THE REPUBLIC OF ZAMBIA
MINISTRY OF AGRICULTURE AND COOPERATIVES (MACO)

THE MASTER PLAN FOR PROMOTION OF IRRIGATED AGRICULTURE FOR SMALLHOLDERS IN THE PERI-URBAN AREA IN THE REPUBLIC OF ZAMBIA

FINAL REPORT ANNEX

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Annex A

Farm Management

The Master Plan for Promotion of Irrigated Agriculture for Smallholders
in the Peri-Urban Areas in the Republic of Zambia
Final Report
Annex A. Farm Management
Table of Contents

page

Chapter 1 Small-scale Farmers in Zambia Agriculture

1.1 Dual Nature in Agriculture

The target areas and beneficiaries targeted by the Study are small-scale farmers located in peri-urban areas along the railway line. Agriculture in Zambia consists of a distinct dual structure. Specifically, there is large scale commercialized farms along the railway line made up of a small number of major farmers and then there are the many traditional small-scale farmers located around the villages. This is a planned study targeting the latter group among farms that coexist in regions along railways. The purpose of the study is to promote small-scale commercial irrigation farming. The undertaking of this study was extremely challenging.

This section will provide a simple explanation of small-scale farmers in the agricultural policy and then statistical materials will be used to examine the positioning of small-scale farms within the nation's overall agricultural production.

1.2 Small-scale Farmers in Agricultural Policy

The Zambian government has promoted market-oriented agriculture since the liberalization of agriculture in 1992. Even the National Agricultural Policy (2004-2015) notes that there has been only limited support for small-scale farmers, which are part of the dual nature of agriculture in Zambia. Specifically, this support has been limited mainly to the Fertilizer Support Program (FSP), to assist the growing of the national staple maize, and the Food Reservation Agency (FRA). In other words, it is expected that small–scale farmers can make a contribution to agricultural growth based on the principles of market competition for crops other than the main staple maize. Moreover, the promotion of large-scale commercialized farms is expected to have a synergy effect for small-scale farmers. However, for agriculture based on the principles of competition, NAP is promoting the organization of famers, including cooperatives, other farmers' organization, taking into consideration legal procedures and with small-scale farmers at the district level.

1.3 Number of Small-scale Farmers in Zambia

There are various types of statistical data on the number of farms in Zambia. In order to grasp the number of farmers by scale, it is essential to first understand the dual nature of agriculture in Zambia. The total number of farmers as of the 1990 Census of Population and Housing came to roughly 570,000 and this number increased 810,000 as of the 2000 census (Table 1.3.1). Statistics typically classify farms based on the area under cultivation. As shown in the table below, area under cultivation of less than 5 ha is "small scale", between 5 and 20ha is "medium scale" and more than 20ha is large scale (Central Statistical Office). However, since the introduction of economic deregulation there has been an awareness of growth for not the conventional commercial farmer but a new class of "small-scale commercial farmer" that has increased the number as producers of agriculture for markets mainly. This group has been classified as "emergent farmer" in various statistics. It has been reported that some 120,000 such farms existed nationwide as of 2000, but more up-to-date statistics cannot be found. This number has likely continued to grow.

Table 1.3.1 Characteristics of Zambian Agriculture

Statistics	Classification	Small-scale	Emergent Farmer	Medium-scale	Large-scale	Total
1990	Cultivation area (ha)	Less than 5ha	-	5.0-20 ha	More than 20 ha	
	No. of Farms	479,717		38,751	2,052	520,529
2000 (PRSP)	Cultivation area (ha)	0.5-9.0 ha	10-20 ha	20-60	More than 60 ha	
	No. of Farms	459,212	119,200	25,230	More than 40 ha	812,940
	Crop Grown	Food Crops	Food/Cash Crops	Food/Cash Crop	Cash Crops	
	Production Focus	Subsistence	Commercial/sub.	Commercial/sub.	Commercial	

Source: Atsushi Suzuki, FoDiS (2009); (MAFF: Agriculture Statistic Bulletin, 1997; PRSP 2002)

There is no clear uniformity among the farmers classified as “small-scale”. The range is from destitute farms that are unable to even produce enough to feed their family members to farms with enough capacity leeway to meet not only their own food needs, but have extra produce that can be sold on the market to earn cash income.

Mr. Suzuki (2009) summarized another useful classification using a classification method based on groupings from the references of the DFID (2003). Estimates for the number of farmers in each classification were also made (Table 1.3.2).

Table 1.3.2 Classification of Zambian Farmers

Classification	Small-scale, Destitute	Small-scale, Poor	Small-medium Scale	Large Commercial	Corporate Management
Approx. Number	200,000	300,000	300,000	2,100	<50
Main Crops	Crops for own consumption (insufficient)	Crops for own consumption (some extra)	Crops for own consumption and crops for sale	Crops for sale (domestic / exports)	Crops for sale Mainly exports
Characteristics	Households headed by women or the elderly with chronic food shortages and almost no access to cash. Isolated regions remote from major roads.	Have some money and/or livestock. Have the capacity to produce surplus crops depending on the conditions for that year.	Have the capacity to produce surplus crops to be sold on regional markets. Already participating in some contractual farming.	Produce crops mainly for exports and some domestic markets. Located near big cities or along railway routes.	Total corporate management. Uses large automated farming equipment to grow and process sugarcane, coffee, cotton, soya bean, wheat, and milk cows.

Quoted from Atsushi Suzuki, FoDiS (2009) (Source: The Socio-Economic Impact of Commercial Agriculture on Rural Poor and Other Vulnerable Groups, DFID 2003)

1.4 Small-scale Farmers in Production

The table 1.4.1 shows the percentage of major crop production in Zambia attributed to small-scale farmers based on data from the Crop Forecast Survey. However, this does not include vegetable cultivation and other garden crops as the relevant statistical data are not provided. Small-scale farmers handle most of the production of corps other than wheat, Irish potatoes, Virginia tobacco and soya bean. Small-scale farms account for a large percentage of the production of cotton and Burley tobacco, but in many cases this is based on contract farming.

Table 1.4.1 Percentage of Major Crops Produced by Small-scale Farmers

Name of Crop	Cultivated Area (ha)	Production (Mt)	% Produced by Small-scale Farms**
1. Maize	1,125,466	1,887,010	87.8
2. Sweet potatoes	64,341	200,450	99.6
3. Wheat	34,296	195,456	0
4. Groundnut	216,126	120,564	97.5
5. Soya bean	64,680	118,794	14.7
6. Seed cotton	103,154	87,018	99.2
7. Millet	61,626	48,967	94.7
8. Mixed bean	83,627	46,729	99.1
9. Rice	31,032	41,929	100.
10. Sunflower	71,290	33,653	96.7
11. Sorghum	40,485	21,829	99.3
12. Irish potatoes	1,305	21,285	6.2
13. Virginia tobacco	11,638	18,487	42.0
14. Burley tobacco	7,785	8,758	98.6
15. Cowpea	12,967	7,462	97.9
16. Paprika	312	1,020	2.9

Source: Crop Forecast Survey 2008/2009 MACO

Chapter 2 Agricultural Situation of Selected Irrigation Schemes

This chapter provides information on the agricultural situation of selected irrigation schemes as related to the farm management study carried out from November to December 2009 on sample farms in 5 schemes, namely Chunga in Lusaka district, Chipapa in Kafue district, Ipafu in Chingola district, Chapula in Kalulushi district, and Nkandabwe in Sinazongwe district,.

2.1 Main Crops

Maize as the staple crop is also the basic crop for all farmers who also cultivate vegetables and beans in a limited area. However, the types of crops and area of cultivation differ from farmers and regions.

The number of crops cultivated per farm varies on average from one to five depending on the available labor, the area of arable lands and the available irrigated fields. Among the schemes, Chunga scheme records the highest number of crops cultivated with 10 crops, which may confer to this scheme the most advanced area of crop diversification. Chunga scheme is followed by Ipafu scheme with 8 crops cultivated. In fact, market mammies and buyers come to both schemes to directly buy crops in the fields.

The cropping pattern in Chunga scheme consists of associating maize cultivation with fresh maize and vegetables in the dry season. On the other hand, the number of crops cultivated in Chipapa scheme is limited, and the cropping pattern includes maize cultivation and beans in the dry season. Bean is given a high importance as a cash crop. The cropping pattern in Ipafu scheme includes the cultivation of maize and vegetables in the dry season. A few farmers grow coffee in this scheme. In Chapula scheme, the cropping pattern consists of maize cultivation, and the inter-cropping of fresh maize and ground nuts in the dry season. Furthermore, sweet potatoes and cabbages are grown in limited areas in this scheme. The cropping pattern in Nkandabwe scheme is similar to that in Chapula scheme which consists of maize cultivation and the mixture of fresh maize, cowpea, and tomatoes in the dry season.

2.2 Cash crops

Various crops are cultivated in the irrigation schemes. The combination of crops is different from one scheme to the other. However in every scheme maize and fresh maize are considered important cash crops. The main cash crops in Chunga scheme are rape, mustard spinach, leaf vegetables such as cabbages, which is closer to big markets.

On the other hand, in Ipafu scheme where the market opportunities are abundant, variety of vegetables are grown such as cabbages, tomatoes and so on for the regional markets as well as Solwezi district in North-West province and the cross-border trading with the DRC.

In Nkandabwe scheme, which is far from regional markets, dry cowpea and maize are mainly cultivated. In Chipapa scheme fresh cowpea is grown as the main crop. In addition, chili, which is not found in other schemes, is also grown. These may be sale strategies for farmers

2.3 Cropping Season

The prices of vegetables vary greatly depending on season, demand and supply. Therefore, sales amount heavily depends on the cultivation/shipping season decided by farmers. The following figure shows the wholesale’s prices of tomato in 2007 and 2008 at Soweto Market and different cropping seasons for smallholders in the study area. There are two-fold differences in wholesale prices during the cropping seasons. Currently, most smallholders are unable to cultivate during high price seasons.

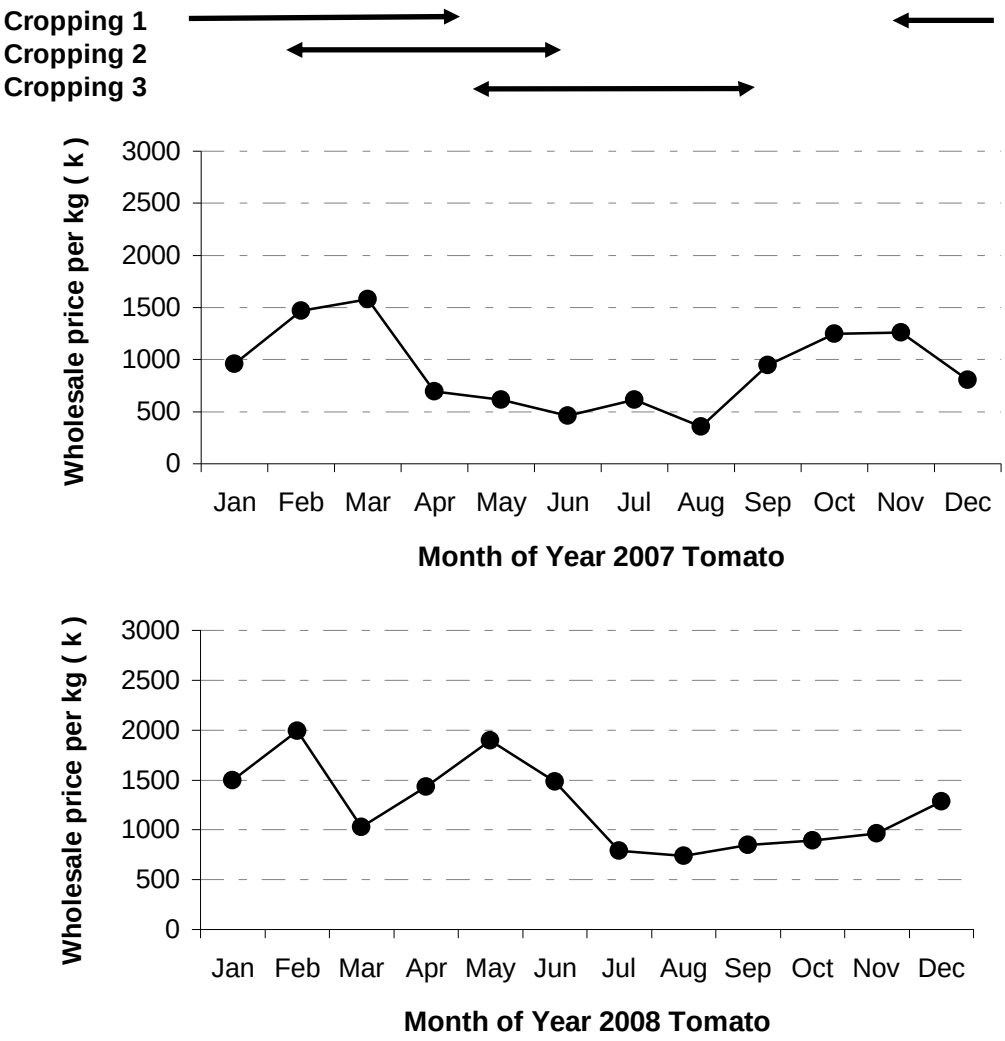


Fig 2.3.1 Cropping Season and Wholesale Prices of Tomato

Notes: Wholesale Price / Area: Soweto Market
Source: JICA Study Team and Munguzwe Hichaambwe (May, 2010)*

*Munguzwe Hichaambwe (2010) Data for the JICA Study on the Master Plan for Promotion of Irrigated Agriculture for Smallholders in Peri-Urban Areas in the Republic of Zambia.

2.4 Profitability of Crops

In the study area, it is expected that high yield of vegetables can be achieved with the dissemination of hybrid seeds. According to the farm survey, tomatoes, carrots, green beans, cabbage, okra and rape are comprehensively high potential vegetables due to profitability, yield potential, easy selling etc. Green beans and cabbage have good profitability, making them suitable for key crops. In addition, tomatoes and okra can prolong the harvesting periods if well managed. The following data concern the dry season and income is expected to increase in the pre-harvest selling period.

Table 2.4.1 Profitability of Major Products

Crop	Production Cost	Gross Income	Net Income		
	ZMK/lima	ZMK/lima	ZMK/lima	ZMK/0.5lima	ZMK/0.25lima
Tomatoes	3,513,000	7,325,000	3,812,000	1,906,000	953,000
Carrots	3,600,000	7,812,000	4,212,000	2,106,000	1,053,000
Green beans	2,482,000	10,416,000	7,934,000	3,967,000	1,983,500
Cabbage	2,468,000	10,868,000	8,400,000	4,200,000	2,100,000
Cauliflower	2,410,000	11,589,000	9,179,000	4,589,500	2,294,750
Okra	1,700,000	4,800,000	3,100,000	1,550,000	775,000
Rape	2,044,000	4,285,000	2,241,000	1,120,500	560,250

Source: JICA Study Team from YR 2010 sampling survey for farm households in Kalulushi, Kabwe, Kafue and Kazungula

Chapter 3 Proposed Cropping Plan in Action Plan Sites

"Cropping Plan" on the pilot project is developed and practiced through trainings of the farmers/the farmer's association. The following table lists the goals on planting plan of respective area which are referred to the agriculture of practical farmers in the area. Therefore, through technical trainings and a visit to the technically advanced site, the farmers/the farmer's association is requested to develop their own maneuver and plans, referring to the following goals. The following table on Planting Plan is a summary on the present condition of farmers' planting and their goals

3.1 Chipapa Irrigation Scheme

120 farms are involved in the scheme. Among them, 90 farms possess irrigation farmland of 7.5 ha and an average cultivating area is as small as 0.4 lima. In the present situation, green beans are mainly cultivated followed by rape, tomato and okra in a small amount. Advanced famers of the scheme perform dual cropping of green beans. Quality of their beans is relatively good, thus it is not so different from the beans found in supermarkets of Lusaka city. Meanwhile, approximately 40% of the farmland is not being used due to an insufficient water use. Accordingly, "affirmative sale on green beans" and "to improve crop intensity" are the main objectives for the Chipapa scheme to attain a sustainable production area.

The plan includes, dual cropping of green beans to be applied in the scheme, and introduction of vegetables which are well suited in the cool season such as Cauliflower, in order to improve an crop intensity of the farmland. Collective shipping and stagger cultivation also need to be introduced, in order to build up the market competitiveness of green beans and to favorably make a good sale.

Table 3.1.1 Sample of Cropping Plan per a farm for Chipapa Irrigation Scheme

Scheme	Present		Plan	
Chipapa	Crop	Planting area	Crop	Planting
	Green beans	0.2 lima	Green beans	0.4 lima
	Rape	0.2 lima	Cauliflower	0.2 lima
Total		0.4 lima		0.6 lima

Note: 1 lima=0.25 ha

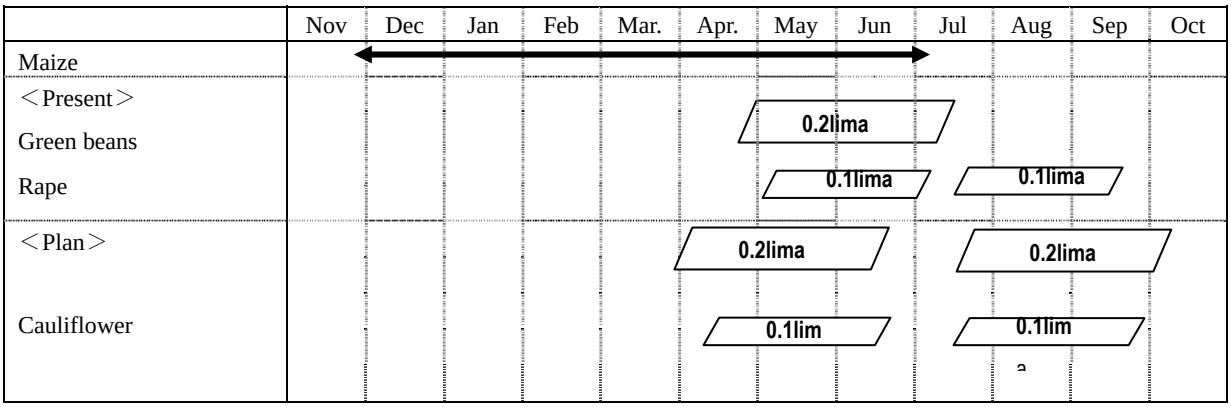


Figure 3.1.1 Sample of Cropping Plan per a farm for Chipapa Irrigation Scheme

3.2 Bwafwano Irrigation Scheme

In the scheme, 176 farms are involved in the scheme with the irrigation farmland of 90ha. An average cultivating area is approximately 1 lima. In the present situation, carrots, tomato, cabbage, and okra are mainly cultivated. Since a great deal of vegetables flow in the Copperbelt province from the other provinces, high demands can be expected within the province however, market competitiveness should be carried out in a favorable manner. Quality improvement and stable production are imperative for the scheme to competing with other production areas.

The plan includes, applying dual cropping of the main crops in the whole scheme, to perform planting at the time of a high price (during the rainy season), and to attain a sustainable production by introducing green beans and Akashi. The scheme as a whole should generate two to three main crops to be on a high name value and also to improve on the market competitiveness.

Table 3.2.1 Sample of Cropping Plan per a farm for Bwafwano Irrigation Scheme

Scheme	Present		Plan	
Bwafwano	Crop	Planting area	Crop	Planting area
	Carrot	0.4 lima	Carrot	0.4 lima
	Cabbage	0.4 lima	Cabbage	0.3 lima
	Tomato	0.2 lima	Green beans	0.3 lima
			Tomato	0.2 lima
Total		1.0 lima		1.2 lima

Note: 1 lima=0.25 ha

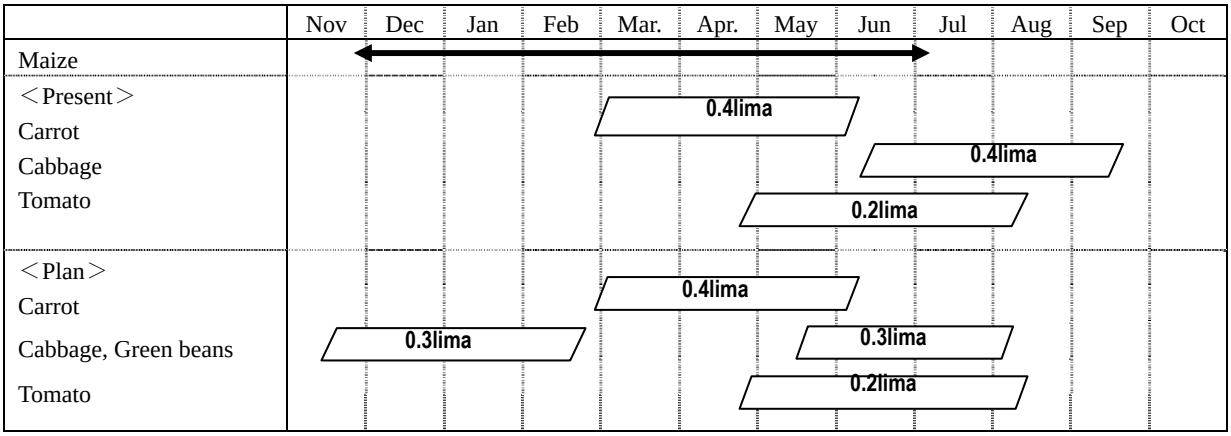


Figure 3.2.1 Sample of Cropping Plan per a farm for Bwafwano Irrigation Scheme

3.3 Natuseko Irrigation Scheme

In the scheme, within Dambo area of Kabuwe city, two groups composed of 76 farms are practicing irrigated agriculture. Presently, each family owns 1 lima of the irrigation farmland out of which 0.8lima is being utilized for vegetable cultivation such as cabbage, rape/Chinese cabbage, tomato and okra. Approximately 80% of the farmers are engaged in vegetable cultivation. The scheme is located approximately 30 minutes to the city market by a bicycle. The advanced farmers are performing cabbage cultivation in the wet season as well stagger cultivation and also adjusting the shipment time with an intension to raise the rate of turnover. As for interfamilial labor, agricultural cultivation on 1 lima is the boundary. Thus some advanced farmers are handling weeding and irrigation works having employed laborers.

The plan includes to have cabbage in the wet season and green beans as the main crops and to introduce green beans as succeeding crop of cabbage. Okra will also be introduced to be planted during the wet season.

Table 3.3.1 Sample of Cropping Plan per a farm for Natuseko Irrigation Scheme

Scheme	Present		Plan	
Natuseko	Crop	Planting area	Crop	Planting area
	Cabbage	0.3 lima	Cabbage	0.3 lima
	Rape	0.3 lima	Green beans	0.3 lima
	Okra	0.2 lima	Okra	0.2 lima
			Rape	0.2 lima
Total		0.8 lima		1.0 lima

Note: 1 lima=0.25 ha

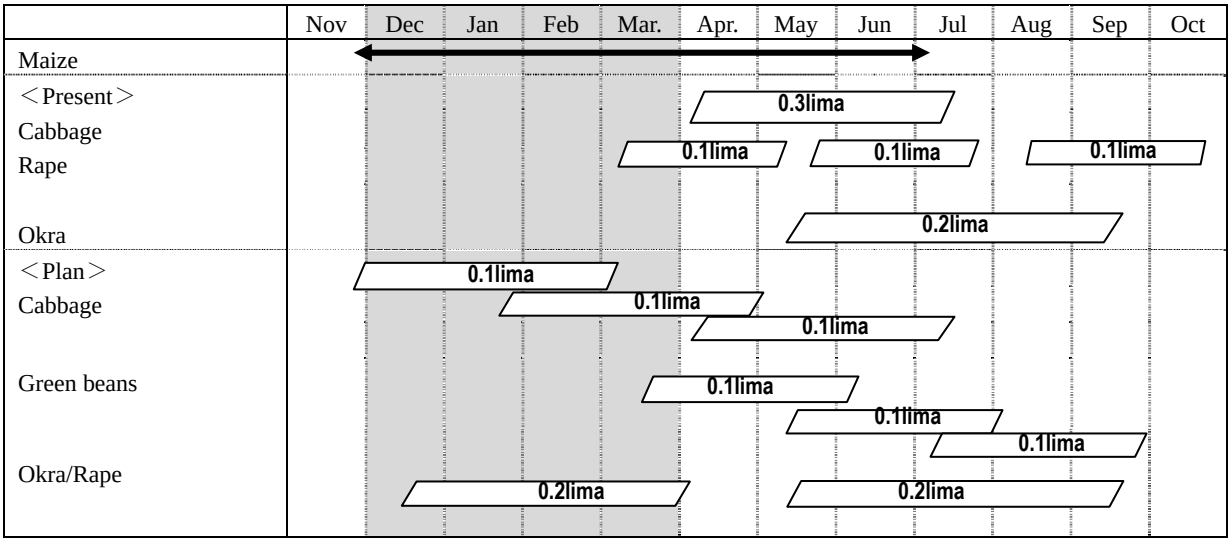


Figure 3.3.1 Sample of Cropping Plan per a farm for Natuseko Irrigation Scheme

3.4 Mulabalaba Irrigation Scheme

In the scheme, 64 farms are practicing agriculture on 5.5ha of the irrigation farmland. An average cultivating area is 0.35 lima. However, a crop intensity of the farmland is still limited to 50% due to livestock invasion problems, and insufficient cultivation skills, marketing and technology of water use. On contrary, the advanced farmers are conducting an active marketing activity by inviting maketeers to their village as an activity of the group. Therefore, increased participation of the engaged cooperative members in such a marketing activity would largely contribute to the development of "a stable production area". Tomato and cabbage will be introduced mainly for the tourist sites in Livingstone and similarly rape will be prepared for local and self support purposes. The plan also includes to introduce green beans as succeeding crop of tomato.

Table 3.4.1 Sample of Cropping Plan per a farm for Mulabalaba Irrigation Scheme

Scheme	Present		Plan	
Mulabalaba	Crop	Planting area	Crop	Planting area
	Tomato	0.2 lima	Tomato	0.2 lima
	Cabbage	0.1 lima	Cabbage	0.1 lima
	Rape	0.1 lima	Green beans	0.2 lima
			Rape	0.1 lima
Total		0.4 lima		0.6 lima

Note: 1 lima=0.25 ha

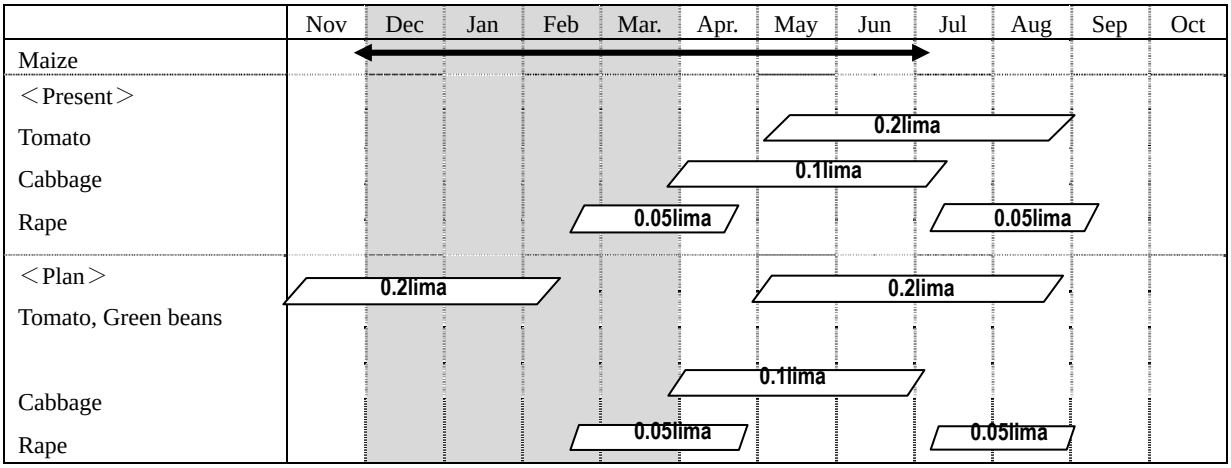


Figure 3.4.1 Sample of Cropping Plan per a farm for Mulabalaba Irrigation Scheme

Chapter 4 Analysis of Agricultural Income

4.1 Agricultural Income per a Household

Direct beneficiaries are the small-scale farmers in peri-urban areas. With development of irrigated agriculture, small-scale farmers would increase vegetable production, become more efficient in land usage, and volume of sales and profits would finally increase by using countermeasures on marketing. In addition to those benefits, improvement of management ability for irrigated agriculture, diversification of crops by irrigation, creation of a business chance by an activity of the cooperative, and finally establishment of job opportunity by project activities are expected.

Pilot projects performed during the A/P have its main purpose in developing a model project by primarily providing it with technical supports. As listed in the following table, the farms which practiced a pilot project can expect an enhancement in the agricultural productivity.

Table 4.1.1 Agricultural Income per household for Chipapa Irrigation Scheme

Present situation			Plan		
Type of crops	Planting area (lima)	New Income (ZMK)	Type of crops	Planting area (lima)	New Income (ZMK)
Green bean	0.2	1,587,000	Green bean	0.4	3,174,000
Rape	0.2	448,000	Rape	0.2	1,836,000
Total	0.4	2,035,000	Total	0.6	5,010,000

Table 4.1.2 Agricultural Income per household for Bwafwano Irrigation Scheme

Present situation			Plan		
Type of crops	Planting area (lima)	New Income (ZMK)	Type of crops	Planting area (lima)	New Income (ZMK)
Carrots	0.4	1,685,000	Carrots	0.4	1,685,000
Cabbage	0.4	3,360,000	Cabbage	0.3	3,024,000
Tomato	0.2	762,000	Green bean	0.3	2,380,000
			Tomato	0.2	762,000
Total	1.0	5,807,000	Total	1.2	7,851,000

Table 4.1.3 Agricultural Income per household for Natuseko Irrigation Scheme

Present situation			Plan		
Type of crops	Planting area (lima)	New Income (ZMK)	Type of crops	Planting area (lima)	New Income (ZMK)
Cabbage	0.3	2,520,000	Cabbage	0.3	3,024,000
Rape	0.3	672,000	Green bean	0.3	2,380,000
Okra	0.2	620,000	Okra	0.2	620,000
			Rape	0.2	448,000
Total	0.8	3,812,000	Total	1.0	6,472,000

Table 4.1.4 Agricultural Income per household for Mulabalaba Irrigation Scheme

Present situation			Plan		
Type of crops	Planting area (lima)	New Income (ZMK)	Type of crops	Planting area (lima)	New Oncome (ZMK)
Tomato	0.2	762,000	Tomato	0.2	1,296,000
Cabbage	0.2	1,680,000	Cabbage	0.2	1,680,000
Rape	0.2	448,000	Green bean	0.2	1,587,000
			Rape	0.2	448,000
Total	0.6	2,890,000	Total	0.8	5,011,000

4.2 Crop Budgets of Major Vegetables (Smallholder Farmers in the Study Area)

Tomato		
OUTPUT		
Yield	kg/lima	5,000
Selling Prices	ZMK/kg	1,465
Output	ZMK/lima	7,325,000
VARIABLE COSTS	Unit	Cost
Seed	ZMK/lima	150,000
Basal Fertilizer	ZMK/lima	550,000
Top Fertilizer	ZMK/lima	760,000
Insecticide	ZMK/lima	200,000
Fungicide	ZMK/lima	220,000
Transport & packing	ZMK/lima	1,320,000
Irrigation water	ZMK/lima	63,000
Others	ZMK/lima	250,000
Total Variable Costs	ZMK/lima	3,513,000
GROSS MARGIN	ZMK/lima	3,812,000

Carrot		
OUTPUT		
Yield	kg/lima	3,125
Selling Prices	ZMK/kg	2,500
Output	ZMK/lima	7,812,000
VARIABLE COSTS	Unit	Cost
Seed	ZMK/lima	225,000
Basal Fertilizer	ZMK/lima	1,562,000
Top Fertilizer	ZMK/lima	781,000
Labour	ZMK/lima	310,000
Transport & packing	ZMK/lima	300,000
Irrigation water	ZMK/lima	375,000
Others	ZMK/lima	47,000
Total Variable Costs	ZMK/lima	3,600,000
GROSS MARGIN	ZMK/lima	4,212,000

Green beans		
OUTPUT		
Yield	kg/lima	4,167
Selling Prices	ZMK/kg	2,500
Output	ZMK/lima	10,416,000
VARIABLE COSTS	Unit	Cost
Seed	ZMK/lima	600,000
Basal Fertilizer	ZMK/lima	520,000
Top Fertilizer	ZMK/lima	470,000
Insecticide	ZMK/lima	360,000
Transport & packing	ZMK/lima	463,000
Irrigation water	ZMK/lima	63,000
Others	ZMK/lima	6,000
Total Variable Costs	ZMK/lima	2,482,000
GROSS MARGIN	ZMK/lima	7,934,000

Cabbage		
OUTPUT		
Yield	heads/lima	7,245
Selling Prices	ZMK/kg	1,500
Output	ZMK/lima	10,868,000
VARIABLE COSTS	Unit	Cost
Seed	ZMK/lima	150,000
Basal Fertilizer	ZMK/lima	520,000
Top Fertilizer	ZMK/lima	620,000
Insecticide	ZMK/lima	250,000
Fungicide	ZMK/lima	220,000
Transport & packing	ZMK/lima	550,000
Irrigation water	ZMK/lima	63,000
Others	ZMK/lima	95,000
Total Variable Costs	ZMK/lima	2,468,000
GROSS MARGIN	ZMK/lima	8,400,000

Cauliflower		
OUTPUT		
Yield	kg/lima	3,500
Selling Prices	ZMK/kg	4,000
Output	ZMK/lima	14,000,000
VARIABLE COSTS	Unit	Cost
Seed	ZMK/lima	707,000
Basal Fertilizer	ZMK/lima	135,000
Top Fertilizer	ZMK/lima	156,000
Insecticide	ZMK/lima	312,000
Fungicide	ZMK/lima	624,000
Packing		50,000
Transport	ZMK/lima	416,000
Irrigation water	ZMK/lima	10,000
Others	ZMK/lima	
Total Variable Costs	ZMK/lima	2,410,000
GROSS MARGIN	ZMK/lima	11,590,000

Okra		
OUTPUT		
Yield	kg/lima	6,000
Selling Prices	ZMK/kg	800
Output	ZMK/lima	4,800,000
VARIABLE COSTS	Unit	Cost
Seed	ZMK/lima	0
Basal Fertilizer	ZMK/lima	340,000
Top Fertilizer	ZMK/lima	370,000
Insecticide	ZMK/lima	340,000
Fungicide	ZMK/lima	400,000
Packing		40,000
Transport	ZMK/lima	200,000
Irrigation water	ZMK/lima	10,000
Others	ZMK/lima	
Total Variable Costs	ZMK/lima	1,700,000
GROSS MARGIN	ZMK/lima	3,100,000

Rape		
OUTPUT		
Yield	kg/lima	7,140
Selling Prices	ZMK/kg	600
Output	ZMK/lima	4,284,000
VARIABLE COSTS	Unit	Cost
Seed	ZMK/lima	267,000
Basal Fertilizer	ZMK/lima	260,000
Top Fertilizer	ZMK/lima	458,000
Insecticide	ZMK/lima	286,000
Fungicide	ZMK/lima	0
Packing		0
Transport	ZMK/lima	708,000
Irrigation water	ZMK/lima	62,000
Others	ZMK/lima	
Total Variable Costs	ZMK/lima	2,041,000
GROSS MARGIN	ZMK/lima	2,244,000

Source: JICA Study Team
Sampling survey for farm households in Kalulushi (Copperbelt), Kabwe (Central), Kafue (Lusaka) and Kazungula (Southern). The survey was carried out in 2010.

Chapter 5 Compost

5.1 Effect of Compost

Principal materials used for making compost are shown in Table 5.1.1. The organic matter such as livestock dung, plant waste etc. includes ingredient such as nitrogen, phosphorous, potassium. Therefore, compost made by fermentation of these materials is useful as a substitute of chemical fertilizer. In addition, the compost has the effect of improving the physical properties of the soil such as drainage and water retention and soil disease suppressive effect. Chemical fertilizer does not have this effect. Soil organic matter is decomposed by microorganisms. Therefore if organic matter is not supplied, the physical and biological property of soil is changed for worse and the land productivity is also decreased. It is recommendable to supply annually about 10t/ha of organic matter to the soil for conservation of the land productivity.

Table 5.1.1 Principal Materials of Compost and Ingredients

Unit: % (dry weight)

Material		Water	N	P_2O_5	K_2O	CaO	MgO
A1	Cattle dung	80	2.3	2.3	1.8	1.8	0.8
	Hog dung	70	3.5	5.5	1.8	4.5	1.3
	Chicken dung (layer)	65	5.5	6.5	3.5	13	1.3
	Rice bran	15	2.5	4.5	1.8	0.1	1.6
	Wheat bran	7	2.4	2.1	1.3	0.1	0.6
	Coffee waste	66	2.2	0.2	0.4	0.1	0.2
A2	Vegetable waste	90	3	1	5	4	1
	Maize stalk and leaf	70	3.8	1.3	1.8	2.8	0.9
	Sweet potato stalk and leaf	70	2.5	1.3	0.8	4.8	0.4
	Weed	80	1.2				
B	Rice husk	10	0.4	0.2	0.5	0.1	0.1
	Fallen leaves	60	1	0.2	0.4	1	0.4
	Peanut husk	10	1.7	0.4	1.3	2.0	1.2
	Bagasse of sugar cane	16	0.3	0.1	0.4	0.5	0.1
	Rice straw	10	0.8	0.4	2.3	0.5	0.2
	Wheat straw	10	0.8	0.2	2.3	0.5	0.2
	Sawdust	10	0.1	0.1	0.2	0.4	0.2
C	Plant ash		0	3	8		
	Charcoal		0	0.2	1.8	0.2	0.1
	Molasses	27	2.1	0.1	3.2	1.2	0.47
	Starch						

A1, A2: Easy compostable materials without addition of other materials.
Effects nutrient supply is high.

B: Difficult compostable materials without addition of other materials.
Effect of soil improvement is high.

Table 5.1.2　Difference of Effect of Chemical Fertilizer and Compost

	Nutrient supply	Improvement of physical properties	Soil disease suppression
Chemical fertilizer	◎	×	×
Compost	△	○	○

◎:Very Good　　○:Good　　△Moderate　　×:No effect

5.2　Object of Composting

Application of raw organic matter causes retardation of germination and damage to root because of the generation of gas and organic acid during the decomposition process of organic matter in soil. In addition, application of the material which is difficult to decompose as Material B of Table 5.1.1 may trigger nitrogen deficiency in plants. It is necessary to ferment and compost the organic matter to prevent these harms. Fermented organic matter can be applied to agricultural land at ease because the generation of gas and organic acid has been completed and the anxiety of nitrogen starvation excluded.

5.3　Point of Composting

1)　Moisture

Adequate moisture content of material for composting is 60 %. The moisture content is estimated roughly by taking a fast hold of material. When the material is taken fast hold and can be turned into a mass and water is oozed out from between fingers, the moisture content is nearly 60 % in the material. If it can not be turned into a mass, this implies the shortage of moisture. If water is dripped out from between fingers, it means excess of moisture in the material. Composting of dry material requires to add water or mixing with watery material. Composting of watery material requires drying or mixing with dry material.

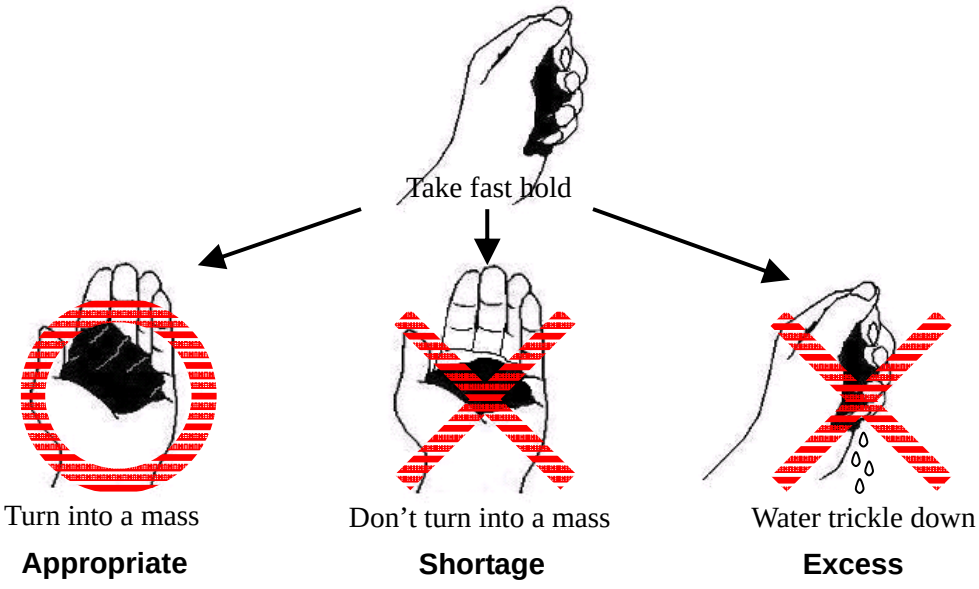


Figure 5.3.1　Decision of Moisture

2) Ventilation

Composting requires proper oxygen amount. However, not only poor ventilation of the material but over ventilation also disturbs the composting process. It is necessary to adjust the specific gravity of the material to about 0.6~0.7 to secure the ventilation necessary to composting (for example: when the material fills a bucket of 10L, and if its weight is 7 kg, its specific gravity is 0.7). In case that the material is too fine and the ventilation is poor, it is necessary to improve the ventilation by mixing with large sized organic matters such as Material A2 and B of Table 5.1.1 or sticking a bamboo bar into the heap of the compost. In case that the percentage of large sized organic matter is high, then it is necessary to cut it fine, and/or stepping on the material requires to release the air.

3) Combination of Material

Material A1, A2 of Table 5.1.1 is easy to ferment and compostable with only adjusting moisture and ventilation. However, Material B is difficult to ferment and not compostable without addition of other material. It is necessary to mix same or more amount of A1, A2 to ferment material B.

In case that if it is difficult to raise fermentation temperature of material due to low temperature of the air it is recommended to add molasses or starch. These materials help fermentation and shorten the period of composting. Molasses is dissolved in water; starch is dissolved in hot water. Then when the moisture of the material requires to be adjusted, these are added. Plant ash supplies the phosphorous and potassium to compost. Charcoal is useful to reinforce the effect of physical properties improvement. However, excessive mixing disturbs fermentation. Therefore, limit of mixing ratio is taken as 3% and 30% for plant ash and charcoal, respectively

5.4 Process of Production

1) Put some of material A2 or B of Table 5.1.1 until the surface of land is disappeared. If the material is dry, add water so that the water content reaches to 60%.（at the moment it is recommended to cut large sized materials to a length of about 30 cm）.
2) Pile up some of material A1 until the material of 1) is disappeared.
3) Pile up to a height of 1 m~2 m repeating the process as said in 1)～2).
4) Put soil on the surface of materials then cover with tarpaulin.

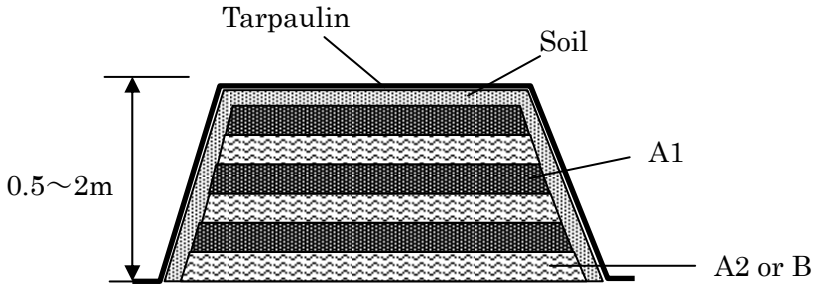


Figure 5.4.1 How to Pile up Materials

5) After 1~2 weeks the temperature of material reaches to about 60℃. Then when the temperature begins to go down, add water so that the water content reaches at 50% by cutting through a

mountain of materials. Pile up again to a height of 1 m~2 m.

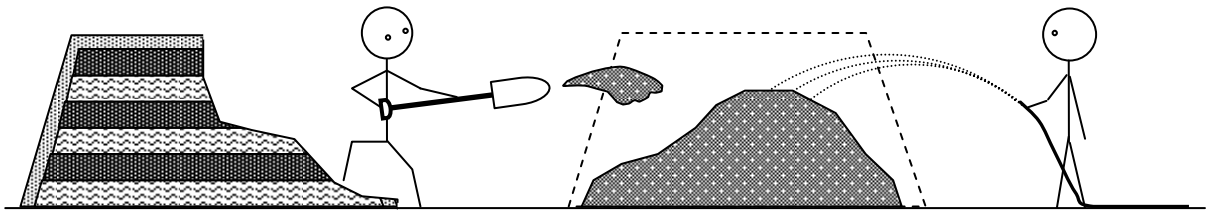


Figure 5.4.2 Mixing of Material and Regulation of Moisture

6) After 1~2 weeks the temperature of material rise again. Then when the temperature begins to go down, add water by cutting through a mountain of material as described in 5) above.

7) Repeat same work one more again. When the temperature falls to a normal temperature, the compost is ready. Pack the compost into a bag. Store the compost under a shelter so that the compost would not be influenced by the direct rainfall.

Finished Compost

Fermenting Compost

Chapter 6 Bokashi

6.1 What is Bokashi ?

In case that compost is produced mainly with the use of materials such as B of Table 5. 1.1, it is necessary to fully ripen the materials through high temperature and long term fermentation to produce safe compost to plants. The compost made in this method is effective for improving the physical properties of soil. However, compost is not very effective as fertilizer.

On the other hand, middle ripe compost made with short term and middle temperature fermentation is called “Bokashi” by Japanese farmers. The Bokashi is applied mainly in expectation of effect as fertilizer. Really the effect of nitrogen of Bokashi is higher and rapider than fully ripe compost made with long term fermentation.

Table 6.1.1 Difference of Effect of Bokashi and Compost

	Nutrient supply	Improvement of physical properties	Soil disease suppression
Bokashi	○	△	○
Compost	△	○	○

6.2 Points of Production

The basic points are same as production of compost. However, the special features are shown below.

1) Produce mainly with easy decomposable organic matters

Materials A1 and A2 of Table 5.1.1 are easy to decompose. Therefore their effect as fertilizer is appeared rapidly.

2) Short term fermentation

Regulate the moisture of material at 50% level and then dry it rapidly, hence, stop forcibly the composting at the middle ripe condition. Don’t add water in the middle of fermentation. When the materials are taken fast hold, if the materials are turned into a mass and it breaks easily, then it implies that the moisture of materials is nearly 50 %. If water is oozed out from between fingers, it means excess of moisture.

6.3 Process of Production

1) Mix uniform materials as said in A1・A2・C of Table 5.1.1. In case of using the material A2 it is necessary to cut the material to a length of less than 5 cm.

   Example of mixing：
   - ・Livestock dung 5 bags of 50kg
   - ・Wheat bran 1 bag of 50kg
   - ・Charcoal 1 bag of 50kg

2) Add water such time as the water content reaches 50%

3) Pile up to a height of 1 m~2 m then cover with tarpaulin。

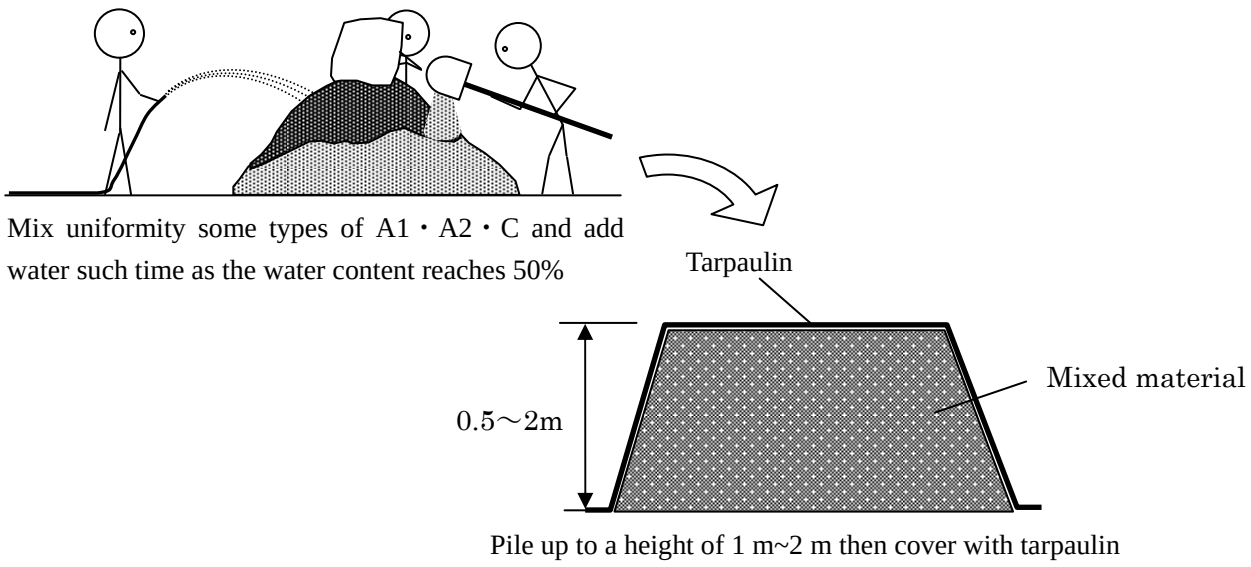


Figure 6.2.1 How to Pile up Materials of Bokashi

4) When the temperature of material reaches to about 50℃ spread the material to a height of about 15 cm cutting through a mountain of material.

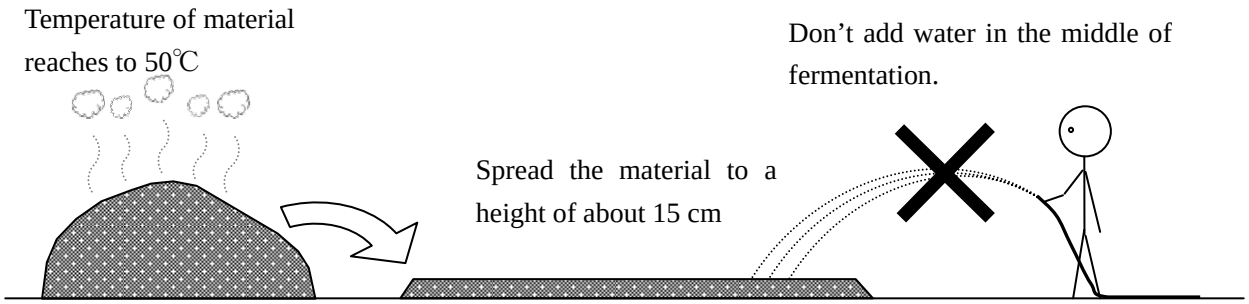


Figure 6.2.2 Control of Fermentation Temperature and Moisture

5) Then stir the material one time at the interval of 2～3 days. At the time, in case that the temperature of material exceeds 50℃, spread the material in more thinner height to control the temperature at less than 50℃. If the material is too hot to grasp, it implies that the temperature of material is more than 50℃.

6) When the temperature falls to a normal temperature it means that the Bokashi is ready (the period of fermentation is about 10 days) .

6.4 Application Method

The rough application standard is shown in Table 6.4.1. However if the exact information of ingredients of the compost and standard of fertilization exist, it is recommended to apply those information.

Table 6.4.1 Application Standard of Compost and Bokashi

Fertilizer	Quantity
Compost (basal fertilizing)	10t/ha
Bokashi (basal fertilizing)	3t/ha
Bokashi (additional fertilizing)	1t/ha

- In case that compost and/or Bokashi are used as basal fertilizer, 1 week after application of the compost and/or Bokashi seed or transplant.
- Application to hole or ditch is more effective than application to soil surface. Make a hole or ditch at a depth of about 30 cm and apply compost or Bokashi to there.

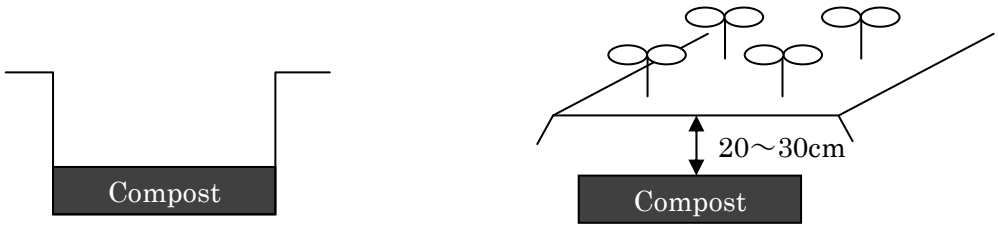


Figure 6.4.1 Example of Basal Fertilizing

- In case that Bokashi is used as additional fertilizer, apply it by making a hole with a stake near root .

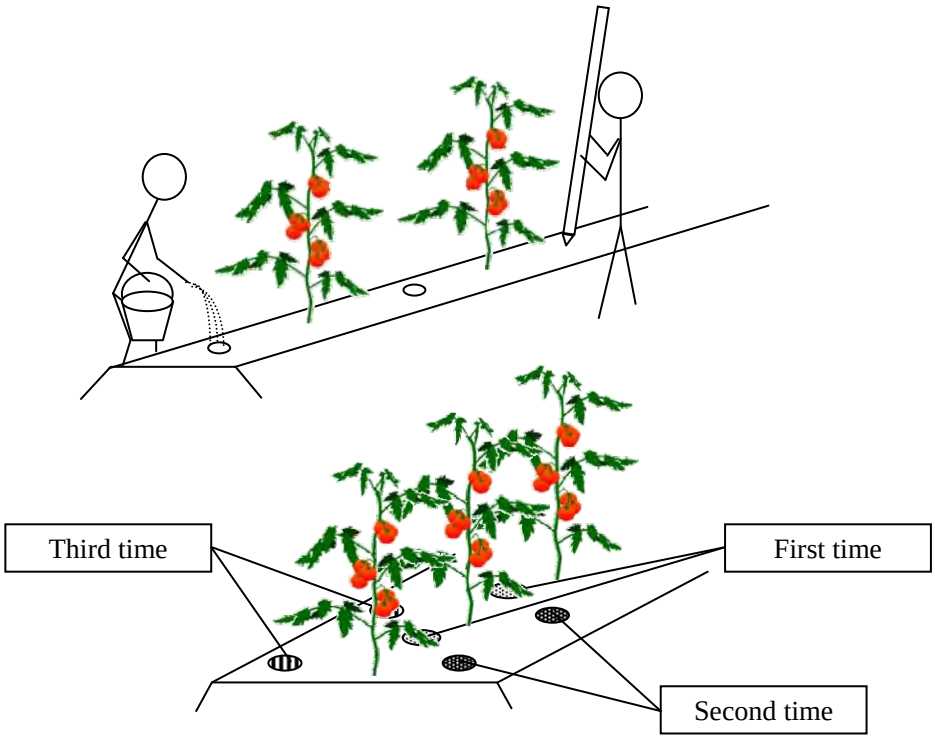


Figure 6.4.2 Example of Additional Fertilizing

6.5 Simplified Method

≪Materials≫

Cow Dung	three bags of 50kg
Maize Bran (or wheat bran or rice bran)	one bag of 50kg
Ash	one bag of 50kg
Soil	one bag of 50kg
Peel of Banana or Mango (or Vegetable Waste)	8 cans of Tomato Paste

≪Method≫

1) Mix maize (or wheat or rice) bran with peel of banana or mango peel
2) Put water little by little until such time as the water content reaches 50%.
3) Put in a bag and place in the store for a week.
4) After a week, mixing maize bran with banana peel or mango, and add cow dung and ash.
5) Put water little by little until such time as the water content reaches 50%.
6) Put in a bag and place in the store for a week.
7) After a week, mixing maize bran with banana and mango peel adding cow dung and ash, and add soil.
8) Crush soil before mixing.
9) Put water little by little until such time as the moisture content reaches 50%.
10) Put in a bag and put it in the store.
11) After three weeks, the organic fertilizer is ready.

Annex B

Distribution and Marketing

The Master Plan for Promotion of Irrigated Agriculture for Smallholders
in the Peri-Urban Areas in the Republic of Zambia
Final Report
Annex B. Distribution and Marketing
Table of Contents

page

Acknowledgment: "The Report on Survey of Agricultural Produce, Marketing and Distribution in Lusaka, Central, Copperbelt and Southern Province" was prepared by the Zambian Development and Management Consulting (ZDMC) for the JICA Study Team in December 2009. Mubita Kanyata, Edward Maembe and Andrew Msiska from the ZDMC are greatly acknowledged for their contribution.

B 1. Report on Survey of Agricultural Produce Marketing and Distribution in Lusaka, Central, Copperbelt and Southern Province

Chapter 1 Southern Province

1.1 Introduction

The Southern Province has historically been the bread basket of Zambia. However, due to severe and persistent climatic changes affecting the region, its contribution to total national agricultural output has progressively declined in relation to the northern and eastern parts of the country. Despite this setback, Southern province still remains one of the country's key agricultural producers, in such sub sectors as maize, cotton, tobacco, and livestock.

In terms of horticultural production, the region continues to lag behind the prime producers in the central parts of the country.

Chapter 2 The Survey of Agricultural Marketing and Distribution in Southern Province

2.1 Survey for Overview of Production and Marketing in Target Districts

2.1.1 Target Area

The target districts for the Southern province survey included Monze, Gwembe, Sinazongwe, Choma, Kalomo, Livingstone, and Kazungula.

2.1.2 Survey items -Main Commodities Grown in Each District

The main commodities grown in the target districts are as shown in Table 1 overleaf. However, the predominant crops in terms of volumes of production and planted area are maize, cotton, and tobacco. In terms of vegetables, the most important commodities are tomatoes, cabbage and rape, and onion to a lesser extent.

Green maize is an important crop in irrigated production in Sinazongwe.

Table 1 Commodities Grown in 7 Districts of Southern Province

District	Commodity	Hectarages				
		2004/5	2005/6	2006/7	2007/8	2008/9
Monze	Maize	21816	17838	33931	29978	123572
	Cotton	10244	4417	1999.5	2093	709377
	Sorghum	251	21	22		
	G/nuts	1753	2403	15032.5	5454.25	5853
	Sunflower	1051	636	1744	581	737
Sinazongwe	Maize	3100	11414	31425.25	12856.24	14882
	Cotton	5035	9513	4936	8583.5	8436
	Sorghum	2420	2921	5185	2062.74	2213
Kalomo	Maize	35476	45000	52200	68000	76656

	Cotton	1300	1625	1868	5253	242
	G/nuts		6240	7668	7919	5269
	Sunflower	1276	1608	1684	6290	1491
	Millet	802			5880	597
	Sorghum	1136	1160		3207	567
	Tobacco	3500	4536	4620	5313	539
Kazungula	Maize	8510	12570	13674	14600	16000
	Sorghum	490	746	780	500	500
	Millet	386	529	680	600	200
	Sunflower	77	172	215	-	-
	G/nuts	980	1924	1250	1000	1500
Gwembe	Maize	5544	6200	5700	4872	9036
	Millet	1159	1300	1793	1386	30009
	Sorghum	2513	2800	2704	1363	5294
	Cotton	2800	2550	2150	2181	2094
	G/nuts	333	512	487	240	683
Choma	Maize	30780	34330	55687	43768.57	45200
	Sunflower	571.8	425.18	850	851	1200
	Cotton	1661	2183	1047.039	1729.333	2010
	Tobacco	5205.8	5823	298.25	285.055	5300
L/stone	Maize	662	859	1112	1500	1500
	Sorghum	41	52	35	55	84
	Millet	11	15	30	19	20
	G/nuts	22	38	50	34	90

Source: ZDMC (Zambian Development and Management Consultancy) survey team

2.2 Features of Production and Marketing in each Target District

2.2.1 Production.

2.2.1.1 Production by Year and Growers' type- Last Five (5) Years

Data and information collected in all survey districts show that predominantly smallholder or traditional growers account for the largest planted areas as well as the highest production in all field and vegetable commodities in all districts.

(a) Seed Varieties/ Cultivars

The whole of southern province is in a low rainfall area. Therefore in terms of field crops, only varieties in the early to medium maturing categories are distributed by input distributors.

(b) Cropping Pattern (single or double)

The cropping pattern with respect to field crops is predominantly single with production occurring during the rain season. The only exception is green maize which is produced under irrigation in the

dry winter months. In the case of vegetables, cropping is twice, and in exceptional cases a third crop is also grown during the drier pre rain season period.

(c) Cropping area

Cropping area for field crops is shows a stable trend being influenced mainly by such factors as cost of production and market conditions. Of the field crops, maize accounts for the largest cropping area. This is because the commodity has traditionally been a staple and commercial crop especially among traditional growers. For vegetable commodities planted area is constrained by such factors as sources of water for irrigation, limited production resources, and uncertain market conditions.

(d) Availability of irrigation

Irrigated production in all the targeted districts still constitutes an insignificant proportion in relation to rain season production. The estimated proportion of irrigated production ranges from 0.18 to 13.7 percent in the targeted districts. See Table 2 below.

Table 2 Availability of Irrigation

District	Average Total Cropping Area	Availability of Irrigation (as a % of total cropped area)	Source of Irrigation
		Dry Season	
Monze	54290.82	3	Dams, Residual Moisture, Streams
Choma	49101	2.6	Dambos, Streams, Ponds, Dams, Weirs, Shallow wells, Residual moisture
Gwembe	14518	0.3	Dams, Stream & lake
Sinazongwe	27691	9.8	Lake, Dams& Stream
Kalomo	69780.5	0.18	Boreholes, Streams,
Kazungula	15595	0.2	River, Streams & Boreholes
Livingstone	1443.8	13.7	River, Streams & Boreholes

Source: ZDMC survey team

(e) Types of irrigation

The predominant type of irrigation in the targeted districts varied from place to place depending on location in relation to surface or underground water resources. Except for Sinazongwe and Kazungula, which are on the shores of a large lake and river respectively, the rest of the district irrigate from rivers, ponds, underground water, and residual flood waters. For the majority of the target district, irrigation water sources tend to be a constraint especially in years of low rainfall when small streams, Dambos, and ponds dry out.

(f) Numbers of growers.

While it was difficult to ascertain the exact number of growers in all the targeted districts, because of outdated farm registers, and further because the last national census was in the year 2000, the survey was able to collect data on numbers of growers as given in the data tables submitted with this report. The emerging evidence appears to indicate some growth in growers numbers especially in the

traditional and emergent grower categories. This is because relatively little investment is required to enter the various commodity sub sectors. However, with respect to commercial growers, numbers appear to take a stable trend. This again is because of the relatively large investment required to operate at this level.

(g) Growers' own consumption and surplus sale - last 5 years

On account of uncertain climatic conditions, the food security status of the targeted districts from, year to year. However, three target districts, namely, Gwembe, Sinazongwe, and Livingstone, are particularly vulnerable. This is because they are located in the great Zambezi valley. Rainfall in these areas is often below the optimum requirements for successful plant growth. Figure1 below shows the food security status of the targeted district.

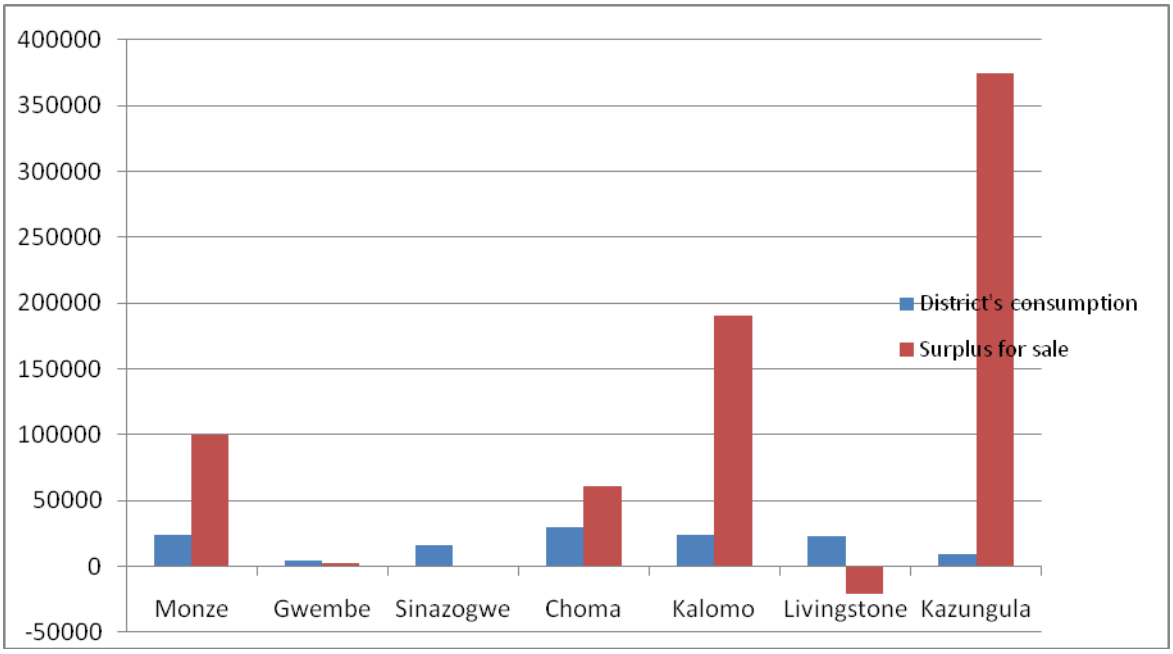


Fig.1 Food security status (MT) for the targeted districts for 2009

Note: The picture portrayed in the chart above is fairly representative of the food security status in the previous four years.

(g) Number of available post harvest machines.

Since this survey was not baseline, it was not possible to ascertain with a higher degree of certainty a representative number of post harvest machines/equipment and storage facilities particularly for the growers in all their categories. However, information from the various DACO offices indicates that typically traditional growers would have an ox drawn plough cultivator, scotch cart, a granary, or the improved version of this called the Ferumbu. With respect to other actors in the marketing and distribution chain, the number of available post harvest machines/equipment and storage facilities vary according to their level on the distribution chain. Table 3 below shows the typical situation for a large scale operator on the distribution chain.

Table 3 Number of available post harvest equipment and storage facilities (Kalomo & Monze)

District	Commodity	Type of Machine/ Equipment	No	Capacity	Owner -ship	Type of Storage Facility	No	Capacity	Owner
Monze	Maize	Stacking Machines	1		FRA	Storage sheds	9	40,000 metric tones	FRA
		Scales	7	1 ton each	FRA				
		Hanging scales	2	100 Kg each	FRA				
		Platform scale	4	100 Kg each	FRA				
		Sieve	8	-	FRA				
Kalomo	Maize	Platform scale		50 Kg	FRA	Storage sheds	7	14,000 metric tones	
		Sieve		3 - 4 bags	FRA				
		Tarpaulins			FRA				
		Probe sticks			FRA				

Source: ZDMC survey team FRA: Food Reserve Agency

(h) Typical methods of harvest and post harvest treatment

For both the traditional and emergent farmers method harvest and post harvest treatment still remain very basic. For both field crops and vegetables, harvesting is labor intensive relying predominantly on farm family labor. For the large scale growers harvesting is mechanized using such equipment as combines to harvest wheat, maize, and soya beans. Post harvest treatment typically, for traditional and emergent farmers involves treatment of commodities with commercially available post harvest treatment chemicals or in lieu of traditional treatment of commodities such as mixing maize grain with dry cow dung. For the large scale growers post harvest treatment is more elaborate and sophisticated, including fumigation against in storage pests.

(i) Post harvest losses.

The survey did not come across any research data with regard to post harvest losses. However, information from MACO officials at the district (based on field experience), and middlemen and other commodity merchants indicated that post harvest losses could range from zero percent to seven (7) percent for commodities such as maize, depending on measures taken and up to seventy five (75) percent for vegetable crops, depending on market conditions. Table 5 below shows the extent of post harvest losses in selected crops.

Table 4 Post harvest losses in selected commodities in targeted districts

District	Commodity	Post Harvest Losses (%)
Monze	Maize	7
	Cotton	Negligible

	Tomatoes	Up to 30 %
	Cabbage	15
	Onions	5
Gwembe	Maize	0.5(May rise Up to 20% without treatment)
	Sorghum	Minimal
	Millet	Minimal
	Cotton	Negligible
	Sunflower	Minimal
	Tomatoes	5
	Cabbage	5
	Onions	-
Sinazongwe	Maize	5
	Sorghum	Minimal
	Cotton	Negligible
	Green maize	0
	Tomatoes	2
	Cabbage	1
	Onions	1
Choma	Maize	5
	Cotton	Negligible
	Tobacco	0
	G / nuts	0
	Tomatoes	5(May rise Up to 75% in depressed market situations)
	Cabbage	2
	Onions	0
	Bananas	0
Kalomo	Maize	3
	Sorghum	Minimal
	Millet	Minimal
	G / nuts	Minimal
	Tobacco	Minimal
	Sunflower	0
	Cabbage	3
	Tomatoes	Up to 10 %
	Rape	5
	Onions	1
	Oranges	5
Livingstone	Maize	1
	Sorghum	Minimal
	Millet	Minimal
	G / nuts	Minimal
	Tomatoes	15
	Cabbage	5
	Onions	0

	Rape	10
Kazungula	Maize	1
	Sorghum	Minimal
	Millet	Minimal
	G / nuts	Minimal
	Tomatoes	10
	Cabbage	5
	Onions	0
	Rape	10

Source: ZDMC survey team

(j) Existing co-operatives and water users associations

Co-operatives have for a very long time been a common form of farmer organization. However in recent year the role of these critical organizations has from time to time changed under the influence of government policies. For example instead of co=operatives being farmer driven to address members' production, marketing, and development needs, they at present largely operate as primary conduit for channeling government input support to farmers. In all districts surveyed there are large numbers of co-operatives set up for this purpose. They become active at the beginning of the rain season and fall dormant thereafter. The data tables submitted with this report shows the number of agricultural co-operatives and their membership.

(k) Difficulties common to post harvest management.

The survey of the targeted districts identified the following as the major issues common to post harvest management:

Insufficient and unsuitable storage facilities with regard to growers and all categories of middlemen

Impassable roads in and out of production areas, especially at the start of the dry season

Farmer groups for example co-operatives are not focusing on the long term and critical needs of members such as capacity building

Low adoption rates of new technologies in post harvest management leading to post harvest loses

2.2.2 Marketing

2.2.2.1 Overall Marketing Channels

Tables submitted with this report give an elaborate presentation of overall marketing channels connecting all actors in distribution of each commodity from production up to consumption including inter district and inter province movements. The development of these channels depends to a very large extent on the economic and commercial significance of the commodity. In this regard three typical channels for three different categories of commodities are significant.

(a) Maize

Maize marketing is dominated by the Food Reserve Agency (FRA), middlemen, large scale grain merchants who are agents of large processors, and growers. The relative share of the various actors

depends on a district basis on the availability of the commodity. In years of high production middlemen and grain merchants take up to seventy (70) percent with the remaining thirty (30) percent distributed by the FRA. The reverse is the case in years of lower production. An interesting development with regard to middlemen is an extension and development of the grower/buyer relationship in which the middlemen finance inputs for production of the commodity. On the basis of this arrangement a commodity sharing scheme is agreed upon to the mutual benefit of both parties. For example, for every 50 Kg bag of fertilizer provided by the middleman, the grower pays 5 by 50 Kg bags of maize.

(b) Cotton

Cotton has a well established marketing channel throughout grower management schemes which operate under different conditions. Basically, the out grower manager, in association with a service provider known as a distributor, finances the production of the commodity and guarantees the market based on pre planting prices quoted in local currency.

(c) Vegetables

The marketing channels for vegetables are dominated by small scale growers and middlemen/traders and marketers/retailers. Others are input and equipment suppliers. By the nature of fragmentation of production and supply of vegetable commodities, all actors in the marketing and distribution chain of vegetables have failed to realize the full benefits of production, marketing and distribution of vegetable commodities. Even in situations where institutional arrangements such as co-operatives are in place, members still prefer to operate outside the main framework of these institutions. A case in point is the co-operative irrigation scheme at Nkandabwe where member growers source markets for their produce individually in neighboring districts of Choma and beyond. The same situation is applicable to fruit growers and traders.

2.2.2.2 Approximate Proportion of Each Channel

As stated in 2.2.2.1 above, the approximate share of each channel by the various players on the marketing and distribution chain is dependent on the type of commodity, the district, and the volume of production. In terms of the commodity, well established commodities tend to attract large actors whereas fruits and vegetables are dominated by small traders/middlemen and marketers. The data tables submitted with this report show an elaborate approximation of proportions of each channel.

2.2.2.3 Business Type, Function and Number of Each Actor

In all targeted districts except for Gwembe and Sinazongwe, which lie off the main supply routes, there is considerable presence and representation of actors in the marketing and distribution chain. These include, apart from individual growers, input suppliers, equipment suppliers, large scale retailers, processors etc. Data tables submitted with this report give a comprehensive picture of the business type function and number of each actor.

2.2.2.4 Distribution Amounts of Target Commodities within the District and by Origin

Management of commodity distribution in all targeted districts is not placed in a central authority or agency which collects this data. While the Food Reserve Agency may maintain some data on the purchases and distribution of maize, this is not done by middlemen who operate informally, and whose marketing and distribution activities in some districts account for over 70 percent of maize purchases in some districts. Therefore, in order to obtain an indication in quantities of commodities distributed within districts, between districts, and between provinces, estimates of distribution amounts of targeted commodities was based on quantities handled and distributed by the Food Reserve Agency as proxy for the general situation. In all targeted districts, the majority of commodities distributed by middlemen/merchants were between districts and provinces.

2.2.2.5 Transportation (Route, forwarder by Full Time Vehicle, Condition of Road)

The general transportation situation in all targeted districts may be analyzed at different levels as follows:

(a) Road network

The road network linking the major districts from Monze to Kazungula is in a satisfactory state. However roads leading to Sinazongwe and Gwembe off the main supply route from Livingstone to Lusaka require attention. The feeder roads the production areas to the district centers were reported to be unsatisfactory especially during the rainy season and immediately thereafter.

(b) Transporters

There are a number of categories of transporters. At the higher level, out grower managers maintain a fleet of vehicles used to collect cotton from collection depots to processing facilities. The middlemen depending on the levels of operations maintain a fleet of trucks or hire from established transporters or individual owners of trucks. In seven targeted districts, Kalomo stands out as one district with the highest number of transporters and light truck owners. This is one district in which a middleman/grain merchant/input distributor has over ten trucks one truck which is over 30 tones. Transporters operate on full time basis transporting whichever commodities require transportation. Data tables submitted with this report show the overall transportation situation in the targeted districts.

2.2.2.6 Growers' Typical Marketing Pattern.

Proportion and basis of conduct of transactions.

In all targeted districts, transactions in agro commodities are predominantly on individual basis. Even in situations where growers are organized formally, such as in cooperatives, individual members will sell their produce on individual basis.

For example, in Sinazongwe, members of Nkandabwe Cooperative Irrigation Scheme reported exclusively transacting on individual basis without suffering any form of sanctions from their cooperative executive board. The data sheets submitted with this report show that individual transactions for most of the targeted commodities in the targeted districts account for percent of total transaction

Chapter 3 Copperbelt Province

3.1 Introduction

In the Copperbelt province, a wide variety of both wet and dry season crops are grown. These include both food (staple) and commercial crops. Although in almost all districts crops are grown for commercial purposes, there is always an element for retention for home consumption in variable degrees. Some of the major crops grown include maize, cassava, beans, groundnuts, finger millet, cowpeas, Mbambara nuts, wheat, rice, sweet potatoes for the wet season; and tomatoes, cabbages, onions and rape for both wet and dry seasons. Wheat is a major production of Mpongwe district under irrigation by some of country's largest farming enterprises. Thus in nutshell the picture one gets when looking at marketing structures of produce from producer to consumer is as follows:

3.2 Summary of Main Findings

3.2.1 Geo-Economic Position of the Copperbelt Province

The Copperbelt shares a very long border with the Congo D. R. and lots of imports of commodities from other provinces find their way into Congo through official and unofficial trade. This presents a very big opportunity for the development of smallholder category of farmers to take advantage of this market. It is estimated that more than ZMK 2.5 billion of commodities go through Kasumbalesa border in Chililabombwe every month(see Appendix 1).

As is clearly evident from Appendix 1, there are limitless opportunities for export trade in agricultural commodities between the Copperbelt province and neighboring Congo DR. However, this potential remains un exploited due to low level of productivity among smallholder farmers within the province.

Existing farmer groups amongst the smallholders have not taken advantage of prevailing market opportunities to add value to their produce by pooling resources and packaging their produce and supplying directly to supermarkets and main markets where prices are far much better than farm-gate prices.

3.2.2 Production of Agricultural Commodities

The Copperbelt is a deficit producer of almost all commodities and relies on the imports from other districts. Some districts do however produce more than their own requirements for the commodity. For example Masaiti, Mpongwe and Lufwanyama each produce more maize than their own population demands.

The Copperbelt province lies in a high rainfall region in Zambia. This means that the soils are highly leached and acidic, meaning a soil amendment program with agricultural lime and other soil conservation practices are important and a necessity for soil productivity.

This is one of the reasons why smallholder producers have very low yields per hectare of maize while large scale commercial farmers have higher yields. For example a smallholder may produce only 1.3 Mt / Ha of maize while the commercial farmer may have yields of 5.1 Mt / Ha.

Many smallholders are not involved with the production of Soybeans because of harvesting problems

as the crop has a short shutter period after maturity (presenting harvesting problems) and is perceived to present difficulties with preparation for consumption even though it is very nutritious.

Many smallholders have hugely depended on the Fertilizer Inputs Support Program (FISP) for many years and are unable to graduate to a higher scale of farming business because their small land holdings are too small. Thus the cycle of low productivity and dependency on government support facilities continues. The proportion of those who practice crop diversification and all year farming with other crops other than monoculture with maize is also small.

The low productivity of the smallholder groups is a result of failure to adopt technologies that can enable them to produce crops even in the face of harsh environmental conditions which are conducive of high disease and pest incidence. This shows up in the very high prices at certain seasons (January-March) because of the short supply of tomato and onions for example. This is further suggestive of poor extension-farmer and marketing linkages as the drivers of enterprise are availability and use of information (see Tables 5 and 6 below).

Table 5 Estimated production of vegetables (overview)

District	Population	Est. % of Households	Est. no. of Households	Tomatoes		
				Est. ha	yield / ha	Production
Chililabombwe	109,900	1	1,099	137.5	13	1,786
Chingola	202,000	0.5	1,010	126	13	1,641
Kalulushi	60,000	5	3,000	375	13	4,875
Kitwe	1,200,000	0.2	2,400	300	13	3,900
Luanshya	208,026	0.5	1,040	130	13	1,690
Lufwanyama	60,000	1	600	75	13	975
Masaiti	95,000	1	950	119	13	1,547
Mpongwe	69,000	1	690	86	13	1,121
Mufulira	200,000	1	2,000	250	13	3,250
Ndola	461,000	1.2	5,532	691	13	8,983

Source: ZDMC survey team

Table 6 Estimated production of vegetables (detailed)

District	Cabbage			Onion		
	Est. ha	Est. yield / ha	Est. Production	Est. ha	Est. yield / ha	Est. Production
Chililabombwe	137	42	5,754	68	17	1,156
Chingola	126	42	5,292	63	17	1,071
Kalulushi	375	42	15,750	188	17	3,196
Kitwe	300	42	12,600	150	17	2,550
Luanshya	130	42	5,460	65	17	1,105

Lufwanyama	75	42	3,150	38	17	646
Masaiti	119	42	4,998	59	17	1003
Mpongwe	86	42	3,612	43	17	731
Mufulira	250	42	10,500	125	17	2,125
Ndola	691	42	29,022	346	17	5,882

Source: ZDMC survey team

3.3 Number of Growers

These growers' numbers are reported for the year 2008/2009 in the CSO reports. The consultants' view is that these numbers could hold true for the past five (5) years. The only significant change which could affect this assumption could be in the traditional farmers scale. These could tend to increase depending on the farmer inputs, support program (FISP). All reports of the DACO's which are compiled by the PACO have tended to show the traditional and emergent scale production by crop as one group. SM in the reports thus indicates production and sales by the small scale (traditional) and medium scale (emergent). When grouped as such production figures do not show therefore how much hectarage to the total production was the contribution by a single category of farmers. All the records however distinguish the production by the commercial farmers, by hectarage and by commodity.

3.4 Availability of Post harvest Machines / Equipment and Storage Facilities

Storage infrastructure and related equipment including the availability of post harvest machines was not assessed because of the vast array of marketing channel actors and the limited time given to the survey. (An assignment to assess only government owned storage facilities alone could take at least a month.) In addition the private enterprises are reluctant to release information any how especially on income and expenditure, and even storage facilities they own because of the fear to have the information passed on to their competitors. It took 3 days before we could secure an appointment with Olympic Milling in Ndola but Chimanga Changa Milling refused completely even after we produced a signed letter from JICA.

3.5 Post-Harvest Losses

There is no documentary information on post harvest losses on commodities but practical experience and observation is helpful in such situations. Cereals and small grains are exposed to various degrees to a number of environmental factors such as insect pest infestation, high humidity and temperature which are conducive for the proliferation of stored product pests.

Prolonged storage of grains, especially for strategic reserve is only possible in silos but of the FRA owned grain silos only the Lusaka one on Mwembeshi is operational after rehabilitation and refurbishment. On the hard standings and grain sheds losses can go as much as 40% in season.

Storage capacity exists in the private sector and is used very efficiently indeed with as minima losses as possible (a true spirit of proprietorship of enterprise). Losses among fruits and vegetables vary but can be very high indeed among highly perishable commodities like tomato and bananas and can reach as much as 90% if there is no refrigeration.

3.6 Availability of Irrigation

A very small percentage of land is irrigated during the dry season in all the districts with a range of 0.01% (Lufwanyama district) to 11.10% (Mpongwe district) of the total hectarage under production. On average only 2.23% of aggregate land under crop production in the Copperbelt is irrigated. The larger irrigation percentage in Mpongwe district is under Commercial agriculture by some of the largest farming enterprises in Zambia. Mpongwe Development Company is one of the largest grower of irrigated wheat and soybeans with about 30,000 hectares under coffee (also irrigated during the dry season), wheat, soybean and maize. Most of the smallholders who irrigate their crops during the dry season have very small holdings indeed and irrigate Cabbage, Chinese cabbage, Rape, Onion, Impwa (African eggplant),and Tomato. The irrigated vegetable land can range from a few seed beds of about 1/8 Lima to 2 Limas (4 limas =1 Ha). In the Kafubu farm block (Luanshya) and Ipafu Farm Block (Chingola) we observed that some growers do grow as much as 1 Ha or 2 Ha depending on their ability to actually manage the irrigation.

Table 7 Availability of Irrigation (% to whole cropping area) for Wet and Dry season

District	Availability of Irrigation (as % of total cropped area)	Source of Irrigation
	Dry Season	
Chililabombwe	0.25	Rivers, Dambos Streams
Chingola	0.72	Dambos, Streams, Ponds
Kalulushi	5.5	Ponds, dams, streams
Kitwe	4.5	Dams, Streams and Rivers
Luanshya	0.3	Dams, Streams and Rivers
Lufwanyama	0.01	Dams, Dambos and Streams
Masaiti	0.11	Dambos, Streams, Ponds
Mpongwe	10.1	Rivers, Dambos, Streams And Boreholes
Mufulira	0.25	Streams, Rivers and Dambos
Ndola	0.6	Dambos, Ponds, Rivers and Dams

Source: ZDMC survey team

The management of irrigation is a very important in realizing the full yield potential of a particular crop. Among the small holders in the Copperbelt the most common method of irrigation is bucket irrigation while others depend on furrow, basin, Dambos (Residual moisture) furrow and a few have ventured into drip irrigation. At Ipafu farm block drip irrigation was practiced for some time until power was cut by the utility company ZESCO for failure to settle electricity bills. The choice of irrigation has thus largely depended on labour availability, source of water, size of production and practical considerations such as soil types.

Bucket irrigation though being the cheapest and the most common used method by small holders is extremely demanding in terms of labour and is in fact not even efficient and the concomitant effect of that method is that it places a limit on the area that can be covered by cultivation. Of course bucket irrigation is versatile in that the source of water can be a stream, a well, or a dam. Furrow irrigation is

practiced among smallholder vegetable producers especially where water is not limited as is the case among the farmers at Kafubu or Ipafu (See pictures). It is a low cost method of irrigation where water is transported from one point of the field to the other via sloping furrows but to achieve this flow it is necessary to level and grade the land to a required slope with a 1-2% gradient. Its attendant effects are erosion of soils and proliferation of birharzias or parasitic worms where these are endemic and public health authorities tend to discourage this method of irrigation for this reason.

Ndola and Kitwe districts have admittedly higher numbers of small holders into vegetable irrigation production as compared to Lufwanyama and Masaiti or even Mufulira and Chingola. This could be a combination of a number of factors including an awareness of the huge demands of vegetable products and the profitability, therefore of vegetable production; that most retrenches and retirees from the mining and other industries have tended to settle in peri-urban areas after separation from their former productive employment and they tend to use the land holdings they acquire to productive activities such as poultry production and vegetable production. About 50% of the settlers at Kafubu block had worked for the mines before recruited as producers on the "Out-grower scheme" (That is before the out-grower scheme collapsed).

3.7 Marketing

3.7.1 Market Channel Actors

In a liberalized marketing environment market actors are virtually free to purchase commodities from anywhere within the country and facts on the ground are not the ones expected. For instance, the surplus maize in Mpongwe and Masaiti is usually pre-sold on contract to the large players Antelope Milling and Olympic Milling and the surplus in Lufwanyama is virtually the preserve the of the FRA because most of the producers are smallholders. Antelope milling's distribution meanwhile also goes as far as North Western. Also National Milling from Lusaka also supplies the void in the Copperbelt produced by insufficient production of Maize; other players like Chimsoro Milling from central province are also involved in the Copperbelt.

3.7.2 Input suppliers

One can also note the complete dominance of Nyiombo Investments in the fertilizer supply subsector who supply almost 90% stocks annually in the province and are the only contractors for the supply of fertilizer on the government's FISP project which supports smallholders nationwide. Nyiombo are proactive and informed us that they already have a ship on seas with 30,000 Mt fertilizer for the 2010/2011 season. One can also observe the selling of pre-packs of fertilizers in all the main markets, the pre-packs of 1 Kg, 5 Kg being targeted at the back yard gardener in the townships.

Kitwe has a large concentration of agrochemical and agri-equipment suppliers who service other districts because of their proximity to Kitwe, for example Kalulushi, Lufwanyama and Mufulira and Chingola.

3.7.3 Forwarders (Transporters)

Hundreds of 3.5 to 5 ton trucks and 10 to 30 ton capacity trucks can be observed plying their

transportation trade role but there is no central place where data base is kept and the routes they ply. Small grains, cassava and beans are transported from Luapula and Northern provinces, while groundnuts come into the Copperbelt from Eastern province and from Kabompo district in Northwestern province.

3.8 Main Markets

Main markets play a pivotal role in the Value chain from small holders to consumers for many the commodities because they act as centers of distribution within the town and also to other towns. They also acts as centers where actors add value by processing such as grinding maize or millet and sorghum in the mini mills within the market. In fact artisans are proactive that peanut processing machines and groundnut mini processor for producing groundnut power are fabricated and assembled by the artisans themselves.

3.9 Commodity prices

The prices obtaining at these markets for most produce, especially vegetables far exceed that at the farm gate but the beneficiaries are not the producers but the marketeers and wholesalers. For example the price of box of at the farm gate could be ZMK 10,000 while the price at the market for the same box could be ZMK 50,000 (December). The transportation cost per box of only ZMK 5,000 from Kafubu in Luanshya to Main Masala in Ndola. This means the producer has lost over ZMK25,000 in the value of his produce If he were to sale by himself. The main beneficiaries of the high market prices are the traders, wholesalers and brokers and retailers at the main markets.

Chapter 4 Lusaka and Central Provinces, Mazabuka and Siavonga Districts

4.1 Introduction

4.1.1 Aims and Objectives of the Survey

The survey of agriculture crops marketing and distribution that was conducted in 23 districts of Zambia IN Southern, Lusaka, Central and Copper belt provinces of Zambia was aimed at contributing to the designing of a Master Plan to Promote Smallholder Irrigation in the Peri-Urban Areas of the country. The specific objective of the survey was to find out how smallholder farmers could be assisted to earn more income by improving the marketing and distribution of top agricultural commodities produced in their areas. This was because marketing and distribution of commodities has been identified by JICA and the Zambian government as the main problem which makes it difficult for smallholder farmers to increase production of irrigated commodities such as fruits and vegetables in the peri-urban areas of Zambia.

Production of top 3 Commodities in the Districts Surveyed

The survey is expected to contribute towards improved marketing and distribution of agricultural crops. As demand for crops is increased, then smallholder production of irrigated crops can be expected to increase. In this regard, the survey included a baseline survey of current production levels of top 3 major commodities. The commodities which were in four categories, cereals, industrial crops, fruits and vegetables are given in Appendix 1 of this report.

It is evident from the data in Appendix 1 that there is hardly any on fruits and vegetables. This is attributed to the fact that neither the Central Statistical Office (CSO) nor the Ministry of Agriculture and Cooperatives (MACO) collects any data and information on fruits and vegetables. They collect data and information on cereals and industrial crops. However, some crop production data on fruits and vegetables was collected in selected districts such as Chongwe, and this is shown in Table 8 below.

Table 8 Production of Top Fruits and Vegetables in 2008/2009 Farming Season, Chongwe District

Type of tree crop	No. of households growing tree crop	Average no. of trees per household	Total no. of trees	Average area per Tree sq. m	Households covered all trees
Mango	625	5	3,125	125	4
Guavas	208	3	624	7	0.4
Bananas	333	3	1,000	7	0.7
Lemon	167	2	334	7	0.2
Orange	83	1	83	7	0.05
Sweet bearings	83	2	166	7	0.1
Paw paw	83	1	83	7	0.05

Source: Field survey (calculations based on assumptions provided by MACO Technical Services Branch)

In addition, efforts have been made by the survey team to estimate fruit and vegetable production using expert advice and assumptions provided by the Field Services Branch of MACO, and experience gained while interviewing smallholder farmers under irrigation schemes. This data is presented in Table 9 below.

Table 9(a) Average Production of Vegetables in each of the Districts Surveyed for the Most Recent Year, 2008/2009 Framing Season

District	Population of vegetable growers	Average Yield (Mt per ha)				Total Production (Mt)			
		Tomatoes	Cabbage	Rape	Onion	Tomatoes	Cabbage	Rape	Onion
1. Lusaka	200,000	35	56	22	33	875,000	1,400,000	550,000	825,000
2. Kafue	6,000	27	54	19	17	20,250	40,500	14,250	12,750
3. Chongwe	12,500	35	50	19	30	54,688	78,125	29,688	46,875
4. Kabwe	23,150	29	49	19	28	83,919	141,794	54,981	81,025
5.Chibombo	30,000	29	49	21	29	108,750	183,750	78,750	108,750
6.Kapiri Mposhi	11,700	29	46	22	29	42,413	67,275	32,175	42,413
7.Siavonga	722	28	46	20	26	2,527	4,152	1,805	2,347
8.Mazabuka	7,203	28	42	18	17	25,211	37,816	16,207	15,306

Source: Field Survey (calculations based on assumptions provided by MACO Technical Services Branch)

In order to appreciate how Table 9 (a) above has been derived, following below are the assumptions.

4.1.2 Scale of production

4.1.2.1 Upper limit for small scale producers

1/2 a lima per grower. However individual crops scale is variable within this limit, that is tomatoes

and cabbage are not at a higher scale compared to rape and onions.

Number of growers per crop

Initially, it was assumed by the consultants that between 5-10% of the total population in the district would grow fruits and vegetables, depending on the location that is, peri-urban or typical rural district. Officials at MACO advised that up to 50%. Of the population would be growing fruits and vegetables. This has proved unreasonable as total production of fruits and vegetables became un reasonable. Consequently, on the basis of the experience consultants had while interviewing smallholder farmers in selected irrigation schemes, it is suggested that becomes the basis for estimating total production of fruits and vegetables. In this regard, it is estimated that 5-10% of the total population in the district will be growing fruits and vegetables in less urbanized areas of Zambia. In Lusaka, Kabwe and Copper belt areas with high levels of urbanization and consequent high demand and production of fruits and vegetables, the proportion of the population growing fruits and vegetables should be estimated to be up to 15%.

Outputs for different varieties of vegetables

Table 9(b) Average Yields for Cabbage

Cultivated (variety)	Yields (Mt / ha)			
	Winter	Summer	Rainy season	-Average-
1.Gloria f1	82	42	43	56
2.Rana f1	72	48	41	54
3.Ray f1	72	35	44	50
4.Rotan f1	74	39	34	49
5.Golden age	68	37	36	49
6.Jkgross f1	53	36	50	46
7.Trunswide ladu	55	43	39	46
8.Copenhagen reaket	65	29	31	42
9. Mareamba	88	65	51	68

Source: Field Survey (calculations based on assumptions provided by MACO Technical Services Branch)

Table 9(c) Average yield for Tomatoes

Cultivated (variety)	Yields (Mt / ha)		
	Winter	Summer	Rain season
1.Heinz 1370	48	25	14
2.Herald	61	25	18
3.Reoney make	47	22	13
4.Monoprecos	45	22	19
5.Red khaki	55	30	15
6.Roforto VFN	54	25	12
7.Roma VF	51	25	22
8.Rosso VFN	51	27	14

Source: Field Survey(calculations based on assumptions provided by MACO Field Services Branch)

Table 9(d) Average yield for Onion

Cultivated (variety)	Yield (Mt)
Red gonnex	17
Henry special	33
Early lockyer brown	28
R 2374	23
Tropic ace F1	27
Yellow grannex F1	29
Texes early grano	29
Yellow dessex F1	33
Red creole	26
Pusa red	35

Source: Field Survey(calculations based on assumptions provided by MACO Technical Services Branch)

Table 9(e) Average yield for Rape

Cultivated (variety)	Average Yield (Mt / ha)
CRRS prior	22
N1RS	19
Samo	19
Karale	19
Nanga	22

Source: Field Survey (calculations based on assumptions provided by MACO Technical Services Branch)

Table 9(f) Estimates of vegetable growers in each of the districts surveyed

District	Proportion (%) of Vegetable Growers	Population	Number of Vegetable Growers			
			Tomatoes	Cabbages	Rape	Onion
1.Lusaka	10	2,000,000	200,000	200,000	200,000	200,000
2.Kafue	3	200,000	6,000	6,000	6,000	6,000
3.Chongwe	5	250,000	12,500	12,500	12,500	12,500
4.Kabwe	5	463,000	23,150	23,150	23,150	23,150
5.Chibombo	10	300,000	30,000	30,000	30,000	30,000
6.Kapiri Mposhi	5	234,000	11,700	11,700	11,700	11,700
7.Siavonga	1	72,162	722	722	722	722
8.Mazabuka	3	240,116	7,203	7,203	7,203	7,203

Source: Field Survey (calculations based on assumptions provided by MACO Technical Services Branch)

Table 9(g) Average yield of Vegetables per Lima by district

District	Average Yield (Mt per ha)			
	Tomatoes	Cabbage	Rape	Onion
1.Lusaka	35	56	22	33
2.Kafue	27	54	19	17
3.Chongwe	35	50	19	30
4.Kabwe	29	49	19	28
5.Chibombo	29	49	21	29
6.Kapiri mposhi	29	46	22	29
7.Siavonga	28	46	20	26
8.Mazabuka	28	42	18	17

Source: Field Survey (calculations based on assumptions provided by MACO Technical Services Branch)

4.2 Summary of Main Findings by District

4.2.1 Chongwe District

4.2.1.1 Distribution/Marketing Channels and Actors

In Chongwe district the main marketing distribution channels for the top 3 commodities of cereals, industrial crops, fruits and vegetables from production up to final consumption are shown in Table 1 of Appendix 3). According to this Table, 90% of the maize in Chongwe is produced within the district, except for a small proportion, 8% and 2% which comes, respectively, from other districts in Lusaka province and other provinces. The main buyers of maize are FRA which purchases more than 75% of the commodity. Only a smaller proportion, 25% is bought by private traders who are middle men.

Most of the industrial crop, cotton (85%) which is grown in Chongwe district is sold to Dunavant, the out-grower scheme manager. Dunavant purchases up to 65% of the crop. The remaining 35% is purchased by other out-grower scheme managers.

With regard to fruits and vegetables, again Chongwe district is self-sufficient. 70% and 95% of fruits and vegetables, respectively are grown within Chongwe. Most of these crops are sold at Chongwe main market, and only a little is sold at Soweto market in Lusaka.

4.2.1.2 Institutional Arrangements

The smallholder farmers' organizations such as farmer groups and cooperatives were found to be weak. They are formed with the primary objective of accessing subsidized fertilizers under the government supported Fertilizer Input Support Program (FISP). They do not do much in term of improving access of their members to marketing and distribution systems. In particular, the few cooperatives and farmer groups involved in vegetable production conducted individual marketing. That is they sold vegetables as individuals. It was difficult for them to sell vegetables as a group because they lack refrigeration facilities such as cold rooms. Being perishable commodities, farmers can not wait for other members' vegetables to be ripe, bulk them and sell as a group. Another reason is timing of vegetable production. Farmers want to time production in such as way that they can supply to the market when vegetables are scarce and earn more profit.

Furthermore, as a result of weak institutional arrangements, it is difficult for smallholders to earn

higher profits in Chongwe district. For example, smallholder farmers in Chongwe are dependence on Dunavant as the out-grower scheme manager. If Dunavant collapsed, the cotton farmers would also find it very difficult to sell their cotton. Another challenge for smallholders is that the government usually announces the floor price of maize in June or July at the official commencement of the crop marketing season. Since the farmers are desperate for cash, they end up selling their maize to middle men, often at half the floor price which the government announces later. In addition, the government owned FRA only buys maize, and to a limited extent rice. FRA also lack adequate funding, and therefore, can not buy most of the maize produced by smallholder farmers. Consequently, they have to sell their crops to middle men and other agents..

4.2.2 Lusaka District

4.2.2.1 Marketing Channels and Actors

Lusaka the capital city of Zambia has an estimated population of 2 million inhabitants. The demand for food by this large population is high. However, 90% of the cereals crops(see table 2 of Appendix 2) are produced within the district mainly by commercial farmers, and a small proportion, 8% comes from other districts and provinces.

Some of the maize, 25% is produced within Lusaka, but a relatively large share, 70% comes from other provinces such as Central and Eastern provinces. A substantial proportion, 80% of the maize is destined for Lusaka, and FRA, Milling and Brewing companies are the major buyers.

A smaller proportion, 10% is estimated to be exported to other countries, particularly Congo Democratic Republic and Angola when there is a surplus of production at national level.

Cotton as an industrial crop is grown within Lusaka district by smallholders under an out-grower arrangement with companies such as Dunavant. Most (80%) of the cotton sold to ginneries in Lusaka comes from other districts and provinces. Apart from selling cotton to Dunavant, small proportion, 7% is sold to small-scale enterprises that use it to make sofas and other household furniture.

Lusaka produces fruits all year round on commercial farms, but most of it, 95%(15% within Lusaka district and 85% other districts) is grown in the peri-urban areas, other districts of Lusaka province and other provinces such as Kabwe and Chibombo. Close to 90% of all the fruits are destined for Soweto market, the largest market in Zambia. From Soweto market fruits find their way to other districts and provinces such as Kafue, Livingstone and Siavonga.

Like fruits, vegetables are also grown by commercial and smallholder farmers in the peri-urban areas of Lusaka. Together these growers are estimated to account for close to 40% of total vegetable production that finds its way to Soweto market. It must be noted, however, that a substantial proportion of the vegetables that are sold in Lusaka are grown in other provinces particularly, Chibombo, Kafue, and Kapiri Mposhi. 80% of the vegetables, just like fruits are destined for Soweto market in Lusaka.

4.2.2.2 Weaknesses of the Marketing and Distribution System

This survey found that farmers who grow cereal crops like maize are dependent on FRA as the main customer. However, un like in other towns, farmers in Lusaka district have other customers, particularly Milling and Brewing companies.

With regard to industrial crop, particularly cotton, farmers don't only depend on Dunavant but there also other out-grower scheme managers who have come on the scene. Out-grower scheme managers are the main buyers of cotton, and a few enterprises that use cotton to make household furniture. In spite of this, the point to note is that since there are fewer large scale buyers of cotton compared to other crops, and the price of cotton is pegged in United States Dollars (USD), exchange rate fluctuations results in either gains or losses for farmers. Often times they incur losses when the Zambian Kwacha becomes strong. In the last 3 years, smallholder farmers have found it unprofitable to grow cotton following strengthening of the Zambian Kwacha against the United States Dollars(USD). This came to light in both Chipapa and Chunga irrigation schemes when the survey team interviewed smallholder farmers.

4.2.2.3 Institutional Arrangements

In addition to the above, the survey found that smallholder farmers who sell their crops, particularly fruits and vegetables at Soweto market are selling through marketing agents on a 10% commission. The commission reduces their profit margins (see Appendix 3.).

Smallholder farmers are forced to sell their fruits and vegetables through middlemen because though some are organized into irrigation cooperatives such as in Chipapa and Chunga, their cooperatives are not involved in selling vegetables and fruits on behalf of their members because individual members prefer to sell on their own to avoid their crops being wasted. Their crops are perishables and there are no cold rooms and other preservation facilities owned by cooperatives. At New Soweto market in Lusaka, cold room facilities are have been put in place, but irrigation cooperatives have to negotiate with Lusaka City Council to store their members produce.

Another difficulty for smallholders which makes tit difficult for them to sell through marketing agents is lack of selling stand at the new Soweto market. Their cooperatives should negotiate for a selling space/stand at Soweto market in Lusaka.

4.2.3 Kafue District

4.2.3.1 Marketing Channels and Actors

It is estimated that about 10% of the maize consumed in Kafue is grown within the district. Most of the maize comes from other districts in Lusaka provinces as well as other provinces, particularly Central province, whose share is estimated at 90%. A smaller proportion, 5% of the maize is consumed within Kafue district, while 60% and 35% is destined for other districts in Lusaka province and the Copper belt province which have large populations.

Cotton and of late, sugar cane are industrial crops grown in Kafue district, in addition to rice which has been grown in Chanyanya area of Kafue. It is estimated that 15% of the cereals are grown in Kafue district, 25% in other districts of Lusaka province, and the remaining 50% is actually grown by other provinces. Most of the provinces in Zambia when they produce crops, they sell them in Lusaka, Copper belt and other urban centers such as Kafue.

The main fruits grown in Kafue district are bananas which are grown in Chiawa area. Production

within Kafue district in Chiawa accounts for almost 70%. Other districts within Lusaka province grow about 30%. Most of the bananas are sold at Soweto market in Lusaka, and some find their way to the Copper belt province of the country.

Kafue produces a relatively smaller proportion of vegetables within the district, estimated at 20%, while other districts in Lusaka province produce about 30%. The remaining 50% is grown by farmers in other provinces particularly Central province. Soweto market in Lusaka receives about 60% of the vegetables, and some of them reach as far as the Copper belt province and Livingstone in Southern province

4.2.3.2 Marketing / Distribution System and Institutional Arrangements

The major weaknesses found in the marketing and distributions of crops in Kafue district are summarized below as follows:

Weak cooperatives that focus on accessing cheap fertilizer and maize marketing to FRA;

Cooperatives for irrigation schemes which focus on ensuring availability of irrigation systems for production of fruits and vegetables and other crops, but neglect the joint marketing by members;

Lack of any institution or large buyers such as retail chain stores(e.g. Shop Rite) and other market actors such as FreshPikt to operate a “horticultural out-grower schemes” that would guarantee a good price and margins for smallholders involved in fruit, vegetable and production of other irrigated crops including green maize.

4.2.4 Kabwe District

4.2.4.1 Marketing Channels and Actors

This survey found that 90% of the maize in Kabwe is grown from within, and only 5% comes from other districts of central province including an equal proportion (5%) which comes from other provinces. 70% of the maize is destined to FRA sheds in either Kabwe, Chibombo or Kapiri Mposhi depending on the distances since these three districts are close to one another.

100% of cotton is grown in Kabwe district under an out-grower scheme, of which Dunavant is a major player. A substantial proportion, 85% of the cotton is bought by Dunavant which takes it to its ginneries in both Kabwe and Lusaka.

Most, 80% of the fruits found in Kabwe are grown from within the province. All(100%) of the fruits are destined for Kabwe Green Market.

Vegetables are abundant in Kabwe, because an estimated 95% are grown in Kabwe district. 70% of these vegetables are sold in other districts of Central province, particularly Chibombo and other provinces, namely Lusaka. Only a smaller share, 5% is sold within Chibombo or goes to Kabwe.

4.2.4.2 Marketing / Distribution System and Institutional Arrangements

Like in other districts, FRA is the major buyer of maize. Out-grower scheme managers such as Dunavant are the key and major buyers of cotton, the industrial crop. These buyers operate in a monopoly market. One of the problems of a monopoly market is that they dictate prices of commodities in such a way as to benefit themselves and not smallholder farmers.

4.2.5 Chibombo District

4.2.5.1 Marketing Channels and Actors

An estimated 80% of the cereal crops, especially maize found in Chibombo is grown within the district. 60% of the maize is sold to FRA satellite depots in either Chibombo or Kabwe, depending on the distances since these tow districts are very close to each other. However, a substantial proportion, 30% of the maize is sold to milling companies such as Chimsoro in Kapiri Mposhi and small-scale brewing companies in Kabwe. Very little, say up to 10% of the maize is sold directly to consumers on retail at the open market such as the Kabwe Green Market located in town centre.

A large proportion of the cotton(100%) found in Chibombo is grown within the district. 90% of this amount is sold by smallholder farmers to out-grower scheme manager, Dunavant. A smaller share, 10% is sold to small-scale enterprises making furniture.

Chibombo is well known for growing of water melons. Water melons together with other minor fruits such as bananas are all(100) grown in Chibombo. Again, 100% of the fruits, particularly the famous watermelons are sold within Chibombo district, at the Chibombo and Lusaka junctions. Thus, almost the entire 100% of these fruits are destined for either Lusaka or the Copper belt province.

Similarly, vegetables estimated at 100% that are found in Chibombo are grown within the district.. Like fruits, they are sold at the Lusaka and Chibombo main junction and an estimated 90% are destined to either Lusaka or the Copper belt provinces.

4.2.5.2 Marketing / Distribution System and Institutional Arrangements

The weaknesses in the marketing arrangements associated with farmer groups and cooperatives found elsewhere in other districts surveyed were also found to exist in Chibombo. FRA is the main large buyer of maize. It does not buy other cereals not even industrial crops, fruits and vegetables. The smallholder farmers are dependent on FRA just as they are on Dunavant and other out-grower scheme buyers of industrial crops, particularly cotton. In addition, the survey found that farmer groups were not involved in the joint marketing of fresh crops such as green maize, fruits and vegetables. There were also no large buyers of fruits and vegetables who operated an out-grower scheme that could guarantee a good price and profit for smallholders.

4.2.6 Kapiri Mposhi District

4.2.6.1 Marketing Channels and Actors

All the maize (100%) found in Kapiri Mposhi is grown within the district. The main buyer of maize is FRA, about 90%, and the remaining 10% is sold to Chimsoro Milling Plant and households that buy in smaller quantities at Kapiri Mposhi open market.

All the cotton(100%) found in Kapiri Mposhi is grown within the district. And, almost all of it(100%) is sold to out-grower scheme managers such as Dunavant. It is destined for the Kabwe and other cotton ginneries based on the Copper belt .

A large share, 40% of all fruits and vegetables found in Kapiri Mposhi are grown within the district. However, it must be noted that 60% of the fruits and vegetables, particularly bananas are grown in Chiawa area of Kafue district which are sold at Kapiri Mposhi market and some of them find their

way to the Copper belt towns of Ndola and Kitwe.

4.2.6.2 Marketing / Distribution System and Institutional Arrangements

The fruits and vegetables are transported and sold by private traders, middlemen who buy from the banana irrigation scheme in Chiawa. These middle-men sell low-grade bananas along the way from Chiawa at TurnPark; Chirundu Mazbuka road junction, while high-grade bananas are the ones transported and sold in Lusaka and the Copperbelt province.

4.2.7 Siavonga District

4.2.7.1 Marketing Channels and Actors

Siavonga is a maize deficit area. Only 20% of the maize in Siavonga comes from within the district. A large proportion, 15% and 65% respectively comes from outside the district. Some (20%) of the maize is sold at Siavonga and Kanyerere markets in Siavonga, while most 80% is sold in Chirundu, and Mazabuka. FRA buys about 70% of the maize while middle men purchase the remaining 30%.

All the cotton, 100% like elsewhere, is grown by smallholder farmers within the district. 100% of the cotton is sold to out-grower scheme managers, and in this case Dunavant.

Bananas are the major fruits. It was estimated by mACO staff that 90% of the bananas are grown in Chiawa, Kafue district (that is outside Siavonga) district. Most of the bananas, 70% are destined for Lusaka, Kafue and the Copper belt provinces, while a smaller proportion, 30% is sold within Siavonga district at open markets such as Lusitu market.

Vegetables found in Siavonga that come from within the district tare estimated at 20%, while a large proportion, 80% come from other provinces. Almost all the vegetables, (100%) are destined for Chirundu, Lusitu and Siavonga markets.

4.2.7.2 Marketing / Distribution System and Institutional Arrangements

FRA, out-grower schemes and private traders constitute key marketing arrangements for smallholders. FRA buys the maize from farmer cooperatives, and is key player accounting for almost 70% of the maize purchases. Private traders also purchase a sizable proportion of the maize crop, estimated at 30%. Private traders also purchase bananas from farmers under the Chiawa irrigation scheme, which they take to high value markets in Lusaka, and the Copper belt provinces.

4.2.8 Mazabuka District

4.2.8.1 Marketing Channels and Actors

Mazabuka gets 20% of its maize from within the district, 30% from other districts within Southern province and the balance(50%) from other provinces of Zambia., Within Mazabuka, it is estimated that only 25% of the maize is sold at the local Mazabuka market including Kapinga milling. 15% of the maize is sold to Choma town particularly Choma milling. This means that FRA is the largest buyer of maize accounting for almost 60% of the total maize sold.

Sugar cane is the main industrial crop grown in Mazabuka. It is estimated that close to 95% of the sugar cane found in Mazabuka is grown within the district. With the coming on scene of Kafue Sugar, it is estimated that about 5% of the sugar cane in Mazabuka could in fact originate from Kafue

district.

The major buyer of sugar cane, estimated at 95% is Zambia Sugar Company which operates an out-grower scheme for smallholder farmers. Only 5 % of the sugar cane is sold at the open markets within Mazabuka district.

Fruits, in this case bananas grown in Mazabuka district , are estimated at 10%, while a substantial majority, 80% is grown from other districts, particularly Chiawa, and 10% comes from other provinces. The bananas from Mazabuka are mostly, 70% destined for Lusaka, and the Copper belt.. 20% of the bananas are sold locally within Mazabuka and 10% is also sold in Kafue district particularly at Turn Park, the Chirundu and Mazabuka road junctions.

Vegetables found in Mazabuka, to the tune of 90% are grown within the district. 10% comes from Chiawa. Most of the vegetables, 80% from Mazabuka are sold at Soweto market in Lusaka, 5% are sold within Mazabuka and the remaining 5% sold in Kafue.

Chapter 5 Conclusions and Recommendations

5.1 Conclusions

The survey found that there were a number of crop marketing and distribution problems or difficulties which are faced by smallholders in the peri-urban areas of Zambia. These are summarized below as follows:

5.1.1 Weak Organization and Management of Farmer Groups

The survey has established that most farmer groups such as cooperatives are weak in terms of management. Most of them are formed to access subsidized inputs such as fertilizers and maize seed under the government supported Fertilizer Input Support Program (FISP)., and to sell maize to the government owned Food Reserve Agency (FRA). As a result of their narrow focus, they do not engage effectively in promoting other business activities for their members such as promoting joint marketing and selling of other agricultural commodities, particularly irrigated horticultural crops.

5.1.2 Weak Market Information Systems (MIS)

In all the districts surveyed, it was found individual farmers and farmer groups lacked adequate access to and effective market information system (MIS). Firstly, the market data captured by MACO is limited to only a few commodities such as maize, among the cereals, beans, and groundnuts (legumes), and maize seed, fertilizers and agro-inputs. There is completely no data captured for horticultural crops such as fruits and vegetables. This makes it difficult for farmers to have comprehensive knowledge on prices of commodities at different times of the year, which is essential for them to plan their production and ell of commodities on the market when they can fetch a good price. This is more so for irrigated crops; fruits and vegetables.

Further to the above, it was also found that most farmers had no knowledge of how to use the SMS technology to access market data such as prices of commodities, quantities and buyers and sellers at different markets in Zambia. This facility is now available through the joint initiative of Zambia

National Farmers Union (ZNFU) and Zain Zambia Limited.

5.1.3 Lack of a "Bulking System" for the Sale of Irrigated Crops

Currently, there is no system of collecting irrigated crops by farmer groups to store them at central assembly or collection points before they could be supplied to large buyers. This is because there are cold storage facilities for irrigated crops for framer groups. In addition, farmers interviewed in both Chipapa and Chunga do not have access to refrigerated cold rooms at open markets such as new Soweto market in Lusaka. This makes it difficult for them to store vegetables until the price is high enough. They are left with no option but to sell their fruits and vegetables to middle men at a commission, thus earning less income.

5.1.4 Lack of Out-Grower Schemes for Fruits and Vegetables

This survey found that there were active out-grower schemes for 2 industrial crops, cotton managed by Dunavant and other out-grower scheme managers and sugar cane for which Zambia Sugar Company operates a large smallholder out-grower scheme called Kaleya Smallholding in Mazabuka.

Although these out-grower schemes operate in a near monopoly or oligopoly (few buyers) markets, and dictate prices for the commodities, at least they guarantee a price and a market for smallholders. This is un like the government supported FRA which never guarantees the price of maize at the start of the farming season to enable farmer plan their farming, knowing exactly how much they will get; and the institution is still under-resourced and, can therefore not buy most of the maize produced by small holders!

There is no out-grower schemes for irrigated crops, on lines similar to that cotton and sugar cane described above. This makes it difficult for smallholders growing irrigated crops, particularly in the peri-urban areas of Zambia to increase their production and productivity because they have no guaranteed market and end up earning low incomes or make losses when they grow and sell irrigated crops.

5.1.5 Lower Margins due to High Production Costs of Crops

It was found that for most of the crops, production costs can take up to 60% of the total cost of production. This reduces the profit margins for the farmers.

5.1.6 Selling Crops through Agents

At most of the markets, particularly at Soweto market in Lusaka farmers are forced to sell their crops such as vegetables through agents who are paid between 10% to 15% commission. This practice also reduces the margins for the farmers.

5.1.7 Selling of Crops through Middlemen

Farmers especially those growing maize, are forced to sell their maize to middlemen because the Zambian government delays in announcing the floor price for maize. The floor prices are announced

in May or June each year. And yet by that time the farmers will already be desperate for money. As a result, they sell their maize to middle men at a price which is often 50% lower than the government price at which the Food reserve Agency(FRA) buys the maize. For example this year (2009) farmers were paid ZMK 30,000 for a 50Kg bag of maize when FRA was buying at ZMK 65,000.

5.1.8 Lack of Own Stand at Markets such as Soweto in Lusaka

As a result of not having a stand in the market from where they can sell their crops, farmers at Soweto market sell through agents. This makes them lose money because they have to pay their agents commission estimated at 10% to 15%.

5.1.9 Low Production Volumes, Grading and Quality Standards

Smallholder farmers cultivate fields of up to 5 Ha. Their production volumes for field crops are low, and in the case of maize, the yield per Ha is estimated at not more than 50 by 50 Kg bags. With regard to irrigated crops such as fruits and vegetables, the area under cultivation in Chipapa and Chunga peri-urban areas was found to be 0.25 of a Ha on average and output averaged about 25 by 50 Kg bags. Admittedly, these volumes are lower. Consequently, the smallholder farmers can not sell to large buyers such as supermarket who require a constant supply of vegetable. Packaging, which adds another cost, is another reason why smallholder framers can not sell to supermarkets such as Shoprite who require special packaging branded according to the company requirements.

5.1.10 Monopoly Market for Out-Growers

Out-growers of cotton in Chipapa and sugar cane in Mazabuka were found to be operating in a monopoly market. They depended a lot on Out-grower Scheme Managers such as Dunavant and Zambia Sugar Company to buy their commodities. As a result of this, they don’t have much bargaining power on the setting of prices.

5.2 Recommendations

In view of the above problems or difficulties faced by smallholder farmers, the following recommendations are made:

5.2.1 Weak Organization and Management of Farmer Groups

The Zambian government, through the Cooperatives Development department of the Ministry of Agriculture and Cooperatives (MACO) strengthen its management capacity building program for farmer groups such as cooperatives. One of the areas of concern that requires addressing is changing the mind-set of members of farmer groups to understand that cooperatives should be founded and operated on the principles of carrying out business activities, and not just accessing cheap fertilizers, for the benefit of all their members.

5.2.2 Weak Market Information Systems (MIS)

The Ministry of Agriculture and Cooperatives(MACO) should through its Agri-Business and Marketing department broaden the scope of market information data and information collection and

dissemination to include a range of not only selected filed crops such as maize, agro-inputs(seeds, fertilizer, agro-chemicals, etc), but to include irrigated crops such as fruits and vegetables, and even green maize.

The dissemination media should not be limited to radio and farmer groups meetings, but should include the use of SMS information and communication technology (ICT) modeled on the ZNFU and Zain Zambia Limited imitative. In other words, MACO should explore the possibility of linking up with Zain Zambia and ZNFU in the collection and dissemination of comprehensive marketing data and information.

5.2.3 Lack of a "Bulking System" for the Sale of Irrigated Crops

Farmer groups such as cooperatives should be assisted by government (MACO) developing marketing infrastructure, and in this respect, cold rooms at central collection or assembly points where farmer groups can store their irrigated crops before transportation to open markets such as Soweto market in Lusaka. Such facilities should utilize economies of scale and be used by several farmer groups to maximize economic returns, bearing in mind their storage capacities. The construction of a cold room at the new Soweto market in Lusaka is a good example of infrastructure that can be used by smallholder farmers growing irrigated crops in the peri-urban areas such as the Chunga and Chipapa farmers.

Models of bulking commodities exist in Zambia, and these are being used by the Zambia Chamber of Small and Medium Business Association (ZACSMBA). Under one of their models, they operate a Warehousing System under framers can store crops, and the vouchers that farmers get, can be used as security to get loans from financial institutions. The Warehouses are under the security of Independent Managers. Farmers store their crops and wait until the demand is high before they can off-load them on the market to earn high income.

5.2.4 Lack of Out-Grower Schemes for Fruits and Vegetables

There is need for the Zambian government to come up with a policy that will provide incentives to large buyers of irrigated crops such as FreshPikt, Shop Rite, etc to develop and promote out-grower schemes for irrigated crops in the peri-urban areas of Zambia. Such an incentive system could include tax concessions given by the Zambia Development Agency (ZDA) to companies investing in the rural areas of the country.

5.2.5 Lower Margins due to High Production Costs of Crops

To lower the cost of production, smallholder farmers should be given technical expertise by the Ministry of Agriculture and Cooperatives(MACO) Extension Officers on sustainable agricultural practices particularly conservation farming. This is because sustainable agricultural practices lower farming production cots; for instance, organic manure is used instead of chemical(inorganic) fertilizers. These framing practices will enable smallholder farmers to earn higher margins.

5.2.6 Selling Crops through Agents

All smallholder farmers sell their vegetables individually and this makes it difficult for them to supply

supermarkets. The smallholders should use their irrigation scheme cooperative to bulk their crop including vegetables and negotiate contracts with supermarkets.

5.2.7 Selling of Crops through Middlemen

The Zambian government should be start announcing floor prices cereal crop such as maize at the beginning of the farming season to enable farmers know in advance the level of profit margin that they are going to make. It is not just a question of announcing floor prices early, but a question of allowing farmers undertake forward planning at the beginning of the farming season!

5.2.8 Lack of Own Stand at Markets such as Soweto in Lusaka

The local Irrigation schemes such as Chipapa and Chunga should consult the Lusaka City Council and request for a market stand at Soweto market.

5.2.9 Monopoly Market for Out-Growers

The commodity market for out-growers is monopolistic. Government needs to encourage other players in the market by putting in place economic policies tat will make it more attractive for other players to enter the same monopoly markets. For example, stabilization of the Zambian Kwacha against major convertible currencies will enable other players to enter the cotton market and compete with Dunavant. Recently, Dunavant is being challenged by a new out-grower scheme manager called Mine land. In a similar vein, Zambia Sugar Company has Kafue Sugar as a new entrant in the sugar cane production and processing industry.

Appendix 1 Kasumbalesa Stock Records – September 2007

Date	Product	Unit in KGs	Quantity	No of Medas	Weight in KGs	Unit Price	Value in ZMK
1-Sep-07	Irish Potatoes	90	18		1,620	ZMK 240,000.00	ZMK 4,320,000.00
1-Sep-07	Red Onions	90	52		4,680	ZMK 240,000.00	ZMK 12,480,000.00
1-Sep-07	Tomatoes	19	200		3,800	ZMK 36,000.00	ZMK 7,200,000.00
1-Sep-07	Cassava	50	60		3,000	ZMK 50,000.00	ZMK 3,000,000.00
3-Sep-07	G/nuts CB	90	1,435	33,579	129,150	ZMK 7,500.00	ZMK 251,842,500.00
3-Sep-07	MGV4	90	108	2,527	9,720	ZMK 8,000.00	ZMK 20,217,600.00
3-Sep-07	Irish Potatoes	90	6		540	ZMK 210,000.00	ZMK 1,260,000.00
3-Sep-07	Red Onions	90	174		15,660	ZMK 200,000.00	ZMK 34,800,000.00
3-Sep-07	White Onion	90	16		1,440	ZMK 270,000.00	ZMK 4,320,000.00
3-Sep-07	Tomatoes	19	420		7,980	ZMK 30,000.00	ZMK 12,600,000.00
3-Sep-07	Cassava	50	167		8,350	ZMK 65,000.00	ZMK 10,855,000.00
4-Sep-07	G/nuts CB	90	948	22,183	85,320	ZMK 8,000.00	ZMK 177,465,600.00
4-Sep-07	MGV4	90	73	1,708	6,570	ZMK 8,000.00	ZMK 13,665,600.00
4-Sep-07	Irish Potatoes	90	10		900	ZMK 220,000.00	ZMK 2,200,000.00
4-Sep-07	Red Onions	90	221		19,890	ZMK 230,000.00	ZMK 50,830,000.00
4-Sep-07	White Onion	90	5		450	ZMK 270,000.00	ZMK 1,350,000.00
4-Sep-07	Tomatoes	19	275		5,225	ZMK 30,000.00	ZMK 8,250,000.00
4-Sep-07	Cassava	50	128		6,400	ZMK 55,000.00	ZMK 7,040,000.00
4-Sep-07	Mixed Beans	90	5	117	450	ZMK 8,500.00	ZMK 994,500.00
5-Sep-07	G/nuts CB	90	1,335	31,239	120,150	ZMK 8,000.00	ZMK 249,912,000.00
5-Sep-07	MGV4	90	66	1,544	5,940	ZMK 8,000.00	ZMK 12,355,200.00
5-Sep-07	Irish Potatoes	90	4		360	ZMK 200,000.00	ZMK 800,000.00
5-Sep-07	Tomatoes	19	482		9,158	ZMK 30,000.00	ZMK 14,460,000.00
5-Sep-07	Cassava	50	125		6,250	ZMK 60,000.00	ZMK 7,500,000.00
5-Sep-07	Mixed Beans	90	27	632	2,430	ZMK 8,500.00	ZMK 5,370,300.00
6-Sep-07	G/nuts CB	90	750	17,550	67,500	ZMK 8,000.00	ZMK 140,400,000.00
6-Sep-07	MGV4	90	138	3,229	12,420	ZMK 8,000.00	ZMK 25,833,600.00
6-Sep-07	Solantoni small	90	80	1,872	7,200	ZMK 8,000.00	ZMK 14,976,000.00
6-Sep-07	Irish Potatoes	90	95		8,550	ZMK 250,000.00	ZMK 23,750,000.00
6-Sep-07	Red Onions	90	168		15,120	ZMK 200,000.00	ZMK 33,600,000.00
6-Sep-07	White Onion	90	15		1,350	ZMK 270,000.00	ZMK 4,050,000.00

Date	Product	Unit in KGs	Quantity	No of Medas	Weight in KGs	Unit Price	Value in ZMK
6-Sep-07	Tomatoes	19	15		285	ZMK 44,000.00	ZMK 660,000.00
6-Sep-07	Cassava	50	21		1,050	ZMK 50,000.00	ZMK 1,050,000.00
6-Sep-07	Kabulangeti	90	18	421	1,620	ZMK 12,000.00	ZMK 5,054,400.00
7-Sep-07	Red Onions	90	545		49,050	ZMK 200,000.00	ZMK 109,000,000.00
7-Sep-07	White Onion	90	15		1,350	ZMK 270,000.00	ZMK 4,050,000.00
7-Sep-07	Tomatoes	19	300		5,700	ZMK 38,000.00	ZMK 11,400,000.00
7-Sep-07	Cassava	50	100		5,000	ZMK 60,000.00	ZMK 6,000,000.00
7-Sep-07	Mixed Beans	90	15	351	1,350	ZMK 9,000.00	ZMK 3,159,000.00
7-Sep-07	Kabulangeti	90	15	351	1,350	ZMK 11,000.00	ZMK 3,861,000.00
7-Sep-07	Soybeans	90	28	655	2,520	ZMK 5,000.00	ZMK 3,276,000.00
8-Sep-07	G/nuts CB	90	394	9,220	35,460	ZMK 8,000.00	ZMK 73,756,800.00
8-Sep-07	MGV4	90	164	3,838	14,760	ZMK 8,000.00	ZMK 30,700,800.00
8-Sep-07	Irish Potatoes	90	40		3,600	ZMK 208,000.00	ZMK 8,320,000.00
8-Sep-07	Red Onions	90	208		18,720	ZMK 200,000.00	ZMK 41,600,000.00
8-Sep-07	White Onion	90	30		2,700	ZMK 270,000.00	ZMK 8,100,000.00
8-Sep-07	Tomatoes	19	143		2,717	ZMK 38,000.00	ZMK 5,434,000.00
8-Sep-07	Cassava	50	88		4,400	ZMK 55,000.00	ZMK 4,840,000.00
8-Sep-07	Mixed Beans	90	10	234	900	ZMK 9,000.00	ZMK 2,106,000.00
8-Sep-07	Kabulangeti	90	10	234	900	ZMK 11,000.00	ZMK 2,574,000.00
8-Sep-07	Soybeans	90	19	445	1,710	ZMK 5,000.00	ZMK 2,223,000.00
11-Sep-07	Irish Potatoes	90	110		9,900	ZMK 240,000.00	ZMK 26,400,000.00
11-Sep-07	Red Onions	90	351		31,590	ZMK 200,000.00	ZMK 70,200,000.00
11-Sep-07	Tomatoes	19	64		1,216	ZMK 35,000.00	ZMK 2,240,000.00
11-Sep-07	Cassava	50	60		3,000	ZMK 55,000.00	ZMK 3,300,000.00
11-Sep-07	Mixed Beans	90	10	234	900	ZMK 9,000.00	ZMK 2,106,000.00
11-Sep-07	Kabulangeti	90	7	164	630	ZMK 11,000.00	ZMK 1,801,800.00
11-Sep-07	Soybeans	90	15	351	1,350	ZMK 5,000.00	ZMK 1,755,000.00
12-Sep-07	Irish Potatoes	90	93		8,370	ZMK 280,000.00	ZMK 26,040,000.00
12-Sep-07	Red Onions	90	270		24,300	ZMK 200,000.00	ZMK 54,000,000.00
12-Sep-07	White Onion	90	16		1,440	ZMK 270,000.00	ZMK 4,320,000.00
12-Sep-07	Tomatoes	19	175		3,325	ZMK 44,000.00	ZMK 7,700,000.00
12-Sep-07	Cassava	50	59		2,950	ZMK 55,000.00	ZMK 3,245,000.00
12-Sep-07	Mixed Beans	90	2	47	180	ZMK 9,000.00	ZMK 421,200.00

Date	Product	Unit in KGs	Quantity	No of Medas	Weight in KGs	Unit Price	Value in ZMK
12-Sep-07	Kabulangeti	90	10	234	900	ZMK 11,000.00	ZMK 2,574,000.00
13-Sep-07	Irish Potatoes	90	69		6,210	ZMK 280,000.00	ZMK 19,320,000.00
13-Sep-07	Red Onions	90	180		16,200	ZMK 180,000.00	ZMK 32,400,000.00
13-Sep-07	White Onion	90	15		1,350	ZMK 270,000.00	ZMK 4,050,000.00
13-Sep-07	Tomatoes	19	127		2,413	ZMK 44,000.00	ZMK 5,588,000.00
13-Sep-07	Cassava	50	58		2,900	ZMK 55,000.00	ZMK 3,190,000.00
13-Sep-07	Mixed Beans	90	1	23	90	ZMK 10,000.00	ZMK 234,000.00
13-Sep-07	Kabulangeti	90	5	117	450	ZMK 10,000.00	ZMK 1,170,000.00
15-Sep-07	G/nuts CB	90	378	8,845	34,020	ZMK 8,000.00	ZMK 70,761,600.00
15-Sep-07	Irish Potatoes	90	60		5,400	ZMK 280,000.00	ZMK 16,800,000.00
15-Sep-07	Red Onions	90	201		18,090	ZMK 200,000.00	ZMK 40,200,000.00
15-Sep-07	White Onion	90	15		1,350	ZMK 270,000.00	ZMK 4,050,000.00
15-Sep-07	Tomatoes	19	80		1,520	ZMK 35,000.00	ZMK 2,800,000.00
15-Sep-07	Cassava	50	39		1,950	ZMK 55,000.00	ZMK 2,145,000.00
15-Sep-07	Kabulangeti	90	5	117	450	ZMK 9,000.00	ZMK 1,053,000.00
15-Sep-07	Soybeans	90	2	47	180	ZMK 5,000.00	ZMK 234,000.00
18-Sep-07	G/nuts CB	90	127	2,972	11,430	ZMK 8,000.00	ZMK 23,774,400.00
18-Sep-07	MGV4	90	42	983	3,780	ZMK 8,000.00	ZMK 7,862,400.00
18-Sep-07	Irish Potatoes	90	97		8,730	ZMK 200,000.00	ZMK 19,400,000.00
18-Sep-07	Red Onions	90	219		19,710	ZMK 200,000.00	ZMK 43,800,000.00
18-Sep-07	White Onion	90	15		1,350	ZMK 270,000.00	ZMK 4,050,000.00
18-Sep-07	Tomatoes	19	82		1,558	ZMK 44,000.00	ZMK 3,608,000.00
18-Sep-07	Cassava	50	24		1,200	ZMK 55,000.00	ZMK 1,320,000.00
18-Sep-07	Kabulangeti	90	11	257	990	ZMK 12,000.00	ZMK 3,088,800.00
18-Sep-07	Soybeans	90	4	94	360	ZMK 5,000.00	ZMK 468,000.00
20-Sep-07	G/nuts CB	90	487	11,396	43,830	ZMK 8,000.00	ZMK 91,166,400.00
20-Sep-07	MGV4	90	431	10,085	38,790	ZMK 8,000.00	ZMK 80,683,200.00
20-Sep-07	Irish Potatoes	90	37		3,330	ZMK 260,000.00	ZMK 9,620,000.00
20-Sep-07	Red Onions	90	95		8,550	ZMK 200,000.00	ZMK 19,000,000.00
20-Sep-07	White Onion	90	15		1,350	ZMK 270,000.00	ZMK 4,050,000.00
20-Sep-07	Tomatoes	19	200		3,800	ZMK 44,000.00	ZMK 8,800,000.00
20-Sep-07	Cassava	50	15		750	ZMK 55,000.00	ZMK 825,000.00
20-Sep-07	Mixed Beans	90	6	140	540	ZMK 10,000.00	ZMK 1,404,000.00

Date	Product	Unit in KGs	Quantity	No of Medas	Weight in KGs	Unit Price	Value in ZMK
20-Sep-07	Kabulangeti	90	6	140	540	ZMK 12,000.00	ZMK 1,684,800.00
22-Sep-07	G/nuts CB	90	390	9,126	35,100	ZMK 7,700.00	ZMK 70,270,200.00
22-Sep-07	MGV4	90	135	3,159	12,150	ZMK 7,700.00	ZMK 24,324,300.00
22-Sep-07	Irish Potatoes	90	105		9,450	ZMK 260,000.00	ZMK 27,300,000.00
22-Sep-07	Red Onions	90	48		4,320	ZMK 180,000.00	ZMK 8,640,000.00
22-Sep-07	White Onion	90	14		1,260	ZMK 270,000.00	ZMK 3,780,000.00
22-Sep-07	Tomatoes	19	98		1,862	ZMK 40,000.00	ZMK 3,920,000.00
22-Sep-07	Cassava	50	12		600	ZMK 50,000.00	ZMK 600,000.00
22-Sep-07	Solwezi Beans	90	12	281	1,080	ZMK 10,000.00	ZMK 2,808,000.00
22-Sep-07	Kabulangeti	90	8	187	720	ZMK 12,000.00	ZMK 2,246,400.00
24-Sep-07	G/nuts CB	90	626	14,648	56,340	ZMK 8,000.00	ZMK 117,187,200.00
24-Sep-07	MGV4	90	216	5,054	19,440	ZMK 8,000.00	ZMK 40,435,200.00
24-Sep-07	Irish Potatoes	90	90		8,100	ZMK 240,000.00	ZMK 21,600,000.00
24-Sep-07	Red Onions	90	120		10,800	ZMK 180,000.00	ZMK 21,600,000.00
24-Sep-07	White Onion	90	14		1,260	ZMK 270,000.00	ZMK 3,780,000.00
24-Sep-07	Tomatoes	19	126		2,394	ZMK 44,000.00	ZMK 5,544,000.00
24-Sep-07	Cassava	50	9		450	ZMK 50,000.00	ZMK 450,000.00
24-Sep-07	Mixed Beans	90	15	351	1,350	ZMK 10,000.00	ZMK 3,510,000.00
24-Sep-07	Kabulangeti	90	45	1,053	4,050	ZMK 12,000.00	ZMK 12,636,000.00
					1,226,653		ZMK 2,590,197,800.00

Appendix 2 Production of Top 3 Commodities in each of the Districts Surveyed for the Recent 5 Years

Table T1 Production (metric tons) by district and commodity for the most recent year 2008/2009 farming season

District	Cereals			Industrial crops		
	Maize	Sorghum	Millet	Sunflower	Groundnuts	Soybeans
Lusaka	2823	3	0	2	33	2
Kafue	20040	22	2	95	288	14530
Chongwe	47745	35	7	364	1164	9408
Chibombo	119960	54	0.11	1121	3743	7301
Kabwe	19725	8	0.10	182	182	5353
Kapiri mposhi	85641	626	134	185	184	388
Mazabuka	1225	162	0	598	940	14256
Siavonga	3098	5339	562	19	57	-

Source: Central Statistical Office (CSO), Lusaka

Table T 2 Production (metric tons) by district and each commodity (Cereals) for different categories of farmers, 2007/2008 farming season

District	Maize				Sorghum				Millet			
	Small medium-scale farmers (S&MSFs)		Large-scale Farmers (LSFs)		Small medium-scale farmers (S&MSFs)		Large-scale Farmers (LSFs)		Small medium-scale farmers (S&MSFs)		Large-scale Farmers (LSFs)	
	Area Planted (ha)	Production (Mt)	Area Planted (ha)	Production (Mt)	Area Planted (ha)	Production (Mt)	Area Planted (ha)	Production (Mt)	Area Planted (ha)	Production (Mt)	Area Planted (ha)	Production (Mt)
1. Lusaka	-	-	-	-	-	-	-	-	-	-	-	-
2. Kafue	7907	11502	2647	15973	32	-	195	624	-	-	-	-
3. Chongwe	13248	23950	1583	7754	45	24	30	130	23	13	0	0
4. Chibombo	42031	74932	2940	15493	192	139	385	378	142	69	1681	12944
5. Kabwe	1060	1329	1214	4192	0	0	0	0	0	0	0	0
6. Kapiri Mposhi	34853	67704	1631	6460	1346	545	40	59	26	28	0	0
7. Mazabuka	22952	46416	2715	14881	274	229	541	1238	0	0	0	0
8. Siavonga	642	492	0	0	8989	1965	0	0	5326	1029	0	0

Source: Central Statistical Office (CSO), Lusaka

Table T 3 Production (metric tons) by district and commodity (Industrial crops) for different categories of farmers, 2005/2006 farming season

District	Sunflower				Groundnuts				Soybeans			
	Small medium-scale farmers (S&MSFs)		Large-scale Farmers (LSFs)		Small medium-scale farmers (S&MSFs)		Large-scale Farmers (LSFs)		Small medium-scale farmers (S&MSFs)		Large-scale Farmers (LSFs)	
	Area Planted (ha)	Production (Mt)	Area Planted (ha)	Production (Mt)	Area Planted (ha)	Production (Mt)	Area Planted (ha)	Production (Mt)	Area Planted (ha)	Production (Mt)	Area Planted (ha)	Production (Mt)
1. Lusaka	1	0	0	0	6	1	0	0	11	6	0	0
2. Kafue	33	3	140	78	416	89	0	0	320	348	1645	3689
3. Chongwe	116	41	10	4	1479	857	0	0	210	119	981	1795

District	Sunflower				Groundnuts				Soybeans			
	Small medium-scale farmers (S&MSFs)		Large-scale Farmers (LSFs)		Small medium-scale farmers (S&MSFs)		Large-scale Farmers (LSFs)		Small medium-scale farmers (S&MSFs)		Large-scale Farmers (LSFs)	
	Area Planted (ha)	Production (Mt)	Area Planted (ha)	Production (Mt)	Area Planted (ha)	Production (Mt)	Area Planted (ha)	Production (Mt)	Area Planted (ha)	Production (Mt)	Area Planted (ha)	Production (Mt)
4. Chibombo	2704	865	0	0	3311	1669	4	2	3020	1624	987	2227
5. Kabwe	4	4	0	0	3	3	16	5	0	0	6	9
6.Kapiri Mposhi	602	233	19	9	3137	1887	62	49	2608	1817	55	39
7. Mazabuka	1100	368	12	8	2707	1378	20	4	0	0	1750	3651
8. Siavonga	54	6	0	0	0	0	0	0	0	0	0	0

Table T 4 Production: Cropping area and production of cereals, 2008/2009 farming season

District	Maize				Sorghum				Millet			
	Hectares Planted (ha)	Production (Mt)	Owner's Consumption (Mt)	Surplus (Mt)	Hectares Planted (ha)	Production (Mt)	Owner's Consumption (Mt)	Surplus (Mt)	Hectares Planted (ha)	Production (Mt)	Owner's Consumption (Mt)	Surplus (Mt)
1. Lusaka	1074	2823	1837	986	4	3	3	0	0	0	0	0
2. Kafue	10598	20040	11400	8640	126	22	22	0	7	2	2	0
3. Chongwe	21803	47745	18991	28754	30	35	0	35	19	7	7	0
4. Chibombo	63269	119960	52351	67609	34	54	53	1	0.26	0.11	0.11	0
5. Kabwe	5908	19725	4689	15036	14	8	6	2	0.26	0.10	0.05	0.05
6. Kapiri Mposhi	45669	85641	45996	39645	745	626	437	129	116	134	98	36
7. Mazabuka	39125	66841	33025	33816	150	161	56	105	0	0	0	0
8. Siavonga	4924	3098	2840	258	13337	5339	4824	515	1524	562	547	15

Source: Central Statistical Office (CSO), Lusaka

Table T 5 Production: Cropping area and production of Industrial crops, 2004/2005 farming season

District	Sunflower				Groundnuts				Soybeans			
	Hectares Planted (ha)	Production (Mt)	Owner's Consumption (Mt)	Surplus (Mt)	Hectares Planted (ha)	Production (Mt)	Owner's Consumption (Mt)	Surplus (Mt)	Hectares Planted (ha)	Production (Mt)	Owner's Consumption (Mt)	Surplus (Mt)
1. Lusaka	8	2	2	0	66	33	30	3	19	2	2	0
2. Kafue	97	95	71	24	373	288	226	62	5619	14530		13546
3. Chongwe	149	365	36	328	1753	1164	837	325	4101	9408		9178
4. Chibombo	3673	1121	1102	19	10893	3744	1967	1777	5194	7300		4836
5. Kabwe	153	182	6	176	196	145	60	85	2025	5353		5228
6. Kapiri Mposhi	504	185	177	8	8321	5123	2586	2537	682	388		26
7. Mazabuka	1767	598	509	89	1936	940	718	222	5605	14256		13730
8. Siavonga	80	19	19	0	189	57	57	0	0	0	0	0

Source: Central Statistical Office (CSO), Lusaka

Table T 6 Production (metric tons) of top 3 commodities in the survey districts for the last 5 years, 2003/2004 farming seasons

District	Cereals			Industrial Crops		
	Maize	Sorghum	Millet	Sunflower	Groundnuts	Soybeans
1. Lusaka	4029	0		0	0	1479
2. Kafue	11884	0	0	290	50	2812
3. Chongwe	16594	1014		23	273	6031
4. Chibombo	33000			4688	3548	2775
5. Kabwe	-	-	-	-	-	-
6. KapiriMposhi	-	-	-	-	--	-
7. Mazabuka	-	-	-	-	-	-
8. Siavonga	-	-	-	-	-	-

Source: Central Statistical Office (CSO), Lusaka

Table T 7 Production (metric tons) of top 3 commodities in the survey districts for the last 5 years, 2005/2006 farming season

District	Cereals			Industrial Crops		
	Maize	Sorghum	Millet	Sunflower	Groundnuts	Soybeans
1. Lusaka	920	0	0	46	1	6
2. Kafue	27475	624	0	81	89	4037
3. Chongwe	31704	154	13	41	857	1913
4. Chibombo	90424	517	13013	865	1671	3851
5. Kabwe	5521	0	0	2	8	9
6. KapiriMposhi	74163	604	29	241	1936	1856
7. Mazabuka	61297	1467	0	171	1382	3651
8. Siavonga	494	1966	1029	1282	-	-

Source: Central Statistical Office (CSO), Lusaka

Table T 8 Production (metric tons) of top 3 commodities in the survey districts for the last 5 years, 2006/2007 farming season

District	Cereals			Industrial Crops		
	Maize	Sorghum	Millet	Sunflower	Groundnuts	Soybeans
1. Lusaka	392	0	0	0	3	0
2. Kafue	35743	30	0	30	64	7353
3. Chongwe	47175	28	3	23	715	2899
4. Chibombo	127686	4	0	372	2166	7001
5. Kabwe	24134	0.1	0	49	111	2283
6. KapiriMposhi	49768	160	48	179	2311	330
7. Mazabuka	41498	848	0	300	889	4467
8. Siavonga	1474	1730	633	6	7	-

Source: Central Statistical Office (CSO), Lusaka

Table T 9 Production (metric tons) of top 3 commodities in the survey districts for the last 5 years 2004/4005 farming season

District	Cereals			Industrial Crops		
	Maize	Sorghum	Millet	Sunflower	Groundnuts	Soybeans
1. Lusaka	-	-	-	-	-	-
2. Kafue	-	-	-	-	-	-
3. Chongwe	-	-	-	-	-	-
4. Chibombo	68258	28	0	29	1326	2302
5. Kabwe	26599	8	39	44	292	3796
6. Kapiri Mposhi	99264	95	280	297	4425	607
7. Mazabuka	-	-	-	-	-	-
8. Siavonga	-	-	-	-	-	-

Source: Central Statistical Office (CSO), Lusaka

Appendix 3 Overall Marketing Channel from Production of Commodities to Final Consumption

Table T 10 Chongwe District

Marketed Commodities	Major production areas where commodities are produced (share as %)				Areas where major commodities are marketed as % of total marketed commodity				Names of major destination of produce
	Within the district	Outside the district (within the same province)	Outside the province	Other countries (import/export)	Within the district	Outside the district (within the same province)	Outside the province	Other countries (import/export)	
1. Cereals (maize)	90	8	2	0	88	12	0	0	Chongwe Business Centre (CBC) and Council market, Palabana, Chinyunyu and Chimusnaya msrkets
2. Industrial crops (cotton)	85	10	5	0	65	30	5	0	Chongwe Business Centre, Lusaka and kabwe Central Ginnerries
3. Fruits (oranges, bananas)	70	5	0	0	90	7	2	0	Chongwe CBC and Chongwe market, Palabana and Lusaka town
4. Vegetables (cabbage, rape)	95	5	0	0	60	40	0	0	Chongwe Business Centre, Palabana, Chinyunyu, and Lusaka Soweto market

Source: Field Survey

Table T 11 Lusaka District

Marketed Commodities	Major production areas where commodities are produced (share as %)				Areas where major commodities are marketed as % of total marketed commodity				Names of major destination of produce
	Within the district	Outside the district (within the same province)	Outside the province	Other countries (import/export)	Within the district	Outside the district (within the same province)	Outside the province	Other countries (import/export)	
1. Cereals (maize)	25	5	70	0	80	10	5	5	FRA, Milling companies and Breweries.
2. Industrial crops (cotton)	10	40	50	0	90	7	3	0	Lusaka cotton ginnery
3. Fruits (bananas)	5	80	15	0	90	0	10	0	Lusaka, Copperbelt

4. Vegetables (rape, tomato, cabbage)	20	20	60	0	80	20	20	0	Lusaka Soweto market, Copperbelt and Livingstone

Source: Field Survey

Table T 12 Kafue District

Marketed Commodities	Major production areas where commodities are produced (share as %)				Areas where major commodities are marketed as % of total marketed commodity				Names of major destination of produce
	Within the district	Outside the district (within the same province)	Outside the province	Other countries (import/export)	Within the district	Outside the district (within the same province)	Outside the province	Other countries (import/export)	
1. Cereals (maize)	10	30	60	0	5	60	35	0	Kafue Estate market, and Lusaka Soweto market.
2. Industrial crops (cotton)	15	25	60	0	5	50	45	0	Lusaka cotton ginnery
3. Fruits (bananas)	70	10	20	0	60	30	20	0	Lusaka Soweto market, Copperbelt and Livingstone
4. Vegetables (rape, tomato, cabbage)	20	30	50	0	15	45	40	0	Lusaka Soweto market, Copperbelt and Livingstone

Source: Field Survey

Table T 13 Chibombo District

Marketed Commodities	Major production areas where commodities are produced (share as %)				Areas where major commodities are marketed as % of total marketed commodity				Names of major destination of produce
	Within the district	Outside the district (within the same province)	Outside the province	Other countries (import/export)	Within the district	Outside the district (within the same province)	Outside the province	Other countries (import/export)	
1. Cereals (maize)	80	20	0	0	60	10	30	0	Chibombo FRA satellite depots, Kabwe, Kitwe, Ndola and Lusaka
2. Industrial crops (cotton)	100	0	0	0	97	3	0	0	Dunavant in Kabwe for Kabwe Ginnery

3. Fruits (watermelons)	100	0	0	0	100	0	0	0	Chibommbo and Lusaka turn-off market and John Chinena market on Lusaka
4. Vegetables (cabbage, rape)	100	0	0	0	90	10	0	0	Chibommbo and Lusaka turn-off market and John Chinena market on Lusaka

Source: Field Survey

Table T 14 Kabwe District

Marketed Commodities	Major production areas where commodities are produced (share as %)				Areas where major commodities are marketed as % of total marketed commodity				Names of major destination of produce
	Within the district	Outside the district (within the same province)	Outside the province	Other countries (import/export)	Within the district	Outside the district (within the same province)	Outside the province	Other countries (import/export)	
1. Cereals (maize)	90	5	5	0	70	15	15	0	Kabwe and Chibombo FRA satellite depots, and Kabwe Green market
2. Industrial crops (cotton)	100	0	0	0	85	15	0	0	Dunavant in Kabwe for kabwe Ginnery
3.Fruits (oranges, watermelons)	80	15	5	0	100	0	0	0	Kabwe Green market and Ndola
4. Vegetables (cabbage, rape)	95	5	0	0	70	5	15	0	Chibommbo and Lusaka turn-off market and John Chinena market on Lusaka-Kabwe Road, Kabwe Green Market and Kitwe and Ndola on the Copperbelt province

Source: Field Survey

Table T 15 Kapiri Mposhi District

Marketed Commodities	Major production areas where commodities are produced (share as %)				Areas where major commodities are marketed as % of total marketed commodity				Names of major destination of produce
	Within the district	Outside the district (within the same province)	Outside the province	Other countries (import/export)	Within the district	Outside the district (within the same province)	Outside the province	Other countries (import/export)	

1. Cereals (maize, sorghum)	100	0	0	0	90	10	30	0	FRA satellite depots in Kapiri Mposhi and Kabwe, and Chimsoro Milling plant in Kapiri Mposhi
2. Industrial crops (cotton)	100	0	0	0	0	100	0	0	Dunavant for the companies Ginnery in Kabwe
3. Fruits (oranges and bananas)	100	0	0	0	85	15	0	0	Kapiri Mposhi market and Kabwe and Ndola
4. Vegetables (cabbage, rape, tomatoes)	100	0	0	0	95	5	0	0	Kapiri Mposhi market and Kabwe

Source: Field Survey

Table T 16 Mazabuka District

Marketed Commodities	Major production areas where commodities are produced (share as %)				Areas where major commodities are marketed as % of total marketed commodity				Names of major destination of produce
	Within the district	Outside the district (within the same province)	Outside the province	Other countries (import/export)	Within the district	Outside the district (within the same province)	Outside the province	Other countries (import/export)	
1. Cereals (maize)	20	30	50	0	25	60	15	0	Food reserve Agency(FRA), Kapinga Milling in Mazabuka, APG and Choma Milling companies
2. Industrial crops (sugar cane)	95	0	5	0	95	2	3	0	Zambia Sugar Company Limited in Mazabuka
3. Fruits (bananas)	10	80	10	0	20	10	70	0	Mazabuka market, Turn Park at Kafue and Chirundu turn-off and Lusaka,
4. Vegetables (cabbage, tomatoes)	90	10	0	0	80	20	0	0	Copperbelt, Lusaka, Livingstone, Nkonkola Hypermarket Mazabukla and Shoprite Mazabuka

Source: Field Survey

Table T 17 Siavonga District

Marketed Commodities	Major production areas where commodities are produced (share as %)	Areas where major commodities are marketed as % of total marketed commodity	Names of major destination of produce

	Within the district	Outside the district (within the same province)	Outside the province	Other countries (import/export)	Within the district	Outside the district (within the same province)	Outside the province	Other countries (import/export)	
1. Cereals (maize)	20	15	65	0	20	0	80	0	Chirundu, Kanyere compound within Siavonga town, and Lusitu markets; Mazabuka, Lusaka and Kafue
2. Industrial crops (cotton)	100	0	0	0	100	0	0	0	Sold to cotton companies such as Dunavant and taken outside Southern province
3. Fruits (bananas)	90	0	10	0	30	0	70	0	Chirundu, Lusitu and Siavonga; Lusak and kafue
4. Vegetables (tomatoes)	20	0	80	0	100	0	0	0	Chrundu, Lusitu and Siavonga markets

Source: Field Survey

Appendix 4 Value Chain Analysis for Top 3 Commodities at the Main Markets Surveyed in Lusaka, Soweto Market, Kabwe and Kafue

Table T 18 Price Structure for Major Commodities Surveyed at the Main Markets

Name of Market	Commodity	Farm gate price (ZMK/Kg)	Margin % (Farm gate price divided by the wholesale price)	Wholesaler/Agent Price (ZMK/Kg)	Margin % (Wholesale price divided by retail price)	Retail price (ZMK/Kg)	Margin % (Retail price divided by consumer price)	Consumer price (ZMK/Kg)
1.Soweto market	1.Cereals							
	Green maize	K700 per cob	30	K1,000 per cob	33	1,500 per cob	30	K1,950
	2.Industrial crops							
	Ground nuts	K20,000 per 25kg-bag (fresh)	11	K 22,500 per 25 Kg bag	10	K25,000 per 25kg-bag	28	K25,700
	Soya beans	K1,250 per Kg	17	K1,500 per Kg	40	K2,500 per Kg	27	K3,175
	3.Fruits							
	Bananas	K1,300 per Kg	24	K1,700 per Kg	23	K2,200 per kg	25	K2,750
	Oranges	K50,000 per box	17	K60,000 per box	15	K70,000 per box	20	K 84,000
	Lemons	K35,000 per box	13	K40,000 per box	20	K50,000 per box	23	K61,500
	4. Vegetables							
	Rape	K90,000 per 90kg-bag	10	K100,000 per 90kg-bag	13	K115,000 per 90kg-bag	15	K132,250
	Tomatoes	K40,000 per box	27	K55,000 per box	16	K65,000 per box	25	K81,250
	Cabbages	K1,000 per head	33	K1,500 per head	25	K2,000 per head	25	K2,500
2.Kafue market	1. Cereals							
	Maize	K700 per cob	30	K1,000 per cob	33	K1,500 per cob	30	K1,950
	2.Industrial crops							
	Sugarcane	K6,000 per bundle of 10 canes	15	K7,000 per bundle of 10 canes	30	K10,000 per bundle of 10	30	K13,000
	Groundnuts	K30,000 per 25kg-bag	15	K35,000 per 25kg-bag	12	K40,000 per 25kg-bag	25	K50,000

	3.Fruits							
	Guavas	K40,000 per 90kg-bag	22	K60,000 per 90kg-bag	18	K85,000 per 90kg-bag	25	K106,250
	Mangoes	K40,000 per 90kg-bag	20	K50,000 per 90kg-bag	23	K65,000 per 90kg-bag	20	K78,000
	4. Vegetables							
	Rape	K90,000 per 90kg-bag	11	K100,000 per 90kg-bag	13	K115,000 per 90kg-bag	15	K 132,250
	Tomatoes	K30,000 per box	14	K35,000 per box	22	K45,000 per Box	18	K53,100
	Cabbages	K800 per head	20	K1,000 per head	33	K1,500 per head	25	K1,875
3.Kabwe market	1.Cereals							
	Green Maize	K800 per cob	20	K1,000 per cob	33	K1,500 per cob	25	K1,875
	2.Industrial crops							
	Groundnuts	K25,000 per 25kg-bag	17	K30,000 per 25kg-bag	15	K35,000 per 25kg-bag	20	K42,000
	3.Fruits							
	Bananas	K1,500 per kg	17	K1,800 per bag	25	K2,400 per Kg	12	2,688
	Oranges	K55,000 per box	15	K65,000 per box	19	K80,000 per box	20	K96,000
	4.Vegetables							
	Cabbage	K800 per head	20	K1,000 per head	33	K1,500 per head	25	K 1,875
	Rape	K85,000 per 90kg-bag	15	K100,000 per 90kg-bag	13	K115,000 per 90kg-bag	20	K138,000
	Tomatoes	K30,000 per box	25	K40,000 per box	27	K55,000 per box	30	K71,500

Source: Survey data obtained at Kabwe main marrket, Lusaka, Soweto main market

Appendix 5 District Profiles-Copperbelt Province

Ndola

Geo-Data

Land area: 1,103 Km²

Arable land: 46,500 Ha

Irrigated land: 250 Ha

Cultivated land: 38,450 Ha

Population: 461,000

Main Commodities grown:

Commodity	Production 2006/2007(Mt)	Surplus/Deficit
Maize	13,707	Deficit (52,677Mt)
Groundnuts	751	Deficit
Soya beans	48	Deficit
Sweet potatoes	714	Deficit
Mixed beans	257	Deficit

Kitwe

Geo-Data

Land Area: 777 Km²

Arable Land: 25,700 Ha

Irrigation Land: 312 Ha

Cultivated Land: 7,004 Ha

Population: 1,200,000

Main Commodities grown:

Commodity	Production 2006/2007(Mt)	Surplus/Deficit
Maize	6,903	Deficit (165,897 Mt)
Groundnuts	1,105	Deficit
Sweet Potatoes	153	Deficit

Kalulushi

Geo-Data

Land Area: 725 Km²

Arable Land: 7,449 Ha

Irrigation Land: 375 Ha

Cultivated Land: 6,809 Ha

Population: 60,000

Main Commodities grown:

Commodity	Production 2006/2007	Surplus/Deficit
Maize	4740	Deficit (3,900 Mt)
Groundnuts	538	Deficit
Soya beans	93	Deficit
Mixed Beans	46	Deficit
Sweet potato	122	Deficit

Mufulira

Geo-Data

Land Area: 1,631.7 Km²

Arable Land: 127,768 Ha

Irrigation Land: 206 Ha

Cultivated Land: 81,421 Ha

Population: 200,000

Main Commodities grown:

Commodity	Production 2008/2009	Surplus/Deficit
Maize	5,445	Deficit (23,355 Mt)
Groundnuts	538	Deficit
Millet	61	Deficit
Sweet Potatoes	321	Deficit

Masaiti

Geo-Data

Land Area: 2,931 Km²

Arable Land: 269,112 Ha

Irrigation Land: 250 Ha

Cultivated Land: 225,070 Ha

Population: 95,000

Main Commodities grown:

Commodity	Production 2008/2009	Surplus/Deficit
Maize	23,430	Surplus (9,750 Mt)
Sorghum	100	Deficit
Ground nuts	1143	Deficit
Sweet potatoes	756	Deficit
Mixed beans	0	Deficit
Soya Beans	178	Deficit

Note: Maize surplus and deficit calculated on the basis of population in the district and an average consumption of 0.144 mt per person per year. Thus although some districts are indicated as producing a surplus, the Copperbelt is a deficit producer of maize and all other commodities. Further consideration should be that produce even when imported from other provinces is shared through official and unofficial exports to the DRC.

Mpongwe

Geo-Data

Land Area: 8,570 Km²

Arable Land: 764,000 Ha

Irrigation Land: 70,500

Cultivated Land: 692,784 Ha

Population: 69,000

Main Commodities grown:

Commodity	Production 2008/2009	Surplus/Deficit
Maize	52,156	Surplus (42,220 Mt)
Sorghum	288	Deficit
Sun Flower	0	Deficit
Ground nuts	266	Deficit
Sweet Potato	219	Deficit
Wheat	1,916	Deficit

Chingola

Geo-Data

Land Area: 1,678 Km²

Arable Land: 141,884 Ha

Irrigation Land: 632.5 Ha

Cultivated Land: 86,700 Ha

Population: 202,000

Main Commodities grown:

Commodity	Production 2008/2009	Surplus/Deficit
3 Maize	5,092.2	Deficit (23,996 Mt)
Millet	38	Deficit
Ground nuts	225	Deficit
Soya Beans	55	Deficit
Mixed Beans	69	Deficit
Sweet Potato	224	Deficit

Commodity	Production 2008/2009	Surplus/Deficit
Cassava	0	Deficit

Lufwanyama

Geo-Data

Land Area: 12,075 Km²

Arable Land: 910,183 Ha

Irrigation Land: 100 Ha

Cultivated Land: 585,000 Ha

Population: 60,000

Main Commodities grown:

Commodity	Production 2008/2009	Surplus/Deficit
Maize	10,414	Surplus (1,774 Mt)
Sorghum	0	Deficit
Ground nuts	505	Deficit
Mixed Beans	172	Deficit
Sweet Potato	0	Deficit

Chilibombwe

Geo-Data

Land Area: 1,026 Km²

Arable Land: 63,996 Ha

Irrigation Land: 125 Ha

Cultivated Land: 49,750 Ha

Population: 109,900

Main Commodities grown:

Commodity	Production 2008/2009	Surplus/Deficit
Maize	4,365	Deficit (11,460 Mt)
Millet	61	Deficit
Ground nuts	338	Deficit
Soya Beans	0	Deficit
Mixed Beans	259	Deficit
Sweet Potato	280	Deficit

Luanshya

Geo-Data

Land Area: 811 Km²

Arable Land: 51,438 Ha
Irrigation Land: 110 Ha
Cultivated Land: 37,850 Ha
Population: 208,026
Main Commodities grown:

Commodity	Production 2008/2009	Surplus/Deficit
Maize	4,377	Deficit (25,578 Mt)
Sorghum	0	Deficit
Ground nuts	486	Deficit
Soya Beans	0	Deficit
Mixed Beans	184	Deficit
Sweet Potato	751	Deficit

Appendix 6 Overall Marketing Channels Connecting All Actors in Distribution of Each Commodity from Production to Consumption (Southern Province)

(Appendix 6 See next page)

District	Commodity	Channel no.	Approx prop of channels (%)	Length of channel (no. of actors)	Commodity movements			
					Intra district	Inter district	Inter province	Import/export
Monze	Maize	1	50	Grower –FRA - processor- Consumer	Local retention	Choma	Lusaka	Zimbabwe
		2	50	Grower – middlemen/wholesales – processors – retailers – consumers	-	Choma, gwembe	Lusaka	-
	Soya beans	1	100	Growers – middlemen/wholesalers/large scale buyers – processors – retailers – consumers	-	-	Lusaka	-
	Sunflower	1	100	Growers – middlemen/wholesalers/large scale buyers – processors – retailers - consumers	Small quantities (oil expelling)	-	Lusaka	-
	Cotton	1	2	Growers – (distributers) – ginning company – weavers – garment makers – retailers - consumers	-	-	Lusaka	-
		2	98	Growers – (distributers) – ginning company – exports	-	-	-	External markets
	Fruits/vegetables	1	80	Growers – trader/wholesaler – trader – retailers – consumers	Monze	Gwembe	-	-
		2	80	Grower – retailers – consumers	Monze	-	-	-
Gwembe	Maize	1	70	Growers – FRA – processors – retailers – consumers	-	-	-	-
		2	30	Growers – middlemen/wholesalers/private institutions – retailers - consumers	Gwembe	-	-	-
	Sorghum	1	100	Growers – consumers (locally consumed at house hold)	Gwembe	-	-	-
	Cotton	1	100	Growers – distributers/growers – ginning companies	-	Gwembe	Lusaka	International external markets
	Fruits/vegetables	1	90	Growers – traders/wholesalers – retailers – consumers	Gwembe	-	-	-
		2	10	Growers – consumers	Gwembe	-	-	-
Sinazongwe	Maize	1	95	Commercial grower – internal processor – retailers – consumer	Sinazongwe	-	-	-

District	Commodity	Channel no.	Approx prop of channels (%)	Length of channel (no. of actors)	Commodity movements			
					Intra district	Inter district	Inter province	Import/export
		2	2	Growers – consumers	Sinazongwe	-	-	-
		3	3	Middlemen – retailers/processors - consumers	-	Choma, Monze	-	-
	Green maize	1	90	Growers – traders/wholesalers – retailers – consumers	Sinazongwe	Monze, Choma, Livingstone, Batoka	-	-
		2	10	Growers – retailers – consumers	Sinazongwe	-	-	-
	cotton	1	100	Growers – distributers – ginning companies (processors) – retailers - consumers	Gwembe	Gwembe	Lusaka	-
	Fruits/vegetables	1	80	Growers – traders/wholesalers – retailers – consumers	Sinazongwe	Choma, mamba	-	-
		2	20	Growers – retailers – consumers	Sinazongwe	-	-	-
Choma	Maize	1	65	Growers – middlemen /wholesalers/grain merchants – processors – retailers - consumers	-	-	-	-
		2	30	Growers – FRA – processors – retailers – consumers	Choma	Gwembe, Sinazongwe	Lusaka	-
		3	5	Growers – traders – consumers	Choma	-	-	-
Choma	Cotton	1	100	Growers – distributers – ginning companies – processors – retailers - consumers	-	Gwembe	Lusaka, Kafue	Exports
	Tobacco	1	100	Tobacco company/processors – wholesalers – retailers - consumers	-	-	Lusaka	Exports
	Sunflower	1	100	Growers – middlemen/wholesalers – retailers – consumers	Small quantities- oil expelling	-	Lusaka	-
	Fruits/vegetables	1	95	Growers – traders/wholesalers – retailers – consumers	Choma markets	Livingstone, Monze	-	-
		2	5	Growers – large buyers (supermarkets) - consumers	spar	-	-	-

District	Commodity	Channel no.	Approx prop of channels (%)	Length of channel (no. of actors)	Commodity movements			
					Intra district	Inter district	Inter province	Import/export
Kalomo	Maize	1	70	Growers – middlemen/wholesaler – processors – retailers – consumers	-	Choma, Livingstone	Lusaka	-
		2	20	Growers - FRA – processors – retailers – consumers	-	Choma, Livingstone	Lusaka	-
		3	10	Growers – agro – processors – retailers - consumers	-	Choma, Livingstone	Lusaka, Chipata	-
	Sorghum	1	100	Growers – traders/ wholesalers – retailers	District trade/consumption	-	-	-
	Millet	1	100	Growers – traders/wholesalers – retailers – consumers	Internal consumption	-	-	-
	Cotton	1	100	Growers – subscribers – ginning companies processors – retailers - consumers	-	-	-	Exports
	Sunflower	1	100	Growers – middlemen/wholesalers – processors – retailers- consumers	Kalomo, oil expelling	-	Choma	-
	Tobacco	1	100	Growers – tobacco companies – processors – wholesalers -retailers - consumers	-	-	Lusaka	Exports
	Fruits/vegetables	1	90	Growers – traders/wholesalers – retailers - consumers	Traded in Kalomo	Choma, Livingstone	-	-
		2	10	Growers – large scale buyers - consumers	-			
Livingstone	Maize	1	80	Grower – FRA – processors – retailers - consumers	Livingstone	Sales to designated areas in other districts	Sales to designated areas within the country	-
		2	20	Grower – middlemen/agro processors agents – processors – retailers - consumers	Livingstone	-	-	-
	Sorghum	1	100	Growers – traders/wholesalers – retailers – consumers	-	-	-	-
	Millet	1	100	Growers – traders/wholesalers – retailers – consumers	Livingstone	-	-	-
	Fruits/vegetables	1	80	Growers – traders/wholesalers – retailers – consumers	Livingstone	-	-	-

District	Commodity	Channel no.	Approx prop of channels (%)	Length of channel (no. of actors)	Commodity movements			
					Intra district	Inter district	Inter province	Import/export
		2	20	Growers – large scale buyers (hotels, spar)- consumers	-	-	-	-
Kazungula	Maize	1	65	Growers – middlemen/wholesalers – processors- retailers	-	Livingstone , Choma	-	-
		2	30	Growers – FRA – processors – retailers – consumers	-	Livingstone, Choma, Sesheke	Sesheke (Western Province)	Exports (Botswana)
		3	5	Growers – retailers – consumers	Kazungula	Livingstone	Sesheke (Western Province)	-
	Sorghum	1	80	Growers – traders/wholesalers – retailers – consumers	Kazungula	Livingstone	-	-
		2	20	Growers – retailers – consumers	Kazungula	Livingstone	-	-
	Fruits/vegetables	1	80	Growers – traders/wholesalers – retailers – consumers	Kazungula	Livingstone	-	-
		2	20	Growers – large scale buyers (hotels, spar)	-	Livingstone	-	-

Note :
During the survey of the seven targeted districts a number of marketing channels for all categories of targeted commodities where evident. However, the key ones are as follows:

Maize – Growers - FRA, large scale grain merchants, transport/middlemen, middlemen, processors, transporters, traders/wholesalers, retailers/marketeers and consumers.
Other cereals – because other cereals are produced at lower volumes, growers, middlemen, traders/ wholesalers, transporters retailers and consumers are the main actors
Cotton – market and distribution chain for this commodity is characteristically linked to the out grower companies who also are involved in the transportation of the commodity.

For fruits and vegetables, due to the low volumes of production and the fragmentations of these commodities the most active members of this distribution chain are growers traders/wholesalers, supermarkets and large institutions, retailers and consumers. Table 12 above gives further details of overall marketing and distribution channels for targeted commodities.

B 2. Supplemental Explanation of Sectional Basic Plan for Distribution and Marketing

Sectional Basic Plan of A/P model projects for distribution/ marketing are summarized as follows:

1) Outline, background and objectives of model projects

Key concept and project components are set as below;

a Key Concept

(a) Collective marketing

(b) Practical, economically feasible and transferable to other similar areas

b Project components

(a) Promotion of collective marketing by use of multi-purpose shed

(b) OJT for strengthening of practical marketing skill smallholders

(c) Technology transfer to district officers through OJT

c Background and objectives

♦Advantages expected by collective marketing are as follows:

(a) Farmers' labor for postharvest handling and shipment is reduced

(b) Farmers' cost for postharvest handling and shipment is reduced

(c) Marketers' cost for handling and transportation is reduced by large-lots distribution

(d) Farmers' products are upgraded in uniformity and quality, with the improvement of production technology

(e) Markets' (consumers') confidence in the products is strengthened

(f) Farmers' bargaining power is increased, leading to fair price formation

(g) Linkage between farmers and marketers is established and expanded, making a win-win relationship

(h) Farmers' income increases, as a result of above

♦Necessity of facilities and success cases:

Farmers' groups conducting collective marketing are very limited. According to the survey so far made, one of the main reasons for that has been found to be a lack of necessary facilities. In only several success cases, farmers' groups do collective marketing and realize most of the advantages shown above, increasing member farmers' income so much.

♦Strengthening of practical marketing skill smallholders by OJT:

According to the previous survey, one of the core problems in smallholders, particularly vegetable growing farmers, has been identified as a lack of experiences, knowledge and business-mind in marketing. OJT is considered to be indispensible and the most effective approach for improvement.

2) Period:

Initial phase of M/P (4 years from 2012 April to 2016 March)

3) Main players involved in implementation

Target farmers' group members in each model site; District officers (1 DMDO and 1 asst. DMDO) for marketing in each district covering model sites; One (1) international marketing expert covering 4 model sites; and One (1) local marketing expert covering 4 model sites

4) Implementation

a Preparation for implementation

(a) Establishment of supporting unit (cross-sectional unit within each district office)

To be organized by each provincial and district office

(b) Baseline survey

Clarify current status on marketing activities of target farmers' groups, market situation, crops, etc.

To be implemented by target farmers' group members in each model site; district officers (1 DMDO and 1 asst. DMDO) for marketing in each district covering model sites; one (1) international marketing expert covering 4 model sites; one (1) local marketing expert covering 4 model sites

(c) Basic implementation plan

Formulate a basic implementation plan, in accordance with a result of the baseline survey

b Promotion of collective marketing by use of Multi-Purpose Shed (MPS)

(a) Construction of MPS

a) Preparation (June – July 2012)

Determine the location, design, contractor, prepare land, electric power, water, etc.

Assumed that the location is near group's place and along main road, and products are carried from farms to the shed by walking, bicycles, etc.

♦Main functions of MPS:

Temporary storage of farm produce, sorting, packaging, preparation for shipment, various meetings and other possible uses

♦Specifications of MPS:

Facilities comprising closed and open structures

[Closed structure]

Functions: Temporary storage of farm produce

Specifications: RC floor, RC pillars, brick walling, and thatched roofing with wooden frame, air vents openings, doors, etc.

[Open structure]

Functions: Sorting, packaging, preparation for shipment, various meetings

Specifications: RC floor, RC pillars, and thatched roofing with wooden frame, etc.

b) Construction (building) (August – December 2012)

c) Procurement and installation of internal facilities (May – Jun 2013 / May – Jun 2014)

Main internal facilities:

Rack for temporary storage, working tables, chairs, scale, etc.

(b) Establishment of collective marketing system (April 2012 – March 2013)

Establish the system for organization, production, harvest, collection, shipment

OJT for strengthening of practical marketing skill of smallholders

(a) Practice of marketing activities by OJT

Main marketing activities in the OJT is, as shown above in Fig. 6.2.1, a cycle to (i) forecast future market trend; (ii) make a plan of production/ selling; (iii) implement production/ selling; (iv) follow-up a result of selling; (v) analyze and feed it back to each process for improvement. Starting point in the cycle may differ depending on the situation. For instance, if there is already the product right before harvest or in the process of growing, the activities should naturally begin from seeking for the best possible marketing channels. Detail items of practice are as listed in Box 6.2.1 below.

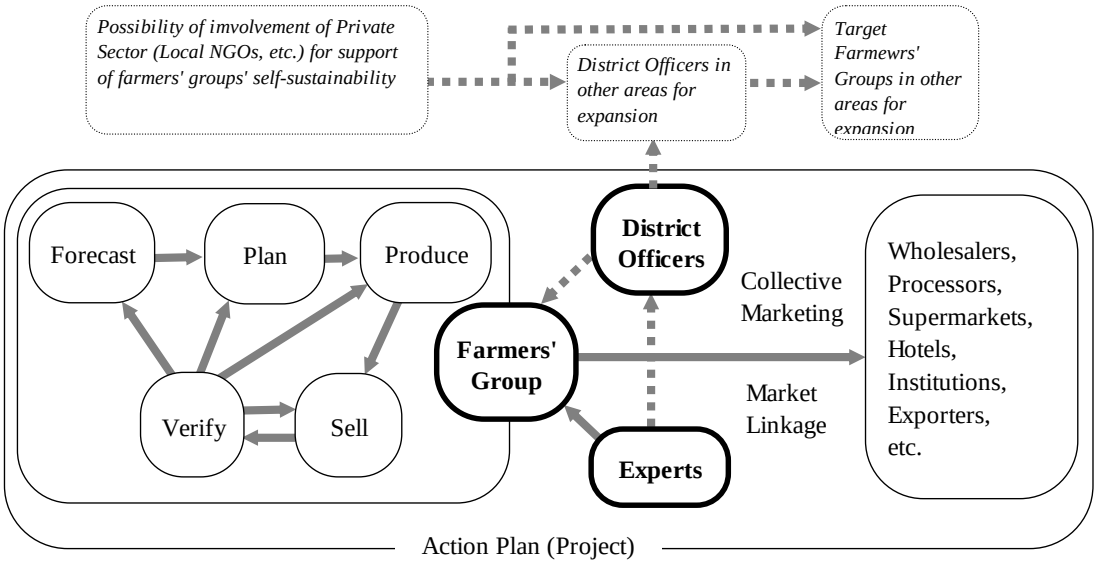


Figure : Support of Farmers' Groups by OJT (Image)

Box : Main Marketing Activities in OJT

(1) Formulation of sales plan based on market requirement

1 Collect information of current market trend

Source of information: Marketplaces for observation and interview to various marketers; intermediary traders; supermarkets; processors; wholesale companies; exporters; public/ private available data

2 Forecast future market trend

Analyze collected information and forecast future market trend on crop, quality, area, prices, demand, customers' classes, etc.

3 Determine marketing strategy

(1) Crops (cf. "C-Target areas and area features")

(2) Potential market channels (cf. "C-Target areas and area features")

(3) Transaction pattern

Transaction on demand; contract/ agreement basis; consignment basis

(4) Type of commodities for sale

Fresh; postharvest treatment (dry, sorting, etc.); primary processing; packaging (material/ procurement)

(5) Point of delivery

Place of farmers' group; place of buyers; marketplaces

(6) Timing of sale

Farm management for control of harvest time; adjustment of timing of sale by use of multi-purpose shed

(7) Sales promotion activities

Advertisement (radio, board along roads, etc.); contact to marketers (acquaintances); participate in information exchange programs (e.g. "matching meeting" under this project); participate in agro-products exhibitions, etc.

4 Formulate production, harvest, sorting, storage, shipment and transportation plan

5 Formulate business income and expenditure plan

6 Set business goal

Goal indicators: Crop, quality, area, prices, packaging, sales amount, customers' classes, cost, profit

(2) Implementation of sales promotion

1 Implement sales promotion activities

2 Find and negotiate with prospective buyers for agreement (contract)

3 Make an agreement with buyers

4 Implement production and shipment

5 Conduct follow-up survey of a result of sales

6 Analyze and feed back a result of follow-up survey to initial plan, method of production/ sales promotion, etc.

(3) Promotion of collective marketing

1 Establish collective marketing system (organization, equipment, materials, transportation, etc.)

2 Implement collective marketing by use of MPS

3 Conduct follow-up survey of a result of collective marketing (whether expected advantages realize)

4 Analyze and feed back a result of follow-up survey to implementing method of collective marketing.

(4) Technology transfer to district officers for self-sustainability of the project

1 District officers join farmers' group's marketing activities as much as possible through the project

2 Donor's experts transfer marketing/ training skills to district officers by OJT.

(b) Roles of main players

Through the A/P period (4 years), Experts join marketing activities of target farmers' groups to fully support them. Experts consist of two (2) members, one international expert and another local expert, who should be familiar and experienced enough in practical marketing activities, in addition to competent OJT skill. Main players of activities are farmers' groups. Two (2) experts cover 4 model sites, with area allocation and information sharing. In activities, experts and target group farmers think together, do market survey together, make a plan together, act everything together for marketing. In this way of OJT through the period of 4 years, target group farmers' practical marketing skill is expected to be strengthened up to self sustainable level.

In this OJT program, District officers concerned are to join activities as much as possible. Experts play 2 roles for support of target farmers' groups and for technology transfer to district officers. District officers are, through OJT, transferred marketing skill and OJT method, which will be useful to make the project self sustainable and transferable to other similar areas. Namely, after A/P model project finished, district officers are expected to support target group farmers playing same role as experts of the project, and also transfer the skill to other district officers for extension of the project. Main players supporting farmers' groups are the experts during implementation of A/P, model projects, and the district officers (expansion target district officers under support of A/P district officers) after the A/P.

Further study needs to be made on possibility for any pattern of involvement of private sector (local NGO, etc.) after the A/P, to more secure self sustainability.

d Technology transfer to district officers

Details of technology transfer to district officers are as described in "c-OJT for strengthening of practical marketing skill smallholders." District officers are expected to join OJT activities, not just in OJT for strengthening of practical marketing skill, also in the project preparation and promotion of collective marketing by use of multi-purpose shed, for multilateral technology transfer.

e Implementation plan (time schedule)

See **MAIN REPORT**

Role of each player are summarized below:

(a) A/P implementation period (April 2012 – March 2016)

Experts (international and local, one (1) each) are responsible for support of target farmers' groups, and also technology transfer to district officers (marketing).

(b) Expansion period (April 2016 – March 2021)

After A/P period, district officers transferred technology during implementation of A/P are, instead of the experts, expected to support target farmers' groups for their further development, and also transfer technology to other district officers for expansion. Likewise, other district officers support farmers' groups in their areas.

Specific Features by Section and Target Area

Specific features by A/P target area for distribution and marketing are summarized in Table (on the next page)

Table Specific Features by A/P Target Area for Distribution and Marketing

Target Area	Specific Features of Area in Marketing Situation	Specific Features of Farmers' Group in Marketing Activities	MPS scale (proposal)
Kalulushi district / Bwafano irrigation scheme	The area has a high market potentiality, with 30km to Kitwe (large consuming area), 100km to cross-border market and adjacent to main road. Potential crops are carrot, cabbages, tomato, and other various vegetables. Potential market channels are Wholesalers (Chisokone market, Kitwe / Main masala market, Ndola); wholesale company; processors; supermarket chains (e.g. Shoprite); hotels/ lodges; institutions; Kasumbalesa border market (exporters in cross border trade to DRC), etc.	♦Target farmers' group: Bulimi Cooperative / Tiwonge Multi-Purpose Cooperative / Tusheni Cooperative ♦Features: Although collective marketing is not conducted at the moment, they have "market" in mind. 3 groups recognize one of the main reason for no collective marketing is a lack of facilities. They desire to own and utilize one (1) shed jointly for realization of collective marketing.	220 m^2
Kabwe district / Natuseko irrigation scheme	The area is located at 15km to Kabwe, the center of central province, where several medium scale marketplaces are in operation. The irrigation site is adjacent to main road. Expansion of marketing channels is expected by linkage with marketers under the background of high self-sufficiency rate of the province. Potential crops are tomato; rape; water melon (new crop); other various vegetables. Potential market channels are wholesalers (New kasanda market, Kabwe / Kabwe town centre market, Kabwe); wholesale companies; exporters (in future), etc.	♦Target farmers' group: Moto-Moto Gardening Group (A and B) ♦Features: 72% of member farmers possess bicycles. They frequently do "group transportation by bicycles" to marketplaces. However, transactions are usually conducted individually. They have a keen interest in the shed for joint utilization (group A and B) for realization of collective marketing, with advantages of location (near marketplaces) and group leadership.	120 m^2
Kafue district /	The area is adjacent to Lusaka, the capital of the country,	♦Target farmers' group:	120

Chipapa irrigation scheme	where large scale marketplaces, supermarkets, processors are available. Market potential is very high, with big demand and various marketing channels. Potential crops are green beans; rapes; cabbages; cauliflowers; various leaf vegetables; etc. Potential market channels are wholesalers (Sowet market and other major market in Lusaka); wholesale company; processors (e.g. Freshpict); supermarket chains (e.g. Shoprite/ Freshmark, Spar, Melisa); hotels/ lodges; institutions; exporters, etc.	Chipapa Dam Garden Community ♦Features: Although collective marketing is not conducted at the moment, they are taking actions for realization of that. They have a fresh memory that their parents have been conducting collective marketing long ago, and recognize the advantage of such operation. This memory is now shared by all member farmers for motivation.	m^2
Kazungula district / Mulabalaba irrigation scheme	The area, the center of Kazungula district, is a strategic point in marketing, being located at 60km to Livingstone, 40km to Western province, and adjacent to neighboring 3 countries. Potential crops are tomato; cabbages; rape; leaf vegetables; green beans; other various vegetables. Potential market channels are wholesalers (Maramba main market/ Mbita market, Livingstone); wholesale companies; LFCS green market (Livingstone); processors; supermarket chains; hotels/ lodges; institutions; Kazungula border market (exporters in cross border trade to Botswana),etc.	♦Target farmers' group: Mukamba Multi-Purpose Cooperative Society ♦Features: This group conducts very active marketing operation, such as collective marketing, contract based transactions with marketers, linkage with other farmers' groups, advertisement, etc. They desire to have much bigger multi-purpose shed, since the existing one is too small for operation.	120 m^2

B 3. (Reference) Supplemental Explanation of Roadside Market as *Development strategy for Diversification of Market Channels* (not included in the A/P)

Cost Estimate and the Basis of Roadside Market

For one (1) site:
Size and cost:
Whole floor area: 200 m2
Construction cost: ZMK 119,780,000.-

♦Cost estimate is made as of September 2010, at the exchange rate of 4,991 ZMK/US$ and 0.017 Yen/ZMK.
♦Internal facilities are included.
♦Preparation of land, electric power and water are not included.

Personnel Man-Months
1) Experts (e.g., A/P period)
♦International (1 No.): 1 No. to cover 4 sites Marketing: 7m/y x 4y = 28 m/m
Possible other areas: Processing 1 No. / Postharvest treatment 1 No. / Packaging 1 No.: total 2m/y x 4y = 8m/m Grand total: 36 m/m

♦Local (1 No.): for work-sharing with international expert over 4 sites 1 No. to cover 4 sites
Marketing: 7m/y x 4y = 28 m/m Possible other areas: Processing 1 No. / Postharvest treatment 1 No. / Packaging 1 No.: total 2m/y x 4y = 8m/m Grand total: 36 m/m

2) Counterpart (2 Nos. for each target district)
♦e.g., A/P period
1 DMDO and 1 Assistant DMDO are to cover target area of each district.
1 DMDO:
Grand Total: 4 months/year (for this project only) x 4 years x 4 sites = 64 M/M
1 Assistant DMDO:
Grand Total: 5 months/year (for this project only) x 4 years x 4 sites = 80 M/M
♦e.g., M/P
The work volume of one (1) district officer for A/P period and the Expansion period is assumed to be same. Total man-months of the district officers per annum are summarized as below:

	DMDO	Assistant DMDO
e.g., A/P period	16 (=4 m/site x 4 sites)	20 (=5 m/site x 4 sites)
Expansion period	56 (=16 m/m x 14 sites / 4 sites)	70 (=20 m/m x 14 sites / 4 sites)

Basic Idea (proposal) of Roadside Market for Diversification of Market Channel

Master Plan Program	Along Main Roads in Peri-Urban Areas (e.g., Zone 1 and 4)
Target Group	Smallholders and local retailers (e.g., in Kitwe and Choma areas)
Implementing Agency	Department of Agribusiness and Marketing / Department of Policy and Planning, MACO
Collaborating Agencies	Provincial & District Agricultural Offices and Local Government in target areas

Background and Objectives

Current roadside markets (street vendors) along main roads keep a firm popularity with the sales point of fresh, cheap and local specialty. Travelling motorists, however, have often difficulty in finding what they need. In general, farmers have a constraint in securing stable market channels, and retailers require consistent procurement source, while consumers desire to have more options of where to purchase. If any improvement is made properly in marketing strategy and tactics, market will continue to expand with the background of a rapid progress of motorization (number of cars reportedly increases by 40-50% per annum) and a possible expansion of regional trade (increase of vehicles passage). While several roadside open markets have been established extensively along the Kafue Road in Chibombo district area (e.g. John Chinena site) with relatively high visitors and their repeat, there still remains insufficient measure for sales over the site (functions of facility, safety of visitors etc). Southern districts, where the targeting areas are located, have an enough space for renovate existing local open markets with micro individual enterprise (mostly women).

Project Goal

This project aims at sales expansion of local products (mainly irrigated cash crops), targeting niche market of travelling motorists (mainly middle-high income class customers and commercial vehicles drivers), by establishing Roadside Markets (RSM) instead of current street vendors, under linkage of smallholders/ local retailers (women) along main roads in the peri-urban areas. The project is headed for increase of income of smallholders through value addition of whole value chains, in compliance with the requirement of farmers, retailers and consumers.

Expected Outputs

(1)Marketing channels are developed and diversified
(2)Value addition of whole value chain is attained with smooth procurement and supply of the products under linkage of smallholders/ local retailers
(3)Local brand is established with increase of sale of local specific products
(4)Market-oriented production is attained, by knowing market requirement always in nearby RSM
(5)Increase of demand is expected by “new shop announcement effect” and quality improvement with indoor sale
(6)As a result of above outputs, farmers’ income increases

Activities

(1)Ownership and implementing body:
Business unit comprising farmers’ group(s) and local Retailers. The linkage is made by work-sharing that farmers are responsible for production/supply and retailers for sales.
(2)Advisor:
Select and make a contract with Advisor (Local private NGO, etc., / one person for one site), who supports from preparation of the project through to initial stage of operation
(3)Preparation and preliminary survey:
Market survey; determination of location; identifying and organizing farmers’ groups/ local retailers; business planning; design of RSM; selection of contractor; etc.
(4)Construction of RSM
Structure of RSM:
RC floor; RC pillars; Brick wall and CGI roofing with wooden frame. All building materials are to be locally available.
(5)Main facilities and functions of RSM:
1)Sale of local agricultural products
Products for sale are mainly irrigated cash crops, such as vegetables and fruit.
2)Function as “Antenna shop”
Record every transaction data (commodity; quantity; price; date; time; etc.) for feedback to the planning
3)Display stand
4)Cash desk
5)Parking (available for various sizes of cars and trucks)
6)Signboard and illuminations (with attractive design)

Annex C

Irrigation and Water Management

The Master Plan for Promotion of Irrigated Agriculture for Smallholders
in the Peri-Urban Areas in the Republic of Zambia
Final Report
Annex C. Irrigation and Water management
Table of Contents

Annex C. Irrigation and Water management

List of Tables

List of Figures

page

List of Tables

List of Figures

Chapter 1 Meteoro-hydrology

1.1 Climate in Zambia

Zambia enjoys an enviably pleasant climate because of its land-locked tropical country. In general, a year in Zambia is divided into two halves, the dry season from May to October and the wet season from November to April. It is however more convenient to divide a year into four (4) unequal seasons from the synoptic point of view as follows:

- Winter season : June to August
- Pre-wet season : September to October
- Wet season : November to March
- Post wet season : April to May

1.2 Meteorology

1.2.1 Rainfall

The annual rainfall in Zambia ranges from 700 mm in the extreme southwest to 1,400 mm in the north. The mean annual rainfall is 858 mm over Lusaka Provincial. The average annual rainfall of each province is as follows:

Table 1.2.1 Provincial Average of the Annual Mean Rainfall

Province	Annual rainfall (mm)	Province	Annual rainfall (mm)
Lusaka	857	Northwestern	1,173
Copperbelt	1,231	Western	808
Central	947	Luapula	1,259
Southern	737	Northern	1,138
		Eastern	961
	Total average in Zambia		1,001

Source: The Study on National Water Resources Master Plan (JICA)

Due to the trade winds and a belt of low pressure over the surface of the equator, the Inter Tropical Convergence Zone (ITCZ) generally moves north and south at the tropics. The change in the rainfall pattern (wet and dry seasons) occurs within the same month throughout the country. From the data analysis observed at meteorological stations in the Study area, annual rainfall distribution is summrized as follows:

- In the Copperbelt, Central, Lusaka and Southern Provinces, isohyetal lines are almost parallel from west to east. Thus the annual rainfall is decreased from the Copperbelt to Southern Provinces.
- The Southern area (i.e., the Southern Province) is the least rainfall area and its annual rainfall is lower than 700 mm.
- Difference in the amount of annual rainfall is due to the number of the rainy days and the rainfall intensity.

Table 1.2.2 Provincial Average of Rainy Days (Average for 30 years)

	Province	Annual Rainy Days
1.	Copperbelt Province	111
2.	Central Province	86
3.	Lusaka Province	77
4.	Southern Province	74

Source: The Study on National Water Resources Master Plan (JICA)

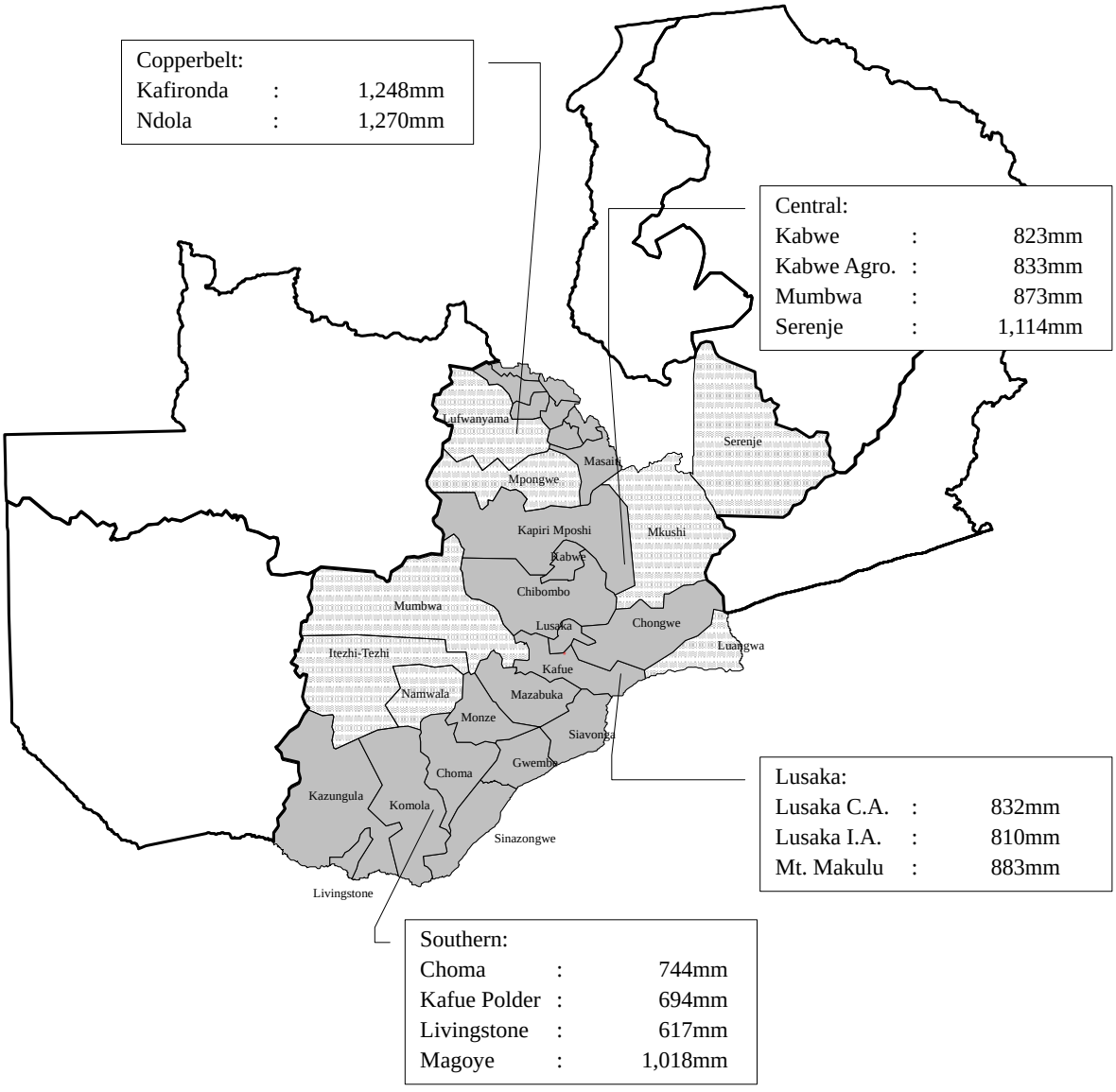


Fig. 1.2.1 Annual Rainfall in the Study Area

In recent decade, drought years were observed in 2001/02, 2002/03 and 2006/07. The droughts considerably influenced the southern area according to the observation data from Lusaka, Kabwe, Mumbwe, Choma, Livingstone.

1.2.2 Temperature

Lusaka, the capital city of Zambia, is located almost in the center of the country at an elevation of 1,280 m above sea level. Mean of the daily maximum and minimum temperatures are 30.1°C in October and 9.1 °C in July, respectively.

The temperature is greatly influenced by elevation. Thus assuming that the temperature rises at a rate of about 0.8 to 1.0 °C per 100m altitude, the temperature in the Siavonga and Sinazongwe located at about 500 m is 3 to 4°C higher than the provincial mean temperature.

Table 1.2.3 Provincial Average of the Annual Mean Temperature

Province	Annual mean temperature (°C)	Province	Annual mean temperature (°C)
Lusaka	20.9	Northwestern	21.1
Copperbelt	20.7	Western	22.5
Central	20.5	Luapula	21.3
Southern	21.5	Northern	21.1
		Eastern	22.0
	Average in Zambia		21.3

Source: The Study on National Water Resources Master Plan (JICA)

1.2.3 Humidity

1) Relative humidity

Table 1.2.4 Provincial Average of the Annual Mean Related Humidity

Province	Annual sunshine duration (%)	Province	Annual sunshine duration (%)
Lusaka	63.9	Northwestern	65.1
Copperbelt	65.5	Western	62.5
Central	64.2	Luapula	65.8
Southern	59.4	Northern	65.5
		Eastern	65.0
	Total average in Zambia		64.2

Source: The Study on National Water Resources Master Plan (JICA)

1.2.4 Other Meteorological Conditions

1) Evaporation

The average annual pan-evaporation ranges from 1,666mm to 2,814mm, and its average is 2,061mm in Zambia. The Copperbelt Province has the lowest annual pan-evaporation of 1,865mm on average. Monthly pan-evaporation is high from August to November, and is low from December to July.

Table 1.2.5 Provincial Average of the Annual Mean Pan-Evaporation

Province	Annual pan-evaporation (mm)	Province	Annual pan-evaporation (mm)
Lusaka	2,218	Northwestern	1,932
Copperbelt	1,865	Western	2,300
Central	2,105	Luapula	1,983
Southern	2,045	Northern	1,907
		Eastern	2,211
	Total average in Zambia		2,061

Source: The Study on National Water Resources Master Plan (JICA)

2) Sunshine duration

Table 1.2.6 Provincial Average of the Annual Mean Sunshine Duration

Province	Annual sunshine duration (hr)	Province	Annual sunshine duration (hr)
Lusaka	2,800	Northwestern	2,670
Copperbelt	2,760	Western	3,104
Central	2,943	Luapula	2,671
Southern	3,064	Northern	2,783
		Eastern	2,773
	Total average in Zambia		2,842

Source: The Study on National Water Resources Master Plan (JICA)

3) Wind speed

Table 1.2.7 Provincial Average of the Annual Mean Wind Speed

Province	Annual sunshine duration (m/sec)	Province	Annual sunshine duration (m/sec)
Lusaka	1.8	Northwestern	1.4
Copperbelt	1.6	Western	1.5
Central	1.8	Luapula	1.6
Southern	1.8	Northern	1.7
		Eastern	1.4
	Total average in Zambia		1.6

Source: The Study on National Water Resources Master Plan (JICA)

1.2.5 Update of Meteorological Data

In addition to the data in above Sub-chapter cited in the Study on National Water Resources Master Plan (JICA), the Study team collected updated meteorological data in the four Provinces of Cooperbelt, Central, Lusaka and Southern as a part of the resource map preparation.

(1) Rainfall data

	Province	Station	Average rainfall (mm)	Calculation period of average	Observation period
1.	Copperbelt	Kafironda	1,243.8	1980/81-2005/06	1979/80-2009/10
2.		Ndola	1,157.3	1980/81-2007/08	1979/80-2009/10
3.	Lusaka	Lusaka CA	794.0	1980/81-2008/09	1979/80-2009/10
4.		Lusaka IA	813.5	1980/81-2008/09	1979/80-2009/10
5.		Mt. Makulu	945.2	1980/81-2008/09	1979/80-2009/10
6.	Central	Kabwe	879.3	1980/81-2008/09	1979/80-2009/10
7.		Mumbwe	796.0	1980/81-2008/09	1979/80-2009/10
8.		Serenje	1,032.9	1980/81-2008/09	1979/80-2009/10
9.	Lusaka	Kafue	740.5	1980/81-2005/06	1979/80-2006/07
10	Southern	Choma	769.0	1980/81-2008/09	1979/80-2009/10
11.		Livingstone	634.3	1980/81-2008/09	1979/80-2009/10

Source: Meteorological Department

(2) Maximum temperature

	Province	Station	Average maximum temperature (°C)	Calculation period of average	Observation period
1.	Copperbelt	Ndola	32.0 (Oct)	1980/81-2007/08	1979/80-2009/10
2.	Central	Kabwe	31.6 (Oct)	1980/81-2007/08	1979/80-2009/10
3.		Serenje	30.7 (Oct)	1980/81-2007/08	1979/80-2009/10
4.	Lusaka	Lusaka CA	30.7 (Oct)	1980/81-2007/08	1979/80-2009/10
5.		Lusaka IA	32.1 (Oct)	1980/81-2007/08	1979/80-2009/10
6.		Kafue	33.2 (Oct)	1980/81-2005/06	1979/80-2008/09
7.	Central	Choma	30.9 (Oct)	1980/81-2007/08	1979/80-2009/10
8.		Livingstone	34.6 (Oct)	1979/80-2009/10	1979/80-2009/10

(3) Minimum temperature

	Province	Station	Average minimum temperature (°C)	Calculation period of average	Observation period
1.	Copperbelt	Ndola	8.4 (Jul)	1980/81-2008/09	1979/80-2009/10
2.	Central	Kabwe	9.2 (Jul)	1980/81-2008/09	1979/80-2009/10
3.		Serenje	8.9 (Jul)	1981/82-2008/09	1979/80-2009/10
		Mumbwe	7.8 (Jul)	1981/82-2008/09	1979/80-2009/10
4.	Lusaka	Lusaka CA	10.1 (Jul)	1980/81-2008/09	1979/80-2009/10
5.		Lusaka IA	7.9 (Jul)	1980/81-2008/09	1979/80-2009/10
6.		Kafue	7.7 (Jul)	1980/81-2001/02	1979/80-2008/09
7.	Central	Choma	5.7 (Jul)	1980/81-2008/09	1979/80-2009/10
8.		Livingstone	7.3 (Jul)	1980/81-2008/09	1979/80-2009/10

(4) Humidity

	Province	Station	Average humidity (%)	Calculation period of average	Observation period
2.	Central	Kabwe	63.3	1980/81-2009/10	1979/80-2009/10
3.	Lusaka	Lusaka CA	62.9	1988/89-2008/09	1987/88-2008/09
		Kafue	60.7	1983/84-2002/03	1980/81-2006/07
4.	Central	Choma	60.8	1980/81-2009/10	1979/803-2009/10
5.		Livingstone	54.4	1980/81-2008/09	1979/80-2009/10

(5) Wind Speed

	Province	Station	Average wind speed (m/sec)	Calculation period of average	Observation period
1.	Central	Serenje	3.3	1980/81-2008/09	1979/80-2008/09
3.		Kabwe	3.3	1980/81-2008/09	1979/80-2008/09
	Lusaka	Lusaka CA	5.0	1987/88-2008/09	1987/88-2008/09
		Mt. Makulu	3.4	1980/81-2001/02	1979/80-2001/02
		Kafue	3.7	1981/82-2006/07	1979/80-2006/07
4.	Central	Choma	3.1	1980/81-2008/09	1979/80-2008/09
5.		Livingstone	3.6	1986/87-2004/05	1986/87-2004/05

(6) Sunshine Duration

	Province	Station	Average sunshine duration (hr/day)	Calculation period of average	Observation period
1.	Central	Kabwe	8.5	1980/81-2008/09	1979/80-2008/09
	Lusaka	Lusaka CA	8.4	1980/81-1996/97	1979/80-1996/97
		Kafue	8.6	1980/81-1994/95	1979/80-1994/95
4.	Central	Choma	8.4	1980/81-1991/92	1979/80-1991/92
5.		Livingstone	8.8	1979/80-1995/96	1979/80-1995/96

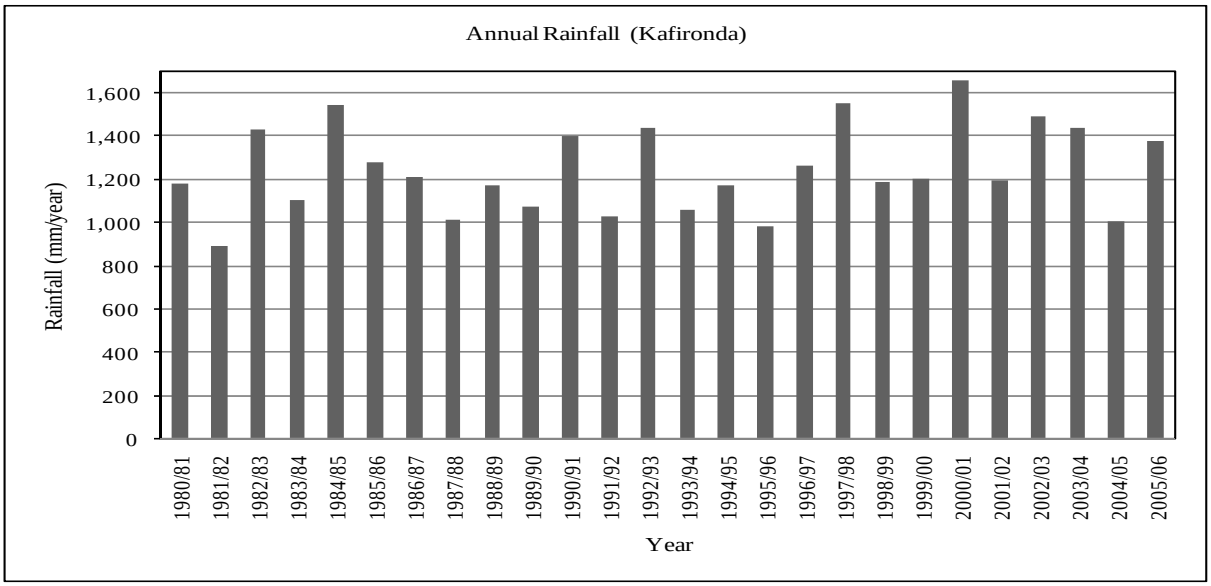
Tables

Table T1.2.1 Rainfall Data

Station: Kafironda

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979	/	1980										0.0	0.0	0.0	0.0
1980	/	1981	65.0	85.2	263.8	308.4	220.3	172.5	64.3	0.0	0.0	0.0	0.0	0.0	1,179.5
1981	/	1982	2.5	94.9	153.0	271.6	247.2	46.8	67.9	11.0	0.0	0.0	0.0	0.0	894.9
1982	/	1983	104.5	205.5	231.3	348.1	231.4	163.5	145.0	3.0	0.0	0.0	0.0	0.0	1,432.3
1983	/	1984	70.0	111.5	335.1	315.8	121.1	113.5	33.0	0.0	0.0	0.0	0.0	0.0	1,100.0
1984	/	1985	9.8	223.1	515.5	302.8	240.1	144.7	66.0	42.5	0.0	0.0	0.0	0.1	1,544.6
1985	/	1986	4.7	94.9	219.7	318.4	213.2	305.9	118.0	0.0	0.0	0.0	0.0	0.0	1,274.8
1986	/	1987	89.4	183.7	102.0	339.3	208.4	277.1	9.5	0.0	0.0	0.0	0.5	0.0	1,209.9
1987	/	1988	54.6	46.4	160.9	349.1	211.9	190.0	1.0	0.0	0.0	0.0	0.0	0.0	1,013.9
1988	/	1989	22.0	132.8	236.7	345.2	186.7	219.0	28.0	0.5	0.0	4.9	0.0	0.0	1,175.8
1989	/	1990	8.2	134.0	314.3	176.3	232.4	106.9	60.4	40.5	0.0	0.0	0.0	1.5	1,074.5
1990	/	1991	34.0	68.1	148.8	659.5	234.3	190.1	48.5	9.8	0.0	4.9	0.0	0.0	1,398.0
1991	/	1992	74.7	83.9	314.3	221.0	92.5	233.8	7.3	0.0	0.0	0.0	0.0	0.0	1,027.5
1992	/	1993	19.7	102.5	270.2	338.7	498.1	156.9	53.5	0.0	0.0	0.0	0.0	0.0	1,439.6
1993	/	1994	9.1	142.3	155.8	300.3	400.9	33.1	6.4	6.5	0.0	0.0	0.0	0.9	1,055.3
1994	/	1995	66.5	97.0	216.2	233.4	381.4	172.8	7.1	0.0	0.0	0.0	0.0	0.0	1,174.4
1995	/	1996	7.7	170.1	148.5	205.8	243.0	169.2	3.2	37.5	0.0	0.0	0.0	0.1	985.1
1996	/	1997	1.0	46.9	342.8	434.7	155.0	155.7	68.7	0.0	0.0	0.0	0.0	56.7	1,261.5
1997	/	1998	12.9	181.0	329.4	435.7	275.5	307.0	7.9	0.0	0.0	0.0	0.0	0.0	1,549.4
1998	/	1999	0.2	52.1	333.9	295.3	156.6	320.5	27.9	0.0	0.0	0.0	1.7	0.0	1,188.2
1999	/	2000	1.0	91.8	152.4	367.0	280.9	279.7	24.9	1.0	0.0	0.0	0.0	0.0	1,198.7
2000	/	2001	23.9	154.5	327.1	456.9	410.6	258.3	13.5	0.0	0.0	0.0	0.0	13.2	1,658.0
2001	/	2002	72.6	137.8	201.0	284.3	232.4	180.9	81.0	0.0	0.0	0.0	0.0	3.4	1,193.4
2002	/	2003	18.1	186.4	359.8	358.4	251.8	190.8	46.1	77.6	0.0	0.0	0.0	0.0	1,489.0
2003	/	2004	25.1	83.8	429.5	409.5	223.8	188.3	77.9	0.0	0.0	0.0	0.0	0.0	1,437.9
2004	/	2005	29.0	101.9	283.8	269.2	135.8	153.7	20.6	0.0	0.0	5.8	0.0	2.9	1,002.7
2005	/	2006	0.0	85.8	360.7	391.6	197.1	308.2	35.1	0.7	0.0	0.0	0.0	0.0	1,379.2
2006	/	2007	-	-	-	-	-	-	-	-	336.3	0.0	0.6	-	336.9
2007	/	2008	29.5	109.2	403.3	395.8	-	148.7	0.0	0.0	0.0	0.0	0.0	0.0	1,086.5
2008	/	2009	-	-	-	-	-	-	-	60.5	0.0	0.0	0.0	0.0	60.5
2009	/	2010	10.7	178.7	329.6	177.3	230.8	289.9							1,217.0
Average			31.8	119.2	265.6	336.0	241.6	193.8	43.2	8.9	0.0	0.6	0.1	3.0	1,243.8

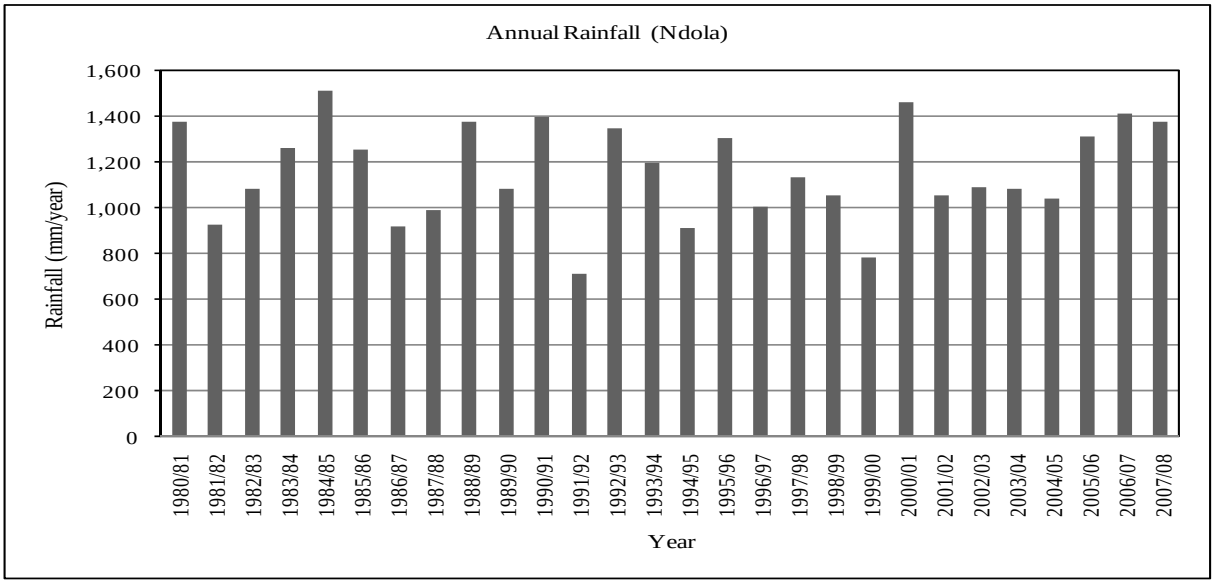
Average: 1980/1981 – 2009-2010



Station: Ndola

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979	/	1980										0.0	0.0	0.0	0.0
1980	/	1981	92.9	155.1	312.9	243.7	305.8	166.3	99.8	0.0	0.0	0.0	0.0	0.0	1,376.5
1981	/	1982	7.3	158.2	71.3	272.8	282.1	56.1	67.1	0.0	0.0	0.0	0.0	7.3	922.2
1982	/	1983	27.0	120.0	238.1	317.4	142.5	136.5	97.7	2.0	0.0	0.0	0.0	0.0	1,081.2
1983	/	1984	81.3	111.0	454.5	204.4	259.5	148.5	2.6	0.0	0.0	0.0	0.0	0.2	1,262.0
1984	/	1985	38.7	182.8	450.8	307.6	268.9	185.5	65.1	6.2	0.0	1.5	0.0	0.0	1,507.1
1985	/	1986	16.2	211.4	191.8	389.0	187.6	201.4	58.2	0.0	0.2	0.0	0.0	0.0	1,255.8
1986	/	1987	101.8	44.3	126.2	265.7	201.0	173.4	1.8	0.0	0.0	0.0	0.8	2.5	917.5
1987	/	1988	13.8	84.1	203.5	249.6	235.1	190.9	9.4	0.0	0.0	0.0	1.4	0.0	987.8
1988	/	1989	58.3	70.4	220.9	372.2	384.2	248.7	17.3	1.5	0.0	0.0	0.0	0.0	1,373.5
1989	/	1990	0.6	102.7	293.6	190.3	259.5	129.9	100.8	3.6	0.0	0.0	0.0	0.0	1,081.0
1990	/	1991	7.5	106.6	413.9	560.2	98.9	152.7	37.5	6.1	0.0	0.0	0.0	13.1	1,396.5
1991	/	1992	47.0	96.5	204.0	143.1	67.3	146.0	1.9	2.3	0.0	0.0	0.0	0.0	708.1
1992	/	1993	48.0	43.8	327.7	529.9	183.3	178.9	31.2	0.0	0.0	0.0	0.0	0.0	1,342.8
1993	/	1994	1.4	194.3	302.9	244.2	314.5	102.6	28.1	0.0	0.0	0.0	0.0	5.9	1,193.9
1994	/	1995	92.5	22.7	119.3	160.4	356.9	148.8	1.4	0.0	0.0	0.0	0.0	8.3	910.3
1995	/	1996	6.6	231.1	410.9	220.6	261.8	116.5	39.7	18.9	0.0	0.0	0.0	0.0	1,306.1
1996	/	1997	0.0	39.7	167.8	381.4	199.9	149.0	46.7	7.2	0.0	0.0	0.0	9.8	1,001.5
1997	/	1998	4.8	154.9	358.1	231.2	157.0	222.4	0.0	0.0	0.0	0.0	0.0	0.0	1,128.4
1998	/	1999	0.0	0.5	307.2	319.2	245.1	171.1	13.4	0.0	0.0	0.0	0.0	0.0	1,056.5
1999	/	2000	13.1	147.5	86.6	181.9	190.2	150.2	5.7	3.0	0.0	0.0	0.0	0.0	778.2
2000	/	2001	2.6	118.7	352.4	386.5	333.3	266.2	0.0	0.0	0.0	0.0	0.8	0.0	1,460.5
2001	/	2002	23.0	102.4	342.5	288.3	203.3	60.4	30.5	0.0	0.4	0.0	0.0	0.0	1,050.8
2002	/	2003	40.6	0.0	283.9	309.3	206.5	246.0	0.0	0.0	0.0	0.0	0.0	0.0	1,086.3
2003	/	2004	43.2	69.3	262.7	217.1	228.7	257.8	0.0	0.0	0.0	0.0	0.0	0.0	1,078.8
2004	/	2005	26.1	118.2	283.0	357.8	92.2	150.4	5.6	0.0	0.0	7.2	0.0	0.0	1,040.5
2005	/	2006	0.0	152.1	251.0	359.7	306.5	212.9	30.1	0.0	0.0	0.0	0.0	0.0	1,312.3
2006	/	2007	20.1	86.7	451.1	420.5	332.2	94.1	8.1	0.0	1.0	0.0	0.0	0.0	1,413.8
2007	/	2008	18.8	100.8	449.5	425.6	276.1	100.9	0.6	0.0	0.0	0.0	0.0	0.0	1,372.3
2008	/	2009	-	233.8	232.8	357.6	279.1	172.3	-	-	-	0.0	0.0	0.0	1,275.6
2009	/	2010	16.9	-	362.3	239.1	244.7	292.2	-	0.0	0.0				1,155.2
Average			29.8	108.1	283.5	305.3	235.0	163.0	28.6	1.8	0.1	0.3	0.1	1.7	1,157.3

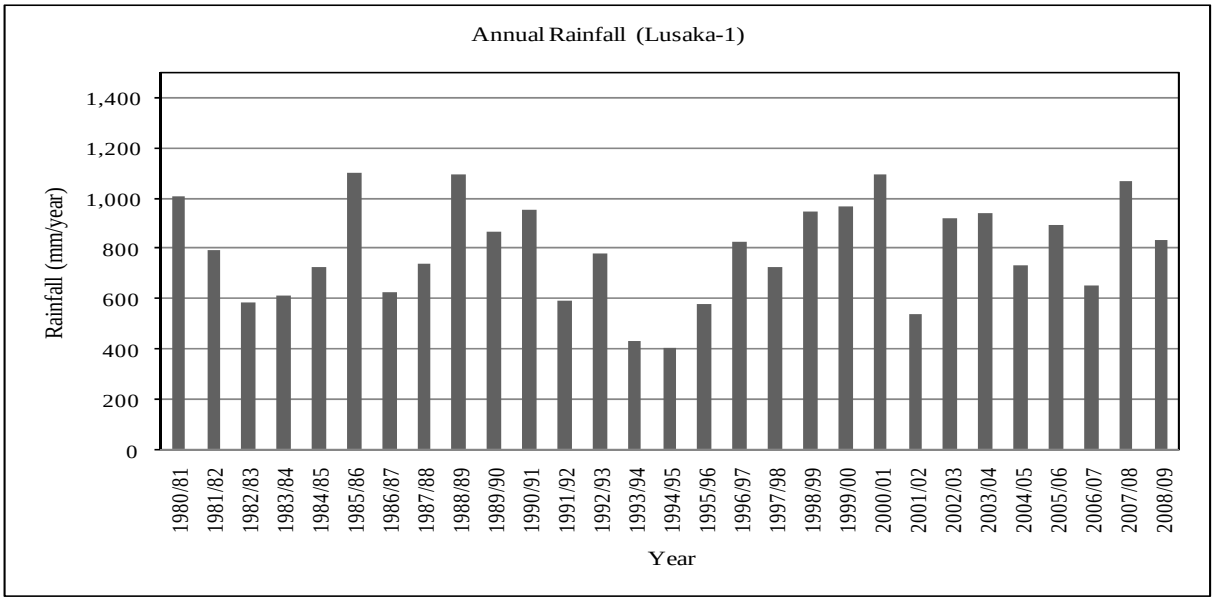
Average: 1980/1981 – 2007/2008



Station: Lusaka-1 (City Airport)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979 / 1980										0.0	0.0	0.0	0.0
1980 / 1981	11.0	61.8	147.0	278.9	286.5	150.6	70.3	0.0	0.0	0.0	0.0	0.0	1,006.1
1981 / 1982	1.8	141.3	45.1	346.5	204.1	9.3	39.3	6.4	0.0	0.0	0.0	0.5	794.3
1982 / 1983	54.3	49.7	62.7	187.0	173.7	40.1	18.8	0.0	0.0	0.0	0.0	0.0	586.3
1983 / 1984	5.4	57.8	210.5	127.0	141.5	54.5	15.6	0.0	0.0	0.0	0.0	0.0	612.3
1984 / 1985	2.2	90.9	191.5	212.2	184.0	42.1	0.6	0.0	0.0	0.0	0.0	0.0	723.5
1985 / 1986	19.7	27.5	326.5	316.9	110.3	122.2	181.0	0.0	0.0	0.0	0.0	0.0	1,104.1
1986 / 1987	41.7	31.0	241.3	217.1	79.5	10.1	0.0	1.5	0.0	0.0	0.0	2.9	625.1
1987 / 1988	3.3	25.6	234.4	96.1	206.5	172.6	0.0	0.0	0.0	0.2	0.0	0.0	738.7
1988 / 1989	6.0	10.0	97.0	412.1	419.9	147.1	0.9	0.0	0.0	0.0	0.7	0.0	1,093.7
1989 / 1990	0.9	78.6	162.5	313.3	208.8	24.6	78.0	0.0	0.0	0.0	0.0	2.2	868.9
1990 / 1991	10.8	45.3	154.5	292.4	205.0	85.9	158.8	0.0	0.0	0.0	0.0	0.0	952.7
1991 / 1992	46.4	120.8	124.6	94.2	55.0	142.4	0.0	11.8	0.0	0.0	0.0	0.0	595.2
1992 / 1993	11.5	61.3	239.1	144.2	154.7	94.9	63.8	0.0	0.0	0.0	0.0	7.2	776.7
1993 / 1994	0.0	113.8	65.4	131.0	72.5	5.6	42.1	0.0	0.0	0.0	0.0	0.0	430.4
1994 / 1995	39.3	43.5	99.5	91.8	105.4	23.9	1.9	0.0	0.0	0.0	0.0	0.0	405.3
1995 / 1996	29.9	42.0	19.9	164.4	216.9	91.2	0.0	11.5	0.0	0.0	0.0	0.0	575.8
1996 / 1997	0.0	77.8	148.7	296.9	169.2	25.7	106.7	0.0	0.0	0.0	0.0	0.0	825.0
1997 / 1998	0.0	86.8	127.9	306.1	128.7	74.1	0.0	0.0	0.0	0.0	0.0	0.0	723.6
1998 / 1999	0.0	42.4	292.1	333.8	254.3	25.7	0.0	0.0	0.0	0.0	0.0	0.0	948.3
1999 / 2000	12.5	36.9	91.3	281.7	308.1	225.0	7.6	0.0	7.0	0.0	0.0	0.0	970.1
2000 / 2001	2.6	116.1	242.3	248.3	322.6	163.1	0.0	0.0	0.0	0.0	0.0	0.0	1,095.0
2001 / 2002	0.0	59.9	164.7	120.4	37.4	51.0	102.2	0.0	0.0	0.0	0.0	2.4	538.0
2002 / 2003	29.1	128.1	183.6	172.0	236.3	170.7	2.5	0.0	0.0	0.0	0.0	0.0	922.3
2003 / 2004	4.0	66.0	231.8	252.2	265.4	118.8	0.0	0.0	0.0	0.0	0.0	0.0	938.2
2004 / 2005	0.0	32.8	469.6	140.8	54.5	35.7	0.0	0.0	0.0	0.0	0.0	0.0	733.4
2005 / 2006	0.0	81.4	182.8	224.0	229.9	175.7	0.0	0.0	0.0	0.0	0.0	0.0	893.8
2006 / 2007	0.0	21.2	153.5	303.3	100.9	60.8	11.1	0.0	0.0	0.0	0.0	0.0	650.8
2007 / 2008	2.7	113.9	343.2	411.0	129.7	65.1	2.0	0.0	0.0	0.0	0.0		1,067.6
2008 / 2009	53.3	105.5	198.2	258.4	60.0	119.4	0.0	39.1	0.0	0.0	0.0	0.0	833.9
2009 / 2010	0.0	181.5	188.7	145.0	-	140.5	-	0.0					655.7
Average	13.4	67.9	181.1	233.6	176.6	87.2	31.1	2.4	0.2	0.0	0.0	0.5	794.0

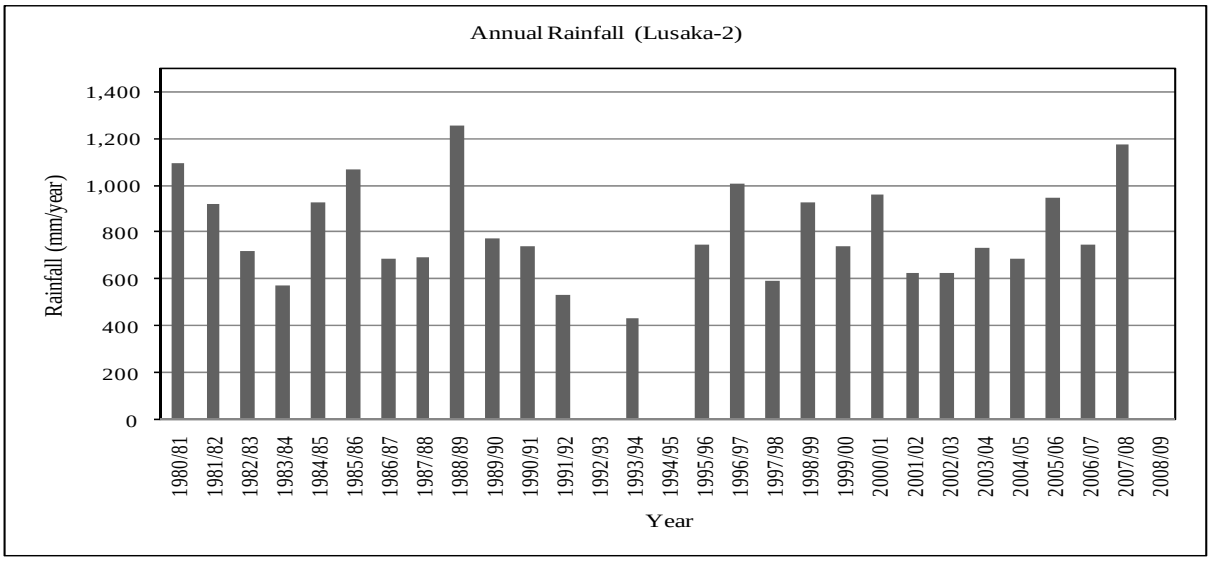
Average: 1980/1981 – 2008/2009



Lusaka-2 (International Airport)

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979	/	1980										0.0	0.0	0.0	0.0
1980	/	1981	14.0	104.9	147.0	276.5	349.7	106.5	96.6	0.0	0.0	0.0	0.0	0.0	1,095.2
1981	/	1982	0.0	116.4	78.4	433.7	232.7	34.9	17.9	7.9	0.0	0.0	0.0	0.0	921.9
1982	/	1983	74.1	118.6	171.9	218.3	97.9	32.9	3.5	0.0	0.0	0.0	0.0	0.0	717.2
1983	/	1984	2.4	36.5	145.9	98.0	221.4	50.7	10.5	5.4	0.0	0.0	0.0	0.0	570.8
1984	/	1985	0.0	133.6	260.7	221.6	222.0	82.3	3.7	0.0	0.0	2.0	0.0	0.0	925.9
1985	/	1986	21.3	34.2	201.1	347.2	156.1	123.3	187.6	0.0	0.0	0.0	0.0	0.0	1,070.8
1986	/	1987	33.8	45.9	217.3	294.8	51.3	28.5	0.0	2.5	0.0	0.0	0.0	9.7	683.8
1987	/	1988	0.0	37.5	233.5	161.3	154.0	102.7	1.0	0.0	0.4	0.0	0.0	0.0	690.4
1988	/	1989	2.2	20.0	145.8	385.9	527.6	163.0	5.5	0.0	0.0	0.0	4.0	0.0	1,254.0
1989	/	1990	0.0	40.8	123.5	312.9	222.0	24.9	52.0	0.0	0.0	0.0	0.0	0.0	776.1
1990	/	1991	46.1	17.7	244.3	268.1	91.5	62.5	10.2	0.4	0.0	0.0	0.0	0.0	740.8
1991	/	1992	22.9	100.2	82.5	101.2	58.3	137.4	23.1	4.0	0.0	0.0	0.0	0.0	529.6
1992	/	1993	2.8	98.2	269.7	-	-	-	-	0.0	0.0	0.0	0.0	0.0	370.7
1993	/	1994	2.7	52.2	112.0	140.1	109.7	0.0	8.9	0.0	0.0	0.0	0.0	4.2	429.8
1994	/	1995	39.8	235.4	128.5	-	-	26.2	2.6	0.0	0.0	0.0	0.0	0.0	432.5
1995	/	1996	27.5	58.7	96.0	223.5	167.9	129.8	0.0	40.5	0.0	1.3	0.0	0.0	745.2
1996	/	1997	0.0	82.7	151.6	303.4	223.7	79.8	149.1	0.2	0.0	0.0	0.0	19.0	1,009.5
1997	/	1998	0.0	75.9	138.8	209.2	96.8	71.4	0.0	0.0	0.0	0.0	0.0	0.0	592.1
1998	/	1999	0.0	38.5	304.9	375.9	181.9	23.7	0.0	0.0	0.0	0.0	0.0	0.0	924.9
1999	/	2000	32.5	47.6	86.0	215.8	165.4	181.8	10.8	2.4	0.0	0.0	0.0	0.0	742.3
2000	/	2001	11.9	55.8	175.2	178.9	363.4	173.5	3.1	0.0	0.0	0.0	0.0	0.0	961.8
2001	/	2002	0.0	132.8	165.2	120.5	90.1	26.8	83.2	0.0	0.0	0.0	0.0	8.3	626.9
2002	/	2003	0.0	56.1	142.9	77.1	168.1	180.5	3.1	0.0	0.0	0.0	0.0	0.0	627.8
2003	/	2004	0.0	61.5	156.4	261.2	130.4	88.5	35.0	0.0	0.0	0.0	0.0	0.0	733.0
2004	/	2005	28.2	55.0	357.3	114.5	71.3	22.4	37.8	0.0	0.0	0.0	0.0	0.0	686.5
2005	/	2006	0.0	73.3	238.4	171.7	222.2	209.0	31.5	0.0	0.0	0.0	0.0	0.0	946.1
2006	/	2007	0.0	64.5	132.8	329.9	178.4	36.1	0.0	0.0	0.0	0.0	0.0	7.6	749.3
2007	/	2008	2.0	109.8	328.0	484.0	114.6	134.0	0.0	0.0	0.0	0.0	0.0	0.0	1,172.4
2008	/	2009	59.2	-	311.5	259.4	0.0	181.3	0.0	27.2	0.0	-	-	0.0	838.6
2009	/	2010	1.2	198.9	175.7										375.8
Aver age			14.6	75.2	184.4	243.9	172.9	89.8	27.7	3.1	0.0	0.1	0.1	1.7	813.5

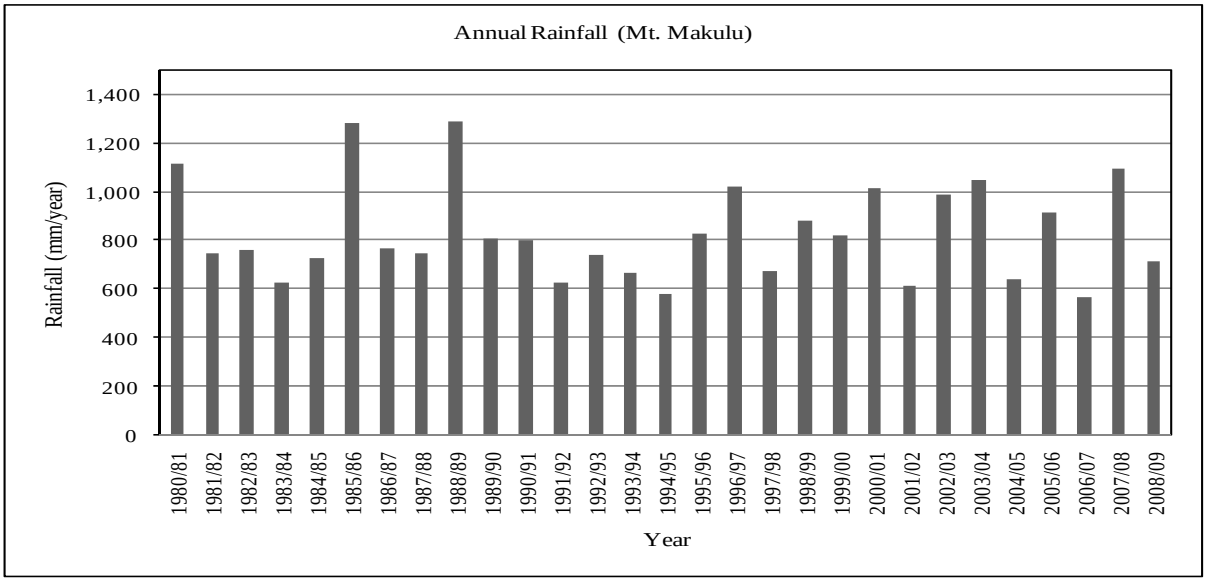
Average: 1980/1981 – 2008/2009



Station: Mt. Makulu

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979	/	1980										0.0	0.0	0.0	0.0
1980	/	1981	10.8	114.6	224.0	283.1	305.3	134.1	42.1	0.0	0.0	0.0	0.0	0.0	1,114.0
1981	/	1982	0.0	177.4	49.5	255.8	231.5	14.7	13.9	0.7	0.0	0.0	0.0	0.0	743.5
1982	/	1983	58.0	102.0	92.1	238.0	84.2	128.4	54.6	0.0	1.9	0.0	0.0	0.0	759.2
1983	/	1984	29.4	38.0	128.8	173.9	188.2	66.6	2.3	0.0	0.0	0.0	0.0	0.0	627.2
1984	/	1985	2.6	63.1	181.1	134.5	205.7	127.2	8.6	0.6	0.0	0.0	0.0	0.0	723.4
1985	/	1986	19.7	142.8	294.8	326.5	210.7	138.3	146.1	2.3	0.0	0.0	0.0	0.0	1,281.2
1986	/	1987	164.5	77.9	205.7	194.8	75.5	33.9	0.0	7.1	0.0	0.0	0.0	3.9	763.3
1987	/	1988	3.9	72.5	188.9	122.0	230.6	125.6	0.0	0.0	0.0	0.0	0.0	0.0	743.5
1988	/	1989	3.4	14.0	154.5	376.6	559.3	179.7	0.0	0.1	0.0	0.0	0.0	0.0	1,287.6
1989	/	1990	2.6	56.0	211.3	264.8	165.2	30.4	69.4	0.0	0.0	0.0	0.0	3.9	803.6
1990	/	1991	3.0	47.9	245.7	231.0	153.1	114.9	4.4	0.0	0.0	0.0	0.0	0.0	800.0
1991	/	1992	26.7	149.9	63.7	168.5	44.9	166.4	5.0	0.0	0.0	0.0	0.0	0.0	625.1
1992	/	1993	4.8	87.7	210.5	167.8	179.6	83.5	4.4	0.0	0.0	0.0	0.0	1.0	739.3
1993	/	1994	11.1	119.7	125.0	244.1	140.7	2.7	21.9	0.0	0.0	0.0	0.0	0.0	665.2
1994	/	1995	27.0	41.1	232.2	67.0	131.3	82.7	0.3	0.0	0.0	0.0	0.0	0.0	581.6
1995	/	1996	62.3	85.2	83.7	241.0	191.7	125.9	0.0	33.6	0.0	0.0	0.0	0.0	823.4
1996	/	1997	0.0	133.6	165.7	371.0	203.5	41.7	96.2	4.9	0.0	0.0	0.0	2.4	1,019.0
1997	/	1998	5.8	151.7	122.1	298.7	60.4	34.9	0.0	0.0	0.0	0.0	0.0	0.0	673.6
1998	/	1999	0.0	60.2	223.5	305.8	240.8	49.7	0.0	0.0	0.0	0.0	0.0	0.0	880.0
1999	/	2000	9.9	41.8	196.3	235.0	122.8	179.2	18.0	13.6	0.0	0.0	0.0	0.0	816.6
2000	/	2001	16.2	121.5	215.7	256.6	280.5	116.7	3.5	0.0	0.0	0.0	0.0	1.5	1,012.2
2001	/	2002	47.0	104.9	216.1	100.2	37.3	25.2	78.8	0.0	0.0	0.0	0.0	0.0	609.5
2002	/	2003	15.5	82.7	159.2	198.7	250.8	274.8	4.6	0.0	0.0	0.0	0.0	0.0	986.3
2003	/	2004	38.1	57.3	291.4	191.3	246.0	198.9	23.7	0.0	0.0	0.0	0.0	0.0	1,046.7
2004	/	2005	44.6	106.5	257.9	122.3	91.3	18.2	0.0	0.0	0.0	0.0	-	-	640.8
2005	/	2006	0.0	22.6	326.4	232.9	176.0	152.6	0.4	0.0	-	-	0.0	0.0	910.9
2006	/	2007	0.0	71.2	115.1	279.7	62.4	20.4	17.3	0.0	0.0		0.0	0.0	566.1
2007	/	2008	19.2	128.3	423.5	374.5	80.2	65.0	1.8	0.0	-	0.0	0.0	0.0	1,092.5
2008	/	2009	-	108.2	284.3	175.6	110.9	0.0	0.0	30.8	-	0.0	-	0.0	709.8
2009	/	2010	0.0	265.9	100.9	246.7	331.7								945.2
Average			22.4	89.0	196.2	228.7	174.5	94.2	21.3	3.2	0.1	0.0	0.0	0.5	830.1

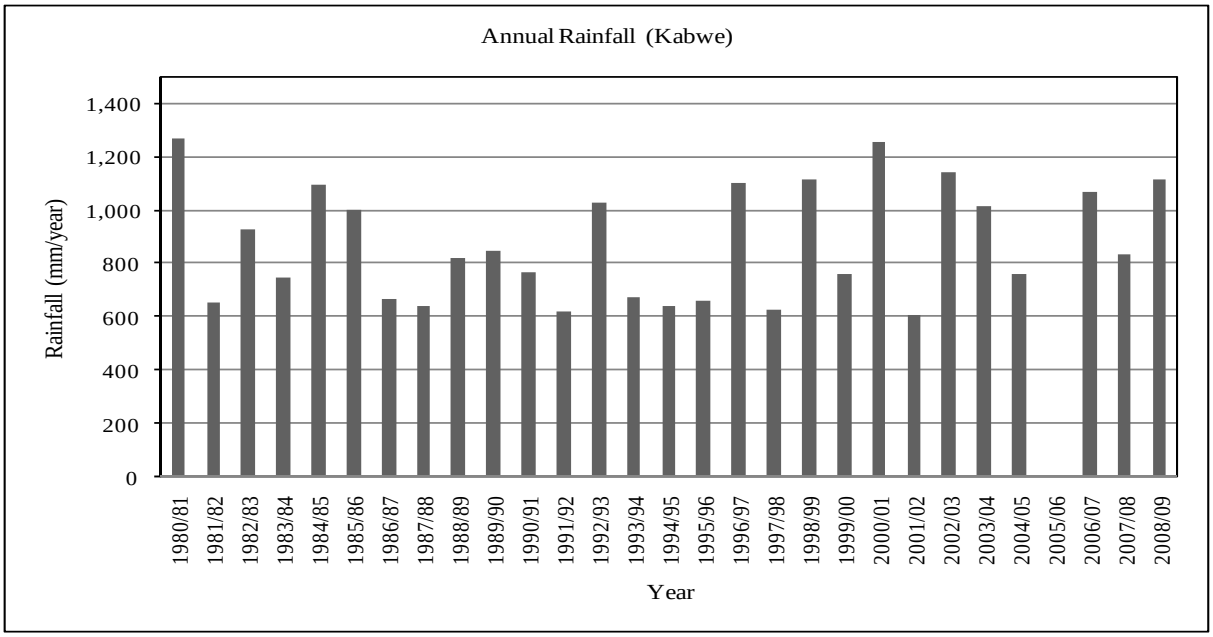
Average: 1980/1981 – 2008/2009



Station: Kabwe

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979	/	1980										0.0	0.0	8.8	8.8
1980	/	1981	40.0	160.8	360.8	248.7	254.4	111.3	91.4	0.0	0.0	0.0	0.0	0.0	1,267.4
1981	/	1982	0.0	20.3	62.3	287.5	229.5	31.7	9.5	12.7	0.0	0.0	0.0	0.0	653.5
1982	/	1983	27.2	206.0	121.1	256.8	181.5	94.6	39.9	2.6	0.0	0.0	0.0	0.0	929.7
1983	/	1984	18.9	111.8	246.0	76.0	181.1	99.7	13.0	0.0	0.0	0.0	0.0	0.0	746.5
1984	/	1985	0.0	97.0	405.6	254.9	173.5	138.4	14.7	10.4	0.0	0.0	0.0	0.0	1,094.5
1985	/	1986	0.0	62.2	300.9	289.1	129.5	81.4	137.7	0.0	0.1	0.0	0.0	0.0	1,000.9
1986	/	1987	37.9	67.2	180.7	251.0	88.8	38.3	0.0	0.9	0.0	0.0	0.0	0.0	664.8
1987	/	1988	2.5	47.0	197.2	169.3	148.3	66.6	2.9	0.0	2.8	0.0	0.0	0.0	636.6
1988	/	1989	43.3	55.0	114.7	233.8	279.0	92.0	5.0	0.0	0.0	0.0	0.0	0.0	822.8
1989	/	1990	1.7	46.5	179.6	374.0	147.4	53.4	43.0	1.7	0.0	0.0	0.0	0.9	848.2
1990	/	1991	0.3	98.2	143.1	281.9	171.5	70.8	0.0	1.1	0.0	0.0	0.0	0.0	766.9
1991	/	1992	75.8	43.6	159.6	69.6	92.8	153.0	24.3	0.2	0.0	0.0	0.0	0.0	618.9
1992	/	1993	5.7	121.1	322.3	182.2	234.7	139.9	20.5	0.0	0.0	0.0	0.0	0.9	1,027.3
1993	/	1994	0.0	106.7	87.1	277.6	196.0	2.7	0.6	0.0	0.0	0.0	0.0	0.0	670.7
1994	/	1995	15.6	25.9	154.7	209.6	231.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	637.2
1995	/	1996	11.9	119.9	63.9	138.9	205.4	76.4	0.3	42.5	0.0	0.0	0.0	0.0	659.2
1996	/	1997	0.0	115.9	356.1	196.9	176.2	99.3	127.0	0.0	0.0	0.0	0.0	33.1	1,104.5
1997	/	1998	0.0	110.1	171.3	197.4	78.4	69.5	0.0	0.0	0.0	0.0	0.0	0.0	626.7
1998	/	1999	0.0	123.0	312.5	343.4	151.0	182.6	0.0	0.0	0.0	0.3	0.3	0.0	1,113.1
1999	/	2000	0.0	26.6	125.9	196.8	207.9	194.5	0.0	8.4	0.0	0.0	0.0	0.0	760.1
2000	/	2001	0.0	209.2	227.9	288.1	256.6	267.6	8.4	0.0	0.0	0.0	0.0	0.0	1,257.8
2001	/	2002	1.3	169.5	171.1	122.6	66.7	26.7	44.1	0.0	0.0	0.0	0.0	1.6	603.6
2002	/	2003	19.9	101.7	307.0	181.6	328.0	197.2	3.1	0.0	0.0	0.0	0.0	0.0	1,138.5
2003	/	2004	20.8	175.4	221.8	261.1	214.2	105.4	18.1	0.0	0.0	0.0	0.0	0.0	1,016.8
2004	/	2005	24.6	143.8	225.1	251.6	51.7	33.3	0.0	0.0	0.0	32.6	0.0	0.0	762.7
2005	/	2006	-	-	353.0	203.0	193.8	119.8	1.7	0.0	0.0	0.0	0.0	0.0	871.3
2006	/	2007	-	102.5	140.5	242.8	518.7	62.5	-	0.0	0.0	0.0	0.0	-	1,067.0
2007	/	2008	-	119.3	302.6	263.1	71.8	73.4	0.0	0.0	0.0	0.0	0.0	-	830.2
2008	/	2009	-	212.5	285.6	283.8	88.4	242.6	0.0	-	-	-	-	0.0	1,112.9
2009	/	2010	4.4	171.0	163.1	129.2	403.7	205.5	126.2	0.0					1,203.1
Average			13.9	107.1	217.2	228.7	184.4	100.8	21.6	2.9	0.1	1.2	0.0	1.4	879.3

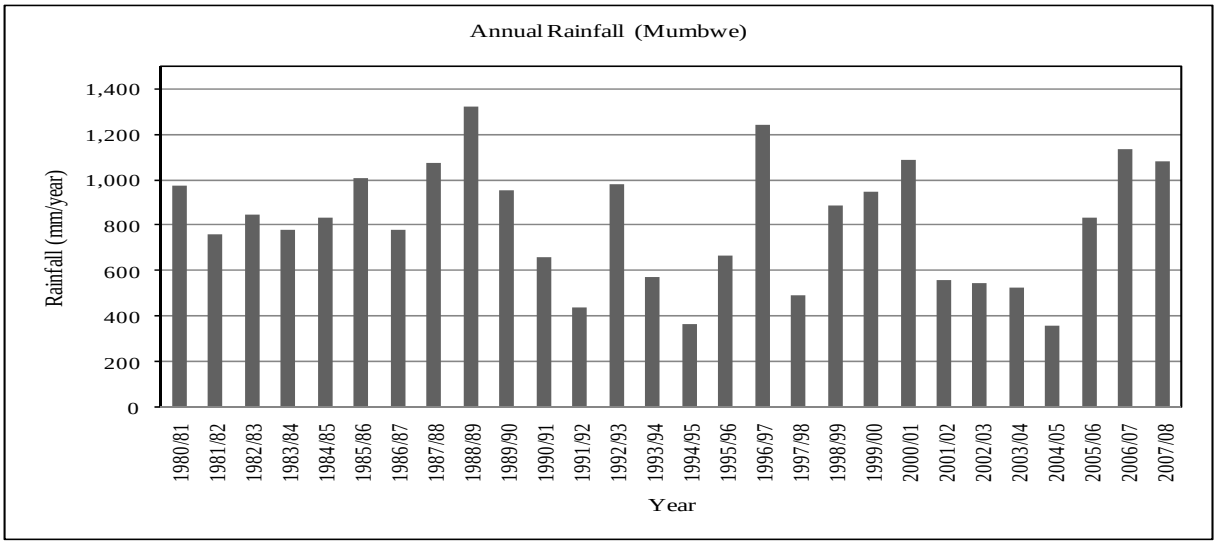
Average: 1980/1981 – 2008/2009



Station: Mumbwe

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979	/	1980										0.0	0.0	0.0	0.0
1980	/	1981	11.5	83.4	111.9	343.6	342.6	37.1	32.5	1.0	0.0	0.0	0.0	6.9	970.5
1981	/	1982	0.0	85.8	56.0	290.3	245.6	39.7	32.5	1.0	0.0	0.0	0.0	6.9	757.8
1982	/	1983	70.9	154.7	50.1	316.3	93.6	121.7	29.4	8.0	0.0	0.0	0.0	0.0	844.7
1983	/	1984	64.4	83.5	207.1	28.2	212.8	179.2	2.2	0.0	0.0	0.0	0.0	0.0	777.4
1984	/	1985	6.1	133.1	238.5	138.1	178.1	136.1	2.3	0.0	0.0	0.0	0.0	0.0	832.3
1985	/	1986	20.3	36.8	262.9	281.3	172.1	83.3	151.6	0.0	0.0	0.0	0.0	0.0	1,008.3
1986	/	1987	74.8	98.8	175.7	186.9	142.2	59.2	0.0	41.0	0.0	0.0	0.0	0.0	778.6
1987	/	1988	63.8	19.2	313.4	250.9	273.7	155.5	0.0	0.0	0.0	0.0	0.0	0.0	1,076.5
1988	/	1989	50.1	47.9	191.6	457.1	449.1	127.1	1.2	0.0	0.0	0.0	0.0	0.0	1,324.1
1989	/	1990	12.8	26.8	226.6	392.5	143.4	81.3	70.2	0.0	0.0	0.0	3.2	0.0	956.8
1990	/	1991	0.0	27.7	240.7	145.0	137.4	109.0	0.3	0.0	0.0	0.0	0.0	0.0	660.1
1991	/	1992	62.3	120.7	127.7	56.2	61.8	0.0	9.7	0.0	0.0	0.0	0.0	0.0	438.4
1992	/	1993	0.2	72.6	238.0	206.3	314.5	147.3	0.0	0.0	0.0	0.0	0.0	0.0	978.9
1993	/	1994	0.0	0.0	115.7	255.0	201.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	572.0
1994	/	1995	20.4	25.0	100.6	75.0	98.0	43.9	0.0	0.0	0.0	0.0	0.0	0.0	362.9
1995	/	1996	17.2	60.4	104.1	207.6	190.2	61.8	0.0	23.9	0.0	0.0	0.0	0.0	665.2
1996	/	1997	0.0	152.0	295.5	331.8	214.6	124.3	112.4	0.0	0.0	0.0	0.0	7.9	1,238.5
1997	/	1998	23.1	82.6	102.5	178.1	33.5	74.8	0.0	0.0	0.0	0.0	0.0	0.0	494.6
1998	/	1999	0.0	174.9	168.0	227.5	214.9	99.6	0.0	0.0	0.0	0.0	0.0	0.0	884.9
1999	/	2000	7.3	60.7	140.0	255.8	234.2	251.8	0.0	0.0	0.0	0.0	0.0	0.0	949.8
2000	/	2001	30.5	125.5	220.7	221.6	270.4	203.4	12.4	0.0	0.0	0.0	0.0	1.5	1,086.0
2001	/	2002	0.0	71.5	185.3	158.3	63.0	16.8	62.3	0.0	0.0	0.0	0.0	3.9	561.1
2002	/	2003	50.9	57.1	160.0	12.2	85.7	181.0	0.0	0.0	0.0	0.0	0.0	0.0	546.9
2003	/	2004	18.0	52.0	56.5	116.1	109.8	161.3	14.0	0.0	0.0	0.0	0.0	0.0	527.7
2004	/	2005	104.9	3.6	214.6	13.0	16.1	5.3	0.3	0.0	0.0	0.0	0.0	0.0	357.8
2005	/	2006	0.0	189.0	176.1	208.6	139.8	120.7	0.4	0.0	0.0	0.0	0.0	0.0	834.6
2006	/	2007	12.9	163.8	198.2	435.0	209.0	117.2	0.0	0.0	0.0	0.0	0.0	0.0	1,136.1
2007	/	2008	0.0	86.1	304.2	381.6	199.7	104.4	6.1	-	-	0.0	0.0	0.0	1,082.1
2008	/	2009	0.2	16.3	21.6	-	13.6	-	0.0	-	0.0	0.0	0.0	-	51.7
2009	/	2010	-	207.5	278.8	233.3	-	-	-	0.0					719.6
Average			24.9	79.7	172.5	220.4	174.5	101.5	18.6	2.8	0.0	0.0	0.1	1.0	796.0

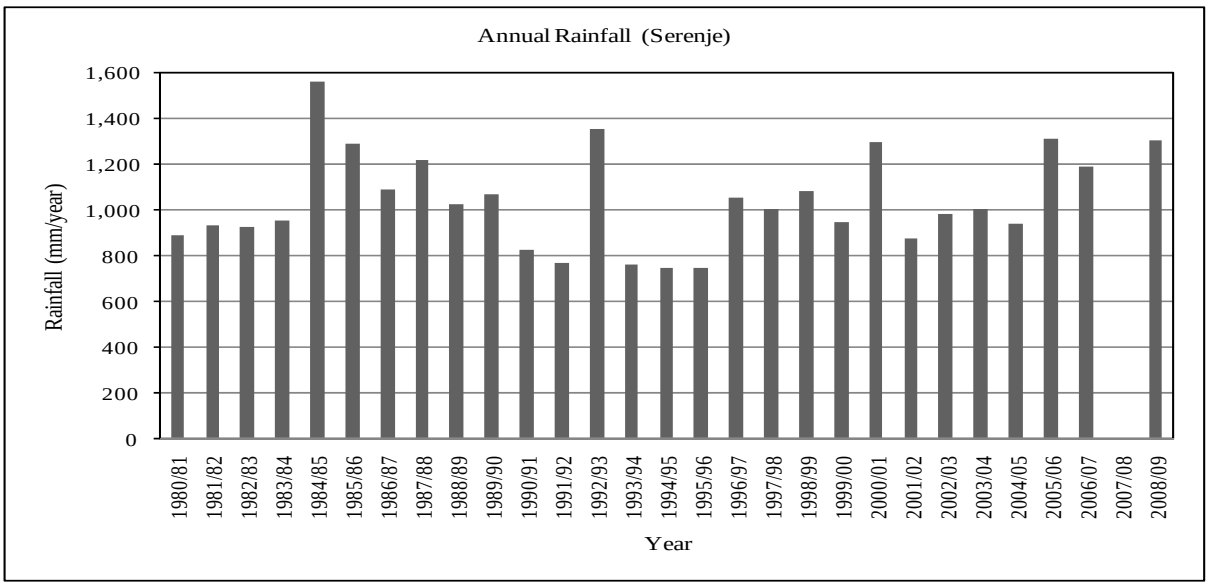
Average: 1980/1981 – 2008/2009



Station: Serenje

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979	/	1980										0.0	0.0	5.3	5.3
1980	/	1981	19.8	75.9	272.2	124.6	179.5	190.1	26.4	0.0	0.0	0.0	0.0	0.0	888.5
1981	/	1982	0.5	86.4	102.3	367.7	287.2	24.2	42.6	22.6	0.0	0.0	0.0	0.0	933.5
1982	/	1983	12.4	162.0	168.2	295.0	248.5	14.2	21.8	1.2	0.0	2.7	0.0	0.0	926.0
1983	/	1984	0.0	55.8	242.6	304.8	174.9	166.3	6.6	0.0	0.0	0.0	0.0	0.0	951.0
1984	/	1985	1.3	124.1	387.5	231.4	299.2	146.1	68.2	2.0	299.1	0.0	0.0	0.0	1,558.9
1985	/	1986	13.7	143.4	221.4	326.0	302.6	152.8	125.5	0.0	0.3	0.0	0.0	0.0	1,285.7
1986	/	1987	34.8	68.2	243.6	436.6	142.4	132.3	28.4	0.0	0.0	0.0	0.0	0.0	1,086.3
1987	/	1988	0.0	102.9	197.2	278.3	335.2	253.4	49.3	0.2	0.0	0.0	0.0	0.0	1,216.5
1988	/	1989	20.8	29.0	164.5	394.3	201.7	187.1	27.7	0.0	0.0	0.0	0.0	0.0	1,025.1
1989	/	1990	4.5	60.8	317.2	339.5	158.7	90.1	72.1	17.7	9.0	0.0	0.4	0.0	1,070.0
1990	/	1991	0.0	33.2	180.5	313.2	193.7	45.3	47.1	9.8	0.0	0.0	0.0	0.0	822.8
1991	/	1992	48.6	74.9	236.9	127.4	118.9	156.5	0.7	4.8	0.0	0.0	0.0	0.0	768.7
1992	/	1993	0.0	170.1	291.9	389.7	261.1	185.9	57.3	0.0	0.0	0.0	0.0	0.0	1,356.0
1993	/	1994	0.0	156.1	99.7	215.4	271.3	3.5	12.8	0.0	0.0	0.0	0.0	0.0	758.8
1994	/	1995	111.4	62.3	157.2	185.9	152.0	68.5	7.7	0.0	0.0	0.0	0.0	0.0	745.0
1995	/	1996	3.6	28.6	179.1	206.9	182.6	99.6	10.1	31.0	0.0	0.0	0.0	1.7	743.2
1996	/	1997	0.0	74.8	262.1	257.7	266.3	55.9	111.2	0.0	0.0	2.3	0.0	21.0	1,051.3
1997	/	1998	5.9	145.0	383.2	232.0	91.0	142.1	0.5	0.0	0.0	0.0	0.0	0.0	999.7
1998	/	1999	3.0	98.7	131.7	238.1	270.5	333.8	4.8	0.0	0.0	0.0	0.0	0.0	1,080.6
1999	/	2000	0.0	67.8	170.9	237.3	257.6	206.3	6.5	2.3	0.0	0.0	0.0	0.0	948.7
2000	/	2001	0.9	183.0	305.1	363.0	221.1	178.4	47.1	0.0	0.0	0.0	0.0	0.0	1,298.6
2001	/	2002	0.0	0.0	229.2	239.9	170.7	199.2	37.6	0.0	0.0	0.0	0.0	1.4	878.0
2002	/	2003	5.7	47.7	297.8	112.8	259.6	187.1	72.6	0.0	0.0	1.9	0.0	0.0	985.2
2003	/	2004	29.3	24.6	139.6	300.6	239.6	186.2	84.3	0.0	0.0	0.0	0.0	0.0	1,004.2
2004	/	2005	0.0	84.1	310.8	346.0	106.0	83.0	0.0	0.0	0.0	5.0	0.0	3.3	938.2
2005	/	2006	0.0	15.6	513.6	318.7	189.9	268.1	2.7	0.0	0.0	0.0	0.0	0.0	1,308.6
2006	/	2007	34.9	86.0	334.2	361.8	246.4	107.1	15.3	0.0	0.0	0.0	0.0	2.7	1,188.4
2007	/	2008	11.7	-	-	185.4	223.0	72.2	0.0	0.0	0.0	0.0	-	-	492.3
2008	/	2009	0.5	121.4	201.9	291.5	400.7	254.4	31.6						1,302.0
2009	/	2010	0.5	189.3	170.3										360.1
Average			12.5	85.1	240.8	276.6	222.5	144.5	35.1	3.3	11.0	0.4	0.0	1.1	1,032.9

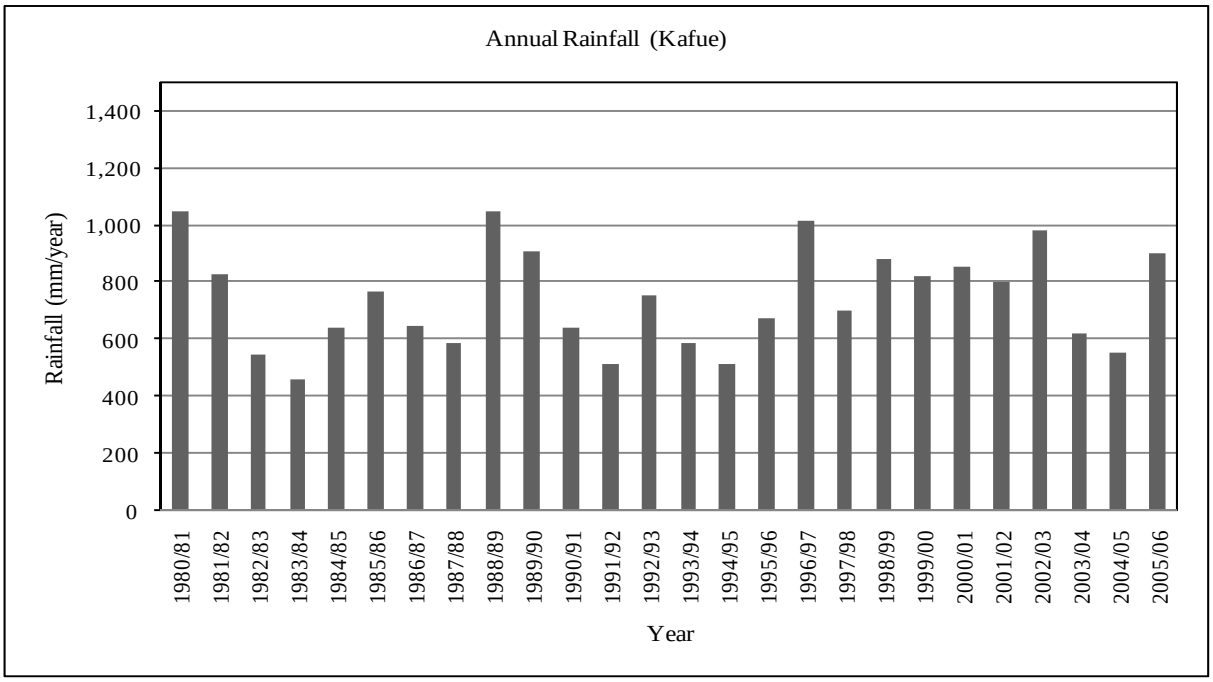
Average: 1980/1981 – 2008/2009



Station: Kafue

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979	/	1980										0.0	0.0	0.0	0.0
1980	/	1981	4.5	71.3	173.7	305.0	348.1	101.2	43.6	0.0	0.0	0.0	0.0	0.0	1,047.4
1981	/	1982	0.0	202.6	158.7	287.8	157.9	7.3	1.7	1.3	0.0	0.0	0.0	7.3	824.6
1982	/	1983	72.1	112.8	50.8	172.6	83.2	18.5	32.4	0.0	0.0	0.0	0.0	0.0	542.4
1983	/	1984	17.1	5.5	134.6	82.7	108.6	103.7	7.9	0.0	0.0	0.0	0.0	0.0	460.1
1984	/	1985	0.0	58.0	168.8	177.2	172.2	63.5	0.0	0.0	0.0	0.0	0.0	0.0	639.7
1985	/	1986	18.1	43.5	222.9	181.8	83.9	70.1	144.4	0.0	0.0	0.0	0.0	0.0	764.7
1986	/	1987	166.0	72.9	171.2	147.1	43.3	43.9	0.0	0.0	0.0	0.0	0.0	0.0	644.4
1987	/	1988	25.2	23.2	176.8	146.5	133.4	80.0	1.7	0.0	0.0	0.0	0.0	0.0	586.8
1988	/	1989	23.2	42.6	125.9	268.4	516.0	69.2	0.0	0.0	0.0	0.0	0.0	0.0	1,045.3
1989	/	1990	1.2	27.2	113.9	578.5	106.2	24.7	53.0	0.0	0.0	0.0	0.0	0.0	904.7
1990	/	1991	0.0	33.4	148.7	200.7	127.4	119.3	8.5	0.0	0.0	0.0	0.0	0.0	638.0
1991	/	1992	35.4	96.2	88.1	135.3	80.9	59.9	10.4	3.0	0.0	0.0	0.0	0.0	509.2
1992	/	1993	18.8	98.4	253.0	92.2	213.3	64.1	10.0	0.0	0.0	0.0	0.0	0.0	749.8
1993	/	1994	0.0	149.3	77.9	170.3	136.5	20.3	31.1	0.0	0.0	0.0	0.0	0.0	585.4
1994	/	1995	120.2	34.9	82.9	80.7	154.3	37.4	0.0	0.0	0.0	0.0	0.0	0.0	510.4
1995	/	1996	50.4	86.9	92.9	226.5	157.1	43.8	0.0	14.5	0.0	0.0	0.0	0.0	672.1
1996	/	1997	0.0	110.1	165.4	361.9	169.6	127.5	71.5	0.0	0.0	0.0	0.0	8.1	1,014.1
1997	/	1998	41.5	87.7	81.6	298.1	133.5	57.9	0.0	0.0	0.0	0.0	0.0	0.0	700.3
1998	/	1999	0.0	74.3	238.5	294.4	253.5	21.3	0.0	0.0	0.0	0.0	0.6	0.0	882.6
1999	/	2000	68.8	40.0	213.5	216.4	110.4	150.4	0.8	19.9	0.0	0.0	0.0	0.0	820.2
2000	/	2001	0.0	40.3	204.0	204.7	270.7	133.9	1.8	0.0	0.0	0.0	0.0	0.0	855.4
2001	/	2002	0.0	146.1	255.1	123.6	48.7	66.1	158.3	0.0	0.0	0.0	0.0	0.0	797.9
2002	/	2003	59.9	42.5	90.9	81.5	150.1	525.6	28.0	0.0	0.0	0.0	0.0	0.0	978.5
2003	/	2004	3.7	75.0	63.9	161.1	126.3	155.2	34.9	0.0	0.0	0.0	0.0	0.0	620.1
2004	/	2005	56.2	32.0	197.2	140.5	31.9	92.5	2.9	0.0	0.0	0.0	0.0	0.0	553.2
2005	/	2006	0.0	90.1	319.7	153.3	221.6	113.3	4.5	0.0	0.0	0.0	0.0	0.0	902.5
2006	/	2007	0.0	125.1											125.1
Average			30.1	73.0	156.6	203.4	159.2	91.2	24.9	1.5	0.0	0.0	0.0	0.6	740.5

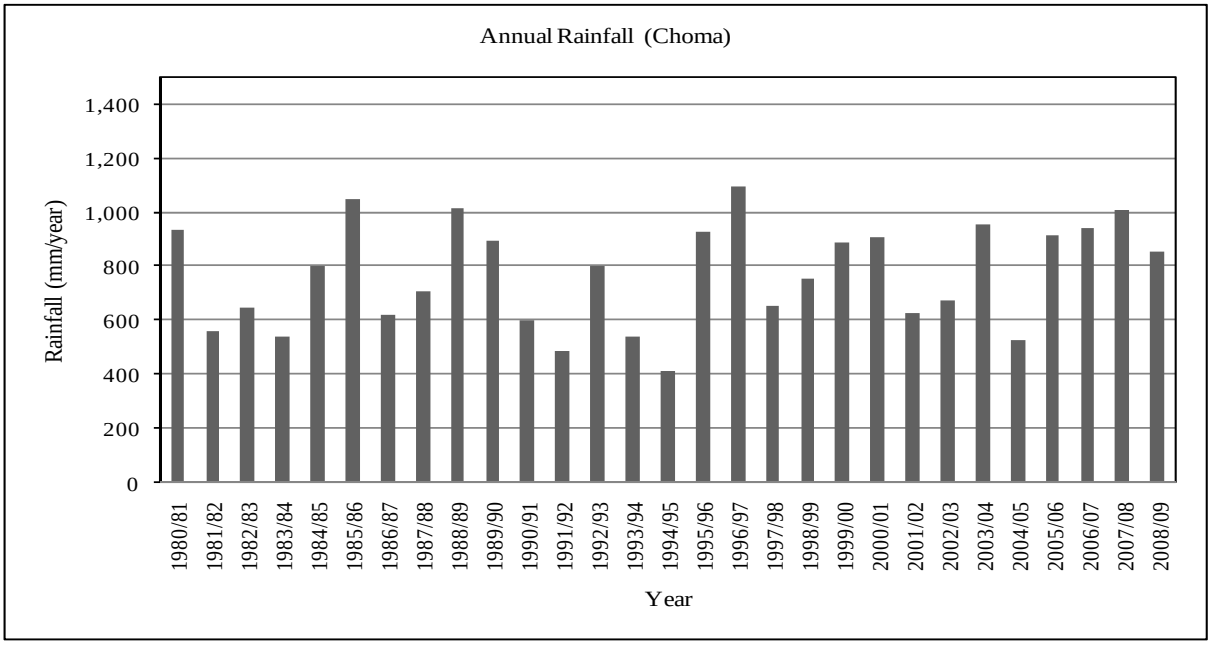
Average: 1980/1981 – 2005/2006



Station: Choma

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979	/	1980										0.0	0.0	0.0	0.0
1980	/	1981	64.8	143.9	209.0	211.2	240.5	27.2	38.5	0.0	0.0	0.0	0.0	0.0	935.1
1981	/	1982	7.0	154.1	45.8	184.1	110.2	54.4	0.0	0.0	0.0	1.8	0.0	0.3	557.7
1982	/	1983	36.4	54.4	68.9	324.3	55.2	78.0	16.8	10.6	0.0	0.0	0.0	0.0	644.6
1983	/	1984	11.7	63.8	177.5	61.5	108.9	98.0	11.4	3.0	0.0	0.0	0.0	0.0	535.8
1984	/	1985	6.5	127.4	145.9	192.9	186.3	140.7	0.0	1.2	0.0	0.0	0.0	0.0	800.9
1985	/	1986	24.6	88.9	194.6	321.5	214.0	106.5	97.6	0.0	0.0	0.0	0.0	0.0	1,047.7
1986	/	1987	173.7	106.8	204.2	45.7	37.2	51.6	0.0	0.9	0.0	0.0	0.0	0.0	620.1
1987	/	1988	10.8	55.3	174.1	154.0	184.0	81.7	27.6	14.1	4.0	0.0	0.0	0.0	705.6
1988	/	1989	46.5	40.3	116.0	320.9	429.2	47.2	14.1	0.0	0.0	0.0	0.0	0.0	1,014.2
1989	/	1990	19.5	94.9	153.0	282.8	251.0	28.1	60.4	1.5	0.0	0.0	0.0	0.0	891.2
1990	/	1991	5.2	53.1	168.9	122.2	152.9	94.6	0.0	0.0	0.0	0.0	0.0	0.0	596.9
1991	/	1992	24.6	51.1	148.5	97.6	10.8	145.2	0.0	4.7	0.0	0.0	0.0	0.0	482.5
1992	/	1993	3.5	79.1	186.4	150.6	270.9	84.1	16.7	0.0	0.0	0.1	5.9	4.6	801.9
1993	/	1994	0.0	99.9	140.8	156.7	122.8	13.9	1.7	0.0	0.0	0.0	0.0	0.0	535.8
1994	/	1995	20.6	99.4	66.4	49.6	127.8	45.1	0.0	0.0	0.0	0.0	0.0	0.0	408.9
1995	/	1996	124.0	46.1	158.4	275.4	193.6	105.5	0.0	25.0	0.6	0.0	0.0	0.0	928.6
1996	/	1997	0.0	122.2	137.0	280.0	243.0	239.9	50.4	0.0	4.5	0.0	0.0	20.0	1,097.0
1997	/	1998	0.2	134.8	48.5	266.7	95.8	107.3	0.4	0.0	0.0	0.0	0.0	0.0	653.7
1998	/	1999	0.0	30.4	263.0	204.2	120.6	127.5	1.3	0.0	0.0	0.0	3.5	0.0	750.5
1999	/	2000	3.4	72.2	78.6	175.8	267.5	155.6	47.4	59.4	29.2	0.0	0.0	0.0	889.1
2000	/	2001	0.0	97.2	216.8	174.2	263.4	127.7	25.1	0.0	0.0	1.3	0.0	4.3	910.0
2001	/	2002	4.5	107.8	128.3	159.9	43.7	31.5	140.0	0.0	3.7	0.0	0.0	7.6	627.0
2002	/	2003	42.3	48.0	95.4	150.0	116.6	213.9	3.6	0.0	3.6	0.0	0.0	0.0	673.4
2003	/	2004	39.3	35.3	184.8	216.8	172.6	274.3	31.0	0.0	0.0	0.0	0.0	0.0	954.1
2004	/	2005	24.9	10.5	162.1	201.3	71.6	32.1	22.4	0.0	0.0	0.0	0.0	0.0	524.9
2005	/	2006	0.0	85.0	210.0	293.8	216.5	107.1	1.2	0.0	0.0	0.0	0.0	0.0	913.6
2006	/	2007	6.8	143.3	221.4	367.3	72.5	72.1	48.2	0.0	0.0	0.0	0.0	6.1	937.7
2007	/	2008	0.0	84.0	419.9	299.5	71.0	116.1	8.4	6.2	0.0	0.0	0.0	0.0	1,005.1
2008	/	2009	4.7	177.0	190.7	192.2	119.4	120.8	0.0	49.8	1.0	0.0	0.0	-	855.6
2009	/	2010	10.3	-	107.3	192.5	152.7	205.4	62.6	3.7					734.5
Average			24.3	86.4	162.6	204.6	157.6	101.0	22.9	6.1	1.6	0.1	0.3	1.5	769.0

Average: 1980/1981 – 2008/2009



Station: Livingstone

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1979	/	1980										0.0	0.0	0.0	0.0
1980	/	1981	18.5	227.7	111.8	156.5	299.0	130.1	9.1	0.0	0.0	0.0	0.0	0.0	952.7
1981	/	1982	7.6	104.3	34.1	109.4	67.9	31.8	16.4	48.5	0.0	0.0	0.0	0.0	420.0
1982	/	1983	148.1	25.7	111.4	191.5	138.7	34.5	74.1	63.0	0.0	0.0	0.0	0.0	787.0
1983	/	1984	7.3	41.5	242.2	26.9	94.1	55.3	18.8	0.0	0.3	0.0	0.0	7.0	493.4
1984	/	1985	24.9	87.8	83.3	202.4	107.9	82.6	7.1	0.7	0.0	5.5	0.0	0.0	602.2
1985	/	1986	20.2	29.0	205.0	113.5	77.0	113.6	77.9	0.0	0.0	0.0	0.0	0.0	636.2
1986	/	1987	68.8	34.1	103.4	220.5	37.0	78.8	0.0	0.0	0.0	0.0	0.0	0.0	542.6
1987	/	1988	2.6	17.0	297.0	124.0	227.3	165.1	12.0	0.1	0.0	0.0	0.0	0.0	845.1
1988	/	1989	42.9	75.2	139.1	157.9	298.9	54.1	10.7	0.0	0.0	0.0	0.0	0.0	778.8
1989	/	1990	28.2	40.3	49.1	274.3	177.2	36.9	109.2	0.0	0.0	0.0	0.0	0.0	715.2
1990	/	1991	0.2	4.6	51.9	157.3	124.3	91.9	1.5	0.0	0.0	0.0	0.0	0.0	431.7
1991	/	1992	9.6	35.5	279.4	50.5	24.3	111.9	0.1	0.0	0.0	0.0	0.0	0.0	511.3
1992	/	1993	9.2	18.1	161.4	260.7	182.0	25.8	4.4	0.0	0.0	0.0	0.0	7.0	668.6
1993	/	1994	2.9	212.5	121.7	214.0	147.6	0.2	0.0	0.0	0.0	0.0	0.0	0.0	698.9
1994	/	1995	27.7	31.0	80.8	156.6	82.0	35.6	12.4	8.5	0.0	0.0	0.0	0.0	434.6
1995	/	1996	3.8	77.9	116.1	211.8	154.2	79.4	0.0	6.7	0.0	0.0	0.0	0.0	649.9
1996	/	1997	0.0	146.9	5.6	250.3	146.6	187.7	0.0	2.0	0.0	0.0	0.0	30.3	769.4
1997	/	1998	22.4	60.9	50.0	183.3	38.1	19.4	4.3	0.0	0.0	0.0	0.0	0.0	378.4
1998	/	1999	0.0	126.7	157.9	199.1	55.6	53.4	0.0	0.0	0.0	1.6	0.0	0.0	594.3
1999	/	2000	12.4	22.5	77.2	136.8	290.9	83.9	17.5	5.5	0.0	0.0	0.0	0.0	646.7
2000	/	2001	33.0	68.2	122.0	28.4	287.2	146.3	4.1	0.0	0.0	0.0	7.6	0.0	696.8
2001	/	2002	15.3	64.5	127.5	61.0	70.9	9.9	39.1	0.0	0.0	0.0	0.0	4.6	392.8
2002	/	2003	0.0	8.6	111.5	75.2	84.6	33.7	8.6	0.0	0.0	0.0	0.0	0.0	322.2
2003	/	2004	92.6	26.2	107.7	164.6	118.4	260.9	0.0	0.0	0.0	0.0	0.0	0.0	770.4
2004	/	2005	0.0	2.5	173.0	183.8	13.1	41.8	4.5	0.0	0.0	0.0	0.0	0.0	418.7
2005	/	2006	0.0	112.4	261.8	176.0	187.6	118.2	9.8	0.0	0.0	0.0	0.0	0.0	865.8
2006	/	2007	20.0	59.5	170.7	212.6	69.9	32.8	25.4	0.0	0.0	0.0	0.0	0.0	590.9
2007	/	2008	0.0	95.1	308.9	461.2	88.1	70.8	0.0	8.2	0.0	0.0	0.0	0.0	1,032.3
2008	/	2009	0.0	237.5	161.5	140.4	77.8	108.2	0.0	19.9	6.3	0.0	0.0		751.6
2009	/	2010	42.6	113.1	154.5	191.3	89.1	163.6	143.3	0.0					897.5
Average			21.3	72.2	138.7	169.0	129.9	79.1	16.1	5.6	0.2	0.2	0.3	1.7	634.3

Average: 1980/1981 – 2008/2009

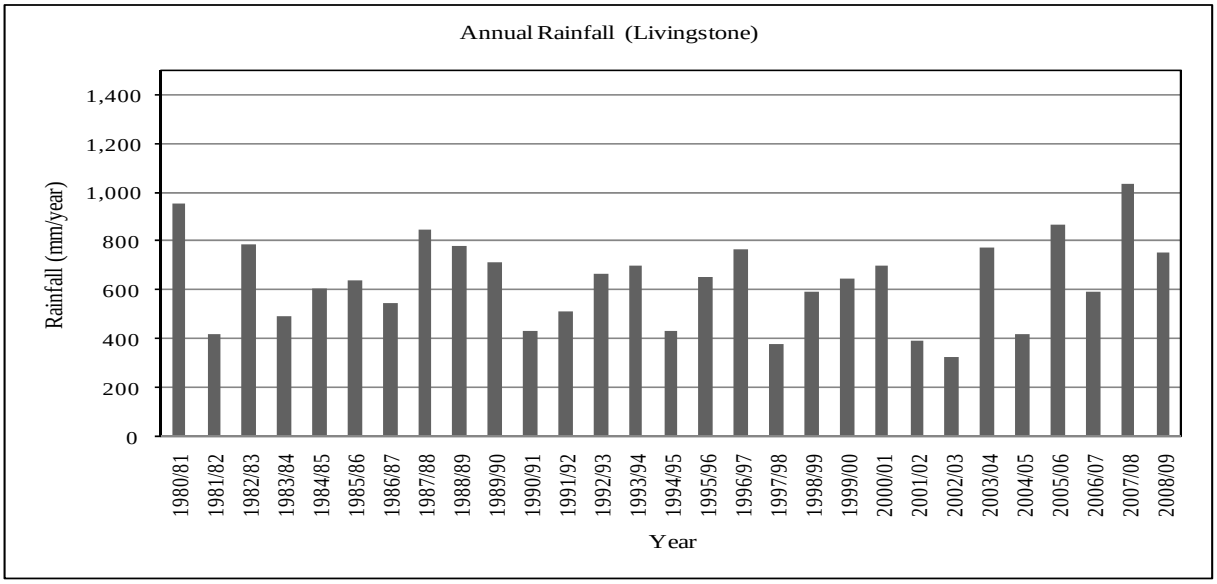


Table T1.2.2 Maximum Temperature

Station: Ndola

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1979	/	1980										25.1	-	-
1980	/	1981	-	29.6	26.9	27.5	26.9	27.8	27.0	25.9	25.4	25.3	28.7	30.5
1981	/	1982	31.7	31.2	29.2	26.7	27.7	29.1	28.3	26.3	26.4	25.3	27.5	30.3
1982	/	1983	30.5	29.2	28.3	28.4	28.3	29.1	28.8	28.3	27.1	26.4	27.5	31.6
1983	/	1984	31.8	31.1	26.9	27.6	26.4	28.2	28.2	27.5	25.2	25.7	27.4	32.2
1984	/	1985	32.5	29.1	26.8	27.3	26.3	27.3	26.8	26.2	25.1	25.6	27.1	31.0
1985	/	1986	31.1	28.9	26.5	26.1	26.7	27.7	27.8	27.0	24.6	25.4	28.3	30.5
1986	/	1987	30.0	29.4	28.1	27.5	28.4	29.0	29.0	28.5	25.6	27.3	29.0	32.0
1987	/	1988	31.9	32.8	29.1	27.6	27.8	27.5	29.5	26.9	27.0	26.7	28.7	31.6
1988	/	1989	31.6	30.1	27.8	25.9	26.4	27.3	27.6	27.2	26.2	25.7	28.6	31.4
1989	/	1990	32.4	31.0	28.5	27.4	28.1	29.3	28.6	27.4	26.8	26.5	27.1	30.4
1990	/	1991	-	32.3	28.2	26.9	28.1	28.5	26.9	27.5	26.1	25.2	28.4	31.8
1991	/	1992	30.5	29.7	28.7	28.1	29.4	28.9	28.9	28.0	26.2	25.5	27.4	31.6
1992	/	1993	33.1	30.4	-	26.9	26.9	27.2	28.3	28.0	25.2	24.9	27.2	30.1
1993	/	1994	32.6	29.4	28.9	27.2	26.8	28.9	28.8	27.8	25.4	25.7	27.8	31.1
1994	/	1995	30.4	31.6	29.3	27.1	26.5	28.4	28.3	27.9	26.3	26.0	29.1	31.6
1995	/	1996	33.0	31.2	27.2	27.5	26.7	27.5	27.8	26.5	24.7	25.8	29.7	-
1996	/	1997	-	-	27.8	26.9	26.4	28.8	27.6	27.1	27.5	24.8	-	31.4
1997	/	1998	31.5	30.2	27.1	27.7	28.6	28.8	29.0	28.4	27.0	26.4	28.3	31.9
1998	/	1999	33.5	32.4	28.2	26.8	27.6	27.1	27.7	27.8	26.0	25.2	27.6	30.7
1999	/	2000	31.5	30.2	29.9	28.3	27.1	27.4	28.9	28.3	26.3	25.0	27.4	31.6
2000	/	2001	32.6	29.2	27.2	26.6	27.1	27.7	29.0	27.9	-	25.9	29.6	32.4
2001	/	2002	32.3	30.5	29.1	27.4	28.0	29.2	-	28.1	25.8	28.5	28.7	30.5
2002	/	2003	32.6	30.2	28.2	28.9	28.6	-	28.5	28.4	26.8	26.0	29.2	32.0
2003	/	2004	32.4	31.3	28.8	28.7	27.9	28.8	28.1	-	-	-	-	-
2004	/	2005	32.1	30.4	28.1	28.2	29.5	29.6	29.5	28.4	27.6	26.0	30.0	31.6
2005	/	2006	33.2	32.1	28.6	-	28.3	27.5	27.6	27.7	26.0	26.0	29.3	30.9
2006	/	2007	33.1	30.9	27.9	27.3	27.9	29.3	29.5	28.3	26.8	26.1	29.2	32.1
2007	/	2008	-	-	27.0	27.2	28.1	28.3	28.9	28.5	25.7	26.2	28.7	33.1
2008	/	2009	-	29.6	27.1	28.2	27.6	28.0	-	-	-	25.0	28.5	32.4
2009	/	2010	33.2	-	28.6	28.2	27.6	28.2	-	28.1	25.7			
Average			32.0	30.6	28.1	27.4	27.6	28.3	28.3	27.6	26.1	25.9	28.4	31.4

Average: 1980/1981 – 2007/2008

Station: Kabwe

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1979	/	1980										22.2	25.5	-
1980	/	1981	30.3	30.1	26.2	27.2	26.9	24.8	23.5	23.6	23.4	23.1	27.0	29.6
1981	/	1982	30.9	31.3	30.3	26.4	26.5	28.5	27.7	-	24.8	23.3	25.8	28.8
1982	/	1983	29.8	29.7	28.8	28.7	28.9	28.4	28.5	27.8	25.4	24.6	25.9	31.1
1983	/	1984	31.2	31.7	27.4	28.6	26.9	27.4	26.9	-	23.7	24.1	26.0	31.5
1984	/	1985	33.0	29.4	25.9	27.3	26.5	27.1	25.7	24.7	23.3	24.0	25.4	30.3
1985	/	1986	30.6	29.6	26.4	26.4	26.9	27.3	26.1	25.1	22.8	23.6	27.1	29.3
1986	/	1987	30.4	29.1	28.3	27.7	29.1	29.4	29.0	27.2	23.8	24.9	27.2	31.4
1987	/	1988	31.3	32.3	28.3	27.9	27.9	27.4	28.7	24.9	24.8	24.4	26.4	30.4
1988	/	1989	30.9	30.2	27.5	26.0	26.6	26.9	26.0	25.2	23.9	23.7	26.8	30.3
1989	/	1990	31.0	31.0	29.0	26.4	27.6	28.1	27.4	25.8	25.6	25.1	25.6	28.7
1990	/	1991	32.8	31.1	28.6	27.0	27.8	27.8	26.0	25.9	24.6	23.5	26.7	30.9
1991	/	1992	30.3	29.6	27.8	28.5	29.9	28.9	28.3	26.8	24.8	23.8	25.7	30.3
1992	/	1993	33.0	30.3	27.8	26.6	26.1	25.8	27.2	27.1	23.3	22.7	-	30.2
1993	/	1994	32.3	29.5	29.0	27.2	27.1	29.8	28.8	26.9	23.9	23.5	26.1	30.3
1994	/	1995	30.9	33.1	30.0	28.5	27.7	-	28.5	27.1	24.6	24.4	28.1	30.8
1995	/	1996	32.8	30.2	-	27.7	27.2	28.7	26.0	24.6	22.7	24.0	28.1	31.2
1996	/	1997	32.8	31.5	27.3	26.8	26.4	28.1	26.3	25.5	26.2	22.6	27.6	29.6
1997	/	1998	30.3	30.3	27.1	27.5	28.9	29.1	27.9	27.2	25.3	24.1	26.2	30.4
1998	/	1999	33.3	31.6	27.6	26.2	27.6	26.4	26.2	26.3	24.5	23.3	26.0	29.3
1999	/	2000	30.5	30.9	29.6	27.5	27.0	27.3	-	25.8	23.8	23.1	24.6	30.4
2000	/	2001	31.7	30.6	26.6	27.1	26.2	27.1	27.4	25.5	-	23.5	27.8	31.3
2001	/	2002	31.5	30.1	28.6	27.8	28.1	28.8	27.8	26.6	24.0	27.1	27.3	30.0
2002	/	2003	31.9	30.3	28.2	-	27.5	27.4	26.4	25.9	24.1	-	-	-
2003	/	2004	-	-	-	-	-	-	-	-	-	-	-	-
2004	/	2005	-	-	-	-	-	-	-	-	-	-	28.9	30.3
2005	/	2006	32.9	31.7	28.0	27.6	28.1	27.2	26.9	26.6	24.7	24.5	-	-
2006	/	2007	-	-	28.9	27.6	28.0	28.9	-	-	25.4	24.1	27.3	31.1
2007	/	2008	-	30.6	26.9	26.9	-	26.8	27.3	27.1	24.3	24.6	26.9	32.1
2008	/	2009	33.3	30.6	28.4	28.1	27.4	26.5	26.3	-	26.2	22.9	26.9	31.6
2009	/	2010	32.9	29.9	28.5	29.1	28.0	28.2	28.2	27.3	23.5	23.7		
Average			31.6	30.6	28.0	27.4	27.5	27.7	27.1	26.1	24.4	23.9	26.7	30.4

Average: 1980/1981 – 2007/2008

Station: Serenje

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1979	/	1980												
1980	/	1981	-	-	-	26.6	25.9	26.5	-	23.7	22.5	-	-	28.2
1981	/	1982	30.7	30.9	27.7	25.2	26.1	27.8	26.6	23.3	24.0	22.3	24.4	-
1982	/	1983	28.8	28.6	27.2	27.3	27.2	27.4	27.6	27.6	-	23.6	-	29.2
1983	/	1984	32.0	31.3	25.9	26.0	25.2	26.5	25.8	-	22.8	23.3	-	30.0
1984	/	1985	31.4	28.8	25.6	26.1	24.6	26.3	24.6	24.4	23.0	23.3	24.4	29.1
1985	/	1986	29.3	27.7	25.8	25.3	-	26.3	25.7	24.8	-	23.3	-	-
1986	/	1987	-	27.7	26.7	26.4	27.9	28.3	27.3	26.2	23.8	25.0	-	-
1987	/	1988	-	32.0	28.2	-	-	26.2	27.6	24.6	24.8	24.5	25.6	29.1
1988	/	1989	29.9	-	27.4	24.7	25.2	26.2	25.7	24.7	23.7	22.5	26.1	28.9
1989	/	1990	30.2	29.3	26.6	26.0	27.0	27.9	27.1	25.0	-	24.5	-	-
1990	/	1991	31.9	31.3	28.3	26.5	27.1	27.1	24.9	25.6	-	-	25.8	29.9
1991	/	1992	-	-	26.8	27.2	28.6	28.1	27.9	26.7	24.8	23.4	25.2	29.4
1992	/	1993	-	29.4	29.1	26.2	25.6	26.7	27.8	26.8	-	23.6	25.0	28.2
1993	/	1994	31.4	28.5	28.3	26.3	26.2	29.0	28.4	26.7	24.5	23.5	25.7	-
1994	/	1995	28.6	30.9	28.2	26.5	26.4	28.3	27.9	26.8	25.0	24.4	27.5	30.0
1995	/	1996	-	-	-	-	-	-	25.9	-	22.3	23.9	28.0	30.4
1996	/	1997	31.8	31.6	27.8	26.4	25.5	28.0	26.6	26.2	26.5	22.3	27.1	-
1997	/	1998	29.8	30.4	26.5	27.1	28.7	29.0	27.4	27.5	25.1	24.5	25.9	30.1
1998	/	1999	32.1	31.6	-	-	-	-	-	-	23.9	-	-	29.4
1999	/	2000	30.1	30.2	-	27.3	-	27.1	27.5	26.5	-	23.2	-	-
2000	/	2001	-	27.7	26.8	26.0	-	27.4	27.7	25.8	-	23.9	-	-
2001	/	2002	31.1	-	-	-	-	-	-	-	-	27.3	26.7	29.2
2002	/	2003	31.6	29.7	27.8	-	27.8	27.6	-	-	-	23.0	-	-
2003	/	2004	-	-	-	-	-	-	-	-	-	-	-	-
2004	/	2005	-	-	-	26.6	28.3	28.7	28.2	26.9	25.4	23.9	28.0	28.6
2005	/	2006	31.7	32.0	28.4	26.1	27.7	26.6	-	26.4	24.0	23.2	-	-
2006	/	2007	-	-	26.6	26.2	-	27.6	27.4	25.6	23.9	23.6	26.4	29.9
2007	/	2008	31.0	-	-	25.6	27.1	26.3	-	25.8	23.2	23.7	25.6	-
2008	/	2009	-	31.7	29.8	-	26.0	26.3	25.6	-	-	-	-	-
2009	/	2010	31.5	28.4	27.3									
Average			30.7	30.0	27.3	26.3	26.7	27.4	26.9	25.8	24.1	23.7	26.1	29.4

Average: 1979/80-2007/08

Station: Lusaka-1 (City Airport)

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1979	/	1980										20.9	24.5	29.4
1980	/	1981	29.3	29.4	25.9	26.3	25.3	25.4	24.8	22.4	21.0	21.8	25.9	28.3
1981	/	1982	29.3	29.9	28.2	25.5	25.2	27.5	26.5	23.5	23.3	22.2	24.5	27.3
1982	/	1983	28.4	28.7	27.9	27.7	27.5	28.0	27.5	26.9	24.4	23.6	24.6	29.7
1983	/	1984	29.7	31.0	26.5	27.4	26.3	26.3	25.7	25.5	22.5	23.2	25.1	30.1
1984	/	1985	31.3	27.9	25.1	26.0	25.2	26.3	25.3	24.0	22.1	22.9	24.2	28.8
1985	/	1986	29.4	28.0	25.5	24.6	25.5	25.7	24.6	23.5	21.6	22.3	25.7	27.8
1986	/	1987	28.9	28.2	26.7	26.6	27.8	28.5	28.2	26.1	22.8	23.5	25.8	29.7
1987	/	1988	29.3	31.7	27.7	26.8	26.4	26.2	27.3	24.1	23.7	23.6	25.7	-
1988	/	1989	30.1	29.8	26.9	25.2	24.9	26.0	24.8	24.2	22.7	22.5	25.5	29.1
1989	/	1990	32.2	29.5	27.5	25.6	26.2	26.9	26.5	25.0	24.3	25.0	25.4	29.5
1990	/	1991	32.7	30.3	27.9	25.9	27.0	26.5	25.1	24.9	23.2	22.7	26.2	30.1
1991	/	1992	30.0	28.5	26.9	27.8	29.8	28.2	27.7	25.8	23.9	23.1	24.9	30.3
1992	/	1993	32.2	29.7	27.0	26.9	25.1	26.0	26.3	26.3	22.7	22.1	24.9	28.2
1993	/	1994	31.4	29.0	28.2	27.7	26.3	29.0	28.0	26.0	23.6	-	25.2	29.6
1994	/	1995	29.9	32.3	28.7	28.0	26.9	27.8	28.7	26.6	23.8	23.5	27.2	30.1
1995	/	1996	32.4	29.4	26.8	26.6	26.9	25.9	25.0	23.9	22.2	22.9	27.2	30.3
1996	/	1997	32.1	30.3	26.7	26.2	25.5	27.7	26.2	25.5	25.2	22.5	27.2	28.9
1997	/	1998	30.2	30.2	28.0	27.5	-	29.1	27.7	26.5	25.5	24.6	26.2	29.8
1998	/	1999	32.7	31.9	26.7	26.5	27.2	26.8	27.0	25.9	23.9	23.0	25.8	28.6
1999	/	2000	29.7	30.2	28.6	27.0	-	26.6	26.0	-	22.8	22.8	24.4	29.6
2000	/	2001	31.0	30.3	26.3	27.1	-	26.6	27.0	24.7	-	-	27.6	30.3
2001	/	2002	-	-	-	-	-	-	-	-	-	-	26.6	29.0
2002	/	2003	30.7	29.1	28.5	28.1	27.5	27.1	26.1	25.5	23.4	22.8	-	-
2003	/	2004	31.9	31.6	27.4	-	26.5	26.0	26.2	23.5	22.3	23.4	27.3	-
2004	/	2005	29.4	30.4	26.8	26.3	-	28.8	28.6	26.0	25.0	23.0	28.2	29.6
2005	/	2006	31.7	31.4	26.8	26.6	26.9	27.0	25.7	25.6	23.2	23.6	-	-
2006	/	2007	-	30.4	28.2	26.0	26.4	21.3	27.1	25.9	23.9	22.7	26.3	29.9
2007	/	2008	31.2	29.6	25.2	25.2	26.5	25.7	25.8	-	22.4	22.8	26.1	30.9
2008	/	2009	31.6	29.4	26.7	26.1	26.4	31.8	24.9	24.9	24.7	22.7	25.4	30.3
2009	/	2010	31.3	28.3	27.7	27.9	26.2	26.9	-	26.0	-	22.1	25.5	
Average			30.7	30.0	27.1	26.6	26.5	26.8	26.5	25.1	23.3	23.0	25.9	29.4

Average: 1979/80-2007/08

Station: Station-2 (International Airport)

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1979	/	1980										22.4	25.8	31.0
1980	/	1981	30.9	30.6	27.2	28.1	26.7	26.8	25.9	23.7	23.1	22.9	27.1	29.5
1981	/	1982	31.0	31.5	29.9	26.8	27.1	29.0	27.8	25.0	24.6	23.5	26.1	28.9
1982	/	1983	29.8	30.1	29.2	28.9	29.1	29.3	29.1	28.4	25.8	25.1	26.3	31.4
1983	/	1984	31.7	33.1	27.7	29.4	27.9	28.0	27.3	27.3	23.9	24.3	26.7	31.9
1984	/	1985	33.2	29.6	26.7	27.6	26.8	27.3	26.7	25.3	23.7	24.1	25.6	30.4
1985	/	1986	31.0	30.0	26.8	26.9	-	27.0	25.9	24.8	22.9	23.7	27.2	29.7
1986	/	1987	30.6	29.5	28.1	28.0	29.3	30.2	29.7	27.6	24.1	25.0	27.4	31.7
1987	/	1988	32.2	33.4	28.9	28.4	28.7	27.7	28.6	25.7	25.1	24.9	27.1	30.5
1988	/	1989	31.8	31.5	27.8	26.5	26.4	27.2	25.9	25.3	23.9	23.9	26.9	31.0
1989	/	1990	31.4	31.4	29.3	26.8	27.4	28.4	28.1	25.9	25.4	25.4	25.8	29.6
1990	/	1991	32.6	31.5	29.1	27.0	28.1	27.8	26.3	26.1	24.5	24.1	27.4	31.5
1991	/	1992	31.4	30.0	28.5	29.2	30.6	29.4	28.8	26.8	25.1	24.3	26.3	31.3
1992	/	1993	33.6	31.2	27.7	-	-	26.4	28.0	-	-	-	-	-
1993	/	1994	-	-	-	-	-	-	-	-	-	26.1	28.1	31.3
1994	/	1995	32.7	-	30.7	-	-	29.9	29.3	27.9	25.2	25.3	28.2	31.4
1995	/	1996	33.7	31.6	28.0	28.2	26.6	27.2	26.6	25.2	23.4	24.3	28.3	32.0
1996	/	1997	33.6	32.0	27.6	27.4	26.4	27.9	26.7	26.1	26.3	23.1	28.1	29.5
1997	/	1998	30.8	31.5	27.8	28.3	29.7	29.5	28.8	27.6	26.0	25.4	26.9	30.9
1998	/	1999	34.3	32.6	27.5	26.3	27.8	26.9	27.6	27.0	25.0	23.5	26.0	29.8
1999	/	2000	30.2	30.5	29.4	27.8	27.3	27.2	26.9	25.3	-	-	-	-
2000	/	2001	32.1	31.1	27.4	27.5	26.5	27.1	27.4	-	-	23.7	28.1	31.4
2001	/	2002	32.6	30.4	-	-	28.9	29.8	28.0	26.9	24.4	27.4	27.4	-
2002	/	2003	-	-	-	-	-	-	-	-	-	-	-	-
2003	/	2004	-	-	-	27.9	27.5	27.7	26.4	24.1	23.1	24.2	28.0	30.5
2004	/	2005	30.7	31.3	27.5	27.3	29.1	29.5	29.0	27.3	26.1	24.7	28.9	30.8
2005	/	2006	33.8	32.6	27.9	27.7	27.8	26.9	-	26.3	24.0	24.4	27.3	29.4
2006	/	2007	33.1	31.8	29.6	27.6	27.8	29.1	28.3	27.0	25.1	24.0	27.8	31.5
2007	/	2008	32.7	31.2	26.5	26.6	28.2	27.1	27.1	26.7	24.1	24.4	27.1	32.0
2008	/	2009	32.7	-	28.0	27.7	27.9	26.4	26.4	25.8	25.8	-	26.6	31.3
2009	/	2010	32.5	29.4	29.2	29.4	27.7	28.0	28.2	27.2	23.9	23.9	26.3	30.4
2010	/	2011	34.2											
Average			32.1	31.3	28.2	27.7	27.9	28.1	27.6	26.2	24.6	24.4	27.2	30.8

Average: 1979/80-2007/08

Station: Kafue

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1979	/	1980										23.7	27.1	32.2
1980	/	1981	32.2	31.8	28.5	28.2	27.3	28.3	26.9	24.7	24.2	24.3	28.6	31.2
1981	/	1982	32.7	32.1	30.5	28.2	28.0	29.8	29.5	26.8	26.3	25.0	27.6	30.0
1982	/	1983	31.1	30.6	30.6	30.5	30.0	31.0	31.1	30.0	27.4	26.4	27.1	33.0
1983	/	1984	32.9	34.3	29.2	30.3	29.3	29.2	28.9	28.8	25.3	26.0	27.6	33.0
1984	/	1985	34.5	31.0	27.6	28.2	28.1	28.7	28.1	27.1	24.9	25.3	26.9	31.6
1985	/	1986	32.3	31.5	28.2	27.5	28.4	28.5	27.8	26.4	24.3	25.0	28.6	30.7
1986	/	1987	31.1	30.2	29.2	29.7	30.6	31.6	31.4	29.1	25.0	26.0	28.7	32.8
1987	/	1988	32.4	34.8	30.5	29.2	29.4	29.2	30.8	27.5	26.7	26.2	28.2	31.6
1988	/	1989	33.0	32.3	29.4	27.4	27.1	28.2	27.4	26.8	25.6	25.3	28.5	31.6
1989	/	1990	32.4	32.4	31.0	26.9	28.7	30.0	29.6	27.6	27.3	27.5	27.8	32.6
1990	/	1991	34.6	33.4	31.2	28.1	29.3	29.7	28.0	28.1	26.4	25.5	28.3	32.4
1991	/	1992	32.9	31.0	29.7	30.3	33.1	31.2	30.9	29.3	27.0	25.9	27.8	33.0
1992	/	1993	35.4	32.7	28.7	28.6	27.3	28.2	28.9	29.4	25.5	24.9	27.6	31.0
1993	/	1994	34.6	31.6	30.1	28.7	29.3	31.4	30.4	28.5	25.4	24.3	27.6	32.0
1994	/	1995	32.2	34.9	32.0	30.8	29.7	30.5	31.4	29.1	26.0	26.4	29.8	33.2
1995	/	1996	35.0	32.6	29.0	29.7	28.6	28.6	28.0	27.0	25.1	25.7	30.0	33.1
1996	/	1997	35.1	32.6	28.5	28.1	27.4	28.7	27.6	26.4	27.0	24.2	28.7	31.0
1997	/	1998	32.1	32.1	30.4	29.0	30.6	30.6	29.8	28.8	26.8	25.8	27.8	32.0
1998	/	1999	35.3	33.5	28.7	27.2	28.1	28.2	28.3	27.6	25.7	25.0	28.3	30.6
1999	/	2000	31.6	31.1	29.3	28.3	27.1	27.6	27.5	25.8	24.5	24.0	26.1	31.6
2000	/	2001	33.2	31.6	27.6	28.0	26.4	27.4	-	-	-	-	29.3	32.4
2001	/	2002	32.9	30.9	29.2	29.3	30.3	30.8	28.5	27.6	24.9	28.0	28.3	30.7
2002	/	2003	32.7	31.0	29.7	27.8	28.7	-	-	-	-	-	-	-
2003	/	2004	-	-	-	-	-	-	-	-	-	-	-	-
2004	/	2005	-	32.4	29.3	-	30.8	31.2	31.0	29.0	27.2	25.1	30.3	32.3
2005	/	2006	35.0	33.1	29.2	28.6	-	28.5	28.4	28.0	-	-	-	29.6
2006	/	2007	-	31.8	-	-	-	-	-	-	-	-	-	-
2007	/	2008	-	-	-	-	-	-	-	-	28.8	25.8	-	-
2008	/	2009	34.6	32.0	29.1	29.1	-	-	-	-	26.4			
Average			33.2	32.2	29.5	28.7	28.9	29.5	29.1	27.8	25.8	25.5	28.2	31.8

Average: 1980/81-2005/06

Station: Choma

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1979	/	1980										20.9	24.4	30.1
1980	/	1981	30.1	28.8	26.9	26.1	25.3	25.5	25.3	22.7	22.0	21.9	26.6	28.5
1981	/	1982	29.5	29.8	28.6	27.0	27.0	28.0	27.6	24.5	23.9	22.5	-	27.6
1982	/	1983	28.5	30.0	29.9	28.6	28.2	28.0	27.8	27.1	24.7	23.7	24.1	30.6
1983	/	1984	30.3	30.9	26.5	28.3	27.3	26.4	25.9	25.4	22.3	23.1	25.3	30.5
1984	/	1985	31.5	28.4	26.4	26.6	26.1	26.7	26.0	24.4	22.5	23.1	24.5	29.5
1985	/	1986	30.0	29.6	26.8	26.0	26.5	26.3	25.6	24.2	22.0	22.8	26.8	28.9
1986	/	1987	29.6	28.4	27.7	28.5	29.3	30.0	29.4	27.1	23.0	23.6	26.6	30.8
1987	/	1988	31.1	32.6	27.8	28.1	27.2	27.0	-	24.1	24.0	23.9	25.9	29.2
1988	/	1989	-	29.6	27.3	25.7	25.2	26.7	25.7	25.2	23.5	23.4	26.5	29.6
1989	/	1990	30.1	31.0	29.0	26.3	27.3	28.2	27.2	25.6	25.3	25.5	25.3	28.7
1990	/	1991	32.1	30.8	28.3	26.4	27.7	27.2	25.9	25.4	24.2	23.0	26.3	30.7
1991	/	1992	-	28.9	27.4	28.8	31.6	28.6	28.0	26.4	24.0	22.8	25.3	30.4
1992	/	1993	32.2	29.7	27.1	27.0	26.1	26.2	26.8	-	23.0	21.9	25.0	28.1
1993	/	1994	32.0	29.7	28.1	26.2	26.7	28.9	28.1	25.7	22.8	22.2	25.3	29.6
1994	/	1995	29.7	32.1	28.9	28.9	27.4	28.4	28.9	26.3	23.6	23.2	26.9	30.0
1995	/	1996	32.6	29.8	27.1	26.7	26.4	26.5	25.8	24.8	22.5	23.4	27.8	30.6
1996	/	1997	32.4	29.8	27.3	26.0	25.6	26.4	25.9	24.5	25.0	22.1	26.4	28.6
1997	/	1998	29.8	30.3	28.7	26.9	28.6	28.4	27.5	26.5	24.4	23.4	25.1	29.7
1998	/	1999	32.6	31.0	26.2	26.0	26.6	26.6	26.4	26.0	23.9	22.3	25.3	28.6
1999	/	2000	29.9	30.6	27.9	26.9	26.4	26.6	25.8	23.7	22.3	22.0	23.9	29.5
2000	/	2001	31.1	29.7	27.3	28.2	26.1	26.1	26.8	24.8	22.9	-	27.8	30.9
2001	/	2002	31.4	29.7	28.7	28.3	29.2	30.0	26.8	26.3	22.5	26.5	26.7	29.1
2002	/	2003	30.7	29.9	29.3	29.7	27.8	26.4	26.6	25.8	23.0	22.0	27.2	30.5
2003	/	2004	31.1	31.2	28.7	28.0	-	-	-	-	-	-	-	-
2004	/	2005	-	-	-	-	-	-	-	-	-	-	-	-
2005	/	2006	-	-	-	-	-	25.8	26.7	26.5	23.0	24.1	27.2	27.8
2006	/	2007	-	30.4	29.3	27.1	28.4	29.1	27.7	26.3	24.5	24.6	26.9	30.7
2007	/	2008	31.7	29.9	24.9	25.5	27.9	-	26.6	25.9	23.3	24.0	26.7	31.7
2008	/	2009	32.7	30.8	26.9	27.4	27.1	25.7	25.6	24.7	24.3	-	-	-
2009	/	2010	-	28.1	27.9	-	26.8	26.6	26.9	26.5				
Average			30.9	30.1	27.8	27.2	27.3	27.4	26.8	25.4	23.4	23.2	26.0	29.6

Average: 1980/81-2007/08

Station: Livingstone

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1979	/	1980										24.1	28.0	33.5
1980	/	1981	34.3	31.9	31.4	29.5	27.9	28.7	29.0	26.5	25.1	25.5	29.9	31.8
1981	/	1982	33.8	33.7	33.6	31.5	31.9	33.5	31.9	27.9	26.8	25.6	28.8	31.4
1982	/	1983	31.8	33.0	33.6	31.5	31.6	31.9	31.3	30.0	27.7	26.8	27.2	34.0
1983	/	1984	33.9	34.6	29.8	32.8	31.2	31.1	30.1	29.3	25.6	26.1	28.8	34.0
1984	/	1985	34.8	32.2	31.0	29.8	29.2	31.0	30.2	28.2	25.8	25.8	27.7	32.9
1985	/	1986	33.5	34.3	30.8	29.2	29.5	29.5	28.5	27.6	25.5	26.2	30.0	32.9
1986	/	1987	32.1	32.3	31.5	32.0	33.1	34.1	33.4	30.3	25.9	25.9	29.5	34.1
1987	/	1988	34.1	35.9	30.8	31.5	29.6	29.5	30.4	27.5	26.7	26.0	28.9	32.3
1988	/	1989	34.2	32.8	30.6	31.0	27.6	29.9	29.0	28.6	26.7	25.9	29.5	33.1
1989	/	1990	33.7	34.0	33.8	29.4	30.9	31.6	30.7	29.1	28.2	28.5	28.7	31.9
1990	/	1991	35.2	35.0	32.5	30.0	30.6	30.6	29.6	28.8	26.7	25.8	29.6	-
1991	/	1992	34.2	33.0	-	31.7	35.2	31.5	31.6	29.3	26.4	25.8	28.2	33.9
1992	/	1993	35.1	33.1	31.3	29.2	28.3	29.5	30.8	30.5	26.2	25.1	28.2	31.4
1993	/	1994	35.4	32.4	30.6	28.6	29.3	33.2	31.9	28.8	25.4	24.0	28.3	32.8
1994	/	1995	33.7	35.1	33.2	33.2	31.3	32.8	32.3	28.9	26.1	26.9	30.6	34.2
1995	/	1996	36.5	34.8	30.5	30.2	29.4	30.5	29.7	28.7	25.7	26.0	31.3	34.2
1996	/	1997	36.6	33.4	32.4	30.3	29.1	30.4	29.2	27.9	27.9	25.7	29.8	32.2
1997	/	1998	33.8	34.7	33.5	30.1	32.1	32.2	31.8	29.8	27.3	26.7	28.2	33.5
1998	/	1999	36.4	33.9	29.3	30.2	30.5	31.6	31.5	29.9	27.3	25.5	28.7	32.1
1999	/	2000	33.6	33.8	32.0	29.2	28.3	29.3	29.7	27.3	25.6	25.2	27.4	33.2
2000	/	2001	35.7	34.0	30.1	34.1	28.9	28.8	30.2	27.5	-	-	31.0	34.1
2001	/	2002	34.8	32.2	31.6	32.8	32.5	33.9	30.3	29.3	25.6	28.6	29.8	31.7
2002	/	2003	34.1	34.4	32.8	33.6	31.0	30.9	30.4	29.1	26.3	25.5	29.5	34.0
2003	/	2004	34.5	34.7	33.2	30.3	29.9	28.9	29.2	26.4	24.9	24.2	30.7	33.2
2004	/	2005	34.6	35.6	31.8	31.7	32.0	32.0	31.9	30.4	28.3	25.7	31.8	33.4
2005	/	2006	36.6	-	28.9	29.0	29.2	29.1	29.9	28.2	25.4	26.3	28.9	-
2006	/	2007	-	-	-	30.0	31.7	33.2	-	-	-	-	29.9	34.5
2007	/	2008	34.9	32.7	27.2	26.9	30.9	29.8	29.9	-	-	26.6	29.7	35.0
2008	/	2009	37.0	31.9	30.0	30.0	30.2	29.3	29.9	28.7	27.3	25.1	29.0	-
2009	/	2010	35.4	31.5	30.9	31.1	30.3	30.5	30.0	29.3	25.9	25.1	28.4	34.1
Average			34.6	33.6	31.4	30.7	30.4	31.0	30.5	28.7	26.4	25.9	29.3	33.2

Average: 1979/80-2009/10

Table T1.2.3 Minimum Temperature

Station: Ndola

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1979	/	1980										7.8	10.7	14.5
1980	/	1981	16.6	17.1	17.0	17.2	17.4	17.0	13.3	10.4	6.8	6.5	10.8	13.0
1981	/	1982	15.7	17.6	17.3	17.6	17.1	15.7	15.2	10.4	8.5	8.2	10.4	13.9
1982	/	1983	16.4	17.6	17.6	17.3	17.0	17.0	15.6	12.5	9.7	9.6	10.0	13.9
1983	/	1984	16.5	17.6	17.4	17.0	16.8	16.2	14.2	11.4	9.4	8.8	9.7	14.0
1984	/	1985	16.7	17.2	17.2	17.2	16.9	17.0	13.1	11.5	7.0	7.9	10.3	14.6
1985	/	1986	16.3	16.4	17.4	17.3	17.1	17.0	15.5	11.1	8.4	7.1	10.2	13.7
1986	/	1987	16.8	17.1	17.4	17.2	17.5	16.7	13.8	11.6	6.9	7.5	12.7	15.3
1987	/	1988	15.9	17.9	17.8	18.0	17.7	17.0	15.2	10.7	10.3	9.5	10.3	14.4
1988	/	1989	16.7	16.4	17.1	17.1	17.2	16.6	14.5	11.0	8.1	7.9	10.8	13.1
1989	/	1990	16.2	17.3	17.2	17.3	16.9	15.7	15.3	12.9	10.0	7.8	9.7	12.9
1990	/	1991	-	17.1	17.3	17.5	17.1	16.9	13.9	12.7	7.3	8.4	9.5	13.2
1991	/	1992	15.6	17.1	17.2	17.1	-	17.2	15.1	13.4	8.9	9.0	9.5	13.8
1992	/	1993	16.3	17.6	-	17.2	17.3	17.0	15.6	11.1	7.9	8.4	10.2	14.1
1993	/	1994	17.2	17.4	17.4	17.9	16.9	15.5	14.5	11.0	7.6	8.4	10.9	13.9
1994	/	1995	16.0	17.1	17.6	17.5	17.5	16.4	13.8	12.3	7.2	8.4	12.5	13.9
1995	/	1996	16.8	17.5	17.4	17.4	17.7	17.0	13.9	12.5	8.7	6.6	9.5	-
1996	/	1997	-	-	17.4	17.4	17.3	17.1	15.1	10.1	9.5	9.0	-	15.5
1997	/	1998	16.5	18.1	17.8	18.6	18.0	18.1	14.6	9.4	7.3	8.9	11.2	14.6
1998	/	1999	16.7	18.2	17.5	17.4	17.4	17.0	14.1	11.0	8.4	9.0	11.8	13.2
1999	/	2000	15.7	17.2	17.0	17.6	17.9	17.3	14.8	11.5	10.3	8.3	11.5	14.7
2000	/	2001	17.0	17.5	17.9	17.4	17.4	17.2	14.8	11.2	-	8.6	10.7	13.3
2001	/	2002	16.8	18.0	18.2	17.4	17.5	16.3	-	10.0	9.1	9.0	12.3	15.0
2002	/	2003	17.3	17.1	18.0	17.6	17.7	-	14.0	10.4	9.1	8.0	9.5	-
2003	/	2004	16.2	18.3	17.8	17.8	17.3	17.8	15.3	9.8	8.5	8.3	11.2	13.7
2004	/	2005	16.9	17.3	18.0	17.6	17.2	17.1	14.8	10.7	9.6	9.4	11.6	14.4
2005	/	2006	16.6	18.4	17.7	-	17.7	17.2	14.5	12.1	8.4	8.5	10.9	13.6
2006	/	2007	17.8	17.3	-	18.0	17.7	16.8	15.1	11.4	9.8	9.1	11.0	15.3
2007	/	2008	-	-	17.6	17.4	16.3	15.6	14.2	11.5	8.3	9.7	11.0	13.4
2008	/	2009	-	18.0	17.4	17.4	16.9	16.5	-	-	-	8.1	10.8	14.6
2009	/	2010	17.4	-	17.9	17.9	18.1	17.6						
Average			16.5	17.5	17.5	17.5	17.3	16.8	14.6	11.3	8.6	8.4	10.7	14.0

Average: 1979/80-2008/09

Station: Serenje

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1980	/	1981				16.0	16.6	16.5	-	11.4	7.3	-	-	12.7
1981	/	1982	14.6	16.6	16.1	16.7	15.9	15.5	14.8	12.4	9.7	8.6	9.9	
1982	/	1983	14.2	16.0	15.0	15.5	15.9	16.5	15.4	11.9	-	9.8	-	11.8
1983	/	1984	14.1	15.0	-	15.1	15.8	15.8	13.1	-	9.5	8.8	-	13.7
1984	/	1985	14.6	-	15.9	16.3	15.7	16.5	13.3	11.5	7.4	7.5	8.7	12.4
1985	/	1986	14.1	14.7	15.2	14.8	-	14.4	14.5	12.3	-	6.6	-	-
1986	/	1987	-	15.7	15.5	15.4	15.1	14.3	12.4	10.9	6.7	7.9	-	-
1987	/	1988	-	15.9	16.4	-	-	15.4	14.0	10.4	9.5	8.3	10.3	11.2
1988	/	1989	13.5	-	16.4	16.3	16.2	16.0	14.7	11.9	8.1	7.4	9.9	12.1
1989	/	1990	14.6	15.1	15.1	15.5	15.1	13.8	13.9	12.1	-	5.6	-	-
1990	/	1991	16.1	17.2	16.7	16.8	16.2	16.6	14.1	13.6	-	-	10.5	13.6
1991	/	1992	-	-	16.3	15.8	15.0	16.2	14.2	13.8	11.1	9.1	10.0	13.6
1992	/	1993	-	-	-	16.4	16.3	15.7	15.4	10.9		9.2	10.6	13.7
1993	/	1994	16.8	16.8	16.8	17.0	16.0	13.9	13.5	12.4	8.6	9.2	10.7	-
1994	/	1995	-	-	16.6	16.2	-	14.4	12.2	11.3	8.9	9.7	12.3	14.3
1995	/	1996	-	-	-	-	-	-	13.5	12.9	9.3	8.5	10.7	13.9
1996	/	1997	17.3	15.5	16.9	16.8	16.4	17.3	15.3	11.4	11.8	10.0	11.6	-
1997	/	1998	16.3	-	17.5	17.7	17.0	17.7	14.4	10.2	8.4	10.0	11.8	14.8
1998	/	1999	16.5	17.4	-	-	-	-	-	-	9.7	-	-	13.4
1999	/	2000	15.6	-	-	16.2	-	16.3	15.2	12.4	-	8.7	-	-
2000	/	2001	-	-	16.8	16.6	-	16.6	15.1	12.4	-	9.6	-	
2001	/	2002	16.6	-	-	-	-	-	-	-	-	10.6	11.8	14.6
2002	/	2003	17.0	16.8	17.6	-	-	-	-	-	-	9.2	10.4	14.4
2003	/	2004	16.3	18.0	-	-	16.4	17.0	15.5	10.9	-	8.6	-	-
2004	/	2005	-	17.0	17.2	16.9	16.6	16.1	14.1	12.1	11.9	9.5	12.3	15.5
2005	/	2006	17.9	18.5	17.6	17.5	17.7	17.5	-	13.2	10.9	10.0	-	-
2006	/	2007	-	-	17.1	17.7	17.2	16.2	16.1	12.8	10.7	10.8	12.4	14.9
2007	/	2008	16.7	-	-	17.0	15.7	15.8	-	13.2	9.6	9.7	12.1	-
2008	/	2009	17.5	17.6	17.2	17.0	16.9	16.7	14.4	-	-	-	-	-
2009	/	2010	17.7	17.2	17.1									
Average			15.8	16.5	16.5	16.4	16.1	15.9	14.3	12.0	9.4	8.9	10.9	13.6

Average: 1981/82-2008/09

Station: Kabwe

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1979	/	1980										8.1	10.9	-
1980	/	1981	16.6	17.7	17.3	17.3	17.9	17.0	13.7	10.4	7.7	7.8	10.7	13.9
1981	/	1982	16.3	17.8	17.9	17.9	17.5	16.1	15.2	11.1	10.1	9.1	10.8	14.2
1982	/	1983	16.6	18.2	17.7	18.0	17.7	17.1	15.5	13.7	10.8	9.8	10.1	15.0
1983	/	1984	17.1	18.4	17.8	16.9	17.0	16.5	13.7	-	9.6	9.3	9.7	14.5
1984	/	1985	17.9	17.4	17.0	17.2	16.9	16.9	13.4	11.2	8.0	8.3	10.1	14.9
1985	/	1986	16.5	16.4	17.3	17.2	17.0	16.6	15.3	10.8	8.7	7.7	10.3	14.2
1986	/	1987	17.1	17.3	17.0	17.4	17.8	16.9	14.6	13.0	8.2	8.1	12.5	15.9
1987	/	1988	16.6	18.6	18.2	17.5	17.3	16.7	15.8	11.0	10.8	10.0	11.1	14.5
1988	/	1989	17.2	16.6	17.2	17.7	17.5	16.5	14.3	11.3	9.2	9.2	11.6	14.8
1989	/	1990	17.4	18.3	18.0	17.4	17.5	15.6	15.2	12.7	11.0	9.1	10.4	14.2
1990	/	1991	17.8	18.1	17.9	17.9	17.6	16.8	13.5	12.5	8.9	9.0	10.7	14.9
1991	/	1992	16.1	17.6	17.8	17.0	17.2	17.7	15.7	13.2	9.4	9.3	11.1	15.7
1992	/	1993	18.3	18.5	18.3	17.6	17.9	16.9	15.9	12.1	9.2	9.4	-	14.7
1993	/	1994	18.2	18.4	17.9	18.0	17.1	15.6	14.6	12.0	9.4	8.7	11.4	15.1
1994	/	1995	17.3	19.5	18.1	17.8	17.5		14.5	13.2	9.0	9.7	13.3	15.1
1995	/	1996	18.8	19.0	-	17.7	18.0	15.8	13.8	13.2	9.0	8.7	12.0	15.7
1996	/	1997	18.2	19.2	17.8	18.0	17.4	17.4	14.5	11.0	11.1	9.5	12.1	16.2
1997	/	1998	17.1	18.8	18.0	18.7	18.3	18.3	14.8	11.3	9.2	9.9	12.0	15.6
1998	/	1999	18.2	19.3	18.0	18.0	17.7	17.0	14.2	11.2	9.1	9.8	12.1	13.8
1999	/	2000	16.7	18.1	18.2	18.4	17.9	18.0	-	12.4	10.9	8.7	10.2	14.7
2000	/	2001	17.0	17.1	17.2	16.9	-	-	-	11.9	-	9.1	12.0	15.2
2001	/	2002	17.3	18.5	18.4	17.5	17.9	17.4	15.1	12.1	10.4	11.7	13.4	16.4
2002	/	2003	18.7	17.9	18.8	-	18.3	18.1	14.2	11.4	10.8	8.4	11.4	15.2
2003	/	2004	18.0	19.4	18.5	18.3	17.5	-	15.6	10.4	9.6	9.6	13.0	15.5
2004	/	2005	17.9	18.6	18.5	18.3	17.8	17.8	-	-	-	-	13.7	15.5
2005	/	2006	18.3	19.4	17.8	18.2	18.2	17.5	14.0	13.3	9.8	9.9	-	-
2006	/	2007	-	-	19.0	18.5	18.3	17.8	-	-	11.2	10.0	12.3	16.3
2007	/	2008	-	18.3	18.4	18.2	-	16.0	14.0	12.5	9.8	9.9	12.2	15.2
2008	/	2009	18.5	19.0	18.1	18.3	17.5	16.8	13.2	-	10.9	8.2	-	16.4
2009	/	2010	18.6	18.3	18.3	18.5	18.4							
Average			17.5	18.3	17.9	17.8	17.6	17.0	14.6	12.0	9.7	9.2	11.5	15.1

Average: 1980/81-2008/09

Station: Mumbwe

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1979	/	1980										6.0	9.8	14.3
1980	/	1981	16.2	17.6	17.4	17.6	17.8	16.8	13.1	9.0	5.4	6.9	-	-
1981	/	1982	-	-	-	17.8	16.7	15.6	14.9	8.9	8.4	8.3	10.6	14.2
1982	/	1983	16.6	17.9	17.6	17.8	16.9	16.5	14.6	11.8	9.8	9.2	9.8	15.4
1983	/	1984	16.8	18.0	18.0	16.7	16.8	16.6	14.0	10.5	8.2	8.3	9.9	14.9
1984	/	1985	18.0	18.4	17.6	17.7	16.5	16.6	12.6	8.7	5.3	7.4	10.0	14.9
1985	/	1986	16.7	17.6	17.8	17.2	15.9	15.7	13.7	8.0	4.9	4.8	9.5	14.5
1986	/	1987	17.2	16.9	16.6	17.2	17.2	16.2	12.6	10.2	4.1	5.7	12.6	17.9
1987	/	1988	16.3	19.7	18.5	17.8	17.4	16.5	14.5	8.2	8.0	6.9	10.5	14.3
1988	/	1989	17.5	16.8	17.1	17.1	17.4	15.8	13.9	9.0	7.5	6.5	11.8	15.3
1989	/	1990	16.7	18.3	18.1	17.9	16.7	15.5	15.0	12.6	9.6	8.3	10.1	13.0
1990	/	1991	18.2	-	-	17.9	17.1	16.5	12.0	10.9	7.2	6.9	10.5	15.1
1991	/	1992	16.5	-	17.5	16.9	17.4	17.9	15.1	11.2	8.1	10.6	10.6	15.7
1992	/	1993	19.5	18.1	18.3	17.7	17.8	16.6	-	11.8	7.0	7.4	10.4	14.5
1993	/	1994	18.7	18.5	-	-	-	15.1	13.4	9.2	-	-	7.2	10.2
1994	/	1995	-	-	-	18.6	17.8	17.0	15.1	13.1	7.5	8.7	12.8	15.8
1995	/	1996	20.2	19.5	18.0	17.8	17.9	16.7	13.2	12.1	7.4	8.0	12.7	16.6
1996	/	1997	19.2	20.1	18.0	18.1	17.3	17.0	14.6	10.6	9.8	8.1	10.5	16.0
1997	/	1998	17.2	18.6	17.8	18.6	18.1	18.1	14.3	10.4	8.5	9.8		16.4
1998	/	1999	19.6	19.5	17.9	17.9	17.1	17.3	14.1	10.3	8.2	7.8	10.8	13.1
1999	/	2000	16.2	18.0	17.2	17.6	17.4	17.1	13.9	11.8	9.1	6.4	8.6	14.9
2000	/	2001	17.1	18.0	17.9	17.4	18.0	17.0	14.8	-	-	-	12.9	15.5
2001	/	2002	17.4	18.1	18.2	17.1	17.3	16.9	14.1	10.1	8.7	9.9	12.8	15.9
2002	/	2003	17.2	17.4	18.2	-	18.1	-	-	9.8	9.8	6.2	-	-
2003	/	2004	-	-	-	-	-	-	-	-	-	-	-	-
2004	/	2005	-	-	-	-	-	-	-	12.4	10.3	-	-	16.2
2005	/	2006	19.6	19.8	-	-	17.4		14.2	12.1	9.8	8.3	10.6	13.0
2006	/	2007	-	-	-	16.7	17.6	15.5	-	10.1	8.8	7.7	10.2	14.7
2007	/	2008	17.5	15.5	16.9	17.1	16.4	15.4	13.1	-	-	8.6	12.2	14.4
2008	/	2009	18.7	18.7	18.6	-	17.3	-	12.6	-	9.6	7.9	9.6	-
2009	/	2010	-	17.1	17.2	16.5	-	-	-	11.4				
Average			17.7	18.2	17.8	17.6	17.3	16.5	13.9	10.5	8.0	7.8	10.7	14.9

Average: 1980/81-2008/09

Station: Lusaka-1 (City Airport)

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1979	/	1980										9.4	12.1	15.3
1980	/	1981	16.4	17.7	16.8	17.1	17.2	16.7	13.5	12.0	8.8	9.1	11.6	14.0
1981	/	1982	16.2	17.9	16.9	16.7	16.4	15.3	15.2	12.3	11.4	10.9	11.5	14.8
1982	/	1983	16.7	18.0	17.3	17.5	17.0	17.1	16.1	14.7	12.4	11.1	11.3	16.1
1983	/	1984	17.2	19.7	17.3	15.8	16.4	16.2	14.4	13.5	10.8	10.6	11.9	15.4
1984	/	1985	18.7	17.4	16.8	16.6	16.0	16.1	13.3	11.8	9.1	9.6	11.5	15.4
1985	/	1986	16.9	16.2	16.7	16.4	16.0	15.4	14.9	11.5	9.1	8.6	11.6	14.3
1986	/	1987	16.2	16.8	15.9	16.4	16.2	15.7	14.1	13.3	8.2	9.2	13.0	16.0
1987	/	1988	17.3	19.7	18.6	17.8	17.4	17.2	16.3	12.6	11.5	10.8	12.5	-
1988	/	1989	17.9	17.6	17.1	17.1	17.1	16.5	15.3	12.4	11.2	10.2	13.0	15.0
1989	/	1990	15.8	18.0	18.1	18.2	17.7	16.1	14.6	12.4	9.9	8.0	9.1	12.4
1990	/	1991	16.7	17.4	18.1	17.4	17.0	17.0	14.3	13.4	9.8	10.2	11.5	16.0
1991	/	1992	16.5	17.6	17.3	16.2	16.5	17.5	16.8	13.8	10.4	10.7	11.8	15.6
1992	/	1993	18.6	18.1	17.3	17.0	17.3	16.5	16.4	13.2	10.3	10.0	11.4	14.6
1993	/	1994	18.1	17.8	17.5	17.0	16.3	15.4	15.2	13.4	-	-	12.1	15.9
1994	/	1995	16.9	19.2	17.5	17.3	17.2	16.5	16.3	14.6	10.3	11.0	14.4	16.1
1995	/	1996	18.9	17.9	16.9	17.4	17.8	16.8	14.6	13.3	9.9	9.3	13.3	16.1
1996	/	1997	18.7	18.8	17.9	17.7	17.0	17.4	14.5	11.1	11.0	10.6	12.5	16.3
1997	/	1998	16.7	18.7	17.7	18.2	-	18.2	15.9	-	10.5	10.6	13.0	16.6
1998	/	1999	18.5	18.9	17.6	17.3	17.2	16.9	14.7	-	10.0	11.1	12.7	15.1
1999	/	2000	17.1	17.4	17.2	17.9	-	17.5	15.9	-	12.0	10.2	12.0	16.1
2000	/	2001	17.5	16.9	17.3	17.2	17.6	17.0	15.7	13.4	-	-	12.8	15.2
2001	/	2002	17.2	17.1	-	16.0	15.7	15.3	13.9	-	-	12.0	13.8	16.4
2002	/	2003	18.6	17.3	18.0	17.0	17.3	16.0	13.5	10.3	11.0	9.3	-	-
2003	/	2004	-	18.9	17.4	-	16.1	-		11.4	10.1	10.5	13.9	-
2004	/	2005	17.3	16.6	14.6	16.7	17.3	17.0	15.4	13.5	-	-	14.1	15.8
2005	/	2006	17.2	18.6	16.9	17.0	16.8	16.6	14.9	12.1	11.2	10.2	13.0	14.4
2006	/	2007	-	-	18.3	17.4	17.1	19.1	15.4	12.6	11.7	10.1	12.4	15.1
2007	/	2008	18.1	17.8	17.2	17.0	15.9	15.9	14.1	-	10.9	10.6	12.4	14.8
2008	/	2009	18.1	18.5	17.7	17.7	17.2	16.3	13.3	12.4	11.9	9.3	11.6	16.5
2009	/	2010	18.3	17.4	17.3	17.4	-	17.1	-	12.7				
Average			17.4	17.9	17.3	17.1	16.8	16.6	14.9	12.7	10.5	10.1	12.3	15.4

Average: 1980/81-2008/09

Station: Lusaka-2 (International Airport)

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1979	/	1980										5.7	8.7	13.8
1980	/	1981	15.5	17.8	18.0	17.8	17.9	16.9	13.2	9.3	5.9	6.0	9.2	12.4
1981	/	1982	15.2	17.7	17.6	18.1	17.4	15.8	14.1	10.1	8.0	7.3	9.2	12.1
1982	/	1983	15.2	17.9	17.8	18.0	17.7	16.9	15.0	12.6	9.4	8.4	8.6	13.0
1983	/	1984	15.8	18.5	18.3	16.8	17.3	16.3	13.4	11.3	8.1	8.5	8.5	13.0
1984	/	1985	17.0	18.2	18.0	17.9	17.0	16.8	12.6	9.9	6.6	7.3	8.9	13.6
1985	/	1986	15.5	16.5	18.1	17.6	17.4	16.0	14.9	10.0	7.2	6.5	9.2	12.4
1986	/	1987	16.2	16.5	16.9	17.5	17.5	17.0	14.1	11.7	7.5	6.7	11.2	14.5
1987	/	1988	15.8	18.4	19.1	18.2	17.7	17.5	15.2	10.2	9.5	8.6	9.6	13.1
1988	/	1989	16.6	16.3	17.5	18.0	17.9	16.6	14.0	10.3	8.1	7.6	9.9	12.8
1989	/	1990	15.8	18.0	18.1	18.2	17.7	16.1	14.6	12.4	9.9	8.0	9.1	12.4
1990	/	1991	16.7	17.4	18.1	18.2	17.7	17.0	13.5	11.5	7.6	8.0	9.1	14.0
1991	/	1992	16.0	17.6	17.8	17.1	17.1	18.0	15.3	12.3	8.6	7.7	9.1	13.1
1992	/	1993	16.0	18.4	18.1	-	-	16.8	14.9	-	8.2	7.6	9.7	-
1993	/	1994	-	-	-	-	-	-	-	-	8.1	9.2	10.6	15.4
1994	/	1995	17.1	-	17.9	-	-	16.8	14.8	12.8	8.1	8.4	12.2	14.3
1995	/	1996	18.1	17.2	17.9	17.8	18.1	16.6	12.6	11.6	8.1	6.9	10.1	14.1
1996	/	1997	16.7	18.3	17.8	18.6	17.5	17.0	14.0	9.9	9.8	7.9	10.2	14.9
1997	/	1998	16.3	18.6	18.1	19.0	18.5	18.0	13.9	10.3	7.9	8.0	11.3	13.8
1998	/	1999	17.3	19.1	18.2	18.4	17.8	16.8	14.6	11.0	8.6	8.8	10.8	13.7
1999	/	2000	15.6	17.8	18.0	18.3	18.3	18.1	15.0	11.9	-	-	-	-
2000	/	2001	15.7	18.1	18.2	18.3	18.2	17.5	-	-	-	7.1	10.7	13.7
2001	/	2002	15.9	18.6	-	16.1	17.7	16.4	14.5	10.4	8.8	9.8	11.4	14.2
2002	/	2003	-	-	-	18.1	18.3	17.4	13.4	10.3	9.7	-	-	-
2003	/	2004	-	-	-	18.5	17.7	18.0	15.7	10.1	8.3	8.0	11.3	13.5
2004	/	2005	16.5	18.1	18.5	18.7	18.2	17.8	14.3	11.9	9.4	8.3	12.2	14.5
2005	/	2006	16.8	19.0	18.6	18.8	18.6	17.0	-	11.7	8.7	7.9	10.1	12.4
2006	/	2007	17.6	18.8	18.8	18.8	18.3	17.4	15.1	10.6	9.5	8.0	10.9	14.4
2007	/	2008	17.3	18.7	18.6	18.2	17.2	15.6	12.5	11.3	8.4	7.8	10.2	13.7
2008	/	2009	17.1	-	18.8	18.8	17.7	17.0	12.7	11.3	9.8	-	9.8	14.8
2009	/	2010	16.6	17.3	17.9									
Average			16.4	18.0	18.1	18.1	17.8	17.0	14.2	11.0	8.4	7.9	10.1	13.6

Average: 1980/81-2008/09

Station: Kafue

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1979	/	1980										7.7	10.9	15.6
1980	/	1981	17.4	19.3	18.9	18.9	18.9	17.8	13.7	9.7	6.1	6.4	9.5	13.0
1981	/	1982	17.4	18.5	18.1	18.9	18.5	16.1	14.6	9.3	8.8	7.9	9.0	15.0
1982	/	1983	17.4	18.9	18.4	18.6	18.1	17.6	15.5	12.5	9.5	8.6	8.9	14.0
1983	/	1984	17.7	19.5	19.1	17.6	17.9	17.5	14.1	12.3	8.9	9.3	9.7	15.6
1984	/	1985	19.5	19.2	18.9	18.6	17.8	17.5	-	10.1	7.4	7.7	10.8	15.8
1985	/	1986	17.6	18.0	19.2	18.6	17.9	17.3	15.3	10.5	6.8	6.2	9.3	14.1
1986	/	1987	18.2	17.6	17.0	18.1	17.9	17.2	13.7	11.8	6.2	6.5	13.1	16.9
1987	/	1988	17.7	19.7	19.8	18.7	18.4	17.8	15.7	10.1	9.8	7.9	11.0	14.8
1988	/	1989	17.3	18.6	18.7	18.6	18.8	17.4	14.5	9.5	8.1	7.0	10.8	13.0
1989	/	1990	17.3	18.8	19.7	19.0	18.1	15.7	14.7	11.7	9.3	7.2	8.7	13.1
1990	/	1991	17.7	18.3	19.0	18.2	18.1	17.5	12.8	10.4	7.2	7.9	9.0	13.4
1991	/	1992	15.6	17.9	18.0	17.3	17.1	18.0	15.1	11.5	7.7	7.2	9.6	12.9
1992	/	1993	18.1	19.0	18.7	17.3	19.0	17.3	15.0	10.1	6.4	7.8	9.7	13.7
1993	/	1994	18.8	18.9	18.7	18.6	17.5	15.2	13.4	10.3	7.1	7.9	10.3	13.6
1994	/	1995	16.9	18.6	18.7	18.7	18.6	16.6	13.9	13.6	7.3	8.0	13.0	14.7
1995	/	1996	18.4	19.0	18.8	18.5	19.0	17.2	12.3	11.8	6.7	6.4	10.5	14.3
1996	/	1997	17.8	19.4	18.7	19.3	18.3	17.9	14.8	10.3	9.9	8.7	10.1	15.5
1997	/	1998	17.6	18.9	18.4	19.8	19.3	18.4	14.0	7.9	6.6	7.5	11.3	14.2
1998	/	1999	18.3	19.8	19.3	19.0	18.6	17.9	13.9	10.1	8.5	9.8	10.9	12.8
1999	/	2000	17.3	17.9	18.2	18.9	18.6	18.3	14.8	12.0	10.8	7.8	9.7	13.2
2000	/	2001	16.1	17.7	18.5	18.3	19.1	18.2	15.0	10.3	8.0	6.4	10.5	13.7
2001	/	2002	16.0	18.9	19.0	17.7	17.5	16.4	14.0	9.6	8.7	8.9	12.9	15.0
2002	/	2003	18.2	17.4	19.3	18.7	19.1	-	-	-	-	-	-	-
2003	/	2004	-	-	-	-	-	-	-	-	-	-	-	-
2004	/	2005	-	17.9	19.2	-	17.6	17.4	13.9	6.9	8.1	7.4	10.9	12.6
2005	/	2006	16.6	18.7	18.3	18.7	-	17.3	13.5	9.9	-	-	-	12.4
2006	/	2007	-	18.2	-	-	-	-	-	-	-	-	-	-
2007	/	2008	-	-	-	-	-	-	-	-	-	-	-	-
2008	/	2009	15.5	17.9	17.9	17.2	-	-	-	-	7.1	-	-	-
2009	/	2010	-	-	-									
Average			17.6	18.7	18.7	18.5	18.3	17.3	14.3	10.7	8.0	7.7	10.4	14.2

Average: 1980/81-2001/02

Station: Choma

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1979	/	1980										3.8	8.0	11.4
1980	/	1981	14.4	16.6	16.5	17.2	17.3	15.5	11.1	7.1	4.0	4.2	8.0	10.7
1981	/	1982	14.5	16.1	16.4	17.0	16.5	14.8	13.0	7.3	5.6	5.1	-	11.7
1982	/	1983	14.5	17.4	17.1	17.5	16.7	16.5	13.6	10.3	6.9	6.0	6.1	12.1
1983	/	1984	15.5	17.6	16.8	15.6	16.1	15.8	12.6	9.6	5.8	5.5	6.4	12.9
1984	/	1985	16.3	17.0	17.0	17.0	16.0	16.0	12.2	8.1	4.3	5.2	7.9	12.9
1985	/	1986	15.8	16.5	17.1	16.5	15.9	15.9	13.9	7.5	4.3	4.7	7.3	11.7
1986	/	1987	16.0	15.5	16.1	16.6	15.9	16.1	12.1	9.7	4.5	4.5	8.8	14.1
1987	/	1988	14.5	17.5	18.0	17.2	16.9	15.8	-	9.0	6.7	5.5	7.5	11.6
1988	/	1989	15.4	15.7	16.8	17.1	17.4	15.7	13.1	8.1	6.7	5.2	9.0	12.2
1989	/	1990	15.3	16.6	17.1	17.8	16.5	14.8	13.4	9.8	7.9	5.9	7.5	11.5
1990	/	1991	15.9	16.9	17.1	17.7	16.9	16.4	10.7	8.5	5.8	6.0	7.2	13.1
1991	/	1992	-	16.5	17.1	16.5	16.7	17.4	13.3	9.2	5.8	5.2	8.0	12.9
1992	/	1993	17.3	17.5	17.1	16.6	17.4	16.0	14.2	-	5.4	7.3	7.9	11.1
1993	/	1994	16.2	17.5	17.0	17.2	16.3	14.2	12.0	7.4	5.0	5.0	7.8	12.1
1994	/	1995	14.7	18.2	17.5	17.1	17.2	15.8	13.3	11.8	5.7	5.6	10.9	13.5
1995	/	1996	18.2	17.5	16.8	17.3	17.4	15.8	11.5	9.9	6.0	4.8	9.5	13.2
1996	/	1997	15.7	17.7	17.4	17.7	16.5	16.3	12.8	8.1	7.5	7.2	8.8	14.0
1997	/	1998	16.0	18.1	17.6	18.5	17.7	17.1	13.1	7.6	5.1	6.4	9.6	13.5
1998	/	1999	17.0	17.8	17.3	17.5	16.6	16.2	12.3	8.4	6.0	6.3	8.8	12.0
1999	/	2000	15.2	16.3	16.8	17.3	17.2	17.0	13.4	10.7	9.1	5.6	7.8	12.5
2000	/	2001	14.6	16.4	16.7	16.8	17.4	16.3	13.7	8.1	5.9	-	9.6	13.0
2001	/	2002	14.8	17.7	17.1	16.7	16.3	16.2	12.9	8.7	7.0	7.7	10.1	12.3
2002	/	2003	15.9	16.2	17.5	17.6	17.8	15.9	11.8	8.5	8.5	4.9	8.6	-
2003	/	2004	16.1	17.8	17.1	17.9	16.8	17.1	14.2	-	6.4	5.0	9.2	12.3
2004	/	2005	15.1	16.7	17.9	17.5	-	16.5	-	-	-	-	-	-
2005	/	2006	-	-	-	-	-	16.3	13.3	9.0	6.2	5.9	8.9	10.8
2006	/	2007	-	17.6	18.0	17.6	17.2	16.1	13.3	8.4	7.0	7.0	7.9	12.8
2007	/	2008	16.6	17.1	17.2	17.3	15.6	14.2	10.7	8.6	5.6	6.8	8.0	12.1
2008	/	2009	15.6	17.5	17.4	17.1	15.9	15.6	11.1	8.5	7.2	-	-	-
2009	/	2010	-	17.1	17.5	17.4	17.7	16.6	15.6	10.2				
Average			15.7	17.1	17.1	17.2	16.7	16.0	12.7	8.8	6.1	5.7	8.4	12.4

Average: 1980/81-2008/09

Station: Livingstone

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1979	/	1980										5.2	10.3	14.3
1980	/	1981	17.9	18.9	19.1	19.2	18.8	16.8	13.4	8.0	4.7	5.1	8.9	11.6
1981	/	1982	17.3	18.6	19.1	19.1	18.9	17.6	15.7	10.4	7.1	7.5	9.3	14.4
1982	/	1983	17.5	19.9	19.4	19.8	18.4	18.6	16.4	11.7	8.1	7.2	7.1	13.8
1983	/	1984	17.9	20.0	19.2	18.4	18.1	18.4	14.6	11.0	8.0	6.0	8.7	15.3
1984	/	1985	19.7	18.7	18.4	19.2	18.0	18.0	14.1	10.1	6.4	7.2	10.2	14.7
1985	/	1986	18.7	19.8	19.7	19.0	18.0	18.0	15.6	9.7	5.9	5.8	9.1	14.5
1986	/	1987	18.6	18.4	18.6	19.0	19.3	18.8	15.8	12.6	6.4	5.9	9.7	16.8
1987	/	1988	18.3	21.1	20.5	19.7	19.0	18.1	16.5	10.9	7.4	6.3	9.6	13.8
1988	/	1989	18.3	18.4	18.7	18.7	18.9	17.4	15.2	10.0	8.3	6.7	9.7	13.1
1989	/	1990	16.8	18.7	19.4	19.3	17.7	17.3	15.4	12.1	9.3	7.7	9.6	14.0
1990	/	1991	18.7	19.9	19.5	19.4	18.7	18.2	13.0	10.1	7.4	7.2	9.3	-
1991	/	1992	17.4	19.1	-	18.7	18.9	19.1	15.1	9.6	7.3	6.9	9.5	14.7
1992	/	1993	20.3	19.6	19.5	18.6	18.8	17.0	15.7	11.5	7.3	9.1	9.6	13.9
1993	/	1994	19.4	20.6	19.1	19.3	18.4	16.7	14.6	10.2	6.1	5.6	8.9	14.1
1994	/	1995	18.3	20.9	19.8	19.5	19.3	18.7	15.9	14.7	5.6	7.7	13.6	15.6
1995	/	1996	20.3	20.3	18.6	19.0	18.9	17.2	14.2	10.9	8.0	5.5	11.0	15.4
1996	/	1997	19.7	20.0	18.9	19.2	18.2	18.1	13.8	10.0	7.7	7.3	-	16.7
1997	/	1998	17.8	20.3	20.4	20.8	20.2	19.7	15.2	10.1	7.6	8.8	11.6	16.3
1998	/	1999	20.7	20.4	19.5	19.3	18.1	18.4	14.6	12.1	8.5	10.0	11.2	14.7
1999	/	2000	18.5	17.4	18.6	18.2	17.7	17.6	13.6	11.6	9.6	7.3	9.7	15.5
2000	/	2001	18.5	18.5	18.5	18.5	19.5	17.9	15.9	10.4	-	-	11.4	15.8
2001	/	2002	18.4	20.1	19.2	19.4	19.1	19.2	15.8	11.0	9.2	9.1	14.0	15.8
2002	/	2003	18.9	20.1	20.4	20.4	20.3	18.4	15.3	11.7	12.1	7.9	11.3	16.4
2003	/	2004	19.4	20.2	20.1	19.2	18.7	18.4	15.0	8.4	7.8	6.1	10.9	14.3
2004	/	2005	18.5	20.7	20.0	19.6	19.4	18.9	16.0	12.8	9.5	7.6	13.3	15.4
2005	/	2006	19.4	-	19.6	19.2	19.4	18.8	15.3	11.0	8.2	7.5	11.1	-
2006	/	2007	-	-	-	19.9	19.5	19.2	-	-	-	-	11.4	17.1
2007	/	2008	20.5	20.3	19.1	19.3	18.4	17.2	13.8	11.8	8.4	9.6	11.4	15.8
2008	/	2009	20.4	20.3	19.6	19.5	18.5	17.2	14.2	12.5	9.6	8.8	9.9	-
2009	/	2010	19.5	-	19.9	20.3	20.1	-						
Average			18.8	19.7	19.4	19.3	18.8	18.1	15.0	11.0	7.8	7.3	10.4	15.0

Average: 1980/81-2008/09

Table T1.2.4 Humidity

Station: Choma

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1982	/	1983								56.9	54.7	55.6	44.2	34.6
1983	/	1984	46.5	52.1	77.2	66.2	75.6	76.2	68.6	60.4	59.7	52.4	43.7	36.3
1984	/	1985	-	62.6	75.6	77.6	76.5	-	-	63.3	58.6	55.5	49.1	44.7
1985	/	1986		54.9	78.9	78.1	79.5	78.7	75.9	67.7	62.1	57.0	44.5	40.7
1986	/	1987	57.7	64.2	70.6	71.9	72.6	67.2	54.9	55.4	55.0	46.8	41.9	39.3
1987	/	1988	41.9	43.4	78.4	74.2		79.1		66.9	59.2	58.6	48.6	41.3
1988	/	1989	-	52.6	73.1	82.7	86.0	77.2	73.2	65.5	61.3	55.6	50.4	43.0
1989	/	1990	46.2	54.0	66.5	81.7	78.4	68.8	69.5	66.3	57.0	51.4	49.9	41.2
1990	/	1991	41.6	50.3	68.1	80.6	76.8	76.8	65.6	57.7	55.6	52.9	-	35.3
1991	/	1992		58.7	70.1	65.7	54.9	70.3	61.8	-	-	-	-	-
1992	/	1993	38.0	56.6	69.9	75.0	81.1	77.5	69.5	55.4	58.4	60.1	48.5	40.1
1993	/	1994	-	-	-	-	77.7	64.7	55.6	52.6	52.8	51.8	49.7	37.1
1994	/	1995	-	-	-	-	78.5	65.7	50.9	57.6	50.5	53.7	46.7	36.3
1995	/	1996	39.1	52.9	75.3	76.9	80.1	75.0	70.1	68.9	60.8	53.1	45.0	39.2
1996	/	1997	36.1	55.2	75.0	82.5	81.8	77.8	68.0	61.5	-	60.1	45.4	52.9
1997	/	1998	46.7	58.4	67.9	80.2	74.7	75.3	63.3	-	-	-	-	39.6
1998	/	1999	39.0	55.3	79.8	82.9	78.5	76.6	67.3	59.0	58.1	60.9	50.3	40.5
1999	/	2000	45.8	51.3	68.5	79.4	-	-	-	75.3	72.7	64.2	56.7	46.3
2000	/	2001	41.0	63.7	-	-	-	-	-	-	-	-	-	-
2001	/	2002	-	-	-	-	-	-	-	-	-	-	-	-
2002	/	2003	-	-	-	-	-	-	-	-	-	-	-	-
2003	/	2004	-	-	-	-	-	-	-	-	-	-	-	-
2004	/	2005	-	-	-	-	-	-	-	-	-	-	-	-
2005	/	2006	-	-	-	-	-	-	-	-	-	-	-	-
2006	/	2007	-	60.5	73.5	83.5	77.0	-	70.9	59.5	-	57.7	49.5	60.0
2007	/	2008	48.5	-	86.8	88.2	-	-	66.8	65.4	-	-	-	-
Average			43.5	54.8	73.0	77.0	76.8	73.8	65.3	62.2	58.7	55.6	47.9	40.9

Average: 1983/84-1999/00

Station: Kabwe

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1979	/	1980										63.1	51.4	-
1980	/	1981	54.2	64.2	83.7	84.0	86.0	83.5	77.2	73.0	64.3	60.4	52.2	42.0
1981	/	1982	49.5		64.0	84.2	83.7	72.0	71.6	68.0	61.5	57.9	50.3	47.0
1982	/	1983	53.9	65.1	75.6	-	75.5	79.0	70.2	65.2	62.5	59.2	48.5	40.2
1983	/	1984	46.8	57.8	77.1	73.4	77.6	80.0	73.8		57.5	52.4	41.5	39.5
1984	/	1985	37.9	63.3	81.8	83.0	78.3	80.5	71.3	66.5	59.7	54.6	51.3	39.2
1985	/	1986	43.0	57.2	81.5	84.7	82.4	81.3	80.5	71.2	65.3	57.1	45.2	44.4
1986	/	1987	57.5	63.9	68.9	77.1	76.9	72.8	59.7	56.2	52.9	49.4	48.8	40.0
1987	/	1988	39.5	46.8	78.8	78.0	78.7	82.0	73.7	66.1	61.3	54.9	46.7	38.2
1988	/	1989	49.0	49.3	71.3	79.4	80.6	76.5	72.6	-	59.8	53.5	48.0	40.1
1989	/	1990	42.9	53.0	69.4	82.3	77.4	70.1	71.8	67.6	58.2	54.9	46.3	43.5
1990	/	1991	40.0	50.0	70.3	80.6	76.4	75.6	67.8	59.1	53.5	53.5	45.8	41.2
1991	/	1992	51.8	62.3	62.4	75.9	70.6	76.6	66.1	57.7	55.3	51.1	46.9	33.4
1992	/	1993	36.8	56.0	70.3	77.5	81.7	81.5	72.9	59.4	65.0	57.7	-	43.3
1993	/	1994	41.4	63.6	70.8	78.3	77.6	61.1	55.6	50.4	50.1	50.1	46.5	39.0
1994	/	1995	48.2	46.6	64.8	72.6	78.3	78.4	57.5	55.9	51.8	50.6	49.3	38.4
1995	/	1996	41.4	55.4	-	75.1	79.9	70.8	69.9	72.4	61.9	56.7	44.1	36.4
1996	/	1997	36.5	52.0	73.7	-	77.5	81.1	78.6	65.8	62.5	66.7	49.6	54.1
1997	/	1998	50.5	65.4	82.1	81.3	76.6	75.8	67.1	52.4	56.5	57.0	54.1	42.0
1998	/	1999	39.6	54.2	78.6	85.1	83.2	83.2	75.5	67.5	63.2	64.8	54.2	42.4
1999	/	2000	49.1	56.3	65.2	80.2	83.4	85.1	78.1	-	69.9	61.7	57.2	42.9
2000	/	2001	41.4	65.5	85.2	84.8	87.7	85.1	78.2	70.9	-	59.2	50.5	43.6
2001	/	2002	43.8	64.2	80.3	80.5	-	-	-	-	60.9	53.2	53.1	44.5
2002	/	2003	45.6	57.1	76.4	-	83.6	83.0	73.5	66.9	-	-	-	-
2003	/	2004	-	-	-	-	79.8	-	79.4	68.5	68.4	59.8	49.4	41.8
2004	/	2005	48.0	56.5	-	80.5	69.0	66.2	-	46.5	49.1	-	-	-
2005	/	2006	-	-	-	-	-	-	-	-	-	-	-	-
2006	/	2007	-	-	-	82.8	-	77.8	-	-	58.2	57.3	46.6	43.6
2007	/	2008	-	66.1	81.8	84.9	79.0	74.2	69.2	66.0	61.8	59.9	52.4	42.4
2008	/	2009	-	-	78.9	80.0	-	-	75.2	-	66.4	66.4	-	42.3
2009	/	2010	43.6	70.2	79.9	80.0	85.2	83.6	82.0	68.6				
Average			45.3	58.5	74.9	80.2	79.5	77.6	71.9	63.6	59.9	56.9	49.1	41.7

Average: 1980/81-2009/10

Station: Lusaka-1 (City Airport)

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1987	/	1988								69.6	-	59.5	47.8	-
1988	/	1989	-	48.8	73.5	85.0	-	-	-	-	-	-	-	47.0
1989	/	1990	42.4	59.1		84.1	-	74.8	-	71.6	64.5	56.4	50.7	46.7
1990	/	1991	49.4	55.4	71.9	86.2	-	-	78.5	-	73.2	65.2	55.7	-
1991	/	1992	53.5	61.4	78.7	77.5	69.9	78.1	65.5	62.6	60.3	51.9	48.3	37.8
1992	/	1993	39.5	61.7	77.5	-	-	87.8	78.6	64.5	61.8	60.5	50.3	43.8
1993	/	1994	44.2	-	-	-	-	-	-	-	-	-	51.4	46.4
1994	/	1995	52.0	-	-	-	-	74.0	-	55.9	55.1	-	49.9	-
1995	/	1996	42.1	58.0	-	-		81.4	-	-	-	-	-	-
1996	/	1997	-	-	-	-	-	-	-	-	-	-	-	-
1997	/	1998	-	-	-	-	-	-	62.6	-	52.8	-	52.6	44.4
1998	/	1999	-	-	-	-	-	-	-	-	-	-	-	-
1999	/	2000	-	-	-	-	-	-	-	-	-	-	-	-
2000	/	2001	-	-	-	-	-	-	-	-	-	-	-	-
2001	/	2002	-	-	-	-	-	-	-	-	-	-	-	-
2002	/	2003	-	-	-	-	-	-	-	-	-	-	-	-
2003	/	2004	-	-	-	-	-	-	-	-	-	-	-	-
2004	/	2005	-	-	-	-	-	-	-	47.1	51.9	54.7	-	-
2005	/	2006	-	66.9	-	87.3	89.3	74.8	65.2	-	-	50.5	45.8	45.8
2006	/	2007	49.0	-	68.2	-	-	-	-	-	-	-	-	-
2007	/	2008	-	-	-	79.5	65.1	-	-	-	48.5	52.0	54.0	38.1
2008	/	2009	48.2	61.8	74.8	77.0	-	-	-	-	-	-	-	-
Average			46.7	59.1	74.1	82.4	74.8	78.5	70.1	60.3	58.5	55.9	51.0	43.8

Average: 1988/89-2008/09

Station: Kafue

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1980	/	1981									59.2	55.7	49.1	43.6
1981	/	1982	46.5	60.0	64.2	-	-	-	-	-	-	-	-	-
1982	/	1983	-	-	-	-	-	-	-	54.9	53.5	50.9	43.5	42.1
1983	/	1984	41.8	46.1	71.4	67.7	73.8	72.5	62.4	53.6	54.6	50.1	41.6	35.2
1984	/	1985	-	59.8	76.3	76.8	79.2		-	62.2	59.2	54.8	48.5	41.8
1985	/	1986	45.1	58.0	77.8	81.1	78.4	77.5	76.0	66.3	-	56.6	26.6	43.5
1986	/	1987	58.9	60.6	72.5	75.4	72.3	67.9	54.4	53.6	53.0	47.8	46.1	40.3
1987	/	1988	40.6	44.1	72.6	74.5	76.0	75.6	64.7	60.3	-	-	47.1	37.1
1988	/	1989	46.4	48.7	69.3	80.6	81.4	75.2	69.7	63.6	60.9	56.0	49.1	43.5
1989	/	1990	40.9	51.3	66.5	84.4	78.0	71.9	66.2	63.3	56.6	52.4	47.1	40.0
1990	/	1991	41.1	47.9	67.5	81.3	77.7	75.1	67.9	-	57.1	55.3	48.9	39.4
1991	/	1992	49.0	59.3	70.4	71.9	62.1	69.5	57.0	54.8	54.0	54.1	48.4	38.4
1992	/	1993	39.8	55.0	72.8	78.7	84.3	78.9	70.7	60.9	61.4	56.7	49.0	42.9
1993	/	1994	41.1	61.5	71.7	77.3	76.0	63.9	56.6	53.6	54.5	52.8	48.0	41.0
1994	/	1995	54.0	46.8	61.3	-	76.3	67.0	55.0	55.3	47.4	50.2	48.6	40.6
1995	/	1996	42.7	54.9	72.9	71.9	77.7	74.3	66.1	67.9	63.6	59.5	49.8	40.8
1996	/	1997	36.9	55.8	77.3	81.5	78.8	-	73.1	64.3	62.3	63.8	50.2	50.8
1997	/	1998	49.1	60.4	70.6	79.3	72.7	72.3	63.6	55.5	60.2	57.6	55.0	42.3
1998	/	1999	38.1	51.6	77.6	82.8	80.3	75.8	68.0	64.2	62.6	64.0	54.7	46.0
1999	/	2000	49.3	59.1	69.4	77.8	79.4	78.8	72.2	71.2	65.7	59.3	54.4	44.5
2000	/	2001	43.9	58.2	77.9	77.6	83.2	78.4	-	-	-	45.6	-	65.9
2001	/	2002	-	-	75.9	73.7	70.5	67.2	66.0	60.5	60.1	55.4	49.5	46.8
2002	/	2003	48.3	54.9	67.0	70.9	78.7	-	-	-	-	-	-	-
2003	/	2004	-	-	-	-	-	-	-	-	-	-	-	-
2004	/	2005	-	-	-	-	-	-	-	-	-	-	-	-
2005	/	2006	-	-	-	-	-	77.3	-	62.5	-	-	-	42.2
2006	/	2007	-	59.6	-	-	-	-	-	-	-	-	-	-
Average			44.8	54.4	71.9	77.1	76.8	73.0	65.3	60.7	58.3	55.1	47.9	43.2

Average: 1983/84-2002/03

Station: Livingstone

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1979	/	1980										51.6	41.5	34.0
1980	/	1981	38.7	64.7	71.7	79.5	85.0	79.5	66.7	61.8	57.4	-	44.2	34.0
1981	/	1982	41.4	56.6	59.5	71.5	67.9	56.4	56.0	55.6	49.0	47.9	39.4	37.2
1982	/	1983	52.0	60.7	65.5	72.6	73.4	67.1	67.4	58.7	52.6		41.7	32.4
1983	/	1984	43.9	52.5	76.5	62.5	71.7	67.7	64.5	52.5	53.0	48.0	39.7	31.0
1984	/	1985	43.1	62.5	69.7	76.5	75.6	71.1	55.6	56.0	50.2	48.1	40.9	33.8
1985	/	1986	38.0	44.2	68.9	75.5	76.0	76.2	75.8	62.7	56.8	54.0	39.8	36.1
1986	/	1987	57.8	61.8	68.7	65.9	67.1	61.9	45.4	46.8	45.4	42.5	39.2	33.0
1987	/	1988	34.7	41.0	79.1	72.9	78.2	77.5	68.8	59.1	55.0	52.4	43.7	35.2
1988	/	1989	43.9	50.3	73.1	80.4	85.9	74.2	72.6	63.2	61.0	53.8	44.8	36.4
1989	/	1990	42.9	49.3	57.8	80.7	75.6	66.6	69.2	60.9	52.0	46.4	40.1	34.3
1990	/	1991	38.0	42.6	64.8	77.4	75.9	73.7	58.8	52.2	52.9	49.0	41.0	-
1991	/	1992	42.3	54.3	71.6	69.6	54.7	72.3	-	49.6	50.0	46.8	39.5	29.6
1992	/	1993	39.2	52.9	65.2	77.6	85.9	75.5	67.4	51.4	53.4	53.2	41.8	37.4
1993	/	1994	-	-	72.5	80.9	77.3	59.0	48.3	46.1	47.9	45.0	40.6	30.4
1994	/	1995	38.3	43.1	58.6	58.9	-	60.6	46.3	54.2	-	-	38.6	29.3
1995	/	1996	33.4	38.5	-	72.3	74.0	67.7	57.1	58.6	51.2	40.1	36.5	29.0
1996	/	1997	27.3	49.5	63.8	75.8	77.7	77.4	67.2	57.8	56.4	57.4	41.2	44.8
1997	/	1998	43.5	47.2	59.0	78.2	70.3	68.5	54.2	45.1	48.2	46.7	37.7	30.1
1998	/	1999	29.5	50.3	72.3	76.0	72.2	63.8	52.0	49.8	47.5	52.8	43.0	35.2
1999	/	2000	37.9	48.1	63.8	73.8	78.5	77.6	66.2	-	60.8	-	46.1	39.5
2000	/	2001	32.2	-	-	50.3	79.1	76.1	61.7	49.8	-	-	41.9	38.9
2001	/	2002	36.5	57.9	63.3	57.4	57.4	45.7	50.7	39.9	43.2	38.9	35.6	32.8
2002	/	2003	37.3	38.2	54.5	54.1	65.0	60.0	48.2	41.0	58.0	41.9	-	28.5
2003	/	2004	39.0	50.5	-	-	-	-	-	-	49.0	44.1	36.1	30.0
2004	/	2005	35.2	36.0	60.8		63.0		48.4	39.7	37.9	-	32.8	-
2005	/	2006	-	-	-	-	-	-	-	-	-	-	35.8	42.0
2006	/	2007	-	-	-	69.6	-	54.4	-	-	-	-	33.2	28.9
2007	/	2008	-	-	79.8	84.3	63.9	63.2	48.1	46.4	43.7	42.5	36.6	30.5
2008	/	2009	29.5	66.0	72.8	-	67.8	66.6	48.7	50.7	46.0	48.2	-	-
2009	/	2010	32.6	-	66.3	-	-	-	62.5	52.5				
Average			38.8	50.8	67.2	71.8	72.8	67.7	58.8	52.4	51.1	47.6	39.7	33.9

Average: 1980/81-2009/10

Table T1.2.5 Wind Speed

Station: Serenje

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1979	/	1980												
1980	/	1981				2.5	2.6	3.8	-	4.5	4.4	-	-	5.3
1981	/	1982	4.9	4.0	3.5	-	-	-	3.9	4.6	4.5	5.3	5.2	-
1982	/	1983	4.9	3.2	2.7	2.5	2.4	3.5	3.8	3.8	-	5.5	-	4.8
1983	/	1984	4.8	3.7	3.1	2.6	2.6	3.4	4.4	-	4.3	4.6	-	5.0
1984	/	1985	4.1	3.3	3.3	2.4	2.8	3.2	3.9	4.2	4.1	4.3	5.0	4.5
1985	/	1986	4.4	3.6	2.6	3.0	-	3.3	3.8	4.1		4.1	-	-
1986	/	1987	-	3.5	2.9	2.9	2.2	2.6	3.0	3.3	3.3	4.1	-	-
1987	/	1988	-	3.8	2.6	-	-	2.7	3.4	4.2	4.1	4.6	5.6	5.1
1988	/	1989	4.7	-	3.5	2.9	2.8	3.6	4.4	4.1	4.0	4.2	4.4	4.6
1989	/	1990	4.8	3.8	2.8	2.5	2.6	3.2	3.0	4.1	-	4.0	5.1	4.3
1990	/	1991	3.0	2.7	2.3	2.0	1.8	2.2	2.3	2.5	2.4	-	3.3	3.4
1991	/	1992	-	-	2.1	1.9	1.6	1.5	1.7	2.0	2.2	2.6	3.0	3.5
1992	/	1993	-	-	2.2	1.5	1.3	1.2	1.4	1.3	-	2.3	2.8	3.6
1993	/	1994	3.8	2.6	2.3	1.3	1.3	-	1.4	2.1	2.7	-	3.6	-
1994	/	1995	3.7	3.3	2.4	1.7	1.2	1.1	1.4	2.1	2.6	3.0	3.4	3.7
1995	/	1996	-	-	-	-	-	-	2.5	-	2.7	3.0	3.2	3.7
1996	/	1997	3.5	3.5	2.0	-	-	-	-	2.3	2.5	3.5	3.4	-
1997	/	1998	3.6	2.6	1.8	1.5	1.5	1.6	2.1	2.1	2.5	3.1	3.5	3.5
1998	/	1999	3.5	2.9	-	-	-	-		-	-	-	-	-
1999	/	2000	-	-	-	-	-	-	2.4	2.5	-	2.8	-	-
2000	/	2001	-	-	1.7	1.5	-	-	-	-	-		-	-
2001	/	2002	-	-	-	-	-	-	-	-	-	2.3	-	-
2002	/	2003	3.3	2.7	2.1	-	1.3	-	-	-	-	-	-	-
2003	/	2004	-	-	-	-	-	-	-	-	-	-	-	-
2004	/	2005	-	-	1.4	-	1.4	-	1.6	2.0	-	-	-	-
2005	/	2006	-	-	-	-	-	-	-	-	-	-	-	-
2006	/	2007	-	-	-	4.2	3.9	4.9	6.5	7.9	7.5	7.8	-	6.8
2007	/	2008	7.0	-	-	3.5	-	5.2	-	-	-	-	-	-
2008	/	2009	4.0	-	-	-	-	-	-	-	-	-	-	-
Average			4.3	3.3	2.5	2.4	2.1	2.9	3.0	3.4	3.6	4.0	4.0	4.4

Average: 1980/81-2008/09

Station: Kabwe

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1979	/	1980												
1980	/	1981						2.9	3.3	3.4	3.6	-	4.3	4.3
1981	/	1982	4.8	4.0	3.9	3.3	2.6	3.1	-	-	-	-	0.0	-
1982	/	1983		3.9	3.2	2.9	2.6	2.9	3.2	3.4	3.6	3.8	4.3	4.3
1983	/	1984	4.5	1.7	3.4	3.0	2.9	3.3	3.4		3.9	4.1	4.3	4.7
1984	/	1985	4.8	4.0	3.4	2.9	2.5	3.0	2.9	3.1	3.1	3.5	4.7	4.2
1985	/	1986	4.5	4.1	3.2	3.2	3.1	3.0	3.5	3.3	3.8	3.9	4.1	4.5
1986	/	1987	4.0	4.1	3.5	3.1	2.7	3.0	3.3	3.5	3.3	3.7	4.3	4.7
1987	/	1988	4.9	4.7	3.2	3.1	2.9	2.7	3.2	3.4	3.4	3.3	4.2	4.8
1988	/	1989	4.5	4.0	3.3	2.9	2.9	2.7	3.3	2.6	2.4	3.3	3.9	4.5
1989	/	1990	4.3	3.8	3.1	2.4	-	-	-	-	-	-	-	-
1990	/	1991	-	-	-	-	-	-	-	-	-	-	-	-
1991	/	1992	-	-	-	-	-	-	-	-	-	-	-	-
1992	/	1993	-	-	-	-	-	-	-	-	2.5	3.3	-	-
1993	/	1994	3.8	3.0	2.8	2.1	1.9	2.0	2.7	2.7	2.8	3.3	3.6	3.8
1994	/	1995	4.2	3.7	2.9	2.6	2.0		3.0	3.4	3.0	3.6	4.0	4.3
1995	/	1996	4.3	3.5	-	3.0	2.2	2.5	3.3	3.0	5.6	3.3	3.6	4.1
1996	/	1997	4.3	3.6	2.8	2.7	2.8	2.9	2.5	2.7	2.7	3.6	3.5	4.6
1997	/	1998	4.3	3.2	2.8	2.4	-	2.7	2.9	2.7	3.0	3.5	3.8	4.0
1998	/	1999	4.1	3.3	2.7	2.5	2.6	2.5	-	2.6	2.7	3.5	3.3	3.8
1999	/	2000	3.8	3.6	3.4	3.0	2.6	1.9	2.7	2.8	3.1	2.7	3.3	4.0
2000	/	2001	4.1	3.4	3.2	2.7	2.7	2.8	3.1	3.3	-	3.5	3.5	3.8
2001	/	2002	3.7	3.3	2.8	2.9	-	-	-	-	3.3	3.2	4.1	4.0
2002	/	2003	4.5	3.6	3.5	-	2.6	3.2	3.0	2.8	-	-	-	-
2003	/	2004	-	-	-	-	2.9	-	3.1	3.0	3.5	3.2	3.6	3.7
2004	/	2005	3.9	3.6	3.1	3.1	2.8	2.9	-	2.9	3.1	-	-	-
2005	/	2006	-	-	-	-	-	-	-	-	-	-	-	-
2006	/	2007	-	-	-	1.5	-	-	-	-	5.1	2.4	2.7	5.6
2007	/	2008	-	2.6	2.0	1.7	1.9	-	2.2	2.3	5.2	5.1	2.7	2.9
2008	/	2009	2.9	-	2.1	3.0	-	-	2.2	-	-	-	-	2.7
Average			4.2	3.6	3.1	2.7	2.6	2.8	3.0	3.0	3.5	3.5	3.6	4.2

Average: 1980/81-2008/09

Station: Lusaka-1 (City Airport)

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1987	/	1988	6.5	6.6	4.3	3.2	3.4	3.0	4.4	4.6	5.2	5.0	6.6	-
1988	/	1989	7.6	-	5.0	3.3	-	-	6.4	5.4	5.5	6.1	6.7	6.7
1989	/	1990	6.5	6.2	4.5	3.6	2.8	4.3	4.0	4.6	4.5	5.0	5.5	6.1
1990	/	1991	6.2	5.7	4.3	3.8	2.8	3.6	4.0	4.0	4.5	4.8	4.8	6.0
1991	/	1992	5.3	4.5	3.6	2.8	2.3	3.5	4.2	3.9	3.8	6.1	6.5	7.1
1992	/	1993	6.0	5.1	4.2	3.6	3.3	3.6	4.9	4.3	5.3	5.8	6.3	6.2
1993	/	1994	7.7	5.2	4.3	3.8	3.2	3.4	-	5.8	-	5.4	6.7	7.3
1994	/	1995	6.5	4.4	3.6	2.8	3.5	3.6	4.6	5.4	5.0	5.8	6.5	7.3
1995	/	1996	6.3	5.5	4.4	3.5	5.5	5.3	5.4	5.0	4.6	5.0	5.8	6.3
1996	/	1997	7.1	5.7	4.0	3.3	3.0	-	4.0	-	4.1	-	-	6.6
1997	/	1998	-	4.2	4.8	3.1	-	4.6	5.8	-	5.1	6.0	6.7	7.2
1998	/	1999	7.2	-	3.7	-	-	-	-	-	-	6.6	6.2	7.0
1999	/	2000	7.5	5.4	4.7	-	-	-	-	-	-	-	6.2	6.8
2000	/	2001	-	4.4	-	-	-	-	-	-	-	-	-	-
2001	/	2002	-	-	-	-	4.5	-	-	-	-	-	6.6	-
2002	/	2003	-	-	-	-	-	-	-	-	-	-	-	-
2003	/	2004	-	-	-	-	-	-	-	-	-	-	-	-
2004	/	2005	-	-	-	-	-	-	-	-	-	-	-	-
2005	/	2006	-	-	-	-	5.1	4.5	-	4.5	-	-	5.0	7.9
2006	/	2007	7.3	5.1	4.3	3.6	2.2	-	-	5.8	-	-	6.0	7.2
2007	/	2008	7.3	-	-	-	-	5.1	-	-	6.3	5.8	-	-
2008	/	2009	6.7	5.8	5.4	-	-	3.2	-	-	-	-	-	-
Average			6.8	5.3	4.3	3.4	3.5	4.0	4.8	4.8	4.9	5.6	6.1	6.8

Average: 1987/88-2008/09

Station: Mt. Makulu

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1979	/	1980										5.3	5.5	5.1
1980	/	1981	5.0	3.7	3.0	3.0	2.6	3.0	3.0	3.4	3.7	4.5	4.9	5.0
1981	/	1982	5.4	3.7	3.4	2.4	2.3	4.6	3.7	4.0	4.3	4.3	4.5	5.2
1982	/	1983	4.2	3.4	3.0	2.6	2.3	2.9	3.0	3.0	3.2	4.1	4.3	5.1
1983	/	1984	5.5	3.8	3.1	2.3	2.2	3.6	3.3	3.3	3.6	3.9	4.5	4.6
1984	/	1985	4.5	3.9	2.9	2.5	2.7	2.7	3.3	3.0	2.8	3.4	4.5	4.6
1985	/	1986	4.3	3.6	3.0	3.5	2.3	2.5	4.4	2.7	3.2	3.9	4.3	4.4
1986	/	1987	3.3	3.3	2.7	2.4	2.4	2.4	2.9	3.2	2.5	3.2	3.9	4.8
1987	/	1988	4.6	4.3	2.6	2.1	2.6	2.6	3.3	3.5	3.6	3.1	4.4	4.7
1988	/	1989	4.6	4.3	3.2	2.0	2.4	2.6	3.3	3.2	3.4	3.5	4.6	4.5
1989	/	1990	4.2	4.0	2.9	2.5	1.7	3.0	2.8	3.2	3.1	3.6	3.8	4.3
1990	/	1991	4.4	4.2	3.2	2.7	1.8	2.4	2.7	2.5	3.3	3.6	3.8	4.1
1991	/	1992	3.7	3.1	2.9	2.0	1.6	2.3	2.2	2.2	2.8	3.6	4.0	4.8
1992	/	1993	3.8	3.2	2.8	2.1	-	2.2	2.9	2.8	3.2	3.4	4.1	4.2
1993	/	1994	4.9	3.4	2.7	2.1	1.9	2.1	2.5	2.7	2.6	3.2	4.0	4.1
1994	/	1995	4.0	-	-	-	1.7	1.4	2.8	3.0	2.8	3.5	4.4	4.3
1995	/	1996	3.2	2.6	-	-	2.1	2.3	3.3	3.0	-	-	-	-
1996	/	1997	-	-	-	-	1.5	-	-	-	-	-	-	-
1997	/	1998	-	-	-	-	-	-	-	1.9	2.1	3.0	-	-
1998	/	1999	-	-	-	-	-	-	-	-	-	-	-	-
1999	/	2000	-	-	-	-	2.6	-	-	-	-	5.1	6.2	6.6
2000	/	2001	6.5	4.8	-	-	-	-	-	-	-	5.1	6.4	6.1
2001	/	2002	5.8	3.3	-	-	-	-	-	3.8	3.9	4.7	5.9	-
Average			4.6	3.7	3.0	2.4	2.2	2.7	3.1	3.0	3.2	3.8	4.6	4.8

Average: 1980/81-2001/02

Station: Kafue

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1979	/	1980												
1980	/	1981									3.7	4.4	4.9	5.1
1981	/	1982	6.2	4.4	3.6	-	2.9	3.0	3.9	4.2	4.2	4.5	4.5	6.4
1982	/	1983	5.2	4.3	3.3	3.0	2.6	3.0	3.5	3.6	3.8	4.5	5.0	5.4
1983	/	1984	6.1	4.7	3.8	-	3.0	3.8	3.7	4.5	4.8	4.8	5.2	6.1
1984	/	1985	-	4.9	1.9	2.6	2.5	3.4	3.5	4.0	3.7	4.3	5.7	5.5
1985	/	1986	5.6	4.7	3.4	3.1	2.6	2.8	3.5	3.3	3.8	3.7	4.5	5.6
1986	/	1987	4.5	3.8	3.1	2.4	2.5	2.8	3.5	3.7	3.6	3.8	5.3	5.4
1987	/	1988	5.2	5.3	3.5	2.8	2.3	2.5	3.2	3.6	3.4	3.5	5.0	5.8
1988	/	1989	5.8	5.3	4.1	2.6	2.8	3.1	3.3	3.0	3.4	3.7	4.6	4.4
1989	/	1990	5.2	4.9	4.4	3.0	2.2	2.6	2.6	3.5	3.4	3.5	4.4	5.1
1990	/	1991	5.6	5.1	4.2	2.9	1.8	2.3	2.8	3.1	3.7	4.2	3.7	5.4
1991	/	1992	4.5	4.1	3.5	2.7	2.5	3.0	3.1	3.4	3.6	4.2	4.5	4.9
1992	/	1993	5.0	4.5	3.1	2.5	1.9	2.2	2.5	2.2	3.4	3.6	4.2	4.2
1993	/	1994	5.2	3.8	3.1	2.6	2.3	2.4	3.0	3.4	3.2	4.3	4.3	4.6
1994	/	1995	4.8	3.9	3.0	2.8	2.2	2.9	3.6	4.2	4.0	4.1	5.0	5.1
1995	/	1996	4.8	4.0	3.8	2.8	2.2	2.3	3.6	3.0	3.0	3.5	4.4	4.3
1996	/	1997	4.9	4.5	2.9	2.1	2.4	3.1	3.0	3.6	2.9	4.0	4.2	4.7
1997	/	1998	4.9	3.1	3.9	3.1	2.5	2.8	3.4	2.8	3.5	4.2	4.8	4.9
1998	/	1999	5.3	4.5	3.4	-	-	-	-	-	-	-	-	4.7
1999	/	2000	5.3	3.9	3.6	-	-	-	2.8	3.0	-	-	-	-
2000	/	2001	-	-	3.0	1.8	2.2	2.7	2.9		3.2	3.7	3.5	4.1
2001	/	2002	3.9	3.3	2.1	1.9	2.0	2.5	2.9	2.9	3.3	3.0	4.4	4.4
2002	/	2003	4.5	3.9	-	-	-	-	-	-	-	-	-	-
2003	/	2004	-	-	-	-	-	-	-	-	-	-	-	-
2004	/	2005	-	-	-	-	-	-	-	-	-	-	-	-
2005	/	2006	-	-	-	-	-	2.8	3.0	2.6	-	-	-	4.8
2006	/	2007	-	3.6										
Average			5.1	4.3	3.4	2.6	2.4	2.8	3.2	3.4	3.6	4.0	4.6	5.0

Average: 1981/82-2006/07

Station: Choma

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1979	/	1980										3.3	4.0	3.9
1980	/	1981	4.1	3.3	3.0	3.5	3.2	2.9	2.8	2.5	2.9	3.1	3.6	3.5
1981	/	1982	4.3	3.9	3.0	2.8	2.6	2.7	3.1	2.8	2.8	3.2	-	4.1
1982	/	1983	4.1	3.5	3.0	3.3	3.0	2.7	2.5	2.8	2.7	3.2	3.5	3.7
1983	/	1984	4.1	3.5	3.2	2.5	2.6	3.0	2.6	2.9	2.8	2.8	3.5	3.8
1984	/	1985	4.3	3.8	3.4	3.1	2.6	2.6	2.5	2.6	2.6	2.7	3.7	3.6
1985	/	1986	4.2	3.3	2.7	2.5	2.0	2.4	2.7	2.4	2.8	2.8	3.0	3.7
1986	/	1987	3.0	2.8	2.8	2.7	2.5	2.5	2.5	2.7	2.7	3.0	3.4	4.0
1987	/	1988	4.2	3.9	3.5	2.9	2.6	2.7	-	2.6	2.6	2.7	3.4	3.9
1988	/	1989	4.2	1.8	3.2	2.5	3.0	2.6	2.7	2.5	2.7	2.8	3.6	3.6
1989	/	1990	3.6	3.9	3.4	3.1	2.6	2.6	2.5	2.4	2.5	2.7	3.3	3.7
1990	/	1991	3.7	3.6	3.6	3.0	2.3	2.2	2.3	2.2	2.6	2.9	3.0	3.6
1991	/	1992	-	3.1	3.2	2.7	2.7	2.5	2.1	2.1	2.1	2.5	3.3	4.1
1992	/	1993	3.8	3.7	3.5	2.7	2.4	2.2	2.6	2.1	2.7	2.8	3.1	3.4
1993	/	1994	4.0	3.9	2.8	2.6	2.1	2.0	2.6	2.3	2.6	2.8	3.3	3.9
1994	/	1995	3.9	4.3	3.2	2.9	2.7	2.6	3.1	3.2	2.7	2.8	3.3	4.0
1995	/	1996	4.6	4.0	3.2	3.0	2.9	2.3	2.4	2.2	2.5	2.7	3.2	3.7
1996	/	1997	4.1	3.7	3.0	2.7	2.3	3.1	2.4	2.3	2.3	3.3	3.2	3.6
1997	/	1998	4.2	3.6	3.4	3.2	2.3	2.5	2.2	2.0	2.0	2.6	3.1	3.2
1998	/	1999	3.8	3.8	3.0	2.4	2.3	2.4	2.5	2.5	2.5	2.9	2.9	3.9
1999	/	2000	3.8	3.8	3.0	3.0	-	2.5	2.2	2.1	2.5	2.5	2.9	1.7
2000	/	2001	1.2	0.8	-	-	-	-	-	-	-	-	-	-
2001	/	2002	-	-	-	-	-	-	-	-	-	-	-	3.4
2002	/	2003	-	-	-	-	-	-	-	-	-	-	-	-
2003	/	2004	-	-	-	-	-	-	-	-	-	-	-	-
2004	/	2005	-	-	-	-	-	-	-	-	-	-	-	-
2005	/	2006	-	-	-	-	-	-	-	-	-	-	-	-
2006	/	2007	-	-	-	-	-	-	-	-	-	-	4.9	5.5
2007	/	2008	6.2	-	4.5	3.9	-	-	3.7	3.8	4.3	4.3	4.7	4.8
2008	/	2009	5.5	-	4.8	3.6	3.9	3.8	-	3.4	4.0	4.6	4.8	-
Average			4.0	3.4	3.3	2.9	2.6	2.6	2.6	2.6	2.7	3.0	3.5	3.8

Average: 1980/81-2008/09

Station: Livingstone

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1986	/	1987		3.6	3.3	3.1	2.7	3.1	4.2	3.3	3.0	3.2	3.7	4.1
1987	/	1988	5.4	5.1	3.9	2.9	3.1	3.0	3.4	3.3	2.9	2.7	3.9	4.7
1988	/	1989	5.0	4.3	3.3	2.9	3.5	3.0	3.3	2.8	3.1	3.3	4.0	4.1
1989	/	1990	4.4	4.7	4.3	3.4	2.8	3.1	2.6	2.8	3.4	3.2	4.1	4.8
1990	/	1991	4.7	4.6	4.5	3.7	2.6	3.0	3.2	3.0	3.0	3.6	3.7	-
1991	/	1992	4.3	4.4	3.8	3.0	3.1	3.2	2.8	2.8	3.0	3.5	4.5	5.0
1992	/	1993	4.7	4.4	4.1	3.3	3.1	2.8	3.0	2.5	2.8	3.9	3.9	4.4
1993	/	1994	4.9	4.4	3.4	3.4	3.1	2.9	3.6	3.0	3.3	3.5	4.1	4.6
1994	/	1995	5.2	4.3	4.0	3.4	3.5	3.6	3.3	3.5	2.8	3.5	4.5	4.8
1995	/	1996	5.0	4.9	3.5	-	3.3	1.9	3.6	3.3	3.2	3.7	3.9	4.4
1996	/	1997	5.5	4.4	3.5	3.7	2.9	3.1	2.8	2.5	2.4	4.1	3.9	4.3
1997	/	1998	4.5	3.8	3.9	3.6	2.9	3.2	3.6	3.1	3.0	4.0	4.3	4.7
1998	/	1999	5.4	4.1	3.7	3.1	2.8	3.9	4.1	3.8	3.4	3.9	3.8	4.8
1999	/	2000	5.4	4.8	3.7	3.6	2.6	2.9	2.7	3.2	3.1	3.9	-	4.4
2000	/	2001	5.1	3.8		3.9	-	3.1	2.9	2.7	-	-	-	4.3
2001	/	2002	3.0	3.3	3.1	3.1	3.3	3.6	3.5	-	3.1	2.6	4.0	-
2002	/	2003	-	4.5	3.8	3.3	-	-	-	3.1	-	-	-	4.6
2003	/	2004	4.7	3.6	-	-	-	-	-	-	-	-	-	-
2004	/	2005	-	-	-	-	-	-	2.8	3.6	2.7	-	3.7	-
Average			4.8	4.3	3.7	3.3	3.0	3.1	3.3	3.1	3.0	3.5	4.0	4.5

Average: 1986/87-2004/05

Table T1.2.6 Sunshine Duration

Station: Kabwe

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1979	/	1980										9.9	10.4	-
1980	/	1981	8.4	8.0	5.4	6.1	4.1	6.3	8.3	9.3	10.4	10.3	10.5	9.3
1981	/	1982	9.5	7.6	7.8	4.4	4.8	9.0	8.5	8.9	9.9	8.6	10.3	9.0
1982	/	1983	8.8	6.7	7.5	6.8	7.3	8.3	9.6	9.4	9.7	9.5	10.4	10.3
1983	/	1984	8.9	8.8	5.3	8.2	6.0	7.1	9.3		8.7	9.6	10.5	10.1
1984	/	1985	9.9	7.2	4.2	5.3	6.3	6.1	8.3	8.8	10.0	9.9	10.4	10.0
1985	/	1986	8.5	8.3	4.0	5.1	6.4	6.8	7.2	9.8	9.2	10.4	10.4	9.3
1986	/	1987	8.0	7.4	7.9	6.2	8.9	8.6	10.7	8.9	9.4	-		9.9
1987	/	1988	9.1	-	-	-	-	-	8.9	9.3	8.8	9.6	10.3	10.7
1988	/	1989	8.9	9.0	6.9	4.9	5.2	7.6	8.3	-	-	-	-	-
1989	/	1990	-	-	-	-	-	-	-	-	-	-	-	-
1990	/	1991	-	-	-	-	-	-	-	-	-	-	-	-
1991	/	1992	-	-	-	-	-	-	-	-	-	-	-	-
1992	/	1993	-	8.3	5.9	6.6	4.8	5.7	9.0	10.5	9.8	9.6	-	10.0
1993	/	1994	10.9	7.6	7.4	6.1	7.4	10.6	9.9	10.2	10.3	10.2	10.0	10.4
1994	/	1995	9.2	10.2	7.9	8.3	6.8	-	10.0	10.1	10.7	10.4	10.5	10.5
1995	/	1996	-	7.6	-	6.6	6.6	9.0	9.1	-	9.8	10.1	-	-
1996	/	1997	-	-	-	-	-	-	-	-	-	-	-	-
1997	/	1998	-	7.3	-	-	-	-	-	-	-	-	-	-
1998	/	1999	-	-	-	-	-	-	-	-	-	-	-	-
1999	/	2000	-	-	-	-	-	-	-	-	-	-	-	-
2000	/	2001	-	-	-	-	-	-	-	-	-	-	-	-
2001	/	2002	-	-	-	-	-	-	-	-	-	-	-	-
2002	/	2003	-	-	-	-	-	-	-	-	-	-	-	-
2003	/	2004	-	-	-	-	-	-	-	-	-	-	-	-
2004	/	2005	-	-	-	-	-	-	-	-	-	-	-	-
2005	/	2006	-	-	-	-	-	-	-	-	-	-	-	-
2006	/	2007	-	-	-	-	-	-	-	-	-	-	10.4	-
2007	/	2008	-	-	-	-	8.9	-	-	10.4	9.6	9.6	9.7	10.6
2008	/	2009	-	-	5.7	5.1	-	-	9.5	-	-	-	-	10.2
Average			9.1	8.0	6.3	6.1	6.4	7.7	9.0	9.6	9.7	9.8	10.3	10.0

Average: 1980/81-2008/09

Station: Lusaka-1 (City Airport)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1979 / 1980												
1980 / 1981								8.4	10.0	9.4	10.2	9.5
1981 / 1982	9.8	8.6	8.8	8.4	10.0	9.4	10.2	9.5	9.8	8.6	8.8	9.0
1982 / 1983	8.7	7.3	8.2	6.5	7.9	8.1	9.1	9.5	9.7	9.1	9.9	10.0
1983 / 1984	9.3	7.4	5.5	7.9	6.6	6.8	9.0	8.9	8.9	9.1	10.2	9.6
1984 / 1985	9.5	6.7	4.6	4.4	6.1	6.1	8.8	8.3	9.1	9.3	9.7	9.4
1985 / 1986	8.4	8.0	4.1	4.3	6.2	6.4	7.1	9.4	9.0	9.7	10.2	9.3
1986 / 1987	7.3	7.3	7.2	6.0	8.8	8.7	10.5	8.6	9.5	10.2	9.5	9.6
1987 / 1988	9.4	-	5.3	6.3	-	6.3	8.9	8.2	8.9	-	-	-
1988 / 1989	8.6	9.0	7.1	4.6	5.3	-		-	9.0	9.7	9.6	9.6
1989 / 1990	-	8.7	7.2	-	-	-	-	-	8.6	-	-	-
1990 / 1991	9.8	9.6	6.9	4.8	6.8	7.0	8.9	8.8	10.0	-	-	9.2
1991 / 1992	8.5	7.1	5.6	8.1	-	6.6	8.1	9.1	9.9	9.7	9.9	10.4
1992 / 1993	10.5	9.1	5.6	-	-	7.0	8.5	9.9	9.1	7.5	10.1	9.5
1993 / 1994	10.0	-	-	5.0	6.4	9.1	9.2	-	-	10.2	9.4	9.9
1994 / 1995	-	9.7	8.1	8.0	6.2	8.4	9.2	9.6	10.2	10.0	-	10.0
1995 / 1996	9.0	7.3	5.5	6.2	5.2	6.7	9.1	8.1	-	-	-	10.2
1996 / 1997	10.5											
Average	9.2	8.1	6.4	6.2	6.9	7.4	9.0	8.9	9.4	9.4	9.8	9.7

Average: 1980/81-1996/97

Station: Kafue

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1979 / 1980												
1980 / 1981									9.4	9.0	10.2	9.6
1981 / 1982	9.6	8.1	8.3	5.9	5.9	9.6	9.5	9.6	9.9	9.1	10.2	9.1
1982 / 1983	8.3	7.4	8.9	6.8	8.2	8.5	9.0	9.4	10.0	9.9	9.9	10.2
1983 / 1984	8.6	7.9	5.4	8.6	7.3	6.9	9.5	9.8	9.5	9.6	10.5	9.8
1984 / 1985	-	6.9	5.0	4.8	6.6	6.4	9.1	8.4	9.6	10.1	10.2	-
1985 / 1986	-	-	-	5.3	7.4	7.2	7.8	10.0	9.5	9.9	10.6	9.6
1986 / 1987	7.3	8.1	7.9	6.5	8.6	8.3	10.2	8.6	8.8	9.2	-	9.1
1987 / 1988	8.8	8.3	5.2	-	6.3	-	9.4	9.0	9.3	10.1	10.7	10.6
1988 / 1989	9.4	9.5	7.7	4.3	4.4	-	-	9.7	9.3	9.7	10.2	9.5
1989 / 1990	8.7	9.1	7.1	-	-	-	-	-	8.7	9.9	9.7	8.6
1990 / 1991	-	-	-	-	-	-	-	-	-	-	-	-
1991 / 1992	-	-	-	-	-	-	-	-	10.1	9.9	10.2	10.4
1992 / 1993	10.4	8.5	4.9	6.3	4.7	7.1	8.9	10.4	9.7	8.1	10.3	9.9
1993 / 1994	10.7	7.8	7.4	6.2	7.2	9.7	9.8	10.2	10.2	10.4	9.7	10.3
1994 / 1995	8.9	-										
Average	9.1	8.2	6.8	6.1	6.7	8.0	9.2	9.5	9.5	9.6	10.2	9.7

Average: 1980/81-1994/95

Station: Choma

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1979	/	1980										9.6	10.4	10.2
1980	/	1981	9.8	6.8	6.2	5.9	3.2	5.4	7.9	9.0	10.2	9.2	10.3	9.3
1981	/	1982	9.0	7.3	8.1	6.3	7.1	9.4	8.8	9.7	9.8	9.1	-	9.4
1982	/	1983	7.7	7.3	8.3	5.9	7.9	7.9	8.2	9.6	9.9	10.1	10.0	10.4
1983	/	1984	8.6	7.0	5.2	8.9	8.0	6.2	9.1	9.4	8.9	9.6	10.6	9.5
1984	/	1985	8.3	5.3	6.3	5.2	8.0	7.4	8.8	7.7	9.4	9.6	9.9	9.6
1985	/	1986	9.1	9.1	4.7	5.8	6.2	6.8	7.2	9.6	9.6	9.7	10.5	9.7
1986	/	1987	7.3	8.0	7.9	8.0	8.7	7.7	10.7	9.5	9.1	10.4	10.1	9.4
1987	/	1988	8.9	9.1	-	-	-	-	-	8.6	9.4	10.0	10.4	10.3
1988	/	1989	9.4	9.1	6.8	5.0	-	7.6	8.5	10.2	8.5	9.4	-	9.8
1989	/	1990	9.6	8.7	7.7	5.0	6.9	8.4	9.2	9.1	9.2	10.0	10.1	9.6
1990	/	1991	9.4	-	-	-	-	-	-	-	-	-	-	9.8
1991	/	1992	-	-	-	-	-	-	-	-	-	-	-	10.3
Average			8.8	7.8	6.8	6.2	7.0	7.4	8.7	9.2	9.4	9.7	10.2	9.8

Average: 1980/81-1991/92

Station: Livingstone

			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1979	/	1980										9.9	10.2	10.3
1980	/	1981	9.8	7.2	8.6	6.2	4.5	6.2	9.5	9.6	10.2	10.1	10.0	9.8
1981	/	1982	9.2	7.6	9.2	7.2	8.0	9.3	8.1	10.1	9.6	9.8	10.5	9.5
1982	/	1983	8.4	7.4	8.7	7.1	8.3	7.7	8.6	9.9	10.1	10.4	10.6	10.2
1983	/	1984	8.5	6.5	6.1	9.4	8.6	6.9	9.1	9.9	9.8	10.2	10.8	10.1
1984	/	1985	7.9	6.6	8.0	5.7	8.0	9.0	9.9	8.5	9.9	9.6	10.1	10.2
1985	/	1986	8.9	10.2	6.4	7.1	8.0	7.2	7.8	10.4	10.2	10.0	10.5	9.3
1986	/	1987	6.8	7.2	8.1	8.9	9.3	8.2	10.8	9.0	10.1	10.5	10.6	9.3
1987	/	1988	9.5	9.2	5.1	8.7	6.2	7.6	8.5	9.5	10.0	10.4	10.6	10.3
1988	/	1989	9.5	9.4	6.9	5.0	4.4	8.7	8.6	10.5	9.4	10.3	10.6	10.3
1989	/	1990	9.0	8.7	8.9	5.3	8.7	8.1	9.4	9.9	9.4	10.3	10.4	9.9
1990	/	1991	9.1	9.1	-	-	-	7.1	-	-	-	-	-	-
1991	/	1992	-	-	-	-	-	6.5	-	10.4	10.4	10.1	10.1	10.3
1992	/	1993	8.2	7.4	7.0	6.9	6.0	7.8	8.6	10.2	10.0	8.3	10.5	9.5
1993	/	1994	9.9	7.6	7.6	5.4	7.6	10.3	10.6	10.2	10.3	10.3	10.6	10.4
1994	/	1995	9.8	8.0	8.3	8.6	6.7	8.4	9.9	8.5	10.6	10.6	10.0	10.0
1995	/	1996	8.4	8.6	-	-	-	-	-	9.6	-	-	-	-
Average			8.9	8.0	7.6	7.0	7.3	7.9	9.2	9.7	10.0	10.1	10.4	10.0

Average: 1979/80-1995/96

Figures

Geographical Information of Meteorological Stations

	Station	Altitude (m)	Latitude	Longitude	Local No.	WMO No.
	Lusaka					
1*[1]	Lusaka CA	1,280	15º25’	28 º19’	2193	666
2*[2]	Lusaka IA	1,154	15º19’	28 º27’	2150	665
3	Mt. Makulu	1,213	15 º33’	28 º15’	2375	667
	Copperbelt					
4	Kafironda	1,242	12 º36’	28 º07’	4375	563
5	Ndola	1,270	13 º00’	28 º39’	4100	561
	Central					
6	Kabwe	1,207	14 º27’	28 º28’	525	663
7	Mfumbwa	1,218	14 º59’	27 º04’	2755	655
8	Serenje	1,384	13 º14’	30 º13’	7850	571
	Southern					
9	Choma	1,267	16 º51’	27 º04’	5350	753
10	Kafue Polder	978	15 º46’	27 º55’	2400	659
11	Livingstone	987	17 º49’	25 º49	5625	743
12	Magoye	1,018	16 º08’	27 º38’	2525	751

Note: *1 Lusaka City Airport

*2 Lusaka International Airport

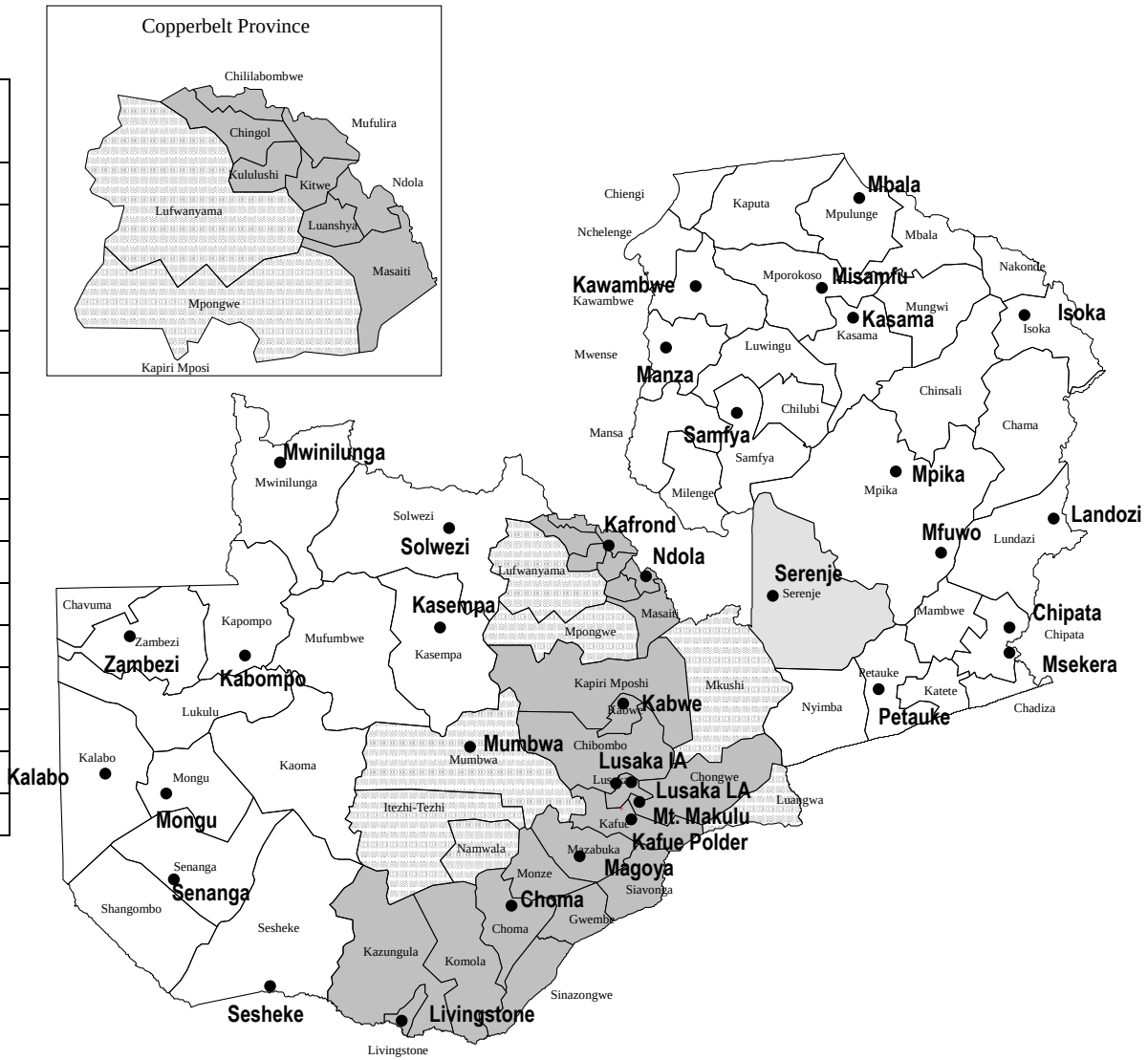


Fig. F1.1.1 Location of Meteorological Station and Voluntary Rainfall Stations

Kafironda

	Items	Unit	Observation
1	Rainfall	mm	1,243.8
2	Max. temperature	°C	---
3	Min. Temperature	°C	---
4	Humidity	%	---
5	Wind speed	m/ssec	---
6	Sunshine	hr/day	---

Kabwe

	Items	Unit	Observation
1	Rainfall	mm	879.3
2	Max. temperature	°C	---
3	Min. Temperature	°C	9.2
4	Humidity	%	63.3
5	Wind speed	m/ssec	3.3
6	Sunshine	hr/day	8.5

Mumbwe

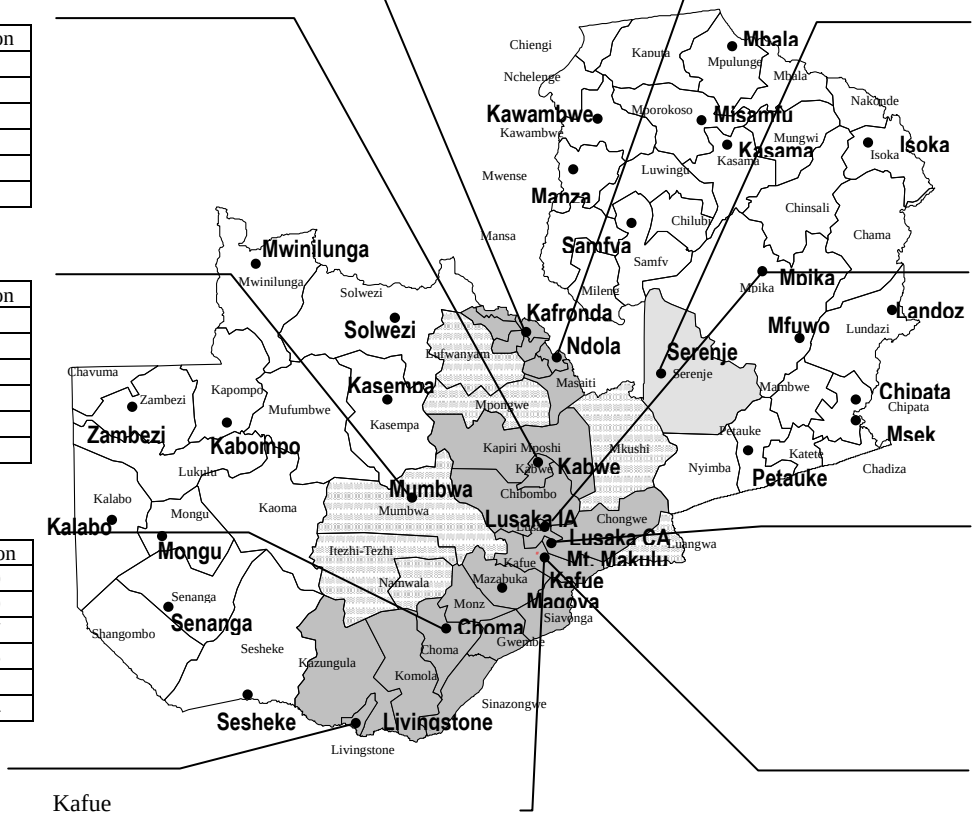
	Items	Unit	Observation
1	Rainfall	mm	796.0
2	Max. temperature	°C	---
3	Min. Temperature	°C	7.8
4	Humidity	%	---
5	Wind speed	m/ssec	---
6	Sunshine	hr/day	---

Choma

	Items	Unit	Observation
1	Rainfall	mm	769.0
2	Max. temperature	°C	30.9
3	Min. Temperature	°C	5.7
4	Humidity	%	60.8
5	Wind speed	m/ssec	3.1
6	Sunshine	hr/day	8.4

Livingstone

	Items	Unit	Observation
1	Rainfall	mm	634.3
2	Max. temperature	°C	34.6
3	Min. Temperature	°C	7.3
4	Humidity	%	54.4
5	Wind speed	m/ssec	3.6
6	Sunshine	hr/day	8.8



Ndola

	Items	Unit	Observation
1	Rainfall	mm	1,157.3
2	Max. temperature	°C	32.0
3	Min. Temperature	°C	8.4
4	Humidity	%	---
5	Wind speed	m/ssec	---
6	Sunshine	hr/day	---

Serenje

	Items	Unit	Observation
1	Rainfall	mm	1,032.9
2	Max. temperature	°C	30.7
3	Min. Temperature	°C	8.9
4	Humidity	%	---
5	Wind speed	m/ssec	3.3
6	Sunshine	hr/day	---

Lusaka IA

	Items	Unit	Observation
1	Rainfall	mm	813.5
2	Max. temperature	°C	32.1
3	Min. Temperature	°C	7.9
4	Humidity	%	---
5	Wind speed	m/ssec	---
6	Sunshine	hr/day	---

Lusaka CA

	Items	Unit	Observation
1	Rainfall	mm	813.5
2	Max. temperature	°C	30.7
3	Min. Temperature	°C	10.1
4	Humidity	%	62.9
5	Wind speed	m/ssec	5.0
6	Sunshine	hr/day	8.4

Mt. Makulu

	Items	Unit	Observation
1	Rainfall	mm	945.2
2	Max. temperature	°C	---
3	Min. Temperature	°C	---
4	Humidity	%	---
5	Wind speed	m/ssec	3.4
6	Sunshine	hr/day	---

Kafue

	Items	Unit	Observation
1	Rainfall	mm	740.5
2	Max. temperature	°C	33.2
3	Min. Temperature	°C	7.7
4	Humidity	%	60.7
5	Wind speed	m/ssec	3.7
6	Sunshine	hr/day	8.6

Fig. F1.1.2 Meteorological Observation Data (Updated in 2010)

Chapter 2 Irrigation Status

2.1 Background of Irrigated Agriculture in Zambia

Irrigation development in Zambia started in the early 1960s, both by the Government and the private sector. The GRZ schemes was classified into three: 1)large scale commercial scheme funded by commercial banks, 2)Medium scale commercial schemes funded by the GRZ and para-statals, and 3) Small holder non-commercial schemes funded by the GRZ, donors and farmers themselves.

The largest GRZ project covering an area of 10,000 ha is Nakambala Sugar Estate in the Southern Province. It was founded in 1986 and it has been owned by the Zambia Sugar Corporation. This was followed by five other large-scale schemes ranging between 1,300 and 2,100 ha in the 1970s and 1980s.

During the period of 1997-99, the RIF has been able to manage, finance and implement over 114 rural infrastructure sub-projects including irrigation, earth dams rehabilitation and construction works costing over US$ 1.8 million. The RIF funded project was established based on participatory project formulation, such as small scale irrigation project in the current days. However the US$ 30,000 procurement limit was set by IDA for the projects. This has proved an inadequate ~~for~~ construction of dams as most of the dam projects undertaken were too expensive.

IFAD financed the Small-scale Irrigation and Water User Program (SIWUP) was started in 1996 for five years implementation period. The project designed 19 earth dams in 1998 and constructed/rehabilitated only seven dams by the end of 1999. The delay in the program was partly due to the restruction of MAFF, delay in procurement process through the Procurement and Supply Unit and its limited technical capacity. In 1999, SIWUP adopted the RIF procurement procedures to improve the project implementation rate. As lesson learnt, the SIP project was designed to use the RIF existing facilities to carry out activities under the irrigation component in a participatory and decentralised manner to ensure long-run sustainability and to minimise possible implementation delays.

The Japanese International Cooperation Agency (JICA) financed the Kanakantapa Settlement Development Project started in 1993. In coordination with the donors, the SIP project will provide farmers in the Kanakantapa Settlement with an earth dam, two irrigation stations and main canals to irrigate about 620 ha.

Gwembe-Tonga Development Project (GTDP) was also implemented by ZESCO as a component of the joint World Bank and Development Bank of South Africa's power rehabilitation project. The project includes agricultural development, recession agriculture and land conservation. The community infrastructure development including electricity supply, health, water supply and schools are also covered. The SIP project benefited from the community development and roads improvement in Sinazongwe where the SIP project developed four sites.

In addition to the above irrigation development projects, projects aiming at enforcement and improvement of the market system which formed a part of the value chain of the produces have been

largely implemented by several donors' assistances. The Agriculture Commercialization Program (ACP) was designed as the main vehicle for implementing the agriculture component of the PRSP, which aimed to reduce 50% of the poverty by 2004. ACP aimed at promoting a competitive private sector in agriculture with a formulation to enforce the agricultural market, to establish agribusiness and etc. ACP is a successor program to the Agriculture Sector Investment Programme (ASIP)

Since the 1990s, Zambia has been implementing an economic adjustment program with the IMF and the World Bank, which has an important component to reduce fiscal public expenditures, as well as to increase expenditures on social services to reverse the decline in health and education facilities. The Government has further committed to honor all debt servicing obligations to donors. For these reasons, a room left for the Government to provide the counterpart funding for a number of development projects was rather constrained. In this regard, a rural/community development project such a SIP, about 55% of the total cost, was to be locally financed due to a lack of the financial sources.

There are three key interventions in the National Irrigation Plan formulated in 2005, as follows:

1) Finance and Investment which encompass~~;~~ infrastructure development, i.e., communal water supply systems (public) and irrigation development fund.
2) Policy and Legal envrionment.
3) Institutional and Social support.

These should be implemented in totality and complementarily to stimulate an irrigation-based agricultural industry in Zambia. With respect to 1) Finance and Investment, the IDF would be a source of the capital for investment in irrigation-related projects and acquisition of technology by farmers, industry operators of peri- urban farmers, outgrower farmers, smallholder farmers and also large scale commercial farmers. Meanwhile in the recent years, a few irrigation projects incorporated the both commercial/emerging farmers and smallholders in the project. The project could provide sufficient irrigation water to the commercial/emerging farmers. A part of the water was sustainably supplied to the smallholders in order to minimize the farming loss caused by poor access to water and to maximize the agricultural productivity obtained from their small farm lands.

In 2) Policy and Legal environment, environmental negative impact of mitigation by reducing energy cost, duty and VAT on the basic irrigation equipments to a manageable level in order to facilitate an enable the environment for the irrigation development. Thus the Government tried to improve the incentive on farming.

These development policies aim at to improve farming produces in the regional and international markets level by means of improving the quality of the irrigated products.

The National Irrigation Policy and Strategy, which was adapted to the National Irrigation Plan, provides the agricultural development policy corresponding to their agri-business scales. The farmers are classified into commercial, emerging and traditional farmers. The NIPS emphasis to increase the farm income by means of higher production through an improvement of farm technology and market oriented agriculture.

In the progress of the NIP, the MACO continued the SIP and has launched IDSP (Irrigation Development Support Project) by a financial assistance of the WB and AfDB. The project implementation plans have been formulated with the Public Private Partnership (PPP) concept. In this regard, private sector, such as commercial farmers, and private consultant firms undertake a part or the entire project management comprising farming practice and marketing as well as water source and irrigation system control to successfully continue the project. The smallholders also joined the project in line with the policies of the NIP and the private sector and this provides technical and financial supports and ensures the benefits for themselves. The PPP is advantageous for the smallholders to ensure an annual stable farm income, while they have an obligation to pay an irrigation fee or consultant fee to the respective private sector.

At present, the IDSP projects by the financial assistance of the WB have been scheduled to be implemented under the concept of project management as well as capacity building of farmers' organizations. In the Mwomboshi area, the smallholders are classified into three groups (Tier1,2 and 3) in order to introduce an appropriate irrigation method and a management skill which corresponds to their respective management level. The first small scale farmers group (Tier-1) mainly cultivates vegetables and staple crops, hence the group bears the minimum operation and maintenance cost. The group (Tier-2) is composed of emerging farmers with not only staple crops but also cash crops to be sold in the market. The emerging farmers are capable to produce high value crops, and sprinkler irrigation system is introduced in the project. The third group (Tier-3) directs forming of large scale farmers group with the smallholders. The farm management mainly for cash crops is entrusted by private consultants, and high value crops are cultivated under the control of so-called agricultural production enterprise (Farm company: FarmCO). The center pivot sprinkler system is applied to the farming. The FarmCO also undertakes instruction of farming, purchase of agricultural input, harvesting and marketing.

In addition to the constitutive three farmers groups with an aim to activate the smallholders, the project includes a large scale farming composed of the eight commercial farmers. The irrigable area under the large scale farming is estimated at about 3,000 ha located at immediately downstream of the dam with its enlarged storage capacity. The storage water is sold to the commercial farmers, and the benefit is used for operation and maintenance of the irrigation systems of the smallholders groups (3 groups) above. This system can lighten the operation and maintenance burdens of the smallholders. The irrigation system is operated by a private company (UtilityCo) and it is entitled to undertake system operation and maintenance, water management, irrigation fee collection and sharing benefit. The UtilityCo is also responsible for maximizing the project benefit for the beneficiaries including smallholders with a proper system operation in corporation with the FarmCO. The PPP contributes to improve the farming skill of the first group, and helps it to emerge into the second group. Similarly, the second group can emerge into the third group after acquiring more advanced farming skills.

The MACO supervises performances of the private companies and conducts an asset management of projected facilities as a leading government body. The introduction of the PPP realizes accountability of the project and reduction of personnel of the government.

The following are transition scheme of the agriculture and irrigation policies of the country.

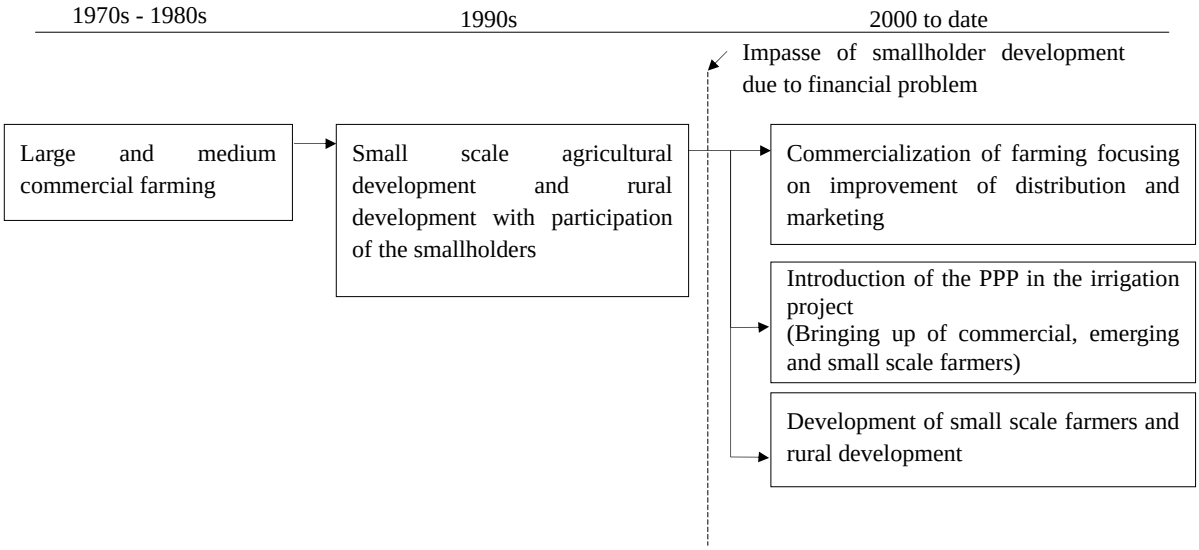
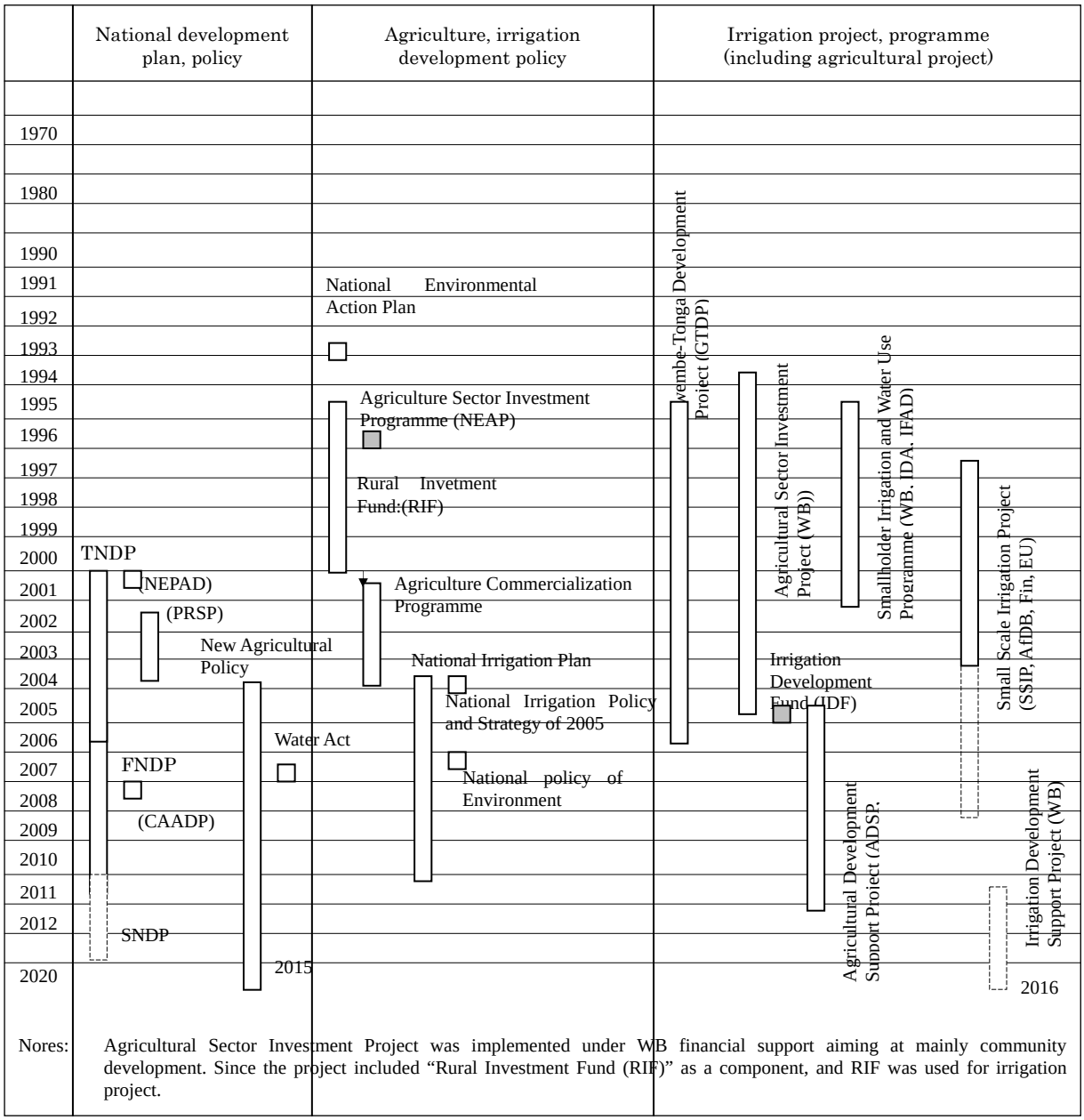


Fig. 2.1.1 Transition of Agriculture and Irrigation Policy of the Country



Nores: Agricultural Sector Investment Project was implemented under WB financial support aiming at mainly community development. Since the project included "Rural Investment Fund (RIF)" as a component, and RIF was used for irrigation project.

CAADP: Comprehensive Africa Agriculture Development Programme
NEPAD: New Partnership for Africa's Development

Fig. 2.1.2 Historical Chart of Agricultural, Irrigation Policy and Project implementation

2.2 Small Scale Irrigation Development

1) In the irrigation project formulation, Private Public Partnership (PPP) has been introduced for assisting farming and market management of the both commercial and traditional farmers, and the WB and AfDB have been financially providing their funds in line with this project formulation. The PPP approach is essential to ensure project implementation from not only the financial point, but also from the managerial point of view. Meanwhile these projects are implemented in specified project areas, so that most of the smallholders are left from an irrigation development by the Government. The PPP approach is recommendable to sustain absolute benefit of the project by technical and financial management expanded to especially large scale irrigation project by the private sectors such as private consultants. On the other hand, beneficiaries will be limited in at most ten farm blocks in the country for the time being. Therefore for the most of smallholders in the country will be left behind from large scale irrigation project under the PPP policy.

2) Surface, groundwater, dambo water are the main water source for irrigation used by the smallholders. It is recommended to implement gravity irrigation project with their water source of primitive intake weirs and small scale ponds, which were constructed in the last two decades in the Southern Province. Irrigation water is drawn up using buckets, treadle pumps and movable small engine pumps during a shortage of surface water in the dry season. The pump irrigation projects were also implemented in several provinces from the Copperbelt to the Southern Provinces. However, most of the projects have not been well operated because of their management problems except a few schemes funded by the SIP.

3) Few irrigation system constructed in 1990s up to the beginning of 2000 has no intake conduits, thus less progress has been made on the irrigation development. In the present situation, rehabilitation project with surface water use is being proposed to be implemented in order to support the smallholders. Because of the system manageability that is an indispensable prerequisite for promoting sustainable irrigation development in the small scale scheme, these projects are also well-recommended from a view of dissemination effects towards surrounding areas.

4) Groundwater is well utilized for irrigation where it is quantitatively obtained from relatively shallow depth. Farmers cultivate staple crops in the upland during the wet season and by utilizing buckets and treadle pumps, and they continues to cultivate cash crops like vegetables and beans in the wet land along the rivers and dambo areas. In the intercropping system, especially in the dry season, cropping contributes to higher farm income and also yields purchase farm input cost of further maize cultivation in the wet season.

5) As stated above, an appropriate irrigation development plan by means of efficient surface and groundwater use including the dambo area development is proposed in the Master plan, aiming to improve livelihood of the smallholders with enhancing agriculture development level in the whole areas.

6) Followings are components of the proposed project:
   - Installation of intake devices on the existing dams to effectively use impounding water.
   - Construction of intake weirs in rivers and streams to expand gravity irrigation system.
   - Canal lining to improve irrigation efficiency.
   - Accelerating groundwater and land use for agriculture in and around dambo areas.
   - Enhancement of WUAs and cooperative activities through promotion of communal purchase and use of treadle and movable engine pumps.
   - Asset management of the existing water source and irrigation facilities to prolong their life span. This includes; dredging of accumulated materials in the reservoir, construction of silt trap dams, soil erosion control by afforestation, sodding, leveling of agricultural lands, installation small pit to catch tabulated drain water from farm lands and etc…

7) A shortage of labor force is recognized as the major constraint when expanding arable land in addition to an insufficient irrigation water source. Drawing irrigation water and plowing work for collective farming during cash crop cultivation in the dry season need a large amount of labor. Since labor need for harvesting wet season crops continues up to May every year, farmers lose an appropriate timing for selling vegetables with the peak market price in June and July.

8) Agricultural model is achieved with an expectation to disseminate the model to the surrounding similar farming areas enforcing an improvement on farm practices and marketability as a pivotal role. Enlargement of the market opportunity and improvement of the farm practices would highly increases the farm income, and investment for irrigation by farmers themselves would contribute to the regional economical development.

9) Traditional land ownership system is also one of many constraints for expanding arable lands. Collective farming system has not been developed because the farmers' houses are scattered under the rainfed farming system. Land allocation system such as an estate project by the MACO shall be encouraged through repeated approaches to the land owners. Building up of collective farm lands forms a habitant area in the vicinity of the farm lands and also solves labor scarcity. Restructuration of the land tenancy system would provide farm lands to the young generation who has no farm land and land cultivation title under the hereditary system at present. Therefore it would eventually solve the shortage of labor force and increase employment opportunity in the rural area. Dambo area has not been effectively used for agriculture because of the traditional land ownership, even through sufficient surface and groundwater were available for agriculture. The Government shall aggressively interfere in the land tenancy system in order to accelerate the use of farm land.

10) The Governmental financial support is inevitable to expand the agricultural model, especially for an initial investment for farming. Enhancement of farmers' group activities would also smoothly enable the project implementation.

11) Taking the agricultural model proposed in the Master plan into account, several models are proposed according to the characteristics of each zone:

- Zone 1 (Copperbelt Province)
  Irrigation system using surface water from the several tributaries in the most upstream of the Kafue river and also using groundwater from the widely developed riverbed.
- Zone 2 (Central Province)
  Irrigation system using small rivers, ponds and groundwater (dambos) in order to enhance the water use efficiency.
- Zone 3 (Lusaka Province)
  Irrigation system effectively utilizes small-scale ponds and installation of irrigation canals.
- Zone 4, 5 (Southern Province)
  Irrigation system using the existing small-scale ponds to accelerate water use of impounding water throughout the year

12) According to the site investigation in the Study, it was clarified that most of the pump irrigation systems have not been used due to poor management, i.e., lack of operation and maintenance skills and costs for the pumps. A constant employment of project supervisor(s) is indispensable in order to regularly inspect condition of the pump operation and properly collect irrigation (electric) fee including employment cost for the supervisor(s) from the beneficiaries; referring to the lessons learnt from the Buleya Malima project under the SIP. Since pump operation and facility maintenance were handed over to the beneficiaries for most of the pump systems, lack of technical skills on system maintenance as well as managerial weakness for water distribution of the beneficiary have caused the irrevocable system failure.

13) A design of practicable irrigation system shall be proposed in order to attain a stable but increased production of products and dissemination of the system under the labor collective farming style. The upland is utilized for staple crop cultivation during the wet season under the land intensive agriculture system (production depends on farm land area), meanwhile irrigated agriculture during the dry season shall be achieved within the limited irrigated area to maximize irrigation efficiency. Thus the farming shall focus on the labor intensive agriculture system. In order to improve agricultural productivity in the irrigated agriculture, the following concepts on irrigation design shall be considered:

- Farm land shall be intensified to minimize the initial construction cost and also to improve the irrigation efficiency.
- Rotation irrigation rule shall be adhered to improve the irrigation efficiency such as by minimizing water conveyance loss and etc…
- Irrigation water volume is controlled corresponding to the crop growth stage, thus water source shall be preserved during the dry season.

- Disused water such as impounding water in the existing reservoir shall be effectively used for irrigation by means of installation of intake facilities.
- Guideline on irrigation system operation including the irrigation fee collection rules shall be established through enhancement of WUAs and agricultural cooperatives.

14) In addition to the irrigation development plan, road infrastructure shall also be rehabilitated. The road networks connecting village to market are relatively improved, however that of farm to market road are still under poor conditions, especially in the wet season. In this regard, road rehabilitation works around the production areas is necessary in order to transport agricultural inputs and outputs. A road net work shall be extended to secure access from villages to the dambo areas to accelerate the dambo use.

15) For new irrigation schemes at the downstream of the existing small scale dams, the proposed farm lands are designated along a relatively flat but narrow river bed. Land distribution rule shall be established between land owners (Chief or head men/women) and beneficiaries to attain collective agriculture. Dambo areas also have a high irrigation potential with sufficient groundwater source. The farmers can draw up groundwater using buckets and treadle pumps in the vicinity areas of their farm lands. Thus in the both cases, the Government shall take an intermediary role of land tenancy.

16) In addition to what already described, features of the basic planning, concepts of the irrigation rehabilitation plan and the dambo use plan shall be promptly investigated and studied for a proper rehabilitation and planning of a new construction, i.e., storage volume of the reservoir, river flow discharge and effective aquifer. The MACO is responsible for building investigation and research structures in the TSB as a core section, especially to investigate the existing irrigation scheme survey and water source profiling.

17) A financial plan which consists of construction works (Initial cost), operation and maintenance costs shall be drawn up according to the project implementation plan. The construction cost shall satisfy the economic condition. When the operation and maintenance costs are estimated, the costs on WUA training on farming and facility maintenance skills shall be included. In addition, the monitoring cost for a constant inspection of the system condition and the farmer's training cost for irrigation staffs of the MACO shall be estimated to achieve a smooth and sustainable project operation. (Supplementary irrigation staffs may be required in the District offices of the MACO.)

It is a great necessity to rehabilitate the dam and the related structures, especially the spillway canal. During the past three decades after completion of the construction works, the dams and the spillway canal have acquired damages, e.g., water leakage from the dam embankment and foundation, slope failure and severe erosion of the spillway canal bed. The rehabilitation plan shall be established with an asset management concept. The required cost shall be shouldered by

the governmental bodies including the local governments. This is because these dams have cross sectoral benefits such as domestic, livestock water supply, mitigation of flood discharge, environmental issue on wild flora and fauna protection.

18) A WUA shall be established to operate and maintain irrigation facilities as well as to decide on a water distribution plan. The WUAs have been already established in some of the irrigation schemes however, the agricultural cooperatives and water committees are taking the roles in most of the schemes. It has been proposed to lay down an official registration system to provide support fund for the WUAs. The system may give a strong incentive to manage WUAs by farmers themselves and also provide a communication channel between farmers groups and the Government.

19) The Fifth National Development Plan (FNDP) for 2006-2011 has been incorporated in the National Irrigation Plan (produced as part of the National Irrigation Policy and Strategy of 2005) and proposes to newly irrigate 70,000 ha by the year 2010. Of this 70,000 ha, 10,000 ha will be for a large scale commercial, 30,000 ha for emerging farmer irrigation and the rest of 30,000 ha for small scale developments. The prospects for achieving the outstanding area under the FNDP are not encouraged due to its high cost for borrowing money (the period only up to three years). Also, the problems in finding collaterals proving the major constraints for smaller scale farmers, the collapse of the Government's Irrigation Development Fund (set up to support the National Irrigation Plan in 2007, but now has moved to the Citizens Economic Empowerment Commission (CEEC)) without lending any money and the current power generation issues are all combined to act as a brake on irrigation development where water, land and other factors (such as market proximity, access) are not yet limited for further development.

20) Considering the current situation of the financial arrangement as explained above, the following irrigation development concepts are proposed to draw up the Master and Action plans:

Table 2.2.1 Irrigation Development Concepts

	Master plan	Action plan
1.	**(Concept)** The project aims to improve the farm income. Improvements of farming practices, accessibility to the market and irrigation development are the key factors to realize the main purpose of this project. Among these factors, which form a value chain component, irrigation development is the fundamental issue since its excessively high cost for operation and maintenance may cause a failure of the project. In this regard, the following project components are selected: • Gravity irrigation shall be proposed to minimize financial burden of operation cost, thus the beneficiaries can manage the system without support of the Government. The existing dam shall be effectively utilized for irrigation development.	As explained in the Master plan concept, irrigation development component is the key factor, but its effect will be realized only when improvement of farming skills and market development are achieved. Model schemes are selected to expect dissemination effect to the surrounding similar schemes primary focusing on the improvement of farm practice and market development. The irrigation investment should be an input to the most effective irrigation component regarding the economical appropriateness. Training program for the irrigation staffs of the MACO is scheduled during the implementation period of the Action plan (Initial stage of the Master plan). The project applies "Trainers Training" concept to the

	Master plan	Action plan
	• The project emphasis on enhancement of farmers' groups (WUAs) activities. Farmers shall have their initiatives to operate the systems. • Communal use of the treadle pumps and movable engine pumps are widely introduced where sufficient groundwater is available such as dambo areas to lighten labor requirement as well as to expand of the irrigable area.	program. Farmers training program is simultaneously conducted during the implementation period of the Action plan. The irrigation staff of the MACO is responsible for training of the farmers.
2.	**(Characteristics of the plan)** Components of the project should be economically vital and obvious effects shall be promptly apparent. • Use of impounding water in the existing reservoir promises significant increase in farm productivity, thus farm income would sharply soared up. • Irrigation system shall all be at the same level so that farmers can construct and maintain it by themselves. • Project components shall be selected by a participatory approach of the beneficial farmers.	Project component shall be selected as a model project to expect dissemination effect to the surrounding schemes. It is remarkable to consider that the rehabilitation components are economically vital to be dispersed to the other farmers' groups.
3.	**(Significance to the Government and beneficiaries)** • The project has a high model consistency. • Extension of the model project accelerates the land tenancy system and increases arable area. • Communal use of treadle and movable engine pumps deduct the initial procurement cost of individual farmers. By taking this opportunity, the farm income would increase but the value chain routine would stay as normally functioned. • Women are freed from laborious work. • The Government support motivates small scale farmers to spur their self-reliant efforts.	The Government technically and financially supports rehabilitation and new construction works for irrigation as well as farming and marketing. The irrigation component(s) should directly contribute to improve farm income and also to reduce labor requirement that would induce expansion of farm land and farm productivity.
4.	**(Implementation)** • Implementation organization: Construction works and training of farmers' groups (WUAs) by the MACO and the local government • Dissemination: The Government (MACO) financially supports rehabilitation work of the existing schemes. Farmers' leaders are responsible for technical transfer to the surrounding schemes. • Technical support: The Government (MACO) is responsible for design and planning of dams and irrigation systems. • Financial plan: The Government (MACO) and the local government financially support the rehabilitation/ construction cost.	• Implementation organizations are the same as that of the M/P. • Outputs verified in the Action plan shall be disseminated to the surrounding areas by farmers and the Government. • Technical supports are provided by the foreign/ local consultants and irrigation engineers of the MACO. • The Action plan includes rehabilitation works of the irrigation schemes, research and training costs for farming technology and marketing. The MACO is responsible for financial arrangement of domestic budget and donors' supports.

2.3 Institutional Set-up

2.3.1 Organizational Set-up of MACO

After the organizational set up in 1996, the MACO was re-organized into four (4) departments, (i) Field Services Department (FSD); (ii) Research and Specialist Services Department; (iii) Economics and Marketing Development Department; and (iv) Human Resources and Administration Department. The FSD was composed of Technical Services Branch (TSB), Agricultural Extension Branch (AEB) and Fisheries Extension Branch (FEB), and the TSB was in charge of the irrigation sector. Through an implementation of the ASIP, the TSB undertook supervisory works of the Provincial Core Teams (PCTs) and District Field Teams (DFTs). These offices were under the control of the Senior Field Services Co-ordinators in the Provincial Agricultural office of the MACO.

At present, the TSB is in charge of irrigation sector in the MACO. The TSB is responsible for planning and implementation of the irrigation projects. The TSB has three (3) sections: ~~of~~ 1) Irrigation Engineering Section, 2) Land Husbandry Section and 3) Farm Product and Machinery Section. The irrigation Engineering Section is further divided into three: 1) Principal Irrigation Engineer, 2) Hydraulic Structure and 3) Catchment Hydrology. Table 2.3.1 indicates required and present number of the irrigation engineers/ technical officers. At present 66 staffs are engaged in the sections, but the number of the staffs are still in short about 73 % compared to the necessary staff number of 91 staffs. Irrigation staffs consist of the Chief Irrigation Engineer, Senior Irrigation Engineers, Irrigation Engineers, Technical Officers and Junior Technical Officers.

Table 2.3.1 Irrigation Staff in MACO

	Position	Location	Required number	Present number
1	Chief Irrigation Engineer	Headquarters	1	1
2	Principal Agronomist	Headquarters	1	0
3	Principal Engineer (Catchment Hydrology)	Headquarters	1	0
4	Principal Engineer (Hydraulics & Civil Structures)	Headquarters	1	0
5	Chief Technical Officer	Headquarters	1	0
	(Sub-Total)		5	4
6	Senior Irrigation Engineer	Lusaka Province	1	1
7	Senior Irrigation Engineer	Choma Province	1	1
8	Senior Irrigation Engineer	Mongu Province	1	1
9	Senior Irrigation Engineer	(Other Provinces)	5	0
10	Senior Agricultural Research Officer	NIRS	1	0
	(Sub-Total)		9	3
11	Irrigation Engineer	Province: Chipata, Central, Copperbelt, Kabwe, Kasama, Lusaka, Mansa, Solwezi District: Choma (2), Chongwe, Kafue, Lusaka, Mongu, Monze, Sinazongwe	13	15
12	Principal Technical Officer	Kalomo, Mazabuka District	4	2
13	Senior Technical Officers	Chipata, Kabwe, Kafue, Luanshya, Lundazi, Sesheke, Sinazongwe,	9	7
14	Technical Officer	Central (3), Chingola, Chongwe, Copperbelt (5), North Western (3), Northern (2), Petauke, Western, Copperbelt Lufwanyama)	18	17

	Position	Location	Required number	Present number
15	Junior Technical Officer	Lusaka (3), Central, Kalomo (2), Luapula, Mpika, Northern (2), Southern (2), Central, Copperbelt (4)	36	17
	Total		91	66
				73%

Small scale irrigation schemes are operated by the technical staff in the Provincial and District Irrigation Offices. The below shows the arrangement of irrigation staffs. Two thirds of the whole staffs are engaged in the four Provinces and District Offices in the Study area. Thus, in order to assign the sufficient number of irrigation staffs to the other provincial and district offices, its number needs to be increased.

Table 2.3.2 Irrigation Engineers in Four Provinces

	Province	Senior irrigation engineers Senior Irrigation Engineer		Irrigation engineers Irrigation Engineer		Senior technical officers Senior Technical Officer		Technical officers Technical Officer		Junior technical officers Junior Technical Officer	
		Province	District	Province	District	Province	District	Province	District	Province	District
1	Copperbelt			1			1	3	4	4	
2	Central			1	1		1	3		2	
3	Lusaka	1		1	3		1		1		3
4	Southern				4		3			2	1
	Total	1	0	3	8	0	6	6	5	8	4
		1		11		6		11		12	
									Total	41	
	MACO	3		15		9		17		17	

Source: MACO

Note: Senior technical officers are composed of Principal Technical Officers and Senior Technical Officers.

The numbers of irrigation staffs are insufficient in both provincial and district offices for undertaking integrated works of investigation, project planning, design, implementation, monitoring and evaluation, construction supervision of the existing irrigation systems and etc... In addition, it has been proposed to establish a cross sectional cooperation with related sections in the MACO to conduct project planning and implementation in terms of marketing, agri-business and also dissemination of framing practice with irrigation sector.

2.3.2 Other Organizations

Researches and investigations in the irrigation sector are conducted by the Zambian Agriculture Research Institute (ZARI) through the National Irrigation Research Station (NIRS) located at Mazabuka District. Presently due to the insufficient number of staffs and aging of the facilities, the NIRS is not well functioning for technical, environmental and socio-economical researches and an investigation on irrigated agriculture.

As an educational institutes, the University of Zambia, School of Agriculture Sciences, the Natural Resources Development College (NRDC), Zambia College of Agriculture in Monze District and the

Zambia Center for Horticulture Training (Chapla) were established for training on water resources and irrigation.

2.3.3 Farmers' Organizations

The ZNFU and the ACF are composed of several farmers' organizations, farmers' cooperatives, government agencies and private enterprises. The irrigation schemes are operated and maintained mainly by the WUAs and the agricultural cooperatives. The WUAs, the agricultural cooperatives and the water committees decide on irrigation operations such as intermittent irrigation schedule, water requirement, intake period, irrigation fee and maintenance program of the existing irrigation systems. In addition, these organizations have a duty to request the MACO for rehabilitation works on dams, reservoirs and spillways, dredging of siltation in the reservoir and protection of spillway which are all beyond the technical and financial abilities of the organizations. However, it should be noted that these rehabilitation works have been carried out by the farmers' organizations. Therefore serious damages were made on the facilities and are still left behind as unrepaired.

Chapter 3 Inventory Survey

3.1 Inventory survey

Inventory survey of the existing and potential irrigation schemes were conducted during the Study period. The sites were selected through discussions with the TSB staffs as well as the irrigation staffs in the Provincial and District offices of the MACO. Inventory of the existing and potential schemes are shown in the end of the Sub-chapter.

Table 3.3.1 displays the existing irrigation schemes by gravity including those located in the dambo areas.

Table 3.1.1 Existing Irrigation Schemes

No	Schemes	Province	District	Irrigation Area (ha)	Water Source	Remarks	Zone
1	Kafubu	Copperbelt	Ndola	10	Stream	Treadle pump	Zone 1
2	Katuba	Central	Chibombo	5	Dam	Gravity with canal	Zone 2
3	Mulila Kazembe	Central	Kapiri Mposhi	8	Dam	Gravity with canal	Zone 2
4	Chunga	Lusaka	Lusaka	8	Stream	Weir, canals	Zone 3
5	Funzwe	Lusaka	Kafue	8	Stream	Gravity	Zone 3
6	Shantumbo	Lusaka	Chongwe	15	Dam	Gravity with canal	Zone 3
7	Chipapa	Lusaka	Kafue	7	Dam	Gravity with canal	Zone 3
8	Kanundwa	Southren	Monze	18	Dam	Gravity with canal	Zone 4
9	Siafwa-kweda	Southern	Choma	8	Dam	Gravity	Zone 4
10	Ndondi	Southern	Choma	11	Dam	Gravity	Zone 4
11	Nkandabwe	Southern	Sinazongwe	10	Dam	Gravity with canal	Zone 4
12	Nabuyani	Southern	Kalomo	20	Dam	Gravity	Zone 5
13	Mulabalaba	Southern	Kazungula	6	Dam	Gravity with canal	Zone 5

Table 3.3.2 shows the potential irrigation schemes selected through discussions and also the field investigations from more than 100 sites in due consideration of their economical viability and organizational set up to sustain the scheme by the beneficial farmers.

Table 3.1.2 Potential Irrigation Schemes

	Potential schemes	Province	District	Irrigation Area (ha)	Water source	Zone
1	Kakoso	Copperbelt	Chililaombwe	26	Spring	Zone 1
2	Bwafwano	Copperbelt	Kalulushi	60	Stream	Zone 1
3	Kasamba	Central	Kapiri Mposhi	12	Dam, stream	Zone 2
4	Juda	Central	Kapiri Mposhi	8	Dam, stream	Zone 2
5	Natuseko	Central	Kabwe	20	Stream, dambo	Zone 2
6	Waya Camp	Central	Kabwe	5	Stream, dambo	Zone 2
7	Lifwambula	Central	Chibombo	22	Dam, stream	Zone 2
8	Munga	Central	Chibombo	23	Dam, stream	Zone 3
9	Chikupi	Lusaka	Kafue	95 (Potential)	Dambo	Zone 3
10	Nakempa	Southern	Choma	16	Dam, stream	Zone 4
11	Siakasipa	Southern	Kazungula	8	Dam	Zone 5
12	Mandia	Southern	Kazungula	---	Stream	Zone 5

Note: 9; Ground use is proposed in the Chikupi area. 95ha is the area along the Kafue river.
12; Mandia is under study by the MACO.

Details of the inventory survey are attached in Chapter 3 of this Annex.

Chapter 4 Water Use

4.1 Surface Water Use

(1) River Water Use

Zambezi and Kafue rivers are the major rivers in the Study area. Water from the both rivers is pumped up by motorized pumps for irrigation. The study results of the river diversion system are displayed in Table 4.1.1. Most of the systems are not well facilitated except two systems which have intake weirs amongst the river diversion systems. Since the irrigation canals are composed of earth lining, concrete/mortar lining would improve irrigation efficiency by minimizing seepage loss through a canal surface.

With respect to the water management, rotation irrigation method is carried out under the control of the Water Board. Furrow irrigation is also applied to raise irrigation efficiency in the on-farm level. The Bwafwano irrigation scheme introduces 24 hour irrigation to maximize water use. The beneficiaries have to visit their farm lands even in mid-night to divert irrigation water to their farm lands. Severe water control system has been established because of the seasonal change and shortage of the irrigation water. Surface water decreases during the mid-end of the dry season, and 25 % of beneficial area is not irrigated in this period in the Bwafwano irrigation scheme.

Farm lands located at the Copperbelt Province and the most upstream area of the Kafue river has a

high potential of surface water irrigation with blessed sufficient annual rainfall in the Study area. Irrigation project with surface water can be implemented with retirees of copper mining companies, land tenancy and lease system in the area.

Table 4.1.1 Operation and Water Management of Surface Water Irrigation Schemes

	Irrigation Scheme	Operation and Water Management
1.	Bwafwano	(Operation) The water source is surface water and outlet water from the siltation pond of the copper mining company (Mindro pond). Most of the farm lands are irrigated by gravity. The irrigation canal is not lined with concrete/ mortar. (Water management) Instead of the water users association, the RDC (Resident Development Committee) regulates the irrigation water distribution system. Rotation irrigation is applied with its water distribution interval of 7 days. The water distribution continues to work in day and night (12 hours shift). Relatively steep slope of the secondary canal enables to minimize the time needs to distribute water reaching the end of farm lands. Water shortage occurs after June or July, and 25% of the farm lands located at the most downstream portion has not been supplied with the irrigation water every year. Water shortage has been observed in September to October in the upstream and midstream farm lands every year due to dry up of surface water as well as outlet water from the siltation pond. The groundwater is pumped up or drawn by buckets for irrigation during the water shortage.
2.	Kakoso	(Operation) Spring water is utilized for irrigation in the Kakoso scheme. Ground water springs out of from relatively elevated portions of the gentle slope valley. Earth canals run like a grid around the rectangular farm plots. (Water management) WUA has not been established in the Kakoso scheme. Spring water yielded on the slopes flow down through the steep canals towards the stream. Since the irrigation canals have been aligned along the steep terrains, innumerable small pits were dug made along the canals to draw irrigation water into the farm plots. Spring water is in perennial condition, so rigorous water management is not necessary in the scheme.
3.	Kafubu	(Operation) Irrigation water is obtained from the surface flow in the beginning of the dry season and groundwater in the middle to late of the dry season. The farmers draw water by buckets and treadle pumps. (Water management) WUA has not been established. The agricultural cooperatives (Kamusanba Cooperatives) were established with its participants of 105 households. Each farmers has a polyethylene water tank (1 m^3) to store water for irrigation by a small diameter pipe.
4.	Chunga	(Operation) River flow is raised by a relatively high masonry intake weir. Upstream of the weir has been deposited with sediments up to the top of the weir. The beneficiaries always have to excavate a small channel to introduce river water into the irrigation canal. The deposits should be removed, and the weir body should be reconstructed with a sediment sluiceway to eliminate sediment accumulation at the upstream of the intake. (Water management) The beneficiaries are 25 households. Rotation irrigation is applied, however the river flow is contaminated due to a flow of untreated sewage water from sewage ponds located about 5 km upstream of the weir site.
5.	Waya	(Operation) Irrigation water is pumped up by a movable engine pump and by a bucket from the river. (Water management) The irrigation water is obtained mainly utilizing a bucket.

(2) Impounding Water Use

Table 4.1.2 indicates present condition of the irrigation systems with dam structure. Since water is distributed by gravity, most of the systems are well operated. The irrigation canals have been constructed with concrete materials since 2000s. However, the canals are still insufficient in length due to the budget ceiling. Thus only the limited irrigation area is covered by the construction works even within the system. Siphon system is applicable for an intake facility of the dam, however small intake capacity through the siphon restricts the irrigable area at the downstream.

It is noted that most of the dams have a sufficient storage volume to extend irrigable area even during the dry season. To fully extend the irrigable area at the downstream using the storage water, a firm water distribution plan shall be applied corresponding to the water requirement of proposed cropping pattern.

Most of the dams have structural problems, i.e., water leakage through the dam embankment and intake conduits, severe erosion of the spillway canal bed as well as insufficient intake capacity. Also the embankment slopes have not been maintained such as by weeding. These problems were not solved by the beneficiaries who are responsible for the dam maintenance works. It is therefore necessary for the MACO to periodically instruct the beneficiaries on the proper maintenance works.

Table 4.1.2 Operation and Water Management of Small Dam Irrigation Schemes

	Irrigation Scheme	Operation and Water Management
1.	Mulabalaba dam	(Operation) The dam and canal facilities have been handed over to the beneficiaries, thus they now have a full responsibility on operation and maintenance of the facilities. Severe damage was not observed since the canal has been constructed except spillway of dam. (Water management) WUA was not established in the scheme. Besides from a WUA, the Irrigation Board consults water management including irrigation fee collection that is ranges from ZMK12,000 to 12,500 per annum. Irrigation schedule is determined by the Board, meanwhile the beneficiaries have no intension to correct such a regulation even though a difference of the irrigation time is found between the beneficiaries. Siphon is available to intake the impounding water in the reservoir. The water users carry out valve operation on a shift.
2.	Katuba dam	(Operation) Siphon type intake was installed on the left side of the dam embankment. Two lines of siphon system are composed of 75mm diameter polyethylene pipes. One of the siphon pipes has not been used because of the clogged siphon pipe on the dam crest. Some division pits located along the irrigation canal were cracked and have been left behind without any repair works. (Water management) The Katuba WUA (Katuba group) was established in the scheme with the membership of 42 households. (60 households will soon be the additional member of the WUA in August 2010 with a plot (20m wide × 30m long) distribution. Rotation irrigation is applied to the farm land with 7 days interval. Since the irrigation canal is located in the middle of the sloped farm lands, lower part of the farm land are irrigated by gravity, but the upper farm lands are irrigated by manpower, i.e., by a bucket. Irrigation water volume depends on the water head between the storage water surface and an outlet of the siphon. (Roughly estimated at about 2.0 lit/sec through a siphon pipe out of two pipes.) Seasonal discharge control corresponding to the crop growth period has not been adapted because of the adequate storage water in the reservoir.

	Irrigation Scheme	Operation and Water Management
3.	Chipapa dam	(Operation) The dam and irrigation canals were handed over to the beneficiaries, thus they now have a full responsibility on operation and maintenance of the facilities. The main irrigation canal was constructed by a financial assistance of the DANIDA, along the left side of the farm lands with its length of 400 m. 7.5 ha (7ha in net) of the whole farm land was squared up and one plot was divided into a plot size of 10m × 12 m. Poorly maintained secondary canals have a low irrigation efficiency, such as leakage loss from the undulated canal surface. The beneficiaries are responsible for the canal maintenance works such as weeding and dredging of canal siltation during the dry season. (Water management) The WUA (Water Committee of Chipapa Irrigation Scheme) has been established with its member of 50 households. Rotation irrigation with irrigation interval of 7 days (Monday to Fridy) is applied for a proper water distribution. For the 7 ha irrigation scheme, in total of ZMK2,500,000 (ZMK3,000 per member, 10m × 12 m plot) is collected as an irrigation fee. The irrigation fee collected during the last 10 years is deposited in the bank, however it was not used on the maintenance works of the scheme.
4.	Mulila Kazembe dam	(Operation) Because of partially incomplete works on the canal mortar lining work and the division pits, the system has not been used even after three years from the completion of the irrigation canal. (Water management) Irrigable area is about 20 ha with gravity irrigation. The Kalumba WUA was established with 72 member households. Water board is composed of 8 members however, an irrigation guideline is not yet prepared. The MACO is aware of the necessity to regulate the water use plan.
5.	Nkandabwe dam	(Operation) The reservoir of the Nkandabwe dam was an open-pit coal mine. The intake weir is located at the exit of the open-pit reservoir to raise the water level of the reservoir, and to increase storage water. Discharge control valve was installed to control intake discharge. The irrigation canal was lined with concrete/mortar, however slight damages are found on the lining because of insufficient renewal of the lining. (Water management) The irrigation group is composed of 84 households and all of the households are the member of the agricultural cooperatives. Rotation irrigation is applied with water control by the intake gate.
6.	Shantumbo dam	(Operation) An intake of the storage water is controlled by the sluice gate installed at the most end of the intake conduit through dam foundation. Since the valve has been damaged, slight water leakage was observed. It is notable that a sub-gate should be immediately installed at the upstream side of the sluice gate to maintain and replace the gate. (Water management) The WUA (Evergreen Water Users Association) was established in 2009. Rotation irrigation is applied in the dry season. Since the irrigation canal was constructed in the limited farm lands, 10 ha is irrigable out of the total irrigation area of 35 ha in the scheme.
7.	Siafwa-kweda dam	(Operation) The storage water is not effectively utilized for irrigation because the dam has no intake devices. Severe erosion on the spillways at both sides of the dam embankment is observed. (Water management) The storage water is utilized for irrigation at the farm lands adjacent to the reservoir using a bucket.

Table 4.1.3 List of Small Scale dams in the Provinces of Kalomo and Kazungula

S/NO.	Dam name	Ward	Constitency	Dam conditions
1	Chaiwila 'A'	Simayakwe		Ended crest and deformed embankment slopes. Overgrown with big trees. Not working.
2	Chaiwila 'B'	Simayakwe		The embankment is overgrown with trees. Eroded slopes. Not working. Eroded spillway channel.
3	Mangwato	Simayakwe		Spillway is badly eroded with large gully erosion at the outfall. Big trees on the crest.
4	Siamusiya	Simayakwe		The downstream toe is eroded. Both slopes and crest are overgrown with trees. Not working.
5	Siakabanze	Simayakwe		Not working. The dam wall is overgrown with trees. Reported to be heavily silted.
6	Siakabizi	Simayakwe		The embankment is overgrown with trees. Reservoir is reported to be heavily silted.
7	Sikweya	Simayakwe		The spillway is gullied. Not working. The crest is eroded.
8	Baswene	Chidi		The Embankment is overgrown with trees. The downstream slope eroded and the spillway is in poor state.
9	Mukalanga	Chidi		The reservoir is silted and the dam wall is overgrown with trees.
10	Siampola	Chidi		The embankment is overgrown with trees. The Downstream slope is eroded.
11	Silundika	Chidi		The embankment is overgrown with trees. Slopes are eroding. Not working has treated the dam safely.
12	Sindono	Chidi		The Embankment is overgrown with trees. The spillway and the crest are both eroded.
13	Chilundika Polo 'A'	Chidi		The downstream slope is badly eroded. Trees have overgrown on the embankment. Not working.
14	Syulikwa	Chidi		The dam is breached. It was just rehabilitated by Africare under IFAD Food Security Programme in May, 1997.
15	Chilundika Polo 'B'	Chidi		The dam wall is breached. Not working. Recently, the dam was rehabilitated by Africare under IFAD Food Security Programme.
16	Luyaba	Chidi		Recently, the dam has been rehabilitated by Africare under IFAD Food Security Programme.
17	Musokotwane	Musokotwane	Katombora	Large gullies are found on the emergency spillway. A few trees growing on the embankment which is used as a foot path.
18	Nsongwe	Mukuni	Livingstone	Too much seepage thus the dam dries up every year at around October. Some gullies have been developed.
19	Siakasipa	Musokotwane	Katombora	The dam wall is still in a good condition.
20	Muzya	Zimba	Mapatizya	Recently, the dam was rehabilitated by Africare under IFAD Food Security Programme June, 1997.
21	Mukwalantila	Zimba	Mapatizya	The spillway is eroded. Trees are overgrown on the embankment. The dam dries up around October.
22	Makunka	Ngwezi	Katombora	The dam crest is deformed by cattle grazing. The slopes are badly eroded. Cracks on the concrete, spillway has been heavily silted.
23	Chundwe	Zimba	Mapatizya	Undefined slopes and crest. Narrow spillway. low embankment may cause damage of the dam.
24	Sianankanga	Zimba	Mapatizya	The dam wall is overgrown with large trees. The spillway channel is eroded. The upstream riprap is in a good condition. It is the source for Zambia Township water supply.
25	Nandukula	Zimba	Mapatizya	The spillway outfall is cutting back. The embankment is in fairly good condition. Reservoir has been heavily silted.
26	Siakasamu	Siamafumba	Mapatizya	The dam walls are overgrown with shrubs. Slopes has been eroded.
27	Simusunge	Siamafumba		The dam walls are overgrown with trees. The spillway has large gullies.
28	Muyaba	Siamafumba		The embankment is overgrown with trees. Embankment and slopes have been heavily eroded.

29	Bize	Siamafumba		The dam wall is overgrown with trees and it's also eroded.
30	Kanyanga	Siamafumba		The dam wall is overgrown with tress. The reservoir has been silted.
31	Sinang'ombe	Siamafumba		The embankment is overgrown with trees. The spillway has been gullied and the reservoir has been silted.
32	Mupolisa	Siamafumba		The embankment is breached and it's also overgrown with trees.
33	Njabalombe	Siamafumba		The dam wall is breached. The embankment is overgrown with trees. The both slopes are badly eroded.
34	Munyeke	Siamafumba		The dam wall is encroached by big trees. Small gully is found on the embankment.
35	Siampondo	Siamafumba		The spillway has a gully. The embankment is overgrown with trees.
36	Siantele	Siamafumba		The dam wall is overgrown with trees. The reservoir is heavily silted.
37	Chili	Ruyala		The both slopes are eroded and overgrown with trees. Not working.
38	Namakube	Siachitema		Trees are growing on the embankment. Not working. Minor gullies are found on the slopes.
39	Manziatuba	Siachitema		The spillway is gullied. Not working on the crest. Shrubs are growing on the embankment.
40	Chuubo Weir	Chikanta		The weir is breached at the middle section.
41	B. Williams	Chonga	Kalomo Central	The spillway outfall is cutting back. The embankment is in fairly good condition though it is overgrown with trees.
42	Chalaluka	Nachikungu		The dam embankment is overgrown with trees. Seepage is found. Not working. Eroding spillway was ehabilitated in May, 1997.
43	Kazizhi	Nachikungu		The both slopes are eroded. Seepage is found. Not working. The dam wall is overgrown with trees.
44	Limbuwa	Nachikungu		The dam wall is overgrown with tress. Not working. Seepage is found.
45	Siambala	Siamayakwe		Deformed crest and slopes. Not working. Trees are growing on the dam wall. Poorly constructed.
46	Lugobo	Siamayakwe		The dam wall is overgrown with trees. Not working. Heavily silted reservoir.
47	Moonde	Siamayakwe		The spillway channel is eroding. The spillway concrete seal is broken. The dam wall is overgrown with trees and the both slopes are eroded.
48	Chifusa	Siachitema		Rehabilitated in October, 1996. The dam is in a good condition. Seepage is found on the right bank toe.
49	Mutoka	Simango		Seepage. Uneven settlement was occurred on the dam crest. Not working.
50	Nanyemu	Chikanta		Not working. Seepage is found. The both slopes and spillway outfall are eroding.
51	Mambo	Chikanta		The dam wall is overgrown with shrubs. The spillway outfall is eroding. Not working.
52	Shika	Siachitema		The dam wall is overgrown with trees. Not working, seepage and uneven dam crest.
53	Chikoli 'A'	Chonga		The dam wall is overgrown with shrubs. Not working, seepage and uneven dam crest are found.
54	Chikolo 'B'	Chonga		Not working. The spillway outfall is eroding. The dam wall is overgrown with shrubs.
55	Museta	Shimayakwe		Deformed embankment, the dam wall is overgrown with trees and the reservoir is heavily silted.
56	Siantomba	Sipatunyana	Mapatizya	Not working. The dam crest is overgrown with trees.
57	Janki	Simayakwe	Mapatizya	The both slopes are eroding. The dam wall is overgrown with trees. Not working.
58	Siasialumba	Simayakwe	Mapatizya	The spillway outfall is eroding. The dam crest is overgrown with trees. Not working.

59	Kalowaba Nyama	Sipatunyana	Mapatizya	Uneven dam crest. Not working. The dam wall is overgrown with shrub.
60	Mulunje 'A'	Nachikungu		The dam wall is overgrown with trees and needs seepage. Not working.
61	Mulunje 'B'	Nachikungu		Deformed dam crest. Not working. The dam wall is overgrown with trees. The spillway outfall is eroding.
62	Katukula Weir	Sipatunyana		Leakage is found.
63	Sipatunyana	Sipatunyana	Mapatizya	The dam wall is overgrown with trees. Not working. Uneven settlement is found on the dam crest.
64	Muhwadi	Nachikungu		The spillway outfall is eroding and cutting back. Excessive seepage. Eroding slopes.
65	Sokotwe	Sipatunyana		Eroding spillway channel.
66	Simwami	Sipatunyana	Mapatizya	Recently rehabilitated by Africare in June, 1997.

The dam inventory study of 66 dams indicates that most of the dams have suffered from severe erosion on the dam slopes and the spillway canal beds. Additionally, water leakages from the embankment and the dam foundation, and also shortage of the spillway flow capacity have lowered the dame safety. An excessive siltation was observed in 10 dams. Apart from these conditions, it is remarkable to consider that most of the dams are impounding water until October except the two. Thus several dams have a high potential for irrigation with an effective use of impounding water by means of installation of an intake device.

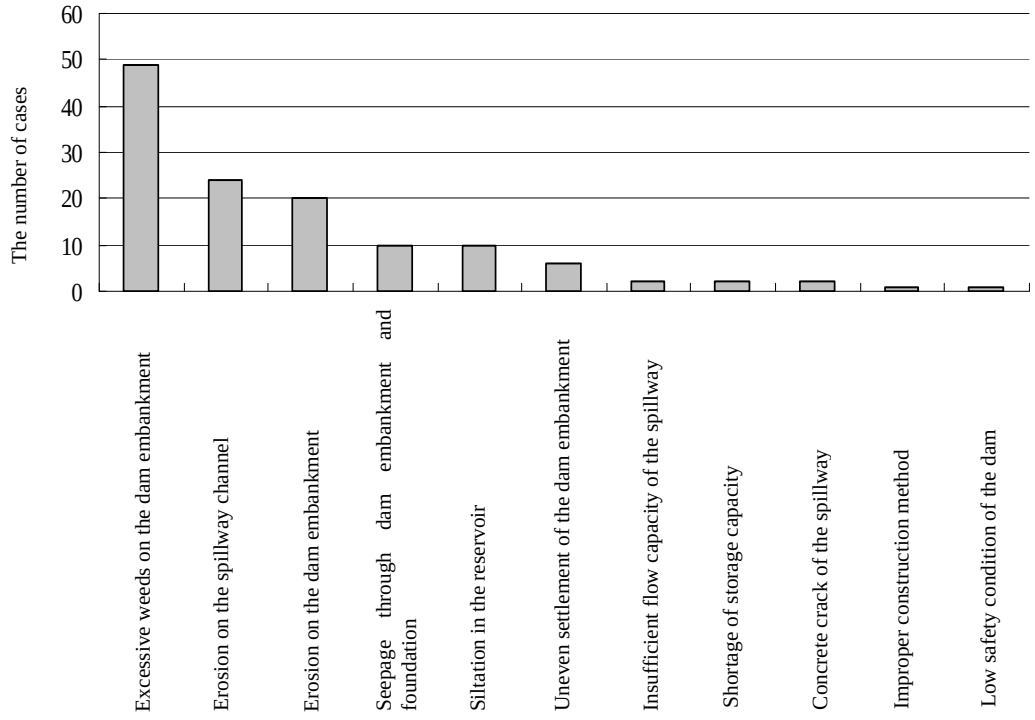


Fig. 4.1.1 Damages of the Small Dams

(3) Pump Water Use

The study result of the pump irrigation system is displayed in Table 4.1.4.

Several pump irrigation schemes have been implemented by the financial assistance of the Government and the donor countries as a compensation work for the inhabitants who lived in the area of the Kariba dam. The Lusitu, Buleya Malima and Siatwinda irrigation schemes are being operated by the project above. However, the other pump irrigation schemes are not well operated. The reasons for this is because, the MACO is responsible for operation and maintenance of the successful projects and his staffs are being assigned on the specific field for pump operation and irrigation management including irrigation fee collection. Thereby, the other schemes have failed to properly manage the systems since all of the facility operation and maintenance works were transferred to the beneficiaries who were not technically and financially capable to manage the systems by themselves.

Tens of the pump irrigation systems were implemented by the Government. However, these are also not well maintained due to the insufficient management skills of the beneficiaries. Excessively high operation cost for pumping was one of the major reasons of their failures, thus the remaining debts of the electric fee hinders embankment of the systems.

Table 4.1.4 Operation and Water Management of Pump Irrigation Schemes

	Irrigation Scheme	Operation and Water Management
1.	Ipafu	(Operation) When pump irrigation system was planned, pumps and drip irrigation system were equipped for coffee plantation in the Ipafu scheme. However, the pumps have not been operating for a long time owing to the unpaid electric fee by the beneficiaries. Thus the drip system was no use. In addition, the open canal is also damaged due to its poor maintenance. (Water management) Water management was not prepared because the irrigation system has been left untouched for a long time.
2.	Chapula	(Operation) The MACO has been operating the Chapula scheme as an agricultural research and training organization, hence the pump system has being well operated and maintained. The pump-up water is conveyed to the regulating pond through a 4km pipeline. An open canal connecting the regulating pond to the farm lands is slightly damaged such by a crack which is the cause of water leakage. (Water management) Agricultural cooperative is responsible for payment of irrigation fee; that is about ZMK400,000 per annum. Furrow irrigation method is applied with rotation irrigation system.
3.	Clixby	(Operation) The beneficiaries installed pumps, conduits and water distributing tanks with the financial assistance of a private firm in 2006. Despite good maintenance of these facilities, loan for the initial investment has not been refunded. Thus the irrigation activities were suspended due to the shortage in operation cost of pumps. (Water management) Since the supply of electricity has stopped, irrigation water has not been supplied to the beneficial farm land.

	Irrigation Scheme	Operation and Water Management
4.	Siatwinda	(Operation) Pump system is well operated and maintained except the conduits from the pump station to the regulating pond where several water leakages were observed. A considerably large water leakage was observed at joints of the concrete open canal. The beneficiaries have not yet repaired the damage. (Water management) Pumps have been well maintained, but the water loss between the pump station and the regulation pond should not be disregarded to attain sustainable use of the facilities. Rotation irrigation is applied to the irrigation works. Irrigation fee is being collected for pumping up cost.
5.	Lusitu	(Operation) Two pump stations were constructed along the Zambezi river. Since 1998 the Government has been providing rehabilitation cost for the irrigation canals. (Water management) Irrigation water is directly supplied from the pump stations to the farm lands. Furrow irrigation is properly conducted with rotation irrigation system. Some division pits and irrigation canal are left without rehabilitation works, thus severe water loss is observed.
6.	Kapululira	(Operation) Two pump stations were constructed along the Zambezi river. Poor maintenance work on pumps and conduits often lowers the irrigation efficiency. Water is directly supplied to the banana farming plots however, most of the pipeline and division pits were heavily damaged due to its age. (Water management) Severe water leakage is observed on the conduits and the division pits.
7.	Buleya Malima	(Operation) The system was rehabilitated by the SIP fund. Water supply loss is minimized due to little water leakages from the regulation pond and the canal. (Water management) Irrigation fee is collected from the beneficiaries; about ZMK480,000 per ha per annum.
8.	Tubalange	(Operation) The system is composed of a small pond and a pump system. The pumps and conduits were removed by the agricultural cooperative due to poor maintenance of the system. (Water management) Irrigation system is not functioning.

Table 4.1.5 Summery of the Small Scale Irrigation Schemes (Existing Schemes)

(Pump Irrigation Schemes)

	Small scale irrigation schemes	District	Province	Water source	Intake	Present conditions/ constraints
1	Ipafu Irrigation System	Chingola	Copperbelt	River	Pump	Since the Government (Zambia Coffee Board) pulled out from the financial support, the activities on irrigation have been stagnant.
2	Chapula Irrigation System	Kalulushi	Copperbelt	River	Pump	Irrigation scheme is well operated under the control of the Chapula Agricultural Training Center.
3	Chibote Irrigation Scheme	Kalulushi	Copperbelt	River	Pump	Pump is not operating due to a shortage of the power cost. Banana is solely planted in the scheme.
4	Mukonchi Irrigation System	Kapiri Mposhi	Central	Dam	Pump	Irrigation has not been operating properly for 20 years because the diesel pumps were damaged due to poor maintenance by the farmers.
5	Tubalange Irrigation System	Lusaka	Lusaka	Dam	Pump	Since the Cooperative has not been fulfilling its function for several years, the irrigation system has not been well operated.
6	Clixby Irrigation System	Kafue	Lusaka	River	Pump	WUA is well operated after two years of its establishment.
7	Lusitu Irrigation System	Siavonga	Southern	River	Pump	Replacement of the system facilities was carried out by the financial support of the Tonga Development Project. .
8	Kapululira Irrigation System	Siavonga	Southern	River	Pump	Banana cultivation using several electric pumps is dominant in the schemes. Repair and rehabilitation of the pumps and the canals are urgently required.
9	Mubyumu Irrigation System	Siavonga	Southern	Lake	Pump	Three engine pumps and one treadle pump were procured by “Harvest help”, Zambian NGO in 2003. The MACO has not yet supported the scheme, thus the scheme is still being recognized as ~~a~~ “Planning”
10	Siatwinda Irrigation System	Sinazongwe	Southern	Lake	Pump	Irrigation water is in short during the dry season because of the declined water surface of the Kariba lake.
11	Chiyabi Irrigation System	Sinazongwe	Southern	Lake (Tributary)	Pump	Irrigation facilities such as pumps and canals are severely damaged since 1980s.
12	Buleya Malima Irrigation System	Sinazongwe	Southern	Lake	Pump	There found a few constraints on the system operation, therefore the pumps need to be well maintained. AfDB provided the financial support.

4.2 Dambo Use

4.2.1 General

Small-scale irrigation covers 11 000 ha (20 % of the total area) and it is characterized by vegetables mainly cultivated on the dambo area and the riverbanks. Shallow wells and small drains were built on an area where it is too wet to grow crops. Farmers used either a treadle pump or a bucket tied to a rope for lifting water from these wells and rivers. Extension of the irrigation scheme using dambo water for smallholders is effective and contributes efficiently to the irrigation activities in the Study area. Followings are the study report for the water use in dambos:

4.2.2 Outline of dambo

A dambo is defined as "*A wide low lying gently sloping treeless grass covered depression which is seasonally waterlogged from surrounding high ground assisted by rainfall and has water tables for most part of the year in upper 0.5 to 1.0 m of the soil profile from which they drain into stream*" (The study report "Dambos in Eastern Province", Department of Agriculture (Feb. 1995))

As shown in Fig. 4.2.1, a dambo area is classified into 1) Dambo margin zone, 2) Upper glass zone, 3) Transition/ seepage zone, 4) Lower glass zone and 5) Central zone. Rainfall is a recharge source of the dambo.

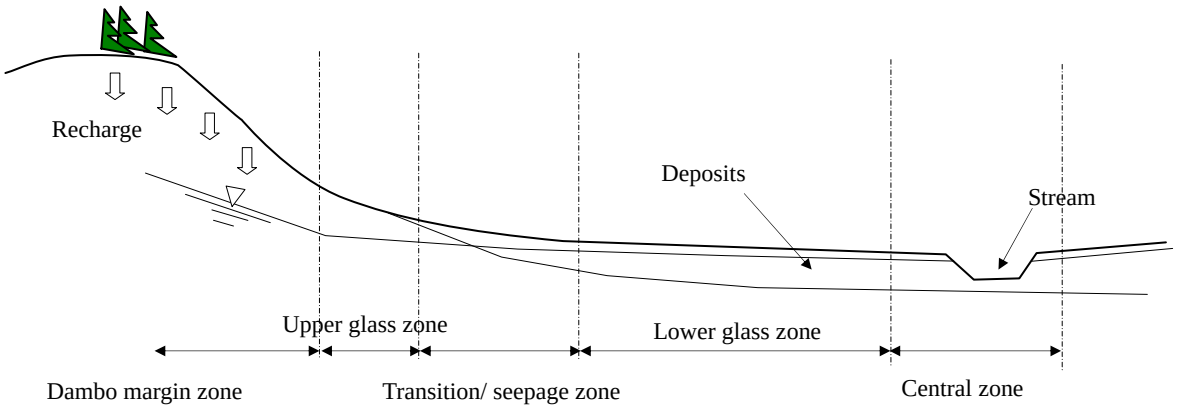


Fig. 4.2.1 Dambo Section (1/2)

Riverbed area also has the similar characteristics as dambo.

"A riverbed covered with alluvial deposits has a relatively elevated groundwater surface even in the dry season. Inundated river flow raises groundwater in the riverbed and the water table does not decrease even in the dry season due to poor drainage. Thickly accumulated river deposit hinders evaporation from the riverbed."

Fig. 4.2.2 shows a typical section of the dambo. In here, recharge into the deposit is different from what is described above. The lower wet portion is inundated due to its poor drainage condition during a few months of the wet season, and it's wet and inundated condition continues in the dry season. Recharge is accelerated during the wet season and evaporation from the surface is reduced by thickly accumulated clayey soil on the soil surface. This kind of wetland is observed along the tributaries in the most upstream stretches of the Kafue River in the Copperbelt Province.

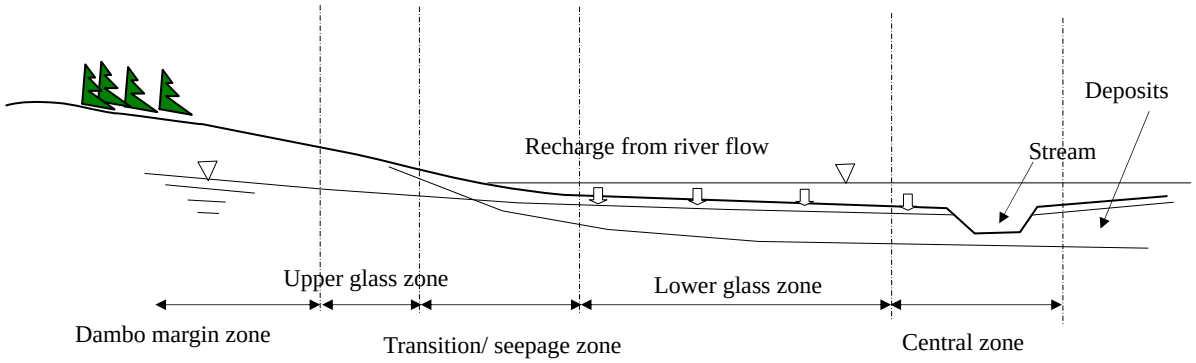


Fig. 4.2.2 Dambo Section (2/2)

4.2.3 Dambo use

Maize and groundnut are cultivated on the upland during the wet season. As the dry season proceeds, the farm land moves to the dambo area where soil is highly moistened. Farmers start a nursery planting of vegetables such as tomato, okura, rape and carrot in the "upper glass zone". As soil moisture gradually decreases, groundwater table also declines and "lower glass zone" is mainly used for cultivation because farming becomes possible even in the lower glass zone. Irrigation is usually carried out using a bucket and a treadle pump. Cereals are dominantly cultivated as a staple crop mainly for self consumption in the wet season. On contrary, cash crop production such as vegetables in the dry season aims to improve livelihood and purchase of farming input, i.e., seeds, fertilizer and chemicals for the next wet season. Such an interaction of the cropping is observed as a characteristic of the dambo areas.

4.2.4 Constraints on sustainable dambo use

(1) Land tenancy and water right should be clarified to accelerate the dambo use for cropping and further increase of the farm income. There is a hereditary system of land ownership found in the surrounding area. As young generation has no land title in general, such system would hinder the possible wide usage of dambos.

(2) Labor force

Much expense is required such as for land construction, especially for the initial cropping in the dambo area. Since the farming in the damobo area is labor intensive, most of the farming works tend to fell on women thus they end up having over loaded works unlike men. This is because women have much domestic works during the dry season than men. The laborious work includes installation of fences to prevent any damage by animals around the farm land, preparation of nursery, clearing, tilling, dredging of drainage, and irrigation using a bucket, etc. These overworks, especially those are burden to the women are one of the major constraints to accelerated a dambo use.

(3) Other constraints

1) Since most of the farmers are living far from the dambo areas, poor road condition tends to hinder smooth transportation of farm inputs and out puts. Accordingly the dambo areas are not being well utilized for agriculture.

2) Other negative livestock – farming interactions include destruction of pasture land.

4.2.5 Dambo Development

(1) Location of Dambos

Dambo areas are generally located far from village areas, hence ways of transportation such as ox-carts should be provided in order for the farmers to transport mainly fertilizer, compost, irrigation tools, and farm products. Road rehabilitation is necessary to transport products to the market in the vicinity of the dambos/ villages. In addition, primary water lifting equipment to supply cattle water is also necessary to accelerate the dambo use.

(2) Environment

Dambo are useful and profitable resources for grazing, but it hiders widening of agricultural land. An intensive use of damsos for farming may terminate sustainable development of farming in progress; farm activities especially soil fertility and chemical pollution. It is furthermore notified that an inundated area may cause pest and disease incidences during the wet season and hot dry season, such as schitosomias~~,~~ and malaria, etc.

(3) Policy and legislation

There was no evidence found that the current dambo use for farming have negative effects on dambo hydrology and soils. Policy and legislation are recommended to ascertain which policy and legislation should be enacted to ensure sustainable use of the dambos prior to its development. As rural villages have a few information, necessary acknowledgement on environment effects and direction of development should be provided to the local farmers.

As for water use, the Water Development Board (WDB) has been authorized to issue a permission on water use in dambos. It is therefore necessary to request a water use application to the WDB by water users or the MACO as a client of the project. There has not been any case in which such an application was submitted to the WDB however, it may be required from the environmental point of water quality.

(4) Proposed areas for dambo development

Distribution of the dambo areas is not clearly investigated, thus it is not identified. Identification of dambo areas using the GIS is necessary, including an investigation of soil fertility and water quality, especially that of pH.

(5) Dambo use areas

1) Outline of the investigation areas

Several dambos are located in the Cooperbelt Province (The most upstream stretches of Kafue River) and three districts in the Central Province in the Study area. Dambos in the Copperbelt Province are categorized by its rechargeing phenomena, i.e., one is recharged by river flow like the dambos located at the Copperbelt Province and another is recharged by rainfall like the dambos in the Central Province as shown in Fig 4.2.2 and 4.2.1, respectively.

In the central area of Chibombo District, left bank of the Kafue river near the Kafue town, widely lying aquifers composed of sandy gravel layers contain adequate groundwater that is originated by recharge of the rainfall in the wet season. These areas are also recommended to develop irrigation schemes using the groundwater source with minimal lifting force of 0.5 to 1.0 m below the ground surface.

2) Copperbelt Province

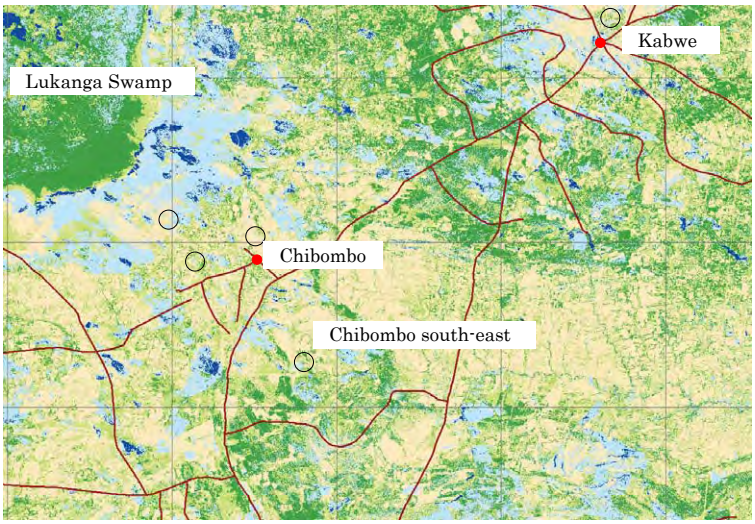
Dambos are located along the rivers/ streams and are endowed with abundant groundwater even in the dry season, in the most upstream stretches of the Kafue River. Farmers in the area can get hold of enough water for irrigation using buckets and treadle pumps. When the farm lands along the rivers/ streams are distributed to the farmers as a tenant land, dry season farming would be encouraged. Installation of small intake weirs and canals would also promote the irrigated agriculture along the rivers in the Copperbelt Province.

3) Central area of the Chibombo District

a) Vicinity area of the Chibombo town

There exists several dambos near Chibombo town and Lukanga swamp. These dambos have their groundwater table below 4 to 5 m from the ground surface. Although the western area of the Chibombo town is blessed with sufficient water, labor shortage inhibited the dambo use. Farmers live near the Chibombo town during inundation period in the wet season, and move to the dambo area for farming at the beginning of the dry season.

Dambo area has been developed in the north of the Chibombo town for about 200 ha. Soil moisture on the surface of the stream decreases in the mid June and the clayey layer under the ground surface dries up in August. Water shortage is caused by the relatively small drainage area and its poor recharge capacity due to the impervious surface layer in the area.



b) South-Eastern area of Chibombo town

The south eastern area of Chibombo town is located at the upstream of the Mwomboshi river in the Chibombo District. The area is generally undulated hills and water is observed at the depressed wetland by the beginning of the dry season. The area has a relatively gentle slope, thus recharged rainfall water gradually flows down towards the lower area. Groundwater in the sandy layer is located in shallow depth of 1.0 m below the ground surface. Thus it can be easily lifted up by buckets for irrigation use.

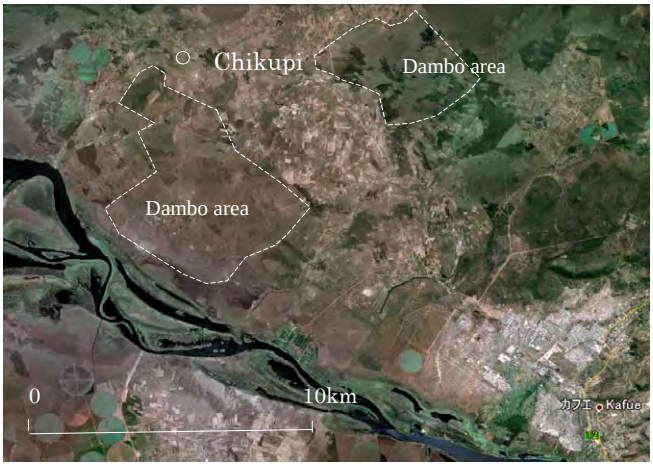
Meanwhile, the traditional land owner system has been maintained in the area and the dambo area is located far from the residential area. To accelerate the dambo use in the south eastern area of Chibombo town, it is proposed to ensure the labor force for farming practice and also to maintain social infrastructures such as a road for farm inputs and outputs transportation.

4) Western area of Kafue town

Dambos are located at the left bank of the Kafue river. Groundwater is observed in a shallow layer, even in the dry season. Since the area is located close to Kafue town and Lusaka city, irrigated agriculture using adequate groundwater is expected.

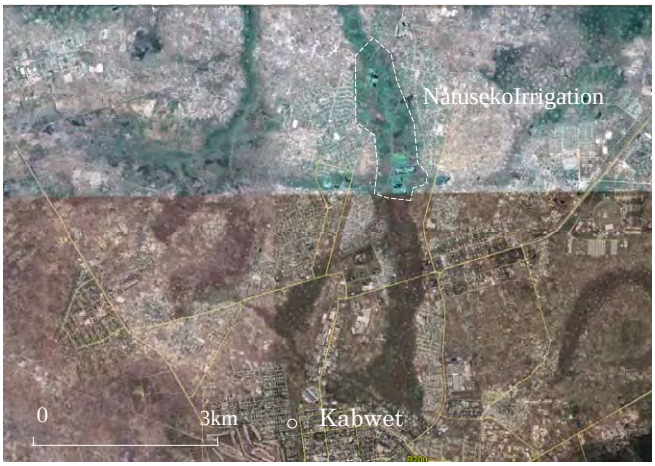
The MACO commenced the land development schemes in the flat plain, for example in the area near Chikupi town, 20km distance to the east from Kafue town. About 50 farmers obtained in total of 250 ha of farm land in the area.

As the MACO reported, the area is hydro-geologically composed like a dambo, and the groundwater is in higher level even in the dry season. It is proposed to rehabilitate a road in the area to secure the market condition of Kafue town and Lusaka city.



5) Suburb area of Kabwe town

Several dambos are located in and around Kabwe town, particularly in the Natuseko area located in the north of Kabwe town. The area is sloped from the gently undulated hill top to the stream in the center of the dambo area. Groundwater is lifted by buckets and treadle pumps for irrigation; however, shortage of labor force hinders the irrigated agriculture in the area.



6) Chisamba area

Chisamba town is located at 50km to the north of Lusaka City or 20km to the east of the National road T2. Road is well maintained and an accessibility to the markets is also good. A flat plain has spread through the whole of the Chisanga area and small streams are developed in the area. More than 90% of the farmers are using groundwater which has its water surface in about 3 m below the ground surface.

Sandy aquifer is lying about 1.0 m below the ground surface. Farmers have a land tenant contract under the traditional land ownership system. Small scale farmers cultivate about 5 ha farm land in average, and some emerging farmers cultivate about 20 ha. Small scale farmers are using bucket irrigation and water is sourced from wells. Treadle pump irrigation has not yet been spread in the area. NGO, namely Development Aid from People to people (DAPP) has a plan to provide 5 set of treadle pumps for 80 households.

Farmlands are not intensively located, but scattered in the total area of 4,000 ha. Most of the farmers do not have their market route, except the emerging farmers who can transport their products by their own trucks when the small scale farmers sell their products through traders. The DAC instructs the farmers on conservation farming to achieve an effective use of the farm land, high profitability and crop diversification.

Chapter 5 Operation and Maintenance at Present

5.1 Gravity irrigation system

Many small scale dams were constructed between 1990 and 2000 with a purpose to supply domestic and livestock water. Thus most of the dams do not have intake facilities for an irrigation purpose. In the recent years, it became well understood by the public that the storage of water in those dams need to be effectively solved to satisfy the growing water demand for irrigation. The dams constructed since 2000s have an intake conduit through the dam foundation and those dams previously constructed in 2000 have devices such a siphon system. Irrigation canal construction has been accelerated since 2000, but their improvement rate is still at low level. It is recommended to promptly layout new construction works of the dam intakes and irrigation canals, and the framework of the rehabilitation. However on contrary to this, a concrete plan for the work has not yet drawn up a comprehensive irrigation plan, especially for smallholders under the present condition. It is inevitable to collect effective information of the existing dams and the irrigation systems by the Provincial and District offices. In the meantime, District offices of Kazungula and Kalomo in the Southern province have set out a basic policy for an irrigation development plan as well as an asset management plan, i.e., rehabilitation of the existing dams and the irrigation systems in line with the study results and the inventory survey of characteristic dams in their provinces. A few dams were still being rehabilitated by a financial assistance of donors such as the SIDA and DANIDA.

5.2 Improvement Issues

In the light of these circumstances, it is further necessary for the MACO to undertake operation and maintenance work of the system and transfers technical skills to the beneficial farmers by full-time

engineers/ technical officers. This should make sustainable irrigation management through proper operation and maintenance work, irrigation fee collection as well as monitoring of farmers irrigation activities and irrigation facilities by the MACO initiative.

At present, the MACO cannot employ necessary irrigation staffs due to the budget ceiling. The MACO has begun a full-scale process to recruit irrigation staffs after 2000, coupled with a formulation of the National Irrigation Plan. However, it is not enough to undertake irrigation scheme management from technical and experimental points of view. It is further necessary for the MACO to strengthen capacity building program for the irrigation engineers and technical officers and put in place appropriate operation and maintenance system of the irrigation schemes. To accelerate effective use of the existing irrigation schemes by the farmers, the MACO is responsible for conducting technical and financial trainings of the farmers, e.g., instruction of irrigation methods, collection of irrigation fee and operation and maintenance of the irrigation facilities.

A basic knowledge should be acquired by OJT method for promoting a new irrigation scheme in the future, such as investigation of water sources, estimates of irrigable area corresponding to water potential, planning of intake, structural analysis, alignment of irrigation canals, selection of canal section, etc. Expansion of the legal systems of environmental assessment, water right and land tenancy are also necessary on an occasion of new irrigation scheme development. Capacity building on such as issues should be achieved to provide knowledge and experiences to the MACO staff. The Government should have an ownership of the main facilities, i.e., dams and main irrigation canals to attain proper maintenance works as a design and institutional arrangements.

5.3 Pump irrigation system

Primary issue of the failure on pump operation and maintenance was the poor maintenance of the pump itself, since few professional contractor that could repair and inspect pumps was in the vicinity of the site. In addition, as the beneficiaries could not bear the minimal repair costs such as for replacement of packing rubber of pump, the pump damages gradually corroded the whole parts of the pump and finally it exhausts operations without replacement of the whole pump. It is also pointed out that the farmers and the MACO staffs also have an inadequate skill to maintain the pump system. Member of the WUAs and the water committees did not mention the necessity of maintenance works and a few machinery problems were unnoticed because the board members of these organizations were selected not from the technical point of view. Excessively large electric fee beyond water requirement also pressed the financial management of the system.

A lack of the technical skill was recognized by the MACO since these schemes were implemented in early 2000s. Insufficient training of the irrigation engineers/ technical officers and a shortage of staff deployment in the Provincial and District offices caused unsustainable operation of the pump irrigation schemes.

Chapter 6 Irrigation Development

6.1 Capacity Building of SIP

The MACO conducted a capacity building of their staffs in earnest in the SIP. The SIP trained irrigation staffs and beneficial farmers through seminars. The capacity building activities are as follows:

(Purpose of capacity building on irrigation staff)

- Technical strengthening of the farmers and Government staff to achieve participatory approach of the irrigation project
- Promotion to implement the participatory irrigation project
- Establishment of a monitoring system, revise of the project approach according to the evaluation process of the monitoring analysis

(Purpose of capacity building on beneficiaries)

- Introduction of participatory approach in the community development project, management method of the WUAs
- Introduction of farming skills of high value crop production in the domestic and international marketing
- Proper operation and maintenance activities of the irrigation systems
- Gender issues related to the community development

Table 6.1.1 Capacity Development for Beneficiaries

	Items		Items
1)	Environmental management	8)	Irrigation, water management
2)	Gender	9)	Sustainable agriculture, organic (conservation) farming
3)	Road planning	10)	Financial management
4)	Enterprise management	11)	Post harvest skill
5)	Cooperative activities	12)	Marketing orientation
6)	Farming practices	13)	Education, dissemination
7)	Crop cultivation		

For the capacity building of the irrigation staffs of the MACO, 24 engineers/ technical officers of irrigation and agriculture sectors were selected from the MACO and NGOs, and training programs in terms of highly benefited project implementation for small scale irrigation project were conducted in the field. Accomplishments of the capacity building programs cover (a) Benefit estimates originated from irrigation improvement, (b) Appropriate facility design of the small scale irrigation schemes, (c) Calculation of water requirement, (d) Farming recording, (e) Management and maintenance plan, (f) Financial management, and (g) Gender issue in the irrigation planning. Cost for the capacity development was estimated at US$218,263 during two-year implementation schedule of the SIP. The cost included the capacity building of irrigation and community development for the TSB staff, enterprise management, farming programs, and post harvest plan for the AEB staff.

6.2 Capacity Building of Irrigation Staff

Referring to the approach of the MACO and the study result of the existing irrigation schemes in the Study, the following capacity development plan is proposed:

Table 6.2.1 Proposed Capacity Building Plan for Irrigation Staff

	Items	Capacity building plan
1.	Participatory irrigation project implementation	Necessity of participatory approach for the irrigation project implementation
2.	Community development	Implementation process of the community development project Study of secondary effects of the irrigation project Present condition of road and social infrastructures Establishment of farmers' groups (WUAs) and preparation of irrigation management guideline, etc.
3.	Planning and design of the irrigation project	Water source investigation Groundwater use (Dambos, wet lands, etc.) Watershed management Irrigable area investigation (including land use condition) Selection of proposed irrigation project (Economical viability, access to the market, etc.) Plan and design of irrigation facilities Land development in on-farm level
4.	Cosntruction management	Construction plan (Schedule, quality control, etc.) Project cost estimates
5.	Operation and maintenance of the irrigation project	Irrigation method, water requirement calculation Facility maintenance Financial management (Irrigation fee collection ,etc.) Operation and maintenance cost estimates and replacement cost
6.	Monitoring and evaluation	Management of irrigation project Replacement of irrigation facilities
7.	Environmental issues	Water sources, water quality Forest area preservation Environmental assessment of dambos (wet land) development
8.	System design process	Regulation, guideline design on water right, land tenancy Adjustment and cooperation with other related Government agencies (Ministry of Energy, Water Development, Ministry of Environment and Natural Resources, Ministry of House Affairs, Ministry of Lands, Ministry of Transport & Communications, Ministry of Local Government & Housing *[1])

*[1] : Ministry of Energy : Water use of surface and groundwater, legal procedure on water use development including construction permission process
Ministry of Environment and Natural Resources : Water quality, wet land preservation
Ministry of House Affairs : Water right, land ownership and tenancy
Ministry of Lands : Land use
Ministry of Transport & Communications : Road, social infrastructures
Ministry of Local Government & Housing : Community development under decentralization process

The capacity building program is subject to the staffs of the TSB as shown in the Fig. 6.2.1. In the program, "Trainer's training" for the irrigation engineers is first conducted. Trainers (Irrigation engineers) shall sequentially perform training for the irrigation technical officers. It is noted that incentives of the irrigation engineers are inevitable to effectively conduct the capacity building program. In this regard, a capacity building programs shall be reformulated with the actual

implementation process of the irrigation and community development projects, facing several problems induced from water right, land tenancy, coordination with other related Governmental agencies and legislation process.

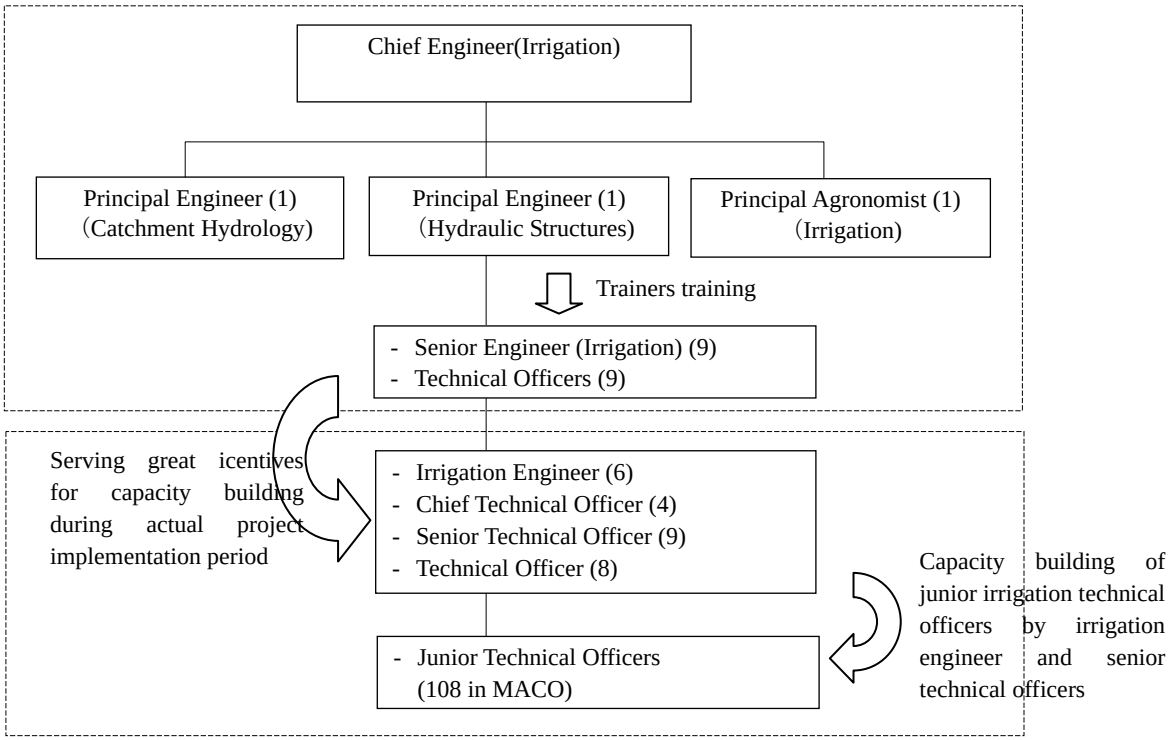


Fig. 6.2.1 Organization Chart of Capacity Building Process in MACO and TSB

Design guidelines and standard drawings shall be prepared for the planning and design process of the irrigation project with certain level of consistency in technical and economical view points. Furthermore, it is strongly proposed to establish a workshop center to repair irrigation tools like a treadle pump, movable engine pump, etc., in the Provincial or District level in the view of present constraints of the irrigation activities in the existing schemes.

The following are the proposed contents of design guidelines and standard drawings:

Table 6.2.2 Design guideline

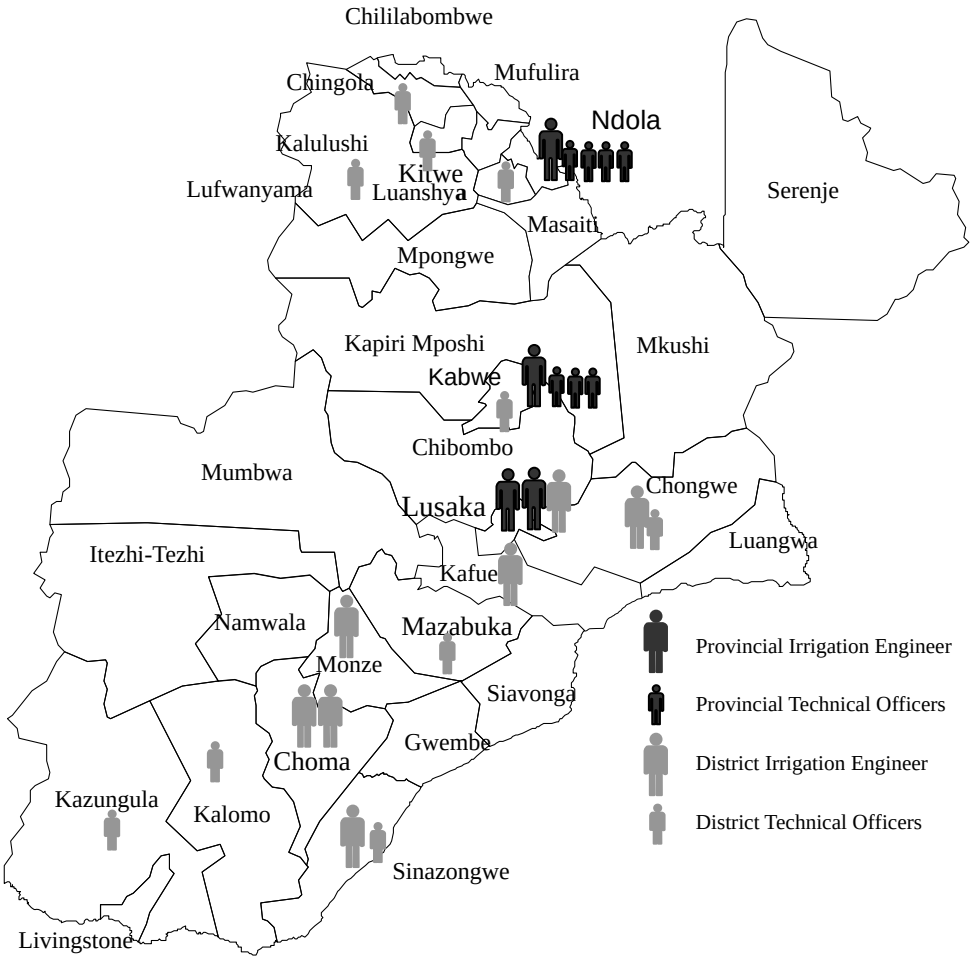
	Items	Details
1.	Water requirement	Water requirement calculation according to a cropping pattern
2.	Design of open canal	Hydraulic calculation (Canal section, slope, etc.)
3.	Design of conduits	Hydraulic calculation of dam, intake, etc.
4.	Design of dam and reservoir	Standard design of dam embankment and appurtenant structures such as spillway, intake Intake design using CAD application
5.	Division pit	Division pit design
6.	Meteolo-hydrological analysis	Data collection and analysis of Meteolo-hydrological data
7.	GIS application	Input support of GIS

Table 6.2.3 Standard drawings

	Items	Details
1.	Dam and intake	Dam (Standard section, spillway and intake design) Intake (Section of intake including scouring sluice, flood section and intake, etc.)
2.	Open canal	Canal structure, division pit, road culverts, etc.
3.	Conduits	Conduits, dam intake, etc.

(5) Capacity building of beneficial farmers

It is important to make beneficiaries recognize the necessity to acquire knowledge of irrigation system for sustainable use of the irrigation systems. The beneficiaries have used excessively large amount of water for irrigation because impounding water in the reservoir is much more sufficient than the water requirement of the whole beneficial area. It is difficult to instruct the beneficiaries to effectively use water in area like that. However when the irrigable area is expanded to the potential of the impounding dam, maximum benefit is not expected without severe water control. As drought years caused by climate change of global warming were recorded three years in 2000s, it is necessary to perform awareness and prevention programs for sustainable development of the small scale irrigation schemes.



Note: Junior Technical Officers are not shown on the figure.
Source: MACO

Fig. 6.2.2 Distribution of Irrigation Engineer and Technical officers of the MACO

Chapter 7 Inventory of the Irrigation Schemes

7.1 Inventory of the Irrigation Schemes

Summary of the existing irrigation schemes and their inventory are shown in Table T7.1.1 to T7.1.3 and following sheets with category of 1) Existing irrigation schemes (gravity), 2) Existing irrigation schemes (pump irrigation) and 3) Potential irrigation schemes (gravity).
Location of these irrigation schemes are plotted in Fig. F7.1.1.

7.2 Potential Irrigation Schemes

In addition, overall potential gravity irrigation schemes selected through several discussions with the MACO staff are listed up in Table T7.2.1. Location of these irrigation schemes are plotted in Fig. F7.2.1.

Tables

Table T7.1.1 Summery of the Small Scale Irrigation Schemes (Existing Schemes)

(Gravity Irrigation Schemes)

	Small scale irrigation schemes	District	Province	Water source	Intake	Present conditions/ constraints
GE.1	Kafubu Irrigation System	Ndola	Copperbelt	River	Pump, manpower	Farmers individually cultivate their own land, thus cooperatives and Water Users Associations (WUA) is not yet established.
GE.2	Katuba Irrigation System	Chibombo	Central	Dam	Gravity	Since the main canal elevation is slightly lower than the irrigation area, irrigable area is limited to the river bank with its extent of 1.5 km or more. SIDA occasionally provided maintenance cost for the system.
GE.3	Chunga Irrigation System	Lusaka	Lusaka	River	Gravity	Intake capacity has been severely small due to the excessive siltation at the upstream of the weir. Irrigation water is contaminated by sewage water.
GE.4	Funzwe Irrigation System	Kafue	Lusaka	River	Manpower	Treadle pumps are used to pump up river water. FAO launched Women in Irrigation and Nutrition, completed in 2004, for empowerment of women.
GE.5	Shantombo Irrigation Scheme	Kafue	Lusaka	Dam	Gravity	Dam and reservoir are well maintained by the beneficiaries. Extension of the irrigation canal increases irrigable area.
GE.6	Chipapa Irrigation System	Kafue	Lusaka	Dam	Gravity	Gravity irrigation from the dam is under operation.
GE.7	Mulila Kazembe Irrigation Scheme					The MACO has completed installation work of the irrigation canal in 2002. Early handing over to the beneficiaries is expected.
GE.8	Kanundwa IrrigationScheme	Monze	Southern	Dam	Gravity	Dam intake siphon has completed in 2008. Irrigation canals are located both right and left sides at the immediately downstream of the dam. Overflow flood through spillway channels sometimes flows down into farmlands, thus degradation of the spillway channels are requested.
GE.9	Siafa-kweda Irrigation System	Choma	Southern	Dam	Man power	The reservoir has enough capacity for irrigation; however bucket irrigation cannot supply with enough irrigation water.
GE.10	Ndondi Irrigation Scheme	Choma	Southern	Dam	Gravity	Dam structures are well maintained. A small intake capacity through siphon shall be improved.
GE.11	Nabuyani Irrigation Scheme	Kalomo	Southern	Dam	Gravity	Dam structures are well maintained. Intake is well controlled during the wet season.
GE.12	Mulabalaba Irrigation Scheme	Kazungula	Southern	Dam	Gravity	Dam structures are well maintained. Water lifting by man-power is necessary for a half of the farmland.
GE.13	Nkandabwe Irrigation System	Sinazongwe	Southern	Dam	Gravity	Irrigation water supplied from the reservoir by gravity. Dead water volume of the reservoir is estimated at about 3 year's irrigation.

Note: GE means Gravity Existing irrigation schemes

Table T7.1.2 Summery of the Small Scale Irrigation Schemes (Existing Schemes)

(Pump Irrigation Schemes)

	Small scale irrigation schemes	District	Province	Water source	Intake	Present conditions/ constraints
P.1	Ipafu Irrigation System	Chingola	Copperbelt	River	Pump	Since the Government (Zambia Coffee Board) pulled out from the financial support, the activities on irrigation have been stagnant. Procurement of treadle pumps and movable engine pumps are great help for beneficiaries.
P.2	Chapula Irrigation System	Kalulushi	Copperbelt	River	Pump	Irrigation scheme is well operated under the control of the Chapula Agricultural Training Center.
P.3	Chibote Irrigation Scheme	Kalulushi	Copperbelt	River	Pump	Pump is not operating due to a shortage of power cost. Banana is solely planted in the scheme.
P.4	Mukonchi Irrigation System	Kapiri Mposhi	Central	Dam	Pump	Irrigation has not been operating properly for 20 years because the diesel pumps were damaged due to poor maintenance by the farmers.
P.5	Tubalange Irrigation System	Lusaka	Lusaka	Dam	Pump	Since the Cooperative has not fulfilled its function for several years, the irrigation system has not been well operated.
P.6	Clixby Irrigation System	Kafue	Lusaka	River	Pump	WUA is well operated after two years of its establishment in 2009. However shortage of electric fee collection caused unstable pump operation.
P.7	Lusitu Irrigation System	Siavonga	Southern	River	Pump	Replacement of the system facilities was carried out by the financial support of the Tonga Development Project.
P.8	Kapululira Irrigation System	Siavonga	Southern	River	Pump	Banana cultivation using several electric pumps is dominant in the schemes. Repair and rehabilitation of the pumps and the canals are urgently required.
P.9	Mubyumu Irrigation System	Siavonga	Southern	Lake	Pump	Three engine pumps and one treadle pump were procured by “Harvest help”, Zambian NGO in 2003. The MACO has not yet supported the scheme, thus the scheme is still being recognized as “Planning”.
P.10	Siatwinda Irrigation System	Sinazongwe	Southern	Lake	Pump	Irrigation water is in short during the dry season because of the declined water surface of the Kariba lake. Canal dredging work about 200m introduces lake water to the suction of the pump.
P.11	Chiyabi Irrigation System	Sinazongwe	Southern	Lake (Tributary)	Pump	Irrigation facilities such as pumps and canals are severely damaged since 1980s.
P.12	Buleya Malima Irrigation System	Sinazongwe	Southern	Lake	Pump	There found a few constraints on the system operation, therefore the pumps need to be well maintained. AfDB provided the financial support (SIP).

Note: P means Pump irrigation schemes

Table T7.1.3 Summery of the Small Scale Irrigation Schemes (Potential Schemes)

(Gravity Irrigation Schemes)

	Small scale irrigation schemes	District	Province	Water source	Intake	Present conditions/ constraints
GP.1	Kakoso Irrigation Scheme	Chililabombwe	Cooperbelt	Spring	Gravity	Spring water is utilized for irrigation. Several spring points are located on the valley slope. Drainage is major problem in the wet season.
GP.2	Bwafwano Irrigation Scheme	Kaluliushi	Cooperbelt	Stream	Gravity	Surface water and impounding water in the Mindro dam (Mining) are used for irrigation. Surface water dries up after June every year. Irrigation system is well maintained.
GP.3	Kasamba Irrigation Scheme	Kapiri Mposhi	Central	Dam	Gravity	Dam and spillway are not maintained, thus rapid maintenance work is required.
GP.4	Juda Irrigation Scheme	Kapiri Mposhi	Central	Dam	Gravity	Dam and spillway are relatively well maintained. Installation of intake on the dam and canal promises higher farm productivity.
GP.5	Natuseko Irrigation Scheme	Kabwe	Central	Stream, dambo	Treadle pump	Productivity of the dambo area is small because of a shortage of labor force. Procurement of the treadle pumps and movable engine pumps realizes higher productivity.
GP.6	Waya Irrigation Scheme	Kabwe	Central	Stream, dambo	Treadle pump	Stream flow is not utilized for irrigation. Procurement of the treadle pumps and movable engine pumps realizes higher productivity.
GP.7	Lifwambula Irrigation Scheme	Chibombo	Central	Dam	Gravity	Spillway is damaged by flood. Land preparation is necessary to irrigate farm land. Intake is not installed on the dam embankment.
GP.8	Munga Irrigation Scheme	Chibombo	Central	Dam	Gravity	Embankment is heavily damaged. Higher farm income is realized by input of adequate labor force.
GP.9	Chikupi Irrigation Scheme	Kafue	Lusaka	Stream, dambo	Treadle pump	Groundwater exists in shallow layer. Agricultural development is achieved by road construction.
GP.10	Nakempa Irrigation Scheme	Choma	Southern	Dam	Man power	Since the intake device was not installed, irrigation has not been carried out for a long time.
GP.11	Siakasipa Irrigation Scheme	Kazugula	Southern	Dam	Gravity	Intake is not installed on the dam embankment. Farmland is well maintained.
GP.12	Mandia Irrigation Scheme	Kazugula	Southern	Stream	Gravity (pump)	The MACO is studying the scheme. It is constitutive point to select gravity irrigation or pump irrigation from economical view point.

Note: GP means Gravity Pump irrigation schemes

GE.1 Kafub Irrigation System (Ndola District) (December 1, 2009)

	Items	Descriptions
1.	Irrigation System	Kafub Irrigation System
2.	Irrigable area	Estimate 10 ha (Reported by MACO 10ha)
3.	Coordination, elevation	S 13° 05.759', E 28° 33.717', El. 1,220m
4.	Completion year	---
5.	Province	Copperbelt Province
6.	District	Ndola District
7.	Beneficiaries	Kafub agricultural camp, Kafub block (Kafub camp has 400 households in total) Kafub block is composed of the camps of Kafub, Madando and Nakupata
8.	Number of households	20 households (Irrigable is not delineated)
9.	Water source	Kamisamba river (Dambo). Water is available in 2m depth pit throughout the year.
10	Irrigation system	20 farmers are individually operating on farming. Water from the river is pumped up by a treadle pump, small engine pump, etc. A farmer has 1m^3 of a plastic small water tank to store irrigation water on anthill (Height: 3-4 m from the irrigation area).
11.	Present condition	- Farmers own "state land" distributed as a certain "Church contribution", it used to be the private (Church) lot. - Farmers are distributed with lot of 10 ha however, cultivated area is limited to 1 ha due to a shortage of irrigation water in the dry season. - About 7 ha is cultivated by each farmer in the wet season. A heavy rain causes water logging (root rotting). Crop: Maize, wild potato, rape, etc. - Seeds and fertilizers are in short to satisfy the expected amount of production. - Emerging farmers (2 households) cultivate about 2 ha with a labor force of more than 10 workers in the Kafub irrigation area.
12.		Water source River deposit has accumulated in the river, and it forms like a "dambo"
		Treadle pump Water head may be limited to 2-3 m.
		Farmers planted seedlings near the swampy area along the river. (Photo shows seedling of rape)
		Maize is cultivated at the end of the dry season using river water.
		Farm land of "emerging farmer" Traditional farmers and emerging farmers are scattered in the irrigation area of 3ha.
		A small engine pump owned by the emerging farmer.
		Tomato cultivation by the emerging farmer.
		Cabbage cultivation by the emerging farmer
13.	Remarks:	- Farmers pay the land use fee for ZMK150,000/ year on average to the Ministry of Land. - Kafubu dam is located at the downstream of the camp for the purpose of potable water supply to the Ndola town (Kafub camp is located at tributary of Kafub River)

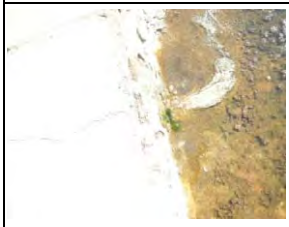
(Additional survey, July 2010)

14.		Downstream end of the beneficial area. Farmers will start tilling in July.		The upland is used for the wet season staple cropping (maize).
		Downstream of the beneficial area Moistened soil in the riverbed is suitable for the dry season cultivation.		Water is stagnant in the river. Farmers use water for irrigation using a bucket.
		Most upstream of the beneficial area Two concrete pipe culverts are installed at the road crossing section.		Upstream of the pipe culverts About 10lit/sec of flow was observed in July 2010. Water usually dries up in October.
		Downstream of the pipe culverts. An intake box is installed to divert water to the beneficial area.		Road embankment Upstream of the dambo area has storage capacity with 2m high embankment.
15.	Remarks:	- Since the farm area is located in the both river sides, 50% of water can be diverted to the beneficial area located on the left side of the river according to the farmers. Water right is not yet set. - It is preferable to use dambo area as a water storage pond however, lifting water level may reduce grazing area around the dambo. - Since the dambo is spread in the whole upstream area, there is no suitable area to construct a small impounding.		

GE.2 Katuba Irrigation System (Chibombo District) (December 11, 2009)

	Items	Descriptions
1.	Irrigation System	Katuba Irrigation System
2.	Irrigable area	Estimate 5 ha (Reported by MACO -ha)
3.	Coordination, elevation	S 14° 47.608', E 28° 11.502', El. 1,110m
4.	Completion year	2000
5.	Province	Central Province
6.	District	Chibombo District
7.	Beneficiaries	Katuba Agricultural Cooperatives, Chankumba camp, Chibombo block
8.	Number of households	42 households
9.	Water source	Katuba dam (Momboshi river)
10	Irrigation system	Reservoir Intake pipe (Siphon type) (Open channel with concrete lining 400m, earth lining 1,400m)
11.	Present condition	- Since the main canal elevation is slightly lower than the irrigation area, irrigable area is limited to the river bank with its area of 1.0 ha. - Farmers use three treadle pumps (cooperative property) to supply irrigation water to the elevated farmland. - SIDA continues being a financial assistance for the maintenance of the system. - Irrigation fee is not collected. The beneficiaries bear a certain amount when rehabilitation work is necessary.
12.		 Left: Reservoir and left bank spillway Right: Right bank spillway Both spillways were rehabilitated in 2009 by the financial assistance of SIDA.
		Embankment is well maintained.  Downstream of the right spillway was eroded. (Photo shows a slope protection by the financial assistance of SIDA)
		Outlet pit and main canal located at immediately downstream of the dam.  Turnout of the main canal, 400m out of total 1,800m canal, was lined with concrete (brick and mortar cover).
		 The dambo located near the irrigation scheme Dambos are well developed in the depression.
13.	Remarks:	- Aquaculture is operated in three fish ponds at the downstream of the reservoir. - Commercial farmers use water from the reservoir for 250ha. - Since canal elevation is lower about 2 - 3 m from the adjacent farmland, raise of the water level of the reservoir would reduce laborious pumping (treadle pump) work. - There exist several dambos around the irrigation system; procurement of the pumps is extremely wide in an irrigable area. Paddy rice cultivation is also practicable in the dambo according to the DACO irrigation officers.

(Additional survey, July 2010)

14.		Spillway at the left side of abutment. Downstream of the spillway crest was damaged, and small leakage is observed though foundation.		Concrete plastering on the upstream crest concrete was cracked and was partially peeled off. It caused water leakage.
		Downstream of epron concrete was cracked.		A pit of siphon on the dam crest. Two polyethylene pipes are installed, but one of them has been clogged with soil.
		A valve installed in the upstream of the siphon. A large water loss would hinder a smooth water flow into the siphon pipe.		Engine pumps are available to irrigate the farm. (3", 6.5kW)
		Diversion pit shall be repaired. Poor construction caused earlier damages.		Irrigation canal was partially damaged, such as erosion behind the canal. A proper drainage shall be constructed where it passes over the irrigation canal.
15.	Remarks:	- Insufficient flow capacity of the siphon shall be improved. (replace it with flap valve instead of spring operated valve and also enlarge the siphon pipe diameter) - Filling time of the siphon pipe can be reduced to a few minutes. (Presently, it takes about 40 minutes because the pipe end is located about 40m at the downstream of the dam.) - Outlet of the diversion pit is slightly narrow. It is preferable to replace it with a wider outlet when flow discharge is increased by siphon replacement. - Since the irrigable area was limited to less than 1ha due to canal alignment, an additional siphon shall be installed along the elevation of 2m higher than the present irrigation canal, in order to enlarge the irrigable area. - Rotation irrigation (7 days of rotation, 12 hours of irrigation per day) is practicable. - Since the reservoir has a sufficient volume of storage, irrigable area can be expanded towards the downstream. (Stream flow dries up in October every year.) - Leakage is observed at the left side of the abutment, close to the left side spillway for 40m long. - Leakage is observed at the right side of the abutment for 30m long.		

GE.3 Chunga Irrigation System (Lusaka District) (November 25, 2009)

	Items	Descriptions
1.	Irrigation System	Chunga Irrigation System
2.	Irrigable area	8ha (Reported by MACO 15ha)
3.	Coordination, elevation	S 15° 19.549', E 28° 12.725', El. 1142m
4.	Completion year	1970s
5.	Province	Lusaka Province
6.	District	Lusaka District
7.	Beneficiaries	Barastone agricultural camp, Lusaka North-west block Lusaka block is composed of seven (7) agricultural camps
8.	Number of households	25 households
9.	Water source	River water (River water has been contaminated ever since the sewage plant is being placed at the upstream of the intake. Although, water from the several creeks dilute the contamination.)
10.	Irrigation system	Diversion weir (Masonry structure) Irrigation canal (Earth lining)
11.	Present condition	- Siltation has been developed immediately at the upstream of the weir and this hinders the intake function of an inlet which is located at the right abutment of the weir. - Farmers diverted river water from 100m upstream of the left bank of the river. The river water is utilized for irrigation at left side of the river, too. - Bubbles were observed on water surface where water velocity is high. - Irrigation canal has not been well maintained, so that siltation and weed has grown slightly thick in and around the canal. - Farming is practicable in the wet season with a little river water.
12.		Upstream of the weir silted with fine sand and clayey materials
		Weir body is composed of stone masonry with a mortar lining. Flood water runs toward the downstream through the spillway on the weir body.
		An abutment of the weir at the downstream has damaged by scouring.
		River water is contaminated with sewage water from the Lusaka city.
		Diverted water course at the upstream of the weir.
		Babbles observed on water surface at the diversion weir.
		Farmers are cultivating vegetables in a small plot to save water for irrigation.
13.	Remarks:	There exist two small-scale irrigation schemes in the Lusaka District, i.e., Chunga and Tuarage systems. However, Tuarage system has not been operating for a long time.

（Additional survey, August 2010）

14.		A canal located in the middle of the irrigated area.		A canal located at the most end of the irrigated area.
		The secondary canal is well maintained by the farmers.		A pipe is used to across a small stream at the most end of the beneficial area.
		Surplus water is disposed to the Chung River (August 2, 2010)		Water is contaminated by untreated sewage water. (clarity decreased to 20 cm in August 2, 2010)
			Kawangwe Dam is located at tributary of the Chunga river. Construction of the dam was completed in 1973, and it has been maintained by the local Government, Chilanga water board.	According to the farmers, water level is at full in August 2010, but it falls about 1m in October
		Farmers installed a pump on the dam crest to directly irrigate their farm lands located immediately the downstream of the dam.		The farmland located in the downstream is estimated at approximately 1.5 ha.
			Left side of the reservoir area When the water level rises higher than 2m, the inundated areas would expand into left side of the reservoir.	
		Spillway is located on left side of the abutment. Spilled water is utilized for irrigation at downstream of the dam.		Several movable engine pumps were used for irrigation. (left side of the reservoir area)
15.	Remarks:	- The storage water is usually utilized for households and livestock. Farmers also use the water to irrigate left side and downstream farm lands of the reservoir. - It is recommended that the maximum of water surface is 1.0 m. When the water level rises higher than 2m, the inundated area would expand into the farm land, especially into the left side of the reservoir.		

GE.4 Funzwe Irrigation System (Kafue District) (December 9, 2009)

	Items	Descriptions
1.	Irrigation System	Funzwe Irrigation System
2.	Irrigable area	8ha (Reported by MACO 3ha)
3.	Coordination, elevation	S 15° 39.310', E 28° 25.157', El. 975m
4.	Completion year	n.a.
5.	Province	Lusaka Province
6.	District	Kafue District
7.	Beneficiaries	Nankanga camp, Chipapa block, Funzwe Agricultural Cooperative
8.	Number of households	60 households
9.	Water source	Funzwe river
10	Irrigation system	Treadle pumps (approx. 3m head)
11.	Present condition	- FAO project provided 10 treadle pumps (Women in Irrigation and Nutrition: completed in 2004) for the empowerment of women. - Since the farms are located in mountainous area, farmers have to transport their farm products to Lusaka by a bicycle.
12.	 Water source is the Funzwe river and water is available throughout a year.	 An intake point by treadle pumps. Water head is about 3 m.
		 The farmland is located along the river stream for about 1.5km long.
	 Upstream of the irrigation area	 Cabbage and maize cultivation (Farmers utilized the sloped farmland along the river)
	 Livestock is also necessary for living.	 Near the Funzwe irrigation area, staffs of the Zambia Agricultural Research Institute (ZARI) instructed the farmers on a farming method.
13.	Remarks:	- Funzwe River has flow discharge of about 0.2 m^3/sec in December 9, 2009. Thus its perennial flow can be utilized for irrigation. The minimum flow is estimated at about 0.2 m^3/sec. - The catchment area is covered with trees and vegetation, and has not been developed at all. - Charcoal production is also a profitable business. Farmers have extended their farmlands with tree-felling - This area might be recognized as Funzwe Irrigation System after implementation of FAO project. 

GE.5 Shamtombo Irrigation System (Kafue District) (December 9, 2009)

	Items	Descriptions
1.	Irrigation System	Shamtombo Irrigation System
2.	Irrigable area	15 ha (Reported by MACO -ha)
3.	Coordination, elevation	S 15° 33.987', E 28° 22.198', El. 1,302m
4.	Completion year	2001
5.	Province	Lusaka Province
6.	District	Kafue District
7.	Beneficiaries	Shamtombo camp, Chipapa block Evergreen Water Users Association (Established in Sep. 2009)
8.	Number of households	40 households
9.	Water source	Reservoir
10	Irrigation system	Reservoir (55,000m^3) (Granted by the MACO) Canals (Main 1.5km, latera1 300m, lateral-2 300m)
11.	Present condition	- Rotation irrigation is applied, especially during the dry season. - Irrigable area with the use of the reservoir is about 10ha out of 35ha of the potential area. - Outlet valve can not be repaired because the sub-valve for main valve repair was not installed, and also an inlet valve was not installed in the reservoir. - Crops: Maize and sugarcane
12.		The reservoir was constructed in 2001
		Downstream of the embankment. The outlet pit locates in center of the photo
		Water is being supplied to three irrigation canals (main and two lateral canals) from this outlet pit.
		This is a sluice valve. Approximately 3 liter/sec of water leaks from the valve due to the problem found in the valve itself.
		This is an irrigation canal locates in the most downstream. Its concrete lining was completed in 2007, but only for 200m. Thus the rest of 1,300m is not yet lined with concrete.
		Beneficial area is located immediately at downstream of the dam. Farmers use slope areas for maize cultivation.
		Farmers plough the farmlands by manpower.
13.	Remarks:	- For eight years since the dam was completed in 2001, water reached the full level only once in the wet season of 2008-2009. The reservoir was too small for irrigation during the drought years of 2001 to 2005. (2001/2002, 2004/2005, 2007 are being recognized as "drought year", when 2006/2007, 2007/2008 were "flood year") - A small pond was constructed in 1990s. The pond has been abandoned because of the severe seepage found in the foundation. Although farmers still wish to use the pond.

GE.6 Chipapa Irrigation System (Kafue District) (November 25, 2009)

	Items	Descriptions
1.	Irrigation System	Chipapa Irrigation System
2.	Irrigable area	8ha (Reported by MACO 10ha)
3.	Coordination, elevation	S 15° 38.318', E 28° 19.440', El. 1,125m
4.	Completion year	1950s
5.	Province	LusakaProvince
6.	District	Kafue District
7.	Beneficiaries	Chipapa camp, Chipapa block
8.	Number of households	115 households
9.	Water source	Reservoir
10	Irrigation system	Gravity irrigation (Open channel) Reservoir Open canal (Main and lateral canals)
11.	Present condition	- Water logging (roof rot by inundation) occurs in the wet season because the soil is impermeable. - Since the drainage area is limited, enlargement of the storage capacity may not be expected.
12.		Reservoir and dam body
		Diversion pit located at downstream of the dam.
		The main irrigation canal alined with a fabricated concrete plate.
		The diversion pit to the lateral canal (Sub-canal). Steel stop log is utilized to control intake capacity.
		Spillway of the dam body located at left side of the abutment. Spillway foundation is composed of slightly weathered rock.
		Upstream of the dam body was not so eroded by natural vegetation.
		The farmland
13.	Remarks:	Other irrigation project: 1) Kalimina irrigation system (8 ha) 2) Shantumbu irrigation system (10 ha by a reservoir, potential area of 35 ha) 3) Ciawa irrigation system (Pump irrigation from the Kafue river / Banana planting with drip irrigation)

(Additional survey July 2010)

14.		Intake valve (Sluice valve) The valve has been exposed without a concrete protection box.		Water seeping through an intake pipe embedded under the embankment was observed. Although, speed of the seepage was not so fast and thus, a rapid rehabilitation may not be necessary.
		Farmers are trying to divert water by earth materials.		Since the capacity of canal flow is not sufficient, farmers have requested to widen the width.
		Secondary canal Earth canal allows a large seepage loss.		Secondary canal Farmers tend to maintain the secondary canal for instance by canal excavation, weeding, etc.
		Some farmers started tilling work in July. Thus, there found “time lag” in cultivation.		Some farmers begun to burn their lands in order to start “tilling work".
		Siltation has been developed since the last dredging work in 1990s.		Weed control is necessary for both up and down slopes of the embankment.
15.	Remarks:	(Rehabilitation work) - Reformation of the main irrigation canal (Widening of canal, modification of longitudinal slope of the canal) - Weed control of dam embankment - Dredging of reservoir siltation - Concrete lining of the secondary canal (Water management) - Water intake capacity should be controlled in correspondence with water requirement of each growth stage (period). - It is preferred to properly schedule a planting period among the farmers to improve irrigation efficiency. (Maintenance work) - Water users association maintains the dam embankment, i.e., weed control once a year and dredging of the main and secondary canals.			

GE.7 Mulila Kazumbe Irrigation System (Kapri Mkoshi District) (July 14, 2010)

	Items	Descriptions
1.	Irrigation System	Mulila Kazumbe Irrigation System
2.	Irrigable area	8ha (Reported by MACO -ha)
3.	Coordination, elevation	S14° 39.585', E28° 56.879', El. 1,107m
4.	Completion year	Dam and irrigation canal in 2002
5.	Province	Central Province
6.	District	Kapri Mkoshi District
7.	Beneficiaries	Kampumba camp, Changondo block, 6 cooperatives Kalundu Water Users Association
8.	Number of households	72 households
9.	Water source	Mulila Kazumbe River
10	Irrigation system	Dam (1,645,000m^3) Irrigation canal (Brick and mortar lining canal, 1,200m)
11.	Present condition	- Since the completion of Irrigation Canal by the MACO in 2002, the system has been not yet handed over the farmers due to a few construction failures found in the diversion pits according to the MACO. - Farmland are scattered along the irrigation canal. - Since the irrigation canal is located in a sufficiently elevated area, most of the farmlands will be irrigated by gravity.
12.		 Irrigable area shown from right side of the dam abutment
		Dam crest is well maintained by the Water Users Association  Spillway is located at right side of the abutment Neither crest concrete nor other protection of spillway bed and side slopes were found in the area.
		Irrigation canal (Brick and mortar lining) According to the MACO, canal mortar plastering is not yet completed.  Asbestos pipe (200mm) passes over a small stream. Its flow condition is an open condition.
		Irrigable area Maize and other vegetable are being cultivated at the most downstream of the beneficial area,  Irrigable area
13.	Remarks:	- Secondary canal shall be placed with lining in order to minimize its water conveyance loss. - Leakage is observed at right side of the embankment

GE.8 Kanundwa Irrigation System (District) (November, 2010)

	Items	Descriptions
1.	Irrigation System	Kanundwa Irrigation System
2.	Irrigable area	18ha (Reported by MACO -ha)
3.	Coordination, elevation	S16° 11’ 45.4", E27° 20’ 7.7"
4.	Completion year	1988 (dam), 2008 (Intake and irrigation canal)
5.	Province	Southern Province
6.	District	Monze District
7.	Beneficiaries	Kanundwa camp, Ntem block (Tuswangane, Tubungone, Tibunbu, Namanene, Namonga cooperatives
8.	Number of households	120 households
9.	Water source	Hufwa River
10	Irrigation system	Dam (6m high from the ground surface), spillway (Crest length is about 25m) Siphon (Right 60mm ×1, left 60mm×1) Irrigation canal (Brick + mortar plastering, right 165m, left 250m)
11.	Present condition	- Both siphons are not functioning since 2009. The MACO looked for the reason, but it has not yet being repaired. - In total of 120 gardens were demarcated to 120 households. (60 gardens each side)
12.	 	Reservoir (Left), spillway (Right) Free board of embankment is about 1.7m. Spillway canal should be installed to avoid flooding in the both dam abutments.
		Intake Siphon box (Left bank)
		Siphon (60mm×1)
		Inlet pipe (siphon) Pipe is made of polyethylene pipe.
		Outlet of siphon (Left bank)
		Outlet of siphon (Right bank)
		Pipe line (Right bank) crossing gully eroded stream Dia 100mm (Asbestos)
13.	Remarks	- Canal dimension varies; W0.25×H0.35m to W0.18×H0.35m in the right bank canal. - Length of a siphon pipe is about 60m from the reservoir in each bank. - Embankment material is composed of sandy clay. Upstream of the embankment is severely eroded by impounding water. - Elevated farmland along the irrigation canal is also being irrigated by a bucket. (Upper part is not on a plan as an irrigable area). - Impounding water is used for irrigation, domestic and livestock use. Inland aquaculture is also conducted. WUA is not yet established. - Irrigable area can be expanded when the land tenancy issue is solved.

GE.9 Siafa-kweda Irrigation System (Choma District) (December 20, 2009)

	Items	Descriptions
1.	Irrigation System	Siafa-kweda Irrigation System
2.	Irrigable area	8ha (Reported by MACO -ha)
3.	Coordination, elevation	S 16° 47.539', E 27° 16.255', El. 1,257m
4.	Completion year	1962
5.	Province	Southern Province
6.	District	Choma District
7.	Beneficiaries	Siafa Water Users Association, Batoka camp, Batoka block
8.	Number of households	7 households
9.	Water source	Batoka reservoir
10	Irrigation system	Reservoir (approx. 120,000m^3) embankment is 4 to 5m in height and its length of about 100m. Bucket irrigation is only applicable.
11.	Present condition	- The reservoir has enough capacity for irrigation however, bucket irrigation cannot supply with the enough amount of irrigation water. - There exist two spillways at the both abutments. Right spillway was rehabilitated by the MACO in October 2000 with masonry and concrete. Length of the crest is 20m. - Beneficiaries have no technical service for system operation. - The reservoir capacity has been decreased due to 40 years of siltation since its completion.
12.	  The reservoir has capacity of 120,000m^3. Upstream of the embankment (Right).	
	 Spillway located at right side of the abutment was rehabilitataed in 2000	 Downstream of the spillway at right side of the abutment was heavily eroded due to floods.
	 Beneficial area at left side of the reservoir.	 Beneficial area immediately at the downstream of the reservoir.
	 Farmers used to cultivate maize and cabbage, and tomato.	 About 75% of the products are being sold to the traders.
13.	Remarks	- A cooperative is not yet established, thus no agricultural service has been provided. Farmers have requested to provide them with certain services, such as seed and fertilizer provisions. However, there has not been any service led by the Government. - Fisheries department visits the reservoir once a year for aquaculture purpose. - It was observed that two households of the beneficiaries out of seven are not so cooperative to the other beneficiaries.

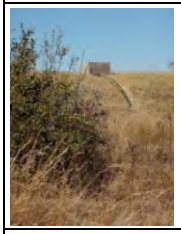
GE.10 Ndondi Irrigation System (Choma District) (November, 2010)

	Items	Descriptions
1.	Irrigation System	Ndondi Irrigation System
2.	Irrigable area	11ha (Reported by MACO -ha)
3.	Coordination, elevation	S16° 44’ 4.6", E27° 23’ 9.3"
4.	Completion year	2008
5.	Province	Southern Province
6.	District	Choma District
7.	Beneficiaries	Ndondi Irrigation Scheme Cooperative, Ndondi camp, Batoka block (Ndondi cooperatives, Ndondi Farmers Association)
8.	Number of households	127 households
9.	Water source	Ndondi river
10	Irrigation system	Dam (30,000 m^3), spillway (crest length =23m) Siphon type intake (Right 40mm ×5 pipes, left 40mm×4 pipes) Irrigation canal (Brick+ mortar plastering: Right 150m, left 350m)
11.	Present condition	- Intake capacity of the right bank is small due to small diameter of the intake pipe. - Dam and irrigation committee was established and irrigation fee has been collected.
12.		Dam and reservoir Water level was about 1.5m lower than that of the full water level at the end of the dry season in 2010.
		Spillway (Crest length= 23m) Apron (Stone masonry), end sill were constructed immediately at the downstream of the crest concrete.
		Spillway canal consolidation at the downstream of spillway canal
		Right bank canal
		Valves in the pit (Left side canal)
		Valve pit and irrigation canal (Left side canal)
		Outlet of the irrigation canal Secondary canal (on-farm canal) was not well installed.
13.	Remarks	- Floods overflew the dam embankment after its completion in 2008. Therefore the spillway was widened from 10 to 23 m by the MACO. - According to the beneficiaries, water volume is insufficient due to the small diameter of the intake pipes (40mm). Length of the conduit pipes is about 70m from the reservoir. - Total irrigation area of 7.3 ha was divided into 127 plots to be allocated to the beneficiaries during land demarcation. - Free board of the embankment is about 1.5m.

GE.11 Nkandabwe Irrigation System (Sinazongwe District) (November 26, 2009)

	Items	Descriptions		
1.	Irrigation System	Nkandabwe Irrigation System		
2.	Irrigable area	10ha (Reported by MACO 10ha)		
3.	Coordination, elevation	S 17° 05.272', E 27° 28.940', El. 556m		
4.	Completion year	1980s		
5.	Province	Southern Province		
6.	District	Sinazongwe District		
7.	Beneficiaries	Nkandabwe agricultural camp		
8.	Number of households	84 households		
9.	Water source	Reservoir (The reservoir originates in inundation of the open pit coal mine. Water depth may reach to several tens meters however, available water depth is limited to about surface two meters because of the location of the intake elevation.)		
10	Irrigation system	Retaining wall dam (Masonry) Main and lateral canals		
11.	Present condition	- When a drought lasts for several years, intake volume through the intake facilities decreses considerably. Thus a pump is utilized to increase the amount of water in the reservoir. - The Cooperative provides seed, fertilizer and pestside with a payment of ZMK100 thousand rima/ha.		
12.		A long distance view of the reservoir Weir is seen in the center, behind the electric pole.		View of the reservoir (Open pit of mining)
		Diversion weir can be structurely categirized into a buttress type made of stone masory. Spillway is located at the center of the weir crest.		Energy stilling basin is still well functioning while buttress wall at the downstream is severely damaged. Slight water leakage was observed at the downstream slope of the weir body.
		Intake of the weir Intake volume is controlled by a sluice valve.		Farmland During the dry season, maize and vegetable are being cultivated using storage water from the reservoir
		Diversion pit Main and lateral irrigation canals are being lined with concrete and mortar.		Open mine near the water surface (inhabitants are illegally exploiting the coals)
13.	Remarks:	- According to the beneficiary, sulfur found in coal is causing their teeth color to change into yellow - Reservoir capacity remains three years irrigation capacity for the irrigation in the dry season.		

GE.12 Nabuyani Irrigation System (Kalomo District) (November, 2010)

	Items	Descriptions		
1.	Irrigation System	Nabuyani Irrigation System		
2.	Irrigable area	20ha (Reported by MACO -ha)		
3.	Coordination, elevation	S16° 57’ 42.8", E26° 43’ 45"		
4.	Completion year	2005 (Dam intake, irrigation canal)		
5.	Province	Southern Province		
6.	District	Kalomo District		
7.	Beneficiaries	Nabuyani Farmers Group, Nabuyani camp		
8.	Number of households	-- households		
9.	Water source	Nabuyani River		
10	Irrigation system	Dam, Intake (Siphon type) Irrigation canal (250m, 450m)		
11.	Present condition	- Irrigation fee (ZMK 10,000 per annum) is collected by Irrigation committee. - The elevated farmland is being irrigated using a bucket and treadle pumps.		
12.		Dam embankment Slope is well maintained by the farmers.		Spillway Photo shows overflow crest of the spillway.
		A pipeline crossing the gally portion		Irrigation canal
		Siphon pit on the embankment		Siphon (Pipe material is polyethylene pipe) It is preferable to replace polyethylene pipe with PVC pipe.
		Irrigation canal Canal is composed of brick and mortar lining.		Treadle pump is used for irrigation.
13.	Remarks	- Drainage improvement was conducted by Conservation Farming Unit (CFU, ZNFU). - Rice cultivation was experimentally carried out in the lowest farmland. - Inland aquaculture and banana cultivation were introduced. - Tomato, maize, cabbage and rape are produced. - Farmland is well maintained. - Damages by cattle and water logging are the problems in the area. - Impounding water is used from March to November. Intake is well controlled during the wet season.		

GE.13 Mulabalaba Irrigation System (Kazungula District) (July 2, 2010)

	Items	Descriptions
1.	Irrigation System	Mulabalaba Irrigation System
2.	Irrigable area	6ha (Reported by MACO -ha)
3.	Coordination, elevation	S17° 27.268', E 26° 01.549'
4.	Completion year	1998 (Canal construction in 2004)
5.	Province	Southern Province
6.	District	Kazungula District
7.	Beneficiaries	Kabuyu camp, Mosokotwane block (Mukamba Cooperatives)
8.	Number of households	39 households at present (82 households in target)
9.	Water source	Tributary of Nampongo River
10	Irrigation system	Dam (158,000 m^3) Canal 500 m (Brick with mortar lining)
11.	Present condition	- Reserved water is supplied through two siphon pipes (dia. 100mm×2pipes) - Irrigation canal is located at the left bank of the river. Rotation irrigation is applied. Interval is 3 days, block 1, block 2 and surplus one day. Three days rotation may be difficult when 82 farmers join the project because the present water distribution method will take time to supply individual plot with enough water, especially by bucket irrigation. - Spillway was found damaged by flood, and about 2 lit/sec of seepage was observed at the downstream of the embankment, mainly from the foundation. - Cultivated products are cabbage, fresh maize, rape, onion, eggplant and impwa, etc.
12.		Reservoir area Sufficient water is stored in the reservoir.
		Spillway Concrete wall is applied to the spillway body.
		Apron downstream of spillway weir was heavily damaged. Spillway erosion may accerelate the damage in the apron concrete if no protection work is performed.
		Water tap for siphon A pipe with its diameter of 100mm (polyethylene) was installed on the dam crest.
		Diversion pit of the irrigation canal. Canal water is diverted by the clogging of earth materials.
		Irrigation canal Canal is composed of brick and mortar plastering.
		Stagnant water due to seepage from the dam or the foundation.
		Treadle pump Farmers operate the treadle pump for 8 hours a day.
13.	Remarks:	- The farmlands are equally divided into 5 ha. Only 39 plots are being cultivated by the respective farmers. Thus about half of the total plots of 82 are not in use at present since some of the farmers are not so eager to cultivate the land. - Irrigation fee of K12,500 is collected per annum. Although, this amount seems too little.

14.		Embankment Weeding was performed by the farmers. Water level of the reservoir was declined for about 1.5m from the full water surface.		Conolidation work by a concrete wall in the spillway canal. The work was financed by the USAID.
		Side wall protection of the spillway canal with concrete. The work was financed by the MACO.		Apron concrete immediately at the downstream of the spillway overflow crest was damaged by floods. Downstream apron should be protected with concrete slab.
		One of the siphons was damaged by clogging of materials in the PVC pipe.		Inlet of the siphon pipe. Flap valve is correctly functioning according to the farmers. (Dia. 60mm)
		Division pit along the irrigation canal. Secondary canal is not well maintained.		Diversion of the water is through the narrow opening.
15.	Remarks:	- Vegetable is cultivated in a few farm plots. Although, the farmer claimed that the low market price in this October lessened their motivation for farming. - Because of the decline in water level of the reservoir and a single use of the siphon pipe, only 2 lit/sec of irrigation water can be diverted for cultivation. - Secondary canal is not correctly maintained at most of the farm plots. A market channel should be rapidly introduced for the farmers to raise their incentive for irrigated agriculture.		

PE.1 Ipufu Irrigation System (Chingola District) (December 2, 2009)

	Items	Descriptions
1.	Irrigation System	Ipufu Irrigation System
2.	Irrigable area	122ha (Reported by MACO 80ha)
3.	Coordination, elevation	S 12° 31.330', E 27° 40.419', El. 1,269m
4.	Completion year	1968
5.	Province	Copperbelt Province
6.	District	Chingola District
7.	Beneficiaries	Ipufu Cooperatives
8.	Number of households	44 households
9.	Water source	Ipafu River
10	Irrigation system	Electric pump (150mm×2, 150mm) Pipeline (1line, 200mm) Reservoir (not in use due to a large seepage loss)
11.	Present condition	- Coffee cultivation was started in 2004 with an assistance of the Government (Zambia Coffee Board). After pull-out of the Coffee Board in 2007, the farmers could not manage the project, especially in shortage of water, fertilizer and pesticide supply. 50% of the coffee trees are dying at present. - The farmers managed to obtain irrigation water, e.g., bucket irrigation using groundwater in the borehole that is, 7 to 8 m in depth.
12.		Pump house near the river The pump is not operating for the last three years because of a shortage in operation cost.
		Pumps installed by the financial assistance of the Zambia Coffee Board
		Reservoir The reservoir is not being used due to its large seepage loss.
		Lateral canals are lined with concrete. It has been 30 years since the completion, thus concrete canals are heavily damaged.
		Inter cropping of coffee tree and maize. Coffee was finally harvested after three years since transplanting.
		Emitter on the drip tube. Necessary pressure is given by the direct connection with pipeline.
		Dambo located near the Ipafu Irrigation Scheme Introduction of a proper drainage system may create a large irrigation area.
13.	Remarks:	- The Government support is effective to re-organize Ipafu cooperatives. - Man-power irrigation shall be introduced to the individual farmer instead of electric pump use.

PE.2 Chapula Irrigation System (Kalulushi District) (December 2, 2009)

	Items	Descriptions
1.	Irrigation System	Chapula Irrigation System
2.	Irrigable area	21ha (Reported by MACO 20ha)
3.	Coordination, elevation	S 12° 55.384', E 28° 01.113', El. 1,201m
4.	Completion year	1970s
5.	Province	Copperbelt Province
6.	District	Kalulushi District
7.	Beneficiaries	Chapula agricultural camp (Nkamo growers multi-purpose Society)
8.	Number of households	30-40 households in the irrigable area
9.	Water source	Chapula River
10	Irrigation system	Electric pump (55kW×2 pumps, 200mm) replacement in 2005 Pipeline (150mm) Reservoir (2,500m^3) Canal (Total length of 6km including lateral canal)
11.	Present condition	- Cooperatives pay ZMK400,000/year as a maintenance fee with a subsidy by the Government. - Pump rehabilitation is urgently needed (replacement of coupling, bearing, etc.) - A large head loss between 3km pipeline connecting the pump to the reservoir is causing a shortage of the irrigation water. In addition, a large concrete crack in the irrigation canal is causing severe water leakage. - Deep sand accumulation in the reservoir reduces an effective water storage capacity of the reservoir. - Crop: Green maize, okura and orange
12.		Irrigation area (Maize, orange, okura, etc.) Farmers own their farms in contract base with the collage.
		Lateral canals with concrete lining
		Suction pipe of the pumps The river water level is lowered at the end of the dry season.
		Electric motors (55kW×2 pumps)
		Main canal A large crack on the concrete lining is causing severe water leakage.
		Main canal Lining concrete is heavily damaged.
		Reservoir with its capacity of 2,500 m^3. Slope lining can reduce water seepage. Outlet of the reservoir (photo in right)
		
13.	Remarks:	- FAO, UNDP launched the irrigation project in 1969 and pulled out from it in 1981. - Irrigation area is owned by the Chapula Agricultural Training Center. 6 month in-service course for the MACO's employees and farmers

PE.3 Chibote Irrigation System (Kalulushi District) (July 30, 2010)

	Items	Descriptions		
1.	Irrigation System	Chibote Irrigation System		
2.	Irrigable area	70ha (Reported by MACO -ha)		
3.	Coordination, elevation	S12° 52.073', E28° 9.772'		
4.	Completion year	1995		
5.	Province	Copperbelt Province		
6.	District	Kalulushi District		
7.	Beneficiaries	- Camp, - Block - Water Users Association		
8.	Number of households	30 households		
9.	Water source	Stream		
10	Irrigation system	Electric pump Pipeline		
11.	Present condition	- The pumps are not operating due to an insufficient collection of the electric fee.		
12.		The pump house located close to the stream. The pumps are not operating due to an insufficient collection of the electric fee.		Suction pipes were installed to deliver stream water.
		Banana cultivation		-do-
		Micro sprinkler in the farmland.		-do-
13.	Remarks:	- Pump irrigation system is not operating due to the poor water management capacity of the farmers		

EP.4 Mukonchi Irrigation System (Kapiri Mposhi District) (December 11, 2009)

	Items	Descriptions
1.	Irrigation System	Mukonchi Irrigation System
2.	Irrigable area	-ha (Reported by MACO 200ha)
3.	Coordination, elevation	S 14° 12.997', E 28° 53.371', El. 1,174m
4.	Completion year	1970s
5.	Province	Central Province
6.	District	Kapiri Mposhi District
7.	Beneficiaries	Nompondu Agricultural Cooperatives, Mukonchi camp, East Bank block
8.	Number of households	(Camp: more than 2,000 households)
9.	Water source	Mubofwe dam (river)
10	Irrigation system	Reservoir (2 million m^3) Diesel pump (3 pumps, all damaged) Pipeline (Main 300mm, lateral, 150 - 200mm) Regulating pond (2 sites)
11.	Present condition	- The reservoir stores water to the full level. - Pumps and pipelines are not in use since 1988.
12.	 Reservoir The reservoir was constructed to supply water for tobacco production.	The reservoir itself is under maintenance by the MACO, but the storage water is under the Ministry of Energy and Water Development Control.
	 Two intake gates are operating by spindle. A stoplog plate is used to repair the gates. Spindle handles can be removed.	 Spillway There found no severe damage in the spillway concrete.
	 Regulating pond Regulating pond is located at 5km from the pump station at the dam site. Water from the reservoir is first supplied into the pond. Stand pipes are the inlet pipes.	 Water supply pipes and control valves located immediately at the downstream of the regulating pond. All valves were removed.
	 Pump house located at downstream of the reservoir.	 Pumps at Mukonchi dam B: see Remarks below Pumps were exchanged to electric pumps by commercial farmers (Foreigner).
13.	Remarks:	- There are two irrigation systems in Mukonchi area; Mukonchi A (Nouth) and B (South). Mukonchi B is well operated by commercial farmer(s) after it being sold by the Government. Pumps were exchanged to electric pumps by the farmer (s). - Irrigation system was completed in 1970s for tobacco cultivation by the Zambia Tabacco Board with irrigable area of more than 2,000 ha and 50 commercial farmers. Since the board pulled out from the operation because of the decline in tobacco price in 1988, the system is neither well operated nor maintained. - Presently, according to the farmers, the irrigation area of about 2,000 ha is being used by about 2,000 farmers within a refined condition and dambo use. - Agricultural Cooperatives exist only for getting fertilizer and seeds from the MACO.

EP.5 Tubalange Irrigation System (Lusaka District) (December 9, 2009)

	Items	Descriptions		
1.	Irrigation System	Tubalange Irrigation System		
2.	Irrigable area	17ha (Reported by MACO 5ha)		
3.	Coordination, elevation	S 15° 20.405', E 28° 11.259', El. 1,150m		
4.	Completion year	1999 (Tubalange reservoir by Rural Investment Fund: RIF) under the MACO 2001 (Irrigation equipment, e.g., electric pump, pipeline, etc.)		
5.	Province	Lusaka Province		
6.	District	Lusaka District		
7.	Beneficiaries	Namolombwe camp, Lusaka west block Tubalange Multi-porpose Society Cooperatives (established in 1960s)		
8.	Number of households	30 households (Cooperatives member: 100 household)		
9.	Water source	Reservoir (Mupilu River)		
10	Irrigation system	Reservoir (approx. 25,000m^3) Electric pump (not installed) Pipeline (not installed) Open canal (earth lining)		
11.	Present condition	- Since the Cooperative did not fulfill its function for several years, the irrigation system has not been well operated. Electric pump and pipeline (PVC) were removed and stored in the warehouse. - Tractor owned by a farmer is available for rent (ZMK450,000/ha) - Some farmers who own the farmland near the reservoir are using a movable diesel pump.		
12.		Reservoir (approx. 25,000m^3)		Embankment was completed in 1999
		Spillway of the dam		Rehabilitation of the spillway increased the reservoir capacity
		Overview of the farmland		Maize cultivation using reservoir water in the dry season.
		Vegetable and bean cultivations using reservoir water in the dry season.		Tractor is available in rental from one farmer.
13.	Remarks:	- Cooperatives own the farmland of about 5ha. Farmers shall pay land use fee of ZMK120,000/season/rima (ZMK480,000/season/ha) - At least 1 m raise of spillway crest (rehabilitation) increases the reservoir capacity on condition that the 1.5m of free board is secured for dam safety.		

EP.6 Clixby Irrigation System (Kafue District) (November 25, 2009)

	Items	Descriptions
1.	Irrigation System	Clixby Irrigation System
2.	Irrigable area	67ha (Reported by MACO 4ha)
3.	Coordination, elevation	S 15° 49.853', E 28° 12.986', El. 982m
4.	Completion year	July 2006 (1st stage: Pump installation in 1995, 2nd stage: Pipe and storage tank installation, 3rd stage: Transmission line, storage tank)
5.	Province	Lusaka Province
6.	District	Kafue District
7.	Beneficiaries	Kasaka agricultural camp
8.	Number of households	22 households
9.	Water source	Kafue River
10	Irrigation system	Electric pump: 150mm (one stand-by pump) Pipeline:
11.	Present condition	- Since the system completed in 2006, no farming record is taken. - Crops: Maize, beans, tomato, eggplant, onion, okura, etc. - Sprinkle irrigation is applied to the irrigation. - One million ZMK is paid to the Water Board as a water fee per annum
12.		Water from the Kafue river is pumped up for irrigation use.
		Overview of the pump station near the lake
		Sump basin and pump house
		Sump basin
		Suction pipe in the sump basin. Weeds growing in the basin may cause a suction problem.
		Electric poles and transformer for power supply to the pump.
		Water tank with its capacity of approximately 200 m^3. Steel tank was procured as a secondhand.
13.	Remarks:	- Construction budget: 75% by the Government (MACO), 25% by Water Users Association - Construction cost: 1 million ZMK on each beneficiary - Redeem problem - The irrigation system has not been operated since 2010 due to a shortage of operation cost (electric fee).

EP.7 Lusitu Irrigation System (Siavonga District) (November 30, 2009)

	Items	Descriptions
1.	Irrigation System	Lusitu Irrigation System
2.	Irrigable area	140ha (Reported by MACO 28ha)
3.	Coordination, elevation	S 16° 08.274', E 28° 51.124', El. 379m
4.	Completion year	1971 (Rehabilitated by the Tonga Development Project in 1998)
5.	Province	Southern Province
6.	District	Siavonga District
7.	Beneficiaries	(Lusitu Irrigation Cooperatives)
8.	Number of households	46 households
9.	Water source	Zambezi River
10	Irrigation system	Electric pump station 1 (200mm), 12 hours operation (6:00 a.m. – 6:00 p.m.), asbestos pipeline of 150mm diameter Electric pump station 2 (22 kW, 100mm), installed by the Zambezi River Authority in 2006 Pump station 1 was financed by Tonga Irrigation Project (WB) Pump station 2 was financed by Zambezi River Authority) Pipeline, earth lined/ concrete lining canals
11.	Present condition	- Rotation irrigation is applied (8 farmers/ day, 2 times/ week) - Crops: Maize, cabbage, potato, okura, cassava, banana, etc.
12.		Pump station 1  200mm pump was installed in 1998.
		Outlet of the pipeline. Water is supplied to the irrigation area through a concrete lined canal. Canal was in a heavily decrepit condition.  A farmer distributing water into each furrow within a smaller plot in order to save some water.
		Pump station 2 Small diameters (100mm) of suction and supply pipe are causing high head water loss.  Pump was placed by the Zambezi River Authority
		Concrete pit connected with pipeline from the pump station 2.  The main irrigation canal lined with concrete.
13.	Remarks:	- WB will provide financial support for 200ha of the newly irrigated area (Present irrigable area is exclusive from the project) - Pump system 1 was rehabilitated by the Tonga Development Project in 1998. However, the actual pump operation was recently started due to a problem in the pipeline.

EP.8 Kapululira Irrigation System (Siavonga District) (December 30,2009)

	Items	Descriptions
1.	Irrigation System	Kapululira Irrigation System
2.	Irrigable area	51ha (Reported by MACO 70ha)
3.	Coordination, elevation	S 15° 57.695', E 28° 54.079', El.371m
4.	Completion year	1970
5.	Province	Southern Province
6.	District	Siavonga District
7.	Beneficiaries	Kapululra camp (village), Musaya Block
8.	Number of households	82 households (old farmers: 41 farmers, new farmers: 41 farmers)
9.	Water source	Zambezi River
10	Irrigation system	Electric pump station 1 (300mm, 200mm), pipeline (asbestos pipe) Electric pump station 2-1 (150mm, 125mm) Replaced in 2004, irrigable area: 15ha Electric pump station 2-2 (150mm, 150mm), capacity 20 grm each irrigable area 30ha
11.	Present condition	- Operation of the pumps is 12 hours (6:00a.m. – 6:00 p.m.) - Irrigation fee (electric fee): ZMK60,000/farmer/month - Bearing was damaged in the pumps in station 1. - Small pumps in the pump station 1 are not properly operating because of the cracked and inclined walls and base floor. - Water level of the Zambezi river fluctuates about 1.5 m between the wet and dry seasons. - Banana is the typical product of the irrigation area. - Pressurized irrigation water is supplied through pipeline networks. In on-farm level, open channel (earth lined) are distributed downstream of outlets of the pipeline valves.
12.		Water source: Zambezi river
		Electric pump station 1
		Two pumps were installed
		On farm outlet Angle and sluice valves were installed to supply water to the irrigation area through an earth lined canal.
		Electric pump station 2-1 Pump station 2-1 and 2-2 are adjacent, with distance of about 500m from the pump station 1.
		Pumps in the station 1 Pumps were replaced in 2004.
		Electric pump station 2-2 About 20m downstream from the pump station 2-1.
		Pumps in the station 2-2
13.	Remarks:	- Some farmers are settled from Zimbabwe. (Goaba tribe) - Farmers cultivate banana as a cash crop, thus they are buying maize as a staple food. - Pumps were replaced in 2004.

EP.9 Mubvumu/ Mandondo Irrigation System (Siavonga District) (December 18, 2009)

	Items	Descriptions
1.	Irrigation System	Mubvumu/ Mandondo Irrigation System
2.	Irrigable area	12ha (Reported by MACO -ha)
3.	Coordination, elevation	S 16°’ 28.196’, E 28° 37.628’, El. 484m
4.	Completion year	---
5.	Province	Southern Province
6.	District	Siavonga District
7.	Beneficiaries	Siamatika Cooperatives, Gwena camp, Buchete Nkuyanda group
8.	Number of households	20 households
9.	Water source	Kariba dam (Zambezi river)
10	Irrigation system	Pump (three movable diesel pumps) Discharge 22 m^3/hour, dia. 50mm
11.	Present condition	- 3 engine pumps, 1 treadle pump were procured by “Harvest help”, Zambian NGO in 2003 - Crops: maize, pigeon peas, pumpkin, tomato, cassava, etc. - Tomato was damaged by insect. - Hippopotamus damaged tomato cultivation. Firm bet fence is effective to prevent damages of hippopotamus.
12.		Irrigated farmland is located near the waterside of the Kariba lake. The area shown in the photo is inundated during the wet season.
		Irrigated area Maize, tomato are main crops.
		Movable engine pump procured by NGO.
		Farmers convey the lake water though 50mm polyethylene pipe.
		Pigeon peas
		Tomato was damaged by insect.
		Swampy area which appears during the dry season is used for irrigation. flood recession cropping is applicable in the area.
13.		- Siamatika Cooperatives has 30 households from 11 villages. Seeds, fertilizer are supplied through the DACO office. - Swampy area appears when lake water level fluctuated. The length of swampy area is about 100m wide towards lake. - Kabyobyo camp has 10 households, and procured of 5 engine pumps and 2 treadle pumps by Harvest Help, NGO - MACO has not supported the scheme, thus the scheme is recognized as a “Planning”. - The area seems to be a resettlement of the Kariba dam construction.

EP.10 Siatwinda Irrigation System (Sinazongwe District) (November 27, 2009)

	Items	Descriptions
1.	Irrigation System	Siatwinda Irrigation System
2.	Irrigable area	78ha (Reported by MACO 30ha)
3.	Coordination, elevation	S 17° 26.053', E 27° 18.979', El. 487m
4.	Completion year	1968 (Operation was started August 2009)
5.	Province	Southern Province
6.	District	Sinazongwe District
7.	Beneficiaries	Muchekwa agricultural camp, Mwemba block
8.	Number of households	120 household
9.	Water source	Kariba lake
10	Irrigation system	Pump station (completed in 2004) (One stand-by pump) Pipelines (100mm – 150mm, 4 lines) Regulating pond (10,000m^3: 70m×70m×3m) Main canals (2 canals), lateral canals (4 canals), Pipeline was embedded to transmit the irrigation water to the diversion pit of each lateral canal.
11.	Present condition	- There is severe water leakage from the main and lateral canals. The leakage volume is about 15%, and inundation by leakage water hinders cultivation in relatively wider areas. - Most downstream lateral canal (Canal D) was not yet completed. Other canals should be rehabilitated, mainly against leakage problem. - Transmission pipelines from the pump to the regulating pond have a severe water leakage due to improper joint connection. - Furrow irrigation is applied for vegetable cultivation. - Cultivated crop: maize, okura, cowpea
12.		Suction pipe from the lake Suction sump was not installed. Water pumpage is not possible when lake water level is low. Wider and deeper pond should be constructed at suction.
		Electric pump
		Leakage from pipelines conncting between pump and regulating pond. Pipeline should be replaced with steel pipe of its diameter of about 300mm.
		Regulating pond Bank slope is protected by concrete lining.
		Outlet of the regulating pond
		Lateral canal (Canal A) and stop-log Canal bottom and slopes are protected with concrete panel.
		Leakage section of lateral canal Concrete lining is proper rehabilitation method to prevent leakage from joint instead of concrete panel.
		Furrow irrigation is applied to the vegetable cultivation. (Block C in photo)
13.	Remarks:	- Irrigation fee is collected only for electric cost. - Distribution of the four transmission pipelines causes high water head loss.

EP.11 Chiyabi Irrigation System (Sinazongwe District) (November 27, 2009)

	Items	Descriptions		
1.	Irrigation System	Chiyabi Irrigation System		
2.	Irrigable area	42ha (Reported by MACO 16ha)		
3.	Coordination, elevation	S 16° 58.012', E 27° 41.037', El. 519m		
4.	Completion year	1983 (Nanga Irrigation project)		
5.	Province	Southern Province		
6.	District	Sinazongwe District		
7.	Beneficiaries	Chiyabi agricultural irrigation camp		
8.	Number of households	35 household		
9.	Water source	Tributary of the Kariba lake		
10	Irrigation system	Diesel pump (removed) Main and lateral irrigation canal (severely damaged or no traces of the canals)		
11.	Present condition	- The system was completed in 1983 by the Nanga Irrigation project, however poor maintenance under the project resulted in only five (5) years operation.		
12.		Water source Tributary to the Kariba lake		Diesel pump had been installed along the water surface. (There found no trace of the pump house at present)
		Distribution pit to the main canal There is no use at present.		View of the beneficial area
		View of the beneficial area		Some farmers are cultivating vegetable.
		Irrigation canal (Lateral) Half pipe shape fabricated concrete canal was used for the irrigation canal		Irrigation canal (Lateral)
13.	Remarks:	- Irrigation system was not operated and maintained after a discontinuation of the Nanga Irrigation project. - Government support of the agriculture for the smallholders is expected. - Road condition (bottom road along the Kariba lake) to the markets, i.e., Sinazongwe and Choma is relatively good. - Nanga Irrigation Project was implemented in late 1960s for the purpose of irrigation. Chiyabi was one of the project site, MACO selected the area as a resettlement of people lived in the Tonga valley. Since project terminated, the farmers should maintain the system, however system was not operated due to poor operation and management of the farmers and insufficient Government support.		

EP.12 Buleya Malima Irrigation System (Sinazongwe District) (November 26, 2009)

	Items	Descriptions
1.	Irrigation System	Buleya Malima Irrigation System
2.	Irrigable area	69ha (Reported by MACO 45ha at present)
3.	Coordination, elevation	S 17° 14.922', E 27° 28.992', El. 613m
4.	Completion year	November 2004
5.	Province	Southern Province
6.	District	Sinazongwe District
7.	Beneficiaries	Buleya Malima agricultural camp (Buleya Malima multi-purpose Cooperative Society)
8.	Number of households	108 household
9.	Water source	Kariba lake
10	Irrigation system	Pump station (dia150mm×2), 2,940rpm, 30 PS) Regulating pond (3,000m^3: 40m ×40m×3m)
11.	Present condition	- One pump has not been operated due to bearing problem. - Cultivation crops are maize, beans, vegetables, orange orchard, and upland NERICA (1 rima: 25m×100m) under the Food Diversification Project. - Irrigation fee: ZMK120 thousand /rima/cropping (not include cost for seed, fertilizer supply by the cooperative.)
12.		Water source (Kariba lake) Fishing boats are shown on the photo.
		Two pumps were installed in the floating platform to control suction head against seasonal fluctuation of the water surface level of the lake.
		Pipeline from pumps to the regulating pond.
		Intake pit located immediately downstream of the regulating pond
		Main irrigation canal and stop-log Maize was mainly cultivated in the end of the dry season (November)
		Lateral irrigation canal Bottom and slops are lined with concrete plate. Canals are well maintained by the cooperatives.
	 	Regulating pond Inlet pipe from the pump station is in the right of the photo. Air supply pipe for outlet pipe is shown just this side in the photo.
13.	Remarks:	- AfDB provided financial support (SIP) - 45ha of the irrigable area was completed by the AfDB loan, remaining 30 ha has not yet funded. - Maize (MRI614, MM604) - Since the irrigation technical and administrative staffs are assigned at the site, operation and maintenance of the project has been well performed after project completion.

GP.1 Kakoso Irrigation System (Chililabombwe District) (July 13, 2010)

	Items	Descriptions
1.	Irrigation System	Kakoso Irrigation System
2.	Irrigable area	26 ha (Reported by MACO -ha)
3.	Coordination, elevation	S12° 22.596', E27° 51.051', El. 1,236m
4.	Completion year	--- (no irrigation facility installed)
5.	Province	Copperbelt Province
6.	District	Chililabombwe District
7.	Beneficiaries	Kakoso camp, Kameza block (No agricultural cooperative)
8.	Number of households	Approximately 200 households along the stream
9.	Water source	Springs located on the slope topographically depressed area
10	Irrigation system	Irrigation canal (Earth canal)
11.	Present condition	- Farmers cultivate by spring water. - As several springs are located on the slopes both sides of the stream, farmers constructed irrigation canals toward stream in relatively steep slope. - Irrigation canals are located adjacent to the farm, like netting shape. Deeper canal is useful to rapidly drain rainfall during the wet season. - Bucket irrigation is practicable to irrigate the farm area during the dry season. Farmers put small depression on the canal to draw water by bucket. - Furrow is not installed, so farm plot seems to be flat and thick carpet.
12.		Overview of irrigable area (see towards downstream of the area)
		Small spring at most upstream of the irrigable area. Tens of spring are located at the slope of the valley.
		Flow from the springs Canal is not lined and not properly dredged.
		Canals installed around the farm plots are mainly for drainage purpose, thus bucket irrigation is practicable in the system.
		Small depressions are constructed to draw irrigation water by bucket.
		Bucket irrigation Farmer is sprinkling the vegetable with spring water by bucket.
		Outlet of sewage disposal The water has a strong distasteful odor. Contaminated water flows into the stream at the center of the farm area.
		Sewage pond has not been operated for a long time.
13.	Remarks:	- Steep slope canal is susceptible to erosion especially in the wet season. However clayey soil may minimize the erosion. - Stream flow with sewage water is drown for irrigation purpose about 1 to 2 km downstream. Re-route of the sewage water by PVC pipe for 2 to 3 km long may improve water quality in the area. - The farmers upstream of the beneficial area can irrigate their farm land with perennial spring water.

GP.2 Bwafwano Irrigation System (Kalulushi District) (July 5, 2010)

	Items	Descriptions		
1.	Irrigation System	Bwafano Irrigation System		
2.	Irrigable area	60ha (Reported by MACO -ha)		
3.	Coordination, elevation	S12° 48.066', E28° 5.977', El. 1,236m		
4.	Completion year	---		
5.	Province	Copperbelt Province		
6.	District	Kalulushi District		
7.	Beneficiaries	Ichimpe camp, Mwambashi block Twafwane, Bulimi and Tionge agricultural cooperatives from upstream area		
8.	Number of households	20 households		
9.	Water source	Stream flow and outflow from settlement pond of cooper mining (Mindro pond)		
10	Irrigation system	Irrigation canal (Earth lining) Diversion canal from settlement pond (Mindro pond)		
11.	Present condition	- Rotation irrigation is applied to the water system. - A half of water is from stream, remaining is from settlement pond. - Water from the settlement pond seems to be not contaminated according to the water quality tests by the Study team. - Area of 1/3 of beneficial area is irrigated by bucket because the irrigation canal is lower than the beneficial area, thus 2/3 of beneficial area is by gravity. - Most downstream area of about 25% of whole area is not irrigated after the end of June when water is insufficient.		
12.		Most upstream of beneficial area Intake weir is not constructed due to unstable foundation.		Upstream farmers use one of streams.
		Main irrigation canal Water is diverted by earth clogging.		Main irrigation canal Since main irrigation canal has shallow, water flow capacity of the canal is insufficient according to farmers.
		Secondary canal Since the area is topographically steep, water reached to the downstream end in relatively short time.		Farmer introduces irrigation water in each furrow by closing on-farm canal.
		Outlet of the Mindro pond of copper mining.		Inlet of excessive water drainage in the Mindrot pond. Inlet pipe diameter is about 400mm. The discharge is variable due to rainfall, discharge amount of mining operation, etc.
13.	Remarks:	- Water quality of water from the settlement pond shall be continuously checked. - Irrigation canal lining with concrete reduces water conveyance loss. - Discharge water from the Mindro pond varies depending on rainfall, mining factory operation, etc. The maximum level at pipe inlet in the pond is about 0.3m according to the farmers.		

12.		Inside of the Mindro pond (Upstream 2 inlets) Channel to introduce impounding water to the inlet almost dried up in November.		Inlet in the Mindro pond. Spilled water depth is so small because the water surface of the pond has declined during the dry season.
		Inlet in the Mindro pond. Spilled water depth is less than 1 cm. (Most downstream inlet)		Outlet of the drainage pit. A little water from the pond runs out by seepage before the beneficial farm.
		Farm land Cultivation is in a few farm lands in October to November.		Farm land Cultivation is in a few farm lands.
		A farmer pumps up water of stream (like dambo) by movable engine pump.		A small bore hole is one of the water source in the end of October to November. A little groundwater gushes out from impervious clayey soil layer.
13.	Remarks:	- Irrigation activities depend on storage water in the Mindro pond. Since impounding water has decreased due to heavy evaporation from the water surface, water drained from the pond is insufficient for irrigation. - Since the price of vegetables is low in the end of the dry season because of adequate market sanction from irrigated agricultural land in the vicinity area, the farmers are not eager to cultivate vegetables according to farmers.		

GP.3 Kasamba Irrigation System (Kapri Mkoshi District) (July 14, 2010)

	Items	Descriptions
1.	Irrigation System	Kasamba Irrigation System
2.	Irrigable area	12ha (Reported by MACO -ha)
3.	Coordination, elevation	S13° 56.396', E28° 51.400', El. 1,200m
4.	Completion year	1998
5.	Province	Central Province
6.	District	Kapri Mkoshi District
7.	Beneficiaries	Lukomba camp, Lunchu block (Kandenke cooperative)
8.	Number of households	72 households
9.	Water source	Luanshimba river
10	Irrigation system	Dam without intake facility
11.	Present condition	- Dam has no intake facility, so no irrigation activity is found in the area. - Farmers immediately downstream of the embankment use water spilled out from the spillway for irrigation purpose. Water table in the reservoir is almost stable in the dry season. - Downstream of the dam is inundated in the dry season, thus farmers can use the water for irrigation.
12.	 Overview of the reservoir	 Upstream of the dam embankment (Spillway at this side of photo)
	 Downstream slope of the embankment	 Spillway has not been well maintained. Weeds may prevent smooth flow of flood.
	 Flow through the spillway Spillway channel has heavily eroded by floods.	 Foundation of the spillway Foundation is composed of sediment rock with 10 to 15 mm particle stone, thus the foundation layer is permeable.
	 Proposed area of irrigation farm	 Few farmer can cultivate the vegetable with dam water immediately downstream of the dam.
13.	Remarks:	- Food water has overtopped from the dam embankment for three times after its completion of 1998. - Right side abutment was collapsed after three months from the completion, so there is relatively deep erosion on the downstream slope of the embankment. - Rising crest of the embankment enlarges storage capacity of the reservoir. - Seepage from both sides of the embankment is observed. Seepage volume amounts to 4 to 5 lit/sec.

GP.4 Juda Irrigation System (Kapiri Mposhi District) (July 30, 2010)

	Items	Descriptions		
1.	Irrigation System	Juda Irrigation System		
2.	Irrigable area	8ha (Reported by MACO -ha)		
3.	Coordination, elevation	S14° 2.064', E28° 37.993'		
4.	Completion year	1998		
5.	Province	Central Province		
6.	District	Kapiri Mposhi District		
7.	Beneficiaries	- camp, - block No Water Users Association (Individual use)		
8.	Number of households	200 households		
9.	Water source	- river		
10	Irrigation system	Dam Movable engine pump		
11.	Present condition	- Intake facility is not installed. - Bucket irrigation is applied to the irrigation. - Some farmers utilize movable engine pumps		
12.		Dam embankment (Photo was taken from the right side abutment)		Spillway
		Pipe line for irrigation purpose		Beneficial area
		Preparation of tomato cultivation		Cabbage was planted on the furrow.
13.	Remarks:	- Dam was completed by MACO. - Since no intake facility was installed, irrigation was not conducted.		

GP.5 Natuseko Irrigation System (Kabwe District) (July 30, 2010)

	Items	Descriptions		
1.	Irrigation System	Natuseko Irrigation System		
2.	Irrigable area	20ha (Reported by MACO -ha)		
3.	Coordination, elevation	S14° 23.622', E28° 27.462'		
4.	Completion year	No facility		
5.	Province	Central Province		
6.	District	Kabwe District		
7.	Beneficiaries	Kuputuba camp, Motomoto block, Motomoto cooperatives No Water Users Association		
8.	Number of households	30 households		
9.	Water source	Small stream, groundwater		
10	Irrigation system	No facility Farm land is roughly estimated about 20 ha out of the total land area of 50 ha of the Natuseko area.		
11.	Present condition	- Buckets and treadle pumps are used for irrigation. - Movable engine pump has not been used in the scheme. - Ground water in the small holes are water source for irrigation in elevated areas. Farmers bore small holes to collect groundwater in shallow depth, and dug ditch to convey groundwater to their farm lands. - Small stream located at most lower area is available for irrigation by bucket.		
12.		Small hole and ditch for irrigation in the dry season Water level was at ground level even in the end of July.		Small canal ditch has enough water due to high groundwater level in July.
		Small stream at lower part of the area Water is available until September according to the farmers.		One framer has constructed small ditch to draw the stream water into his farm land.
		Farmland in lower area Water is flow into the farm land through furrow.		Relatively wide and deep furrow (Wide and deep furrow is for water storage and prevention from water logging according to the farmers)
		Deeper furrow is useful to prevent root from rotting.		Vegetable is cultivated in furrow bottom in the dry season, on contrarily, cultivated on the top of furrow in the wet season.
13.	Remarks:	- Farmers desire eagerly to obtain movable engine pump to enlarge their cultivated lands. For this purpose, marketing condition shall be improved to increase farm income for the a payment of fuel. - One farmer can irrigate at most 1 rima (0.25ha) due to a limitation of labor force.		

14.			Whole area of the Natuseko area. Land area is estimated at about 50 ha.	
		Sewage pond located at most southern (upstream) part of the Natuseko area. Water is not so contaminated even in the end of the dry season, 2010.		Outlet of sewage pond. Outflow mainly by rainfall is observed from January to March every year.
		Ditches were excavated to introduce stream water into farm land to lighten labor force for drawing water for irrigation.		Farmers make a furrow. As the top soil is clayey, tilling work is so laborious.
		Groundwater surface in the small bore hole is about 0.7 m below ground surface in the dry season (November).		Since surface layer is composed of fine silt, yield volume is limited.
15.	Remarks:	- Farmers cultivate vegetable such as tomato, okura, etc. - Since the market price of vegetables declines in October and November, farmers are reluctant to cultivated produces. - Sewage ponds are composed of 6 ponds. Discharge from textile factory operated by a Chinese private company flows into one of these ponds. Water is not so contaminated when rainfall is adequate according to a farmer.		

GP.6 Waya Irrigation System (Kabwe District) (July 30, 2010)

	Items	Descriptions		
1.	Irrigation System	Waya Irrigation System		
2.	Irrigable area	5ha (Reported by MACO -ha)		
3.	Coordination, elevation	S14° 31.504', E28° 29.979'		
4.	Completion year	No facility		
5.	Province	Central Province		
6.	District	Kabwe District		
7.	Beneficiaries	Tubakange camp, Waya block, no cooperatives Tubakange Irrigation group		
8.	Number of households	40 households		
9.	Water source	Muswishi river		
10	Irrigation system	No facility One farmer has movable engine pump		
11.	Present condition	- Most of the farmers use bucket for irrigation. - River flow is used for irrigation. Since farmers are not affordable to buy treadle pump and movable engine pump, they irrigate the farm land by buckets. - Water harvest method (Dip hole irrigation) is applied by the farmers.		
12.		Water sourece (Tributary of Muswishi river) Discharge is sufficient for irrigation, about 1 m^3/sec in July 2010.		Elevated farm land is used for staple crops (Maize) in the wet season.
		Small plot is 1.75m x 3.5m length. 5 to 6 buckets are enough to irrigated the small plot according to the farmer.		Dip hole is applied for water melon, pumpkin, as well.
		Canal was constructed between farm lands. It is mainly used for drainage during the wet season.		Farm area is irrigated by small stream.
		Farm area irrigated by small stream		Farm area in the undulated terrain.
13.	Remarks:	- Similar irrigable areas are located along the river in the Waya irrigation scheme. - Since ate area is located slightly undulated hilly terrain, it may be costly to construct irrigation canal.		

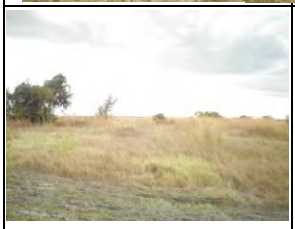
GP.7 Lifwambora Irrigation System (Chibombo District) (July 30, 2010)

	Items	Descriptions
1.	Irrigation System	Lifwambora Irrigation System
2.	Irrigable area	22ha (Reported by MACO -ha)
3.	Coordination, elevation	S14° 45.640', E28° 34.760'
4.	Completion year	Not identified
5.	Province	Central Province
6.	District	Chibombo District
7.	Beneficiaries	Lifwambora camp, Musswishi block, Lifwambora cooperatives
8.	Number of households	- households
9.	Water source	Lwamabwe river
10	Irrigation system	Dam (for domestic and animal use)
11.	Present condition	- Dam is not used because intake facility has not been installed. - Few farm lands are located at downstream of the dam. - Both slopes of the dam embankment were well maintained by the farmers. - Spillway channel bed was heavily eroded by floods. - A large volume of seepage flow is observed from both sides of the embankment. (Center to left side: 5 – 6 lit/sec, right side: 2 lit/sec)
12.		Overview of Reservoir
		Upstream of embankment is well maintained. Dam crest is used for local road.
		Spillway (Wideth=30m)
		Spillway bed has been heavily eroded by floods (Photo shows 25m downstream from dam axis)
		There exists sand rock about 1.5m below soil layer (Downstream of spillway)
		Downstream of embankment Slopes are well maintained by the farmers.
		Downstream of the dam has not been utilized for faming, however relatively flat terrain has an advantage to easily convert to a farm land.
13.	Remarks:	- Embankment has its height of 15m from the ground surface. - Dam crest is used for road. - Foundation rock has slightly wider cracks, and it may cause seepage through dam foundation. - Height between spillway bed and dam crest is about 2.5m. - Spillway is too close to the embankment, thus masonry wall shall be constructed to prevent erosion of dam embankment.

GP.8 Munga Irrigation System (Chibombo District) (July 30, 2010)

	Items	Descriptions
1.	Irrigation System	Munga Irrigation System
2.	Irrigable area	23ha (Reported by MACO -ha)
3.	Coordination, elevation	S14° 31.192', E28° 14.377'
4.	Completion year	Not identified
5.	Province	Central Province
6.	District	Chibombo District
7.	Beneficiaries	Kabwe camp, Kapandwe block, Malele cooperatives No Water Users Association
8.	Number of households	20 households
9.	Water source	Munga river
10	Irrigation system	Dam (no intake was installed)
11.	Present condition	- Heavy siltation has developed in the reservoir. - Intake was not installed on the embankment. - Farmers have been cultivating in the adjoining elevated land of the dam. - Water depth is 3m in deepest portion. - Seepage is observed through whole dam embankment.
12.		Siltation has developed.
		Dam embankment Both sides of embankment were well maintained.
		Dam downstream
		Downstream of dam is swampy area. Drainage work is required to dry up the area for farming.
		Downstream of embankment
		Embankment composed of clayey soil was partially eroded.
		Spillway shown from upstream Free board between spillway bed and embankment crest is minimal, i.e., 1m.
		Few farmers has started cultivation at immediately downstream of the dam.
13.	Remarks:	- Land allocation (land lease) promotes intensive farming at downstream of the dam. - Spillway shall be repaired to enlarge flow capacity. - Spillway is located at both abutment (left side' 30m wide, right side: 15m wide) - It is necessary to settle farmers to acquire labor force for scheme development.

GP.9 Chikupi Irrigation System (Kafue District) (July 5, 2010)

	Items	Descriptions
1.	Irrigation System	Chikupi Irrigation System
2.	Irrigable area	95ha (Reported by MACO 250ha)
3.	Coordination, elevation	S15° 43.473', E28° 2.785'
4.	Completion year	---
5.	Province	Lusaka Province
6.	District	Kafue District
7.	Beneficiaries	Chikupi agricultural camp, Mungu block (Mungu bloch consists of Canrad, Busiku and Chikupi camps)
8.	Number of households	50 households (5ha/household as a estate in 1990s)
9.	Water source	Groundwater from catchment area in the dry season (dambo)
10	Irrigation system	50 farmers individually operates farming using groundwater (dambo).
11.	Present condition	- Estate is composed of 50 households. (5ha per household) - Some farmers have engine pumps. - Water table is about 1.0m depth from ground level. - Wet season cultivation (maize) is dominant in the upper area.
12.		Area was inundated area of the Kafue river. The whole area is overgrowth of weeds.
		Farmers houses are scattered in the estate.
		-do-
		A cultivated area rarely exists in the area.
		Farmer uses a treadle pump for irrigation.
		Water table is 0.5m below from the ground surface.
13.	Remarks:	- Improvement of market accessibility to Kafue may accelerate irrigation activities. - It seems difficult to access into the area in the wet season due to poor road drainage system. Road embankment will tremendously improve agriculture infrastructure in the estate. - Dambo area is widely spread in the Chikupi area, thus large investment plan shall be established by the Government.

GP.10 Nakempa Irrigation System (Choma District) (July 30, 2010)

	Items	Descriptions		
1.	Irrigation System	Nakempa Irrigation System		
2.	Irrigable area	16ha (Reported by MACO -ha)		
3.	Coordination, elevation	S16° 58.045', E26° 51.413'		
4.	Completion year	1999		
5.	Province	Southern Province		
6.	District	Choma District		
7.	Beneficiaries	- camp, - block, - cooperatives		
8.	Number of households	15 households		
9.	Water source	- river		
10	Irrigation system	Dam and reservoir		
11.	Present condition	- Farmers obtained high farming skills. - Spillway shall be re-constructed to secure dam safety during flood. -		
12.		Dam embankment Slopes of the dam embankment were well maintained.		Downstream of the dam embankment
		Spillway There is no protection slab, and walls.		Spillway Weeds shall be removed from the spillway channel.
		Spillway Center of the spillway canal was eroded by flood.		Immediate downstream of the dam embankment Relatively plain area can be converted to farmland.
		Beneficial area Furrow irrigation is applied in the area.		Since farm land is located in the flat plain, installation of the irrigation canal system improves farm productivity.
13.	Remarks:	- Spillway canal bed shall be protected to prevent further erosion by flood. - Intake facility such as siphon type is recommended to promptly commence irrigation activities. - Beneficial area shall be demarcated among the potential farm area.		

GP.11 Siakasipa Irrigation System (Kazungula District) (July 1, 2010)

	Items	Descriptions
1.	Irrigation System	Siakasipa Irrigation System
2.	Irrigable area	8ha (Reported by MACO -ha)
3.	Coordination, elevation	S 17° 33.191', E 25° 56.184'
4.	Completion year	1988
5.	Province	Southern Province
6.	District	Kazungula District
7.	Beneficiaries	Musokotwane camp, Mosokotwane block (Mubula cooperative, Simuwida cooperative)
8.	Number of households	About 30households in the irrigable area
9.	Water source	River
10	Irrigation system	Dam embankment (no intake device)
11.	Present condition	- Spillways located at both sides of the embankment have insufficient capacity against flood. Protection of the spillway canal is required, in addition degradation of spillway canal raising the dam crest is inevitable to secure impounding capacity of the dam. - Sediment flow from the road has been rapidly reducing impounding capacity. - Since intake device was not installed, water was not effectively used. Farmers downstream of the dam use pumps to supply water for their farmlands. - Seepage water from embankment is observed. The seepage volume is minimal. - Cultivated produces are cabbage, fresh maize, rape, onion, eggplant, impwa, etc.
12.		Dam body and reservoir (see from left side abutment) Sediment flow from the road has been developed in the reservoir.
		Dam body and spillway (see from left side abutment)
		Spillway at the left side has insufficient flow capacity, so that it should be rehabilitated to secure dam safety.
		Spillway at right side abutment Since spillway canal elevation at right side is higher than that left side, flow capacity is minimal.
		Beneficial area (left side of stream)
		Beneficial area (left side of stream) Farmers use water spilled out through spillway of the dam for irrigation.
		Beneficial area (right side of stream) Water in the reservoir is directly diverted to the cultivated area by small pump.
13.	Remarks:	- Intake device surely increase farm production in the downstream farm land. - River capacity downstream of the dam should be improved to avoid inundation of cultivable area during the wet season. - Beneficial area is extended about 2 to 3 km downstream of the dam. - Proper drainage canal of road should be installed to minimize sediment inflow that causes deduction of impounding capacity of the reservoir.

Table T7.2.1 Potential Irrigation Schemes

	Name of potential area	Province	District	Water source	Irrigable area (ha)	1) Capacity of existing dam (m^3)	2) Catchment area (km^2)	3) Rough estimate of irrigable area (ha)	4) Irrigable area in/ around dambo (ha)	Other information
1	Fikolonga	Copperbelt	Chililabombwe	Stream	-	-	-	-	-	Perennial
2	Kakoso	Copperbelt	Chililabombwe	Stream	-	-	-	-	-	Perennial
3	Mingo'mba	Copperbelt	Chililabombwe	Dam, stream	-	-	-	-	-	Perennial
4	Milyashi	Copperbelt	Chililabombwe	Dam, river	-	-	-	-	-	Perennial
5	Cibwe	Copperbelt	Chililabombwe	Stream	-	-	-	-	-	Perennial
6	Chilima	Copperbelt	Chililabombwe	River, dambos	-	-	-	-	-	Perennial
7	Musakashi	Copperbelt	Mufulira	Kafue R. dambo	-	-	-	-	-	-
8	Murundu	Copperbelt	Mufulira	River, dambos	5	n/a	2.5	150	4	Perennial
9	Mupena	Copperbelt	Mufulira	Stream, dambo	2	n/a	2.0	100	1.5	Perennial
10	Kafue	Copperbelt	Mufulira	Kafue R. dambo	2	n/a	1.2	50	2	Perennial
11	Kalindini	Copperbelt	Mufulira	Stream, dambo	<1	n/a	1.5	50	0.25	Perennial
12	Horasho	Copperbelt	Mufulira	Stream, dambo	5	n/a	3.5	210	3	Perennial
13	Chibote	Copperbelt	Kalulushi	Stream	25	n/a	-	60	n/a	Perennial
14	Kameme	Copperbelt	Kalulushi	Stream	20	n/a	-	25	5	Perennial
15	Chembe east	Copperbelt	Kalulushi	Stream	0.5	n/a	-	30	10	Seasonal
16	Chembe west	Copperbelt	Kalulushi	Dambo	0.5	n/a	-	2.0	n/a	-
17	Kalengwa	Copperbelt	Kalulushi	Borehole	0.25	n/a	-	1.0	n/a	-
18	Bwafwano	Copperbelt	Kalulushi	Stream, dam	70	n/a	-	90	-	Mindro dam
19	Misundu Dairy	Copperbelt	Ndola	Borehole	5	-	-	38	5	-
20	Munkulungwe	Copperbelt	Ndola	Stream	32	-	-	144	-	-
21	Kafubu	Copperbelt	Ndola	Dam	20	-	-	200	-	-
22	Luano	Copperbelt	Chingola	Stream/dambo	70	-		-	70	Perennial
23	Kakosa	Copperbelt	Chingola	Stream/dambo	180	200	180	1.8	80	Perennial
24	Kakalo	Copperbelt	Chingola	Stream/dambo	7	-	1.35	-	75	Perennial
25	Fisonge	Copperbelt	Chingola	Stream/dambo	27	265	2.6	-	120	Perennial
26	Mutenda	Copperbelt	Chingola	Stream/dambo	7	-	1.45	-	75	Perennial l
27	Ipafu	Copperbelt	Chingola	Stream/dambo	10	-	2	200	25	Perennial
28	Minshinshe	Copperbelt	Luanshya	(Stream)	35	17,924.5	7	200	40	Perennial
29	Nkulumashiba	Copperbelt	Luanshya	(Stream)	85	-	17	220	100	Perennial
30	Chilabula	Copperbelt	Luanshya	(Stream)	30	-	6	165	30	Perennial

	Name of potential area	Province	District	Water source	Irrigable area (ha)	1) Capacity of existing dam (m^3)	2) Catchment area (km^2)	3) Rough estimate of irrigable area (ha)	4) Irrigable area in/ around dambo (ha)	Other information
31	Fisenge	Copperbelt	Luanshya	(Stream)	45	-	9	100	70	Perennial
32	Baluba	Copperbelt	Luanshya	(Stream)	95	-	19	270	100	Perennial
33	Mazumba	Copperbelt	Luanshya	(Stream)	55	-	11	100	70	Perennial
34	Luanshya stream	Copperbelt	Luanshya	(Stream)	60	-	12	302	60	Perennial
35	Chitwi	Copperbelt	Luanshya	(Stream)	40	-	9	280	70	Perennial
36	Mutaba	Copperbelt	Masaiti	(Stream)	72	1.1	-	80	72	Perennial
37	Mukulungwe	Copperbelt	Masaiti	(Stream)	60	0.113	-	70	60	Perennial
38	Kafulafuta	Copperbelt	Masaiti	(Stream)	40	1.1	-	50	-	Perennial
39	Mukolwe	Copperbelt	Masaiti	(Stream)	50	1.19	-	70	50	Perennial
40	Figungo	Copperbelt	Masaiti	(Stream)	112	0.	-	150	112	Perennial
41	Kasamba dam	Central	Kapiri Mposhi	Dam, stream	1.5	124,416	-	26	-	Dam need rehb.
42	Chilaka dam	Central	Kapiri Mposhi	Dam, stream	2	88,800	-	16	-	Dam need rehb.
43	Lunchu	Central	Kapiri Mposhi	Stream	10.2	-	-	200	-	Perennial
44	Imansa dam	Central	Kapiri Mposhi	Dam, stream	2.7	2,150,000	-	60	-	Dam need rehb.
45	Juda dam	Central	Kapiri Mposhi	Dam, stream	15	44,800	-	20	-	Dam need rehb.
46	Waya Camp	Central	Kabwe	Stream, dambo	20	-	-	20	15	No dam
47	Mukobeko	Central	Kabwe	(Stream)	7	-	-	7	5	Dambo
48	Katwetwe	Central	Kabwe	(Stream)	5	-	-	5	5	Dambo
49	Kafulamase	Central	Kabwe	(Stream)	40	-	-	40	40	Dambo
50	Mpima	Central	Kabwe	(Stream)	65	-	-	65	2	Stream
51	Natuseko	Central	Kabwe	Dambo	60	-	-	60	40	Dambo
52	Munga	Central	Kabwe	Dam, stream	15	-	-	15	10	Stream
53	Mwachisompola	Central	Chibombo	Borehole	20	-	-	20	20	-
54	Chankumba	Central	Chibombo	Dam, borehole	10	229,493	130	460	450	Perennial
55	Chisamba	Central	Chibombo	River, borehole	15	-	-	175	160	Perennial
56	Chikumbi	Central	Chibombo	Dam, borehole	20	-	-	200	180	Perennial
57	Lifwambula	Central	Chibombo	Dam, stream	25	-	-	100	75	-
58	Shimbilo	Central	Chibombo	Lake	-	-	-	220	220	-
59	Kalola	Central	Chibombo	Lake	-	-	-	-	-	-
60	Muswishi	Central	Chibombo	Dambo, stream	50	-	-	250	200	Perennial
61	Mumangwa	Central	Chibombo	Dam, dambo	15	-	-	115	100	-
62	Chititi	Central	Chibombo	Dam, dambo	8	-	-	28	20	-

	Name of potential area	Province	District	Water source	Irrigable area (ha)	1) Capacity of existing dam (m^3)	2) Catchment area (km^2)	3) Rough estimate of irrigable area (ha)	4) Irrigable area in/ around dambo (ha)	Other information
63	Kabangalala	Central	Chibombo	Dam, dambo	20	22,613	10	60	40	-
64	Chibombo Central	Central	Chibombo	Dambo	-	-	-	300	300	-
65	Ipongo Central	Central	Chibombo	Stream, dambo	5	-	-	155	150	Perennial
66	Kanakatapa	Central	Chimbobo	Dambo, stream	30	-	-	430	400	Perennial
67	Chipembi	Central	Chibombo	Dam, dambo	20	11,300	-	70	50	-
68	Chowa	Central	Chibombo	Stream, dambo	30	-	-	130	100	-
69	Kabangwe	Lusaka	Lusaka		-	-	-	-	-	-
70	Chipwalu	Lusaka	Kafue	Stream	11	n/a	11	17	n/a	Seasonal
71	Chipongwe	Lusaka	Kafue	Stream	25	3 million	8	25	n/a	Seasonal
72	Mungu	Lusaka	Kafue	Dambo	59	n/a	11	59	78.5	Always moist
73	Mwembeshi	Lusaka	Kafue	Dambo, spring	23	n/a	10	28	5	Spring always moist
74	Chiota	Lusaka	Chongwe	Stream, spring	22	-	375	35	22	Perennial
75	Lwimba	Lusaka	Chongwe	Dambo, stream	37	-	415	43	37	Perennial
76	Katoba	Lusaka	Chongwe	Dam, dambo	49	0.5-1.0 million	314.29	55	49	Dam need rehb.
77	Kanakantapa	Lusaka	Chongwe	-	-	-	-	-	-	-
78	Kasenga	Lusaka	Chongwe	-	-	-	-	-	-	-
79	Lukwipa	Lusaka	Chongwe	-	-	-	-	-	-	-
80	Mainza	Southern	Mazabuka	Dam	10	280,000	18	15	-	-
81	Mabwentuba	Southern	Mazabuka	Stream, spring	5	20,000	5	10	-	-
82	Upper Kaleya	Southern	Mazabuka	Stream	6	45,000	5	9	-	Weir
83	Chivuna	Southern	Mazabuka	Dam	5	100,000	15	8	-	-
84	Nanduba	Southern	Mazabuka	Dam, canal	6	300,000	11	10	-	-
85	Chiyobola	Southern	Monze	Dam	6	270,000	4	7	3.75	Dam is silted
86	Siakasenke	Southern	Monze	Dam	10	250,000	6	10	2.5	Dam is silted
87	Munyenze	Southern	Monze	Dam	9	300,000	8	9	n/a	Dam is silted
88	Kaumba	Southern	Monze	Dam	7	600,000	12	5	n/a	Dam is silted
89	Siakacheka	Southern	Choma	Dam,stream	11	800,000	50	14	10	-
90	Pangwe	Southern	Choma	Stream	10	-	-	16	14	-
91	Nakempa	Southern	Choma	Dam, stream	10	525,000	40	12	16	-
92	Siamuleya	Southern	Choma	Stream	12	-	-	20	10	-
93	Lakeshore	Southern	Siavonga	Lake	100	n/a	n/a	100	n/a	Potential scheme

	Name of potential area	Province	District	Water source	Irrigable area (ha)	1) Capacity of existing dam (m^3)	2) Catchment area (km^2)	3) Rough estimate of irrigable area (ha)	4) Irrigable area in/ around dambo (ha)	Other information
94	Siabbamba	Southern	Gwembe	Dam	22	1,000,000	-	12	n/a	Dam siltation
95	Bbondo	Southern	Gwembe	Dam	32	1,500,000	-	20	n/a	Dam siltation
96	Nkwenga	Southern	Sinazongwe	Dam	15	330,000	2	6	-	Individual siphon
97	Nangubo	Southern	Kalomo	Dam	12	300,000	43	20	5	-
98	Mangwato	Southern	Kalomo	Dam	12	400,000	50	50	3	-
99	Nabuyani	Southern	Kalomo	Dam	7	250,000	6.94	50	2	-
100	Kabwe Kasala	Southern	Kalomo	Dam	8	250,000	24	20	3	-
101	Munyeke	Southern	Kalomo	Dam	7	250,000	24	30	4	-
102	Moonde	Southern	Kalomo	Stream	5	1,197,145	81.85	100	5	-
103	Kasizi	Southern	Kalomo	Dambo	2	900,000	50	80	2	-
104	Siakasipa	Southern	Kazungula	Dam	5	240,000	11.23	15	-	N60km LS
105	Manyemonyemo	Southern	Kazungula	Dam	10	70,000	1.49	10	-	E25km Zimba
106	Sinde	Southern	Kazungula	Spring	10	20 m3/sec	Groundwater	10	-	45km Sesheke Rd
107	Momba	Southern	Kazungula	Dambo	20	-	-	-	30	200km of LS, Mulobezi
108	Katapazi	Southern	Kazungula	Stream	15	20 m3/sec	-	20	-	45km of LS, Zimba Rd
109	Jack Mwanapapa	Southern	Livingstone	River	10	20 m3/sec	25	5	-	15km of LS, Simatobolo Rd
110	Linde	Southern	Livingstone	Stream	-	-	-	-	-	-
111	Siandazya	Southern	Livingstone	Dam, stream	5	150,000	17	2	-	E25km, LS
112	Sinde	Southern	Livingstone	River	20	20 m^3/sec	5.6	15	-	W15km, LS
113	Kasiya	Southern	Livingstone	Stream	30	20 m^3/sec	11.1	15	-	W10km, LS
114	Nansazu/Mulamba	Southern	Livingstone	Stream	18	20 m^3/sec	28	20	-	E5km LS
115	Mubiana	Southern	Kazungula	Dam	8	84,632	12.25	15	-	60km of LS, Zimba Rd
116	Mulabalaba	Southern	Kazungula	Dam	5	158,300	21.0817ha	20	-	N55km of LS, Zimba Rd
	Total				2,490			7,698	4,194	

Source: JICA Study Team

Note: There are potential irrigation scheme in the Districts of Kitwe, but they are not identified in the Table.
The potential irrigation schemes are listed according to information of the MACO Provincial and District offices. Pump irrigation schemes are excluded from the Table.

Figures

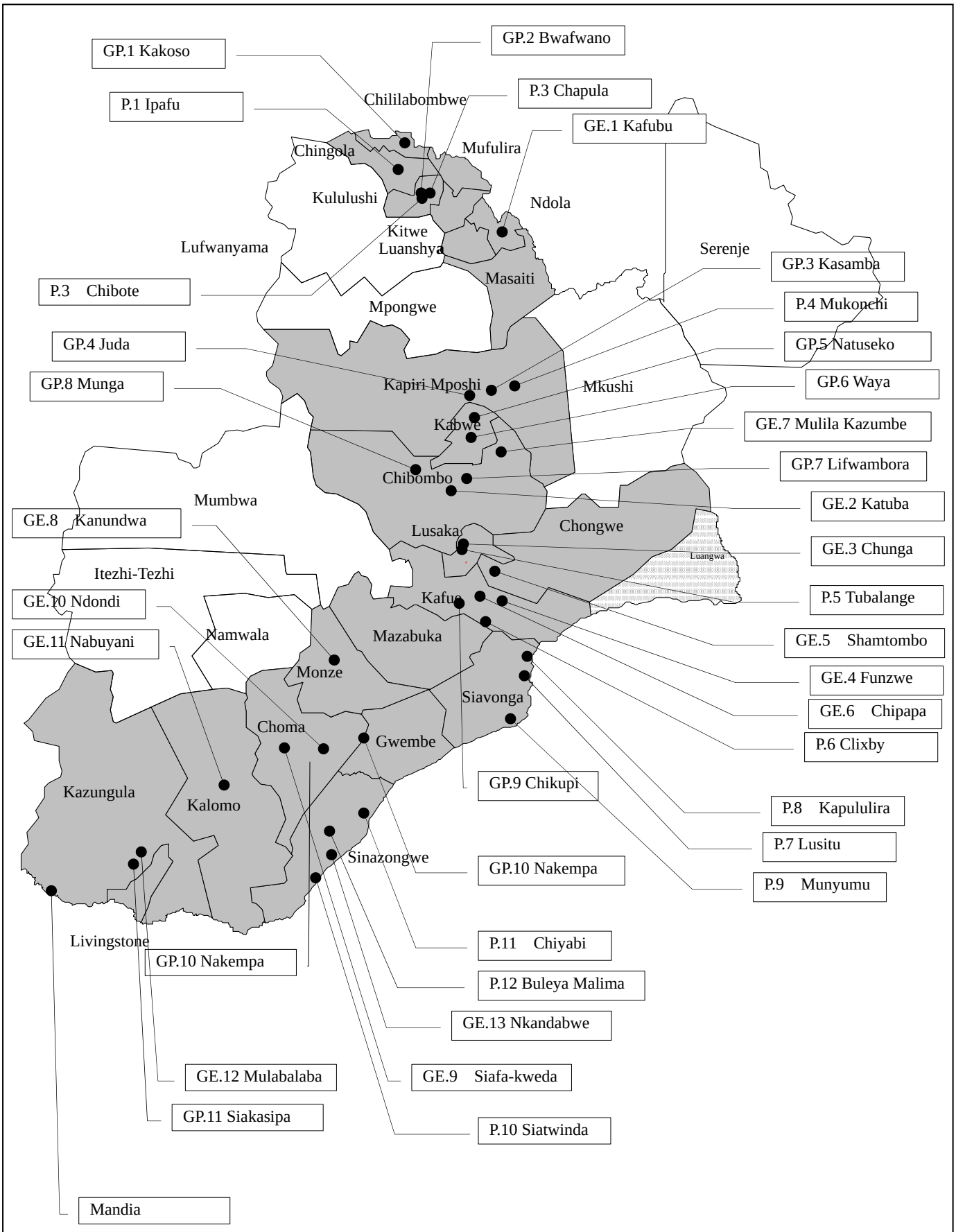


Fig. F7.1.1 Location of Small Scale Irrigation Schemes

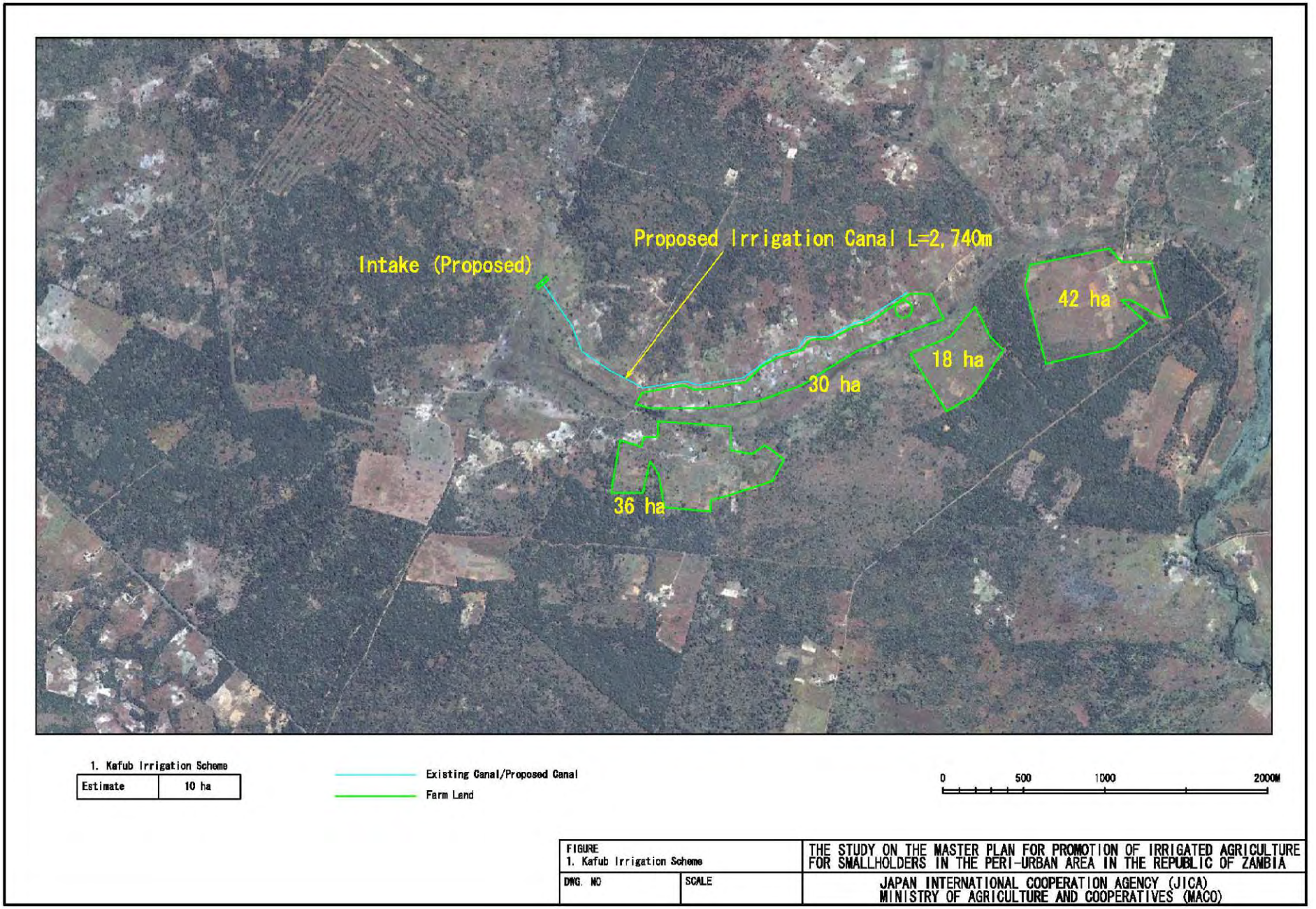
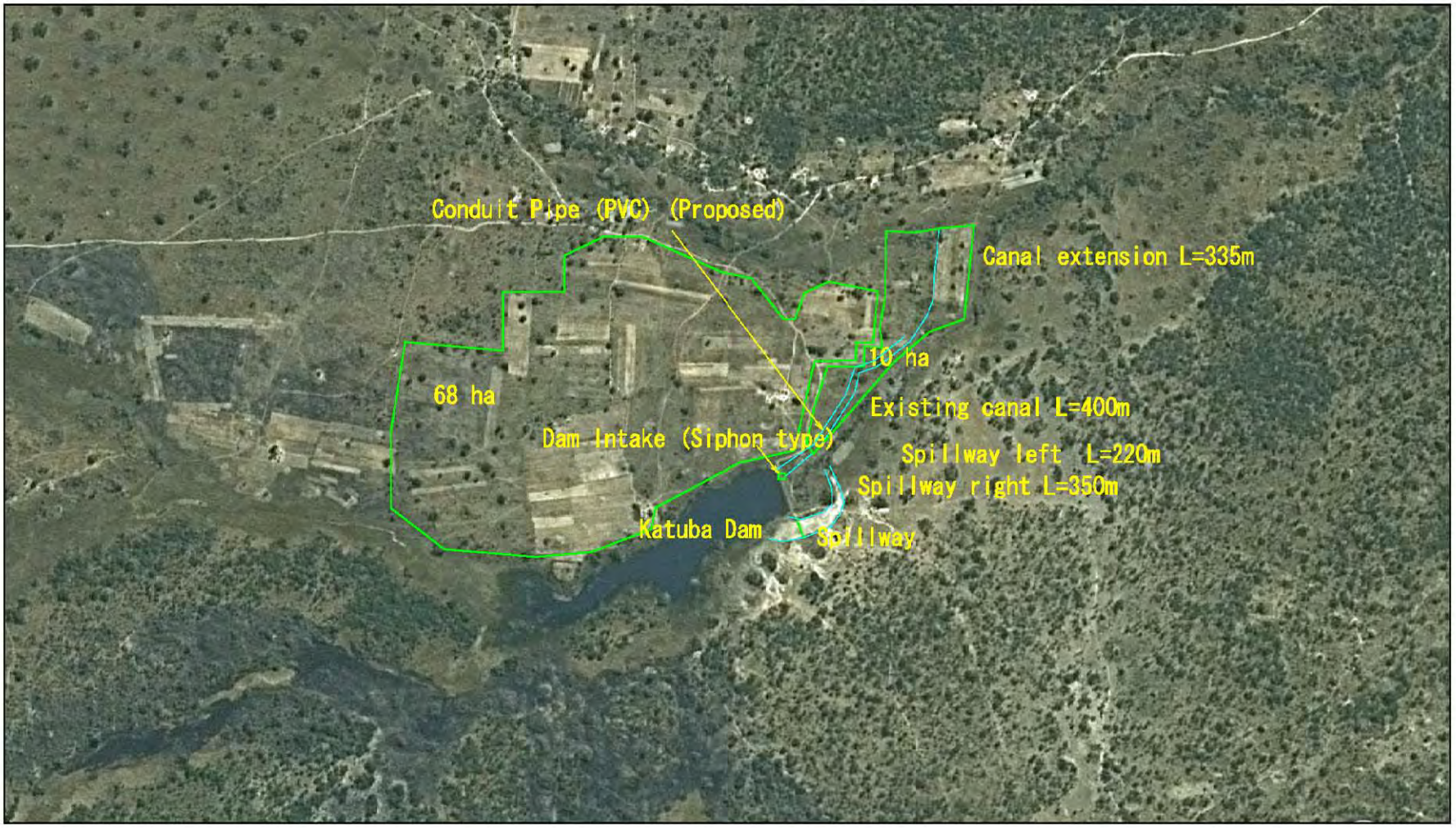


Fig. 7.2.1 General Plan of Irrigation Schemes



2. Katuba Irrigation Scheme

Estimate	5 ha

Existing Canal/Proposed Canal

Farm Land

FIGURE 2. Katuba Irrigation Scheme		THE STUDY ON THE MASTER PLAN FOR PROMOTION OF IRRIGATED AGRICULTURE FOR SMALLHOLDERS IN THE PERI-URBAN AREA IN THE REPUBLIC OF ZAMBIA
DWG. NO	SCALE	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) MINISTRY OF AGRICULTURE AND COOPERATIVES (MACO)

3. Mulila Kazembe Irrigation Scheme

Estimate	8 ha

Existing Canal/Proposed Canal

Farm Land

0 250 500 1000M

FIGURE 3. Mulila Kazembe Irrigation Scheme		THE STUDY ON THE MASTER PLAN FOR PROMOTION OF IRRIGATED AGRICULTURE FOR SMALLHOLDERS IN THE PERI-URBAN AREA IN THE REPUBLIC OF ZAMBIA
DWG. NO	SCALE	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) MINISTRY OF AGRICULTURE AND COOPERATIVES (MACO)

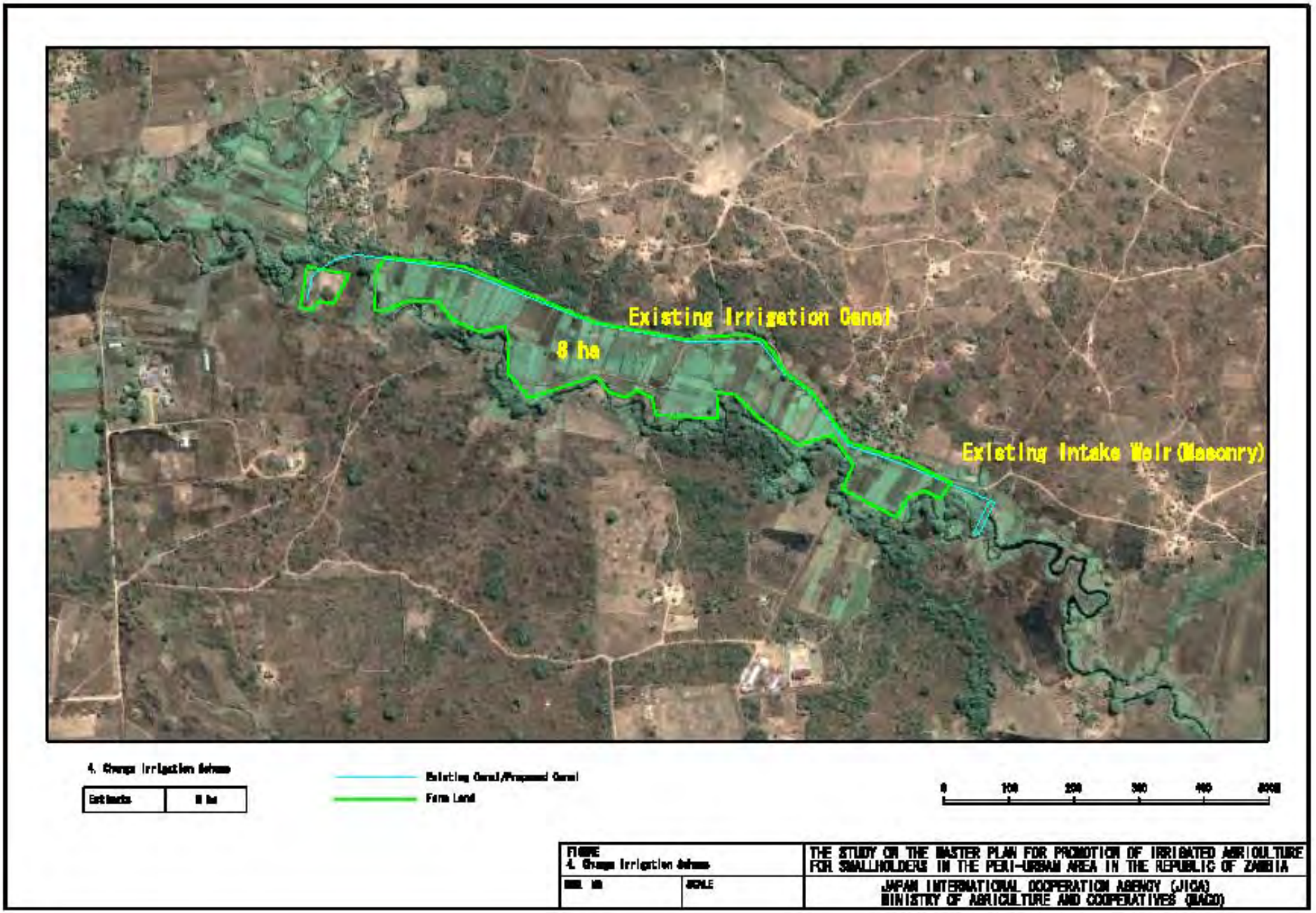


FIGURE 4. Chunga Irrigation Scheme	THE STUDY ON THE MASTER PLAN FOR PROMOTION OF IRRIGATED AGRICULTURE FOR SMALLHOLDERS IN THE PERI-URBAN AREA IN THE REPUBLIC OF ZAMBIA
NOT TO SCALE	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) MINISTRY OF AGRICULTURE AND COOPERATIVES (MACO)

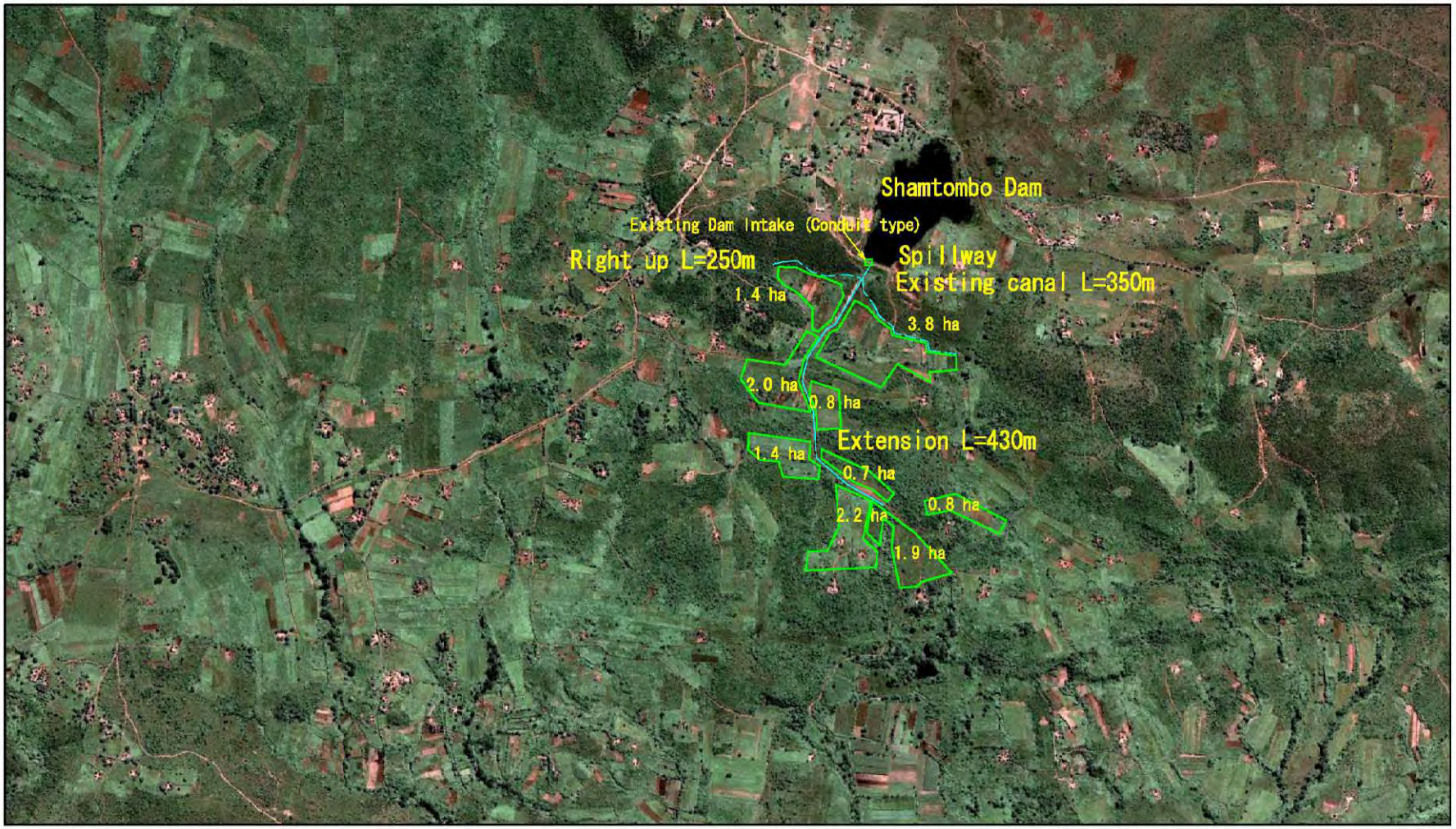
5. Fuzeni Irrigation Scheme

Estimate	6 ha

Existing Canal/Proposed Canal

Farm Land

FIGURE 4. Fuzeni Irrigation Scheme	THE STUDY ON THE MASTER PLAN FOR PROMOTION OF IRRIGATED AGRICULTURE FOR SMALLHOLDERS IN THE PERI-URBAN AREA IN THE REPUBLIC OF ZAMBIA
SCALE	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) MINISTRY OF AGRICULTURE AND COOPERATIVES (MACO)



6. Shamtombo Irrigation Scheme

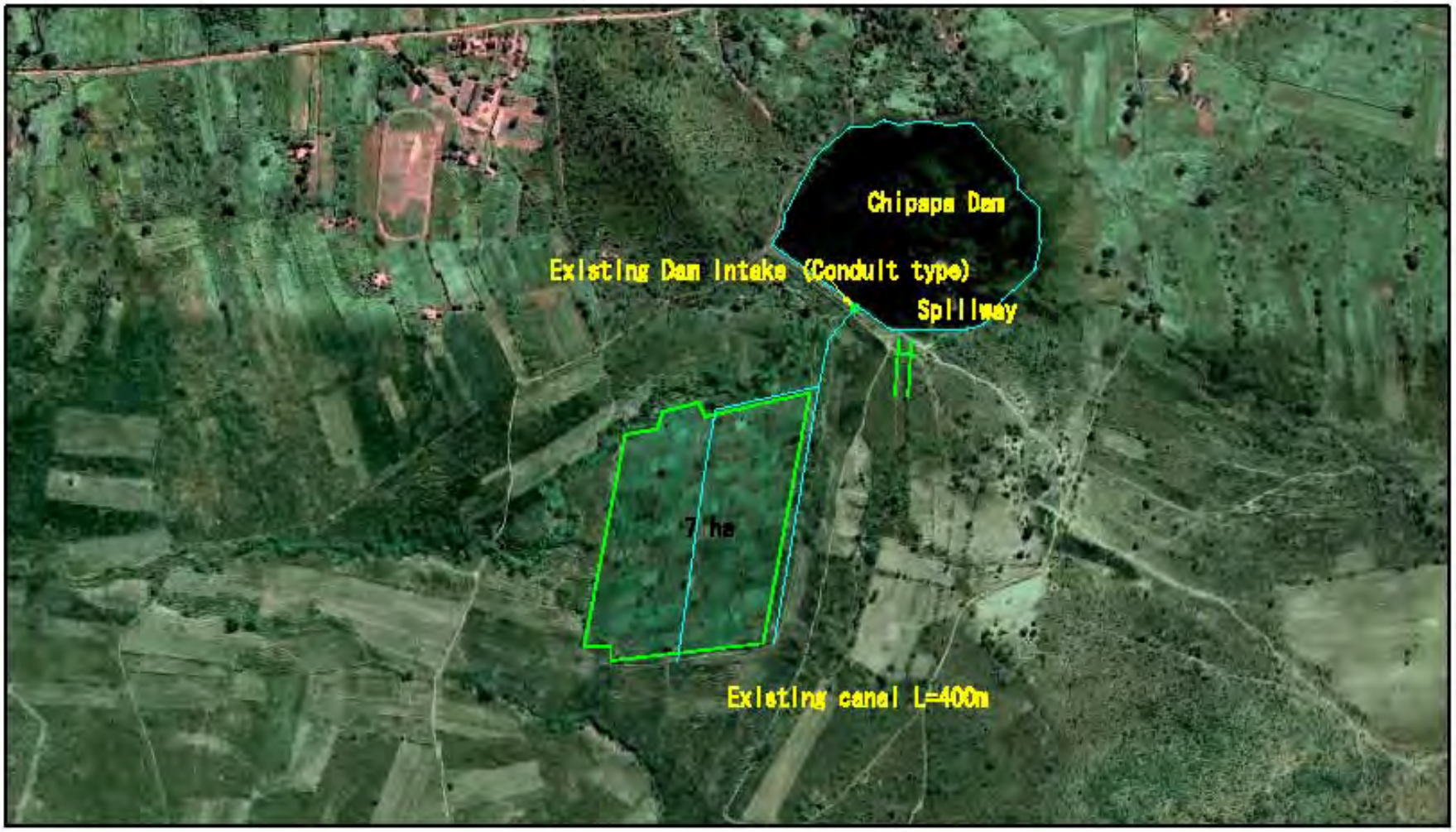
Estimate	15 ha

Existing Canal/Proposed Canal

Farm Land

0 250 500 1000M

FIGURE 6. Shamtombo Irrigation Scheme		THE STUDY ON THE MASTER PLAN FOR PROMOTION OF IRRIGATED AGRICULTURE FOR SMALLHOLDERS IN THE PERI-URBAN AREA IN THE REPUBLIC OF ZAMBIA
DWG. NO	SCALE	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) MINISTRY OF AGRICULTURE AND COOPERATIVES (MACO)



7. Chipapa Irrigation Scheme

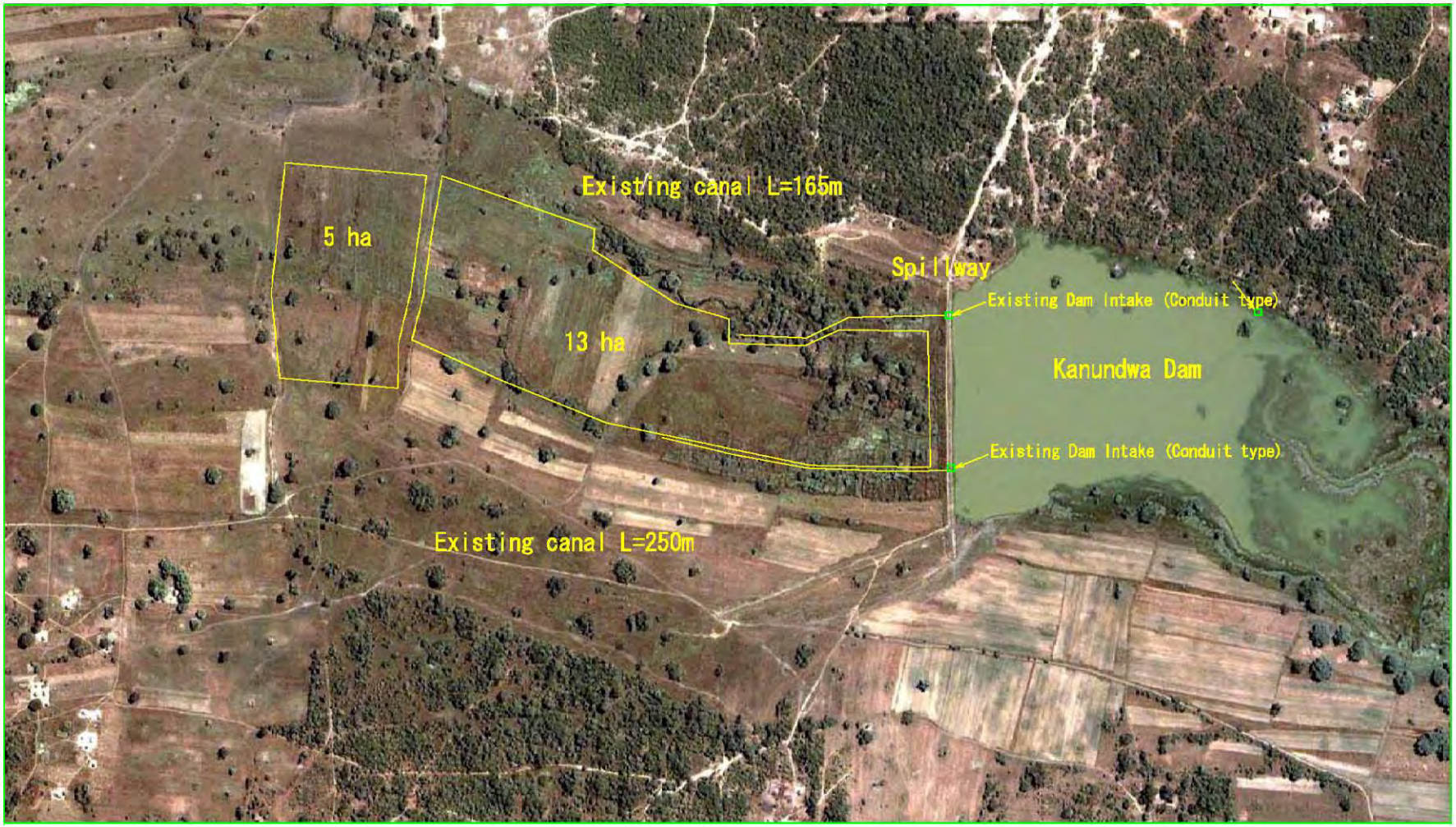
Estimate	7 ha

Existing Canal/Proposed Canal

Farm Land

0 100 200 300 400 500m

FIGURE 7. Chipapa Irrigation Scheme	THE STUDY ON THE MASTER PLAN FOR PROMOTION OF IRRIGATED AGRICULTURE FOR SMALLHOLDERS IN THE PERI-URBAN AREA IN THE REPUBLIC OF ZAMBIA
DWG. NO. / SCALE	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) MINISTRY OF AGRICULTURE AND COOPERATIVES (MACO)



8. Kanundwa Irrigation Scheme

Estimate	18 ha

Existing Canal/Proposed Canal

Farm Land

0 100 200 300 400 500M

FIGURE 8. Kanundwa Irrigation Scheme		THE STUDY ON THE MASTER PLAN FOR PROMOTION OF IRRIGATED AGRICULTURE FOR SMALLHOLDERS IN THE PERI-URBAN AREA IN THE REPUBLIC OF ZAMBIA
DWG. NO	SCALE	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) MINISTRY OF AGRICULTURE AND COOPERATIVES (MACO)

9. Siafa-kweda Irrigation Scheme

Estimate	5 ha

Existing Canal/Proposed Canal

Farm Land

0 100 200 300 400 500m

FIGURE 9. Siafa-kweda Irrigation Scheme		THE STUDY ON THE MASTER PLAN FOR PROMOTION OF IRRIGATED AGRICULTURE FOR SMALLHOLDERS IN THE PERI-URBAN AREA IN THE REPUBLIC OF ZAMBIA
NOV. '00	SCALE	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) MINISTRY OF AGRICULTURE AND COOPERATIVES (MACO)

10. Ndondi Irrigation Scheme

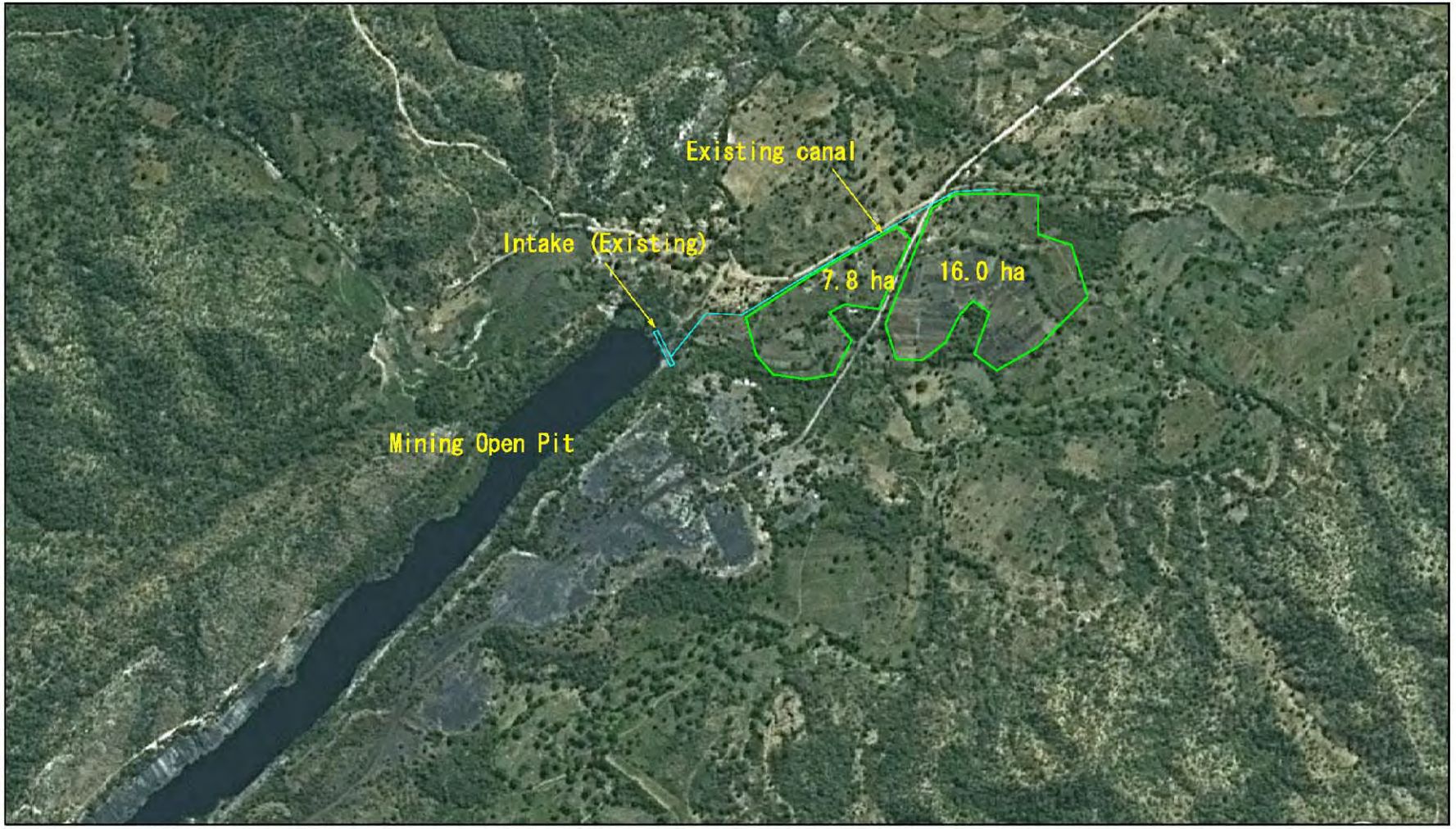
Estimate	11 ha

Existing Canal/Proposed Canal

Farm Land

0 100 200 300 400 500M

FIGURE 10. Ndondi Irrigation Scheme		THE STUDY ON THE MASTER PLAN FOR PROMOTION OF IRRIGATED AGRICULTURE FOR SMALLHOLDERS IN THE PERI-URBAN AREA IN THE REPUBLIC OF ZAMBIA
DWG. NO	SCALE	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) MINISTRY OF AGRICULTURE AND COOPERATIVES (MACO)



11. Nkandabwe Irrigation Scheme

Estimate	10 ha

Existing Canal/Proposed Canal

Farm Land

0 250 500 1000M

FIGURE 11. Nkandabwe Irrigation Scheme		THE STUDY ON THE MASTER PLAN FOR PROMOTION OF IRRIGATED AGRICULTURE FOR SMALLHOLDERS IN THE PERI-URBAN AREA IN THE REPUBLIC OF ZAMBIA
DWG. NO	SCALE	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) MINISTRY OF AGRICULTURE AND COOPERATIVES (MACO)

12. Nabuyani Irrigation Scheme

Estimate	20 ha

Existing Canal/Proposed Canal

Farm Land

0 100 200 300 400 500M

FIGURE 12. Nabuyani Irrigation Scheme		THE STUDY ON THE MASTER PLAN FOR PROMOTION OF IRRIGATED AGRICULTURE FOR SMALLHOLDERS IN THE PERI-URBAN AREA IN THE REPUBLIC OF ZAMBIA
DWG. NO	SCALE	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) MINISTRY OF AGRICULTURE AND COOPERATIVES (MACO)

13. Mulabalaba Irrigation Scheme

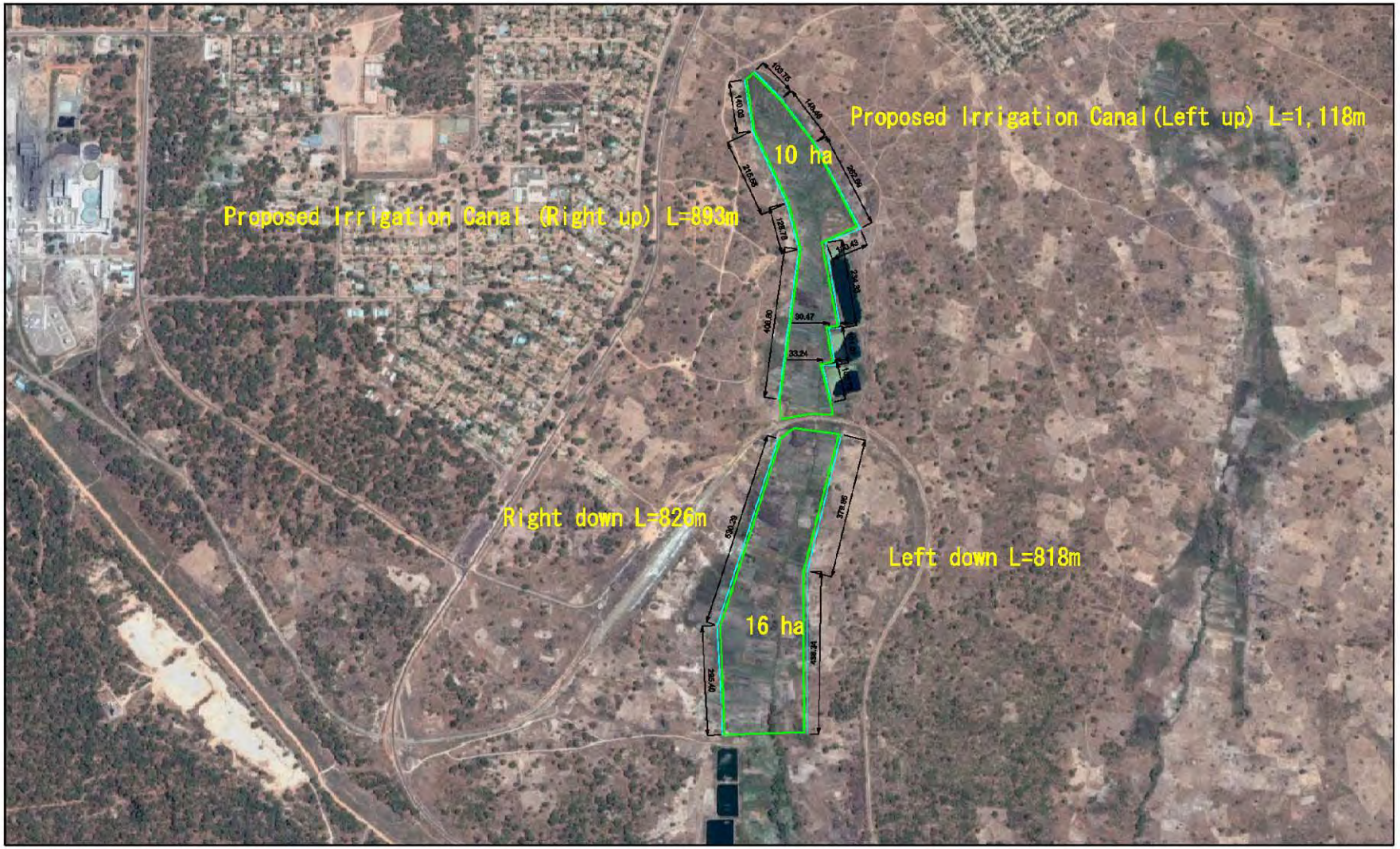
Estimate	6 ha

Existing Canal/Proposed Canal

Farm Land

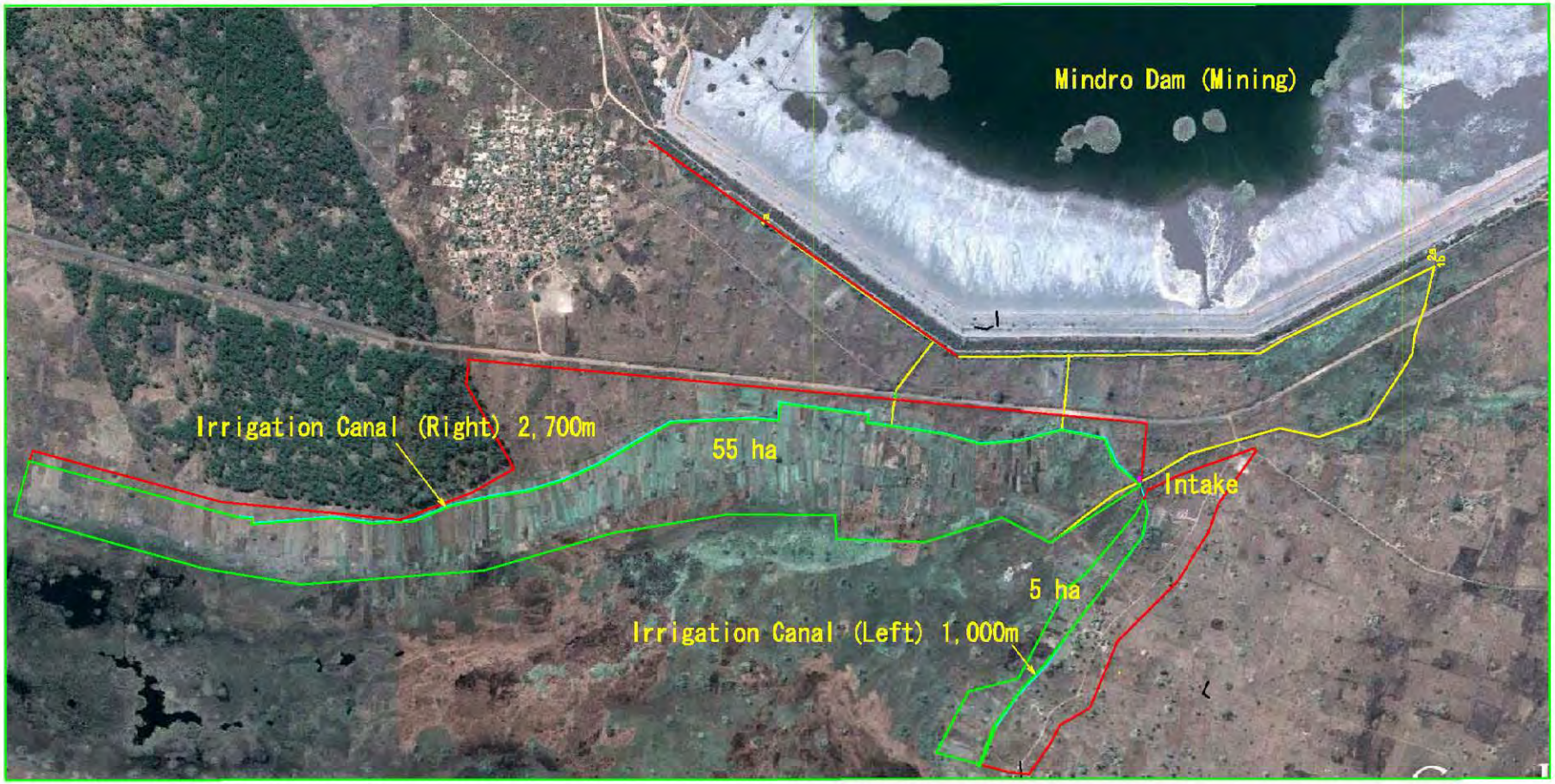
0 100 200 300 400 500M

FIGURE 13. Mulabalaba Irrigation Scheme		THE STUDY ON THE MASTER PLAN FOR PROMOTION OF IRRIGATED AGRICULTURE FOR SMALLHOLDERS IN THE PERI-URBAN AREA IN THE REPUBLIC OF ZAMBIA
DWG NO	SCALE	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) MINISTRY OF AGRICULTURE AND COOPERATIVES (MACO)



Estimate	26 ha

FIGURE 1. Kakoso Irrigation Scheme	THE STUDY ON THE MASTER PLAN FOR PROMOTION OF IRRIGATED AGRICULTURE FOR SMALLHOLDERS IN THE PERI-URBAN AREA IN THE REPUBLIC OF ZAMBIA
DWG. NO / SCALE	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) MINISTRY OF AGRICULTURE AND COOPERATIVES (MACO)



2. Bwafwano Irrigation Scheme

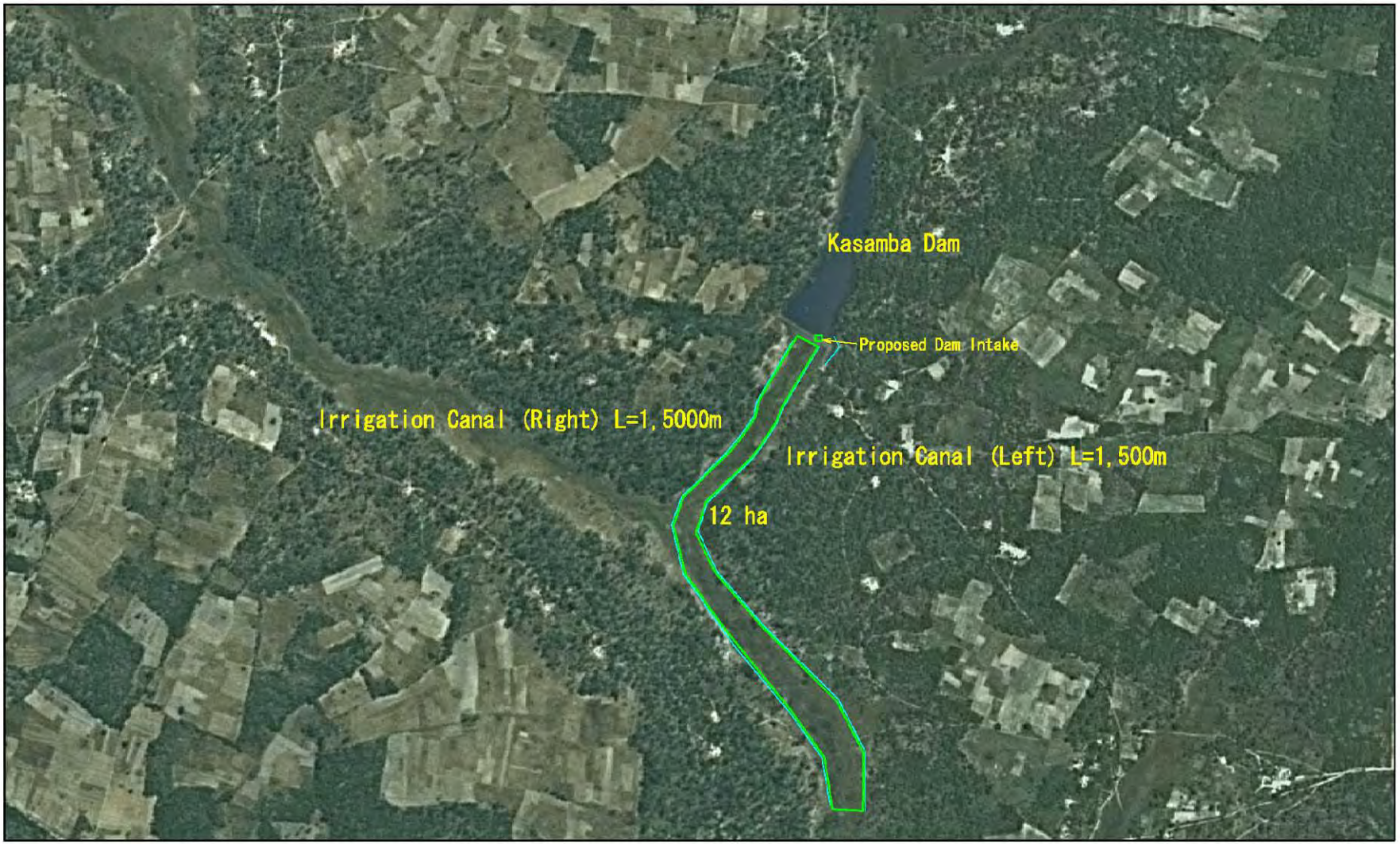
Estimate	60 ha

Existing Canal/Proposed Canal

Farm Land

0 250 500 1000M

FIGURE 2. Bwafwano Irrigation Scheme		THE STUDY ON THE MASTER PLAN FOR PROMOTION OF IRRIGATED AGRICULTURE FOR SMALLHOLDERS IN THE PERI-URBAN AREA IN THE REPUBLIC OF ZAMBIA
DWG. NO	SCALE	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) MINISTRY OF AGRICULTURE AND COOPERATIVES (MACO)



3. Kasamba Irrigation Scheme

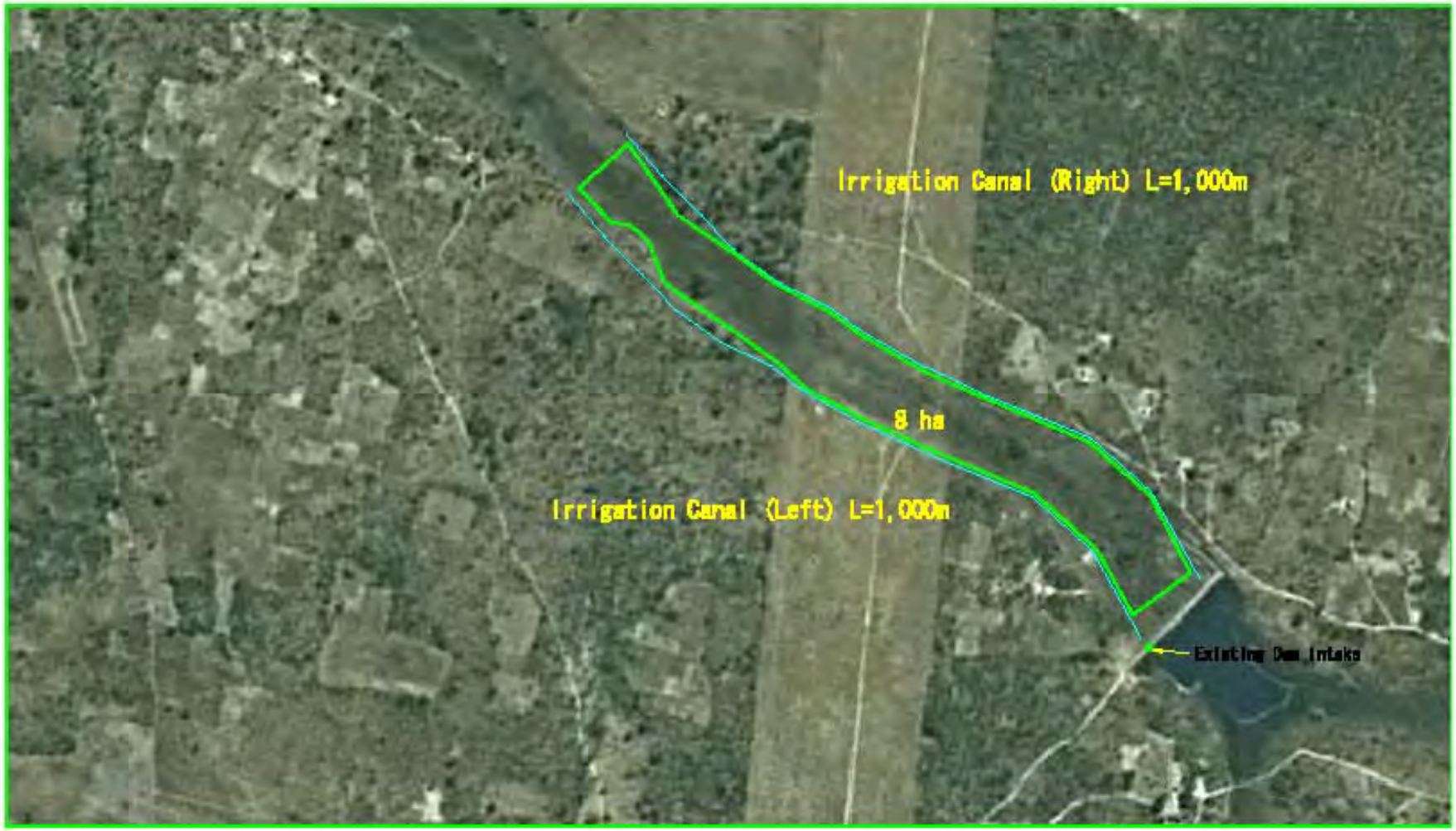
Estimate	12 ha

Existing Canal/Proposed Canal

Farm Land

0 250 500 1000m

FIGURE 3. Kasamba Irrigation Scheme		THE STUDY ON THE MASTER PLAN FOR PROMOTION OF IRRIGATED AGRICULTURE FOR SMALLHOLDERS IN THE PERI-URBAN AREA IN THE REPUBLIC OF ZAMBIA
DWG. NO	SCALE	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) MINISTRY OF AGRICULTURE AND COOPERATIVES (MACO)



4. Jada Irrigation Scheme

Estimate	8 ha

Existing Canal/Proposed Canal

Farm Land

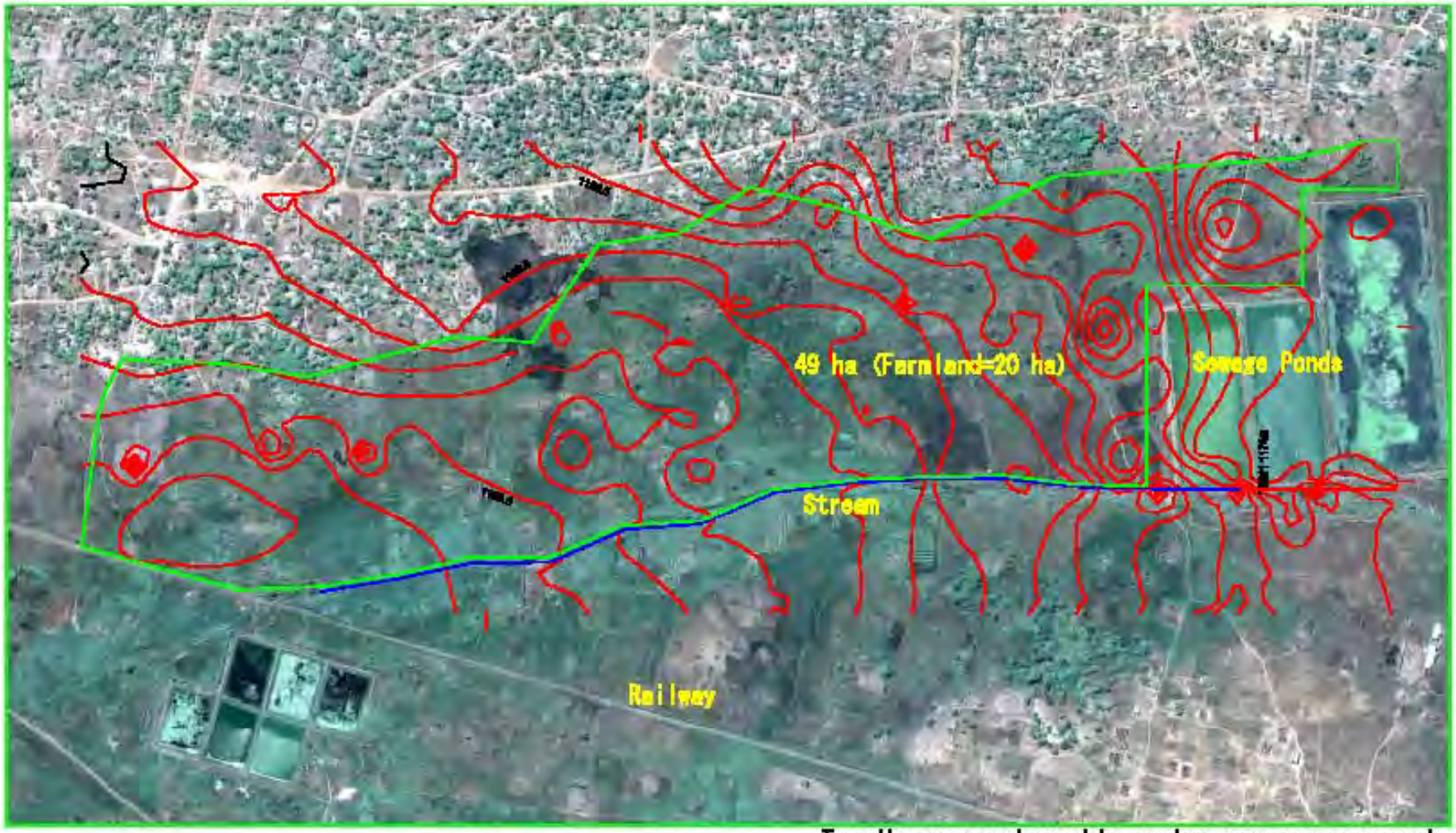
0 500 1000m

FIGURE
4. Jada Irrigation Scheme

SCALE

THE STUDY ON THE MASTER PLAN FOR PROMOTION OF IRRIGATED AGRICULTURE FOR SMALLHOLDERS IN THE PERI-URBAN AREA IN THE REPUBLIC OF ZAMBIA

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
MINISTRY OF AGRICULTURE AND COOPERATIVES (MACO)



Treadle pump and movable engine pump are procured.

6. Matanuska Irrigation Scheme

Estimate	20 ha

Existing Canal/Proposed Canal

Farm Land

FIGURE 6. Matanuska Irrigation Scheme	THE STUDY ON THE MASTER PLAN FOR PROMOTION OF IRRIGATED AGRICULTURE FOR SMALLHOLDERS IN THE PERI-URBAN AREA IN THE REPUBLIC OF ZAMBIA
NOT TO SCALE	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) MINISTRY OF AGRICULTURE AND COOPERATIVES (MACO)

6. Waya Irrigation Scheme

Estimate	5 ha

Existing Canal/Proposed Canal

Farm Land

0 100 200 300 400 500M

FIGURE 6. Waya Irrigation Scheme		THE STUDY ON THE MASTER PLAN FOR PROMOTION OF IRRIGATED AGRICULTURE FOR SMALLHOLDERS IN THE PERI-URBAN AREA IN THE REPUBLIC OF ZAMBIA
DWG. NO	SCALE	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) MINISTRY OF AGRICULTURE AND COOPERATIVES (MACO)

7. Lifumbora Irrigation Scheme

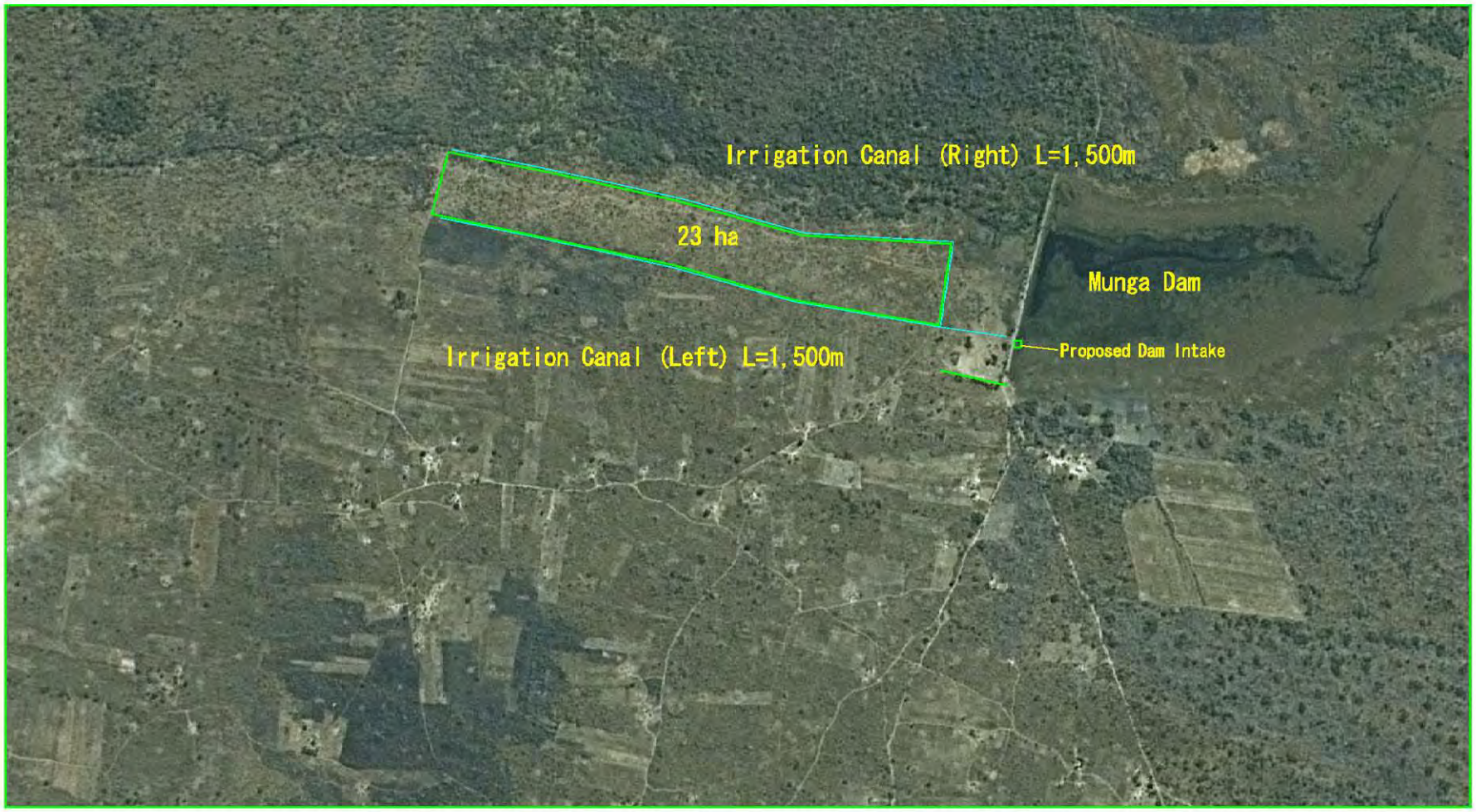
Estimate	22 ha

Existing Canal/Proposed Canal

Farm Land

0 250 500 1000m

FIGURE 7. Lifumbora Irrigation Scheme		THE STUDY ON THE MASTER PLAN FOR PROMOTION OF IRRIGATED AGRICULTURE FOR SMALLHOLDERS IN THE PERI-URBAN AREA IN THE REPUBLIC OF ZAMBIA
NOT TO	SCALE	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) MINISTRY OF AGRICULTURE AND COOPERATIVES (MACO)



8. Munga Irrigation Scheme

Estimate	23 ha

Existing Canal/Proposed Canal

Farm Land

0 250 500 1000M

FIGURE 8. Munga Irrigation Scheme	THE STUDY ON THE MASTER PLAN FOR PROMOTION OF IRRIGATED AGRICULTURE FOR SMALLHOLDERS IN THE PERI-URBAN AREA IN THE REPUBLIC OF ZAMBIA
DWG. NO / SCALE	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) MINISTRY OF AGRICULTURE AND COOPERATIVES (MACO)

9. Chikupi Irrigation Scheme

Estimate	10 ha

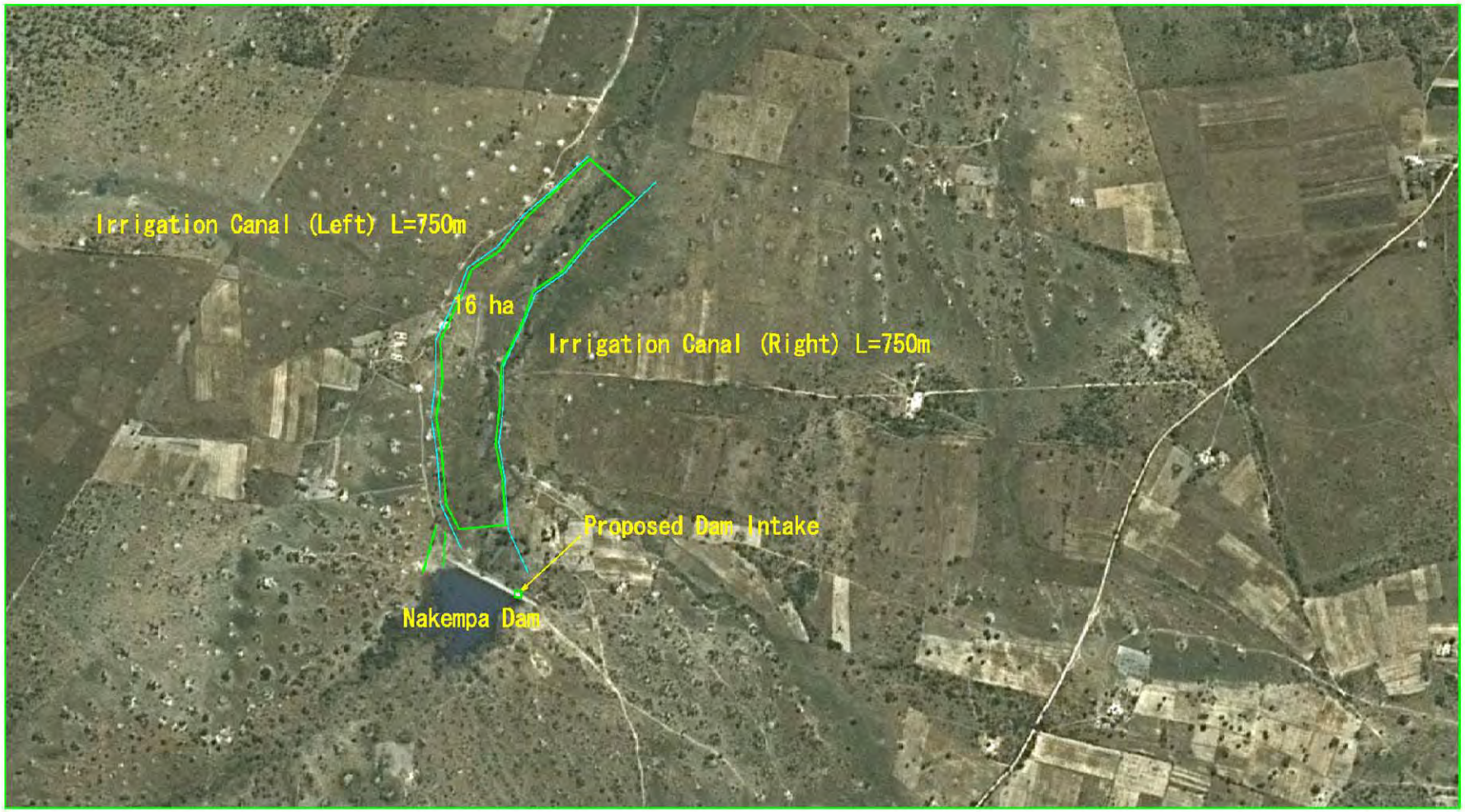
Part of 95 ha farm land.

Existing Canal/Proposed Canal

Farm Land

0 250 500 1000M

FIGURE 9. Chikupi Irrigation Shceme		THE STUDY ON THE MASTER PLAN FOR PROMOTION OF IRRIGATED AGRICULTURE FOR SMALLHOLDERS IN THE PERI-URBAN AREA IN THE REPUBLIC OF ZAMBIA
DWG. NO	SCALE	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) MINISTRY OF AGRICULTURE AND COOPERATIVES (MACO)



10. Nakempa Irrigation Scheme

Estimate	16 ha

Existing Canal/Proposed Canal

Farm Land

0 250 500 1000M

FIGURE 10. Nakempa Irrigation Scheme		THE STUDY ON THE MASTER PLAN FOR PROMOTION OF IRRIGATED AGRICULTURE FOR SMALLHOLDERS IN THE PERI-URBAN AREA IN THE REPUBLIC OF ZAMBIA
DWG. NO	SCALE	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) MINISTRY OF AGRICULTURE AND COOPERATIVES (MACO)

11. Siakasipa Irrigation Scheme

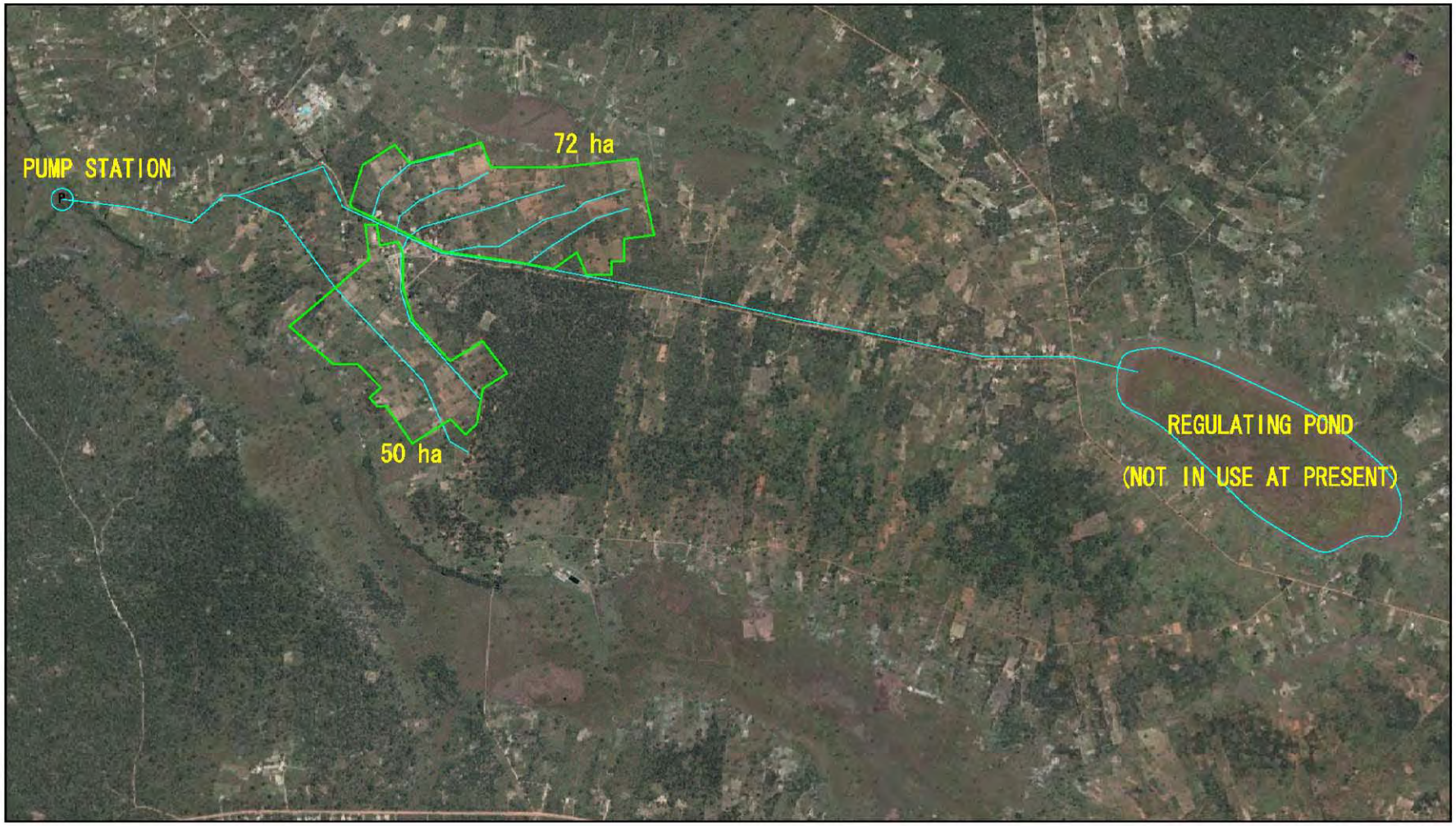
Estimate	8 ha

Existing Canal/Proposed Canal

Farm Land

0 250 500 1000M

FIGURE 11. Siakasipa Irrigation Scheme		THE STUDY ON THE MASTER PLAN FOR PROMOTION OF IRRIGATED AGRICULTURE FOR SMALLHOLDERS IN THE PERI-URBAN AREA IN THE REPUBLIC OF ZAMBIA
DWG. NO	SCALE	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) MINISTRY OF AGRICULTURE AND COOPERATIVES (MACO)



1. Ipufu Irrigation Scheme

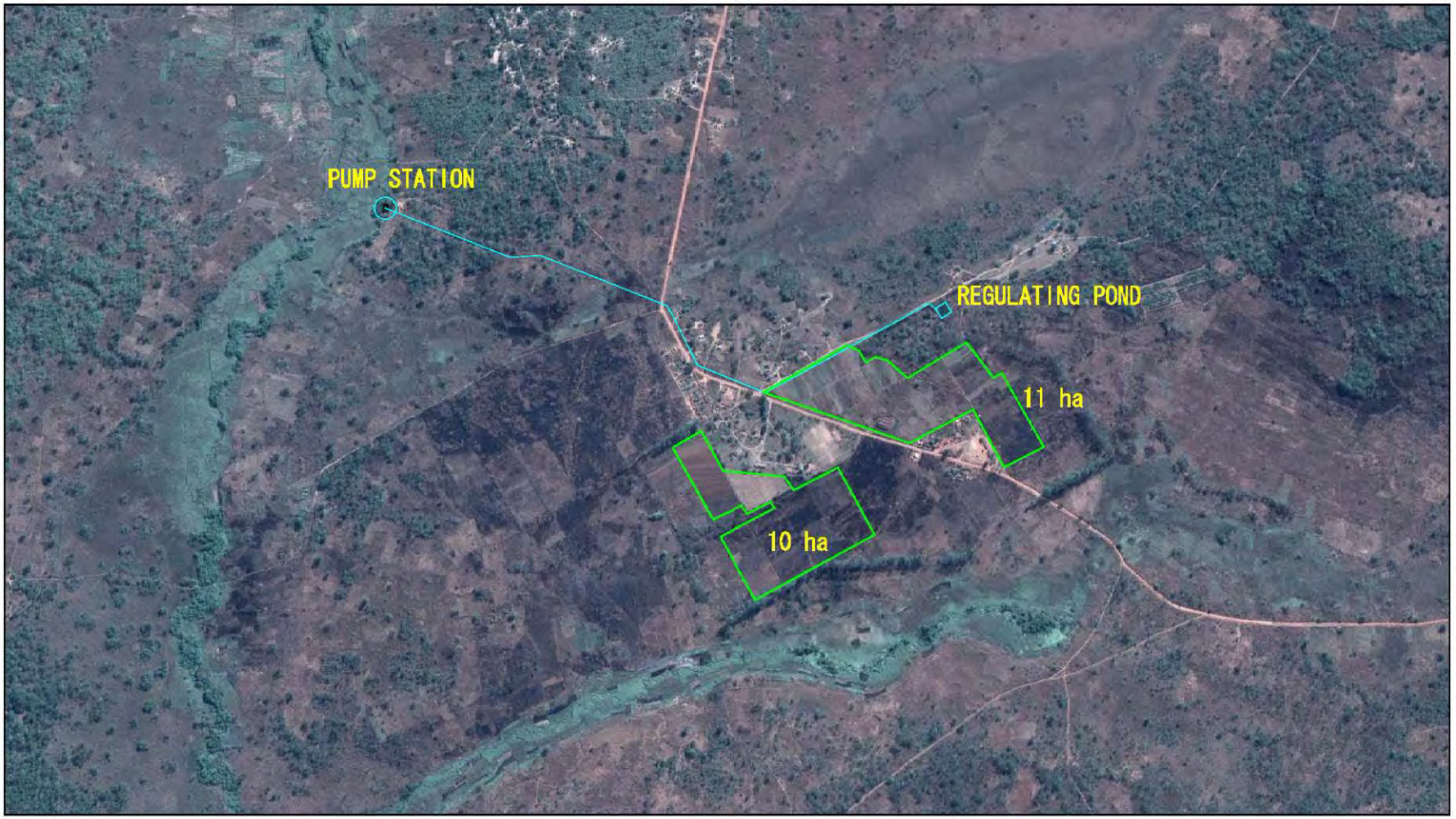
Estimate	122 ha

Existing Canal/Pipeline

Farm Land

0 500 1000 2000M

FIGURE 1. Ipufu Irrigation Scheme		THE STUDY ON THE MASTER PLAN FOR PROMOTION OF IRRIGATED AGRICULTURE FOR SMALLHOLDERS IN THE PERI-URBAN AREA IN THE REPUBLIC OF ZAMBIA
DWG. NO	SCALE	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) MINISTRY OF AGRICULTURE AND COOPERATIVES (MACO)



2. Chapula Irrigation Scheme

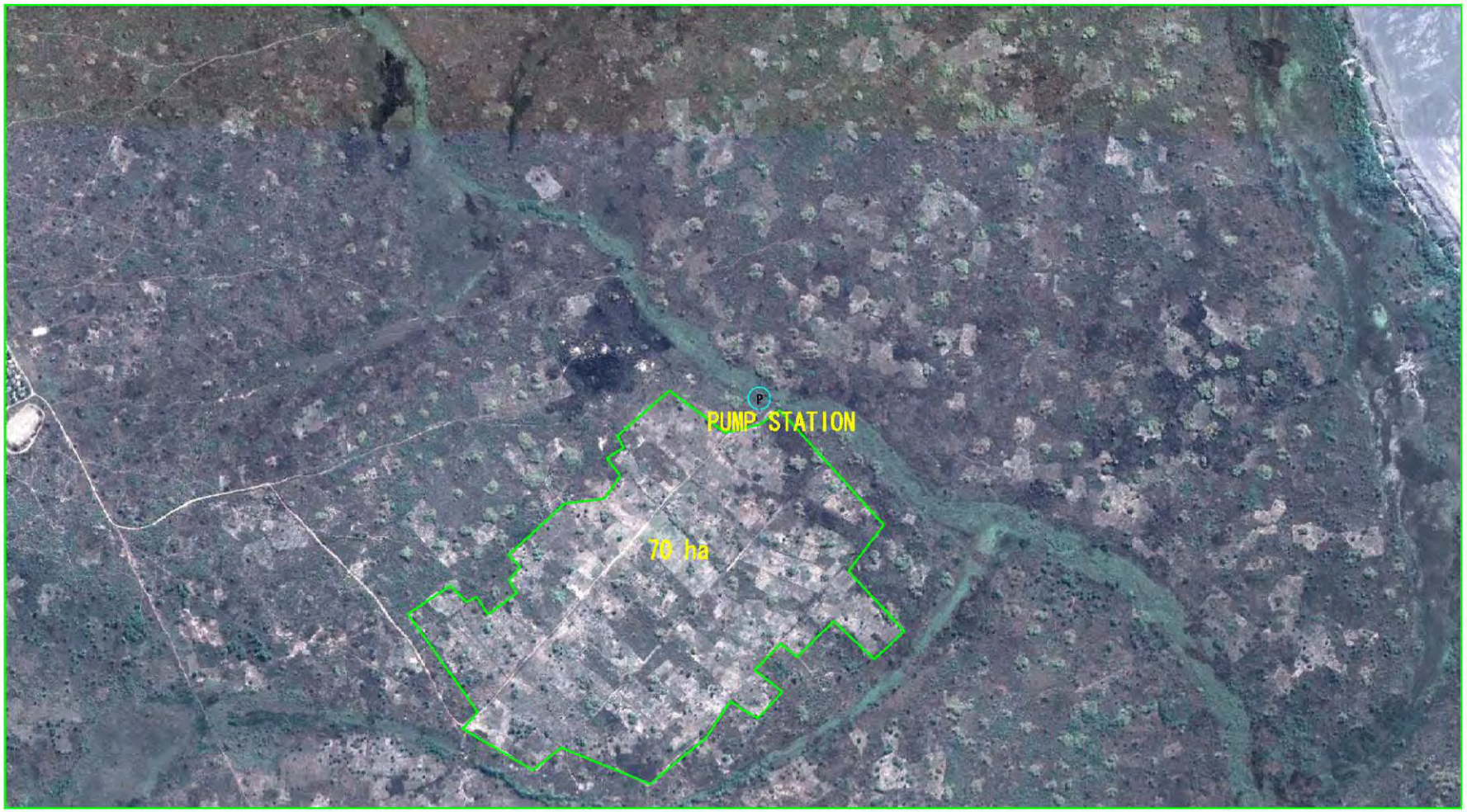
Estimate	21 ha

Existing Canal/Pipeline

Farm Land

0 250 500 1000M

FIGURE 2. Chapula Irrigation Scheme		THE STUDY ON THE MASTER PLAN FOR PROMOTION OF IRRIGATED AGRICULTURE FOR SMALLHOLDERS IN THE PERI-URBAN AREA IN THE REPUBLIC OF ZAMBIA
DWG. NO	SCALE	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) MINISTRY OF AGRICULTURE AND COOPERATIVES (MACO)



3. Chibote Irrigation Scheme

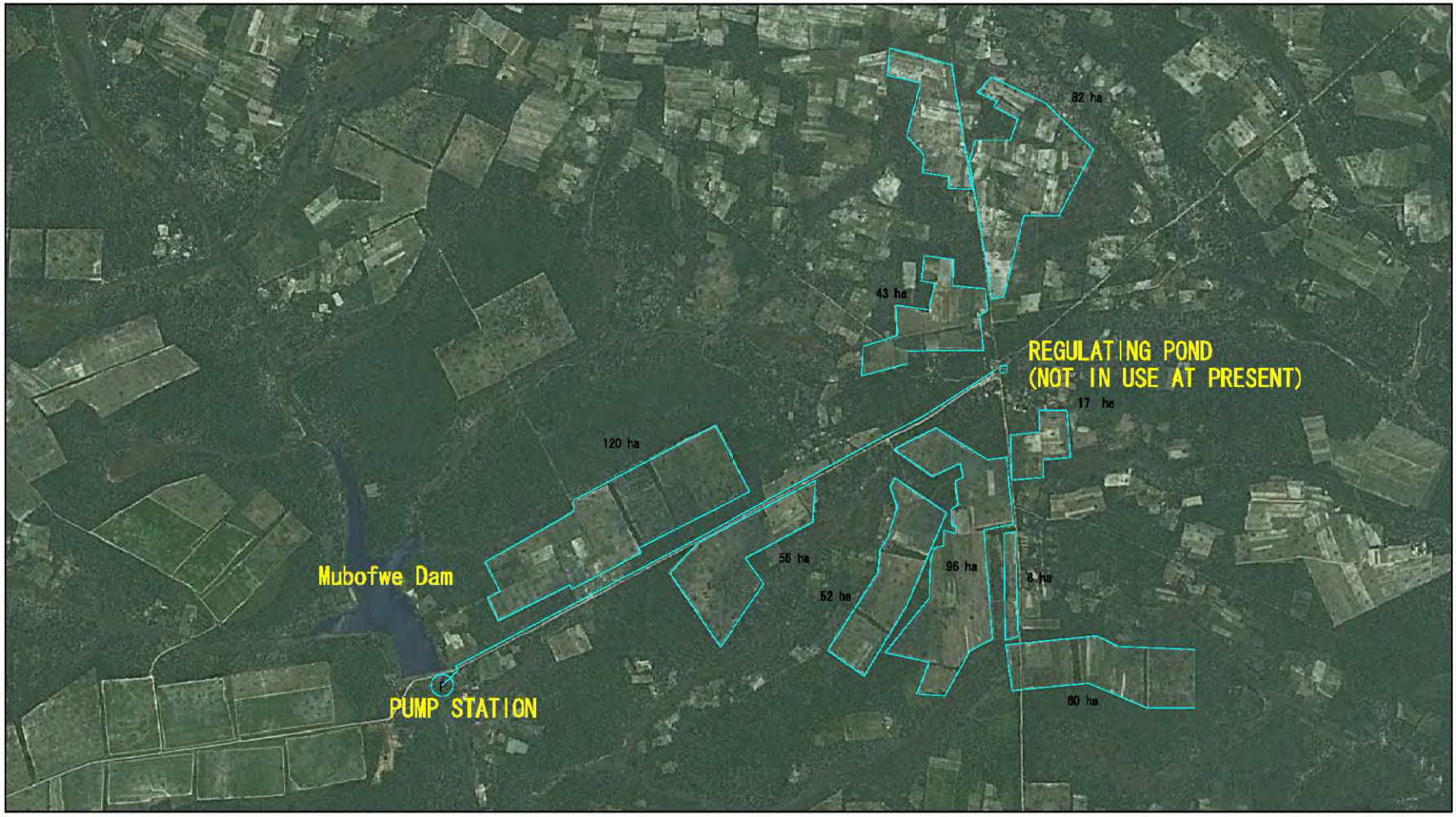
Estimate	70 ha

Existing Canal/Pipeline

Farm Land

0 250 500 1000M

FIGURE 3. Chibote Irrigation Scheme	THE STUDY ON THE MASTER PLAN FOR PROMOTION OF IRRIGATED AGRICULTURE FOR SMALLHOLDERS IN THE PERI-URBAN AREA IN THE REPUBLIC OF ZAMBIA
DWG. NO / SCALE	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) MINISTRY OF AGRICULTURE AND COOPERATIVES (MACO)



4. Mukonchi Irrigation Scheme

Estimate	- ha

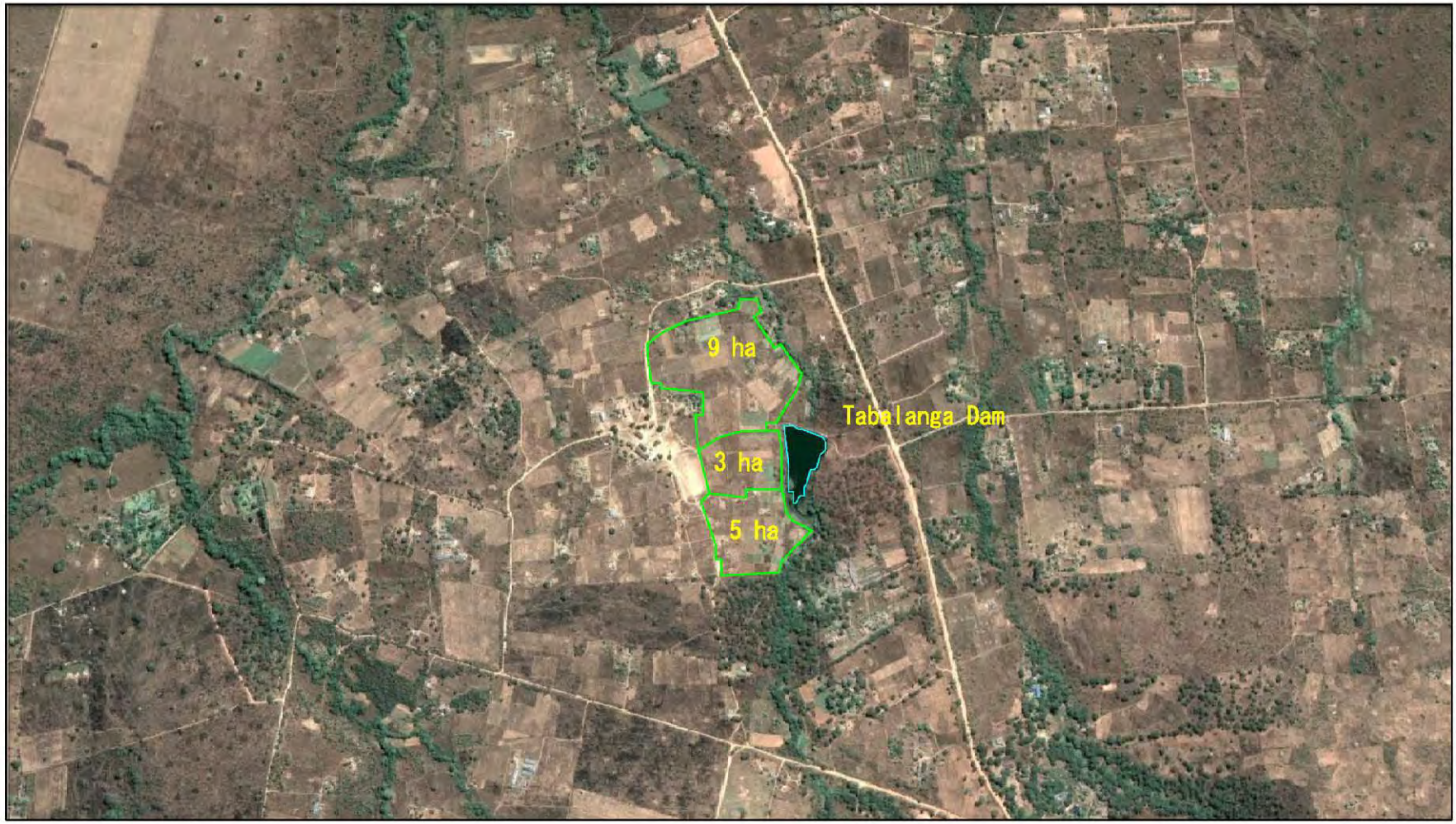
Total 500ha is irrigable when water is supplied from the Mukonchi dam.

Existing Canal/Pipeline

Farm Land

0 1000 2000 3000M

FIGURE 4. Mukonchi Irrigation Scheme		THE STUDY ON THE MASTER PLAN FOR PROMOTION OF IRRIGATED AGRICULTURE FOR SMALLHOLDERS IN THE PERI-URBAN AREA IN THE REPUBLIC OF ZAMBIA
DWG. NO	SCALE	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) MINISTRY OF AGRICULTURE AND COOPERATIVES (MACO)



5. Tubalange Irrigation Scheme

Estimate	17 ha

Existing Canal/Pipeline

Farm Land

0 250 500 1000M

FIGURE 5. Tubalange Irrigation Scheme		THE STUDY ON THE MASTER PLAN FOR PROMOTION OF IRRIGATED AGRICULTURE FOR SMALLHOLDERS IN THE PERI-URBAN AREA IN THE REPUBLIC OF ZAMBIA
DWG. NO	SCALE	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) MINISTRY OF AGRICULTURE AND COOPERATIVES (MACO)

6. Clixby Irrigation Scheme

Estimate	67 ha

Existing Canal/Pipeline

Farm Land

0 500 1000 2000M

FIGURE 6. Clixby Irrigation Scheme		THE STUDY ON THE MASTER PLAN FOR PROMOTION OF IRRIGATED AGRICULTURE FOR SMALLHOLDERS IN THE PERI-URBAN AREA IN THE REPUBLIC OF ZAMBIA
DWG. NO	SCALE	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) MINISTRY OF AGRICULTURE AND COOPERATIVES (MACO)

7. Lusitu Irrigation Scheme

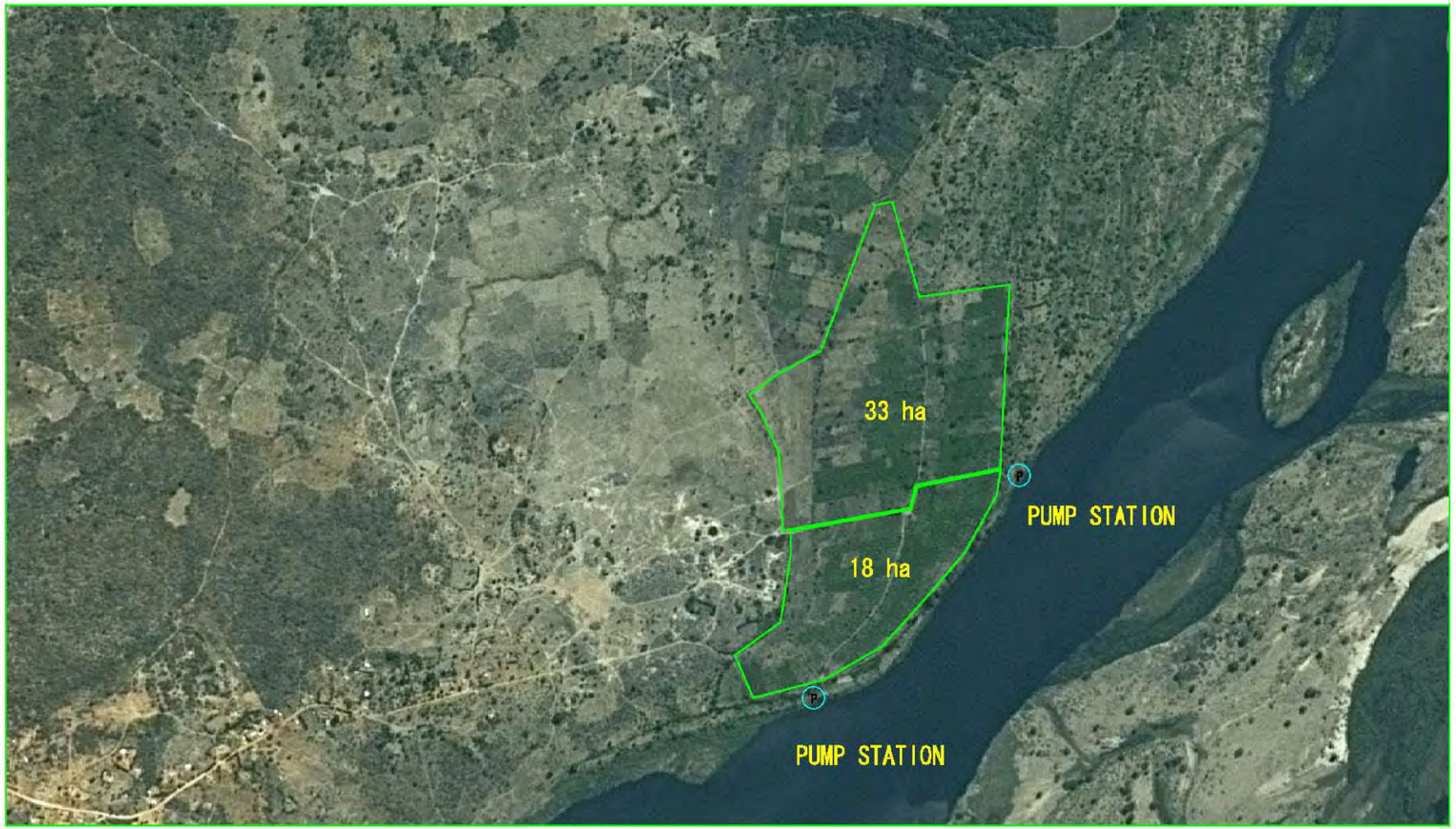
Estimate	140 ha

Existing Canal/Pipeline

Farm Land

0 500 1000 2000M

FIGURE 7. Lusitu Irrigation Scheme		THE STUDY ON THE MASTER PLAN FOR PROMOTION OF IRRIGATED AGRICULTURE FOR SMALLHOLDERS IN THE PERI-URBAN AREA IN THE REPUBLIC OF ZAMBIA
DWG. NO	SCALE	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) MINISTRY OF AGRICULTURE AND COOPERATIVES (MACO)



8. Kapululira Irrigation Scheme

Estimate	51 ha

Existing Canal/Pipeline
Farm Land

0 250 500 1000M

FIGURE 8. Kapululira Irrigation Scheme		THE STUDY ON THE MASTER PLAN FOR PROMOTION OF IRRIGATED AGRICULTURE FOR SMALLHOLDERS IN THE PERI-URBAN AREA IN THE REPUBLIC OF ZAMBIA
DWG. NO	SCALE	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) MINISTRY OF AGRICULTURE AND COOPERATIVES (MACO)

9. Mubyumu Irrigation Scheme

Estimate	12 ha

Existing Canal/Pipeline

Farm Land

0 250 500 1000M

FIGURE 9. Mubyumu Irrigation Scheme		THE STUDY ON THE MASTER PLAN FOR PROMOTION OF IRRIGATED AGRICULTURE FOR SMALLHOLDERS IN THE PERI-URBAN AREA IN THE REPUBLIC OF ZAMBIA
DWG. NO	SCALE	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) MINISTRY OF AGRICULTURE AND COOPERATIVES (MACO)

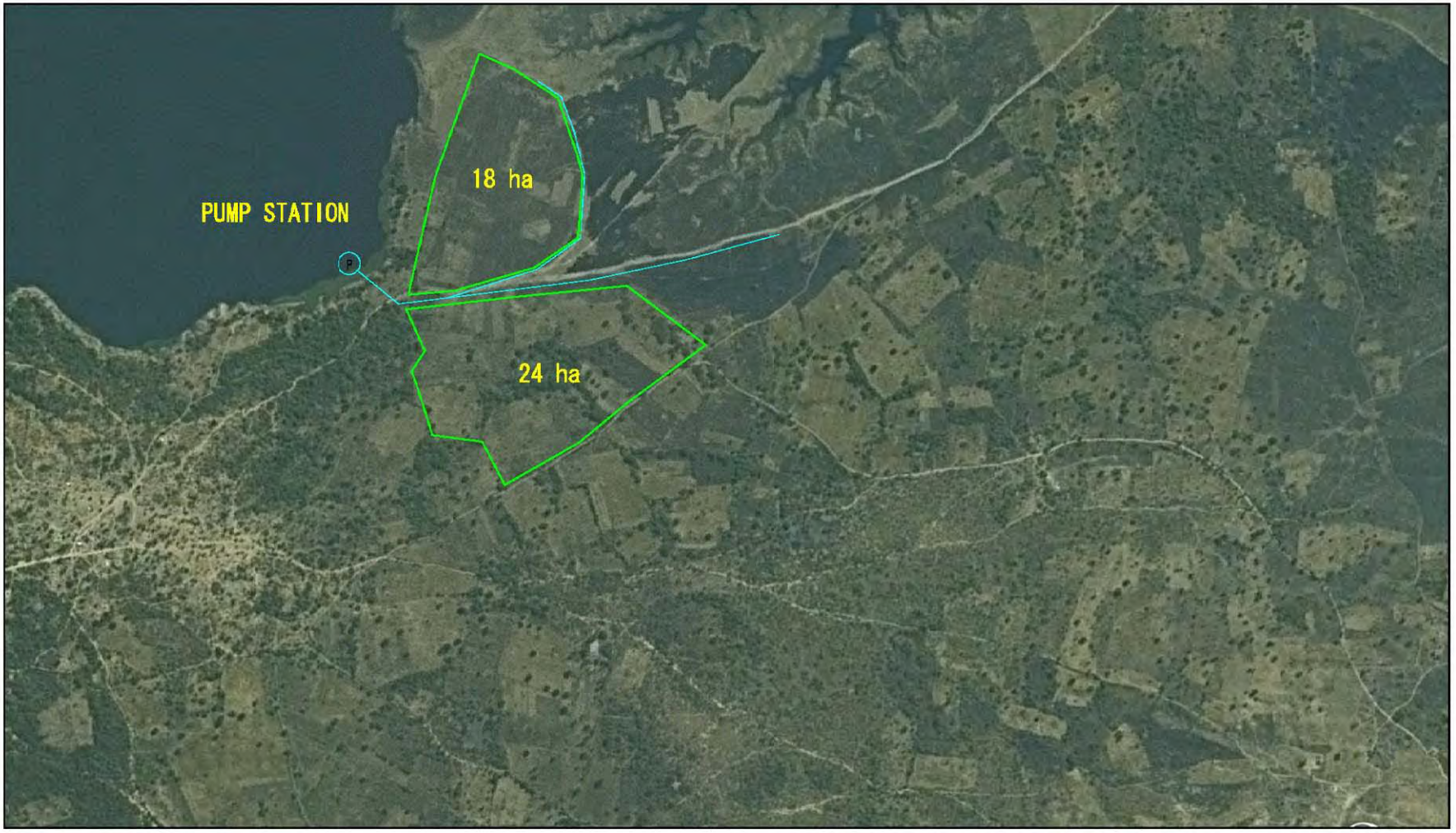
Existing Canal/Pipeline
Farm Land

0 250 500 1000M

10. Siatwinda Irrigation Scheme

Estimate	78 ha

FIGURE 10. Siatwinda Irrigation Scheme		THE STUDY ON THE MASTER PLAN FOR PROMOTION OF IRRIGATED AGRICULTURE FOR SMALLHOLDERS IN THE PERI-URBAN AREA IN THE REPUBLIC OF ZAMBIA
DWG. NO	SCALE	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) MINISTRY OF AGRICULTURE AND COOPERATIVES (MACO)



11. Chiyabi Irrigation Scheme

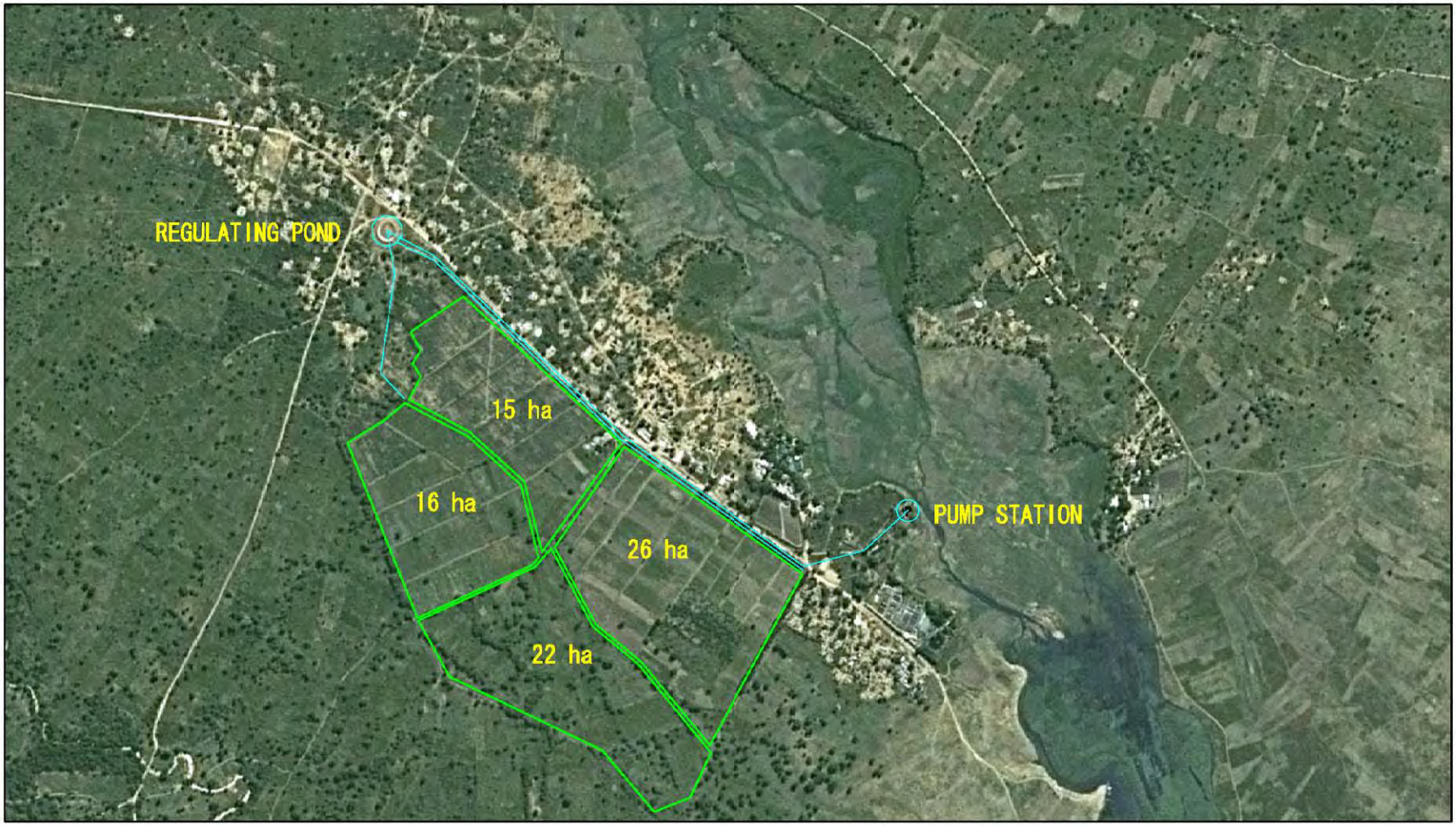
Estimate	42 ha

Existing Canal/Pipeline

Farm Land

0 250 500 1000M

FIGURE 11. Chiyabi Irrigation Scheme		THE STUDY ON THE MASTER PLAN FOR PROMOTION OF IRRIGATED AGRICULTURE FOR SMALLHOLDERS IN THE PERI-URBAN AREA IN THE REPUBLIC OF ZAMBIA
DWG. NO	SCALE	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) MINISTRY OF AGRICULTURE AND COOPERATIVES (MACO)



12. Buleya Malima Irrigation Scheme

Estimate	69 ha

Existing Canal/Pipeline
Farm Land

0 250 500 1000M

FIGURE 12. Buleya Malima Irrigation Scheme		THE STUDY ON THE MASTER PLAN FOR PROMOTION OF IRRIGATED AGRICULTURE FOR SMALLHOLDERS IN THE PERI-URBAN AREA IN THE REPUBLIC OF ZAMBIA
DWG. NO	SCALE	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) MINISTRY OF AGRICULTURE AND COOPERATIVES (MACO)