumed >

The electricity consumption of the Zambian interconnected system in 1992/93 was 6,400 GWh and the proportion of consumption was divided as shown below. More than 100% of the energy generated by the interconnected power stations was needed to satisfy Zambia's own need. About 20% of total consumption was exported to Zimbabwe and the balance imported from Zaire.

- Zambia	:	6,600 GWh	103 %
- Exports to Zimbabwe	:	1,200 GWh	19 %
- Exports / Imports to Zaire	:	-1,400 GWh	-22 % (Import)
< Total >	:	6,400 GWh	100 %

The electricity consumption of the Zambian interconnected system of 6,600 GWh was divided between the bulk consumers in the following proportions. The energy consumption of ZCCM power division was 4,220 GWh corresponding to 64% of the Zambian total. The total energy consumption by ZESCO was 2,380 GWh corresponding to 36% of the total.

- ZCCM power division	:	4,220 GWh	64 %
- ZESCO South	:	1,610 GWh	24 %
- ZESCO North	:	770 GWh	12 %
< Total >	:	6,600 GWh	100 %

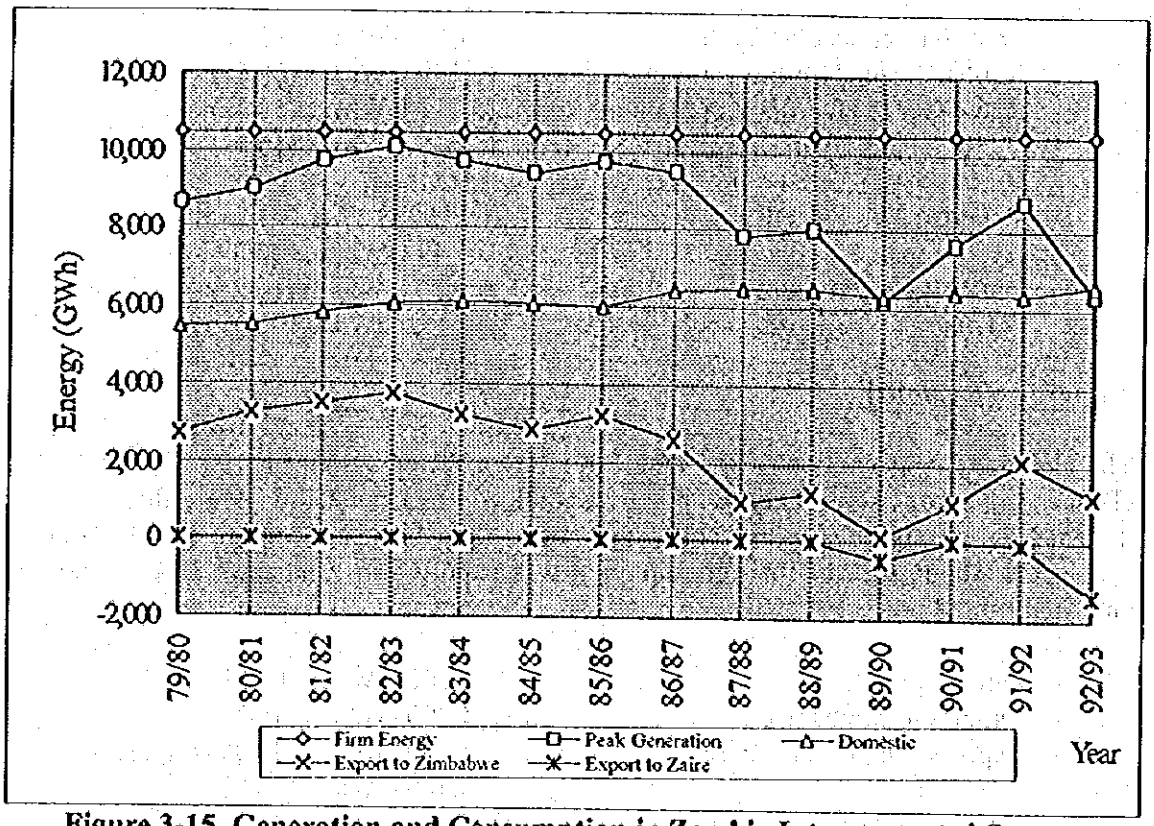


Figure 3-15 Generation and Consumption in Zambia Interconnected System

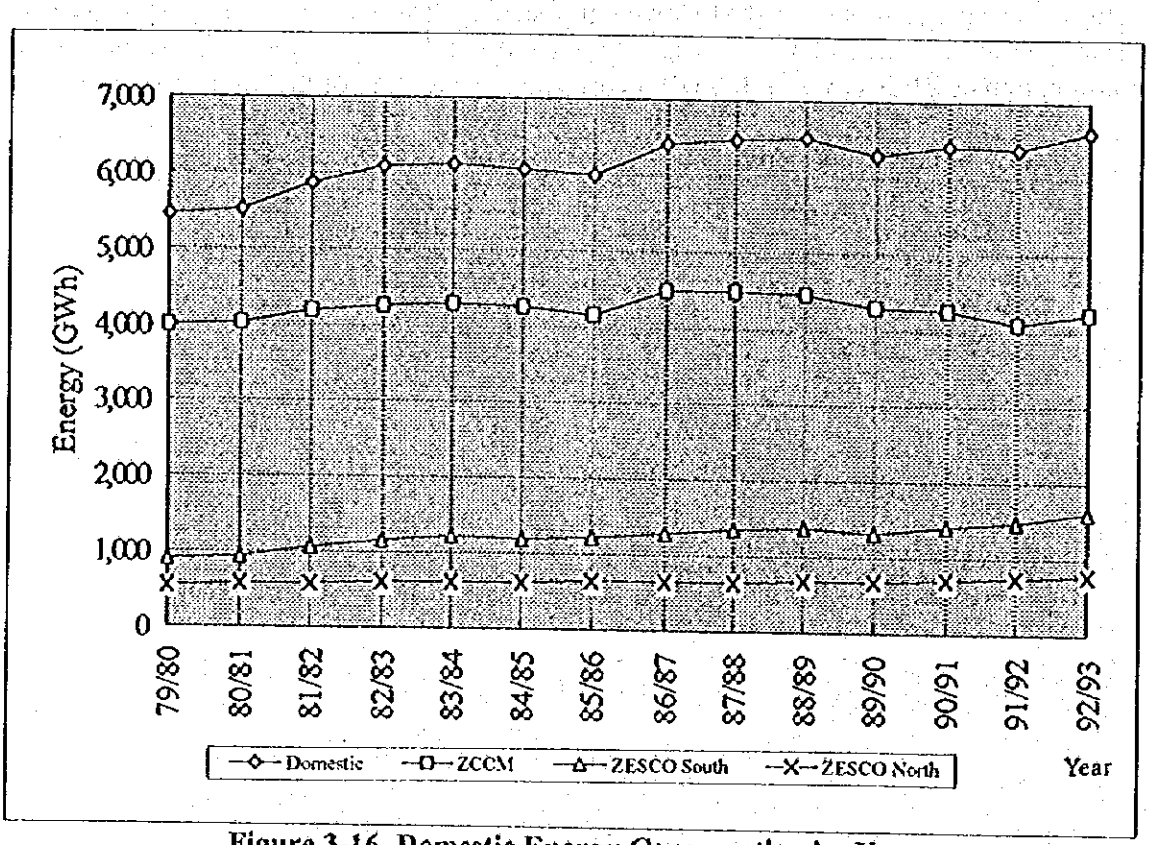


Figure 3-16 Domestic Energy Consumption by User

3.5.2 Electricity Demand Forecast

(1) Future Domestic Demand

The Zambian bulk consumers comprise ZCCM and ZESCO retail users (South and North). Generally, the electricity demand will increase at the same rate as GDP. As shown in Table 3-57 the future electricity demand for ZESCO retail users (ZESCO South and ZESCO North) is estimated according to the changes in GDP discussed in Supporting Report [A] . As far the future electric demand for ZCCM, it is projected judging from the past records and future development programmes that the current situations (Peak demand: 562 MW, Annual consumed energy: 4,220 GWh, in1992/93 level) will continue.

Table 3-57 ZESCO Retail Users Demand Forecast

Year	BaseScenario Agricultural Expansion			Base Scenario Industrialization			Conservative Scenario		
	Growth Rate (%)	Demand (MW)	Consump. (GWh)	Growth Rate (%)	Demand (MW)	Consump. (GWh)	Growth Rate (%)	Demand (MW)	Consump. (GWh)
1993 (Actual)		431	2,380		431	2,380		431	2,380
1994	3.9	448	2,473	4.7	451	2,492	2.2	440	2,432
1995	5.1	471	2,599	5.3	475	2,624	2.7	452	2,498
2000	4.9	598	3,301	5.3	615	3,397	2.4	509	2,813
2005	3.5	710	3,921	4.0	748	4,133	1.9	560	3,090
2010	3.3	835	4,612	4.0	911	5,028	1.7	609	3,362
2015	3.2	978	5,399	4.0	1108	6,118	1.5	656	3,622

(b) Future Export Demand

At present, Zambia exports electricity to Zimbabwe and Zaire. Increased electric power exports to neighbouring countries have been planned by ZESCO. ZESCO plans power exports as shown in Table 3-58. At the beginning of the 21st century, the export power demand to neighbouring countries will be 840 MW (5,040GWh). This future export demand is equivalent to 85% of 1992/93 domestic peak demand (993 MW) and 76% of 1992/93 domestic energy generated (6,600 GWh).

Table 3-58 Export Plan for Hydro-power up to 2015

Country	Year	Demand (MW)	Energy / Annum (GWh)
Zimbabwe	1993 to 2015	100	600
Botswana	1993 to 2015	30	180
South Africa	1996 to 2015	500	3,000
Namibia	1994 to 1997	2	10
	1998 to 2015	50	300
Tanzania	2000 to 2015	100	600
Malawi	2000 to 2015	60	360
Zaire	1993 to 2015	0	0
	<Total in 1995>	132	790
	<Total from 2000>	840	5,040

(Note) Energy/Ann. estimated as 8,760 hr x (MW/1000) x 0.7 (GWh)

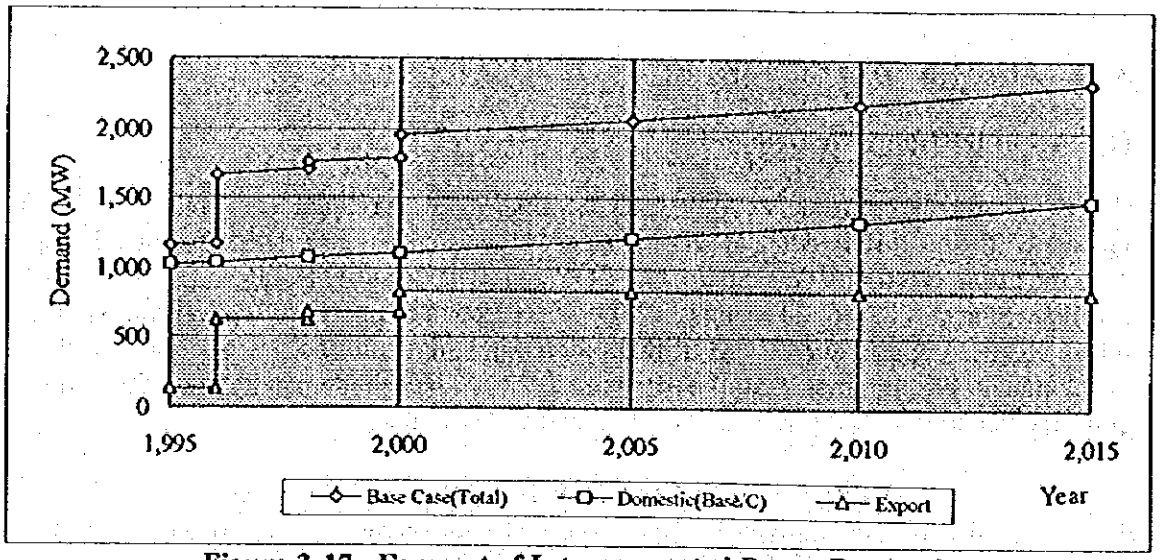


Figure 3-17 Forecast of Interconnected Power Demand

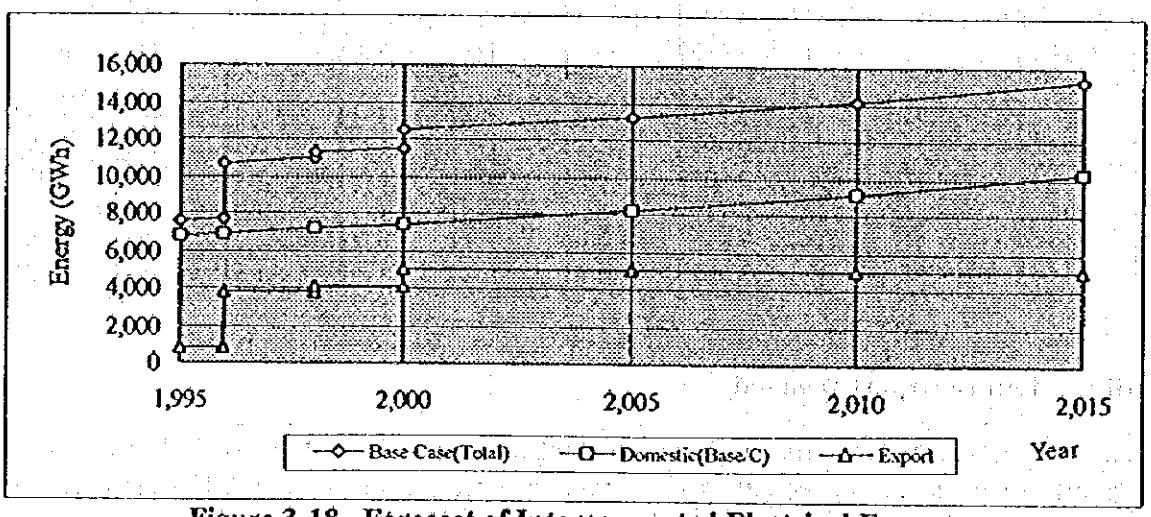


Figure 3-18 Forecast of Interconnected Electrical Energy

3.5.3 Future Programme of Hydroelectric Power Generation

(1) Promotion of Large-Scale Projects for Export of Electric Power

In 1992/93, Zambia exported 440 MW of electric power. This was equivalent to 30 % of the total demand in Zambia. According to the ZESCO programme for power export, the export power will increase to 840 MW as shown in Table 3-59. This is almost double the present demand.

Table 3-59 Export Plan for Hydro-power up to 2015

Year	Domestic Use	Export Use	Total
Demand (MW)			
- 1993 (Actual)	993 (70%)	440 (30%)	1,433 (100%)
- 2005	1,272 (60%)	840 (40%)	2,112 (100%)
- 2015	1,540 (65%)	840 (35%)	2,380 (100%)
Energy (GWh)			
- 1993 (Actual)	5,600 (104%)	-200 (-4%)	5,400 (100%)
- 2005	8,141 (62%)	5,040 (38%)	13,181 (100%)
- 2015	9,619 (66%)	5,040 (34%)	14,659 (100%)

To accomplish this programme, ZESCO proposed the construction of two projects, namely the Kafue Gorge Lower Project and Batoka Gorge Project to be completed during the coming two decades -see below. Following several studies, the feasibility of both of these projects has been confirmed. After agreement between Zambia and the countries which import power from Zambia, the final decision of project commencement will be made.

Kafue Gorge Lower P.S.
- Installed Capacity : 450 MW
- Firm Energy : 2,500 GWh
- Project Cost : 486 Million US$

Batoka Gorge P.S.
- Installed Capacity : 800 MW (No.1 & No.2, Zambia Share : 400 MW)
- Firm Energy : 4,600 GWh (No.1 & No.2, Zambia Share : 2,300 GWh)
- Project Cost : 1,648 Million US$ (Final Stage)

With regard to the promotion of large-scale projects for export of electric power, these programmes are attractive if the electric power export would be agreed between Zambia and each neighbouring country because the power export will contribute greatly to the Zambian economy.

(2) Stabilisation of Power Supply for Northern Parts of Zambia

Within the Northern Isolated System of ZESCO, the following problematic issues were highlighted in the ZESCO annual report of 1990/91.

- Chisimba Falls P.S. - due to low river flow in the dry season, it was found necessary to carry out load shedding.
- Musonda Falls P.S. - occasional load shedding was carried out during winter season due to the discharge is nil.

Serenje Substation Project was completed during 1994. This substation connected the ZESCO Interconnected System to the Northern Isolated System and Lusiwasi Isolated System. However, because of the long transmission lines to these areas, the line is frequently cut by lightning. Power supply stabilisation is therefore still required.

(3) Improvement of Rural Electrification

In several isolated townships, electric power is supplied by diesel power stations installed at each township. To meet the increasing future power demand for these towns, the diesel power stations should be reinforced. Also, small scale hydro-power station project should be considered to secure rural electrification.

3.6 Fishery

3.6.1 Present Status of Fishery

(1) General

Zambia has several large bodies of water such as lakes, rivers and swamps covering about 25,000 km^2 of the country. Capture fisheries are conducted in these water bodies. Capture fisheries are operated on a commercial basis by professional fishermen or by commercial companies. On the other hand, aquaculture has started only recently on a commercial or government initiated basis. Production of aquaculture is still limited compared to the capture fisheries.

(2) Capture Fishery

The national annual fish catch in 1994, 1990, 1985 and 1980 was 71,800 tons, 64,800 tons, 67,700 tons and 51,000 tons, respectively. Total fish catch appears to be growing steadily. However, fluctuations of fish catches are seriously large at the fishery areas, much higher than those of the total. Fish catches have been threatened not only by natural conditions but social situations such as outbreaks of cholera or wars. When cholera occurred near Lake Tanganyika in 1981, capture fishery was restricted or closed in the surrounding fishery areas. Lake Kariba was closed for almost 5 years during the Zimbabwe War of Independence.

Per capita fish consumption decreased gradually from 12 kgs/year level to 8 kgs/year since 1966. The decrease of per capita consumption is definitely caused by population growth rapidly exceeding the growth of fish catch.

(3) Aquaculture

As mentioned above, aquaculture has recently been initiated, and is expected to contribute significantly to increase fish production to meet high demand growth. In these circumstances, aquaculture is growing rapidly at present. However, the exact status of aquaculture is not known by the DOF. Following table shows the present status of aquaculture as reported to the DOF and registered in the Water Board.

Table 3-60 Current Fish Pond Acreage

Province	Acreage (ha) Reported to DOF	Acreage (ha) Registered in Water Board	Acreage Applied in the Study
Lusaka	61.3	3	61
Copperbelt	1.4	1,259	1,259
Central	6.7	4	7
N/Western	12.9	3	13
Western	3.6	0	4
Southern	1.3	100	100
Luapula	0.0	42	42
Northern	64.5	194	194
Eastern	11.8	57	57
Total	163.5	1,662	1,737

There is much difference between two sources. But, there are much lack of registration in the DOF. The fish pond area reported by DOF was only 163.5 ha in 1992. On the other hand, the acreage of fish ponds as estimated by the Water Right Survey was 1,662 ha. The acreage of fish pond was estimated at 1,737 ha, that was agreed by the DOF in principle. This figure can be applied as the acreage of fish ponds as of 1993, and annual production of aquaculture can be estimated at 3,474 tons based on productivity of 2.0 tons/ha/year which is an average productivity under livestock manure feeding.

(4) Farm Gate Price of Fish

There are two major price systems for fish, one is for sardine by capture fishery and the other is for a large fish as tilapia by aquaculture. Price of large fish is much higher than sardine. Most up-to-date farm gate prices of fish are K34.25/kg in 1991 and K56.39/kg in 1992 for sardine. Using these prices and consumer index of food in general, the fish price in 1993 has been estimated at K200/kg for sardine.

On the other hand, price of large fish is not surveyed yet, because market of large fish was expanded recently. According to the DOF, the price of large fish was about K1,200/kg in 1993.

3.6.2 Fishery Development

(1) Target of Fish Supply

The annual fish catch of capture fishery reached 71,793 tons by the year 1994. However, per capita consumption has decreased to 8 kg/year from 12 kg/year due to rapid population increase. Fish production appears to have steadily increased, but fluctuations are observed in specific rivers, reservoirs and lakes. The Fisheries Sub-Programme aims to supply 12 kg/year per capita as a long term target in Agriculture Sector Investment Programme (ASIP). The population is estimated to reach 12.738 million in 2015 for the case of the Base Scenario-Agricultural Expansion. In this scenario, fish demand will increase to about 153,000 tons per year.

Capture fishing is expected to grow, but is seems unlikely to increase markedly. From the trend of past growth, the fish catch will grow linearly with an annual increase rate of 984 tons from 66,400 tons in 1990, and is expected to reach 91,000 tons per year in 2015.

From this viewpoint, aquaculture has to expand to meet the deficit of about 62,000 tons per annum for the Base Scenario-Agricultural Expansion.

(2) Development Policy for Three Scenarios

Target fish supply is set at 12 kg/capita/year for all scenarios. It is almost impossible to increase the supply from 8.61 kg/capita/year in 1993 to 12 kg/capita/year to meet the raised target of consumption by capture fishery alone. Thus, rapid expansion of aqua-culture as well as encouragement of capture fishery, will be necessary. Because of intensive endeavour for promotion and expansion of aqua-culture by the Department of Fishery (DOF) with support of foreign donors, Zambian aqua-culture will expand, even though the industry is only in the initial stage so far. However, first 10years will be reduced in its increase rate of supply. The target of 2005 will be set at 10kg/capita/yr, and reach final target of 12kg/capita/yr in 2015.

<Fish Productivity of Aquaculture>
Aqua-culture utilising manure of poultry or pigs is recommended by the DOF for small scale farmers. Productivity in this case is 2 ton/ha/year. In the future, commercial farmers or enterprises will enter into aqua-cultural business. In that case, direct feeding will be the manner of breeding. Even in the latter case, productivity is estimated as 4 ton/ha/year because of low temperature in winter and insufficient oxygen dissolution at high altitude. It is assumed for higher productivity of aquaculture to keep mean temperature over 20°C through the year. However, mean temperature drops lower than 20 °C during winter for four months from May to August. In the present plan, productivity of aqua-culture is assumed as 2 ton/ha/year as a conservative projection.

Under the above mentioned conditions and basic development policy, fish supply and demand for respective target years can be estimated as below;

1) Domestic fish demand is supposed to be fulfilled with domestic production. Target supply is achieved with capture fishery and aqua-culture. Growth in capture fishery is projected as the current rate.
2) Fish consumption is targeted as 10 kg/capita/year in 2005 and 12 kg/capita/year in 2015.

Table 3-61 Projection of Aqua-culture

	Population (1000 persons)	Unit Consumption (kg/capita/year)	Required Production (ton/year)	Capture Fishery (ton/year)	Aqua-culture (ton/year)	Required Ponds for Aqua Culture (ha)	Water Demand (1000 m³/day)
<Actual in 1993>	7,969	8.61	68,625	65,151	3,474	1,737	117
Base Scenario-Agricultural Expansion							
- 2005	10,465	10.00	104,700	81,200	23,500	11,750	813
- 2015	12,738	12.00	152,900	91,000	61,900	30,950	2,131
Base Scenario-Industrialisation							
- 2005	10,994	10.00	109,900	81,200	28,700	14,350	996
- 2015	14,336	12.00	172,000	91,000	81,000	40,500	2,793
Conservative Scenario							
- 2005	10,025	10.00	100,300	81,200	19,100	9,550	656
- 2015	11,589	12.00	139,100	91,000	48,100	24,050	1,648

(3) Value Added (VA) of Fishery Production

Value added (VA) of fishery product has been estimated as shown in Table 3-62 in accordance with the growth of production in each scenario. Value added amounts to maximum of about M'K42,700 in Base Scenario-Industrialisation, to M'K36,900 in Base Scenario-Agricultural Expansion, and to M'K32,800 in Conservative Scenario. The acreage of fish ponds reaches 40,500 ha, 30,950 ha and 24,050 ha respectively.

Table 3-62 Fish Production and Value Added by Three Scenarios

Year			1993	1994	1995	2000	2005	2010	2015
Base Scenario- Agricultural Expansion									
Population	(million)		7.969	8.164	8.359	9.412	10.465	11.602	12.738
Plan of GVA to 1993			1.000	1.060	1.124	1.504	1.743	2.021	2.343
Consumption	(kg/capita/yr)		8.61	9.22	8.84	9.42	10.00	11.00	12.00
Production	(tons/yr)		68,625	75,267	73,900	88,700	104,700	127,600	152,900
Capture Fishery			65,151	71,793	71,300	76,200	81,200	86,100	91,000
Aqua-Culture			3,474	3,474	2,600	12,500	23,500	41,500	61,900
GVA	(K million)	*	14,081.6	15,410.0	15,046.9	19,023.1	23,352.3	29,780.0	36,934.0
GVA to 1993 (%)			1.000	1.094	1.069	1.351	1.658	2.115	2.623
Fish Pond	(ha)		1,737	1,737	=====>	6,250	11,750	20,750	30,950
Base Scenario- Industrialisation									
Population	(million)		8.012	8.221	8.431	9.713	10.994	12.665	14.336
Plan of GVA ratio to 1993			1.000	1.030	1.060	1.226	1.419	1.642	1.899
Consumption	(kg/capita/yr)		8.57	9.16	8.81	9.40	10.00	11.00	12.00
Production	(tons/yr)		68,625	75,267	74,300	91,300	109,900	139,300	172,000
Capture Fishery			65,151	71,793	71,300	76,200	81,200	86,100	91,000
Aqua-Culture			3,474	3,474	3,000	15,100	28,700	53,200	81,000
GVA	(K million)	*	14,081.6	15,410.0	15,168.0	19,810.0	24,926.1	33,321.0	42,714.7
GVA to 1993 (%)			1.000	1.094	1.077	1.407	1.770	2.366	3.033
Fish Pond	(ha)		1,737	1,737	=====>	7,550	14,350	26,600	40,500
Conservative Scenario									
Population	(million)		7.928	8.109	8.291	9.158	10.025	10.807	11.589
Plan of GVA ratio to 1993			1.000	1.026	1.052	1.176	1.297	1.412	1.521
Consumption	(kg/capita/yr)		8.66	9.28	8.88	9.44	10.00	11.00	12.00
Production	(tons/yr)		68,625	75,267	73,600	86,500	100,300	118,900	139,100
Capture Fishery			65,151	71,793	71,300	76,200	81,200	86,100	91,000
Aqua-Culture			3,474	3,474	2,300	10,300	19,100	32,800	48,100
GVA	(K million)	*	14,081.6	15,410.0	14,956.1	18,357.3	22,020.6	27,146.9	32,757.5
GVA to 1993 (%)			1.000	1.094	1.062	1.304	1.564	1.928	2.326
Fish Pond	(ha)		1,737	1,737	=====>	5,150	9,550	16,400	24,050

(Note)

1) *: VA: Capture Fishery = K200,000/ton, Aqua-Culture = K302,650/ton (1993 Constant Price)

3) [ ]: actual production

(4) Water Requirement of Fishery Sector

(a) Unit Water Requirement

Water requirement of fish ponds has been calculated in each agro-ecological zone based on evapotranspiration and 1 in 5-year drought rainfall.

In accordance with above considerations, water requirement of fish ponds can be summarised as below:

	Peak Irrigation Rate (Supply Rate)		Annual Water Consumption	
<Zone>	<Facility>	<Water Resources>	<Facility>	<Water Resources>
Zone-III	1.06 lit/s/ha	0.77 lit/s/ha	16,414 m^3/ha	7,289 m^3/ha
Zone-II	1.09 lit/s/ha	0.80 lit/s/ha	19,630 m^3/ha	10,505 m^3/ha
Zone-I	1.13 lit/s/ha	0.84 lit/s/ha	23,149 m^3/ha	14,024 m^3/ha
<Average>	1.09 lit/s/ha	0.80 lit/s/ha	19,731 m^3/ha	10,606 m^3/ha

From above results, if water is available, it is more preferable to introduce fish ponds in the northern regions (Zone-III) than in the southern region (Zone-I) to save water resources as well as operation cost of water. Fish ponds in the southern region consume almost twice the amount of water than those in the northern region. (e.g. 14,024 m^3/ha compared to 7,289 m^3/ha)

(b) Selection of Development Sites

Development sites of aquaculture are selected based on the criteria as shown below:

- Soils are not suitable for irrigation development like heavy texture and poorly drained like Luangwa River (P-70 site) or like acidity in the northern region (P-2 Luswishi, P-43 Samfya State Farm, P-44 Bangweulu West, P-64 Mutale Mokonge, P-66 Chandamali)
- Floodplains, where large evaporation losses are observed, like Kafue Floodplain.
- Edge (locally named Sishanjo) of Zambezi Floodplain where seepage water from plateau can be utilised and somewhat free from flood. Small scale development will be suitable in Sishanjo because seepage water amount is limited.
- Upstream tributaries of Kabompo River, where perennial flow can be expected. However, development scale will be limited less than 100ha at one site due to limitation of flow capacity.

Among above locations, large scale development can be expected at Kafue Floodplain and Luangwa River. Above locations are shown in Figure 3-11.

(c) Regional Allocation of Fish Pond

On the regional allocation of fish ponds, following factors are to be considered.

- Policy of eachScenario, and its proposed acreage
- Regional balance of fish demand together with capture fishery
- Water resource availability
- Marketability
- Investment Amount

Depend upon the targeted fish supply levels, regional allocation of fish ponds are planned for 2005, and 2015 taking regional balance of fish. The larger development like the Kafue Floodplain Development and the Luangwa River Development have been scheduled to be constructed after 2005, because investment amount is too large for earlier construction. Fish pond allocation and water requirement are summarised as shown in the Table 3-63.

Area of fish pond and required water for aqua-culture is estimated as 30,950 ha and 2,131 thousand m^3/day, respectively, in the Base Scenario-Agricultural Expansion. The figures for the Base Scenario-Industrialisation are 40,500 ha and 2,793 thousand m^3/day, while for the Conservative Scenario they are 24,050 ha, and 1,648 thousand m^3/day.
Water consumption reaches 309 MCM/yr in case of the Base Scenario-Agricultural Expansion, and 411 MCM/yr for the Base Scenario-Industrialisation and 231 MCM/yr for the Conservative Scenario.

Table 3-63 Summary of Fish Allocation and Water Demand

	Present	Base Scenario-Agricultural Expansion		Base Scenario-Industrialisation		Conservative Scenario	
Province	1993	2005	2015	2005	2015	2005	2015
Population	7,969	10,465	12,738	10,994	14,336	10,025	11,589
Proposed Fish Ponds (ha)							
Lusaka	0	0	0	0	0	0	0
Copperbelt	0	1,200	1,200	1,200	1,200	1,200	1,200
Central	0	0	1,400	0	1,400	0	1,400
N/Western	0	2,590	3,690	2,740	4,140	2,490	3,340
Western	0	340	1,140	490	1,790	190	690
Southern	0	0	8,425	1,825	15,875	0	4,325
Luapula	0	4,105	4,105	4,105	4,105	2,000	4,105
Northern	0	2,000	2,250	2,250	2,250	2,000	2,250
Eastern	0	0	7,000	0	8,000	0	5,000
Total	0	10,235	29,210	12,610	38,760	7,880	22,310
Total Fish Ponds including Existing (ha)							
Lusaka	60	60	60	60	60	60	60
Copperbelt	1,260	2,460	2,460	2,460	2,460	2,460	2,460
Central)	10	10	1,410	10	1,410	10	1,410
N/Western	10	2,600	3,700	2,750	4,150	2,500	3,350
Western	10	350	1,150	500	1,800	200	700
Southern	100	100	8,525	1,925	15,975	100	4,425
Luapula	40	4,145	4,145	4,145	4,145	2,040	4,145
Northern	190	2,190	2,440	2,440	2,440	2,190	2,440
Eastern	60	60	7,060	60	8,060	60	5,060
Total Fish Ponds	1,740	11,975	30,950	14,350	40,500	9,620	24,050
Water Requirement (m^3/day at Peak Demand by Water Resources Basis)							
Lusaka	4,147	4,147	4,147	4,147	4,147	4,147	4,147
Copperbelt	83,825	163,659	163,659	163,659	163,659	163,659	163,659
Central)	691	691	97,459	691	97,459	691	97,459
N/Western	665	172,973	246,154	182,952	276,091	166,320	222,869
Western	691	24,192	79,488	34,560	124,416	13,824	48,384
Southern	6,912	6,912	589,248	133,056	1,104,192	6,912	305,856
Luapula	2,661	275,759	275,759	275,759	275,759	135,717	275,759
Northern	12,640	145,696	162,328	162,328	162,328	145,696	162,328
Eastern	4,355	4,355	512,387	4,355	584,963	4,355	367,235
Total	116,587	798,384	2,130,629	961,507	2,793,014	641,321	1,647,696
Water Requirement (MCM/yr by Water Resources Basis)							
Lusaka	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Copperbelt	9.2	17.9	17.9	17.9	17.9	17.9	17.9
Central	0.1	0.1	14.8	0.1	14.8	0.1	14.8
N/Western	0.1	19.0	27.0	20.0	30.3	18.2	24.4
Western	0.1	3.7	12.1	5.3	18.9	2.1	7.4
Southern	1.1	1.1	89.6	20.2	167.9	1.1	46.5
Luapula	0.3	30.2	30.2	30.2	30.2	14.9	30.2
Northern	1.4	16.0	17.8	17.8	17.8	16.0	17.8
Eastern	0.8	0.8	99.0	0.8	113.0	0.8	70.9
Total	13.7	89.4	309.0	112.9	411.4	71.7	230.5

3.7 Forestry

3.7.1 Present Status of Forest and Forestry

(1) Role of Forest

Forests plays a significant role in balancing the carbon-dioxide components of the atmosphere. Forests build up and retain soil fertility, protect soil from erosion or degradation, helps rainfall smoothly to infiltrate into soil and in producing a continuous flow of clean water in the rivers, in reducing the danger of flooding, in protecting crops and settlements against desiccation winds or excessive temperatures. Evapotranspiration over large areas sustains humidity to keep moderate climate for crops and human. In watersheds, forests contribute to their stability by protecting the soil surface from the direct impact of intensive rainstorm.

Deforestation and soil erosion in upstream may affect siltation, water usage in down stream and power generation. The Zambezi and the Kafue rivers contribute significant roles in assisting the economic activities of Zambia. From this aspect, watershed management is quite important to protect rivers from erosion and siltation.

Forests also provide goods obtained from trunks and parts of the trees. The woody products are numerous; timber and sawn-wood for furniture, walls, doors and shuttering, pulpwood for pulp and paper, poles, posts, mining timber, railway sleepers and fuelwood. The non woody products are varied, ranging from fruits, fodder and game meat to pharmaceutical products and honey.

(2) Forest Distribution and Forest Management

In analysis of landsat satellite imagery, forests are analysed covering 105,700 km2 of lands equivalent to about 14% of the national land 751,851 km2 by the data from 1991 to 1993.

The forests cover the land densely about 24% in Lusaka and Copperbelt Provinces, where large urban cities are located. Forests cover scarcely in Eastern Province only 7.3% lands. On the other hand, watershed areas are covered by forests higher than national average in Copperbelt and North-Western Provinces, but less than average in Luapula and Northern Provinces. The Forest Department gazetted the forests estates to protect and manage the forest. The forest estates cover some of 7,203,495 ha lands of the national land, that is about 9.6% of the national land. From forest management aspect, the forest estates cover 68% of forests in national average. The Forests of North-Western Province, where the watershed area of the Zambezi River, are covered mostly by the forest estates, and managed by the Forest Department. Other water sheds are not enough covered by the forest estates.

The present forest estates area amounts to 7,203,495 ha in 1993. The general trend shows that the forest estate area is decreasing from 7,631,491 ha in 1983 (10.2% of National Land) to 7,203,495 ha in 1993 (9.6 %).

Summary of Forest Estates (Dec. 31, 1993)

Forest Type	Area (ha.)			% of Total Land
	National	Local	Total	
State Forest	939,294	401,359	940,633	1.2
Trust Forest	3,708,360	1,226,562	4,935,422	6.6
Reserve Forest	789,308	538,132	1,327,440	1.8
Total	5,037,442	2,166,053	7,203,495	9.6

(3) Vegetation

The major vegetation of the country can be divided into four types. Characteristics of each type can be summarised as follows:

1) The dense Miombo woodland of the plateau divided by grass and swamps along dambos, covering Northern, Copperbelt, Luapula and North-western Provinces.
2) Kalahari Chipya alternating with grass in the south and west.
3) The Mopane Woodlands of the lower Luangwa and Zambezi Valleys.
4) The dry evergreen woodlands and their Chipya derivatives in the northwest on the Kalahari Sands and northeast on lake basin soils in Luwinsy and Kasama.

Miombo woodland accounts for 80% of the forested area, the dominant species being Brachystegia, Isoberlinia and Julberna. The distribution of these forests is influenced by the climate which is subtropical, moderated by altitude. The distribution also follows the four agro-ecological zones based on rainfall, described in Section 3.4.1 of this report.

Over 70% of the country's land area (55 million ha.) is covered by productive forests and woodlands. The forest is derived into two groups, namely the closed forests of southern and western parts of the country called teak forests, and the open forests of Miombo woodland.

In 1988, an estimate of the standing merchantable timber in teak forests stood at 1.7 million m^3 for Mukusi and 0.8 million m^3 for Mukwa in areas within 50km radius of major mills. Without affecting the ecological balance, 63,000m^3 of round wood can be harvested which can sustain 19,000m^3 sawn timber output per annum in these forests. Production in the mills operating in the area in 1991 was 9,700m^3 per annum.

The Miombo forests are more extensive and contain more commercial species. The 1985 Forest Resource Survey showed the extent of the forest as 35 million ha. The merchantable timber in Miombo forests was estimated at 5 - 10m^3/ha in undisturbed areas. The same survey indicated an availability of 4 billion m^3 of timber in these forests.

The forests in North-western Province appear not to have been disturbed. Great potential for setting up primary forest industries exists and are waiting for exploitation this province.

(4) Deforestation

The Government is aware of the alarming deforestation taking place and its consequences for the livelihood of the people, the environment and the country's economy. The Government is

also aware of the constraints related to these issues, as well as the lack of resources (finance, institution, equipment, personnel, etc.) to bring about the necessary changes to enable the forestry sector to play its appropriate role.

(a) Present Forest Cover and Deforestation

In the absence of a national forest inventory, the last one being undertaken in 1952, the rate of deforestation differs depending on the source of information. On the basis of the above table, the country has lost 139 thousand ha of forest every year for the past 15 years (1975 - 1990).

(b) Main Causes of Deforestation

Among the various causes of deforestation, the main ones include clearing for firewood, charcoal, timber, poles, medicine and agriculture. Most of these are taking place in the areas with high concentrations of population. The problems of deforestation have been compounded by various factors, including the following :

- high population growth
- forest fires which occur in dry months of August to October
- over grazing
- cultural heritage, such as Chitemene cultivation
- demand for fuel wood and building poles, which account for 80% of domestic forest products consumption

(c) Impact of Deforestation

Deforestation has been threatening the environment on which agriculture for food production depends. In some areas, the effects of deforestation, such as soil erosion, silting and drying up of streams and rivers, general land degradation and shortage of forest products, are already becoming critical.

(d) Solutions to Deforestation

The Forest Department wishes to protect its forests for rational utilisation of forestry resources by present and future generations. The Department is also aware of the importance of forests for water resource conservation, in particular those in the northern parts of the Kafue and Zambezi catchment areas.

(5) Forest Plantation

Until 1983, the Industrial Plantation Division was part of the Forest Department, but since then, it has been changed to a public company, assuming the corporate title of Zambia Forestry and Forest Industries Corporation (ZAFFICO) under Zambia Industrial and Mining Corporation (ZIMCO). The company was established to sustain plantation and utilisation of timber for mining and other timber using industries.

In 1962, the Forest Department created a plantation establishment in Copperbelt and began a long term plantation programme of pines and eucalyptus. In 1968, the Government of Zambia obtained the first loan for industrial plantation from the World Bank. By 1984, the project had planted approximately 50,000 ha. of exotic forest plantations, 40,000 ha for pine and 10,000

ha. for eucalyptus. The Department also embarked on the Rural Plantation Programme and has planted 7,000 ha. to date distributed throughout the country.
The ownership of forest plantations can be divided into two classifications : (a) private forest plantations and (b) public forest plantations., however, effort of these plantation is much less comparing to the plantation by ZAFFICO.

(6) Forest Product

Although sawmilling based on plantation grown raw timber is relatively new in the country, it has reached to around 60% of the total sawmilling activities. The most important mills are run by ZAFFICO, who own most of the country's plantation. In 1991, the company had 80,000 m^3 built in capacity in its sawmills. The plantations run by ZAFFICO, however, have a potential of producing well over 500,000m^3 round wood per annum. The company currently produces 59,000m^3 of sawn timber which forms 50% of the total production timber in the country.

In addition, natural forest based sawmills are estimated to produce 51,700m^3 timber per annum, roughly 40% of the total production. Most of natural forest based mills are privately owned.

Both plantation based and natural forest based sawmills are suffering from low operation rates, having installed capacities of 208,500m^3 and 158,000m^3, while the actual production is 62,300m^3 and 51,700m^3 respectively. The operation rate can be estimated at about 30% for both types of sawmilling.

3.7.2 Forest Conservation from Water Resources Development Aspect

(1) Watershed Management in Important River Basins

As stated above, forests make important roles in protecting watersheds of the rivers from soil erosion and in maintaining continuous stable flow in the river. Watershed areas of the Zambezi and the Kafue are comparatively maintained better than the watershed of the Chambeshi and the Luapula. The forests are suffering from deforestation caused by collection of the fuelwoods and by natural disaster such as fire. As fuelwoods is the only source of heat for rural people, it is difficult to reduce this cause of deforestation without providing alternative sources.

(2) Forest Conservation Measures

Studies show that there is higher consumption of wood-fuel in the form of charcoal in urban areas of Zambia, while firewood is consumed more in rural areas. For both urban and rural areas there is little available wood for fuel substitution in the near future. In order to ensure sustainable supply of fuelwood in rural areas, small holder farmers and villagers must take up tree growing and management for multiple purposes needs including agroforestry. This is the most practical and economical way of solving the problem. In addition large scale distribution of efficient wood stoves, research in agro-processing and other wood based rural industries can contribute significantly in reducing wood-fuel demand.

In urban areas, production and supply of wood-fuel is commercialised. Better control of harvesting and directing charcoal producers to surplus areas should be encouraged.

Establishment of fuelwood farms and agro-forestry projects in peri-urban areas and nearby rural areas could contribute to solving fuelwood problems.

3.8 Navigation

Based on the report "The Development of Zambia's Inland Water Transportation System", published in April 1984, and discussions with the Ministry of Transport and Communications (MOTC), it is apparent that there is need to develop and expand the existing water transport system. The MOTC is in the process of establishing a Directorate of Shipping, Maritime Affairs and Inland Waterways (name not yet decided) to produce a government register of ports and shipping. It is hoped that this organisation will soon be fully operational and one of its functions will be to implement and monitor progress of the recommendations made in the report referenced above.

3.8.1 Potential Inland Navigation Areas

There is no nation-wide long-distance water borne transportation system in Zambia. Railway transportation and trucking provide the majority of the existing transportation network. This is due to difficulties in establishing and maintaining inland waterways because there are so many rapids and falls on the Zambian rivers, in addition to large seasonal fluctuation of river flows. On the other hand, there are some parts of rivers with gentle and stable flows as well as swamps, lakes and large scale reservoirs suitable for navigation. These areas are indicated in Figure 3-19 and are listed below.

1) Barotse Flood Plain, upstream of the Zambezi River
2) Kafue Flats, middle reaches of the Kafue river
3) Lake Mweru
4) Lake Tanganyika
5) Lake Bangweulu
6) Lake Mweru Wantipa
7) Lake Kariba
8) Lake Itezhi-Tezhi

The above-mentioned eight areas have possibilities for boat transportation. At present, boat transportation is only being operated in the four areas listed below.

- Barotse Flood Plain, upstream of the Zambezi River
- Lake Mweru
- Lake Tanganyika
- Lake Bangweulu

3.8.2 Present Situation of Navigation

(1) Upper Zambezi (Barotse Flood Plain)

Kalabo District, with a population of about 47,000, is the only area really dependent on water transport as no proper road links exist. All other districts on the Upper Zambezi are connected to the Zambian road network and are presently supplied satisfactorily by road vehicles, ferry and pontoon. The Mongu-Kalabo waterway, crossing the Zambezi main stream, is more important for water transport than the main Zambezi River. The only significant water transport carried out at present is between Mongu and Kalabo. However, during the dry season, there are problems of siltation leading to the river becoming too shallow for boat traffic.

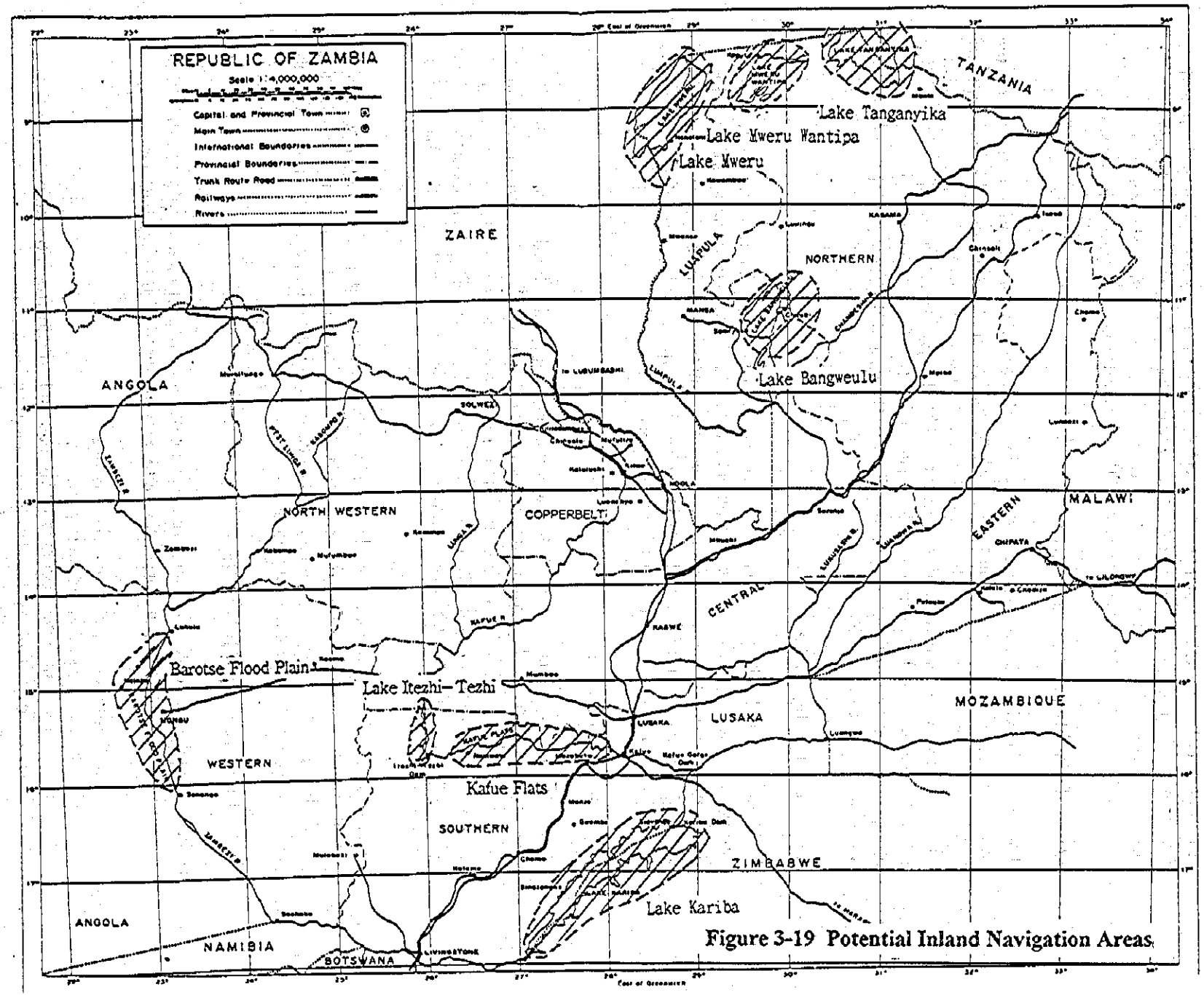


Figure 3-19 Potential Inland Navigation Areas