MINISTRY OF AGRICULTURE AND COOPERATIVES
THE GOVERNMENT OF THE REPUBLIC OF ZAMBIA

THE STUDY ON THE CAPACITY BUILDING AND DEVELOPMENT FOR SMALLHOLDER IRRIGATION SCHEME IN NORTHERN AND LUAPULA PROVINCES IN THE REPUBLIC OF ZAMBIA

FINAL REPORT (MAIN)

JULY 2011

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
SANYU CONSULTANTS INC., JAPAN

PREFACE

In response to a request from the Government of the Republic of Zambia, the Government of Japan decided to conduct a study, The Study for the Capacity Building and Development for Community-based Smallholder Irrigation Scheme in Northern and Luapula Provinces, and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Kosei HASHIGUCHI of Sanyu Consultants Inc. and composed of members from the said consultancy company between March 2009 and June 2011.

The team held discussions with the officials concerned of the Government of the Republic of Zambia and conducted field surveys at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the implementation of the development plans identified therein and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Zambia for their close cooperation extended to the study.

July 2011

TAKASHIMA Izumi
Vice-President
Japan International Cooperation Agency

July 2011

Mr. TAKASHIMA Izumi
Vice-president
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

Dear Mr. TAHASHIMA,

We are pleased to submit herewith the Final Report on the Study for the Capacity Building and Development for Community-based Smallholder Irrigation Scheme in Northern and Luapula Provinces in the Republic of Zambia. This Report presents the development plans of the target two provinces formulated with the advices and suggestions of the authorities concerned of the Government of Japan and your Agency. Also incorporated were comments made by the steering committee members during the technical discussions on the draft final report, which was held at Lusaka on May 27, 2011.

The overall goal of this Study is to provide a design to promote food security for the smallholder farmers in the two provinces of Northern and Luapula. The Study has been conducted in partnership with and by guidance from the Ministry of Agriculture and Cooperatives in the Republic of Zambia. The process of this Study centered on the following which themselves were the objectives of the Study:

1) To formulate an Action Plan (AP) to promote effective smallholder irrigation schemes for improving the agricultural productivity in Northern and Luapula Provinces; and

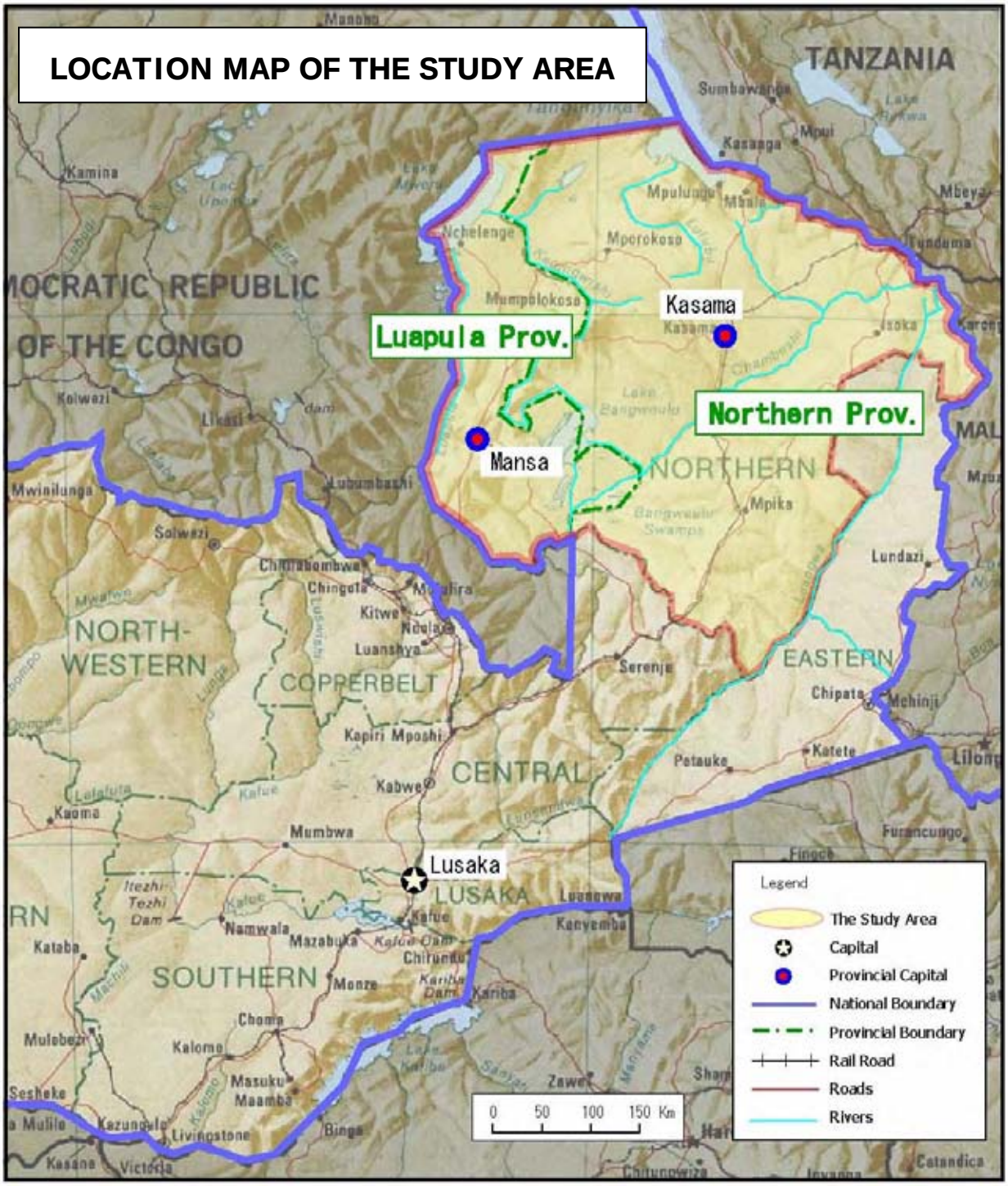
2) To transfer the technology and build the capacity in smallholder irrigation development for counterpart personnel and concerned communities through implementation of the Study.

To attain the above objectives, this Study was carried out in two phases: Phase I dealt mainly with situation analysis, formulation of the draft Action Plan and implementation of pilot project, while Phase 2 undertook the extension of the pilot project, including an upgrading from temporary irrigation facilities to permanent ones. The draft action plan was finalized by reflecting the feedbacks and lessons from the implementation of those pilot projects. The Phase I study was commenced in March 2009 and completed by March 2010, and the Phase II study started in April 2010 and ended with the submission of this final report in July 2011.

We wish to take this opportunity to express our sincere gratitude to your Agency, the Ministry of Foreign Affairs and relevant authorities of the Government of Japan. We also wish to express our deep gratitude to the Ministry of Agriculture and Cooperatives in the Republic of Zambia for the close cooperation and assistances extended to us during the Study.

Very truly yours,

HASHIGUCHI Kosei
Team Leader of the Study Team



Particular	Area	Population (2000) Density, p./km^2	Distirct		Rural Population, %	Poverty Ratio, %
			Nr.	Area/distrct		
Northern	147,826km^2 (384x384km)	1,258,696 (8.5)	12	12,319km^2 (111x111km)	86	74
Luapula	50,567km^2 (225x225km)	775,353 (15.3)	7	7,224km^2 (85x85km)	87	79
Total	198,393km^2 (445x445km)	2,034,049 (10.3)	19	10,442km^2 (102x102km)	86	76
Zambia	752,612km^2	9,885,591 (13.1)	–	–	65	68

Source: National Census 2000 for Population and Area, Living Conditions Monitoring Survey Report 2004 for Poverty Ratio

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A view of Kasama Town from a gentle hill, the provincial capital of Northern Province: as represented by the picture, flat land characterizes the most parts of the Study area wherein there are a number of small streams ideal for the promotion of community based smallholder irrigation schemes.

There are also hilly or mountainous areas in the Study area. In such areas, due to relatively abundant precipitation (approximately 1,000mm/annum), there are a number of small and large rivers and thus high potential for smallholder irrigation development can be seen especially in shallow rivers.

Farmers are constructing a trigonal-prop type weir, the most complicated weir amongst all types of simple weirs promoted in the Study. Assemble pyramidal structures with timbers and put them across the river at about 3m intervals and the weir will be completed after reinforcing with grasses and clay soil. This type of weir can be constructed even on rocky foundation where wooden piles can not be transfixed.

An example of permanent type weir which was upgraded from a simple weir in Mansa district, Luapula province: this 44m-width weir was originally constructed only with timber and clay soils, and was upgraded to this concrete weir. Cement and iron bars were provided both by beneficiary farmers and JICA, and technical assistance had been provided by provincial and district TSB officers.

Beautiful alignment of a furrow (small irrigation canal) along the contour line of a gentle hill, which is running all the way from the weir constructed on an upper part of a large *Dambo* plain. The furrow is running toward the far end of the village, along which irrigated agriculture is now taking place.

A tomato field divided by maize plants into small plots, successful scenery of smallholder irrigation in a newly developed site: after the construction of weir, digging of furrow, and preparation of farm plot, tomato plants were planted and had been carefully managed without any problem—the outcome of the pilot project is about to come.

EXECUTIVE SUMMARY

PREFACE

0.1 Submitted herewith is the Final Report (FR) compiled in accordance with the Scope of Works (SW) on "The Study for the Capacity Building and Development for Community-based Smallholder Irrigation Scheme in Northern and Luapula Provinces in the Republic of Zambia" (the Study) signed between the Ministry of Agriculture and Cooperatives (MACO), Republic of Zambia and Japan International Cooperation Agency (JICA) on June 27, 2007 and the attached Minutes of Meetings (MM).

0.2 This Report covers all the issues the JICA Study Team has undertaken since the inception of the Study up until the end. The issues incorporated in this Report are, among others, results of situation analysis, identification of irrigation potential, pilot project implementation and the achievements, action plan for the smallholder irrigation scheme development, a proposal for investment, and conclusion and recommendations.

1. RATIONALE AND GOAL OF THE STUDY

1.1 The Study area, Northern and Luapula provinces, has much rain and surface water as compared to other provinces in Zambia. The area is also endowed with gentle rolling-hill like topography. There is, therefore, high potential to introduce gravity—and to some extent pumping—irrigation for smallholder farmers. Making use of irrigation, smallholder farmers in the Study area can improve their agricultural productivity even with less agricultural input combined with improved farm management.

1.2 To establish smallholder irrigation systems in the provinces, there is an urgent need of carrying out a comprehensive study, which provides a concrete action plan towards the promotion of the systems. Smallholder irrigation systems to be developed are expected to contribute to improving agricultural productivity of smallholder farmers in the target area, and be replicated in other locations where same geographical and natural environmental features prevail.

1.3 The overall goal of the Study is to enhance food security in Zambia through promoting irrigated agriculture in community-based smallholder irrigation schemes. This Study is carried out in partnership with and by guidance from Department of Agriculture (DOA), MACO, and incorporates the views of beneficiaries and other stakeholders such as relevant departments under MACO, regional and field offices of MACO, and local authorities. The objectives of the Study are:

1) To formulate Action Plan (AP) to promote effective smallholder irrigation schemes for improving the agricultural productivity in Northern and Luapula Provinces, and

2) To transfer the technology and build the capacity in smallholder irrigation development for counterpart personnel and concerned communities through implementation of the Study.

1.4 Smallholder irrigation schemes undertaken in this Study should be those which: 1) are operated and maintained by the beneficiary smallholder farmers; 2) are constructed with farmers' participation; and 3) have preferably less than 50 ha of irrigation command area, where full scale of Environmental Impact Assessment (EIA) is not required.

1.5 Sanyu Consultants Inc. of Japan was contracted by JICA to carry out the Study. Since March 2009, the JICA Study Team has conducted necessary surveys and studies agreed in the SW. The Team has undertaken inventory survey of existing irrigation schemes, irrigation potential identification, rural society, agriculture and marketing, and action plan formulation together with implementation arrangement. In addition, pilot project has been carried out on simple diversion schemes, and, in 2010, permanent schemes were carried out. The results from the pilot project were fully reflected in the

action plan.

2. DEVELOPMENT AND POVERTY IN ZAMBIA

2.1 Zambia is a land-locked country bordering with eight countries: Botswana, Namibia, Zimbabwe, Tanzania, Angola, Malawi, Democratic Republic of the Congo (DRC), and Mozambique. Zambia has a total land area of about 753,000 sq.km and its population is estimated at about 11.9 million as of 2007. The average population density of the 8 neighboring countries is 24 and the average of sub-Saharan African countries is 31, while that of Zambia arrives only at 16 persons per sq.km.

The economy of Zambia is marking almost continuous growth since 1999, thanks to the price hike of copper in the international market, robust development of construction and service sectors, debt relief under enhanced HIPC Initiative, etc. The average real GDP growth ratio between 1999 and 2010 was at 5.1%, and GDP per capita at current price has also reached over 900 US$ in 2006. Annual inflation ratio, once peaked over 180% in 1993, started subsiding, and single digits were marked in the years of 2006 (8.2%), 2007 (8.9%), 2009 (9.9%) and 2010 (7.9%); the first time during the last 3 decades.

2.2 On the other hand, agriculture sector has been staggering and not grown from 1996 to 2007. The average growth ratio was 0.2%, almost negligible. It is also pointed out that there were 7 times of years out of the 12 years when the growth ratio hit negative percentage. These negative growth ratios are well correlated with unstable weather such as drought. However, there was once a big leap in the growth in 2009 and 2010, recording as high as 12.4% and 12.9%, which correspond to a good rainfall in these years.

2.3 The share of agriculture sector in the total GDP is minimal ranging from 7.1% in 1995 to as low as 3.3% recorded in 2008. The share is on the declining trend after reaching the peak of 7.1% in 1995 though there was a bit of increase in 2009 supported by the aforementioned 12.4% growth ratio. This minimal share of agriculture sector in the total GDP does not necessarily indicate that the sector does not play an important role in the national production. A fact is that about two-thirds of the whole population live in rural area and are engaged in agriculture. Due efforts should therefore be brought in to enhance agriculture production, or great number of rural population remains in poverty.

2.4 In terms of the Human Development Index (HDI), Zambia is placed at 150th among 169 countries, with the value of 0.395. Concerning the Study area, lower literacy can be found: 60% in Northern and 62 % in Luapula province, while that of national level is 67%. For the gross primary enrollment, those for the Study area are not quite lower than that of national level: 75% and 74% for Northern and Luapula provinces as compared to 79% of the national level. It is however pointed out that life expectancies for the Study area are remarkably lower than that of national level: only 45 years for Northern province and 44 years for Luapula province against the national level of 50 years.

2.5 About two thirds of the population lives in rural area. It is projected that nearly 90% of the rural population is engaged in agriculture. Zambian farmers are distinguished into three categories: small (less than 5 ha), medium (5 to 20 ha) and large (more than 20 ha) scales. As of year 2006, small-scale farmer population shares as much as 91.7% of the rural population and 96.2% of the total number of farmers. In addition to those categories, some farmers are also categorized in “out-growers” who practice farming based on the formal or informal contract with commercial producers.

2.6 Of a total 75,261,200 ha of the national land, 35,273,000 ha (46.9%) is categorized as arable land, of which 5,265,000 ha is seen as agricultural land. Of the total agricultural land, 360,000 ha (6.8%) is estimated irrigable but only 43% of it is under irrigation. The irrigated area of 155,912 ha is composed of 32,189 ha for surface irrigation, 17,570 ha for sprinkler irrigation, 5,628 ha for localized irrigation and 100,525 ha for irrigated wetlands. By size, about 72% of the total irrigated area falls

under the category of small irrigation schemes, 5% under medium irrigation schemes, and the rest 24% under large irrigation schemes.

2.7 MACO is the responsible agency in the agriculture sector of Zambia. In the DOA, there are three major branches: agricultural advisory service branch, crops production branch, and Technical Services Branch (TSB). The TSB has been the principal organization responsible for the planning, development and management of irrigation schemes. TSB used to be engaged in operation and maintenance of the government managed irrigation schemes. However, it had become a small organization in the 1990s, and nowadays TSB no longer manages irrigation schemes directly.

2.8 At the provincial level, organizational structure of the DOA reflects the one in the headquarters. All the related departments are under the authority of Provincial Agriculture Coordinator (PACO), who is designated by the Permanent Secretary (PS) of the ministry. As for the provincial DOA, Provincial Agricultural Officer (PAO) takes charge and, under PAO, there are also three branches as in the headquarters. At the district level, the same structure is replicated. Instead of PACO and PAO, there are District Agriculture Coordinator (DACO) and Senior Agriculture Officer (SAO) at district.

2.9 Under the district level, there are special units defined specifically by MACO for its extension operation: block and camp. Block is in general composed of several camps: on average four blocks are under a district, in which five to six camps are included in the Study area. For those units, Block Extension Officer (BEO) and Camp Extension Officer (CEO) are respectively assigned. Thus, CEOs are the tail-end agents of MACO, who deliver agricultural technologies to clientele farmers in the villages and then forward to the district the needs of and feedback from the farmers.

3. THE STUDY AREA

3.1 LAND, POPULATION, CLIMATE AND WATER RESOURCES

3.1 The Study area encompasses two provinces: Northern and Luapula provinces. Total area of the two provinces is 198,393 sq.km (about 445 km square), which accounts for 26% of the total national land. The total population of the 2 provinces as of the year 2000 is about 2 millions with population density of 10 persons per sq.km, very low population density—one of the typical characteristics of the Study area.

3.2 Northern province is composed of 12 districts while Luapula province is made up of 7 districts. A typical district in the Study area extends over an area of about 10,000 sq.km on average, equivalent to 100 km square. However, the area by district varies widely: from the smallest of 3,965 sq.km (63 km square) of Chienge district in Luapula province to the biggest of 40,935 sq.km (202 km square) of Mpika in Northern province. Here is as much as 10 times difference in terms of extent of the land.

3.3 The Study area has clearly separated dry and rainy seasons. From December to March is the rainy season, during which more than 80% of the annual precipitation falls. According to climate records at Kasama and Mansa stations, monthly rainfall peaks in December at Kasama and January in Mansa. The peak monthly rainfall reaches as much as 290 mm at Kasama station while that of Mansa station is around 270 mm. The average annual rainfalls for the record periods are 1,310 mm for Kasama station and 1,154 mm for Mansa station, both of which far exceed those precipitations falling in other parts of Zambia.

3.4 The Study area has many perennial water sources and wetlands. The major rivers are Chambeshi river and Luapula river. Chambeshi river drains the whole of the central part of Northern province into the large Bangweulu swamps (about 5,000 sq.km), which drains into Luapula river. Apart from the major two rivers, Luangwa, Lukulu, Lubansenshi and Kalungwishi are also key rives. Luangwa river drains into Zambezi river system, Lukulu and Lubansenshi rivers join Chambeshi river, and

Kalungwishi drains into Lake Mweru and then joins Congo river system.

3.5 The two provinces provide more surface water resources than other parts of Zambia: 304 cum/day/sq.km for Northern and 357 cum/day/sq.km for Luapula in a 10-year return period. Likewise, those of Chambeshi and Luapula river basins are 322 and 338 cum/day/sq.km respectively. Runoff depths are 168 mm for Chambeshi river basin and 161 mm for Luapula river basin. Applying annual rainfalls in the catchment areas give runoff percentages: 12.8% for Chambeshi river basin and 14.0% for Luapula river basin. Monthly runoff for Chambeshi river varies from 1.15 to 13.56 litre/s/sq.km. Luapula river gives its lowest runoff in November with only 1.21 litre/s/sq.km while the maximum one appears in March with 10.90 litre/s/sq.km.

3.2 RURAL SOCIETY IN THE STUDY AREA

3.6 Most of the ethnic groups in the Study area originate in Luba, once established in the south-eastern part of the present DRC. The people started migrating from Luba to northern parts of Zambia, where the Study area is located. Today, the majority in Northern province is Bemba people sharing about half of the population, and followed by Namwanga, Mambwe, and Bisa, each of whom consists of about 10% of the population. In Luapula province, Bemba people still share the majority of about 24%, followed by Ushi (21%), Lunda (14%), Chishinga (10%), etc.

3.7 At the village level, there is “village committee” chaired by village headman, which is the supreme decision making body in the village. Village committee discusses various issues and topics wherein decision is basically made as the committee’s consensus under the chairpersonship of the village headman. Topics discussed are related to village development such as road and bridge maintenance, construction of school and health post, construction and maintenance of village shelter (a public meeting place), establishment of village community fields.

3.8 According to a baseline survey in 12 villages carried out in 2009 and 2010 by the JICA Study Team, number of family members per household ranged from 5.4 to 8.9 with an average of 7.0 members. Number of children under-15 years per household varied from 2.6 to 4.0 giving a dependent ratio from 37% to 58% with an overall average of 46%. Share of the female-headed households was from 3% to 23 % with the average of 8.6 %.

3.9 January to March was identified as the period the people suffer from food shortage, waiting for the harvest of rainy season crops. Excepting bumper yield years, some villagers get only one meal per day. To avert this hunger, they usually start drying cassava chips in the dry season for their staple food (*Nshima*). They also preserve leaves of pumpkin, cowpeas, beans, okra and sweet potato to make sure of food security during rainy season.

3.10 In the villages, there were times when they faced drought, giving damages to their crops. Apart from drought, there were heavy rainfalls which also damaged or even devastated their crops than drought did. A village had 3 times of heavy rains in 1962, 1963 and 1972 after the village establishment of 1947, while others had 2 times in 1978 and 1997 and 3 times in 1962, 1996 and 1997. Those cases resulted in severe hunger. Note that though the Study area is well known blessed with rich rainfall, the rainfall on the other side has caused heavy damages on their crops.

3.11 As for asset holdings, it was revealed that there is a high rate of possession of mobile phone. Almost all the villages are covered with constant mobile phone network. Mobile phone receives text message when the person moves into the network area. With this reason, mobile phone has become very popular even in remote areas of Zambia. The ratio of the sampled households, who have mobile phone, ranges from 9.7% to as high as 63% with an average of 44%.

3.12 Extension officer and family members are the most dominant information sources of

agricultural information, followed by extension programmes of donors, NGOs, the government, and radio programme. There were farmers who have gotten agricultural information from colleague farmers outside his/her village and also within the village. As for CEO visit, almost half of the respondents (43%) have chance to see CEO more than once a month, and more than half of the respondents (55%) listen to the radio extension program almost every week.

3.13 Annual income, including self-consumed food converted with farm-gate prices, ranged from ZMK 2.9 million to ZMK 16.3 million. In fact, the biggest income level of ZMK 16.3 million surpassed by far the others as the 2nd biggest income level was only ZMK 6.8 million. Overall average of the annual income for the total of 12 villages arrived at ZMK 5.8 million, or ZMK 4.7 million excluding the biggest income level of ZMK 16.3 million. Median annual income was ZMK 3.98 million, or ZMK 3.69 million excluding the biggest one. First quartile annual income was ZMK 2.44 million. Food crop income shares the majority of the income from 53% to 92 % of the total annual income, averaging 71%.

3.14 The Gini index for total income varied from 0.25 to 0.37 with an overall average of 0.40. Gini index for food crop income also varied from 0.26 to 0.45 with an overall average of 0.41. In sum, the inequality in the income of the sampled households was not quite big. However, when looking into disposable annual income, the difference is already more than 0.4 in about half of the villages, which means the inequality is somewhat already serious.

3.15 Poverty line was established based on Cost of Basic Needs method. It arrived at ZMK 1,437,044 (US$ 275.6) composed of ZMK 1,192,226 for food poverty line and ZMK 244,818 for non-food poverty line. The former shares as much as 83 % while the latter does 17 % only. The 83% corresponds to Angel's coefficient, whereby a very high share by food expenditure was observed. Based on the average adult equivalent member in a family (5.7 per family), the poverty line per household comes to ZMK 8,191,150 (US$ 1,570), composed of ZMK 6,795,688 (US$ 1,303) for food poverty line and ZMK 1,395,462 (US$ 267) for non-food poverty line. Given this poverty line, poverty ratio by all the sampled households arrived at 56.2%, ranging from 29% to 76% by village.

3.16 Poverty gap ratio indicates the depth of the poverty which corresponds to the distance between the poverty line and the average of expenditures for those who fall below the poverty line. The overall poverty gap ratio was 18.4%, ranging from 7.2% to 28.1%. The poverty gap ratio is used to provide an estimate of the sum required to raise the consumption level of all poor families up to the poverty line. For example, at the average level, if a project can produce an additional value of ZMK 1,507,172 (=0.184 x 8,191,150) per household, an average poor household who is below the poverty line can now be lifted to the poverty line.

3.3 AGRICULTURE IN THE STUDY AREA

3.17 One of unique characteristics of agriculture in the Study area is a mixture of extensive and intensive agriculture. In the Study area, they are located closely to each other with mosaic-like arrangement. Extensive agriculture practice, like *Chitemene* (thrush and burn) shifting cultivation, is still a major farming practice for rainy season agriculture and can be sporadically found even along an irrigation canal.

3.18 Major crops are grown in rainy season. Land preparation of maize, for example, starts in early September and maize is planted during November to December when the first rain comes. Maize takes for four months or more to harvest. Usually, grains are left on the field for months after it matured so that grains can get dried. Sorghum and finger millet are also cultivated during the rainy season and harvested after the rainy season.

3.19 Cassava has a longer growing period, which even goes beyond a year. Cassava cultivation starts in the middle of the rainy season. Although harvest of cassava can start as early as 7 months after the planting, main harvest usually starts after a year or around. Farmers can harvest cassava anytime in a year, making it difficult to capture production statistics. Cassava is given a credit of food security crop for its longer harvesting period coupled with its relative tolerance to low humidity.

3.20 As of the average size of planted area of each crop per household, based on the baseline survey, the biggest was maize, 0.73 ha/household. The second biggest was cassava at 0.50 ha/household. Beans, sweet potato and groundnuts are cultivated at about an area of 0.3 ha/household. Farming is almost exclusively carried out by manual, making the farmers difficult to expand the faming area. These limited land areas imply how hard it is to expand their farmland without farm power mechanization.

3.21 Northern province enjoys enough amount of cereal at 226 kg/capita as of 2009/10, while Luapula province face a deficit; per capita production reached only 72 kg/capita. By district, Mbala, Isoka, and Nakonde in Northern province have marked more than 300 kg/capita, suggesting those districts have surpluses for export. On the other hand Chilubu and Kaputa in Northern province and most of the districts in Luapula province except Kawambwa and Milenge encounter the shortage; they go under 100 kg/capita that is equal to approximately 1,000 kcal/day per capita.

3.22 A large number of people in the Study area consume starch as a form of cassava, sweet potato, and some Irish potato. CSO data for the harvest of 2009/10 season indicated that 98% of starch is shared by cassava. Per capita production of starch crops at dry weight averaged at 219 kg/capita for Northern and 289 kg/capita for Luapula. There were two districts which marked more than 350 kg/capita: Luwingu and Kawambwa. Although data accuracy issue remains in the estimation of cassava production, there should be marketing potential to export from these districts.

3.23 Totals productions of cereal and starch per capita arrive at 445 (226+219) kg/capita in Northern province and 361 kg (72+289) in Luapula province, which far surpass the minimum requirement of the population in the area in terms of total calories (a typical adult requires about 200 kg of cereals/starch per year). Farmers in the Study area are therefore no longer in such situation as to pursue self-sufficiency of staple food. Rather, they are in the stage to diversify their diet to improve their nutritious balance – enough rationality to start vegetable production under irrigated agriculture.

3.24 Groundnuts and mixed beans are the major legume crops in the area. Different from cereal crops, Luwingu and Mporokoso in Northern province are outstanding in per capita production of the pulses as 91 kg and 83 kg respectively according to the CSO data for 2009/10 season. The large production of pulses may be associated with the allocation of fertilizer under the Farm Input Support Programme (FISP). Luwingu has been allocated a fewer amount of fertilizer from the FISP and thus farmers in this area try to make up for the shortfall by cultivating pulses, which are to improve soil fertility at some point.

3.25 As far as cash crops are concerned, there are a variety of marketing opportunities. According to an agricultural marketing survey, considerable percentages of agricultural produce go to other provinces or countries. For example, on average 22% of the produces on the market goes outside of the province where they were produced. In the share of produces shipped within the province (78% of total), 70% is actually shipped within the districts—only 8% of the marketed produces are traded toward other districts in the province. Farmers tend to choose either high potential big market in other provinces or, if not, local markets in their own district.

3.26 Market prices change significantly along the timeline. In a year, it increases at 112% on average of all the crops. Specifically, tomato shows the largest rate of increase at 305%; it changes from ZMK

15,778/ 20kg to ZMK 63,889/ 20kg. The least price change was found in soybean at 28%, suggesting the stability of the crop price or otherwise not much preferred by markets throughout year. Prices for vegetables generally rise during the wet season when there is scarcity of harvests, and then it hits the bottom when dry season produces mostly from *dambo* areas appear in the market.

3.4 IRRIGATION IN THE STUDY AREA

3.27 Topography in the Study area can be divided into four types: 1) mountainous area, 2) transition area from mountain to upstream *dambo* area, 3) upstream of *dambo* areas and 4) middle – downstream of *dambo* area. Mountainous areas and transition areas are physically not suitable for large-scale irrigation schemes due mainly to its hilly and undulating topography. On the other hand, those areas can provide high potential for small-scale gravity irrigation systems due to its easiness of water abstraction. In contrast, upstream and mid stream *dambo* areas, where large wetlands extend alongside the river/stream, can be developed for medium to large-scale irrigation schemes.

3.28 Existing irrigation schemes in the Study area are categorized in two types: 1) permanent irrigation scheme and 2) simple irrigation scheme. The former type is established with permanent structures like concrete river diversion weir, dam reservoir to impound river/stream water. The latter irrigation scheme is in most cases constructed by farmer themselves utilizing locally available materials such as grass, clay soil, twigs, bamboos, or just digging a water furrow (small channel).

3.29 According to an inventory survey, there are 104 permanent irrigation schemes in the two provinces, composed of 67 sites in Northern province and 37 sites in Luapula province. The total irrigated area by these permanent schemes is reported at 441 ha, composed of 361 ha in Northern and 80 ha in Luapula provinces. From these figures, an average irrigated area per scheme arrives at only 4.2 ha: 5.4 ha in Northern province and 2.2 ha in Luapula province.

3.30 As for farmer beneficiaries of the permanent irrigation schemes, there are as many as total 3,727 farmers in these irrigation schemes: 2,780 beneficiaries in Northern province and 947 in Luapula province. Average number of beneficiaries per site is only 36 farmers for the both provinces; 41 in Northern province and 26 in Luapula. This is attributable to the fact that average irrigated area per site in Northern province is bigger than that of Luapula province, 5.4 ha vs. 2.2 ha.

3.31 For simple (temporally) schemes, there are a total of 1,024 existing sites, composed of 850 sites in Northern province and 174 sites in Luapula province. The total irrigated area arrives at 1,772 ha, composed of 1,564 ha in Northern province and 208 ha in Luapula province. The total area counts about 4 times more than that of permanent ones. Irrigated area per site is not big; just 1.7 ha as the overall average. A typical simple scheme accommodates an average of 17 farmer beneficiaries.

3.32 Permanent irrigation schemes are in most cases designed by the government officers, provincial and district Technical Services Branch (TSB) officers. Officers at the provincial and district TSBs carry out necessary works, e.g. topographic survey, designing, preparation of bill of quantities, cost estimation. Given the disbursement of budget, provincial and district TSBs procure necessary materials and BEO/CEO in charge of the area start mobilizing the beneficiary farmers concerned.

3.33 There are mainly two types of permanent irrigation structures in river/stream diversion schemes: wet-masonry type and concrete wall type, with the latter being the majority at present. Though concrete-wall type structure requires formwork to pour concrete, the construction work can be finished in a shorter period of time than masonry type weir. Concrete-wall type weir entails higher project cost, but it is durable than wet masonry type weir.

3.34 In the Study area, no irrigation schemes are operated by the government but exclusively by the farmer beneficiaries. Some of the schemes are well operated and maintained since its commissioning.

In most of the existing irrigation schemes, clearing, mowing weeds and de-silting are major maintenance works by the beneficiaries. Farmers regularly carry out those works through contributing their own labors and in cases some cash as well, for example, to purchase some packets of cement.

3.35 On the other hand, mending works of permanent facilities seems to be rather difficult for the farmers due to both technical and financial reasons. There are sites, where farmers gave up practicing irrigation. In a site, a concrete weir had gradually shown seepage underneath, which let the weir sinking down because of muddy foundation being eroded. Mending works under this situation may require technical and also financial supports from outside.

4. SMALLHOLDER IRRIGATION DEVELOPMENT: PLANNING

4.1 ISSUES IDENTIFIED AT KICK-OFF WORKSHOP

4.1 Through a SWOT analysis in the Kick-off Workshop, government officers identified that weaknesses are ‘shortage of staff’ and ‘inadequate logistic support’ especially relating to ‘transport.’ In addition, camp officers identified ‘lack of opportunities for capacity building’ as one of their weaknesses. In fact, without donor’s support, very little opportunities are available for any kind of training courses especially for lower cadre of government officers. Threats identified are ‘natural calamities,’ ‘poor infrastructure’ especially poor road condition and its network, ‘land tenure,’ ‘low adoption rate’ by farmers, ‘migration among villagers,’ and ‘expensive farm input.’

4.2 As to Northern province, ‘inadequate function of irrigation infrastructure’ was identified as a cause of ‘over-dependency on rain-fed agriculture,’ causing the core problem of ‘low production.’ Reasons further causing this problem are: 1) lack of technical skill of farmers, 2) low investment levels and 3) vandalism. As for Luapula, ‘inadequate irrigation facilities’ was identified as the cause of ‘dependency on rain-fed crops.’ New irrigation schemes may be more required in Luapula province while in Northern province improvement of existing facilities may have higher priority.

4.3 With regard to ‘low production’ identified in the Problem Analysis, soil related issues were emphasized: ‘low soil fertility’ caused by ‘land degradation,’ ‘high level of soil degradation’ caused by ‘acidity problem soil.’ Furthermore, ‘inadequate extension services’ are caused by ‘less staff employed,’ ‘inadequate logistical support,’ and ‘wide coverage area.’ To pursue effective extension, logistical support could be a critical issue taking into account their wide coverage area.

4.2 ISSUES IDENTIFIED AT VILLAGE LEVEL WORKSHOPS

4.4 Out of six villages where village level workshop was held, three villages identified ‘no community canal,’ ‘not enough water for agriculture,’ or ‘cannot cultivate in dry season’ as the top problem, leading to the core problem of ‘life is not easy.’ Though the rest of three villages did not identified irrigation related issue(s) as one of top three problems, ‘low crop production,’ ‘cannot cultivate in dry season,’ were listed. In fact, all the six villages identified ‘no community canal/furrow’ as one of their problems, at least occupying a position in the problem trees.

4.5 Two villages identified ‘chemical fertilizer issue’ as one of top three problems. In addition, all the villages identified ‘chemical fertilizer’ as a problem. Low soil fertility was identified in 5 villages. Market related issues were identified as the problem of some villages. Other problems identified by as many as 4 villages were: ‘quality seeds,’ ‘low crop production,’ ‘hunger/not-enough food,’ ‘livestock,’ and ‘clinic/health center far away.’

4.3 DEVELOPMENT CONSTRAINTS

4.6 *Large Area Coverage in Agriculture Extension*: For agricultural extension activities, the biggest

challenge is outreach. Coverage area of one CEO is estimated around 657 sq.km, or 26 km square in Northern province and 372 sq.km, or 19 km square in Luapula province. Average numbers of rural households that a CEO is supposed to take care of are estimated at 1,301 households and 1,398 households in Northern and Luapula provinces according to the estimated population as at 2009.

4.7 *Lack of Mobility*: What makes it more difficult is the lack of, or delay of, funding for the transportation arrangement. Some CEOs have motorcycle but the majority of CEOs do not have. As of 2009, 33% of the CEOs in Northern provinces are given motorcycle and 19% in Luapula province. The majority of CEOs are equipped only with bicycle or just no means of transportation. To deal with this situation, CEOs often borrow motorcycle from their colleagues in the same district or from the district office.

4.8 *Difficulty for BEOs/CEOs to Meet at Plenary*: Although BEOs/CEOs are supposed to meet quarterly, due to logistics problem it is often once a year only. While BEOs are meeting as planned, the lack of meeting opportunity makes them difficult to communicate each other and to exchange up-dated information. As a result, it is rarely possible to organize peer-to-peer training. Though CEOs expect supervision and support from SAO and subject matter officers, it seldom takes place.

4.9 *Shortage of Technical Staff in Irrigation Development*: Shortage of technical staff in irrigation sector is one of critical constraints in irrigation development. There are only two irrigation officers, excluding the deputy director at the TSB headquarters as of April 2011, and six each in the two provinces. Number of officers specialized in irrigation at the provincial level is only one each. At the district level, there are only 2-3 TSB officers, who should undertake not only irrigation but also land husbandry, farm power mechanization, etc.

4.10 *High Cost of Input*: The cost of fertilizer stands as a primary constraint to smallholder farmers. Market price of chemical fertilizer has skyrocketed in the past several years. Price of D-compound increased from ZMK 18,000/50kg in 2001 to ZMK 150,000/50kg in 2009. The inflation adjusted price actually remained almost the same from 2001 until 2006. Then, it was suddenly doubled in 2007 and tripled in 2008. Without the subsidy programme of FISP, most of small scale farmers can hardly have access to the fertilizer.

4.4 DEVELOPMENT OPPORTUNITIES

4.11 *Strengths & Opportunities identified by a SWOT analysis*: Strengths identified in SWOT were ‘qualified/ knowledgeable and trained staff,’ and ‘well established organizational structure.’ In fact, except for the Ministry of Education and the Ministry of Health, no other ministry assigns their staff up to camp level. These two strengths can be an essential driver to extend smallholder irrigation to a large extent. On the other hand, Opportunities are ‘the area blessed with natural resources,’ ‘water and land,’ ‘locally available materials and local resources for construction.’

4.12 *Mobile Phone Network and Text Messaging*: Most of government officers nowadays have mobile phones and 44% of the sampled households were mobile phone users. Short Message Service (SMS) can send messages to a large number of mobile phone users at once—one of development opportunities in disseminating smallholder irrigation, coping with the sparse population density in the Study area.

4.13 *Radio Broadcast Programmes*: There are four radio programmes which broadcast topics on agriculture and rural livelihood improvement. About 60% to over 90% of the surveyed households by village have radio, and most of them listen to the radio programme(s) almost every week. There was a case that a programme motivated farmers to establish their own community irrigation scheme. These radio programmes can be a good opportunity for promoting smallholder irrigation schemes to a wider

extent.

4.14 *Urbanized Areas accessible from the Study Area*: There are a couple of best practices in inter-district or inter-provincial marketing. While Zambia is low in the population density, population is actually concentrated in some small and medium towns along the railroad or trunk road. In such urbanized area, there is a huge demand for food; that is one of development opportunities for smallholder irrigation. There are actually a number of cases that smallholder farmers carry their produces to other district or other province like Copperbelt, by hiring transportation by themselves.

4.15 *Debt Relief and Development Fund Available from PRP*: Zambia reached the Decision Point under the Enhanced HIPC Initiative in December 2000, and then the debt relief assistances became available in 2005. In line with the debt relief, PRP fund became available since 2005. Under this arrangement, one to three projects per year have been implemented in the Study area over the last several years with annual disbursed budget ranging from about US$ 7,000 to about US$ 400,000 per province per annum. This financial situation works as an opportunity in developing irrigation projects.

4.5 PRIORITIZATION OF IRRIGATION POTENTIAL

4.16 Based on the inventory survey, an area of 9,792 ha has been identified as 'confirmed irrigation potential' in the 2 provinces. Of them, an area of 2,213 ha is already under irrigation – 7,579 ha remains as potential. In addition, LANDSAT Image reading identified a total area of 149,400 ha as 'maximum probable irrigation potential.' Since this result does not automatically entail the feasibility, it must be taken as an indicative figure of farmland availability around wetland, rivers and streams.

4.17 Considering the identified irrigation potentials and other critical parameters e.g. stream density, road density, existence of smallholder irrigation schemes, government officers' prioritization, districts were prioritized for smallholder irrigation development. Group A (High potential districts): Mbala, Mungwi, Luwingu and Kasama districts in Northern province, and Kawambwa and Mansa districts in Luapula province; Group B (middle potential districts): Nakonde, Isoka, Mpika, Mporokoso, and Chinsali districts in Northern province, and Mwense and Milenge districts in Luapula province; Group C (low potential districts): Kaputa, Mpulungu, and Chilubi districts in Northern province, and Nchelenge, Chienge, and Samfya districts in Luapula province.

5. SMALLHOLDER IRRIGATION DEVELOPMENT: ACTION PLAN

5.1 SMALLHOLDER IRRIGATION DEVELOPMENT

5.1 Through the implementation of smallholder irrigation development, such outputs are expected: 1) institutional capacity development for the concerned government officers, 2) establishment of farmer organization responsible for the construction and O&M, 3) establishment of irrigation schemes either temporal or permanent, and 4) establishment of irrigation during dry season as well as during onset of rainy season as supplemental irrigation.

5.2 With the above outputs, farmers' livelihood is to be improved, which itself is the programme purpose of smallholder irrigation development. In particular, the livelihood improvement will be realized mainly through two ways: 1) fulfilling food shortage in between the rainy seasons, and 2) diversifying crops thereby promoting cash crops such as vegetables. Though the Study area is no longer in staple food shortage, still there are years when crops are damaged by drought and/or heavy rainfall. Their present income is not yet enough to cope with the poverty. The smallholder irrigation can mitigate these issues.

5.3 Such major development opportunities and constraints are taken into account in the planning as: 1) broad engagement of BEOs/CEOs in smallholder irrigation development, in particular for simple

diversion schemes, 2) extensive involvement of beneficiary farmers not only in simple scheme development but also in permanent scheme construction, and 3) utilization of information technologies such as mobile-phone, and radio programme to widely disseminate the scheme and also motivate the farmers.

5.4 Gravity irrigation system starts with diversion weir. Potential diversion sites should be blessed with perennial flow but the depth should not be so deep, e.g., not more than 2m depth. Good sites can be found near the footpath which crosses a perennial stream and also at just upstream of natural drops (small fall). Footpath usually traverses streams at a shallower place, forming a suitable topographic condition for gravity diversion. Just upstream of natural drops can easily lead the water into canal by gravity thanks to the elevation difference.

5.5 As for simple schemes, 4 types of diversion structures are proposed: 1) inclined type, 2) single-line type, 3) double-line type, and 4) trigonal prop supported diversion type. In any cases, important point is to believe that the diversion weirs can be constructed with locally available materials and can raise the water level across even over a 20 meter width stream and by as high as 1.5 meter in depth.

5.6 As for permanent irrigation scheme, 3 types of permanent diversion structures are proposed: 1) wet-masonry wall type weir supported by buttresses, 2) concrete wall type weir supported by buttresses, and 3) wet-masonry gravity type weir. The first 2 structures have buttress, prop type supports. With the buttress, the weir body can self-stand as a vertical wall thereby reducing cement volume. As the height of the wall becomes taller, wall-type weir would have difficulty of standing against water pressure. Also sliding on the foundation might take place. In such case, more stable structure should be introduced, e.g. gravity type wet-masonry weir.

5.7 To align canal, a simple tool called “sprit line level” can be used rather than dumpy level (however, the use is not conventional alternate placing but should be progressing with one tied point a little higher than the other tied point). Canal structure is categorized into two: non-lining and lined. Lining made of clay soil is often tried by farmers themselves over a stretch which has leakage. Also used are artificial materials: stone lining, brick lining and wet-masonry lining. Concrete lining is sometimes seen but the cost goes beyond farmers’ affordability.

5.8 Considering the financial affordability of the farmers, construction should be managed by intensive labor manual work of the farmers themselves. In principle, heavy equipment or local contractor is not employed. In this regard, even the construction of permanent structures should be primarily carried out under direct force account by the government officers. Under this system, district TSB procures necessary foreign materials such as cement, iron bars, and timbers for formwork and farmers undertake the work under the technical supervision of the TSB officers.

5.9 Operation and maintenance is crucial in sustaining irrigation schemes. First, operation should be carried out to secure an equal water distribution amongst the scheme members. A means to ensure equitable water distribution is the introduction of rotational irrigation. Second, maintenance should be carried out all by farmer beneficiaries. Government may provide advices or facilitation but physical assistances from the government should no be considered in maintenance.

5.10 Smallholder irrigation adopts surface irrigation methods for on-farm irrigation. This method is categorized into: 1) sunken-bed irrigation, and 2) furrow irrigation. For efficient water use, sunken-bed irrigation is recommended as this irrigation method could avail the water about 10% more than furrow irrigation. However, if a topographic condition is associated with 4% slope (1/25) or more, furrow irrigation is much adaptable.

5.11 As to building an organization, the Study proposes to start the activities right after the selection

of the potential leaders in the initial process of making the organization, for which middle to latter half of the process will proceed in parallel with the implementation of the project. In this case, the potential leaders are given roles of mobilizing the fellow villagers for voluntary labor work, arranging local materials with strong leadership, whereby they are to grow as real leaders.

5.12 To make an organization well operational, role and authority on 1) planning, 2) decision-making and 3) implementation should be clearly defined. The organization should put up the general assembly as the supreme decision making organ, which is composed of all the membership. Out of the general assembly, the members of the management committee are selected, e.g. chairperson, vice-chairperson, secretary, treasurer, auditor and some other committee members if needed. They are in charge of day-to-day management of the irrigation scheme but not in the decision-making.

5.2 IRRIGATED AGRICULTURE DEVELOPMENT

5.13 The production of staple food is already sufficient to its population in the Study area. Therefore, market-oriented agriculture should be promoted rather than self-sufficiency of food crops. To this end, it is required to produce not just what farmers can produce but what the market wants. As 88% of the produces are already traded on the market according to a harvest survey carried out for the sites developed under the pilot project implementation, market-oriented agriculture has certain feasibility. By selling vegetables in dry season, on average 1.78 million ZMK/lima of net income can be expected, having an enough impact for poor farmers to reach the poverty line.

5.14 Low fertility of the soil is a deep seated problem in promoting crop production in the area. The area is widely covered by acidic soil called “acrisols” with average pH of sampled soil 4.2. To cope with this unfavorable soil condition, application of organic fertilizer is recommended. In addition to conventional method, a more efficient method of making compost, called BOKASHI, is proposed and introduced in the technical manual. BOKASHI can be produced in two to three weeks while conventional method requires about three months, and therefore BOKASI can be used in time for dry season agriculture.

5.15 Another effective countermeasure of soil problems is the application of intercropping especially with legume. Legume help improve soil fertility through nitrogen fixation. A proposed method is the combination of maize and climbing beans; maize provides good support for bean while bean improve soil fertility. There are many effective combinations of intercropping: cabbage-onion, carrot-onion, and cabbage-tomato. By using good combination of the crops, risk of disease can be reduced.

5.16 Crop rotation is also a good method to avoid loosing particular nutritious elements in the soil and minimize the emergence of diseases. Brassica (rape, cabbage and Chinese cabbage) and Solanaceae (tomato, eggplant, and Irish potato) families are prone to the disease caused by continued production, and thus rotation should be considered when those crops are planted. Incorporating legume crops in the rotation system is highly recommended especially for those who cannot purchase enough amount of chemical fertilizer. Legume crops can grow without fertilizer.

5.17 Conservation agriculture is now getting much attention in Zambia. Leaving plant residues on the soil surface, soil can be protected from erosion. The organic materials are to be incorporated in the soil, resulting in improved soil fertility and improved physical characteristics. This conservation agriculture can be also managed under furrow on-farm irrigation system. Crop residues are left in on-farm furrows along which irrigation water can flow gradually. Same applies to sunken-bed irrigation; crop residues are placed in the bed to which irrigation water is withdrawn.

5.18 Smallholder irrigation under this Study aims at promoting market oriented irrigation agriculture. Yet, there are some difficulties for the farmers; first, farmers are always challenged by imperfect

information, and thereby they cannot always predict market trend and often sell their produces at disadvantageous price. Second, they are not confident to do what they have never tried. Therefore, the main task of extension officers is to provide farmers with the latest information of crop production and marketing.

5.19 In this regard, general profitability of major crops should be presented by extension officers. Even if farmers know the market price of crops in the area, they do not necessarily know the profitability of that crop. Support in getting market linkage is also a potential activity of extension officers, as they usually have better access to market oriented information including market prices in different locations and existence of buyers from other places.

5.3 FEASIBILITY EXAMINATION IN ECONOMIC AND FINANCIAL TERMS PER SCHEME

5.20 Economic and financial analysis was carried out for simple scheme development (in this analysis, benefit is assumed to take place from the 2nd year). The result is highly viable in both economic and financial terms: 27 % for EIRR with 1.0 ha of irrigated area. If a simple scheme can irrigate 2 ha, the EIRR would be 54%, likewise to 79 % with 3 ha of irrigated land. FIRR shows even bigger return as 54 % with 1.0 ha of irrigated area, and 102 % with 2.0 ha of irrigated area. The programme cost during the implementation period will be around US$ 343 per hector, and one site can irrigate an average of 1.3 ha at the initial stage. Even with this initial small area, about 30% EIRR and 70% FIRR can be expected. B/C ratios are to be more than 2.5 with the 1.3 ha irrigated area per site.

5.21 An economic and financial analysis was also carried out on permanent scheme development (Benefit is assumed to take place from the 2nd year). EIRR changes a lot depending on the scale of investment and irrigated area to be developed. In order to keep an EIRR more than 12% (equivalent to the opportunity cost in Zambia), the unit investment per 1.0 ha of irrigated area should be maintained within US$ 10,000. The programme cost for permanent scheme is to be around US$ 2,500 investment per hector under direct-force-account construction. This low unit investment can generate very high return such as 44 % for EIRR and 69 % for FIRR in case that an area of 2 ha is irrigated with US$ 5,000 investment as case study. B/C ratio gives 4.6 for economic term and 3.9 in financial term.

5.4 TECHNICAL PACKAGE

5.22 This Study presents a 'Technical Package,' a set of dissemination materials. Since different cadres of offices are engaged in irrigation development, the technical package should be cascaded. The package consists of "comprehensive guideline" and "technical manual" which are in one volume. In addition, 2 kinds of leaflets and total 6 sheets of A-3 posters are included. Leaflet is meant to serve wide range of dissemination and to be used by frontline extension officers. The posters work as a kind of picture stories which tell farmers the steps of, for example, how to establish a simple weir. Also, an A-3 poster delivers a health issue whereby smallholder irrigation can contribute to improving rural population's nutrition.

6. IMPLANTATION ARRANGEMENT OF THE PROJECT

6.1 CONCEPTUAL DEVELOPMENT FRAMEWORK

6.1 With regard to development modalities by irrigation scheme, simple weir development scheme can complement the current modality of smallholder irrigation development which stems from permanent scheme construction. Combination of increased investment in permanent scheme development and simple (temporary) scheme development best facilitates the development process of

smallholder irrigation schemes. This strategy can be pursued through a combination of “construction” modality for permanent scheme and “extension” modality for simple (temporary) scheme.

6.2 The above-mentioned two different implementation modalities can co-exist. Development of permanent schemes is oriented to construction modality, or in other words, project type development modality, while the development of simple schemes can be implemented on extension modality, or programme type development modality. In sum, there are 2 different modalities: construction modality vs. extension modality or project type development modality vs. programme type development modality. Combination of those two modalities can best perform in increasing the irrigated area to be developed.

6.3 MACO is expected to secure investment from the government and development partners in constructing permanent schemes. Even if the investment is secured, MACO should also strengthen the human resources in the provincial and district TSBs. Or otherwise engaging local contractors in constructing permanent schemes could be an option to develop more permanent schemes than the present practice. On top of this arrangement, MACO can disseminate simple temporary schemes by deploying BEOs and CEOs in order to accelerate the development of irrigated areas from an earliest time as well as to maximize the benefit for the sake of beneficiary farmers.

6.4 The year 2011 can be the preparation period for the implementation stage and also for the follow up period of the pilot project. Stage I implementation can be programmed to cover 4 years from 2012 to 2015. Year 2015 is corresponding to the final years of Sixth National Development Plan, National Agricultural Policy and National Irrigation Policy. Also it is the target year of MDGs. Stage II may be set from year 2016 to year 2020. In short, the implementation plan presented by this Study is to cover a total of 10 years as; 1) Preparation/Follow-up of Pilot Project in Year 2011 (1 year), 2) Stage I from Year 2012 – Year 2015 (4 years), and 3) Stage II from Year 2016 – Year 2020 (5 years).

6.5 For the permanent schemes construction which is in fact upgrading from simple schemes, provincial and district TSBs will be responsible. On the other hand, for simple irrigation schemes, BEOs/CEOs will be the prime responsible implementers together with the beneficiary farmers. Of course, implementation of the simple schemes should be closely supervised and supported by provincial and district TSBs. In sum, with respect to organizational arrangement in the implementation, this Study makes a great use of the existing organizational structure.

6.6 Simple irrigation scheme is promoted by BEOs and CEOs back-supported by provincial and district TSB officers as above-mentioned. The entry point for promoting simple irrigation schemes is to be a kick-off training course. BEOs and CEOs from potential areas should be invited to the kick-off training. Upon completion of the kick-off training, trained BEOs/CEOs are to develop simple irrigation schemes at their own block/camp areas. They are supposed to carry out the extension of simple schemes over the dry season, and gather once again at the end of the season. In that meeting, they are to report their achievement. This opportunity can also work as a venue for sharing lessons.

6.7 Permanent irrigation schemes should be established by upgrading simple schemes. Since beneficiary farmers with simple schemes are already used to irrigation with those simple structures, this upgrading approach can automatically ensure sustainability of irrigation agriculture. Permanent irrigation scheme requires engineering knowledge and also experiences for civil works. In this regard, the office in charge of permanent irrigation schemes should be the district TSB and also provincial TSB. The priority implementation modality for the permanent scheme should be direct-force account. However, if civil contractor is engaged, permanent scheme development will be accelerated.

6.2 TARGET SETTING AND BENEFIT TO ACCRUE

6.8 For the targets during the Stage I implementation, total 1,232 simple sites are to be improved while another 1,232 simple sites are to be newly constructed. With the improvement altogether, total 1,232 ha of farmlands will be irrigated benefiting total 12,321 farmers. The benefit in terms of net income is estimated at an aggregated amount of ZMK 22.549 billon (US$ 4.69 million) over the Stage I period. With respect to new development during the Stage I period, total 1,232 sites will be developed, of which 1,081 sites are to start irrigation. With the irrigation at 1,081 sites, total 1,630 ha are to be irrigated, benefiting 9,207 farmers. The monetary benefit aggregated over the 4 years arrives at ZMK 25.255 billion (US$ 5.25 million).

6.9 For the both improvement and new development for simple scheme during the Stage I project implementation period, total 2,464 sites will be undertaken, of which total 2,313 sites are to enjoy irrigation. These sites altogether are expected to irrigate total farmland area of 2,862 ha, benefiting as many as 21,528 farmers. The total net income is expected to be ZMK 47.804 billion (US$ 9.95 million) as aggregated value over the 4-year project implementation period.

6.10 During Stage II project implementation period, only new development is undertaken in the simple scheme construction (it is assumed that all the exiting sites can be improved during the Stage I period). Over the period of 5 years of the Stage II, total 1,412 sites are to be implemented, of which 1,271 sites are to start irrigation within the implementation period. These 1,271 sites together are to irrigate 2,094 ha, benefiting as many as 11,204 farmers. The aggregated net profit is expected to reach ZMK 40.636 billion (US$ 8.45 million) over the 5-year implementation period.

6.11 With respect to the simple scheme establishment through Stage I and Stage II periods, total 3,876 simple sites are to be undertaken/ constructed both for improvement and new construction, of which 3,584 sites are to enjoy irrigation. With these sites, total farmland area of 4,956 ha is to be irrigated. With this irrigation agriculture, as many as 32,732 farmers will be benefited over the Stage I and Stage II implementation periods. The aggregated net profit arrives at ZMK 88.44 billion (US$ 18.40 million).

6.12 For the permanent scheme construction under the direct force account, total 88 and 110 sites are to be constructed during Stage I and Stage II respectively. These sites are to irrigate 429 ha and another 660 ha, totaling 1,089 ha. Note that a part of 660 ha of the Stage II comes from those sites constructed in Stage I (irrigated area is assumed to increase over 4 years, whereby some increases take place in the successive stage). Farmers benefited are to be 2,354 for the Stage I and 3,520 for the Stage II, totaling 5,874 members. Net incomes are estimated at ZMK 6.978 billion (US$ 1.452 million) and ZMK 10.977 billion (US$ 2.284 million) respectively.

6.13 To accelerate permanent scheme construction, contract-out-construction by civil contractors is needed. Under this implementation modality, total 204 and 255 sites are to be constructed during Stage I and Stage II. These sites are to irrigate 995 ha and another 1,530 ha, totaling 2,525 ha. There will be 5,457 farmers and 8,160 farmers to be benefited in each of the stages, totaling 13,617 farmer members. Net income is estimated at ZMK 16.177 billion (US$ 3.366 million) during Stage I and ZMK 25.447 billion (US$ 5.294) during Stage II. Total net profit over the Stage I and Stage II implementation periods will arrive at ZMK 41.624 billion (US$ 8.660 million).

6.14 It is, in sum, targeted that throughout the Stage I and Stage II implementation periods, total 657 permanent sites are to be constructed, composed of 198 sites under direct-force account and another 459 sites under contract-out-construction by civil contractors. With these permanent sites altogether, total 3,614 ha of farm lands are to be irrigated. Number of beneficiary farmers is expected to be 19,491. The aggregated net income will arrive at ZMK 59.579 billion (US$ 12.396 million).

6.3 PROGRAMME IMPLEMENTATION COST

6.15 Programme costs for simple scheme promotion are estimated at a total of ZMK 1.180 billion (US$ 245,491) per annum during Stage I period for the 2 provinces and another ZMK 691 million (US$ 143,809) per annum during the Stage II period. The total programme costs for Stage I (4 years) and Stage II (5 years) therefore arrive at ZMK 4.721 billion (US$ 981,964) and ZMK 3.457 billion (US$ 719,045) for the 2 provinces, totaling ZMK 8.178 billion (US$ 1.701 million).

6.16 Given the area to be irrigated by simple schemes by stage, the unit development costs are estimated at ZMK 1.650 million (US$ 343) and ZMK 1.651 million (US$ 343) for Stage I and Stage II. Unit development cost at this range, say about US$ 340 – 350 per hectare, seems minimum as compared to conventional irrigation projects wherein it could reach as much as US$ 10,000 per hector. This can be attributed to the materials with which the main structure, diversion weir, is constructed. The materials are almost all locally available ones, which do not incur cost.

6.17 In developing permanent schemes, same construction quantity is planned throughout Stage I and Stage II. Under direct-force-account construction, a total ZMK 1.425 billion (US$ 296,362) per annum during Stage I period for the 2 provinces is required and the same for the Stage II period. With this cost, total 22 permanent sites are to be constructed every year through Stage I and Stage II. These sites altogether are to irrigate 429 ha by the end of Stage I and another 660 ha during Stage II. Therefore unit development cost arrives at ZMK 13.29 million (US$ 2,763) and ZMK 10.79 million (US$ 2,245) for Stage I and Stage II. Average unit development cost through Stage I and Stage II arrives at ZMK 11.78 million (US$ 2,449).

6.18 By engaging civil contractors, construction of permanent scheme can be accelerated. Under this construction modality engaging civil contractors, total 51 schemes are to be constructed for the 2 provinces every year. Construction cost per year accounts at ZMK 4.06 billion(US$ 843,618), totaling to ZMK 16.224 billion (US$ 3.374 million) for Stage I (4 years) and another ZMK 20.28 billion (US$ 4.218 million) for Stage II (5 years). Therefore, unit development cost arrives at ZMK 16.31 million (US$ 3,393) for Stage I and ZMK 13.26 million (US$ 2,757), averaging them at ZMK 14.46 million (US$ 3,008).

6.4 ECONOMIC FEASIBILITY IN INVESTMENT

6.19 Economic viability in investing simple scheme programme is very promising. In fact, EIRR for the simple scheme programme cannot be calculated simply because the benefit at the 1st year is bigger than the investment cost at the same 1st year in all the cases of; 1) Improved Site, 2) Newly Constructed Site, and 3) the case both aggregated. NPV for the simple scheme programme arrives at ZMK 46.03 billion in case of Improvement, ZMK 144.31 billion in case of New Construction, and ZMK 190.34 billion for the case both aggregated. These NPVs are very high, and thus B/C ratio becomes large as 4.2 to as much as 7.4.

6.20 In case of permanent scheme programme, EIRRs for the cases where the benefit is counted from all the irrigated area show very high values as 52% in case of direct-force account construction, 42% in case of contract-out construction, and 47% for the case both aggregated. These very high IRRs are counted on the low-cost investment per unit area. As a result, NPV as well as B/C ratio for the permanent scheme development proposed in this programme show very high attractive values. For example, B/C ratio ranges from 2.7 to 3.1.

6.21 Permanent scheme development is basically done by upgrading a simple structure as aforementioned. The simple structure must have been irrigating some area. It means that the net benefit only on the permanent structure should be from the extended irrigated area with the permanent

structure. Benefit from the only extended area with the permanent structure is, of course, smaller than that from all the irrigated area. Yet, EIRRs are still high even in this case as 27% in case of direct-force account construction, 22% in case of contract-out construction, and 25% for the case both aggregated. It means that the permanent scheme programme can also be very viable project from the economic investment point of view.

7. THE PILOT PROJECT[1]

7.1 DESIGNING OF THE PILOT PROJECT

7.1 Rationale of implementing pilot project lies on knowing "limit," "how" and "preview." The Study aims at formulating an action plan of smallholder irrigation development. It is therefore envisaged to identify a "limit" or "limits" of current government institutional frame prior to the regular implementation of the action plan. Best way to know the limit(s) is to test the plan under an arrangement of pilot project. It is also required to identify concrete implementation methodologies e.g. modus operandi. The modus operandi should be verified through an implementation trial that is to know so-called "how." Through the implementation of pilot project, "preview" of the Study area can be indicated.

7.2 The pilot project undertakes simple irrigation schemes and also permanent schemes, which are in fact upgraded ones from simple schemes constructed in the previous year. In 2009, this Study put first priority on the simple irrigation schemes. The JICA Study Team, in collaboration with provincial TSB, district TSB and also CEOs, started implementing pilot project for simple diversion weir schemes from May 2009. The pilot project covered a total of 8 districts in 2009, and 13 districts in 2010, composed of 8 districts in Northern province and 5 districts in Luapula province.

7.3 In 2010, an upgrade from the simple ones tried in 2009 to permanent ones, e.g. wet-masonry and/or concrete made ones were also commenced. Of the simple irrigation schemes done in 2009, those sites which have potential of expanding the irrigation areas as well as where farmers are well organized were selected for the upgrading. Total 8 simple sites were selected for the upgrade composed of one earth type dam permanent scheme, 3 concrete wall type permanent schemes and 4 masonry wall type permanent schemes.

7.2 ACHIEVEMENT OF SIMPLE SCHEME DEVELOPMENT

7.4 Since the completion of the kick-off training carried out early in 2009 and 2010 dry seasons, the trained officers have promoted smallholder irrigation in their areas. Most of the trained CEOs proceeded by his/her own while some of them sometimes just waited for district TSB to come for backstopping. The JICA Study Team, together with the counterparts in Northern and Luapula provinces, has followed up the implementation. The final outputs from the simple scheme development are as follows:

1) During the 2 years pilot project implementation, total 95 officers, BEOs/CEOs and TSB officers, have been directly trained during kick-off training course, 3-day course in 2009 and 5-day course in 2010. They have also trained their colleagues mostly at the sites through TOTs. Total 133 TOTs have been carried out by the kick-off participant officers on the ground wherein total 309 fellow officers were trained.
2) With regard to the improvement of existing temporary schemes, total 293 sites have been undertaken, composed of 100 sites in 2009 and 193 sites in 2010. Of the sites improved in 2010, 26 sites were the ones constructed in 2009. In the total 293 improved sites, total 7,550 farmers

[1] For detail information of the pilot project, refer to the Report 'Pilot Project' prepared separately from the Main Report.

have participated while those who had started irrigation in the respective years were 4,393 farmers. Under the Improvement category, 112 km of canal has been newly constructed composed of 27 km in 2009 and 85 km in 2010, while there was total 451 km canal already existent, making the total 563 km for the 293 sites. Those canals together have newly irrigated the total area of 290 ha in addition to the original irrigated area of 354 ha, now making the total 644 ha.

3) With regard to new development of simple irrigation scheme, total 275 sites have been established, composed of 94 sites in 2009 and 181 sites in 2010. Of them, 63 sites and 146 sites had started irrigation in the same year, totaling 209 sites. During the construction of these schemes, total 6,499 farmers have participated while about one-third of the participants, 2,481 farmers, started irrigation in the same year. The total stretch of the canals arrived at 234 km or 307 km including the ones done in 2010 for the sites developed in 2009. Under newly developed 275 sites, farmers have opened total 366 ha of land, of which 183 ha were irrigated. In addition, another 70 ha was put under irrigation in 2010 mostly by farmers for those sites established in 2009. Adding this 70 ha, there is a total area of 253 ha irrigated as of the 2010 dry season for the newly developed sites over the 2 years.

4) In sum, total 568 sites have been undertaken during the 2 years pilot project operation, composed of improvement and new development. Of them, 527 sites were put under irrigation as of the end of the 2010 dry season. Total 14,049 farmers have participated in the programme, creating as many as 6,874 irrigators who have actually benefited from irrigated agriculture. Total area irrigated comes to 473 ha, and adding another 70 ha which was put under irrigation by farmers in 2010 for those sites developed in 2009, total area irrigated arrived at 544 ha. There was originally irrigated area for those sites improved, which was 354 ha. With this originally irrigated area of 354 ha, the total irrigated area under 542 individual sites come to as much as 898 ha.

5) For the economic impact from the irrigated area, the newly irrigated area under the pilot project generated a total sum of ZMK 1.069 billion in 2009 and another ZMK 2.805 billion in 2010 respectively. As at 2010 and also onward, total ZMK 3.874 billion is generated as net income out of the 527 sites which already started irrigation. When considering the originally irrigated areas for those improved sites, the net profit comes to ZMK 2.130 billion, ZMK 4.269 billion and ZMK 6.399 billion. In US$ term, it is US$ 222,394, US$ 583,417 and US$ 805,811 respectively in case of considering only areas irrigated under the pilot project. When considering the originally irrigated areas, it comes to US$ 442,965, US$ 887,950 and US$ 1,330,915.

7.3 ACHIEVEMENT OF PERMANENT SCHEME DEVELOPMENT

7.5 One-day session in the kick-off training held in 2010 was rendered for the training of permanent scheme construction, inviting provincial and district TSB officers only. During the session, the participants discussed and arrived at a consensus whereby they decided which districts should have permanent scheme construction. Accordingly, there are 8 permanent schemes constructed in 6 districts. Since the construction of the permanent scheme requires longer time of construction period than simple scheme, there was a difficulty of enlarging the irrigated land within the same year of 2010.

7.6 However those permanent schemes can irrigate at least the area already put under irrigation in the previous years with simple schemes. This is because all the permanent schemes were designed as upgrading from simple schemes, and they are designed to enlarge the irrigated area from the following year onwards. Following are the achievements including designed irrigation area as well as designed economic profit with regard to the permanent scheme implemented under the pilot project in the year 2010:

1) Total 23 TSB officers were trained to construct permanent schemes, composed of 18 district TSB officers and 5 provincial TSB officers. They mobilized concerned farmers with BEOs/CEOs in

charge of the area, and the construction has been progressed under direct-force account. By the end of the dry season 2010, all the 8 permanents sites have been completed.

2) All these 8 sites had irrigated some farm lands even during the construction of permanent structures since there was an arrangement of connecting de-watering channel, which makes the construction site dried, to the existing canal. The total area irrigated in 2010 arrived at 27.9 ha and this is to be increased to 48.5 ha according to the design within a couple of years. There are 257 members engaged: 137 male and 120 female members. A typical beneficiary farmer irrigates 0.109 ha and it is to increase up to 0.189 ha by design.

3) By applying a net profit of ZMK 7.128 million per hector, total 27.9 ha of irrigated area generated a net income of ZMK 199 million (US$ 41,363), and this is to increase to ZMK 346 million (US$ 71,903) in a couple years referring to the design. Likewise, the net average profit per irrigator arrived at ZMK 773,818 (US$ 161) in 2010 and this is to be ZMK 1.345 million (US$ 280) in years.

7.4 IMPACTS FROM PILOT PROJECT IMPLEMENTATION

7.7 To know the impact of the pilot project, a harvest survey was carried out with a manner of questionnaire survey. Cost and gross income per lima (1/4 ha) were found ZMK 738,000 and ZMK 2,520,000 respectively and thus net income resulted in ZMK 1,782,000 per a lima as an average of major 10 types of crops. Note that this net income includes the value of what was consumed by the farmer households. The result of harvest survey also found that farmers cultivated an average of 0.873 lima per household. Based on this result, an average net income per household arrives at ZMK 1,554,994. Subtracting the monetary value of what was consumed by the households, disposable cash income came to ZMK 1,291,465 (88%).

7.8 Based on the baseline survey, villagers' income level ranged from ZMK 2.9 million to ZMK 16.3 million (2nd biggest was only ZMK 6.8 million) with an average of ZMK 5.8 million (or ZMK 4.7 million excluding the biggest income). The additional income of ZMK 1.555 million per household from the irrigated agriculture is commensurate to a top up of 27% to the original income (or 33% to the original income excluding the biggest one). This can be concluded as is very noticeable impact. Further, when comparing to the original income of those people ranked at 1 quartile, it can be as much as 64% increment (or 69% increment excluding the village of the biggest income level).

7.9 Poverty Line established under this Study is ZMK 8,191,150 per typical household. The share of the poor people who cannot spend on the expenditure of this amount is defined as poverty ratio, which arrives at 56.2%. Monetary value necessary to reach the poverty line ranges from ZMK 2.30 million to about ZMK 590,000 depending on the surveyed village with the overall average of ZMK 1.507 million. With the expected additional income from irrigated agriculture, ZMK 1.555 million, a typical poor family of all the sampled households can now get out of the poverty, reaching to a level of ZMK 48,000 over the poverty line.

7.10 Out of the above irrigation profit, Investment in agricultural production for the next season is also an important consumption behavior of the farmers. In addition to fertilizer, which was first ranked, cost for "seed" including vegetables, rain-fed maize, and groundnuts came the fourth rank. Income is also spent for land preparation for the rain season agriculture. As a whole, frequency related to agricultural production accounted for 43%: fertilizer (23%), seeds (15%), land preparation (4%), chemicals (1%).

7.11 As above-mentioned, one of the spillover effects from irrigated agriculture is a re-investment in year round agriculture. Production of rain-fed maize has thus increased since farmers started irrigated agriculture. For an average of 373 farmers, their production of rain-fed maize has increased from 18

bags (50kg) to 31 bags per household—74% of increase. In fact, 333 farmers out of 373 experienced an increase in rain-fed maize production. Although the irrigated agriculture alone may not necessarily explain this increase, irrigated agriculture must have brought about some positive impact to this rain-fed agriculture.

7.12 The harvest survey also revealed the change in the use of chemical fertilizer since starting irrigated agriculture. 300 households out of 327 households increased the use of fertilizer in the following rain-fed maize production. On average, farmers increased from 76 kg/household to 176 kg/household; 100 kg was newly added after they had started irrigation. The income from the irrigated agriculture must have contributed to this increase to a greater extent.

7.13 There were also positive changes in the farmers' life with the profit from irrigated agriculture. Farmers reported such examples as; 1) We used to go for piece work when we faced food shortage. Even that, we could manage one-time *Nshima* a day only. But now, we can eat thee times meal throughout year, 2) I could not pay for our children's school fee for 3 consecutive years before the irrigation. But now I can send all my children back to the school. Their futures are bright and much brighter than ever before, and 3) Our family used to be soaked by heavy rain under the thatched house before the irrigation. But now we cannot be troubled throughout the year with the iron sheet house.

8. CAPACITY BUILDING AND DEVELOPMENT

8.1 JICA Study Team has conducted a series of trainings and also workshops for government officers. Also on-site trainings based on peer-to-peer were conducted through the implementation of the pilot project in 2009 and 2010. Through those occasions, a total sum of 606 personnel (or 452 individuals since some officers participated in the previous trainings hence double counted) has learned technologies relating to smallholder irrigation development and put in practice through the pilot project implementation. Also total person-days in those trainings arrived at 1,136. Issues undertaken include SWOT analysis, PCM problem analysis, identification of smallholder irrigation potential sites, implementation of smallholder irrigation schemes centering on both simple and permanent facilities, a quick making compost, etc.

8.2 Capacity development of farmers was also undertaken through the pilot project implementation. There were 7,172 farmers in 2009 and 6,245 farmers in 2010 who learned some relevant skills with respect to smallholder irrigation development. The total number of farmers undertaken during the 2 years arrives at 13,405 composed of 8,711 males and 4,694 females. They have learned how to construct simple diversion weirs, how to align canal in such sites where new alignment was required, basic norm of how to operate their organization, and also they have learned irrigated agriculture by sunken-bed or furrow irrigation method. In 2010, 8 permanent schemes were constructed, in which total 257 farmers participated. They learned how to de-water the site, how to mix and place concrete, how to construct masonry and/or concrete structures, etc.

9. CONCLUSION AND RECOMMENDATIONS

9.1 CONCLUSION

Taking the points below into account, this Study concludes that the community based smallholder irrigation (COBSI) development approach can be at the core amongst remedial measures in improving agricultural production whereby reducing poverty the people are suffering. The Government of Zambia should therefore embark, at her own cost or together with assistance from donors, on implementing and disseminating the COBSI development program in the target 2 provinces of Northern and Luapula as well as over the Country where applicable.

1) The smallholder irrigation development tried out throughout the pilot project implementation contributed to generating cash income whereby improving the livelihood of the beneficiary farmers. In fact, according to a harvest survey which covered 471 households, an average farmer gained a net income of ZMK 1.55 million out of an average cultivated area of 0.873 lima (47 m square). This is equivalent to a top up income by 33% to what the typical farmer household used to earn, ZMK 4.67 million. Also, the net income is enough to uplift a typical poor farmer household to and beyond the poverty line. A typical poor needs ZMK 1.51 million to reach the poverty line, while the average net income from irrigated agriculture is ZMK 1.55 million.

2) Other positive impacts were observed, for example, in a way that the beneficiary farmers got capital from the irrigated agriculture to invest in fertilizers and improved seeds for following rain-fed crops. In fact, fertilizer application for the rain-fed maize was increased from 76 kg to 176 kg per household according to a harvest survey (valid sample number 327 households). Accordingly, the production of rain-fed maize has increased, e.g., from 18.1 bags (50kg/bag) to 31.5 bags per household—as much as 74% of increase with reference to the harvest survey (valid sample number 373 households). Thus, a spillover effect from irrigated agriculture is a re-investment in year round agriculture, improving their livelihood over a season.

3) In addition to the increment of income, vulnerability of the beneficiary farmers was also improved. There were specific months, e.g. January to March, when many farmers faced food shortage according to interviews. Farmers who faced food shortage had to engage themselves in working at "other" farmers' fields or borrow money, resulting in vicious cycle of poverty. The income from irrigation can now contribute to the stabilization of the income of those farmers who used to depend only on rain-fed income, one-time income per year. Likewise, income from irrigated crop in January, when parents face two major difficulties of school fee and food shortage, can be a big relief.

4) A principle concept of this Study is not to wait for someone else to come with investment but to start whatever the beneficiary farmers can do in their locality, i.e. starting up irrigated agriculture with simple irrigation schemes made out of locally available materials. Then, sometime after the beneficiaries have got used to irrigation with the simple structure, here comes an upgrading to permanent structures upon an investment availed. This upgrading approach, from simple one to permanent one, can ensure sustainability of the permanent-structured irrigation schemes since farmers have already learned how to irrigate with the simple structures.

5) The pilot project has put a total area of 572 ha under irrigation over the 2 years of 2009 and 2010, composed of 544 ha by simple schemes and 28 ha by permanent schemes. These areas were brought under irrigation by 568 simple schemes and 8 permanent schemes respectively. With this area irrigated, 7,131 farmers were benefited, composed of 6,874 farmers by simple schemes and 257 farmers by permanent ones. Though an irrigated area covered by one scheme may look very small, say only 1-4 ha per scheme in most cases, these great number of smalls can ultimately make a big great.

6) One of the strengths that the MACO has is its extension structure already in place; not just at the provincial level, extension officers are deployed even at the block (BEOs) and camp level (CEOs) for whole Country. Proceeding hand in hand with the government's existing extension structure is another operation principle especially in disseminating simple structures to wider area. Putting the frontline extension officers, BEOs/CEOs, in the forefront of the development activities assisted by TSB supervisory offices was proved well workable to pursue a wide range of dissemination of simple schemes. Simple schemes can thus be disseminated through the existing extension structure.

9.2 RECOMMENDATIONS

There have been a number of issues that the JICA Study Team encountered during the Study. Through pilot project implementation, a number of solutions and/or recommendations were found. Below are some of these recommendations. As is the case with continuous processes, the recommendations made below are by no means exhaustive and may need to be changed or modified, depending on in-situ condition. However, it is believed that the ones covered here nevertheless constitute a broader spectrum capable of fitting in most conditions in implementing smallholder irrigation schemes:

1) Smallholder irrigation development should, as far as applicable, start with simple diversion structures. Simple structures can be put up with locally available materials only as proved through the pilot project implementation. It does not need monetary investment for the structures. Farmer themselves can construct most of the simple structures within half day to maximum, say, 2 days given a sound technical assistance from BEOs/CEOs. Extension by BEOs/CEOs can also be a good opportunity for the farmers to start irrigation since they are accessible by the farmers than the TSB officers at district/province. So far, there was a conventional belief that irrigation was an engineer's task. However, irrigation with the simple structures has proved that even extension officers can promote a lot. In order not to let the potential farmers wait long for irrigation, simple schemes should be tried wherever applicable.

2) Permanent structures should, in principle, be introduced by upgrading the simple structures. This upgrading approach can automatically ensure sustainability of the permanent schemes. This is simply because the beneficiary farmers for permanent structure are already used to irrigation with the simple structure. Therefore, as long as the permanent diversion structure continues functioning as designed, the beneficiary farmers will not fail in carrying out water distribution and thereby on-farm irrigation. Another benefit from the upgrade approach is that the irrigated agriculture which has been practiced with simple structure can not be hampered by the construction of permanent structure. During the construction of permanent structure, the site should be dried up by, for example, putting a detour channel, which can be connected to the existing canal. Thus, the stream water can be delivered to the existing canal even and the farmers can enjoy irrigation even during the construction of the permanent structure.

3) There is a limitation pertinent to the development of this community based smallholder irrigation schemes by its nature. As the scheme focuses mainly on gravity irrigation systems, there should be a perennial river and also ideal topographic condition so that neither reservoir nor pumping is required and water can be tapped by gravity. Those requirements were fulfilled at many places in Northern and Luapula provinces, whereby a lot of diversion schemes had easily been constructed through the implementation of the pilot project. Though the Country still has high potential of introducing this gravity irrigation scheme, there is a limitation in parts of the Country where most of the rivers are not perennial and/or flowing in a gorge, requiring pumping facilities. Therefore, introducing the gravity smallholder irrigation scheme should always refer to these requirements at the onset of the development. Otherwise, other alternatives such as reservoir systems as well as pumping systems should be taken into account.

4) A concern on water right acquisition is highlighted in relation to any irrigation development project. In fact, since there is much water than what the rural population needs in the 2 provinces with rich rainfall, not much conflict on water allocation amongst the users has been reported by now. However, as the irrigation site increases, water right issue may arise. To cope with this, the development of an irrigation scheme in a catchment area should always be started from upper reach of the stream, and then move to downstream. In addition, TSB officers and extension officers are requested to facilitate the farmer groups to apply water right. In this case collaboration

between the Department of Water Affairs and the DOA should always be sought.

5) Irrigation obviously cannot serve all the villagers simply because irrigation cannot serve all the land according to the topography. Also, the amount of water available for irrigation in potential sites may be limited, so that only less than one tenth of the whole villagers may have land within the potential service area in cases. This situation may cause other farmers' jealousy to the landowners and create social problem amongst concerned villagers. It is therefore recommended to divide the potential service area into small plots and lend out to the have-nots who are the farmers not having any land in the service area, either for free or with a minimal rental fee. This measure was observed in many sites under the supervision of village headperson, and contributed to equity amongst the villagers.

6) Another important point worth to mention is also a land issue. Some landowners have refused to lend their lands to other people. While water is a public good, it goes to land that is a private good, causing equity issue amongst concerned villagers. Equity amongst the concerned villagers and individual interest are somewhat bipolarized. To amicably settle the land issue, there may be such arrangements as: allocating larger portion to the landowners, paying reasonable rental fee to the owners, due caring of the land by renters by means of applying more compost manure, etc. Local leaders should also play a distinguished role to settle. Transparency since the onset of the development should be imparted and in this regard the local leadership in terms of equity is also challenged. Taking stranded farmers inclusive of the landowners and the local leaders to well organized area can strongly influence to solve the situation.

7) Irrigation, in most cases, if not all, over-exploits the land by intensive use of the same land for years. This in true sense means that in the near short-time, the land will be greatly affected, both physically and chemically, and in the end will hardly be able to produce anything. This problem is further exacerbated by the farmers' tendency of applying chemical fertilizer only. Though chemical fertilizer is highly effective, it has a disadvantage of disregarding the need to improve soil physical properties. Therefore, it is highly recommended to encourage farmers to apply more compost manure. Compost manure is good not only as nutrients but also for improving the physical characteristics of soil so that chemical fertilizer can be well retained in the soil to be fully consumed by the plants. In addition, irrigation canal avails of water by nature, which is a prerequisite of making compost manure. Irrigation canal can therefore promote compost making alongside the canal, which automatically solves the problem of transporting the compost manure. Compost should be promoted in these ways.

8) Irrigation can have an enough impact to change the fundamental lifestyle of farmer households. For years and years, major farming style in the area has been based heavily on *Chitemene* slush and burn agriculture in which limas of forest area are cut down to cultivate a small piece of land. As a result, natural forest has been gradually and widely decreased especially where population has increased. While, irrigated agriculture can provide farmers with an alternative means of production, by which overdependence on *Chitemene* cultivation can be moderated. In fact, it was observed that the area under *Chitemene* has been, by and large, decreased after farmers started irrigation. Therefore, smallholder irrigation should be promoted also as a means of natural forest conservation.

9) Most potential sites are located in gentle hilly areas which are crisscrossed by streams. Under this situation, if there are no proper soil conservation measures, land degradation will undoubtedly occur or even be accelerated which will ultimately make it unfit for cultivation in subsequent years. Thus extension of smallholder irrigation should go hand in hand with land conservation measures. This may include creating a distance from the rivers to the edge of the field which should always

remain under fallow, simple storm drains, vetiver grass planting along the main canal as well as along lower peripheral of service area, contour ridge and hedge, etc. In addition, there is an on-going national extension project, Scaling Up Conservation Agriculture. By linking up a technology extended under this programme, e.g. mulching, erosion of the farmlands by irrigation water can be minimized.

10) Irrigation development is not the end but the means to an end. For the frontline extension officers, therefore, promotion of smallholder irrigation development should always go with the encouragement of best agricultural practice. In this regard, taking agriculture as business, it is far important to address the market-oriented agriculture rather than just producing what other farmers cultivate. Diversification of crops in the area, for basic instance, helps avert the risk of extreme price decline. It should be also mentioned that the cropping timing is better tuned to hit the highest price when harvesting. For example, price of groundnuts per bag (50kg/bag) can change from 120,000ZMK in January to 65,000ZMK in March. Irrigation should be promoted as a helpful tool for farmers to fine-tune the timing of crop production even during the dry season.

11) Different from many conventional community based projects, no free seed and fertilizer have been provided in the pilot project. Participants to a workshop commented the approach of not providing any free input pursued under this Study as: “The approach tells the farmers the truth about life and is not just pleasing them by short-term assistance i.e. in terms of handouts.”, “The approach has instilled a spirit of self-reliance than ever before what farmers depended on handouts.” The approach of not providing any free seed and fertilizer may have been unique for the frontline officers. The JICA Study Team thinks that those who can access to the irrigation water which is a precious natural resource can still be categorized as better-off farmers. Yet, does it make any sense of equity to give free goods to those better-off? Though the principle concept may be unique as compared to conventional approaches, the pilot project at least showed that Zambian farmers can move ahead even without free handouts, suggesting the agriculture is their business.

12) The pilot project has established as many as 568 simple schemes. During the extension of the simple structures, there was a unique strategy the JICA Study Team took to the farmers who wanted free input as a condition that they were to try the irrigation with simple structures. One may think there may have been a great difficulty of motivating such farmers without giving free input. However, there was such simple measure as to leave the community and move to next potential site by saying ‘OK, that’s good. We go to next village by leaving you.’ If there is monetary investment already done, it will be very difficult for the goverment/donors to leave the site once after engaged. However, the measure, leaving the community, can be put in practice as the simple scheme does not require any monetary investment. The measure thus increases flexibility of the extension programme for smallholder irrigation schemes, which automatically raises the possibility of programme success. It is therefore recommended not to stick to a community which is not interested, and instead of wasting time move to next potential site.

13) Though irrigation brings about a lot of positive impacts, there could be some negative impacts, e.g. soil erosion, increased salinity, and increased cases of *schistosomiasis*. To cope with these issues, recommended measures are: 1) for the soil erosion; shortening of on-farm furrows, installation of small dissipaters along on-farm canals, and introduction of drop structures along main/secondary canals, 2) for the increased salinity; introduction of leaching water by increasing the amount of irrigation water itself by 5-10% in most cases, flush out of salt at the beginning of irrigation season if accumulated on the surface, and introduction of drainages which can push down the saline water into drainage whereby no salt accumulation on the ground takes place, and 3) for *schistosomiasis*, not to leave any stagnant water in the irrigation system, expose all the sections of canal under sunshine (grasses should be thoroughly cut and disposed), use gumboot to walk in the

water, and feces are well treated with toilet facility.

CONTENTS

ACRONYMS AND ABBREVIATIONS

ADSP	Agriculture Development Support Programme (WB)
ASP	Agricultural Support Programme (SIDA)
AfDB	African Development Bank
B/C	Benefit Cost Ratio
CEO	Camp Extension Officer
COBSI	Community Based Smallholder Irrigation (this Study undertakes)
CSO	Central Statistical Organization
DACO	District Agricultural Coordinator
DAM	Department of Agribusiness and Marketing (under MACO)
DC	Department of Cooperatives (under MACO)
DF	Department of Fisheries (under the Ministry of Livestock and Fisheries)
DFID	Department of International Development (UK)
DOA	Department of Agricultural
DPP	Department of Policy and Planning (under MACO)
DSA	Debt Sustainability Analysis
DSA	Daily Subsistence Allowance
DVLD	Department of Veterinary and Livestock Department
EU	European Union
FAO	Food and Agriculture Organization
FoDiS	Food Crop Diversification Support Project for Enhancement of Food Security
FISP	Farmer Input Support Programme
FNDP	Fifth National Development Plan (of Zambia, 2006 – 2010)
FSP	Fertilizer Support Programme (changed to FISP since 2009)
GOJ	Government of Japan
GRZ	Government of Republic of Zambia
HDI	Human Development Index
HIV/AIDS	Human Immunodeficiency Virus/ Acquired Immunodeficiency Syndrome
HIPC	Highly Indebted Poor Country
HRA	Human Resources Administration (under MACO)
IDA	International Development Association
IDF	Irrigation Development Fund
IFMIS	Integrated Financial Management and Information System
IMF	International Monetary Fund
IRR	Internal Rate of Return
JICA	Japan International Cooperation Agency
JSPRF	Justice and Solidarity for Poverty Reduction Fund, a Catholic Fund
MA	Meal Allowance
MACO	Ministry of Agriculture and Cooperatives
MDG	Millennium Development Goal
MTEF	Mid Term Expenditure Framework
NAP	National Agricultural Policy (2004 – 2015)
NAIS	National Agricultural Information Services (under MACO)
NERICA	New Rice for Africa
NIP	National Irrigation Plan (2006 – 2011)

NPK	Nitrogen, Phosphate, Potassium
NPV	Net Present Value
PACO	Provincial Agricultural Coordinator
PAO	Provincial Agricultural Officer
PaViDIA	Participatory Village Development in Isolated Areas (JICA)
PCM	Project Cycle Management
PIE	Provincial Irrigation Engineer
PLARD	Program for Luapula Agricultural and Rural Development (Government of Finland)
POU	Provincial Operation Unit
PRA	Participatory Rural Appraisal
PRBS	Poverty Reduction Budget Support
PRP	Poverty Reduction Programme
RESCAP	Rural Extension Services Advancement Project
RIF	Rural Investment Fund, the World Bank
SMS	Short Message Service
SWAP	Sector Wide Approach
SAO	Senior Agricultural Officer
SCCI	Seed Control and Certification Institute
SIWUP	Smallholder Irrigation and Water Use Programme (FAO)
SNDP	Sixth National Development Plan
SWOT	Strengths, Weaknesses, Opportunities, and Threats
TOT	Training of Trainers
TSB	Technical Services Branch (the principal counterpart organization at the DOA HQs)
WFP	World Food Programme
ZESCO	Zambia Electricity Supply Company
ZNCB	Zambia National Commercial Bank
ZMK	Zambian Kwacha
ZARI	Zambia Agricultural Research Institute

UNIT CONVERSATION

1 meter (m)	=	3.28 feet
1 kilometer (km)	=	0.62 miles
1 hectare (ha)	=	2.47 acres
1 acre	=	0.405 ha
1 inch (in.)	=	2.54 cm
1 foot (ft.)	=	12 inches (30.48 cm)
1 ac-ft		1233.4 cum

CURRENCY EQUIVALENTS (AS AT MARCH 2011)

US$ 1.00	=	ZMK 4,808 (TTB)
US$ 1.00	=	81.73 Japanese Yen (TTB)
ZMK 1.00	=	0.017 Yen

ZAMBIA FINANCIAL YEAR

January 1 to December 31

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MAIN REPORT

CHAPTER 1 RATIONALE AND GOAL OF THE STUDY

Submitted herewith is the Final Report compiled according to the Scope of Works (SW) on "The Study for the Capacity Building and Development for Community-based Smallholder Irrigation Scheme in Northern and Luapula Provinces in the Republic of Zambia" (the Study) signed between the Ministry of Agriculture and Cooperatives (MACO), Republic of Zambia and Japan International Cooperation Agency (JICA) on June 27, 2007 and the Minutes of Meetings (MM) attached to.

This report covers all the issues the JICA Study Team has undertaken since the inception of the Study up until the end. The issues incorporated in this report among others are results of situation analysis, identification of irrigation potential, pilot project implementation and the achievements (for detail, see separate volume), action plan for the smallholder irrigation scheme development, a proposal for investment, and conclusion and recommendations.

1.1 Rationale of the Study

The annual rainfall experienced in the Republic of Zambia (Zambia) reaches over 1,000 mm in some regions. Ninety percent of annual rainfall concentrates in rainy season from December to April. Unstable rainfall pattern causes unstable agricultural productivity, resulting in serious food shortages in certain areas. Although irrigation potential in the country is estimated to be around 360,000 ha, only about 156,000 ha have been developed so far[1]. Therefore, improvement of smallholders' productivity through introduction of irrigation agriculture is believed to be an urgent task for food security, poverty reduction and economic development.

The Study area of Northern and Luapula provinces has much rain and surface water as compared to other provinces in Zambia. The area, in many places, is also endowed with gentle rolling-hills, which could be of high potential to introduce gravity (and to some extent pumping) irrigations for smallholder farmers using simple techniques. Making use of such irrigation, smallholder farmers in the Study area can improve their agricultural productivity even with small input combined with improved farm management.

As it is stated in the SW, the development of smallholder irrigation facilities needs to be low-cost and easy to manage, taking into account their financial status. Cost of the construction materials such as reinforcement steel bars and cement are also comparatively expensive in the landlocked country, Zambia. Therefore, in developing smallholder irrigation schemes, farmers should be able to play the greatest role by utilizing locally available resources, both materials and human as much as possible.

There is therefore an urgent need of carrying out a comprehensive study to establish smallholder irrigation schemes including technology of development and maintenance of the facilities and cropping systems with effective use of irrigation water. Smallholder irrigation schemes in Northern and Luapula provinces are expected to contribute to improving agricultural productivity of smallholder farmers in the target area, and replicating them with lessons of the Study to other regions in which same geographical and natural environmental features prevail.

[1] According to Irrigation Policy and Strategy, Sep. 2004, irrigation potential is estimated at 2.75 million ha, which may be overestimated. On the other hand, Smallholder Irrigation and Water Use Programme, FAO, 2004 estimated its potential at 300,000 ha from surface water and 60,000 ha from groundwater, totaling 360,000 ha. This figure may be a reasonable indication which is referred to in this Report. According to the Policy and Strategy, Sep. 2004, land under irrigation (surface irrigation) is estimated at 32, 189 ha, land under irrigation by sprinkler is 17,570 ha, land under irrigation by localized one is 5,628 ha, land under irrigation by developed lowlands is 100,525 ha being the biggest, totaling 155,912 ha. Of the total irrigated area, 6,750 ha is by groundwater and the rest, 149,162 ha is by surface water. In terms of schemes, 111,525 ha is under small irrigation schemes, 7,372 ha is under medium irrigation schemes, and 37,015 ha is under large irrigation schemes.

1.2 Objectives and Basic Strategies

The overall goal of the Study is, as stated in the SW, to secure food security in the Republic of Zambia through promoting irrigated agriculture in community-based smallholder irrigation schemes. Towards this end, this Study is carried out in partnership with and by guidance from Department of Agriculture (DOA), the Ministry of Agriculture and Cooperatives (MACO), and incorporates the views of beneficiaries and other stakeholders such as relevant departments under MACO, regional and field offices of MACO, local authorities, etc. The process of the Study centers on the following which themselves are the objectives of the Study;

1) To formulate Action Plan (AP) to promote effective smallholder irrigation schemes for improving the agricultural productivity in Northern and Luapula Provinces, and
2) To transfer the technology and build the capacity in smallholder irrigation development for counterpart personnel and concerned communities through implementation of the Study.

In line with the above objectives, this Study further puts the following specifics as the study strategies:

1) To establish such methodologies with which farmers themselves can discharge maximum initiatives in not only operating and maintaining irrigation facilities but also in constructing irrigation facilities with the Government's technical assistance, while physical assistances should always be minimal,
2) To establish irrigation farming for the smallholders with special emphasis on dry season agriculture, which can facilitate the commercialization of agriculture that the Sixth National Development Plan (SNDP, 2011-2015) uphold, paying due attention to marketing of agriculture produce,
3) To present a comprehensive guideline together with technical manuals, dissemination leaflets and picture stories, etc., as a dissemination package, which can be easily referred to by extension officers as well as beneficiary farmers, and
4) To pursue capacity development and building of both farmers and government officers concerned by means of participating in workshops, trainings and seminars, and through the implementation of pilot project.

This Study, as in the first strategy, stresses that to the maximum extent there should be farmers' initiative not only in operation and maintenance of irrigation facilities but also even in construction. This means physical assistance from outside should be always minimal taking into account; 1) budgetary constraints of the government and donors, 2) capacity building of the beneficiary farmers, and 3) project sustainability. It is believed that the more hardships farmers have gone through, the more capacity they can develop by overcoming them, and the more difficulties they have overcome, the higher sustainability of project we can expect.

Second strategy is the promotion of dry season agriculture with the smallholder irrigation development. There are many farmers throughout the country whose staple food cannot last until the next harvest. The dry season agriculture on the smallholder irrigation schemes would bridge up the gap between the seasons, contributing to food security and making those subsistence farmers free from hunger. On top of that, it should be considered to embark on commercialization of agriculture in the dry season. Dry season agriculture can promote cash crop cultivation since it induces less pests and diseases as compared to rainy season agriculture. Commercialization of agriculture is one of the top priority areas that the SNDP stresses, to which irrigated agriculture can make a lot of contribution.

The package, mentioned in the third strategy, is composed of comprehensive guidelines and technical

manuals which together consist of one volume, and leaflets and picture stories that can be of great help for the users to understand at their jurisdiction. The guidelines will be mainly for DOA headquarters, provincial and district TSB officers, and manuals mainly for district TSB officers and frontline extension officers who are the block and camp extension officers (BEOs/CEOs). Leaflets and picture stories can enhance the frontline officers' activities on the ground. These dissemination materials will contribute to promoting smallholder irrigation development to a greater extent.

As for capacity development, the forth strategy above and also stated in the second objective in the SW, training courses for provincial/ district officers concerned and BEOs/CEOs are scheduled in both FY 2009 and FY 2010. The training courses aim at equipping the officers with necessary knowledge, skills and attitude to promote smallholder irrigation in their jurisdiction. This Study tries, as much as possible, to establish a functional extension mechanism within the government's present framework and not on project basis exclusively budgeted. This means that the JICA Study Team believes that an extension mechanism operated on a special account may not be extensively duplicable to other areas.

Apart from the trainings, capacity development should be pursued throughout the implementation of this Study. The basic concept of the capacity development under this Study is to understand the process of doing something as a tool of capacity development. The process itself, for example doing this Study and implementing pilot projects, is called capacity development. This concept comes up with the idea of "learning by implementing, and developing capacity by learning", which is a central concept of adult-learning. Therefore, the capacity development stressed in this Study will not be achieved only by attending training courses but by joining in the process of the Study and implementing the pilot projects together with the JICA Study Team.

1.3 Smallholder Irrigation in the Context of National Irrigation Plan

National Irrigation Plan (NIP) was established in July 2005 to promote a use of irrigation to accelerate sustainable agriculture development. Major target groups for this intervention are smallholder farmers who are also the target of this Study, emerging out-grower[2] farmers, and large-scale commercial farmers, all living in the areas with a high potential for irrigation. The NIP summarizes the areas to intervene as in the Table 1.3.1. This Study is relevant to the category No.3 "smallholder Irrigation" that utilizes water from *dambos*, rivers, streams, lakes and other water bodies for food and cash crops in rural areas.

Table 1.3.1 Categories Specified in the National Irrigation Plan (NIP)

Category	Particular	Relevance to the Study
1. Peri-urban Irrigation	To grow cash and export crops in peri-urban areas	
2. Out-grower Schemes	To grow cash and food crops, linked to an out-grower promoter in rural and peri-urban areas.	
3. Smallholder Irrigation	**To utilize water from *dambos*, rivers, streams, lakes and other water bodies for food and cash crops in rural areas.**	**This Study undertakes:**
4.Large Scale Commercial and Estates	To produce cash, food and export crops; for commercial farmers under ZNFU Taskforce	
5. Other Private Farmers	To develop long-term large water transfer systems such as dams weirs, canals, etc.	
6. Manufacturing	To expand or test new irrigation technology for import substitution and cost saving	

Source: National Irrigation Plan, July, 2005, MACO

[2] "Out-grower farmer" means those who are contracted with commercial large scale farmers, agro-processing companies, agricultural produce distributors, etc. They produce cash crops which are to be delivered to the contract partners.

The NIP does not specify what kind of irrigation schemes should fall under the category of smallholder irrigation, but only mentions the schemes for the smallholders. In this Study, the following are recommendations to specify what the smallholder irrigation is;

Smallholder irrigation schemes are those that;

1) should be operated and maintained exclusively by the beneficiary smallholder farmers, and may require government/donors' assistances in case of upgrading of existing facilities, e.g. from simple (temporary) scheme to permanent scheme, or in the event of major rehabilitation of permanent schemes;

1) should be constructed with farmers' participation to the maximum extent; where simple structures, e.g. temporary diversion weirs made out of locally available materials, can be constructed by themselves with the government's technical assistances, and even permanent facilities made of foreign materials, upon being provided by the government, donors, etc., should be tried by themselves together with skilled labors who may be contracted; and

2) should have preferably less than 50 ha of irrigation command area, where full scale of Environmental Impact Assessment (EIA) is not required according to the Environment Protection and Pollution Control (Environmental Impact Assessment) Regulations, 1997. Then, smallholder irrigation schemes less than 50 ha of command area may further be divided into 2 categories such as those less than 5 ha as mini-scale and the others more over 5 ha as small scale. Irrigation schemes with over 50 ha can, of course, be categorized in smallholder irrigation if it is fully operated and maintained by smallholder farmers. However it may be better to further segregate it within the category of smallholder.

With above in mind, sub-categories of smallholder irrigation are further specified as in Table 1.3.2:

Table 1.3.2 Sub-categories of Smallholder Irrigation in this Study

Category	Features	Remarks
3. Smallholder Irrigation	To utilize water from *dambos*, rivers, streams, lakes and other water bodies for food and cash crops in rural areas.	This Study Undertakes:
3.1 By Simple (Temporary) Facilities Almost all under mini scale, say 1 – 3 ha only	Major irrigation facilities are constructed with locally available materials, e.g. simple (temporary) diversion weir schemes	Construction done by smallholder farmers with government technical assistances According to experiences, no simple facilities can irrigate more than 5 ha except for special cases, so that this category falls in mini-scale in the smallholder irrigation.
3.2 (1) By Permanent Facilities Generally less than 50ha, EIA not required Mostly in small scale (more than 5ha) but still some in mini-scale (less than 5ha)	Major irrigation facilities are constructed with foreign materials such as wet masonry and concrete, etc.	Construction requires skilled labors, and in exceptional cases it may be contracted out to local contractors. Since this type of irrigation scheme can irrigate more than those by simple irrigation scheme, it falls under small scale (more than 5 ha) but some cases may be still under mini scale because the irrigable area may be limited to less than 5 ha.
3.2 (2) By Permanente Facilities More than 50ha, full EIA required All under small scale (over 5ha)	Major irrigation facilities are constructed with concrete.	Construction is in most cases carried out by civil contractors, and also full EIA should be carried out beforehand.

Source: JICA Study Team

Note: Category No.1 is 'Peri-urban irrigation' and No.2 is 'Out-grower schemes' as shown in the Table 1.3.1, whereby the above table starts with category No.3 'Smallholder Irrigation'.

1.4 The Scope and the Schedule of the Study

To attain the objectives, this Study is carried out in a phasing manner divided into two: Phase 1 deals mainly with situation analysis, participatory workshops, formulation of a draft Smallholder Irrigation

Development Action Plan, identification and preliminary implementation of some potential pilot projects, and Phase 2 undertakes the implementation of the pilot projects including extension, and presents the final version of the Action Plan upon getting feedbacks from all the lessons therein. Following are the overall schedule of the Study and the scopes agreed upon in the SW:

Table 1.4.1 Overall Study Schedule, Divided into 2 Phases

Year	2009				2010				2011	
Quarter	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd
Phase I										
Phase II										
DFR submission										
Report	IC/R		PR1		ITR1		PR2	PR3		DRF FR

Where; IC/R: Inception Report, PR: Progress Report, ITR: Interim Report, DFR: Draft Final Report

Major activities in Phase 1 are:

1) To compile the resource map regarding the nature, society and market condition of the target area;
   1.1) To classify the potential area for community-based smallholder irrigation schemes;
   1.2) To classify the natural resource condition and type of the target farmers;
   1.3) To propose recommended crops for the community-based smallholder irrigation schemes; and,
   1.4) To formulate an inventory of the existing irrigation schemes.
2) To formulate packages[3] for the community-based smallholder irrigation schemes.
   2.1) To select high potential candidacy area for community-based smallholder irrigation schemes;
   2.2) To conduct field survey in the high potential area for technical, socio-cultural, economical aspects;
   2.3) To specify the local human and material resources (arrangement of extension officer, local construction supplies and presence of local contractor);
   2.4) To formulate a draft package of methodologies of development, rehabilitation, operation and maintenance for the smallholder irrigation schemes;
   2.5) To select pilot areas to implement priority projects; and,
   2.6) To conduct baseline survey and formulate draft implementation plan for the pilot projects.
3) To formulate a draft Action Plan, composed of:
   3.1) Plan for community-based smallholder irrigation schemes development;
   3.2) Plan for farm management;
   3.3) Plan for water management improvement;
   3.4) Plan for extension service; and,
   3.5) Plan for implementation and budget.

Major activities in Phase 2 are:

4) To verify pilot projects for the model package of methodologies for development, rehabilitation, and operation and maintenance for the existing community-based smallholder irrigation schemes in the following areas:
   4.1) To formalize the agreement with farmers in the pilot project areas to join the project;

[3] This package should include comprehensive process and implementation mechanism with low input technology for the development of community-based smallholder irrigation schemes.

4.2) To conduct and monitor the pilot projects; and,

4.3) To verify the validity of the methodologies for development, rehabilitation, and operation and maintenance for the community-based smallholder irrigation schemes.

5) To pursue capacity development in the course of the verification study.

6) To finalize the Action Plan by feeding back the results of the pilot projects.

1.5 The Study Area

The Study area covers Northern and Luapula Provinces with 12 districts for Northern and 7 districts for Luapula respectively. Total area of the two provinces is 198,393km^2, which accounts for 26 % of the total national land. According to National Census 2000, the total population of the 2 provinces as of year 2000 is about 2 millions with population density of 10 persons/ km^2. One of the typical characteristics of the Study area, and to greater extent of Zambia, is its low population density as compared to most of the neighboring southern African countries[4]. Table 1.5.1 shows the details of the Study area:

Table 1.5.1 Demographic Information of the Study Area

Particular	Area	Population, 2000 (Density, p./km^2)	District	
			Nr.	Area/district
Northern	147,826km^2 384x384km	1,258,696 (8.5)	12	12,319km^2 111x111km
Luapula	50,567km^2 225x225km	775,353 (15.3)	7	7,224km^2 85x85km
Total	198,393km^2 445x445km	2,034,049 (10.3)	19	10,442km^2 102x102km
Zambia	752,612km^2	9,885,591 (13.1)	–	–

Source: Zambia Statistical Office, Census 2000

1.6 The Study Approach

The action plan that the Study is to produce includes interventions such as participatory development, formation of farmers organization, planning and design based upon appropriate technology, construction by beneficiary farmers' initiative, operation and maintenance by the smallholders, agriculture extension to be required, implementation arrangement and dissemination procedure. To produce a workable action plan, a participatory approach is employed by not only beneficiary farmers but also all those government officers concerned.

In Phase 1 study, a draft action plan for smallholder irrigation development is produced, and the draft is finalized by the end of the Phase 2 study. Before finalizing

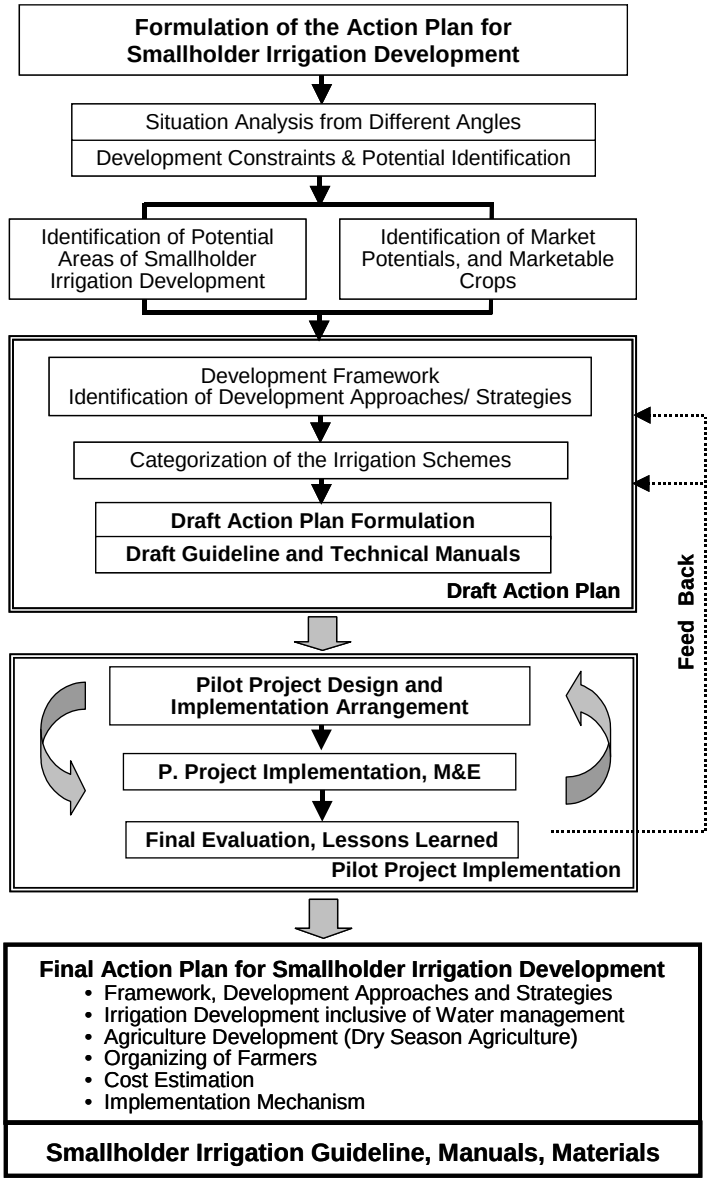


Figure 1.6.1 Overall Study Approach

[4] In SADC counties, however, Botswana and Namibia have the least population density, 3 persons/km^2 each and Angola's population density is also low, 14 persons/km^2. It is because there are desert lands in these countries. In Zambia, there is no desert but the population density is still very low. Source: Human Development Report 2005.

the action plan, several of the most important hypotheses of the draft action plan are verified through the actual implementation of certain components of the action plan including extension, which may be called as a verification study as referred to in the SW. The pilot projects are to start in Phase 1 study on demonstrative basis, and thereafter it is extended in Phase 2 study covering wider areas. Also piloted in Phase 2 study is an upgrade from simple (temporary) facilities to permanent ones and if any rehabilitation of existing schemes. The draft action plan is finalized by getting feedbacks from the experiences and lessons coming up through the implementation of those pilot projects. The study approach is illustrated in Figure 1.6.1.

1.7 Implementation Arrangement of the Study

The counterpart organization of the Study is the Ministry of Agriculture and Cooperatives (MACO), and the responsible partner wing to the JICA Study Team is Department of Agriculture (DOA). The department is therefore responsible for providing counterpart personnel, whereby the Study is carried out hand in hand. At the central level, a Steering Committee is established comprising of directors and deputy directors of the related departments under MACO, and PACO and PAO of the target 2 provinces, which is chaired by the Director of DOA.

The JICA Study Team and counterparts (CPs) report what has been studied to the Steering Committee where a representative from JICA office in Zambia is also to attend. Thus, the Study is implemented in line with the consultations to be made in the Committee. Likewise, at the regional level, a pilot project working group composed of regular staff of provinces, districts and extension camps in the Study area is established under MACO that functions as a joint promoter in implementing the pilot projects. Figure below 1.7.1 shows the implementation arrangement of the Study.

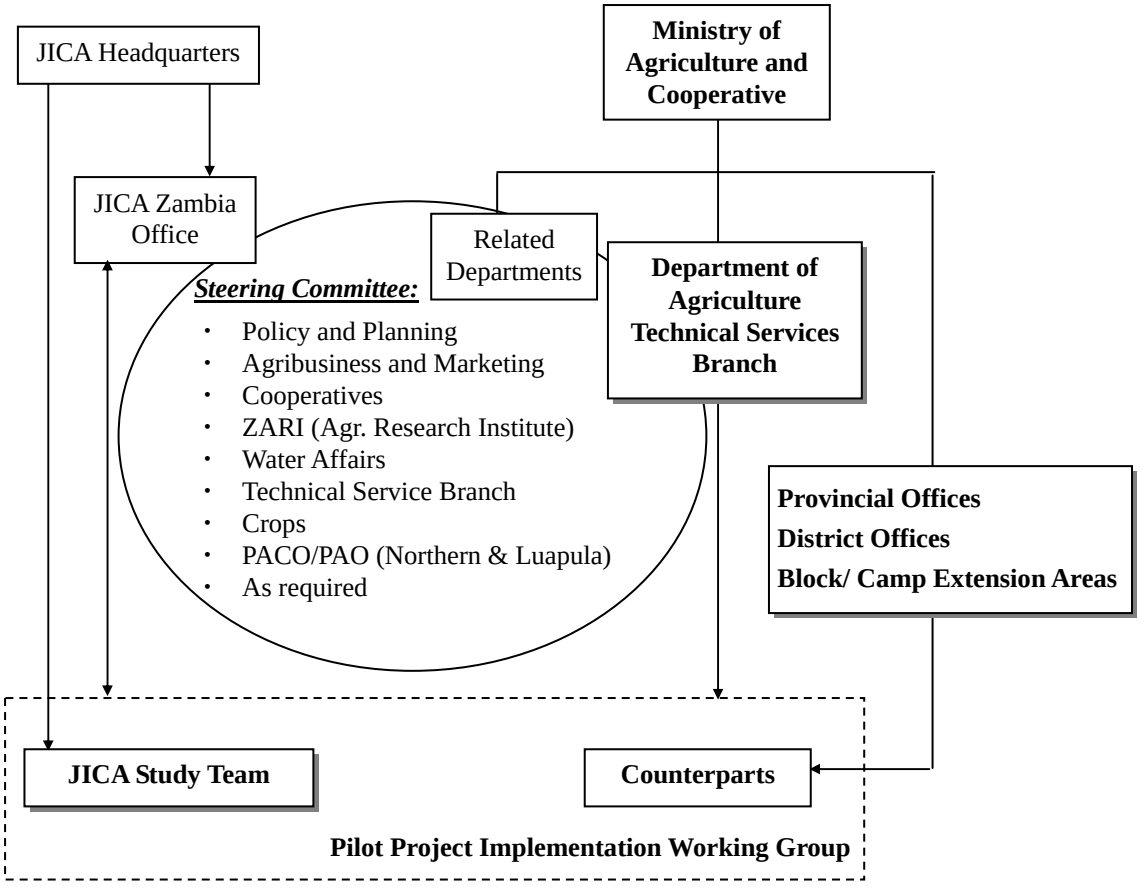


Figure 1.7.1 Implementation Arrangement of the Study

CHAPTER 2 DEVELOPMENT AND POVERTY IN ZAMBIA

This chapter presents comprehensive views of development and poverty including agriculture and irrigation sectors in Zambia. It starts with overview of Zambia and then describes the status of development and poverty in Zambia. It is further followed by salient features of agriculture and then of irrigation in Zambia. These briefings could give the readers introductory understandings, following which detail discussions for the Study area are presented in the next chapter.

2.1 Overview of Zambia

Zambia is a land-locked south-central African country bordering with eight countries; Botswana, Namibia, Zimbabwe, Tanzania, Angola, Malawi, Democratic Republic Congo (DRC), and Mozambique. It has a vast land area of 753,000 sq.km, extending from the longitude of 22 degrees West to about 34 degrees East and from the latitude of about 8 degrees North to 18 degrees South. The country is on the Great Plateau of Central Africa, and has three distinct relief divisions such as: 1) mountains with an altitude of over 1,200m, that is to say the hill areas, 2) a plateau with an altitude ranging from 900 to 1,200 meters, that is so-called the plateaus, 3) lowlands with an altitude of below 900 m (between 400 and 900 meters), that is to say the plains.

Zambia has clearly separated dry and rainy seasons as most land-locked African countries do. Rainy season usually starts from October and ends in April the following year, while rest of the year falls in dry season. Rainfall comes with North-West rain-bearing winds from DRC direction and North-East Monsoons from Tanzania direction and also affected by South-East Trades Wind from Mozambique direction. Annual rainfall ranges from only 700 mm to 800 mm in south and south-western areas and reaches as much as over 1,500 mm in northern parts of the country. The amount of precipitation that falls in some areas can vary considerably from the average of any year, and this variability tends to be greatest in areas of low rainfall, e.g. south and south-western areas.

Zambia's total land area is about 753,000 sq.km and its population is estimated at about 11.9 million people as of 2007. This gives us an average population density of about 16 people per sq.km, which is relatively low as compared to most of the neighboring countries and also to the average of sub-Saharan African countries.

Table 2.1.1 Comparison of Land, Population, and Density

Country	Population	Land Area	Density
	In 2007	km2	Population/ km2
Zambia	**11,919,870**	**752,614**	**16**
Neighboring countries	**172,500,683**	**7,273,635**	**24**
Botswana	1,881,432	600,370	3
Namibia	2,073,624	825,418	3
Zimbabwe	13,402,661	390,580	34
Tanzania	40,432,163	945,087	43
Angola	17,019,315	1,246,700	14
Malawi	13,920,062	118,480	117
DRC	62,399,224	2,345,410	27
Mozambique	21,372,202	801,590	27
Sub-Saharan Africa	**688,705,785**	**22,000,000**	**31**
Japan	127,767,994	377,835	338

Source: Population; http://ddp-ext.worldbank.org/ext/DDPQQ
Land Area; http://ja.wikipedia.org/wiki/

As Table 2.1.1 shows, the average population density of the 8 neighboring countries is 24 people per sq.km and the average of sub-Saharan African countries is 31 people per sq.km while that of Zambia is 16 population per sq.km only. Areas where population density is relatively higher can be found along railroads and main roads where human settlement and economic activities were initiated back to the colonial era. Otherwise, relatively low population density prevails; one of typical characteristics that Zambia presents.

2.1.1 Economy in Zambia

Zambian economy has, as is well known, been historically dependent on copper mining. The gradual decline in world copper prices till late 1990s had led to economic decline and erosion of the relatively high standard of living enjoyed by the people in the 1970s. Figure 2.1.1 shows the annual growth ratio

of real GDP since 1980 to date[1], from which one may see how the Zambian real GDP had been staggering or hovering just around zero percent growth till late 1990s. In fact, the average growth ratio of the real GDP from 1980 to 1998 was only 0.4%, much lower than that of population growth ratio of about 3% during that time. This situation had also lowered the share of the Zambian GDP to the world total GDP as shown in Figure 2.1.2. In early 1980s, Zambian GDP to the world total once consisted of nearly about 0.040 percent but the share was continuously decreasing to as low as 0.023 percent level till the time of late 1990s[2].

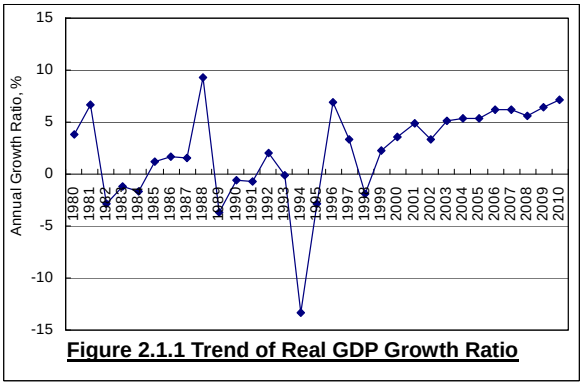


Figure 2.1.1 Trend of Real GDP Growth Ratio

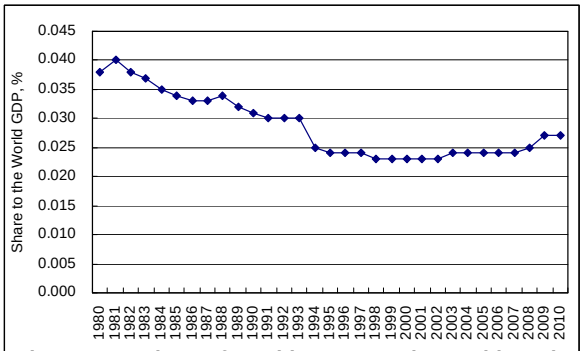


Figure 2.1.2 Share of Zambian GDP to the World Total

Then, the economy started marking almost continuous growth since 1999 thanks to the price hike of copper in the international market, robust development of construction and service sectors, debt relief under enhanced HIPC Initiative, etc (see Table 2.1.2 for the economic indicators). The average real GDP growth ratio between 1999 and 2010 is recorded at 5.1 percent, and GDP per capita in current price has also reached over 900 US$ in 2006 and onward (see Figure 2.1.3).

Table 2.1.2 Summary of Key Economic Indicators

Country	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Real GDP Growth, %	4.9	3.3	5.1	5.4	5.3	6.2	6.2	5.7	6.4	7.1
CPI (end of period), %	18.7	26.6	17.2	17.5	15.9	8.2	8.9	16.6	9.9	7.9
Exports (MUS$)	979	944	979	1,577	2,177	3,682	4,617	5,099	4,312	7,200
of which copper	-	510	607	1,075	1,516	3,029	3,407	NA	NA	NA
Nominal GDP, MUS$	3,593	3,727	4,271	5,371	7,179	10,702	11,541	14,704	13,000*	16,072*
Population, million	10.09	10.41	10.74	11.09	11.44	11.80	12.16	12.53	12.90	13.05
GDP per capita, US$	340.7	345.1	386.2	474.3	619.1	901.4	1,002	1,251.9	1,086	1,317
External Debt to GDP, %	-	178.7	156.5	126.7	86.0	8.8	9.9	NA	NA	NA

Source: IMF Economic Outlook (*: IMF staff estimate), Central Statistics Office of Zambia, Bank of Zambia

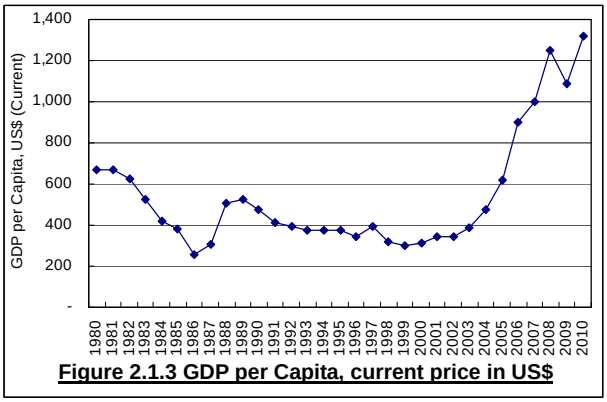


Figure 2.1.3 GDP per Capita, current price in US$

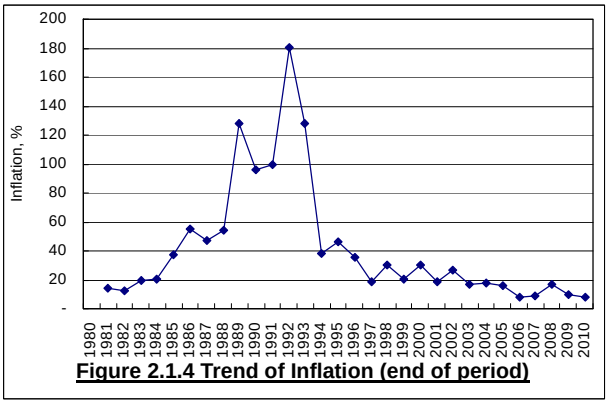


Figure 2.1.4 Trend of Inflation (end of period)

Another achievement after 1999 was a reduction of inflation. Zambia had been suffering from high

[1] IMF Economic Outlook, April 2010 (Note that data for 2009 & 2010 are estimate by IMF staff).

[2] IMF Economic Outlook, April 2010 (Note that data for 2009 & 2010 are estimate by IMF staff). As for share of population of Zambia to the world population, it is 0.18 percent where 11,919,870 of Zambian population in 2007 versus 6,660,000,000 of world estimated population as of 2008.

inflation especially in early 1990s, peaking over 180 percent in 1993. Though the inflation after mid 1990s had not been as high as those of early 1990s, it had still been about 20 percent per annum. One of the targets under HIPC Initiative was to lower the inflation to single digit, and it has been achieved in the years of 2006 (8.2%), 2007 (8.9%), 2009 (9.9%) and 2010 (7.9%); the first time during the last 3 decades (see Figure 2.1.4)[3].

2.1.2 Growth of Agriculture Sector and Its Share in Total GDP

Figure 2.1.5 shows real growth ratio of agriculture sector together with the growth ratio of total GDP and those by sector such as primary, secondary and tertiary[4]. As revealed in the figure, agriculture sector has been staggering and in fact not grown over the 12 years period from 1996 to 2007. The average growth ratio is 0.2% only, almost negligible or even negative growth if counted as the growth ratio per capita since the population growth ratio at that time is estimated at 2.4 % per annum according to the National Census 2000. It is also pointed out that there were 7 times of year out of the 12 years when the growth ratio hit negative percent, e.g. -6.6% in 1997, -6.0% in 2001, -6.3% in 2002, etc. These negative growth ratios are well correlated with unstable weather such as drought. However, there is a big leap in the growth of agriculture sector in 2009 and 2010, recording as high as 12.4% and 12.9%, which correspond to a good rainfall in these years.

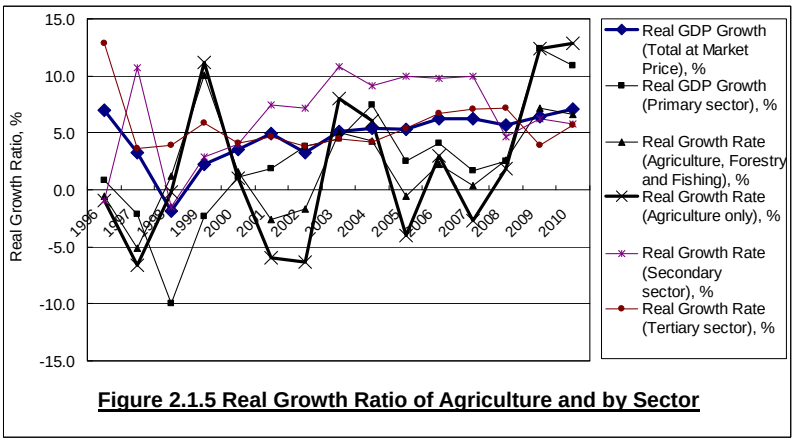


Figure 2.1.5 Real Growth Ratio of Agriculture and by Sector

Figure 2.1.6 shows GDP share by agriculture sub-sector as in the bottom bar, GDP share by forestry & fishing sub-sector, GDP share by mining & quarrying, which together make so-called primary sector, and GDP shares of secondary sector and tertiary sector[5]. As clearly understood, the share of agriculture sub-sector in total GDP is very minimal ranging from 7.1% in 1995 to as low as 3.3% recorded in 2008. It is also revealed that the share is on the declining trend after reaching the peak of 7.1% in 1995, though there is a bit of increase in 2009 supported by the aforementioned 12.4% growth ratio. Share of forestry and fishing had, on the other hand, increased from 8.6% in 1994 to 15.5% in 1999, and then has stayed at around 15-17%. The summed share of agriculture, forestry and fishing therefore consists of about 20% of the total GDP.

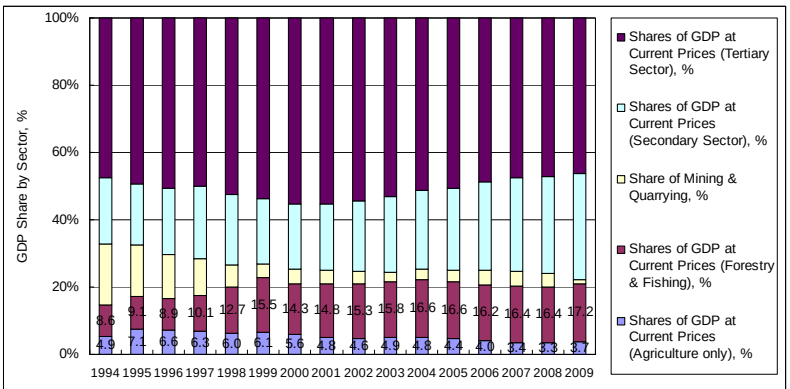


Figure 2.1.6 Share of Agriculture and Sectors in Total GDP

[3] Source: IMF Economic Outlook, April 2010 (Note that data for 2009 & 2010 are estimate by IMF staff).
[4] Source; CSO GDP data from homepage, http://www.zamstats.gov.zm/GDP_table.php, Data for 2010 is provisional.
[5] Source; CSO GDP data from homepage, http://www.zamstats.gov.zm/GDP_table.php, Data for 2009 is provisional. The shares are slightly different from those presented by CSO. This is because the original shares included 'less FISIM' and 'taxes on products', aside from commonly used sector productions, which were omitted in the figure.

That minimal share of agriculture sub-sector in the total GDP does not necessarily mean that the sub-sector does not play an important role in the national production. Yet, it implies people in rural areas, who are engaged in agriculture production, are rather suffering from prevalent poverty. As a matter of fact, as much as 65% of the whole population reside in rural area according to the national Census 2000. In addition, Living Condition Monitoring Survey 2004 found that 1,372,760 households out of total 2,110,640 households were engaged in agriculture in the survey year 2004. The share of the agriculture households arrives at 65% of the total households.

About two-thirds of the whole population live in rural area and also are engaged in agriculture. Yet agriculture production shares only meager percentage, say 4-6 % only, in the total GDP. Even topping up of the GDP shares of forestry and fishing sub-sectors on that of agriculture sub-sector arrives at only about 20% of the total GDP, while once again about two-third of the population live in rural area. It is therefore pointed out that due efforts should be brought in to enhance agriculture production, thereby improving the people's economic status and mitigating the poverty prevalent in rural areas.

2.2 Human Development in Zambia

This sub-chapter briefly discusses human development situation in Zambia as well as in the Study area. In fact, human diversity of factors that constitute human well-being makes the concept of human development very complex. However, there is need to simplify reality this way to practically assess performance and make comparisons. This sub-chapter therefore refers to HDI first, and then several factors affecting the magnitude of the human development. With this, one may see the human development situation of Zambia as compared to neighboring countries and also of the Study area comparing those of other provinces of Zambia.

2.2.1 Human Development Index (HDI) of Zambia

HDI is to provide a quantitative representation of three essential dimensions of life e.g. income, education and health also interpreted as; 1) enjoying a decent standard of living, 2) to be knowledgeable, and 3) a long and healthy life. Each of these dimensions has been assigned corresponding quantitative indicators: 1) a decent standard of living measured by GNI per capita (PPP$); 2) educational attainment representing knowledge by a combination index of mean years of schooling and expected years of schooling – the years of schooling that a child can expect to receive given current enrolment, and 3) a long and health life measured by life expectancy at birth[6].

Thus the HDI is a composite index of the three indexes; the adjusted GNI per capita index, the education attainment index and the life expectancy index. It is a geometric mean of the three indexes. The HDI therefore puts all the three basic indicators on a common measuring horizon. The minimum and maximum values of each variable range between 0.0 and 1.0. One thing noted here is that the HDI is a comparative index amongst all the countries where HDIs are available. Therefore even if a country has improved the real GDP per capita, educational attainment and life expectancy, it may happen that the country's HDI gets lower should the country's attainments be lower than those of other countries.

Figure 2.2.1 shows HDIs for those countries whose rankings are placed after 100th position in year 2010 (HDR 2010)[7]. There are 169 countries whose HDIs are available in year 2010, and unfortunately Zambia is placed at 150th position with the HDI value of 0.395 amongst them. Courtiers placed just better side from Zambia are Cote d'Ivoire, Tanzania, Djibouti, Angola, Haiti, Senegal, etc. and those placed right after Zambia are Gambia, Rwanda, Malawi, Sudan, Afghanistan, Guinea, Ethiopia, etc.

[6] In fact, decent standard of living was once measured by GDP (PPP$) till 2009 and in the Human Development Report 2010 the GNI (PPP$) replaced it. Likewise, the mean years of schooling replaced literacy and the expected years of schooling recast the enrolment, which were both used till 2009 in measuring education attainment.

[7] Human Development Report 2010, UNDP.

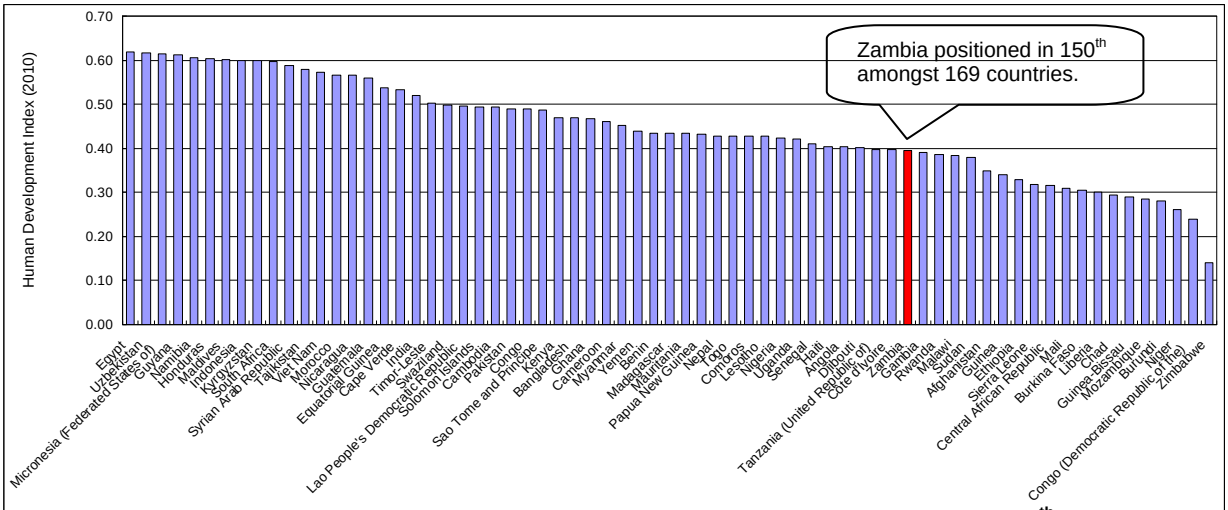


Figure 2.2.1 Order of Human Development Indexes for the Countries placed After 100th Position

2.2.2 Examination of Constitutes of Zambia's HDI

As aforementioned, HDI refers to GNI per capita (PPP$), educational attainment associated with mean years of schooling and expected years of schooling, and life expectancy. These are examined separately as compared to those indexes for neighboring countries. First, Figure 2.2.2 shows the HDIs of Zambia as compared with those of neighboring countries including the overall average of Sub-Sahara African countries. As is shown, Zambia is placed 9th position among 14 neighboring countries such as South Africa, Botswana, Namibia, Lesotho, Swaziland, Madagascar, Zimbabwe, Tanzania, Malawi, DRC, and Mozambique. Also it is reveled that the HDI of Zambia is more or less same as that of Sub-Sahara African countries (0.40 vs. 0.39).

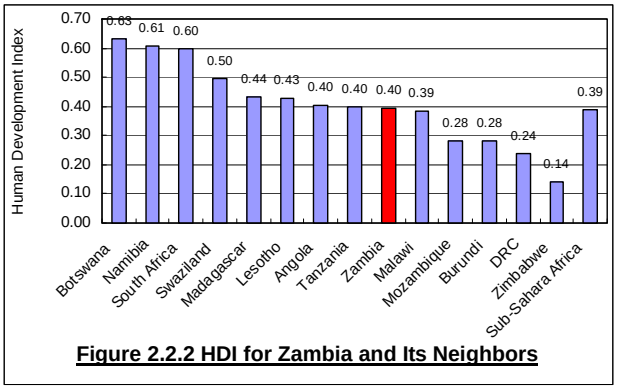


Figure 2.2.2 HDI for Zambia and Its Neighbors

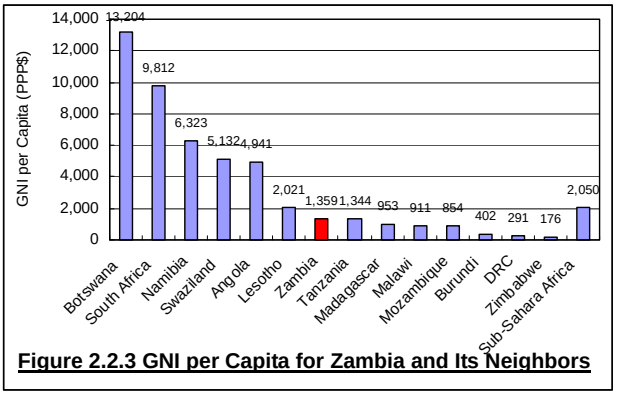


Figure 2.2.3 GNI per Capita for Zambia and Its Neighbors

When looking at GNI per capita in PPP$ shown in Figure 2.2.3, it is now placed in 7th position among the neighbors with a PPP$ value of 1,359. The figure also shows wide variation by country from Botswana with the highest PPP$ value of 13,204 to Zimbabwe with the lowest PPP$ value of 176 only. As compared with that of Sub-Sahara African countries, Zambia's PPP$ 1,359 is about two-thirds of it, namely PPP$ 2,050 vs. PPP$ 1,359.

Figure 2.2.4 shows expected years of schooling, which replaced combined gross enrollment of primary, secondary and tertiary schools formerly employed till 2009. Figure 2.2.5 illustrates the mean years of schooling, which replaced adult literacy previously used. The expected years of schooling of Zambia is 10th among the 14 neighboring countries. It is 8.2 years which is a little lower than that of Sub-Sahara African countries, 9.0 years. With respect to mean years of schooling, Zambia presents 4.4 years only, ranked again at 10th amongst the 14 neighboring countries. Zambian's mean years of schooling, 4.4 years, is almost equal to that of Sub-Sahara African countries, 4.5 years.

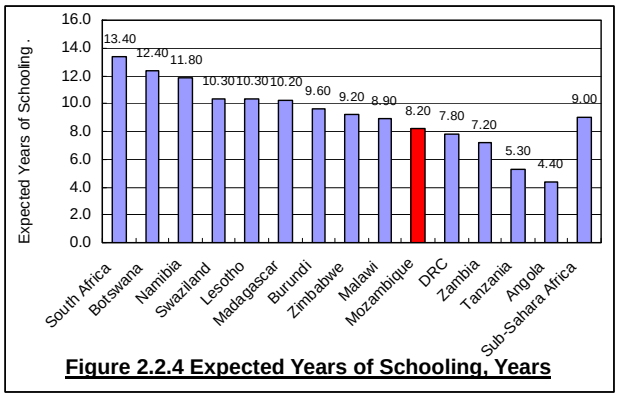


Figure 2.2.4 Expected Years of Schooling, Years

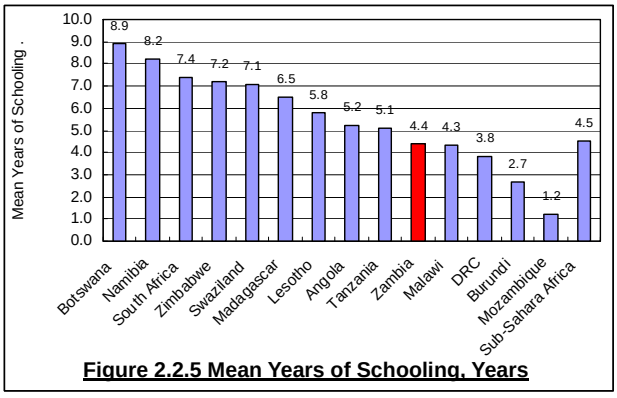


Figure 2.2.5 Mean Years of Schooling, Years

Figure 2.2.6 summarizes the life expectancy at birth. The expectancy of Zambia is 47.3 years old at birth, ranked at 11th petition among the 14 countries. The overall average of Sub-Sahara African countries is 52.7 years to which Zambia shows about 5 years less life expectancy. This low life expectancy of Zambia affects the country's HDI to be lowered. In fact, Census 2000, Zambia, reports such life expectancies at birth as 52 years in Yr1980 Census, 47 years old in Yr1990 Census and 50 years old in Yr2000 Census.

From these past records, it can be said that Zambia has not increased life expectancy, or there may be even a trend of decreasing from year 2000 when the country presented 50 years of life expectancy. This may be the effect of HIV/AIDS.

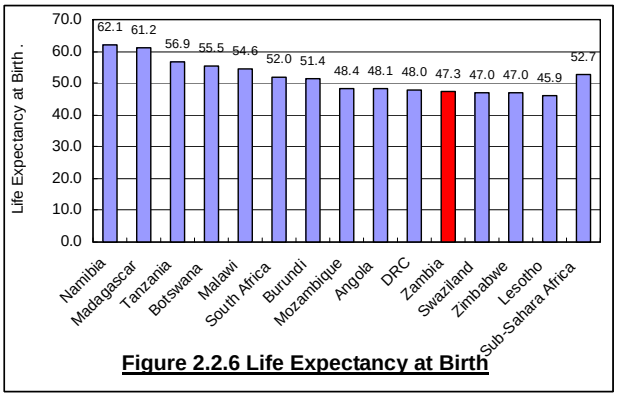


Figure 2.2.6 Life Expectancy at Birth

2.2.3 HDI Related Indexes of the Study Area

This session examines human development issues of the Study area in comparison with other provinces and also amongst districts wherein. Some of the data are, however, not available at regional level, and therefore following are the indexes referred to in the discussions below:

1) Labor force participation: since real GDP per capita is not available at regional level, labor force participation ratio is, instead, referred to know the extent of economic activities by the population. The data source is the National Census 2000.

2) Adult literacy ratio, and gross primary enrolment and gross secondary enrollment ratios: These data are available at regional level as of 2000. Note here is that Zambia introduced free primary education in 2003, and therefore that state of year 2000 could be obsolete as compared to latest situation. It can however reveal a comparative assessment by province and by district.

3) Life expectancy at birth: data of life expectancy at birth is available at regional level in the National Census 2000. Therefore the data is referred to. Also under-5 years child mortality is examined, which can indicate why some of the districts present very low life expectancy.

Figure 2.2.7 presents labor force participation for the Study area, by province and by district, as compared to that of national level and those of other provinces. The labor force participation rate is defined as the proportion of persons of particular age group, in this case 12-year old and over that year, who were in labor-force at that survey period. It measures the extent to which the particular age groups are involved in economic activities. The rate at national level is 56 % while that of Northern province is 58% and that of Luapula province is 62%. Looking into district level of the Study area, Luwingu district and Kawambwa district present the lowest rate, 46% each, while there are three districts in

Luapula province where we can see the rate over 70%; Milenge, Mwense, and Samfya districts.

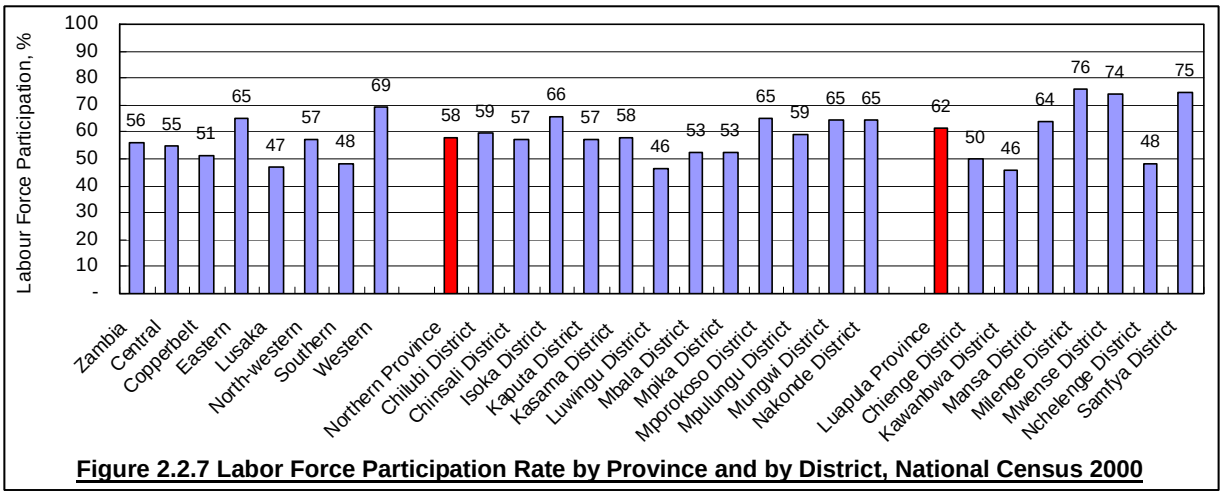


Figure 2.2.7 Labor Force Participation Rate by Province and by District, National Census 2000

Figure 2.2.8 shows adult literacy rates for the Study area. It obviously shows lower literacy in the Study area; 60% in Northern province and 62 % in Luapula province while that of national level is 67%. Districts presenting lower literacy rates than 50% are; Chilubi district (46%) and Chienge district (50%), while relatively urbanized districts like Kasama, Mporokoso, Kawambwa and Mansa show higher rates.

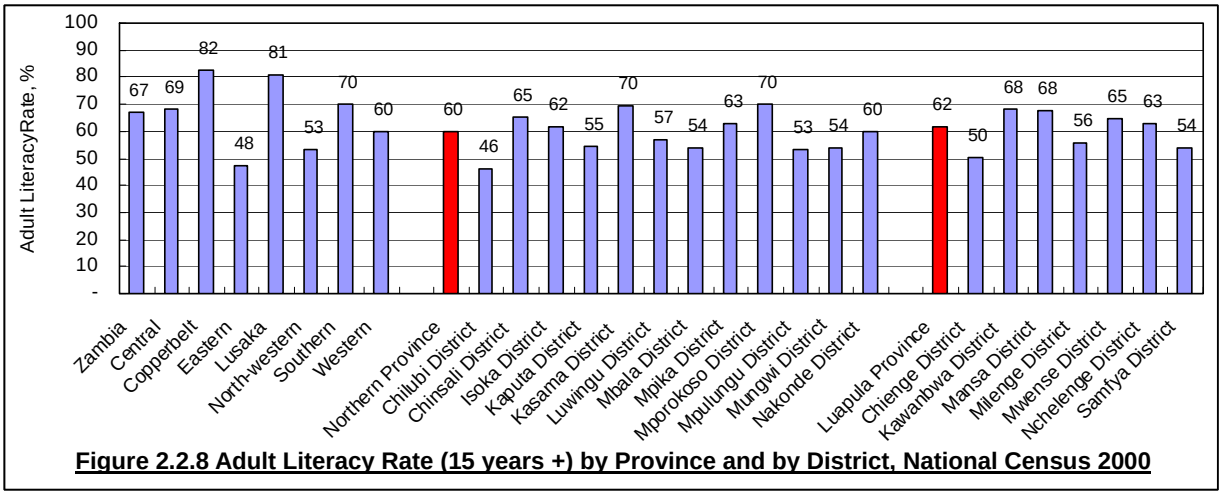


Figure 2.2.8 Adult Literacy Rate (15 years +) by Province and by District, National Census 2000

Figure 2.2.9 indicates gross primary enrollment ratios and Figure 2.2.10 shows gross secondary enrollment ratios. As far as gross primary enrollment ratios are concerned, those for the Study area are not quite lower than that of national level; 75% and 74% for Northern province and Luapula province

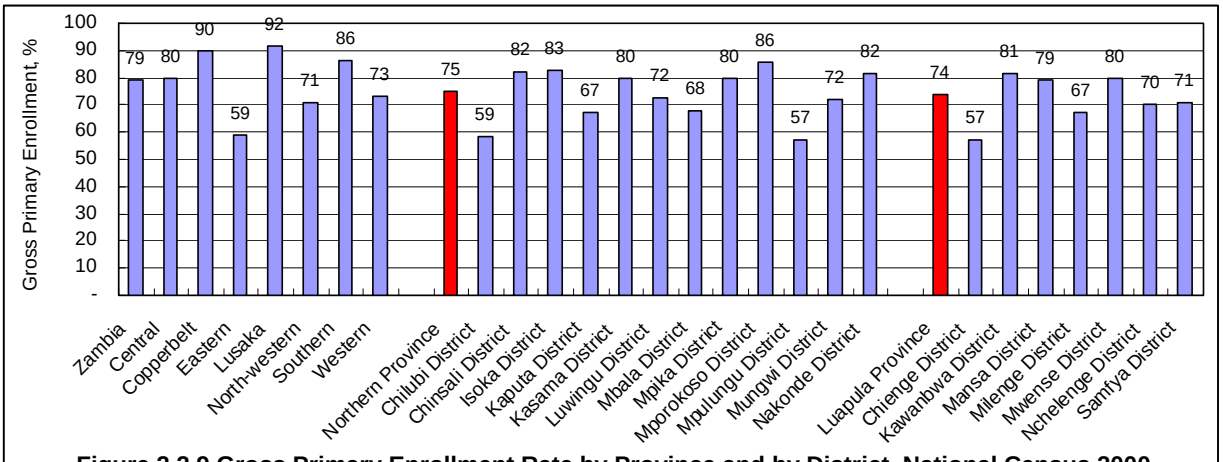


Figure 2.2.9 Gross Primary Enrollment Rate by Province and by District, National Census 2000

respectively as compared to 79% of the national level. However, when it goes to secondary level, the enrollment ratios for the Study area become very low; 35% and 31% for Northern province and Luapula province respectively while that of national level is 45%.

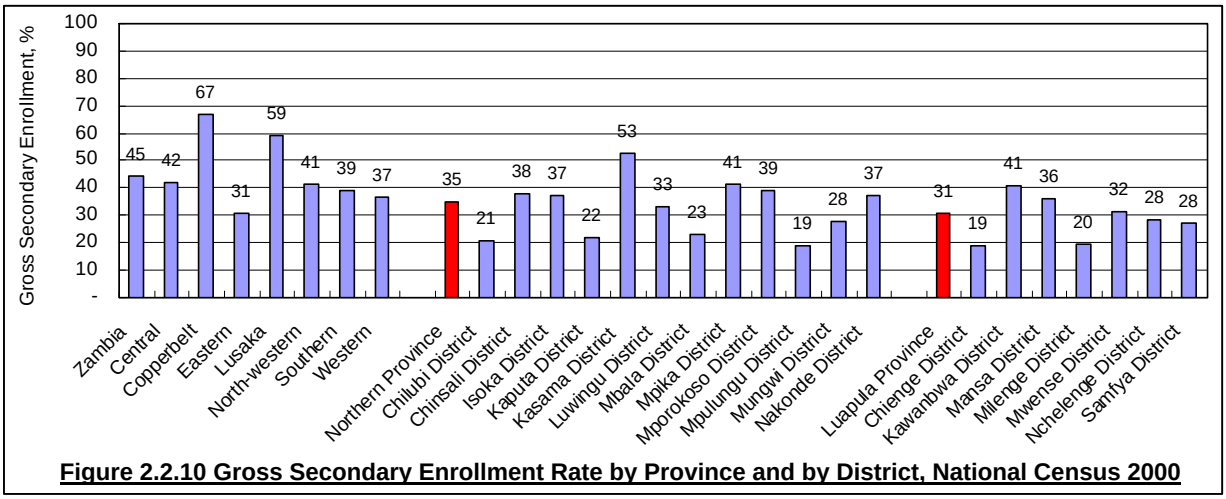


Figure 2.2.10 Gross Secondary Enrollment Rate by Province and by District, National Census 2000

Figure 2.2.11 summarizes life expectancy at birth. It is pointed out that life expectancies for the Study area are remarkably lower than that of national level. For example, National level's life expectancy at birth is 50 years while that of Northern province is only 45 years, less by 5 years from the national average, and the one of Luapula province is 44 years, less by 6 years from the national average. There are two districts in Northern province where they expect less than 40 years life expectancy at birth. These districts are Chilubi (34 years) and Kaputa (38 years).

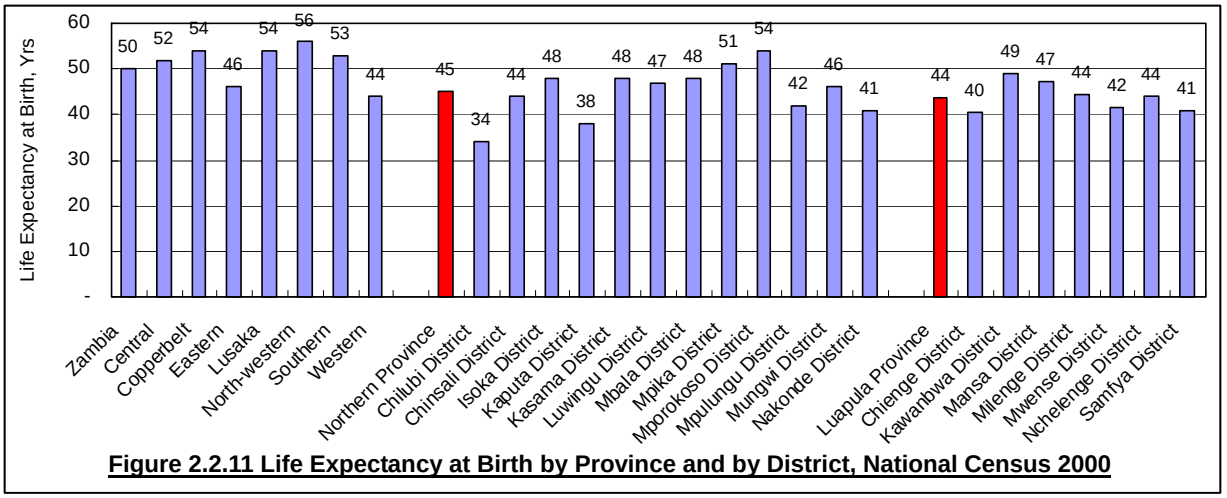


Figure 2.2.11 Life Expectancy at Birth by Province and by District, National Census 2000

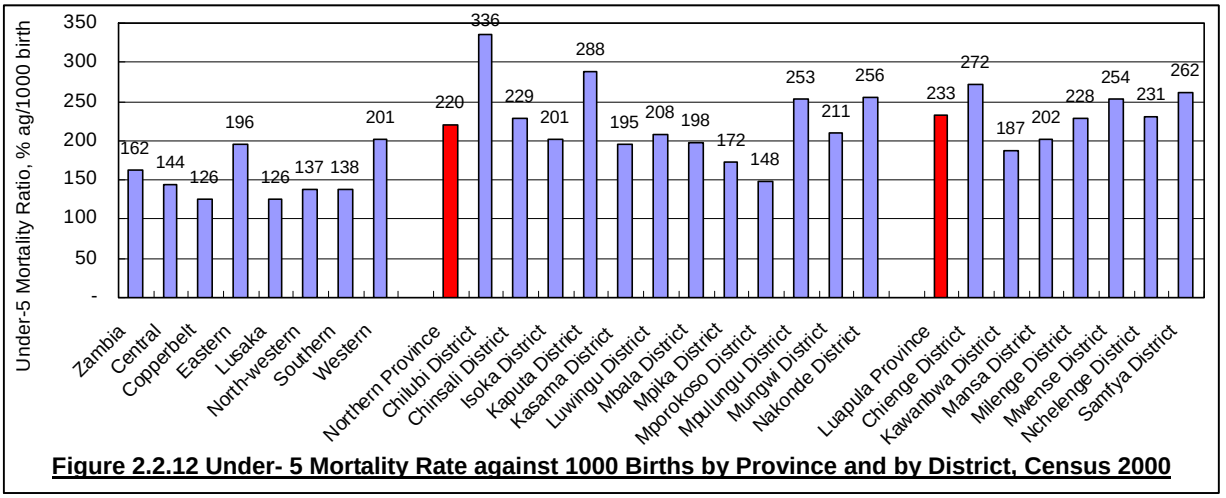


Figure 2.2.12 Under- 5 Mortality Rate against 1000 Births by Province and by District, Census 2000

It is well known that child mortality rate strongly correlates life expectancy at birth, e.g., higher child mortality lower life expectancy and visa versa. Figure 2.2.12 shows under-5 years old child mortality ratios against 1000 live births. National level under-5 child mortality ratio is 162, while that of Northern province is 220 and that of Luapula province is 233. Mortality 220 – 233 against 1000 births means about one in every 4-5 children cannot see their five-year birthday. Surprisingly, Chilubi's mortality rate is by far higher than those of other districts in the Study area, 336 mortality against 1000 births. This implies one out of every three children cannot have chance to see their 5-year birthday.

2.3 Poverty in Zambia

There is a consensus that poverty is a widespread problem not in rural area but also in urban areas. To measure the poverty level in Zambia, Central Statistics Office, Zambia, has carried out Living Conditions Monitoring Survey (LCMS) in the years of 1991, 1993, 1996, 1998, 2004 and 2006. The office additionally carried out a 2002-03 LCMS, which covered over a 12 months period while the others collected concerned expenditure data over a short period between October and December, known as the 'hungry season'. This sub-chapter summarizes those poverty related survey results, and presents a base with which we are to quantitatively assess impact from irrigated agriculture in latter chapters.

2.3.1 Poverty Lines in Zambia

Poverty lines in Zambia are based on the food-energy intake (FEI) approach. This method attempts to establish a monetary value at which basic needs are met. This poverty line presents only the minimum levels of basic needs, blow which a decent material style is deemed not possible[8]. The FEI method sets the minimum food requirement by finding the consumption expenditure level at which food energy intake is just sufficient to meet pre-determined average food energy requirements for normal bodily functions.

LCMS 2006 shows calorie requirements for a typical family with adult equivalent scale. In fact, children do not need as much calorie as adult requires, and therefore there should be a discount factor when taking into account child family members. As shown in the table below, a typical adult in Zambia requires 2,750 kcal per day and a child does 0.36 – 0.95 of what a typical adult needs depending upon his/her age.

Table 2.3.1 Calorie Requirements for a Typical Family and the Adjusted Adult Equivalent Scale

Age group	Calorie Requirement, kcal	Adjusted Adult Equivalent	Remarks
Child			
0-3 years	1,000	0.36	
4-6 years	1,700	0.62	
7-9 years	2,150	0.78	
10-12 years	2,600	0.95	
Adult above 12 years	2,750	1.00	1/

Source: Living Conditions Monitoring Survey Report 2004/2006, CSO

Note: 1/ Originally, the calorie requirement per day for male adult and female adult were 2,750 kcal and 2,600 kcal respectively, however, for simple calculation purpose, same 2,750 kcal was applied to both adult sexes in this report.

Poverty Line is composed of 1) food poverty line and 2) non-food poverty line under Cost of Basic Needs method, applied in Zambia. Food poverty line is the monetary value in order to consume a food basket which can give the calories shown in above table. The LCMS reports had, until LCMS 2004, used a food basket proposed by National Food and Nutrition Commission in 1991. The food cost to maintain the nutritional requirements of an average Zambian family was worked out at ZMK 961 per adult-equivalent per month as at the 1991 price. Then, LCMS 2006 updated the food basket in order to

[8] Living Conditions Monitoring Survey Report,(LCMS), 2004 and 2006, CSO

well reflect the popular food contents for common Zambians. The cost for food basket established in the LCMS 2006 arrived at ZMK 65,710 per adult-equivalent per month.

Another poverty line, the Non-food Poverty Line, is usually estimated by knowing how much in average non-food expenditure is spent for the people who are on the Food Poverty Line. The LCMS survey 1991 found that households spend on average about 70 % of their total expenditure on food and the rest, 30%, on other necessary items which are the non-food items. Therefore, to the LCMS 1991 food poverty line of ZMK 961, ZMK 419 was added which came to a total of ZMK 1,380 as Poverty Line. For the LCMS 2006 food poverty line of ZMK 65,710, ZMK 28,162 was estimated as the non-food poverty line, totaling ZMK 93,872 as the Poverty Line. The former consists of 70%, while the latter does of 30% of the Poverty Line.

All the poverty lines established in Zambia are summarized in the following Table 2.3.2. As aforementioned, the poverty lines until LCMS 2004 were inflation adjusted based on the poverty lines of LCMS 1991, and then they were updated in the LCMS 2006 report. As it is recognized, poverty lines of LCMS 2006 are lower than those of LCMS 2004, rather close to those of LCMS 2002/03. This result attributes to the updating of the food basket carried out in the LCMS 2006. By applying the consumer price index from July 2006 to July 2010 to the poverty lines of LCMS 2006, the inflation adjusted poverty line as at July 2010, when the JICA study team carried out 2nd batch of baseline survey, are also estimated as shown in the bottom columns of the table below:

Table 2.3.2 Poverty Lines per Adult-equivalent per Month from 1991 to 2009

Year	Food Poverty Line ZMK/AP/M, 1/	Non-food Poverty Line, ZMK/AP/M	Poverty Line (Overall), ZMK/AP/M	Change in CPI	Remarks
1991	961	419	1,380	100 (base)	2/
1993	5,910	2,570	8,480	614	2/
1996	20,181	8,798	28,979	2,100	2/
1998	32,861	14,326	47,187	3,419	2/
2002/03	64,530	27,655	92,185	6,680	2/
2004	78,223	33,524	111,747	8,098	2/
2006	**65,710**	**28,162**	**93,872**	**-**	
2010 (July)	**101,673**	**43,575**	**145,248**	**154.73**	Fr. July 2006 – July 2010
in US$	**$ 19.50**	**$ 8.36**	**$ 27.86**	**-**	@5,215 as at July 2010

Note: 1/ means ZMK per Adult Person per Month.
2/ Poverty lines were from Living Conditions Monitoring Survey Report 2004, CSO (based on that of LCMS 1991)
3/ Poverty lines were estimated by applying CPI increase from July 2006 to July 2010, the month when JICA study team carried out 2nd batch baseline survey under this Study. The CPI of 154.73 is an aggregated CPI from 11.2% from July 2006 – July 2007, 12.6% from July 2007 – July 2008, 14.0% from July 2008 – July 2009, and 8.4% from July 2009 – July 2010 based on The Monthly CSO Bulletin, Volume 91, October 2010.

As shown in the table above, the poverty lines as at July 2010 are estimated at ZMK 101,673 for food and ZMK 43,575 for non-food, giving together the Poverty Line of ZMK 145,248 per adult equivalent per month. These are translated in US$ 19.50, US$ 8.36 and US$ 27.86 per adult equivalent per month respectively by applying the exchange rate of ZMK 5,215 against one dollar as of July 2010. With these per-adult-equivalent monthly poverty lines, poverty lines per annum and also lines for a typical household with 4, 5, 6 adult-equivalent members are calculated as below:

Table 2.3.3 Poverty Lines as at July 2010 at Different Terms, as of July 2010

Particulars	Food Poverty Line	Non-food Poverty Line	Poverty Line (Overall)	Remarks
In Zambian Kwacha				
Per adult equivalent per month	101,673 (70%)	43,575 (30%)	145,248	
Per adult equivalent per annum	1,505,388	656,352	2,161,740	
4 adult-equivalents per annum	1,220,076	522,900	1,742,976	
5 adult-equivalents per annum	4,880,304	2,091,600	6,971,904	
6 adult-equivalents per annum	6,100,380	2,614,500	8,714,880	
In US$				
Per adult equivalent per month	19.50 (70%)	8.36 (30%)	28.86 (100%)	@5,215

Per adult equivalent per annum	234	100	334	
4 adult-equivalents per annum	936	401	1,337	
5 adult-equivalents per annum	1,170	501	1,671	
6 adult-equivalents per annum	1,404	602	2,005	

Source: JICA Study Team based on Poverty Lines of 2004 presented in Living Conditions Monitoring Survey 2004, CSO

The above poverty lines can be referred to quantitatively assess the impact from the irrigated agriculture; e.g. be able to know with the profit from irrigated agriculture how much they can come to or exceed from the poverty line, or how much area for irrigated agriculture they need to develop to come over the poverty line, etc.

There are, however, in fact limitations for the above poverty lines to employ in this Study. One of the limitations is that the original poverty lines were established in 2006, about 3 years ago. The lines as of 2010 were just estimated by applying consumer price index for the 4 years (154.73% increase), assuming that the content of the food basket has not changed. Another limitations may be associated with people's diet style and also with where they live whether in urban area or in rural area.

Many people in the Study area consume more cassava than maize as staple food, former of which is usually cheaper than the latter. This implies the food basket wherein staple food consists of considerable portion may not need to spend as much money as for those who depend mainly on maize. Likewise, people who live in rural area should spend less money that those counterparts living in urban area. For example, people living in urban area spend more money on housing, one of non-food items. Also, food available in urban area is more expensive than those available in rural areas. People living in urban area should spend more money than those counterparts in rural area even though they are supposed to consume same food basket.

In many countries, two poverty lines are usually established, e.g. poverty line for those living in urban area and the line for those living in rural area. The former line is, of course, higher than the latter. This implies that should there be a same poverty line applied regardless where they live, one would overestimate the poverty ratio in rural area higher than it is supposed to be, or visa versa. Poverty concerned reports so far published often mention that poverty ratio in rural area in Zambia is very much high, one of typical characters. Such high poverty ratio in rural area might be overestimated, accordingly.

Taking above into consideration, this Study is to establish its own poverty lines based on a baseline survey carried out from May – June 2009 and May – July 2010. The baseline survey in the period covered 12 villages in Northern and Luapula provinces. About 370 households were sampled, and asked their daily expenditure, monthly expenditure and yearly expenditures, etc. The sample may not be enough to establish the poverty line which is adaptable over the Study area due to limited sample numbers. Nevertheless, it could give a correct sight for the food basket based on what they actually consume and thereby poverty line based on what rural people have to spend.

2.3.2 Poverty Ratios Estimated by 2002-03 LCMS

Among the Living Conditions Monitoring Surveys, the 2002-03 LCMS is an integrated household survey, similar in design to the World Bank's Living Standard Measurement Study surveys. The LCMS covered a wide range of topics, and markedly different from the practices employed in the previous LCMS, as well as the subsequent LCMS 2004 and LCMS 2006. In other years the LCMS was conducted over a brief period, usually over one or two months in the period between October and December.

The LCMS 2002-03 had collected data over a 12-month period from November 2002 to October 2003. The LCMS survey also distributed diaries to the sample households for them to record expenditures

in-between the visits by the interviewers. With such arrangement, the 2002-03 LCMS is believed to be much accurate than other years' LCMS results. A practice was therefore carried out by using the results of 2002-03 LCMS to assess poverty by not only province but also by district over the Country[9].

The results of poverty ratios, poverty gap ratios and squared poverty gap ratios, based on 2002 -03 LCMS, are summarized in the following figure and table, from which we can learn:

1) The poverty ratio for Northern province is the highest amongst all the provinces in Zambia, as it is 81% (84% for rural and 54% for urban), while Luapula is ranked at fourth position with the poverty ratio of 70.4 % (72% for rural and 53% for urban) after Northern (81%), North-western (71.9%) and Eastern (70.7%) provinces. [10]

2) The poverty ratio for the district[11] in Northern province ranges from 68% for Kasama district to as high as 83% for Mungwi district. The ratio for the district in Luapula province falls in a rage between 58% for Samfya district and 84% for Milenge District.

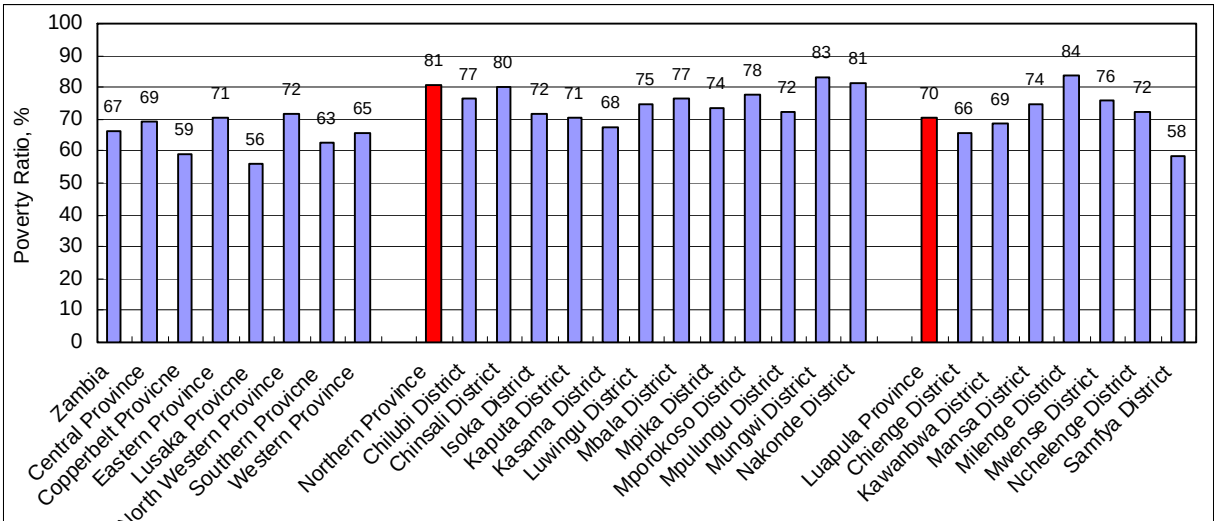


Figure 2.3.1 Poverty Ratios by Province and by District for the Study Provinces, LCMS 2002-03

Table 2.3.4 Poverty Ratios, Poverty Gap Rations and Squared Poverty gap Ratios as of 2002-03

Category	Poverty Ratio, %	Poverty Gap Ratio, %	Squared Poverty Gap Ratio, %	Remarks
Zambia	66.5	27.1	13.9	
Rural area	74.3	31.3	16.5	
Urban area	52.2	19.2	9.3	
Central Province	69.1	29.5	15.5	
Copperbelt Province	58.8	23.1	11.6	
Eastern Province	70.7	28.2	14.1	
Lusaka Province	56.3	21.6	10.9	
North Western Province	71.9	30.0	15.5	
Southern Province	62.9	23.6	11.5	
Western Province	65.4	24.0	11.7	
Northern Province	**80.5 (78)**	**38**	**21**	**( ) in LCMS 2006**
Rural area	84	40	23	
Urban Area	59	24	12	
Chilubi District	77	36	21	
Chinsali District	80	39	23	
Isoka District	72	31	17	

[9] Micro-level Estimates of Poverty in Zambia, 2007, CSO

[10] Note that according to LCMS 2006, the latest one, the poverty ratio of Northern province is 78% which is ranked at 3rd position after Western province (84%) and Eastern province (79%) while the ratio of Luapula province is 73% ranked at 4th position.

[11] Note that apart from 2002-03 LCMS, no poverty ratio by district is available for other LCMS reports.

Category	Poverty Ratio, %	Poverty Gap Ratio, %	Squared Poverty Gap Ratio, %	Remarks
Kaputa District	71	31	17	
Kasama District	68	29	16	
Luwingu District	75	33	18	
Mbala District	77	36	20	
Mpika District	74	34	19	
Mporokoso District	78	35	19	
Mpulungu District	72	32	18	
Mungwi District	83	41	25	
Nakonde District	81	42	26	
Luapula Province	**70.4 (73)**	**29**	**15**	**( ) in LCMS 2006**
Rural area	72	31	17	
Urban Area	53	18	9	
Chienge District	66	25	12	
Kawanbwa District	69	28	15	
Mansa District	74	34	19	
Milenge District	84	43	26	
Mwense District	76	32	17	
Nchelenge District	72	30	15	
Samfya District	58	23	12	
Poverty Line	**US$ 334 pre adult equivalent per annum as at July 2010**			
Food Poverty Line	**US$ 234 pre adult equivalent per annum as at July 2010**			
Non-food Poverty Line	**US$ 100 pre adult equivalent per annum as at July 2010**			

Source: Micro-level Estimates of Poverty in Zambia, 2007, CSO

2.4 Development Policies and Plans Relevant to the Study

On the course of development to date, Zambia has experienced several policy changes and formulated development policies, strategies, and plans. This sub-chapter briefly reviews policy changes in the history putting an emphasis on agriculture sector, and also those policies, strategies and plans relevant to this Study.

2.4.1 Policy Change in Agriculture Sector[12]

During the 1970s, the government adopted an inward-oriented development strategy based on nationalized and protected state enterprises. In fact, this policy prevailed until 1991 and over three quarters of GDP had been generated by the public sector. The subsequent dependence on copper earning, as a source of both foreign exchange and public revenues, created an economy that was vulnerable to crisis. Rather than undergo structural reform, the government chose instead to borrow from abroad to maintain the consumption. This marked the beginning of escalating foreign debt, which by early 1990s made Zambia one of the most indebted countries in the world.

Despite foreign borrowing, the continued deterioration in trade and falling revenues led to a reduction in social spending during the 1980s. The substantial gains in social outcomes that were achieved during the first decade after independence slowly began to deteriorate. During the global recession of the 1980s, the government again refused to embrace public sector reform, this time opting to reduce public investment, first in rural infrastructure and later in its own industrial enterprises. This contraction of the public investment and the limited size of the private investments explain the country's poor growth performance into the 1990s.

The government's reliance on the mining sector directed social spending favor toward the urbanized Copperbelt and Lusaka provinces. Perhaps the most important event of this urban bias was the food subsidies for urban dwellers. Broadly speaking, the government's agricultural policies, of which food subsidies formed part, had a profound effect on poverty and vulnerability in rural areas. Largely driven

[12] This sub-chapter referred to 'Agriculture and Achieving the Millennium Development Goals, Agricultural and Rural Development Department, Report No.32729-GLB, the World Bank', 'Country Assistance Strategy, April 2008, IDA', 'Fifth National Development Plan 2006-2010, 2005, GRZ'.

by its desire to protect urban food prices, the government chose to support maize production throughout the country. This was done through publicly provided input subsidies and marketing support, and through pan-territorial price controls.

The effect was to distort the pattern of agricultural production, such that over 80% of the land planted was devoted to maize. Apart from concentrating on staple production in maize, overvalued exchange rate caused by copper effectively undermined incentives to produce exportable cash crops. At the beginning of the 1990s, Zambia exported few agricultural commodities and was a net importer of food. This led to the country's severe food insecurity. Faced with revenue shortage, rural infrastructure has been further deteriorating. Many remote areas of the country became isolated from input and out markets.

Due to the poor performance of the Zambian economy at the end of 1980s, the newly elected government in 1991 chose a political platform based on the implementation of a comprehensive structural adjustment program. This program, which was implemented during the 1990s, included macro-economic stabilization, trade liberalization, privatization, and agricultural reforms. The government implemented a stabilization programme aimed at curbing inflation and creating an environment conducive to private enterprise. The impact of deregulated financial markets, and the removal of food subsidies under agricultural reform, led to rapid increases in consumer prices. Inflation during the early 1990s undermined real incomes and raised the cost of living, especially in urban areas.

Agricultural reforms were also implemented. The government abandoned the support to maize by removing subsidies and pre-determined floor prices. The loss of protection revealed that the artificial profitability of maize led to its rapid decline in the production. As a matter of fact, production halved during the 1990s, leading to rising poverty within rural areas. However, farmers shifted production toward more appropriate crops including cassava which is now very much cultivated in the Study area, millet and sorghum adaptable to dryer areas, etc.

While the rain-fed Northern and Luapula provinces reverted to cassava, the drier southern provinces planted millet. Production of these two crops almost doubled in response to agricultural reforms. Furthermore, cash crop production rose, which were meant for export since depreciated Zambian currency made export internationally competitive. Cotton, sugar, and horticulture showed rapid growth. The incidence of poverty has generally declined by the improvement in cash crop production in rural areas in the late 1990s and also in early 2000s as 88% (1991) [13], 92% (1993), 80% (1996), 83% (1998), 74% (2002/03), 78 % (2004) and 80% (2006), though it has been fluctuating by time.

2.4.2 Policies, Strategies and Plans relative to the Study

The overarching development policy in Zambia is the Vision 2030 for Zambia (2005). This vision presents a long term national goal for Zambian people. Under this long term development vision, there is a national medium-term strategic plan that is the 'Sixth National Development Plan (SNDP)' covering 2011 – 2015. This Plan is articulated as Poverty Reduction Strategy Paper (PRSP) as well.

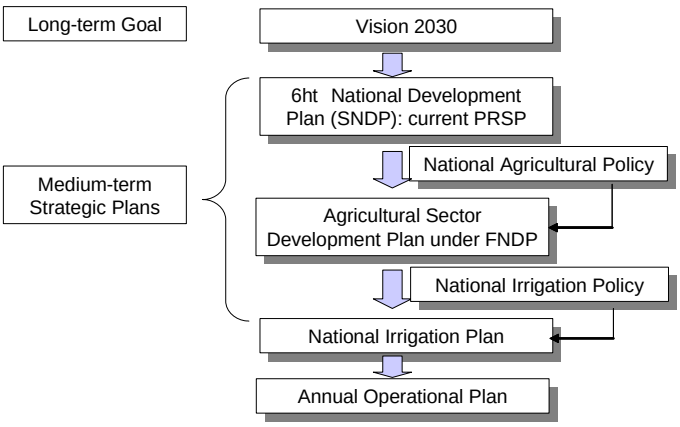


Figure 2.4.1 Relationship of Policies and Plans

[13] Source: LCMS 2006.

In agriculture sector, the overall strategic policy is 'National Agricultural Policy (2003) covering 2004 - 2015, which was referred to in preparing the agricultural sector development plan under the FNDP. Irrigation sub-sector has its own policy called National Irrigation Policy as sub-sector policy to the National Agricultural Policy. Then, National Irrigation Plan (NIP) was articulated in 2005, covering 2006 – 2011. Realization of the Vision will be through the implementation of these medium-term and annual plans thereof. Relationship among these policies and plans are shown in Figure 2.4.1.

1) Vision 2030 for Zambia (2005)

The vision states that Zambia is to be 'A Prosperous Middle Income Country Nation by 2030'. This was formulated out of the desire by the Zambian people to create a better future and through consultation with various stakeholders at national and regional levels. The Vision upholds 7 key principles; 1) sustainable development, 2) upholding democracy, 3) respect for human rights, 4) fostering family values, 5) positive attitude to work, 6) peaceful coexistence, and 7) upholding good traditional values. The vision views following objectives to be achieved by 2030:

i) To attain and sustain annual real economic growth rates of between 6 and 10 percent (5.9% as average from 2005-2010: Note that rates for 2009 and 2010 are IMF estimates),

ii) To attain and maintain a moderate inflation rate of 5 percent (11.3% as average from 2005 – 2010: Note that rates for 2009 and 2010 area IMF estimates),

iii) To slow down the annual population growth rate from its 2005 rate of 2.9% to a rate of less than 1.0 % by 2030,

iv) To reduce national poverty head count to less than 20 % of the population (64% as at 2006, LCMS 2006), and

v) To reduce income inequalities significantly.

So as to achieve the above objectives and thereby the vision that Zambia is to be a middle income country by 2030, the Vision examined 3 scenarios; 1) baseline scenario maintaining the status quo (business as usual), 2) preferred scenario, and 3) optimistic scenario.

Baseline Scenario brings Zambian nation an income of US$ 676 by 2030. The preferred scenario is expected to raise per-capita income in 2030 to US$ 1,639, a lower middle income country. Assumptions under this scenario are 6% real growth rate over the first 5 years with higher rates in each of the four succeeding 5-year terms – 8% from 2011 – 2025 and 11% from 2026 – 2030. The optimistic scenario, under the assumptions that 6% real growth rate over the first 5 years and then rising progressively to 14% by 2030, raises Zambian's per-capita income to US$ 2,185. This translates into a period average growth rate of 10% which can push Zambia to upper middle income county.

As above, the Vision does not necessarily point out agriculture or irrigation sector development objectives since it is the overarching development policy for Zambia. However, under the Vision it is the Sixth National Development Plan 2011-2015 which articulates sector development strategic plans including agriculture.

2) Sixth National Development Plan (SNDP) 2011-2015

The SNDP focuses on policies, strategies and programmes that will contribute significantly to addressing the challenges of realizing broad-based pro-poor growth, employment creation and human development. Thus, the strategic focus of the SNDP is 'infrastructure and human development'. The objectives of the SNDP are; 1) to accelerate infrastructure development, economic growth and diversification, 2) to promote rural investment and accelerate poverty reduction, and 3) to enhance human development.

With above broad strategies, agriculture remains the priority sector in achieving sustainable economic growth and reducing poverty. During the SNDP period, the agriculture sector will continue to be a strategic focus area in promoting economic growth, reducing poverty and creating employment. In order to achieve this, the focus will be on enhancing investment for sustainable agricultural production and productivity of crops, livestock and fisheries as was the case during the FNDP period. Climatic change is also emphasized in that appropriate adaptation measures will be developed and implemented to minimize the adverse impacts of climate change.

The SNDP upholds the goal in the agriculture sector as 'To increase and diversify agriculture production and productivity so as to raise the share of its contribution to 20 percent of GDP'. In line with this goal, the strategic focus under crop production is to develop irrigation and farm block, enhance research and extension services and promote utilization of improved seed varieties. The GRZ is to continue to creating conducive environment to promote private sector-led agriculture development.

Referring to the crop sub-sector, there are 3 objectives; namely, 1) To diversify and attain national and household food security, 2) To promote soil management for sustainable agricultural production and growth, and 3) To promote the development of competitive, efficient and transparent public and private sector driven marketing system for agricultural commodities and inputs. Under the 2nd objective, the over-arching programme is Sustainable Land and Water Management Programme, under which there are 3 sub-programmes, e.g. irrigation development sub-programme, conservation agriculture and agro-forestry promotion sub-programme, and agriculture land information system sub-programme.

3) National Agricultural Policy (NAP) 2004 - 2015

Main thrusts of the National Agricultural Policy (NAP) are increased production, sector liberalization, commercialization, promotion of public and private sector partnerships and provision of effective services that will ensure sustainable agricultural growth. The NAP states, in doing so, that the government will not ordinarily intervene in inputs distribution or crop marketing in a way that will undermine or undercut private sector participation especially if the private sector has the will or capacity to do so.

Up till the onset of 1990s, agricultural policies in Zambia used to be restrictive and constraining with strong government intervention including heavy subsidy provision. This had led to a failed growth in the sector, resulting in introduction of Structural Adjustment Programme in 1992. The main policy thrust of the programme was liberalization of the agricultural sector and promotion of private sector participation in all the sub-sectors of production, marketing, input supply, processing and credit provision. These key principles of the reform programme shaped the NAP.

The NAP was prepared in 2003, and the contents were fully integrated in the agricultural sector development plan of the FNDP prepared in 2005, and then of the SNDP prepared in 2010. Therefore, the vision set up in NAP is as stated in the agricultural sector development plan of the FNDP, namely, "to promote development of an efficient, competitive and sustainable agricultural sector, which assures food security and increased income". This vision also strives to contribute to the overall goal of the PSRP, which was meant to achieve "poverty reduction and economic growth".

4) National Irrigation Policy (NAPolicy) 2004 - 2015

Since NAP is a broad policy paper of the agricultural sector, it consists of sub-sector policies including irrigation policy. The overall objective of the irrigation policy is to put in place a well-regulated and profitable irrigation sector that is attractive to both private investors and Zambia's development partners. Since this is a policy governing irrigation sub-sector, no numerical targets were set, but

provided sub-objectives under the overall objectives and also strategies to accelerate irrigation sub-sector development.

Under the overall objective, seven sub-objectives were set as; 1) accessible, demand-driven institutions characterized by efficient, transparent procedures and a service oriented ethos, 2) regulated, stable, transferable and mortgageable water rights, 3) transparent, well regulated irrigation resources, goods and services, 4) affordable, appropriate accessible credit mechanisms, 5) functional, expanded access and communications infrastructure, 6) Zambia's market chain adding value to irrigated produce, and 7) increased profitability of irrigated farming.

Generally, the sub-sector wise strategies to achieve these objectives include: 1) re-align services required for the production and marketing of irrigated produce, 2) promote an up-to-date agricultural water rights system, 3) promote adaptive commercial credit mechanisms appropriate for the needs of private investors in irrigation, 4) construct rural feeder roads in high irrigation potential areas, 5) improve telecommunication and other information services, 6) identify and remove market distortions while providing incentives for investment in added value opportunities, 7) ease government regulations on input costs, and 8) a review and revision of the existing water tariff structure.

5) National Irrigation Plan (NIP) 2006 – 2011 (5 years plan)

The aforementioned National Irrigation Policy has provided guidance to all levels and types of investment in irrigated agriculture. Based on this policy document, MACO started preparing National Irrigation Plan (NIP) which was in fact a part of the FNDP to specify costed strategic investments and activities required to initiate and operate a competitive and sustainable agricultural sector. The NIP was prepared in July 2005, running from 2006 to 2011, and categorized farmers in relation to irrigation type they would apply to as follows;

Table 2.4.1 Categories of Farmers Targeted in National Irrigation Plan 2006 – 2011 (5 years)

Category	Requirement
Peri-urban farmers	Requiring a basic package of irrigation tools and equipment (boreholes, irrigation schemes, pumps, pipes, drips, sprinklers, etc.) for growing cash and export crops in peri-urban areas at individual household level.
Outgrower farmers	Requiring basic package of irrigation tools and equipment (treadle pumps, sprinklers, drips, pipes, etc.) to grow cash and food crops, linked to an outgrower promoter in rural and peri-urban areas.
Smallholder farmers	**Requiring a basic irrigation package (watering canes, treadle pumps, rope and washer pumps, low pressure sprinklers, low cost drips, etc) to utilize water from *dambos*, rivers, streams, lakes and other water bodies for food and cash crops in rural areas;**
Large scale commercial farmers	Requiring a basic irrigation package (center pivots, self-moved systems, rain guns, fixed systems, etc) to produce cash, food and export crops; This component will cater for the proposed acquisition of irrigation equipment for large scale commercial farmers under Zambian National Farmers Union Taskforce. It will provide for a recoverable loan amount at concessional rate for access by such category of farmers.
Other private farmers	Requiring to establish medium to long-term large water transfer systems such as dams weirs, canals and pumps at individual farm level. This would also cater for medium and emergent farmers wishing to construct weirs, canals, pumps and piping required to harvest water from water bodies at individual farm level.
Manufacturers of irrigation equipment and tools	Wishing to expand or test new irrigation technology for import substitution and cost saving, but lack working capital. Such manufacturers could access this loan component of the IDF for investment in expanding capacity and for working capital to produce targeted amounts of irrigation equipment for sale to different categories of farmers.

Source: National Irrigation Plan 2006 - 2011

NIP's objective is to promote the use of irrigation to accelerate sustainable agriculture development. Toward this end, NIP specifies three key intervention areas; 1) finance and investment which encompass infrastructures development such as communal water supply systems and irrigation development fund, 2) policy and legal, and 3) institutional and social support.

Irrigation development fund (IDF), mentioned in the above first intervention area, was a proposal in the NIP by MACO in order to have farmers access to water for irrigation, though it has not been realized to date. MACO proposed that the IDF would be a source of capital for investment in

irrigation-related projects and acquisition of technology by farmers and industry operators falling in the aforementioned categories:

NIP further estimated costs required to develop irrigation schemes together with relevant capacity building, logistics, etc. in basically accordance with the aforementioned category. Table 2.4.2 summarizes the costs estimated in the NIP together with target areas;

i) The NIP intends to develop 70,000 ha as the total target area over 5 years period from 2006 – 2011, of which development of 30,000 ha is targeted for smallholder irrigation. These target areas are translated in an average of 14,000 ha per year and an average of 6,000 ha per year respectively.

ii) Required total direct cost estimated under IDF category arrives at US$ 113 million over 5 years, indicating US$ 22.6 million per annum. As for smallholder irrigation, US$ 31.25 million is to be required for the 5 years period, indicating an annual requirement of US$ 6.25 million.

iii) Investment cost per ha under IDF category is therefore estimated at US$ 1,615 per ha, while the unit cost for the smallholder irrigation only is US$ 1,042 per ha. These unit investment costs could fall in a relatively low cost irrigation development with reference to worldwide practices.

iv) Capacity building programmes are to require a total of US$ 19 million over the 5 years period, indicating US$ 3.8 million requirement per annum. Including this investment, total required cost over the 5 years period to develop the targeted 70,000 ha arrives at US$ 150 million, or US$ 30 million per annum. The unit investment cost per ha is estimated at US$ 2,143.

Table 2.4.2 Cost Required in National Irrigation Plan 2006 – 2011 (5 years)

Category	Target, Nr.	Unit ha	Total ha	US$	Cost per Year, US$	US$/ha
Irrigation Development Fund (IDF)						
Peri-urban irrigation	3,000	5	15,000	25,000,000	5,000,000	1,667
Outgrower schemes	5,000	1	5,000	20,833,333	4,166,667	4,167
Smallholder Irrigation	**60,000**	**1**	**30,000**	**31,250,000**	**6,250,000**	**1,042**
Large scale commercial and estates	100	50	5,000	10,416,667	2,083,333	2,083
Water harvesting	10	500	5,000	8,333,333	1,666,667	1,667
	500	20	10,000	6,770,833	1,354,167	677
Manufacturing	5			10,416,667	2,083,333	
Sub-total (1)			**70,000**	**113,020,833**	**22,604,167**	**1,615**
Infrastructure development (public fund)	3	NA	NA	18,000,000	3,600,000	
Sub total (2): (1) + Infrastructure development				131,020,833	26,204,167	
Capacity building of MACO extension				13,735,835	2,747,167	
Capacity building - farmer organizations				2,812,875	562,575	
Capacity building - outgrower promoters				115,200	23,040	
Strengthen irrigation - research capacity				1,836,000	367,200	
Capacity building - technology development and advisory - UNZA				480,000	96,000	
Sub-total (3)				18,979,910	3,795,982	
Total Investment Cost				**150,000,743**	**30,000,149**	**2,143**

Source: National Irrigation Plan 2006 - 2011

Unfortunately IDF has not been realized to date. Therefore irrigation development is now funded by Poverty Reduction Programme (PRP) fund (a kind of basket fund), donors' project specific funds, and government funds. Given limited fund assistance, irrigation development has been very slow, e.g. 3,885[14] ha developed in 2007, 384 ha only in 2008, and 2,325 ha in 2009[15]. Note is that these irrigated areas are said to have included large scale commercial areas, which were not supported by the Government.

[14] Development of 3,885 ha was presented to the Joint Assessment of Poverty Reduction Budget Support in 20008, however it was reported in 2009 Joint Assessment that out of 3,885 ha only 220 ha was newly brought in under irrigation.

[15] Source: Report on Progress under the Performance Assessment Framework for the period 2009-2011 for the June 2010 Joint Annual Review of Poverty Reduction Budget Support (PRBS).

2.5 Agricultural Development in Zambia

This sub-chapter discusses agriculture in Zambia in general, starting with presenting salient features of the agriculture sector, followed by crop production in Zambia where comparative study is carried out by province, and then by institutions in the sector. Also presented are projects relative to this Study such as Agriculture Support Program, Agricultural Development Support Project, Food Crop Diversification Project, etc. together with lessons learnt.

2.5.1 Salient Features of the Agriculture Sector

As of a total 75,261,200 ha of the national land of Zambia, 46.9 percent, 35,273,000 ha is categorized as arable land, of which 5,265,000 ha (7.0% of total land and 14.9% of the agricultural land) is seen as agricultural land. Of the total agricultural land of the country, 360,000 ha (6.8%) is estimated irrigable and actually only 155,912 ha (43% of the irrigable land) is under irrigation.

Table 2.5.1 Total Land Use in Zambia

Items	Area, ha	Percent (per total area)	Percent (per Arable land)
Total Area	75,261,200	100.0%	
Land Area	74,339,000	98.8%	
Arable Land	35,273,000	46.9%	
Agricultural land	5,265,000	7.0%	100.0%
Area Planted	2,057,513	2.7%	39.1%
Irrigation Potential	360,000	0.5%	6.8%
Land under Irrigation	155,912	0.2%	3.0%

Source:
Total area to arable land from the top: Agricultural Statistics Bulletin 1995/1996 (MACO 1997)
Irrigable and irrigated land: "CROPWAT Exercise Report for Zambia"
(The Centre for Environmental Economics and Policy in Africa)
Area Planted: CSO Data for planted area of 2009/10

In Zambia, land is divided into three zones based on the agro-ecological characteristics: zone I, II, and III. As shown in Table 2.5.2, Zone I shares 20% of the total land area of the country, where small grains are the major crops. Due to the limited rainfall (800mm on average), it is a risk prone area. Zone II, on the other hand, is blessed with better soil fertility and is characterized as commercialized area. Zone III covers the northern high rainfall area of the country including Luapula and Northern provinces, wherein 1,200mm or even more annual rainfall can be anticipated. However, soil is highly leached and acidic and therefore low in fertility.

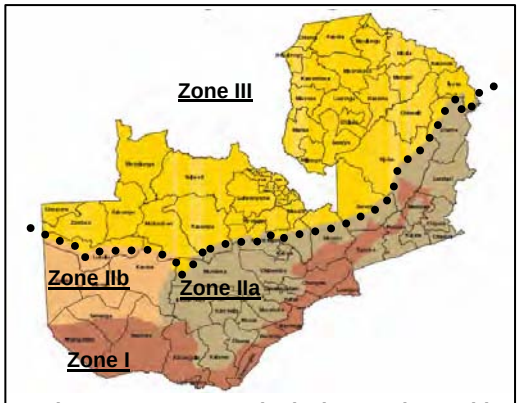


Figure 2.5.1 Agro-ecological Zones in Zambia
Source: Zambia Agricultural Research Institute

Table 2.5.2 Agro-ecological Zones

Zone	Area (%)	Characteristic
Zone I	20%	Dominated by small grain production such as sorghum and millet. Annual precipitation is averaged less than 800mm, which is highly unpredictable. Coupled with primitive farming practices using hand hoes, this zone is in a high risk of food insecurity.
Zone II	34%	Most commercialized area of the country with relatively fertile ferrous soil and an annual rainfall of between 800mm and 1,000mm. In addition to maize as the most common crop, cash crops including cotton, wheat, and soybean are also cultivated.
Zone III	46%	Blessed with the annual rainfall of 1,200mm or more, cassava, maize and finger millet dominate the area with subsistence basis. Crop production potential is low because of low soil fertility that is highly leached and acidic. The Study area is located in this Zone III.

Source: Ministry of Environment and Natural Resource, and Zambia Agricultural Research Institute (ZARI)

Based on the National Census 2000, it is projected that nearly 90% of the rural population, 65% of the total population, is engaged in agriculture. According to Living Conditions Monitoring Survey Report (2006), they are distinguished into three categories: small (less than 5 ha), medium (5 to 20 ha) and large (more than 20 ha) scales. As of 20005/06, small scale population shares 91.7% of the rural population and 96.2% of the total number of farmers. In addition to those categories, some farmers are also categorized in "out-growers" who practice farming based on the formal or informal contract with commercial producers.

Table 2.5.3 Rural Population in Zambia (2004)

Category	Population	Percentage (per rural pop.)	Percentage (per total no. of farmers)
Small scale (<5ha)	**6,980,935**	**91.7%**	**96.2%**
Medium scale (5-20ha)	267,991	3.5%	3.7%
Large scale (20ha<)	9,057	0.1%	0.1%
Farmers Total	7,257,983	95.3%	100.0%
Non-agriculture	354,489	4.7%	
Rural Population Total	7,612,472	100.0%	
Urban Population	4,098,751		
Zambia Total	11,711,223		

Source: Living Conditions Monitoring Survey Report (CSO 2006)
Note: Definition of scales is based on Agricultural Statistics Bulletin 1995/06 (MACO 1997)

2.5.2 Crop Production in Zambia and its Comparison by Province

Concerning the crop plantation and production in Zambia, maize is outstanding. As shown in Figure 2.5.2, planted area of maize reached as much as 1,242,268 ha, which account for 60.3% of the total planted area of the year 2009/10 in the country. As such, maize production stands out; in terms of the tonnage, it accounted 68.7% of the production. This result clearly suggests the importance of maize in this country. It is noted that cassava is also an important crop and becoming familiar crop ever before in this country. However, as it takes more than one year to grow, accurate statistic is rarely available.

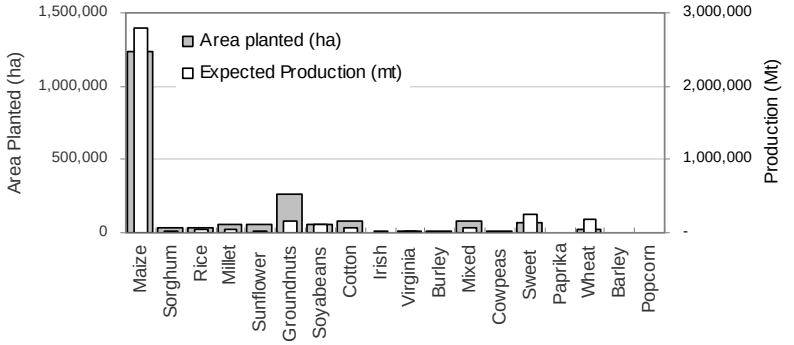


Figure 2.5.2 Planted Area and Production of Different Crops (2009/10)
Source: CSO Data on Planted area of 2009/10

Production of maize, the major staple food in Zambia, has increased nearly twice in the past decade: from 638,134 tons in 1998 to 1,211,566 tons (190%) in 2008. As shown in Figure 2.5.3, this increase is significantly supported by the growth in the area under maize production, which has also increased from 510,372 ha to 928,224 ha (182%) during the same period.

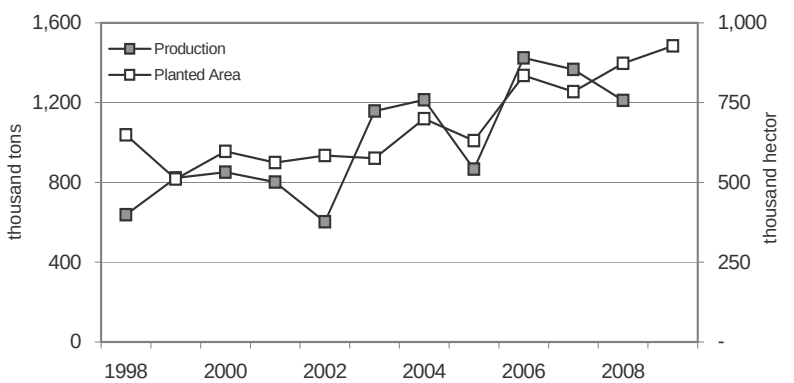
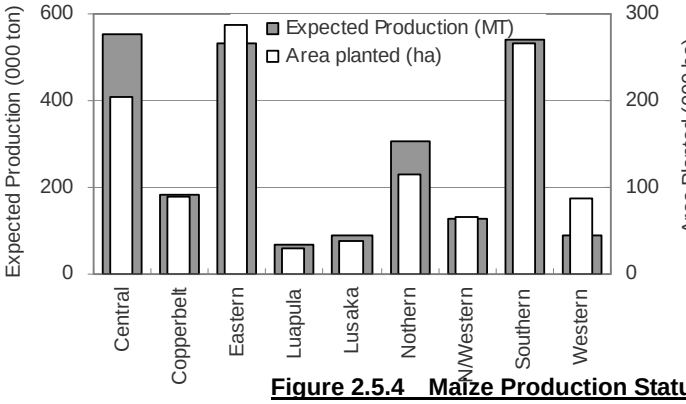


Figure 2.5.3 Maize Production in Zambia (1998-2008)
Source: TSB Northern Province (2009)

In terms of maize production, Central province was the largest province, producing 551,843 tons of maize in

2009/10. Second and third ranked were Southern and Eastern provinces: 541,507 and 531,810 tons respectively. These three provinces share 65% of the total production of maize in the country. Looking at the yield of maize, it has increased from 1.25 ton/ha in 1998 to 2.10 ton/ha in 2009/10, resulting in the 68% of increase during the 10 year-period, although the year 2009/10 is said to be a bumper year. In each province, Central province is the highest at 2.70 tons/ha, followed by Northern province at 2.68 tons/ha. The smallest yield can be found in Western province having 1.01 tons/ha, which is less than half of that of Central province.



Province	Area planted (ha)	Expected Production (MT)	Yield (MT/ha)
Central	204,490	551,843	2.70
Copperbelt	89,605	182,022	2.03
Eastern	286,811	531,810	1.85
Luapula	30,022	67,919	2.26
Lusaka	38,068	89,586	2.35
Nothern	114,129	306,216	2.68
N/Western	66,200	129,237	1.95
Southern	265,275	541,507	2.04
Western	87,948	88,804	1.01
Total	1,182,547	2,488,943	2.10

Figure 2.5.4 Maize Production Status in Each Province (2009/10)

Source: CSO (2009/10)

2.5.3 Staple Food Production and its Self-sufficiency

FAOSTAT, as of November 2010, provides food supply per capita by country. With reference to the data, Zambian population generally enjoys high level of food consumption per capita. As shown in Figure 2.5.5, maize supply per capita had marked more than 150 kg/capita since the 1960s. Although it declined to a level around 125kg/capita since the 1990s, maize consumption is still at a considerable level—it is supported by the fact that Zambia is almost a net exporting country during the 2000s. Instead of the decline in 1990s in maize supply, the supply of cassava has kept increasing since the mid 1970s. It increased from around 50kg/capita/year to more than 75kg/capita/year during the late 1980s.

Combining those two tendencies, the total supply of maize and cassava remained approximately 200 kg/capita for more than four decades. Considering the standard calories of both crops at around 365 kcal/100g, a total of 200kg/ capita/year of those consumptions is equivalent to 2,000 kcal/ capita/day.

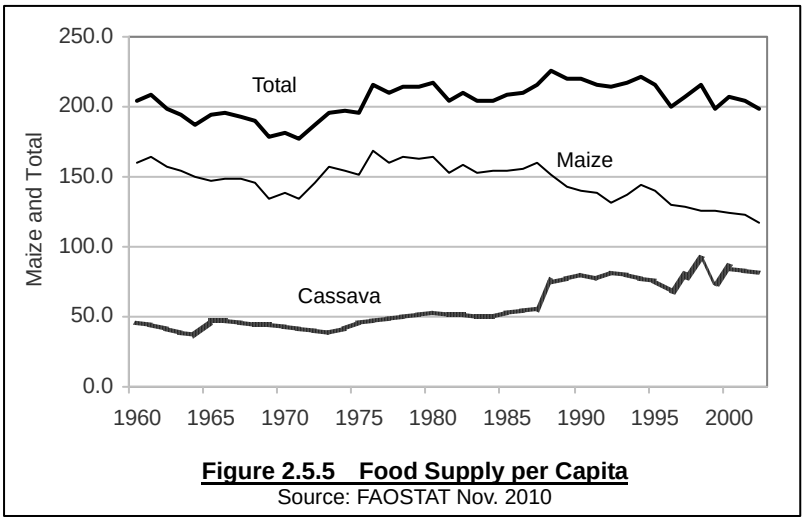


Figure 2.5.5 Food Supply per Capita

Source: FAOSTAT Nov. 2010

This condition can be interpreted in the following way: now that Zambians have already achieved the first goal of self sufficiency in calorie consumption, next stage is to pursue more balanced dietary life in which nutritional balance is more concerned.

2.5.4 Institutions in Agriculture Development

The Ministry of Agriculture and Cooperative (MACO) is the responsible agency in the agriculture sector of Zambia. As of the fiscal year 2008, MACO maintains a total of 11,412 positions, although not all the positions are fulfilled. In the organization, there are three technical departments; namely, agriculture, agribusiness and cooperatives. There were once department of fisheries and department of veterinary and livestock development. However, these departments went to a separate ministry named as the Ministry of Livestock and Fisheries Development in 2009. In addition, agricultural research institute and seed control and certification institute play a pivotal role in the sub sector of agricultural research.

In the department of agriculture, or DOA, there are three major branches: agricultural advisory service branch, crops production branch, and Technical Services Branch (TSB). In fact, crop production branch, or sometimes referred to as "crop husbandry branch," was once dissolved during the period of Structure Adjustment Program (SAP) in the 1990s. However, it reestablished as the said branch in 2009 as a part of reconstruction policy of MACO. Current structure of the DOA is shown in Figure 2.5.6.

At the provincial level, organizational structure reflects the one in the headquarters. As shown in Figure 2.5.7, all the related departments are under the authority of Provincial Agriculture Coordinator (PACO), who is designated by the Permanent Secretary (PS) of the ministry. As for the provincial DOA, Principal Agricultural Officer (PAO) takes charge and, under PAO, there are also three branches as in the headquarters.

Although crop production branch is restructured also at the province level, staffing yet to be completed and thus a limited number of staff, if not at all, is available as of 2010. At the district level, the same structure is replicated. Apart from PACO and PAO, there are District Agriculture Coordinator (DACO) and Senior Agriculture Officer (SAO). For most of practical coordination, provincial technical officers under each branch coordinate closely with SAO and district officers under the branch rather than coordinating through DACO.

Under the district level, there are special units defined specifically by MACO for its extension operation: block and camp. Block is in general composed of several camps. For example, average numbers of block are 3.8 in Northern province and 6.1 in Luapula province, ranging from two (Kaputa) to nine blocks (Kawambwa). The numbers of camps in each district, on the other hand, are 4.7 and 3.3 in Northern and Luapula provinces respectively. For those units, Block Extension Officer (BEO) and Camp Extension Officer (CEO) are respectively assigned. Thus, CEOs are the tail-end agents of MACO who deliver agricultural technologies to clientele farmers in the villages and then deliver the needs and feedback from the farmers.

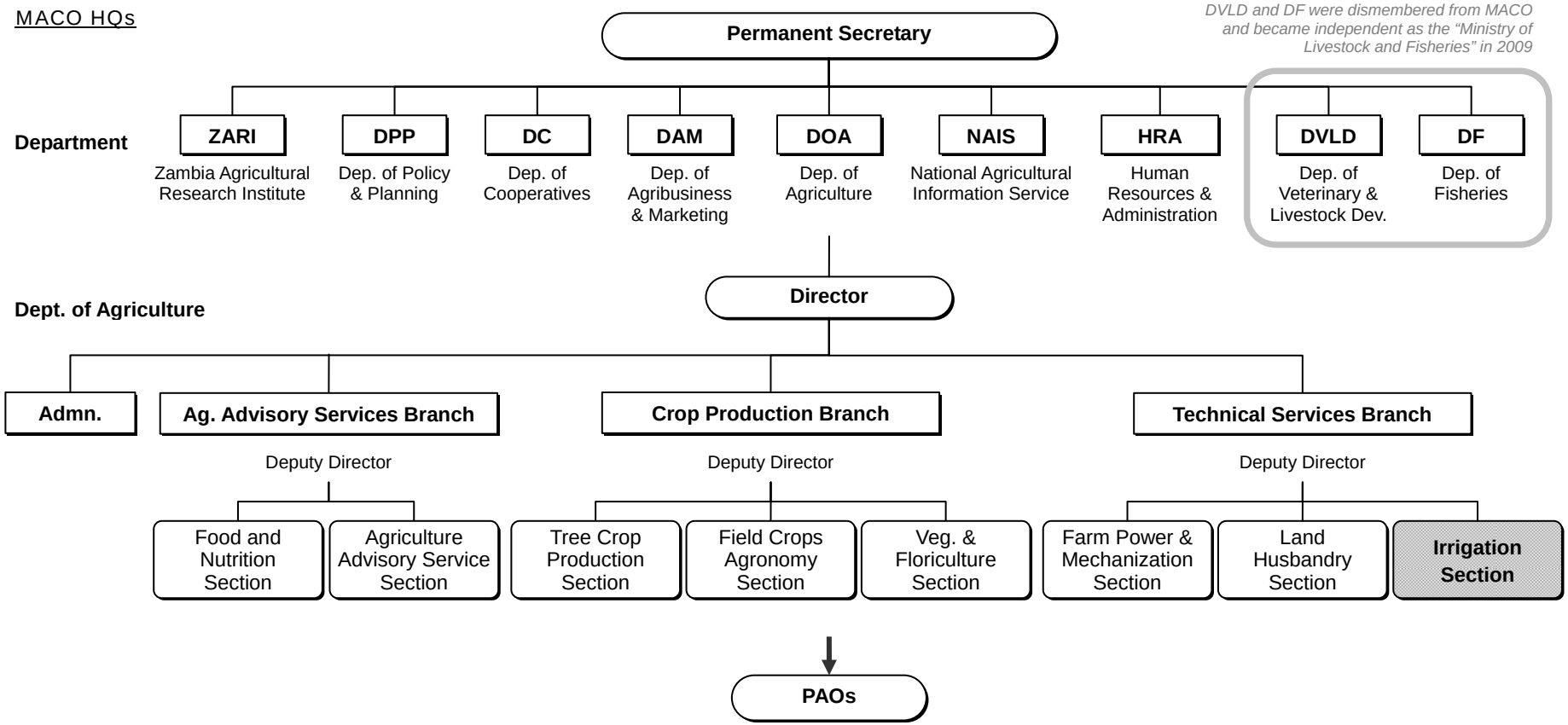


Figure 2.5.6 Organizational Structure of DOA

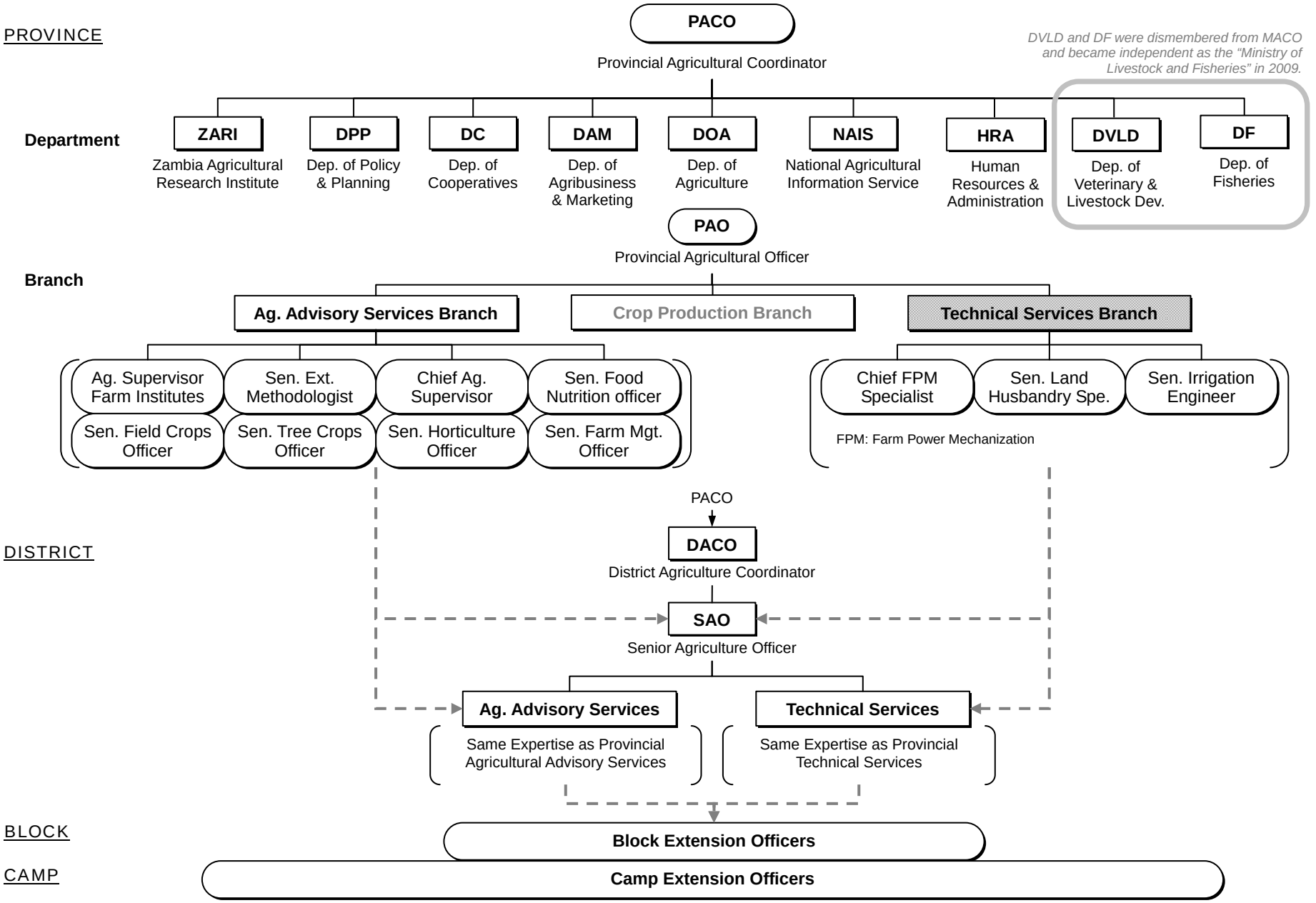


Figure 2.5.7 Organizational Structure of Provincial MACO

2.5.5 Past and On-going Projects in Agriculture Development

During 1980s and till late 1990s, not many agriculture projects were implemented, probably faced with the Structural Adjustment Programme. However, since late 1990s there has been number of projects implemented and being implemented in the agriculture sector of Zambia. Some of the projects have covered the Study area, and some are very much related to the Study. Following are brief descriptions of the projects related to this Study:

1) Agriculture Support Programme

Supported by Swedish International Development Cooperation Agency (SIDA), Agriculture Support Program (ASP) had been carried out in 2003-2008. The program was operated in a total of 242 camps in 22 districts of four provinces: Central, Southern, Eastern and Northern provinces. There were 2 districts, Mpika and Kasama, covered by the programme in Northern province. To improve food and nutritional security and to increase income through agriculture-related business, the program was implemented with a total of four components: 1) entrepreneurship building, 2) agriculture development, 3) infrastructure development, and 4) service delivery and outreach improvement.

The ASP promoted farming as a business rather than a mere means of sustenance, whereby a total of 44,000 smallholder farmers had been trained. To provide a series of technical trainings, infrastructure development, and resource mobilization, management unit and facilitation units were constituted. In the five-year operation, SEK 330,263,149, or US$ 43,326,269 (at 7.6227SEK/US$ as of July 22, 2009) had been spent, of which 49% was spent for the administration and management including mobilization of management unit and facilitation teams.

One of the unique features of the program was found in the management and funding system. Management unit at the central (Lusaka) provided technical, financial, and logistical supports directly to the facilitation teams on the ground which was composed of district coordinators, CEOs, and so-called “own facilitators” hired with the program budget. Through those facilitation teams, the above listed supports were provided to the form of interest groups rather than individual farmers.

Table 2.5.4 Outline of Agriculture Support Program (ASP)

Item	Description		
Name	Agriculture Support Program (ASP)		
Organization	Zambia: MACO/ Donor: SIDA		
Period	2003-2008	Budget	US$ 45 million
Target Area	A total of 242 camps in 20 districts in Central, Southern, Eastern and Northern provinces (In Northern, Mpika and Kasama were included)		
Objectives	1) Improve food and nutritional security 2) Increase income through sale of mainly agricultural and agricultural related products and services		

Source: Agriculture Support Programme, 2003-2008, End of Programme Report Draft

2) Agricultural Development Support Project

Agricultural Development Support Project (ADSP), funded by the WB, aims at improving smallholders’ access to markets and the competitiveness of their agricultural commodities. This project is now carried out over a period of 2006 – 2012. Adopting a value chain approach, the project focuses on high potential agricultural areas so that all levels of the chains are operating efficiently and increasing value added. To this end the project is promoting the development of a network of well functioning and competitive value chains and supporting the improvement of the public sector’s capacity.

The project components include 1) support to farmers and agribusiness enterprises, 2) institutional development, and 3) project management and coordination. The first component includes supply chain

credit facility that is to provide credit to agro-enterprises, traders and commercial farmers; matching grant, providing financial resources for innovating business on a matching basis; and development of rural road network. Pilot project of rural road development is being carried out in a total of three districts in Southern and Eastern provinces.

Institutional development component is focused on MACO's core functions such as data collection and analysis, policy analysis, monitoring and evaluation, dissemination of market information, and seed certification and control. The target groups include Department of Policy and Planning, Agricultural Marketing Information Center (AMIC), Seed Control and Certification Institute (SCCI), and Zambia Agricultural Research Centre (ZARI).

For the project implementation, the African Development Bank (AfDB) agreed to coordinate through its proposed Smallholder Agricultural Production and Marketing Support Project (SAPMSP); The World Bank finances to road construction, value chain strengthening, and a line of credit, while AfDB is supposed to address capacity building of farmer groups, provision of extension services and support to rural seed industry and livestock production.

Table 2.5.5 Outline of Agricultural Development Support Project (ADSP)

Item	Description		
Name	Agriculture Development Support Project (ADSP)		
Organization	Zambia: MACO/ Donor: The World Bank		
Period	2006-2012	Budget	US$ 40 million (US$37.2 million Granted)
Target Area	Whole Country (High potential areas of agriculture)		
Objectives	Improve smallholders' access to markets and the competitiveness of their agricultural commodities		

Source: Project Appraisal Document (The World Bank 2006)/ The World Bank's website

3) Food Crop Diversification Support Project for Enhancement of Food Security (FoDiS)

Food Crop Diversification Support Project for Enhancement of Food Security (FoDiS) is a technical cooperation project funded by JICA. Through capacity development of Zambia Agricultural Research Institute, it aims to diversify food crops in drought-prone areas that include Luapula, Southern, and Eastern provinces. By diversifying the crop production with cassava, sweet potato etc., it is expected to mitigate the risk in maize production that is largely influenced by climate change.

The project is composed of four components: 1) strengthening the propagation and distribution system for improved varieties of cassava and sweet potato; 2) identifying and production of drought-tolerant crops other than cassava and sweet potato; 3) accelerating the existing agricultural extension activities for the increased production of target crops; and 4) promoting the technologies on food processing, preservation, and other use of the food crops.

FoDiS is focusing on the improvement of research and extension functions of MACO in the drought prone areas. To this end, officers and researchers in ZARI are being trained on the matter of propagation of the target crops, while the extension officers at the district level are involved in the extension process of those improved varieties to the target farmers. One of the target provinces of the project, namely Luapula province, is also included in this Study.

Table 2.5.6 Outline of Food Crop Diversification Support Project for Enhancement of Food Security

Item	Description		
Name	Food Crop Diversification Support Project for Enhancement of Food Security in Zambia (FoDiS)		
Organization	Zambia: ZARI of MACO/ Donor: JICA		
Period	2006-2011	Budget	N/A
Target Area	ZARI's central and regional offices in Northwestern, Luapula, Southern, Eastern provinces		

Objectives	Diversify food crops in draught-prone areas in Zambia for mitigating too much dependence on maize

Source: Project outline (written in Japanese, FoDIS 2009)

4) Participatory Village Development in Isolated Areas (PaViDIA)

Participatory Village Development in Isolated Areas (PaViDIA) is a technical cooperation project funded by JICA. It had been implemented since 2002 and completed in 2009 right after the Study was started. After a while, the project was carried on as a new technical cooperation project of JICA called "Rural Extension Services Capacity Advancement Project (RESCAP)." PaViDIA's project objective was to reduce poverty by improving food security and by stimulating local economy in the isolated areas. To this end, it employed a participatory approach named "Participatory Approach to Sustainable Village Development (PASViD), by which ownership of villagers can be nurtured.

The project implemented a number of micro projects. The micro project was composed of three components: 1) provision of seed money for agricultural oriented income generation activities, 2) infrastructure development, 3) trainings on income generation activities. For the implementation of micro projects, seed money was provided at US$ 100 per household, as a prescribed amount, for a group of villagers.

To support the implementation process, MACO's existing organization structure was fully utilized; CEOs were the ones who actually help villagers prepare their proposals, formulate plans and implement the micro projects. By the end of 2008, a total of 62,640 villagers of 10,440 households in 87 villages in isolated areas had been benefited by the project.

Some of the target districts of the project, such as Mporokoso and Luwingu, are within the Study are. Also, provincial operation units, abbreviated by "POU," were established in Luapula and Northern provinces. Although irrigation development was not the main component of PaViDIA, target area was overlapping and it applied a similar extension mechanism to the Study. Thus, the Study's irrigation development can be a supplemental activity to the villages where micro projects were implemented.

Table 2.5.7 Outline of Participatory Village Development in Isolated Areas (PaViDIA)

Item	Description		
Name	Participatory Village Development in Isolated Areas (PaViDIA)		
Organization	Zambia: MACO/ Donor: JICA		
Period	Phase I: 2002-2007 Phase II: 2007-2009	Budget	US$ 6.2 million
Target Area	Villages located in isolated areas in the whole country including the pilot sites in Luapula province (1 district) and Northern province (2 districts)		
Objectives	Reduce poverty through food security and by invigorating local economy of the village communities in isolated areas		

Source: PaViDIA Implementation Guidelines (MACO-JICA 2007)/ PaViDIA website/
Pre-evaluation report, Japanese version (JICA 2002)

5) Rural Extension Services Capacity Advancement Project (RESCAP)

The project approach of PaViDIA had been carried on into the Rural Extension Services Capacity Advancement Project (RESCAP). RESCAP was started in December 2009 covering Northern and Western provinces. Applying the participatory development model developed though PaViDIA, RESCAP aims to improve the rural extension services of MACO. To this end, a series of micro projects are being carried out in the isolated areas of the two provinces with an active participation of MACO's extension officers and farmers on the ground.

Expected outputs are: 1) appropriate farming techniques are identified and disseminated thorough extension; 2) practical abilities of agricultural extension officers are improved; 3) monitoring and backstopping capacity of camp/block, district and provincial level are strengthened; and 4) MACO's

management capacity on extension service is improved.

As of November 2010, the project teams of RESCAP are already placed in MACO headquarters, Northern and Western province. In Northern province, it is expected that smallholder irrigation schemes promoted by this Study be incorporated in the project component of RESCAP where applicable, which may create a synergy effect in the development activities in the area.

Table 2.5.8 Outline of Rural Extension Services Capacity Advancement Project (RESCAP)

Item	Description		
Name	Rural Extension Services Capacity Advancement Project (RESCAP)		
Organization	Zambia: MACO/ Donor: JICA		
Period	2009-2014	Budget	US$ 6.585 million
Target Area	Northern and Western province		
Objectives	Rural extension services provided by MACO are improved by using PaViDIA approach (as an entry point) in target area.		

Source: One-page Profile of "RESCAP" Project officer at the HQs of MACO

6) Program for Luapula Agricultural and Rural Development (PLARD)

Program for Luapula Agricultural and Rural Development (PLARD) addresses the sub-sector of agricultural production, fisheries and aquaculture, and agribusinesses in Luapula province. To ensure increased income and food security in Luapula province, it has four components: 1) sustainable fisheries development; 2) agriculture development, 3) agribusiness development and 4) policy, regulation and institutions.

The direct beneficiaries of the program include the fishing communities and the "progressive" and "intermediate" producers and entrepreneurs. Then, poorer segments of the rural and urban communities are defined as indirect beneficiaries. PLARD places an emphasis on the planning stage so as to identify comparative advantages of the province at macro and micro level. The program also employs a sustainable livelihood approach (SLA), by which all the necessary capitals, such as human, social, natural, financial and physical capitals, can be harmonized for the sustainable development.

Also employed is the value chain analysis, by which potential and constraints in each segment of the value chain can be clearly understood and addressed. In its agriculture sub-sector, PLARD addresses the enhancement of access to seeds and planting materials, appropriate technology, and business development services as well as soil fertility improvement. As for the sustainable integrated production systems development, furthermore, integrated wetland production system is developed as pilot basis, which specifically seeks for the better use of *dambo* area.

Luapula province, the target province of this program, is completely included in the Study area of the JICA study. In addition, development of improved farming system in wetland may include the use of smallholder irrigation schemes to be developed under JICA study.

Table 2.5.9 Outline of Program for Luapula Agricultural and Rural Development (PLARD)

Item	Description		
Name	Program for Luapula Agricultural and Rural Development (PLARD)		
Organization	Zambia: MFNP/ Donor: Ministry of Foreign Affaires of Finland		
Period	2006-2010[1]	Budget	US$10.3 million (US$10.0M granted)
Target Area	Luapula province		
Objectives	Develop an efficient, competitive and sustainable agricultural and rural sector, which ensures increased income and food security for the people of Luapula province		

Source: PLARD Program Document (2007)

[1] PLARD stage II started in 2011 for a period of another 5 years.

7) Scaling Up Conservation Agriculture in Zambia

With a concern to a continued decline in agricultural productivity caused by in appropriate farming practices, the "Scaling up Conservation Agriculture in Zambia" was started in May 2009 by the partnership between MACO and FAO with support from the European Union (EU). This program aims to promote conservation agriculture in five provinces: Lusaka, Eastern, Southern, Central and Western provinces. Luapula and Northern provinces were reportedly added later in the year 2010.

Conservation agriculture (CA) promoted here is composed of three principles: 1) soil cover, particularly through the retention of crop residues on the soil surface; 2) using good profitable rotations with legumes, and 3) a minimum level of soil movement (reduced or zero). Particularly, maize, sunflower, velvet beans, cowpeas, and groundnuts are being promoted with a financial support by the EU.

The target of the program is to reach out a total of 58,000 farmers participating in conservation agriculture activities. To this end, intensified training is to be provided to 145 MACO extension officers and then 400,000 lead farmers. Also employed in the program is a voucher system by which fertilizer, seeds, herbicides, lime and agricultural equipments are being distributed.

To draw a synergy effect as well as to make a great use of existing development activities, the Study aims to integrate this approach into its operation approach. As a first step, a operation manual of conservation agriculture was prepared with Picture Description method.

Table 2.5.10 Outline of Scaling Up Conservation Agriculture in Zambia

Item	Description		
Name	Scaling Up Conservation Agriculture in Zambia		
Organization	Zambia: MACO/ Donor: FAO and European Union		
Period	2009-2011	Budget	EUR 7.5 million
Target Area	Lusaka (Chongwe), Eastern (Petauke, Katete, Chipata), Southern (Mazabuka, Monze, Choma and Kalomo), Central (Chibombo, Kapiri Mposhi and Mumbwa) and Western (Kaoma). Later, Luapula (Kawambwa, Mwense, Mansa, Chienge, Samfya) and Northern (Isoka) were added.		
Objectives	Develop an efficient, competitive and sustainable agricultural and rural sector, which ensures increased income and food security for the people of Luapula province		

Source: "Scaling Up Conservation Agriculture in Zambia "(FAO)

According to an interview to an extension officer in Mansa district, 20 camps were selected in the district. In each camp, two of Farmer Field School (FFS) are to be established where 28 lead farmers are invited for the intensive training, resulting in a total of 560 farmers in the district to be trained for the first year. In the following year, those lead farmers are expected to establish a demonstration plot where neighbor farmers can learn how to do it.

In the FFS, three types of crops, maize, legume, and deep rooted crop, are to be rotated in three lima of land. To support lead farmers to conduct demonstration, seeds and fertilizer are accordingly provided, while extension officers are entitled to receive 960,000ZMK/month. In the initial plan, this allowance was to be paid directly to the bank account of individual officers but, in Luapula province, it is being managed by MACO provincial office. Of the 960,000ZMK, about a half is for meal allowance and the other half is set for fuel and stationary.

2.5.6 Lessons Learnt from Past Experiences

Taking into consideration the experiences from the above projects/programmes, lessons and issues that have to be considered in this Study are presented below; these are 'Factors Limiting the Mobilization of CEOs', 'A Direct Funding to CEOs', 'Provision of "Handouts" Alone (a Case of Livestock)'.

1) Factors Limiting the Mobilization of CEOs

Outreach is always a big challenge for many agricultural projects or programme that internalizes the technology dissemination or service delivery to the remote areas. First of all, number of staff is chronically limited. Although, one CEO is registered in each camp in theory, in actuality, not all the camps are equipped with CEOs. According to some officers in Northern province, only 80% of camps are staffed with CEOs. Although number of CEOs is recently increasing, in those cases, extension network from the central to farmers is unfortunately disconnected, that is, no matter how useful the technical packages are, they may not be delivered to the users.

Donors are/were aware of that rationale and devised countermeasures. For example, due to the vacant in some of the target camps, the ASP had hired a total of 62 "own facilitator." These temporary staff reportedly helped complement the deficit and disseminated necessary technologies instead of CEOs. It might be an only countermeasure to tackle on the issues in the target villages but it might not help improve the substantial inadequacy of the extension system in the country; what will happen after the completion of the programme?

Second, mobilization of the CEOs was found as a significant constraint to the agricultural extension system in Zambia. As one CEO has to cover a wide range of area, about 20km square for an example of Northern province, they absolutely need any means of transportation. Therefore, to begin with, a number of programmes/projects had to provide a means of transportation not only for the supervisors at the provincial level but also to the CEOs concerned. In the case of the ASP, motorcycles were provided to the CEOs in the target camps and on average 20 litters of fuel per CEO per month had been supplied; mobilization of the tail end officers was such a big challenge.

Third, it was also mentioned that the qualification of officers was not always in line with what the project/programme was aiming to address. In general, a majority of CEOs studied general agriculture in agricultural college (diploma) or any agricultural courses (certificate) and thus they usually built their capacity on more practical aspect of farming technologies. Therefore, when introducing improved farming technologies or like, it would best suite to their background and thus higher performance can be expected. However, if dealing with more theoretical arrangements such as "farming as business" or non-farming issues such as processing and marketing, more time has to be secured.

In short, there are a number of negative factors against the mobilization of CEOs. Donors are therefore required to come up with some countermeasures to cope with those factors. In this regard, it is desirable to propose any alternative that can be functional with Zambian resources even after the withdrawal of the donors' assistances. In fact, since Zambia had reached HIPC completion point in 2000, debt release was put in effective, and further a basket fund, called Poverty Reduction Fund, became available in 2005 (for detail, refer to '4.4.5 Debt Relief and Development Fund Available from PRP'). To cope with above-mentioned issues, the government fund together with such basket fund should be fully utilized. Otherwise, more labor intensive extension works, by means of even walking and with bicycles, may have to be pursued with workable extension materials and means.

2) A Direct Funding to CEOs

As mentioned above, fuel cost is a critical factor that has a decisive influence to the extent of the extension service. The government has many times faced a difficulty in delivering the necessary cost for the full mobilization of CEOs on the ground. In addition to the lack of total funding, some CEOs claim that they are not always paid as expected because DACO, their supervisor at the district level, does not acknowledge the importance of CEOs' activities or put higher priority on them. As a result, very limited funding, if not at all, is often disbursed to cover the cost of CEOs' mobilization.

In this context, an ad hoc funding mechanism was attempted by the ASP in its target areas where some target districts of this Study are also included. To supplement the mobilization cost of CEOs, the ASP provided a set of funding directly to the CEOs in the target areas. To be direct, the ASP established a completely different funding mechanism in parallel with the government's recurrent funding mechanism. First, a project office was established at the central and then all the necessary budgets were disbursed directly to the CEOs of the target camps. It should be noted that DACO or SAO, supervisor of CEOs, was bypassed in this mechanism so that all the planned operation cost was directly delivered to the CEOs.

It was probably successful in delivering necessary funding, usually 20 to 30 litters a month, surely to the target CEOs, while it might have disturbed the regular interaction between DACO/SAO and CEOs. In this mechanism, DACO did not have much authority to administrate the CEOs. The problematic issue was that DACO and SAO did not have enough funding or did not receive any funding from the ASP for the fuel and thus faced some difficulties in supervising the CEOs. It might have been an ambitious attempt but did not have a concrete exit strategy; the government funding system was not harnessed through this attempt.

Nevertheless, mobilization of CEOs and BEOs is a vital factor in promoting a new technology such as smallholder irrigation and it can be a primary constraint since the coverage area of one CEO is relatively large: about 20km square. Considering the fact that the majority of the CEOs in the Study area do not have motorcycle, or sometimes even bicycle either, unless they received from PaViDIA or the ASP, present available government budget and the basket fund, PRP fund, should consider of strengthening the extension officers' mobility. In fact, the government should think of possible measures, apart from providing of motorcycles, including the distribution of bicycle and/or spare parts of grounded motorcycles rather than just distributing fuel to those who already have motorcycles.

3) Provision of "Handouts" Alone (a Case of Livestock)

Based on the team's observation and experience, livestock rearing does not seem to be as popular in the Study area as other neighboring countries. When asking about the possibility of making compost, a lot of farmers responded that they did not have any cattle, swine or goat to obtain manure. In such area, livestock rearing is sometimes promoted by donors and NGOs. In a case of World Vision, pigs were provided to each household in Mayanga village in Mbala district, Northern province. However, it turned out that a large number of villagers just abandoned the activity instead of grazing and multiplying them. Reportedly, major reasons include:

i) Sensitizing was not enough so that some villagers thought it was just a "present;"
ii) Villagers were not ready as they did not have any stall to keep;
iii) Pigs messed up their or neighbors' field crops;
iv) Pigs were stolen, and
v) Villagers were not familiar with the procedure of raising pigs.

Farmers in the Study area may not have enough knowledge, experience and necessary establishments for livestock rearing. Therefore, provision of domestic animals may not guarantee the improvement of their livelihood in a long run, or more simply, it may not be sustainable. To be sustainable, therefore, more close and continuous support is necessary from the very beginning of the programme: provision of technical assistance, explanatory workshop to the programme, selection of farmers who are willing to participate, and also technical and, if necessary financial assistance for the establishment of surrounding facilities. Adverse influence of "hand out" is also addressed by the ASP; it would influence the attitude of farmers and thus make it difficult for the introduction of self-help concept for the next occasion.

2.6 Irrigation Development in Zambia

Zambia has been affected by recurrent droughts during the last 20 years though it was to lesser extent for the two provinces under the Study area. Irrigation can alleviate the impact of drought, supplement rainfall to overcome uneven distribution of it within season, facilitate the extension of seasons at either end and also make agricultural production during dry season possible. This sub-chapter reviews the irrigation development in Zambia:

2.6.1 Salient Features of the Irrigation Sub-sector

Zambia has substantial irrigation potential, estimated in 1987 at 300,000 ha from surface waters and 60,000 ha from underground water resources, totaling 360,000 ha. Out of this potential, it is reported that a total area of 155,912 ha has been placed under irrigation till 2004 (see Table 2.6.1). It is composed of 32,189 ha for surface irrigation, 17,570 ha for sprinkler irrigation, 5,628 ha for localized irrigation and 100,525 ha for irrigated wetlands.

As is the above case, most of the irrigated lands, say 65% of the total irrigated area, are placed in lowlands called *dambos*. In general, most of the irrigation schemes in the lowlands are not capital intensive and is often spontaneous in origin. It can very often include diversion of stream water through furrows (small unlined canal), digging of shallow wells in the wetlands, use of buckets to irrigate crops, and use of seepage from earth dams for irrigation of small gardens downstream. Although the area covered by informal irrigation activities cannot be known exactly, the role from the viewpoint of household food security is quite high.

By source of irrigation water, only an area of 6,750 ha (4.3% of the irrigated area) is covered by groundwater while the rest of the irrigated area of 149,162 ha (95.7%) is with surface water. As for irrigation scheme by size, about 72% of the total irrigated area, 111,525 ha, falls under the category of small irrigation scheme, 5% (7,372 ha) under medium irrigation scheme, and the rest, 24% (37,015 ha) under large irrigation scheme.

Table 2.6.1 Estimates of Irrigated Lands in Zambia

Land under Agricultural Water Management	Area, ha	Remarks
Zambia	752,612 (sq.km)	
Arable land	352,730 (sq.km)	1/
Agricultural land	5,265,000	1/
Area planted	1,448,040	As of 2007/08, 2/
Irrigation potential	360,000	As of 1987, 3/
Land under irrigation	**155,912**	**4/**
Surface irrigation	32,189 (20.6%)	4/
Sprinkler irrigation (including center-pivot)	17,570 (11.3%)	4/
Localized irrigation (drip)	5,628 (3.6%)	4/
Developed lowlands (irrigated wet lands)	100,525 (64.5%)	Irrigation in *dambo* area, 4/
Land under irrigation by source of water		4/
Land area irrigated by groundwater	6,750 (4.3%)	4/
Land area irrigated by surface water	149,162 (95.7%)	4/
Irrigation schemes by size		4/
Total area of small irrigation schemes	111,525 (71.5%)	4/
Total area of medium irrigation schemes	7,372 (4.7%)	4/
Total area of large irrigation schemes	37,015 (23.7%)	4/
Flood recession cropping area	100	4/
Cultivated lowland	100,000	4/
Agricultural water managed area	256,012	4/

Source: 1/ Agricultural Statistics Bulletin 1995/96 (MACO, 1997), 2/ CSO Data for planted area of 2007/08, 3/ Smallholder Irrigation and Water Use Programme, FAO, 2004, 4/ Irrigation Policy and Strategy, September 2004

The small irrigation scheme includes both farmer constructed ones and government constructed ones, and in any case there is no longer government intervention in recurrent O&M. Irrigated wetlands,

consisting of 65% of total irrigated area, fall in almost all the cases under this category of irrigation. Medium schemes mean the irrigation schemes still operated and managed by the government as at 2004 (though those of the schemes had been already transferred to farmer organizations). Large scale irrigation schemes are mostly owned by large scale commercial farmers.

Aside from above areas, it is estimated that there is about 100ha for flood recession cropping area taking place around lakeshore areas and approximately another 100,000 ha for cultivated lowland (*dambos*), both of which can be said as water controlled cultivated area. Adding these areas, it is now estimated that the agriculture water managed area in Zambia is around 256,000 ha including the areas under irrigation.

It is said that the development of irrigation schemes in the above table can be divided into two periods according to the TSB at headquarters. As the first movement, irrigation schemes were developed by the Government throughout the Country in the 1970s and 1980s. Those schemes were established aiming at; 1) improving the livelihood of the local people, 2) increasing crop production, 3) helping displaced people, 4) earning foreign exchange by exporting cash crops. The Government established big infrastructure in these schemes. An example in the Study area back to this date is an irrigation scheme established so as to promote coffee growing.

The second movement of the irrigation development may be said to have started in late 1990s under RIF (Rural Investment Fund, the World Bank) and JSPRF (Justice and Solidarity for Poverty Reduction Fund, Catholic Fund). These projects did not necessarily target only irrigation development but also rural infrastructure. In fact, small-scale irrigation project was only a mere component of the projects, however number of small-scale irrigation projects had been developed under these funds. Those irrigation schemes are constructed with permanent structures like concrete/masonry diversion weir, earth/concrete dam reservoir and in cases pumping facilities, but categorized in small irrigation scheme.

2.6.2 Authorities in Irrigation Development

Department of Agriculture (DOA) is one of 7 departments under the Ministry of Agriculture and Cooperatives. DOA is mandated in agriculture development including irrigation in the country, under which there are three branches as 'Technical Services Branch (TSB)', 'Agriculture Advisory Services Branch' and 'Crop Production Branch'. TSB is further divided into 6 units including administration, of which 4 units are charged with technical operations as; 1) Irrigation Services, 2) Land Husbandry, 3) Farm Power and Mechanization (FPM), and 4) Technical Services Unit (see Figure 2.6.1).

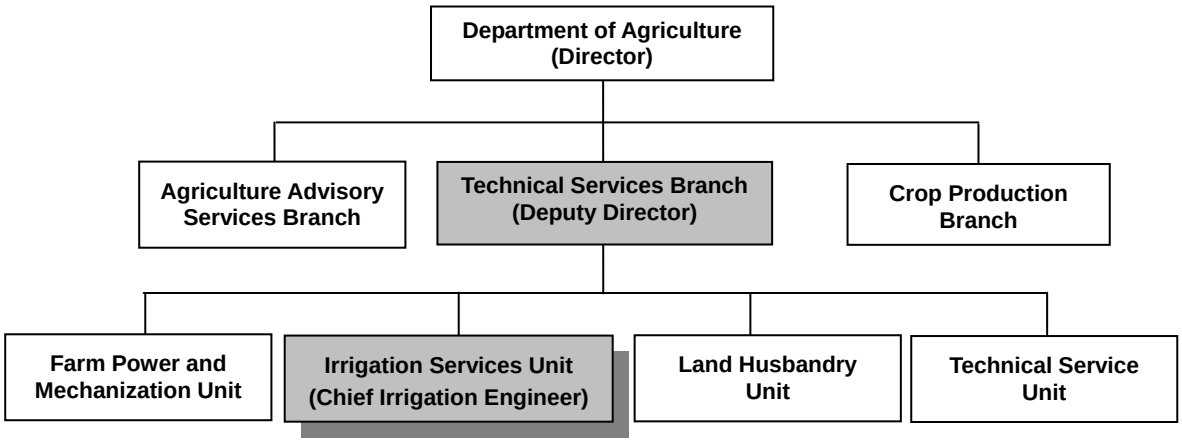


Figure 2.6.1 Establishment of DOA, and Its Branches and Units
Source: Ministry of Agriculture and Cooperatives

The TSB having the Irrigation Services Unit has been the principal government organization

responsible for the planning, development and management of irrigation schemes in the country. Through changes during Structural Adjustment Programme which was introduced in early 1990s, TSB had become a small organization involved in planning, designing, and construction of irrigation schemes. TSB once used to be engaged in operation and maintenance of the government managed irrigation schemes. However, by the time of late 1990s, all the irrigation schemes had been transferred to farmer organizations with assistance from FAO. In nowadays context, therefore, TSB does not engage itself in the operation and maintenance of irrigation schemes.

At provincial level, same structure is applied as the DOA headquarters; e.g. there is Technical Services Branch established, apart from Agricultural Advisory Services Branch and Crop Production Branch, all of which are under PAO (Principal Agricultural Officer). The TSB at provincial level does not have specified units unlike does the headquarters, but it is still mandated to cover such areas of irrigation, land husbandry, and farm power and mechanization. This structure is also applied at district level, but under SAO (Senior Agricultural Officer) in lieu of PAO.

Staff shortage, or vacancy against established register posts, has been a critical issue in the sector of irrigation development. Table 2.6.2 summarizes the staff establishment as compared to actually manned posts. As a surprise, there are only 2 officers in the Irrigation Service Unit at the TSB of DOA headquarters though the established posts according to registration should be 15 in total.

The situation at provincial level is more or less same or even worse in terms of the staffing. In case of Luapula province, there are only 3 officers in the TSB against 31 established posts while in Northern province only 3 officers against 41 registered posts. The TSB at provincial level should not be engaged only in irrigation but also in land husbandry and farm power and mechanization. It is therefore by nature there are vacancies of officers in one or two of the expertise in the provincial TSB. In most cases, however, irrigation officer with an educational background for irrigation engineering is posted.

As for district level as exampled for the Study area, the originally established posts are, as a matter of fact, very few, e.g. only 2 – posts per district in case of Northern province (data not available for Luapula province). Actually posted are almost as the established ones, and therefore typical TSB at district level is manned with only 2 – 3 technical staff. The TSB at district level should cover irrigation, FPM, and land husbandry, and their educational backgrounds are not necessary irrigation engineering but in most cases agriculture in general.

Table 2.6.2 Staff Establishment for TSB at HQs and Luapula and Northern Provinces, as of March 2011

Office	Established Posts	Actually Posted	Remarks
Department of Agriculture (Director)	1	1	
TSB (Deputy Director)	1	1	
Irrigation Service Unit			
Chief Irrigation Engineer		1	
Principal Irrigation Engineer	3	1	Hydraulics and Civil Structure
Senior Irrigation Engineer	2	-	
Chief Technical Officer	3	-	
Principal Technical Officer	1	-	
Senior Technical Officer	2	-	
Technical Officer	2	-	
Junior Technical Officer	2	-	
Total in Irrigation Service Unit	15	2	
TSB at Provincial Level			
Northern Province	41	5	Including Land Hus. and FPM
Luapula Province	31	4	Including Land Hus. and FPM
TSB at District Level			
Districts of Northern Province	30 (2.5/district)	34 (2.8/district), 1/	1/ Including some Junior Tech. Officer
Districts of Luapula Province	NA	14 (2.0/district)	

Source: Establishment Register for Ministries and Provinces to Support Estimate of Expenditure, 2008

2.6.3 Related Past and On-going Irrigation Project

Zambia had not much implemented irrigation projects in 1980s and 1990s, probably faced with financial difficulties which resulted in accepting Structural Adjustment Programme in 1991. In 1990s, there were assistances from FAO and from the Government of Japan (GOJ). FAO provided assistance in the strengthening of existing informal irrigation schemes and also in so-called irrigation management transfer, under which government managed irrigation schemes were to be transferred to established farmers organizations. GOJ provided a grant to construct a medium sized gravity irrigation scheme called Sefula scheme in Mongu district, Western province.

Then, on the onset of 2000s, an irrigation project was appraised by AfDB under the title of Small Scale Irrigation Project, major construction of which had completed as at the end of 2009[2]. Also in 2009, another irrigation project, called Irrigation Development Project, was appraised by the World Bank and the feasibility report is prepared as at December 2010. Apart from these donor funded projects, GRZ has carried out several small-scale projects by utilizing HIPC fund availed in 2004 and Poverty Reduction Programme (PRP) fund, a kind of common basket fund supported by 9 donors since year 2008.

1) Smallholder Irrigation and Water Use Programme[3] (SIWUP, FAO)

SIWUP became operational in December 1997 with the arrival of the first technical assistance staff from FAO. The project was extended to December 1999, and then to December 2001. The total project cost was US$ 968,000. The project had two major components; 1) reinforcement of informal irrigation (not government managed irrigation schemes), and 2) transfer of government irrigation schemes.

Under the first component, SIWUP rehabilitated three dams in Southern province (Siafwkwenda, Hagwanama and Mangwato) and two dams in Eastern province (Vuu and Mangwato). Six other dams were designed under SIWUP, two of which were rehabilitated by Department of Water Affairs. Four new dams were also built under SIWUP at Shantumbu, Mcheleka, Likwele and Kabwang located in Lusaka, Eastern, Southern and Central provinces respectively. These achievements were far below than the target of 30 new dams construction. The result was attributed to lack of capacity of TSB or otherwise target itself may have been too ambitious.

Under the component of transfer of government irrigation schemes, so-call IMT programme, it was planned to carry out complete feasibility studies for 14 government irrigation schemes, to develop criteria for the planning, design, and to implement rehabilitation of the schemes and then transfer the O&M to the farmer organizations established. By the end of the project, 8 government schemes were feasibility studied, of which only 4 schemes (Makungwa, Lukuzie, Vuu and Mwase in Eastern province) were rehabilitated and then transferred. The irrigated areas for the schemes are 5ha, 5ha, 8ha, and 5ha respectively. Under this component too, the target was not met due partly to limited capacity of TSB, delayed fund release which was to come from Rural Investment Fund, a government programme, etc.

2) Sefula Irrigation Scheme (GOJ's Grant Aid Project)

A feasibility study was completed in 1995 for development of Sefula river food plain for agricultural purposes. The river is located in Mongu district, Western province. Following the feasibility result, GOJ provided a grant to establish the Sefula irrigation scheme covering about 200 ha. The construction was completed in 1998, and commissioned with agro-processing facilities, marketing

[2] As at December 2010, the irrigation has yet to start due to delay of on-farm development, arrangement of operation and maintenance to be entrusted to an organization in charge, etc.

[3] Discussions here are based on 'Zambian Funds in Trust, Smallholder Irrigation and Water Use Programme, Project Findings and Recommendations, FAO, Rome 2004.

facilities and training facilities also covered under the grant.

There was a flood which caused damage on the main canal, which used to be the Sefula river itself. To repair the damaged parts of the canal, GOJ additionally provided with another grant of about US$ 100,000 in 2004. Also provided was a technical cooperation by JOCVs who promoted paddy cultivation, vegetable cultivation, irrigation engineering, rural development, etc. Activities concerning paddy cultivation included extension of quality seeds of paddy which are highly marketable, cooking method for rice to increase the consumption, post harvest technology, etc.

The operation and maintenance is on the hands of the farmers. There is the water user association responsible for the O&M of the scheme. However there are parts in the scheme where maintenance have been very minimal. For example, silting basin is almost always filled with sand originating in Kalahari dessert. The main canal branches off 8 secondary canals each to both sides. Though all the secondary canals are supposed to have flow stoppage at the entrances, none of them can be found[4]. This makes flow uncontrollable, making water management difficult especially during dry season.

3) Small Scale Irrigation Project (AfDB)

The project originally was to develop six schemes located in three districts namely Sinazongwe and Mazabuka in Southern province and Chongwe in Lusaka province. Though in Sinazongwe district, the project was to develop 4 sites in Gwembe valley, 2 projects such as Simupande and Sinazongwe were dropped out due to fund shortage. Of the 2 schemes left, Nzenga Fishing Camp was contracted with a civil contractor for the construction as of March 2011 and Buleya Malima scheme was completed in 2007.

In Mazabuka district, the project is now constructing Nega Nega Settlement B scheme for the out-growers with an average area of 5.0 ha. As of March 2011, the construction was completed almost 90%. In Chongwe district, the project is to develop Kanakantapa Settlement Scheme for smallholder farmers with an average landholding of 4.0 ha, which is under detail designing and tender documents preparation as at March 2011. Construction costs for these largest two schemes are MUS$ 5.7 for Nega Nega and MUS$ 4.2 for Kanakantapa, giving a unit development cost of about US$ 10,000 per ha and US$ 7,000 per ha respectively, relatively high construction cost.

Table 2.6.3 Salient Features of Small Scale Irrigation Project (AfDB funded)

District	Scheme	Type	C. Area, ha	Nr. of Farm HHs	Remarks
Sinazongwe	Simupande Village	Pump	112	200	Dropped
	Nzenga Fishing Camp	Pump	98	130	Fr. L Kariba
	Sinazongwe	Pump	89	200	Dropped
	Buleya Malima (rehab.&Enp.)	Pump	275	436	Fr. L. Kariba
Mazabuka	*Nega Nega Resettlement B*	Pump	550	164	MUS$ 5.7
Chongwe	Kanakantapa Settement	Dam+pump	620	483	MUS$ 4.2
Total			1,790	1,613	-

Source: Appraisal Report, Small Scale Irrigation Project, OCDS, AfDB, May 2000

Nega Nega Scheme was initially expected to start the operation from early 2010, and it is now expected in late 2011 due to delay of on-farm development and organizational matters with respect to O&M. The government will not be engaged in the O&M of the scheme as the current policy governs; government being only in charge of planning, designing, and construction but not in the management of scheme. The O&M in Nega Nega scheme will not be handed over to the farmers or farmer association, however. The O&M is to be entrusted to a private entity, and this arrangement takes time.

[4] Referred to in a field note (Japanese version), prepared by Mr. Masaki ITO, a member of preparatory mission of the Study, June 2007.

The government had carried out irrigation management transfer (IMT) in 1990s as aforementioned with FAO. However, the outcome was not as expected. The command area of Nega Nega scheme is about 600ha, quite larger than those schemes once undertaken by IMT, leading to the idea of involving private entity in the O&M. Farmers in the Nega Nega scheme will form an association with the main committee being the apex organ. This main committee will be in charge of supervising the experts of O&M dispatched by the private entity.

4) Irrigation Development and Support Project (WB)

As the project objective indicates, this project put a very emphasis on agricultural commercialization. The project is composed of three components; 1) irrigation development, 2) smallholder commercialization, and 3) project management. Major investment is in the irrigation development where the project is to finance the physical investment and construction to establish smallholder irrigation sub-projects including infrastructure of bulk water storage, irrigation water distribution, equipment such as pumps, sprinkler systems and distribution pipes, and supporting infrastructure, e.g. access road, electrification, etc.

Three irrigation development sub-projects are considered for implementation. These are Musakashi in Mufulira district of Copperbelt province, Mwomboshi in Chibombo district of Central province, and Lusitu in Siavonga district of Southern province. Pre-feasibility level survey was completed in February 2009. According to the survey result, the irrigation schemes are; dam + pump + gravity distribution for the first two schemes and the last one, Lusitu Scheme, is a pumping irrigation scheme directory from Zambezi river. These schemes will have 3 tires of beneficiaries i.e. small-scale farmers (Tier 1), emergent farmers (Tier 2)and professionally managing farmers (Tier 3).

As the feasibility study is to start from May 2011, accurate irrigable areas are not known as of March 2011. However, according to the pre-feasibility study which was completed in May 2011, potential area of the 3 sites will be around 5,350 ha. The budget to be financed was once planned at around U$ 35 million. Then, this amount was increased to as much as US$ 115 million including the construction of the 3 sites. Though the project cost for the 3 sites may vary greatly according to the result of feasibility study, the unit development cost per ha based on the pre-feasibility study can be estimated at a level of US$ 21,500 per ha. The likely unit development cost is quite high with reference to worldwide experiences.

5) Irrigation Scheme Construction by PRP Fund (GRZ)

Upon reaching the HIPC completion point in 2004, the government was relieved from the heavy burden of repaying loans and also became able to receive Poverty Reduction Programme fund, a sort of basket fund participated by 9 donors as of 2010. By utilizing this PRP fund, TSB has started constructing small-scale irrigation schemes by direct force account. Examples can be found both in Northern and Luapula provinces.

Chinenke irrigation scheme under rehabilitation of the diversion weir. The weir was re-constructed with concrete wall in 2009.

In Northern province, a gravity diversion scheme, called Mwashe Scheme, was constructed in 2008. The construction cost was ZMK 54 million (about US$ 10,000). The main facility is a concrete diversion weir with 24 m width and 2.2 m maximum height, and it is now providing irrigation water to 2 – 3 ha of farmlands though the potential irrigable area is around 5 ha. The reason why they

cannot expand the irrigable area is that the canal passes through a sandy area, causing a lot of seepage. The extension of the canal rests in the farmers, however de-motivated with this leakage the farmers would hardly do the extension work as at 2010.

In Mbala district of Northern province, Chinenke community based agricultural scheme is situated 12 km along the Mbala – Mpulungu road. The first funding which was under PRP was ZMK 158 million released in 2004. With this, a total of 1.2 km of canal was lined from the intake point. The second allocation was ZMK 234 million, and with this an additional 1.5 km of the canal was lined bringing the total to 2.7 km. The fund was released in 2007. Then, for the remaining stretch and improvement of the intake, a total of ZMK 250 million has been disbursed under the 2008 PRP budget. This covered the remaining 1.5 km canal lining and the whole canal measures 4.2 km long starting from the rehabilitated diversion weir. Altogether the canal irrigates total 65 ha of farm land as at end 2009. The construction of this scheme was carried out under direct force account which does not engage any contractor but by TSB officers with beneficiary farmers.

In Luapula province, there is a wet-masonry diversion weir scheme, called Kapako Irrigation Scheme in Kawambwa district. The diversion weir was constructed in May 2008, and unfortunately it could not stand against a flood taken place in November 2008, thereby right side of the weir collapsed down (see photo). In fact, the weir was a vertical type, whose height reached almost over 4 m at the deepest point of the stream, but the weir body was not supported by any buttress structure on the both sides. The construction cost was ZMK 110 million, and in 2009 another ZMK 130 million was allocated for the repair with which the scheme finally became operational. The total cost was therefore ZMK 240 million, equivalent to approximately US$ 48,000.

Kapaka diversion dam; right side of the weir body collapsed during a flood in late 2008.

There is a large man-made earth dam in Luapula province. The dam was constructed in 2005, and provides with irrigation water to Mansa Resettlement Scheme. The length of the dam body is 206m; maximum height is 6m; the embankment volume is about 5,000 cum; and the reservoir capacity is about 92,000 cum at the full supply level (see photo). Approximately 100 farmers had participated almost every day for 7 months to complete the dam, paid ZMK 6,000 each per day equivalent to official minimum wage as of the time.

Large man-made earth dam with the length of 206m and the maximum height of 6m. It stays irrigating only 2.5 ha as of 2010.

Total project cost of the dam construction was around ZMK 600 million, equivalent to US$ 134,000 with the exchange rate in 2005. On the other hand, command area remains only 2.5 ha as of 2010 due partly to seepage along the main canal though it was supposed to irrigate about 15 ha. Unit development cost therefore arrives at over US$ 50,000, too high investment per hector should the present irrigable area remain as it is.

2.6.4 Lessons Learnt from Past Experiences

Taking into consideration the past experiences, lessons and issues that have to be due considered in

this Study are presented below; these are 'technical capacity of TSB staff with few staffing', 'delay of counterpart fund release', 'not too be ambitious for irrigable area'. In addition, lessons that we can learn from irrigation projects in other African countries are also presented hereunder:

1) Technical Capacity of TSB with Few Staffing

SIWUP finished with low achievements against the planned targets. It is reported that SIWUP identified a lack of capacity of the TSB in designing dams, preparing specifications and tender documents, and supervising dam construction as a major weakness. In fact, a consultant was provided for a 6-month period during the first two years of the project, and an intensive in-service and on-the-job training programme was designed and implemented. Another one-month consultancy on dam design and construction was also provided during the third year of the project. To facilitate the TSB's operation, SIWUP also provided with manuals for the design, tendering and construction of dams.

Looking at Kapako Irrigation Scheme where right side of the diversion weir fell down, it could be said the designing did not meet the required standard. Such a diversion weir, with a height of over 4m at the deepest point, should have been supported by a number of buttresses. Combined with tight budget, it was not properly designed, leading to the collapse of the weir during a flood. Or, even if there was not enough budget in that year, step-wise construction by year should have been adopted, say, during first year construct the both sides of the weir only and during the second year finish the deepest part of the weir; the central part of the weir.

One may say that TSB's technical capacity, thus, may not be enough as to the required level. However, it is necessary to consider the staffing of TSB. During the period of SAP, the TSB had become smaller organ and in fact as of 2010, there are only 2 irrigation officers at the headquarters of TSB, only 2-4 technical staff at provincial level as well as only 2-3 technical staff at district. Further, those few technical staff at the provincial and district levels are not meant to provide their services only to irrigation but to land husbandry as well as farm power and mechanization activities, though major parts of the activities rest on irrigation.

Given this situation, without contracting out certain parts of the planning, designing, construction supervision, etc., TSB can hardly pursue their mandate. This is what we should recognize as a pre-condition in planning irrigation project in Zambia. Likewise, target and/or workload should not be set as ambitious especially in case that the TSB is to implement irrigation project by direct force account.

2) Delay of Fund Release

SIWUP reported that another factor for the low achievements against the targets was the delay in releasing of the fund, together with setting of low blanket cost limits for dam rehabilitation and construction of new dams. As a matter of fact, the fund availed for SIWUP from FAO was around US$ 1 million, which seemed not enough to cover all the planned components to be completed. Therefore, the project was directed to utilize Rural Investment Fund (RIF), an IDA funded programme.

Procurement under RIF was decentralized at regional level to facilitate rural construction works, however there were often delays for releasing the fund due partly to financial management capacity for the regional staff. Absence of contractors in rural areas further delayed the commencement of rehabilitation and new construction of dams. Also US$ 30,000 procurement limit set by IDA for the projects had been proved inadequate for the construction of dams, as most of the dam projects under

SIWUP had been more expensive[5]. With these issues, SIWUP achievement remained that level.

Delay of fund release was also found in one of the irrigation construction projects under Small-scale Irrigation Project; Nega Nega Resettlement Scheme, which was under construction as of march 2011. The project was to receive 20% of the cost from the government as counterpart fund. Coupled with a lot of reviews for the design especially on the pumping station, this delay of counterpart fund release was affecting the level of payment to the contractor[6].

Delay of fund release can also be found in PRP funded projects, which are carried out by direct force account. There are 10 irrigation projects authorized under the budget of year 2009, of which two projects are located in Northern province and another two in Luapula province[7]. Authorized budgets are ZMK 3 billion for Lukulu North Irrigation Scheme (Kasama, Northern P.), ZMK 600 million for Chinenke Irrigation Scheme (Mbala, Northern P.), ZMK 130 million for Kapako Irrigation Scheme (Kawambwa, Luapula P.), and ZMK 250 million for Mulumbi Irrigation Scheme (Mansa, Luapula P.).

As for the above projects, as at end July 2009, no fund had arrived yet, and then lastly after August – September the Lukulu North Irrigation Scheme had received ZMK 1.9 billon, Chinenke scheme did ZMK 250 million, Kapako scheme received ZMK 100 million and Mulumbi Scheme received all the allocated amount of ZMK 250 million. The fund release was delayed and also 3 schemes out of the 4 had received not all the allocated amounts. Taking into account dry season finishing October, the fund should have been released earlier.

Construction for irrigation facilities can only be done during dry season starting from April and ending in October. In fact, irrigation projects funded by AfDB and WB need over one year construction period taking into account the project size, for which year basis disbursement is programmed. However, whenever project size is such that it can be finished in half a year period, it should be completed within that period; otherwise additional cost will incur for demobilization and mobilization. To this end, it is due needed to release fund as early as possible once dry season starts.

3) Not-Too-Be-Ambitious for Irrigable Area

One of the issues in smallholder irrigation development in Zambia is actually irrigated area much smaller than those of originally planned or those of potentially expected. Table 2.6.4 summarizes the number of small scale irrigation schemes, total areas irrigated presently by those schemes, total potential irrigable areas, those comparison in percentage between the two areas, and average irrigated area per scheme.

Table 2.6.4 Summary of Existing Small Scale Irrigation Schemes in Zambia

Province	Nr. of Schemes	Currently Irrigated Area, ha	Potential Irrigable Area, ha	%	Currently Irrigated Area per Scheme
Northern	**10**	**142**	**1,020**	**14**	14.2
Luapula	**12**	**102**	**1,130**	**9**	8.5
Copperbelt	10	130	1,140	11	13.0
Northern Western	20	196	1,760	11	9.8
Central	8	575	1,230	47	71.9
Eastern	10	109	980	11	10.9
Western	3	52	250	21	17.3
Lusaka	20	259	1,250	21	13.0
Southern	7	85	143	59	12.1
Total/ Average	**78**	**1,406**	**6,753**	**21**	**18.0**

Source: Brief Report of An Inventory of Irrigation Schemes in Zambia for Possible Inclusion in the ADB Poject, August 2003, Irrigation Engineering Section, TSB

[5] Source: Appraisal report Small Scale Irrigation Project (SIP), Country Department, South Region, ADB, OCDS May 2000.
[6] Source: Fourth Quarter Report (October-December, 2008), Small Scale Irrigation Project (SIP), MACO
[7] Source: Estimates of Revenue & Expenditure (Activity Based Budget) for the year 1st January 2009 to 31st December 2009.

From the table, it is learned that currently irrigated area covers only 21 % of what is defined as potential irrigable area as average; namely, total 1,406 ha actually irrigated by 78 schemes vs. as much as 6,753 ha in total potential area. Another finding is the small irrigated area itself, as is called small-scale. Average irrigated area per scheme by province ranges from as small as 8 ha to 72 ha and most of the averaged irrigated areas fall below 20 ha per scheme. There may be several reasons why the current irrigable areas are so small than what are expected; e.g. 1) dilapidated facilities, 2) limited water resources not enough to extend irrigated areas, 3) water management not compatible to fairly distribute irrigation water down to the tail of the schemes, etc.

One thing that has to be mentioned in relation to above situation may be associated with land distribution in Zambia. Land, either it is farm land actually cultivated or just fallowed, per household in Zambia is relatively very large as compared to those of other countries, due partly to low population density. There are lots of rural households who own more than 10 ha each or even more than 50 ha of land. Rural population under traditional authority states that they have at least more than 5 ha of land in most cases, despite being uncultivated.

In addition, resettlement programmes[8] are put in place in Zambia where an area of land is allocated according to what the applicant is to intend. According to the guidelines prepared by MACO, if the land was opened for irrigation purposes, a piece of land ranging from 5 – 20 ha is to be distributed per applicant, and in case of arable land it is to be from 30 – 100 ha, and if it is for ranching purpose one applicant could get 50 to as much as 250 ha. In fact, without farm machineries, one household can hardly cultivate more than 2 ha in most cases. Therefore even the 5 ha, proposed as the minimum area in the guideline for irrigated farmland distribution, is so big as farmland that one can cultivate.

If the applicant cannot manage the distributed area, the MACO has a mandate to get it back and further divides into pieces and then redistributes to new comers. With this arrangement previously allocated lands have further been divided into smaller areas and then redistributed to new applicants. Likewise, from the beginning, an area less than 5 ha is now often distributed per applicant. However still average area owned by a typical household is large as compared to other countries. From the irrigation development point of view, this situation tends to involve fewer irrigation beneficiaries per scheme, and thereby smaller areas to be irrigated provided that they do not have agriculture machineries, as does the case in most of Zambia. To design irrigable area, therefore, should not be too much ambitious.

4) Lessons from Irrigation Projects in Other African Countries

In Africa, to a larger extent, there are many irrigation facilities having been constructed by governments, donors, and so on. Lessons from these schemes could be utilized as a guide for the Study as summarized in the following table:

Table 2.6.5 Summary and Lessons from Existing Irrigation Projects in African Countries

Project	Summary & Lessons
Lower Moshi Irrigation Scheme in Tanzania (Loan, Technical	Summary: The scheme started as an irrigation development project, which covered 1,100ha of paddy field & 1,200ha of farm upland, by Japanese loan. Since then, the Japanese Government supported the scheme for more than 20 years; e.g. technical cooperation project for rice cultivation and water management and grant of agricultural machines by KR2. After that, the yield of rice in

[8] There are two resettlement schemes in Zambia; one is administered by the Vice President Office and the other by MACO. Vice President Office carries out Land Resettlement Scheme for which one applicant can be granted a land ranging from 10 to 50 ha, and prevalent practice is around 20 ha distribution per applicant. MACO is mandated with another resettlement scheme carried out under Farm Block arrangement. It is to provide, according to guidelines, 5-20 ha of land per applicant meant for irrigation, 30-100 ha for arable purposes, and 50-250 ha for ranching purpose. However, the figures of minimum sides are indication and not a 'must'. MACO nowadays distributes smaller areas than those specified in the guidelines as many applicants show up nowadays and also MACO has found out many cases that the farmers had not been able to manage the distributed lands.

Project	Summary & Lessons
Cooperation and KR2 of Japan） Large Scale (2,300ha)	Lower Moshi area has increased more than three times, which is almost same as that of Asian countries. Lessons: Nowadays, the Japanese Government has been supporting Kilimanjaro Agricultural Training Centre (KATC) to extend the result of the Lower Moshi to other areas including neighboring countries. The centre works as a regional rice cultivation training centre by inviting and training farmers from other countries. The scheme has been successful in improvement of rice production and technical extension. Concerning the initial cost, however, it was huge as much as 2 million Japanese Yen per hectare. That is, the cost effectiveness would have been low if the cooperation had ended right after the loan aid. It seems that the subsequent continuous technical cooperation played an important role.
Mwea Irrigation Scheme in Kenya (Grant Aid, Technical Cooperation and KR2 of Japan) Large Scale (9,200ha)	Summary: The irrigation scheme was firstly opened during colonial era, during which paddy cultivation was introduced. Then, to improve the paddy cultivation in the irrigation scheme, Japanese grant aid, technical cooperation project etc. have been implemented since 1986. It covers 9,200ha of paddy field and 4,600 farmers as of 2006/07, and produces 60,000 tons of rice that accounts for 80% of the production in the country. Lessons: In technical term, the achievement of the scheme is similar to that of the Lower Moshi scheme. However, it has some problems that farmers did not have land title but worked as labors. National Irrigation Board (NIB) managed facilities and supplied inputs, e.g. seeds and fertilizer etc., to farmers while the farmers were obliged to sell all of the harvests to NIB at low price. The farmers have risen in rebellion against it in the early 2000s. Nowadays the farmers are allowed to sell the products through cooperative. Though the technical achievement was good, the technical cooperation provided till then may have been questionable since assistance only in technical term was conducted without any institutional improvement.
Bwanje Valley Irrigation Scheme in Malawi (Grant Aid, JOCV and Experts of Japan) Medium Scale (800ha)	Summary: It is a gravity irrigation scheme constructed in 2000, which covers about 800ha. At the beginning, the Japanese Government constructed only the construction of intake weir and canals while the Malawian Government was supposed to reclaim the farmlands. However, the reclamation of the paddy field was not implemented smoothly because the Government could not allocate the necessary budget. Moreover, a flood at over 200 years return period took place, which damaged apron of the diversion weir and also washed away a part of the main canal at the left bank in February 2003. After that, an additional grant work from Japan was carried out in remedy works, replacement of the canal stretch, land reclamation, etc. Given technical cooperation from a Japanese paddy expert and Japan Overseas Cooperation Volunteers (JOCV), and also with intensive deployment of extension officers, the yield finally reached as high as 4.8 ton/ha. Lessons: Though it was agreed that the Malawian Government undertake the reclamation of farmland, it was not considered well that the Government did not have own development budget enough to reclaim. In addition, rainfall intensity in African countries is generally high though annual rainfall itself is not much, causing increase of flood peak. Therefore, necessary measures should have been taken in the development of irrigation schemes where accurate hydrological data exists (e.g. construct the canals away from the river, etc.).
SiGuiCod Irrigation Scheme in Guinea (France and China) Medium Scale (800ha)	Summary: The irrigation scheme covers 800ha of paddy field. It was constructed by grant aid of the French Government and maintained by the Guinean Government. However, a Chinese private company purchased the operation right since it was not well maintained by the Guinean Government. Since then, a Chinese rice research institute has supported technically and developed new varieties while the private company has grown the developed varieties and sold the harvest. The new varieties have been supplied to farmers through extension staff in all parts of the country. Lessons: The project employs about 1,000 farmers for rice cultivation and transferred the technique to them. Moreover, the combination of a private company, which manages the irrigation scheme and sells the rice, and Chinese Government, which conducts the technical cooperation, is interesting.
Small Scale Irrigation Development Programme in Kenya (Grant Aid of Holland) Small/Medium Scale (5-100ha)	Summary: They are small scale irrigation schemes covering 5 to 100ha per farmland, which were constructed by Grant Aid of Holland in 1980s. It adopts gravity irrigation from small rivers, which flow down to the Lake Victoria in western area of Kenya. The operation and maintenance of the facilities have been done by farmer associations while the ownership of the irrigation facilities is under the Kenyan Government. Lessons: It has been operated and maintained by the farmers while there have been some problems in maintenance, dredging of sediments in canals, etc. However, the performance of the project is generally high, since it is small gravity irrigation scheme that does not need high cost for operation and maintenance. Though there are some areas to improve, e.g. seed selection, transplanting, fertilization etc., 12 advanced farmers, who participated in training of KATC in 2003, have been extending improved paddy cultivation practices to other farmers.
Smallholder Irrigation Scheme in Malawi (Technical Cooperation and Pilot Project, Experts, Japan)	Summary: It is a development study carried out in 2002 - 2004 inclusive of implementation of pilot projects. The irrigated area per scheme is in most cases less than 2 ha, which is in fact of micro-scale rather than small-scale. The main facility, the diversion weir, is constructed by locally available materials. It does not require foreign inputs, like cement and iron bars, but only locally available materials such as timber, tree branch, leaves, bamboo, clay soil, etc., to construct the diversion weirs. By the end of the pilot project implementation, such temporary diversion weir was constructed at as many as 287 sites and another 2,264 sites had been constructed till the end of

Project	Summary & Lessons
Small (Micro) Scale (Less than 2 ha)	2009 during the follow up technical cooperation project period. Lessons: The diversion weir, which is constructed out of locally available materials, was not welcomed by the Malawian Government when the study started. However, it was constructed at as many as 287 sites, which covered 351ha and 6,000 farmers in total, and finally the JICA Study team received address of thanks such that "The irrigation has become a culture and the idea was implanted in the Malawian blood". Furthermore, extension staff became voluntarily promoters of the smallholder irrigation. The extension staff became proud of their activities, resulting in 287 sites during the study and another 2,264 sites for the follow-up cooperation period.

As summarized in the table above, one may say large scale irrigation schemes were successful only when they have received continuous supports from outsider for long time. Medium scale schemes, one may again say, may not be successful unless there are donor supports. Therefore, it could be said that the sustainability of operation and maintenance is generally low in large and medium scale irrigation schemes taking into consideration technical and financial difficulties of the host countries.

In case of small scale gravity irrigation, however, they have been generally well operated and maintained. Especially the irrigation schemes having temporary weirs in Malawi brought technical innovation in social term, even though the applied technology in engineering sense was primitive. Furthermore, these temporary weirs can be easily upgraded to permanent weirs made of, e.g., wet masonry and concrete. This Study is to undertake smallholder irrigation by temporary weir and permanent weir either by upgrading from temporary weir, by rehabilitation of existing ones or otherwise even by new construction. The scale of these schemes are all small, examples of which have entailed comparative sustainability according to experiences in African countries.

CHAPTER 3 THE STUDY AREA

This chapter elaborates the Study area from different angles such as; spatial alignment, topography, demography, climate and water resources, rural society, agriculture and irrigation, extension structure and relevant projects implemented and on-going in the Study area.

3.1 Spatial Alignment and the Topography

The Study area encompasses two provinces; Northern and Luapula provinces. It extends between the longitudes of 28 degrees 25 minutes West and 33 degrees 40 minutes East (about 586km stretch), and latitudes of 8 degrees 15 minutes North and 13 degree 30 minutes South (about 579km stretch). Of the two provinces, Northern province occupies most of the central part and the whole eastern part of the Study area, e.g. between the longitudes of 29 degrees 10 minutes West and 33 degrees 40 minutes East, and latitudes of 8 degrees 15 minutes North and 13 degrees 30 minutes South. Luapula province on the other hand lies in the western part of the Study area between the longitudes of 28 degrees 25 minutes West and 30 degree 30 minutes East and between the latitudes of 8 degrees 20 minutes North and 12 degrees 30 minutes South.

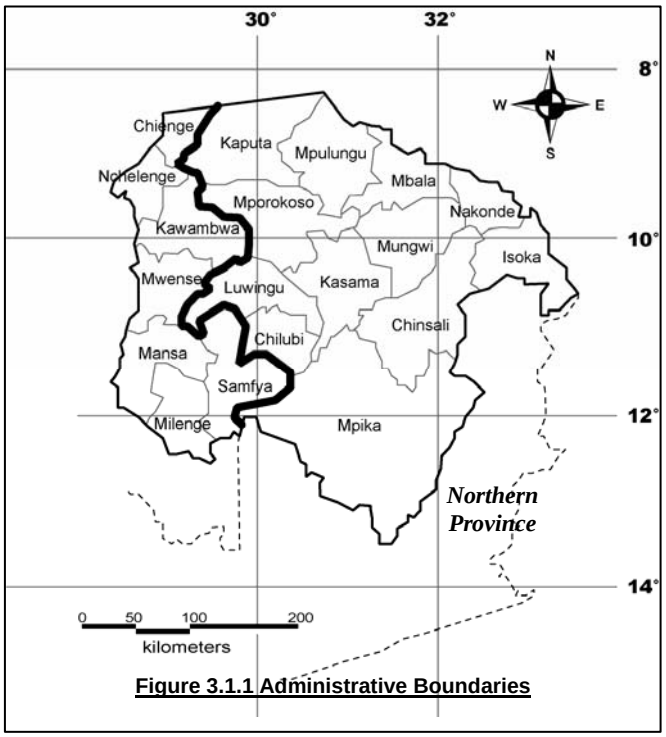


Figure 3.1.1 Administrative Boundaries

Northern province is the largest province in Zambia occupying about 20% of Zambia, while Luapula does only 7%. Northern province is composed of 12 districts while Luapula province is made up of 7 districts. The administrative boundaries are shown in the Figure 3.1.1. A typical district in the Study area extends over an area of about 10,000 sq.km as the average, equivalent to about 100 km square. However the area by district varies widely, e.g. from the smallest of 3,965 sq.km of Chienge district in Luapula province to the biggest of 40,935 sq.km of Mpika district in Northern province. Here there is as much as 10 times difference.

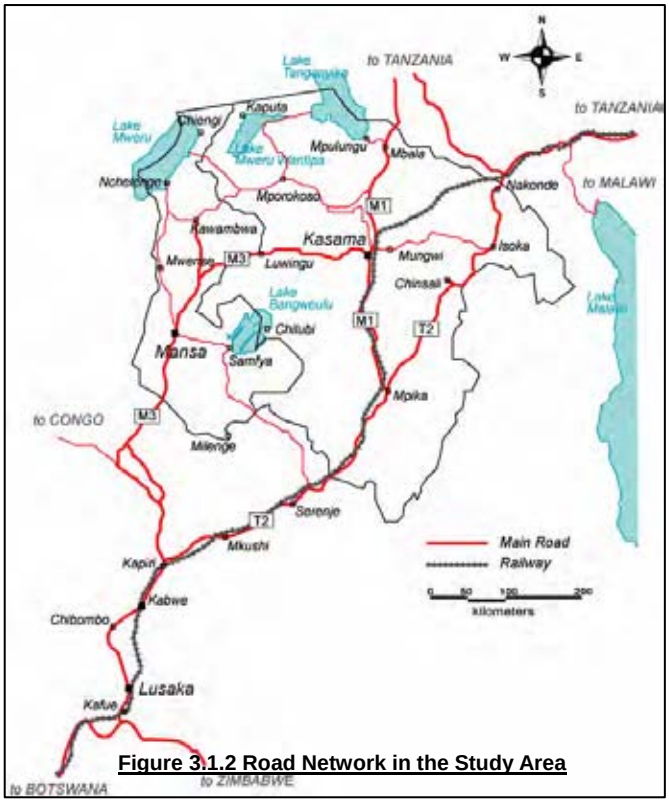


Figure 3.1.2 Road Network in the Study Area

Road network has been developed over the Study area, however the density is not yet enough to facilitate economic activities. There is an international road, T2, going for Tanzania via Nakonde. This road runs along the southern peripheral of the Study area.

Apart from the international road, M1 can be a major one connecting Mpika and Mbala, or connecting the southern part of the Study area and northern tip of the Study area, and then going to Tanzania. This road facilitates the mobility of the Study area between the northern part and southern part of the Study area via Kasama. Road M3 starts at Kasama towards westwards, and joins a major road coming from Kawanbwa, a northern district in Luapula province. The M3 further extends towards southwestern direction via Mansa, going into DRC and then back to Zambia. Though there is a railroad in the Study area, which goes to Tanzania, very few people utilize it.

The highest elevation in the Study area shows up at Mafinga mountain bordering to Malawi with an elevation of 2,164 m, followed by the peak of Mubala highlands with an elevation of 2,067m. Lowest elevation is corresponding to the surfaces of lakes in northern tip of the Study area, e.g. Tanganyika, Mweru Wantipa, and Mweru. These elevations of the lake surfaces are around 1,020m. Within the altitudes, the topography varies depending upon the location though most of the areas are set in plateau and highlands with elevations of 1,200 – 1,500m.

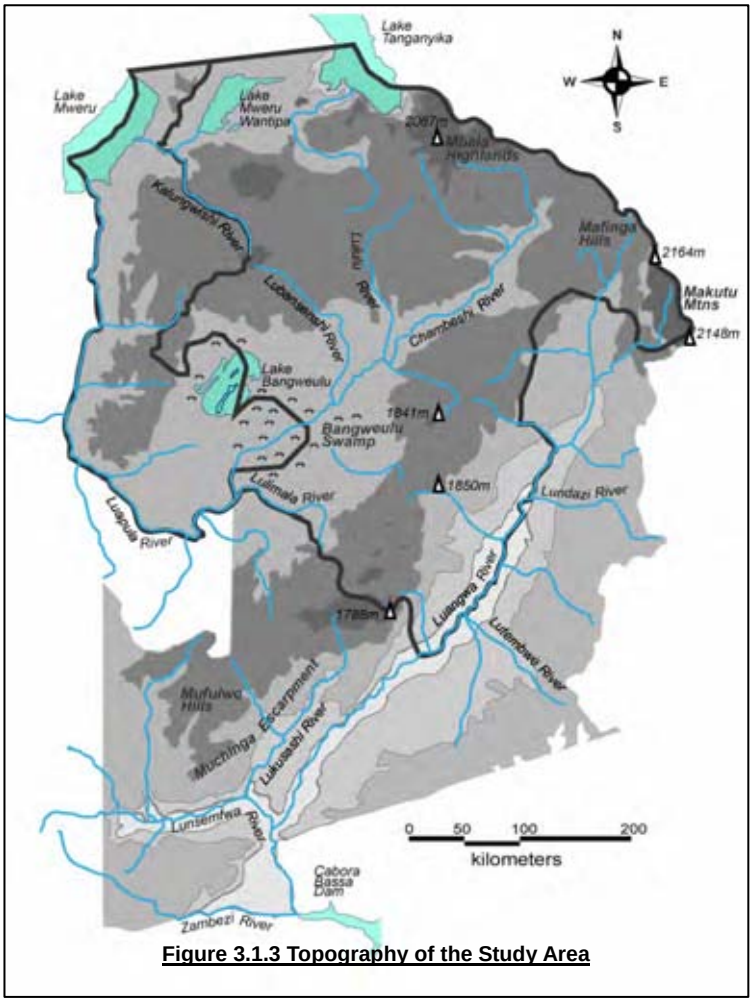


Figure 3.1.3 Topography of the Study Area

Northern province shows large extent of plateau areas in general, but according to location it has a different topography or mixed topography; e.g. high mountain range area in the eastern and northern parts, plateau in the central and southern parts and flat wet areas in the western part, and swamps and rivers dotted all over the province. The main lakes are Lake Tanganyika in Mpulungu district, Lake Bangweulu in Chilubi district and lake Mweru Wantipa in Kaputa district. The main rivers are Chambeshi, Luangwa, Kalungwishi, Lukulu and Lubansenshi Rivers.

Luapula province runs from north to south in a relatively narrow band, e.g. 450 km stretch from north to south direction against 120 km stretch from west to east direction. The topography varies from very flat wetland to a valley-like rugged hilly area. For example, approximately two thirds of Samfya district, where most of the Lake Bangweulu lies, is covered by lakes, swamps, rivers and *dambos*. The district is situated at about 1,100m above sea level, and it does not have any significant hills or mountains. On the other hand, Chienge district, located at most northern part of Luapula province, has many valleys along the lakeside and lower areas of the valley land. Due to earth's land formation, the valley areas are undulating, leaving much of the valley with a lot of streams and rivers.

3.2 Area, Population and Population Density

Table 3.2.1 and Figures 3.2.1 and 3.2.2 summarize the land area, population and population density by

district for the two provinces together with those for other provinces and national. The table is based on the national Census 2000, and the populations in year 2009 were estimated based on the population growth rates for the period of last 2 census years; 1990 – 2000. As the table shows, Northern province extends in an area of 147,826 sq.km while Luapula does in an area of 50,567 sq.km, totaling 198,393 sq.km (equivalent to an rectangular square of 445km x 445km).

It is estimated that there are 1,659,719 population and 1,029,477 population in Northern and Luapula provinces respectively, totaling 2,686,196 population. Estimated population densities in 2009 are 11.2 persons per sq.km and 20.4 persons per sq.km in Northern and Luapula provinces. Population density by district in Northern province varies from the lowest of 4.2 persons per sq.km in Mpika district to 23.5 persons per sq.km in Nakonde district. In Luapula province, the lowest population density shows up in Milenge district while that of Nchelenge district is the highest, which is 39.7 persons per sq.km. It can be said that population density in the Study area and, by and large, that of Zambia are low.

Table 3.2.1 also shows population by residence; rural area and urban area. It reveals very small population living in urban area; only 14 % in Northern province and only 13% in Luapula province. It means more than 80% or close to 90% of the population lives in rural area for the two provinces with some exceptions. Provincial capital is placed in Kasama district for Northern province and Mansa district for Luapula province. In these two districts, we can see relatively higher population density such as 43 persons per sq.km for Kasama and 23 persons per sq.km for Mansa.

Table 3.2.1 Land, Population and Population Density of the Study Area

Particulars	Area	Population	Pop. Growth Ratio	Population Estimated	Density, 2009	Population by Residence, 2000		
	sq.km	Yr 2000	% (90-2000)	Yr 2009	Pop./sq.km	Rural	Urban	% of Urban
Zambia	**752,612**	**9,885,591**	**2.5**	**12,345,749**	**16.4**	**6,458,729**	**3,426,862**	**35**
Male		4,946,298		4,946,298		3,220,939	1,725,359	35
Female		4,939,293		4,939,293		3,237,790	1,701,503	34
Central	94,394	1,012,257	2.7	1,286,544	13.6	769,202	243,055	24
Copperbelt	31,328	1,581,221	0.8	1,698,781	54.2	350,093	1,231,128	78
Eastern	69,106	1,306,173	2.6	1,645,610	23.8	1,190,865	115,308	9
Lusaka	21,896	1,391,329	3.4	1,879,813	85.9	252,869	1,138,460	82
North-western	125,826	583,350	2.9	754,514	6.0	511,647	71,703	12
Southern	85,283	1,212,124	2.3	1,487,400	17.4	955,268	256,856	21
Western	126,386	765,088	1.8	898,341	7.1	672,999	92,089	12
Northern Province	**147,826**	**1,258,696**	**3.1**	**1,656,719**	**11.2**	**1,081,599**	**177,097**	**14**
Chilubi District	4,648	66,338	4.1	95,240	20.5	62,796	3,542	5
Chinsali District	15,395	128,646	3.7	178,404	11.6	117,139	11,507	9
Isoka District	9,225	99,319	1.9	117,652	12.8	87,831	11,488	12
Kaputa District	13,004	87,233	5.0	135,327	10.4	84,882	2,351	3
Kasama District	10,788	170,929	3.1	224,980	20.9	96,686	74,243	43
Luwingu District	8,892	80,758	1.1	89,114	10.0	75,360	5,398	7
Mbala District	8,343	149,634	3.0	195,238	23.4	132,698	16,936	11
Mpika District	40,935	146,196	1.7	170,147	4.2	120,340	25,856	18
Mporokoso District	12,043	73,929	3.0	96,461	8.0	70,949	2,980	4
Mpulungu District	9,865	67,602	4.3	98,746	10.0	60,114	7,488	11
Mungwi District	9,766	112,977	4.2	163,606	16.8	107,001	5,976	5
Nakonde District	4,621	75,135	4.2	108,806	23.5	65,803	9,332	12
Luapula Province	**50,567**	**775,353**	**3.2**	**1,029,477**	**20.4**	**674,187**	**101,166**	**13**
Chienge District	3,965	83,824	5.9	140,421	35.4	83,824		0
Kawanbwa District	9,303	102,503	1.9	121,424	13.1	84,549	17,954	18
Mansa District	9,900	179,749	3.1	236,589	23.9	138,690	41,059	23
Milenge District	6,261	28,790	3.7	39,926	6.4	28,790		0
Mwense District	6,718	105,759	2.1	127,511	19.0	101,941	3,818	4
Nchelenge District	4,090	111,119	4.3	162,311	39.7	90,410	20,709	19
Samfya District	10,329	163,609	3.1	215,345	20.8	145,987	17,622	11

Source: National Census 2000

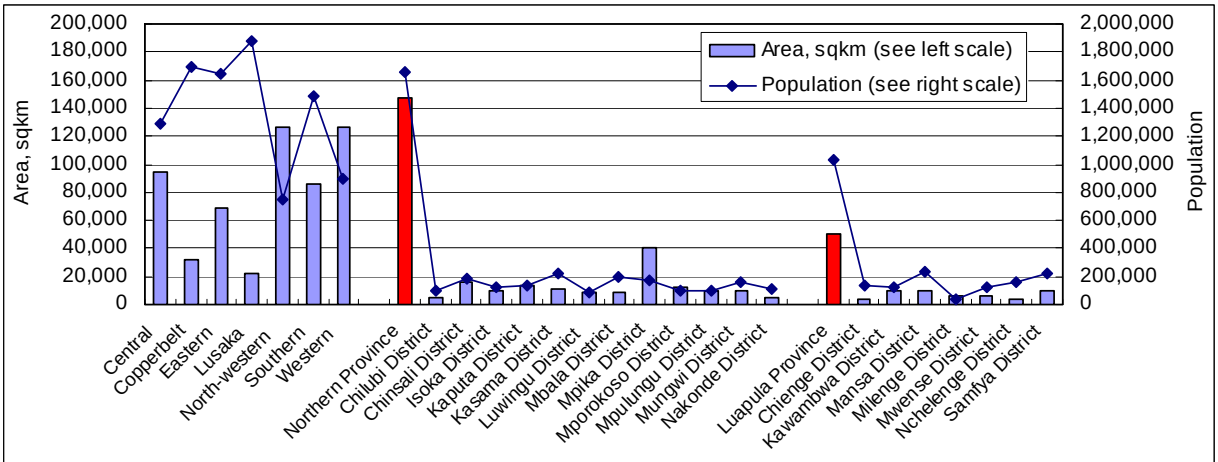


Figure 3.2.1 Area and Population by Province and District of the Study Area

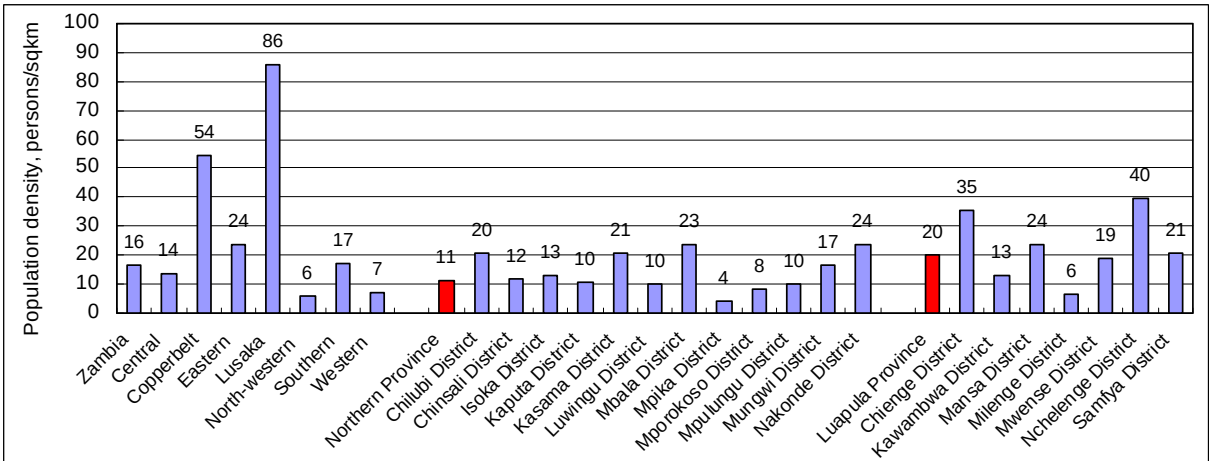


Figure 3.2.2 Population Density by Province and District of the Study Area, persons per sq.km

3.3 Meteorology and Hydrology

As located in the south-central of Africa, the Study area has clearly separated dry and rainy seasons according to south-to-north movement of the Inter Tropical Convergence Zone (ITCZ). The year is generally divided into three seasons, namely main rainy season (warm wet season) lasting from November to April during which more than 90% of the annual precipitation falls, post-rainy season (cool dry season) stretching for about three months from May to July with cool and cold temperatures, and a hot dry season prevailing from August to October.

As aforementioned, Zambia is divided into three regions from the agro-ecological point of view with Region II further subdivided into two sub-regions. Of them, the Study area falls in the Region III. Rainfall is the highest in the Region III over the country, varying between 1,000 and 1,500 mm in general. Crop growing season with rainfall ranges between 120 and 150 days in this Region III, and in some places goes up to about 180 days (6 months) which is one of the longest in Zambia. Following session examines the meteorology and also hydrology, e.g. water resources, in the Study area.

3.3.1 Monthly Mean Temperature and Rainfall

A long term monthly mean temperature data, covering 30 years from 1978 to 2008, have been collected from Kasama airport station and Mansa airport station (see Figure 3.3.1 and Figure 3.3.2). Temperatures in the stations fall in a range of about 10 to 30 Celsius degrees. The temperature starts rising from July up to October, and then the monthly mean minimum temperature stays around at 17

Celsius degrees till March while the monthly mean maximum temperature once peaks at around 32 Celsius degrees in October and then decreases to around 27 – 28 Celsius degrees after the peaking.

Figure 3.3.1 and Figure 3.3.2 also show monthly average rainfall for the 30 years for the two stations. As clearly shown, most of the precipitation falls from November to April, though onset of rain usually comes in as early as September. Monthly rainfall peaks in December at Kasama station while that of Mansa does in January. The peak monthly rainfall reaches as much as 290 mm at Kasama station while that of Mansa station does around 270 mm. A period of four months from December to March, including the peak months, is the proper rainy season, during which more than 80% of the annual precipitation falls.

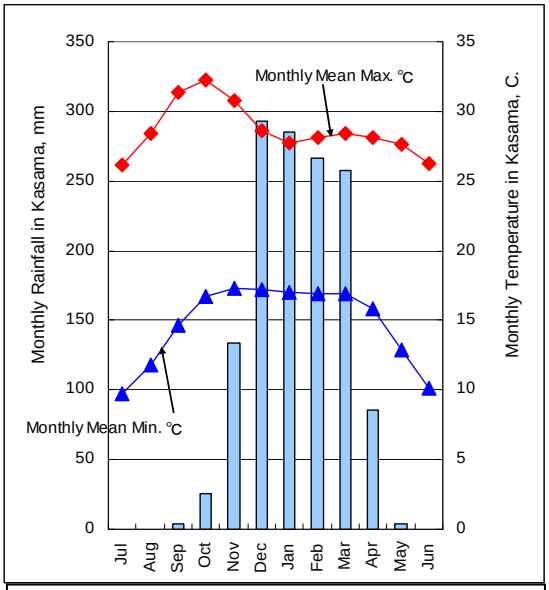


Figure 3.3.1 Climate Graph for Kasama, Northern Province
Data Source; Kasama Airport

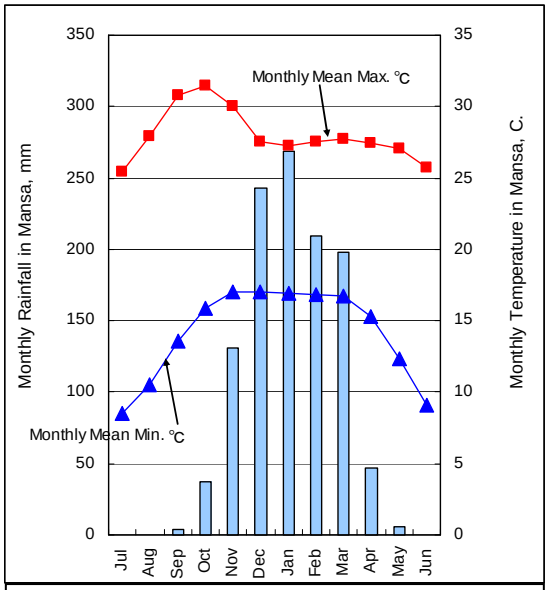


Figure 3.3.2 Climate Graph for Mansa, Luapula Province
Data Source; Mansa Airport

3.3.2 Long Term Change in Monthly Average Maximum Temperature

Figure 3.3.3 and Figure 3.3.4 show 30-year trend of 2-month average maximums temperatures at Kasama station and Mansa station respectively. The periods of 2-month are September-October, November-December, January-February and March-April, excluding May-August period when the temperature becomes lowest in years.

As the figures show, average maximum temperatures have all, but January-February period at Mansa station, been increasing over the 30 years period though there are fluctuations. The increase over the 30 years at Kasama station is 0.6 Celsius degrees, 1.2 Celsius degrees, 0.3 Celsius degrees, and 1.1 Celsius degrees for the periods of September-October, November-December, January-February and March-April. The increase at Mansa station is 1.6 Celsius degrees (September-October), 1.0 Celsius degrees (November-December), and 0.7 Celsius degrees (March-April), while the temperature for the period of January-February has decreased by 0.2 Celsius degrees.

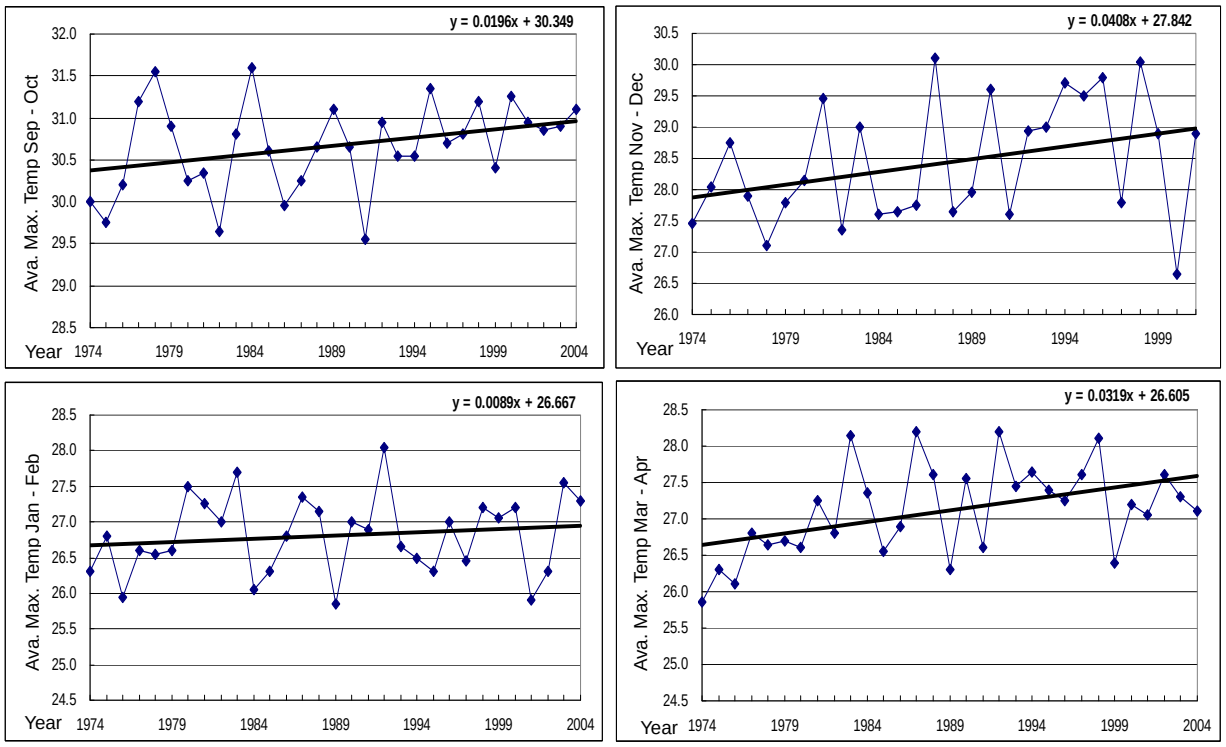


Figure 3.3.3 Trend of 2-month Average Maximum Temperature at Kasama Station, Northern Province
Data Source; Kasama Airport

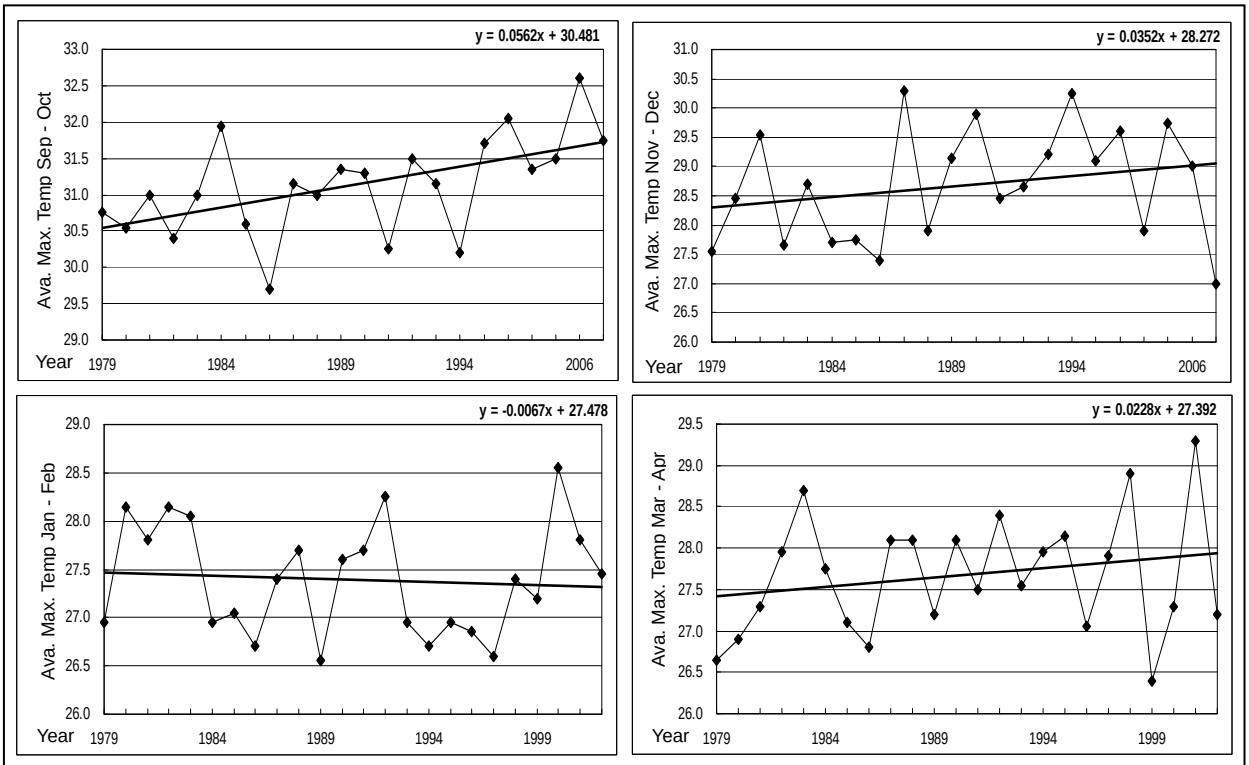


Figure 3.3.4 Trend of 2-month Average Maximum Temperature at Mansa Station, Luapula Province
Data Source; Mansa Airport

3.3.3 Annual Rainfall and Its Long Term Trend

Figure 3.3.5 shows long-term trend of annual rainfall at Kasama station from 1933/34 to 2009/10, while Figure 3.3.6 shows that of Mansa station from 1960/61 to 2009/10. The average annual rainfalls for the record periods are 1,310 mm and 1,154 mm for Kasama station and Mansa station respectively, both of which far exceed those precipitations falling in other parts of Zambia.

The maximum annual rainfall at Kasama station took place in 19961/62 with 1,888 mm comparative to that of monsoon regions while the minimum one was 902 mm recorded in 1952/53. There were only 2 years when annual rainfall could not reach 1,000 mm in Kasama station, e.g. 1952/53 and 1999/00. However none of the years has recorded annual rainfall less than 900 mm. The figure also shows change of the trend of annual rainfall by linier regression as Y (annual rainfall) = 0.2003 X (Year) + 1,302.6 (constant). This implies there is almost no change in the long terms trend of annual rainfall, although one may think there are more often years having less rainfall in recent years.

As per annual rainfall recorded at Mansa station, the maximum rainfall took place in 1978/79 with 1,573 mm while the least one was in 815 mm in 1987/88. Years in which annual rainfall was less than 1,000 mm were; 1964/65, 1981/82, 1987/88, 1991/92 – 1994/95, 1996/97-1997/98, 1999/2100 and 2009/10. Though there was no year when annul rainfall failed to reach 800 mm over the last 50 years, one may notice these is a tendency of annul rainfall decreasing over the period. With this trend, linier regression over the period is estimated as Y = -1.879 X + 1,202, showing a declining trend.

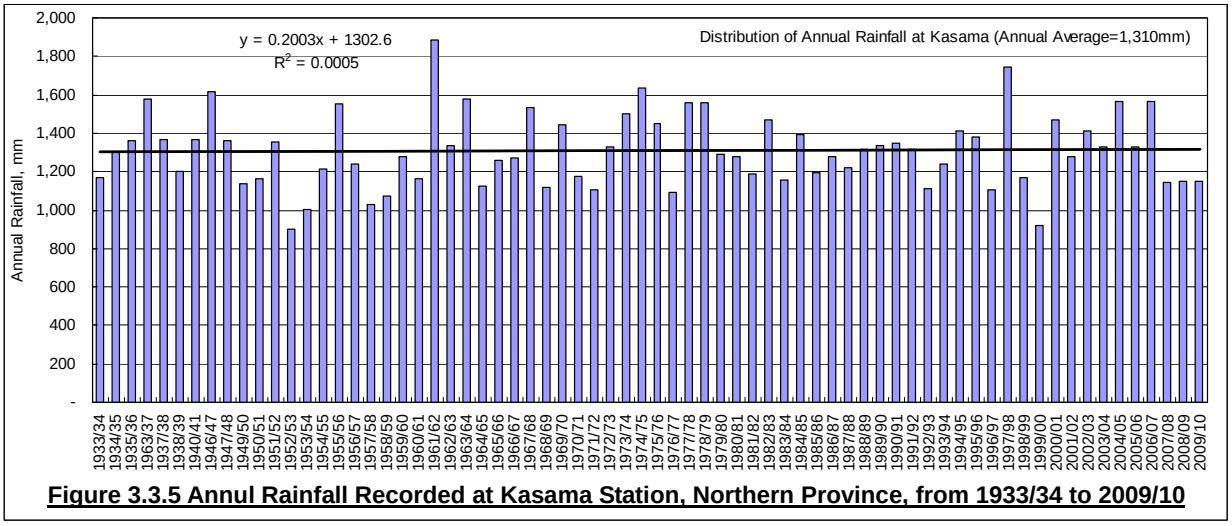


Figure 3.3.5 Annul Rainfall Recorded at Kasama Station, Northern Province, from 1933/34 to 2009/10

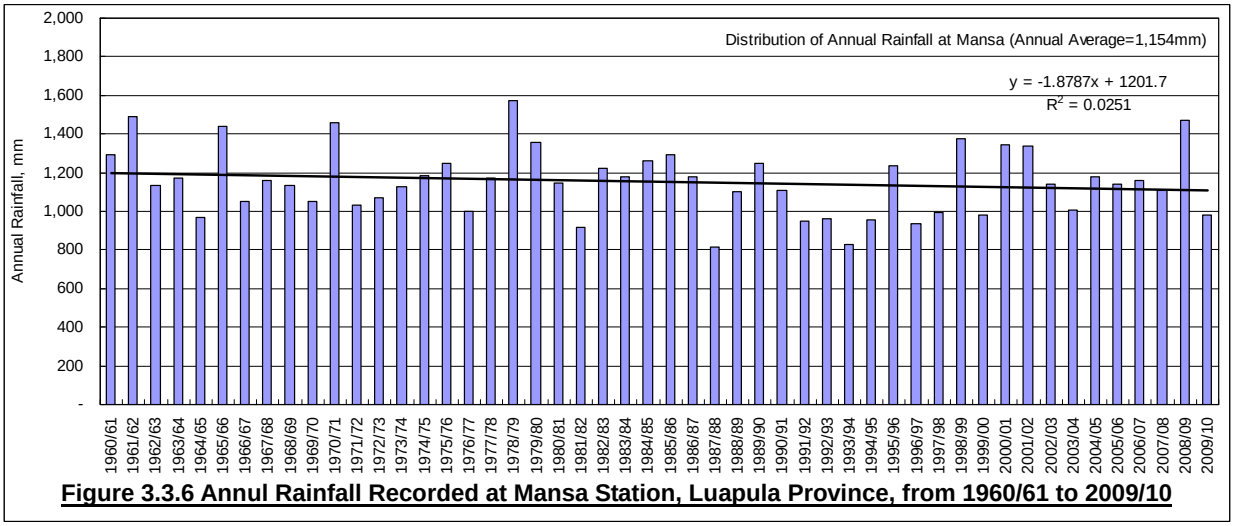


Figure 3.3.6 Annul Rainfall Recorded at Mansa Station, Luapula Province, from 1960/61 to 2009/10

3.3.4 Water Resources

The Study area has many perennial water sources and wetlands. The major rivers are Chambeshi river and Luapula river. The Chambeshi river drains the whole of the central part of the Northern province into the large Bangweulu swamps (5,000 sq.km), which are themselves drained by the Luapula river. Apart from the major two rivers, others are Luangwa, Lukulu, Lubansenshi and Kalungwishi, of which Luangwa river drains into Zambezi system, Lukulu and Lubansenshi rivers join Chambeshi river, and Kalungwishi drains into Lake Mweru and then joins Congo river system (see Figure 3.3.7).

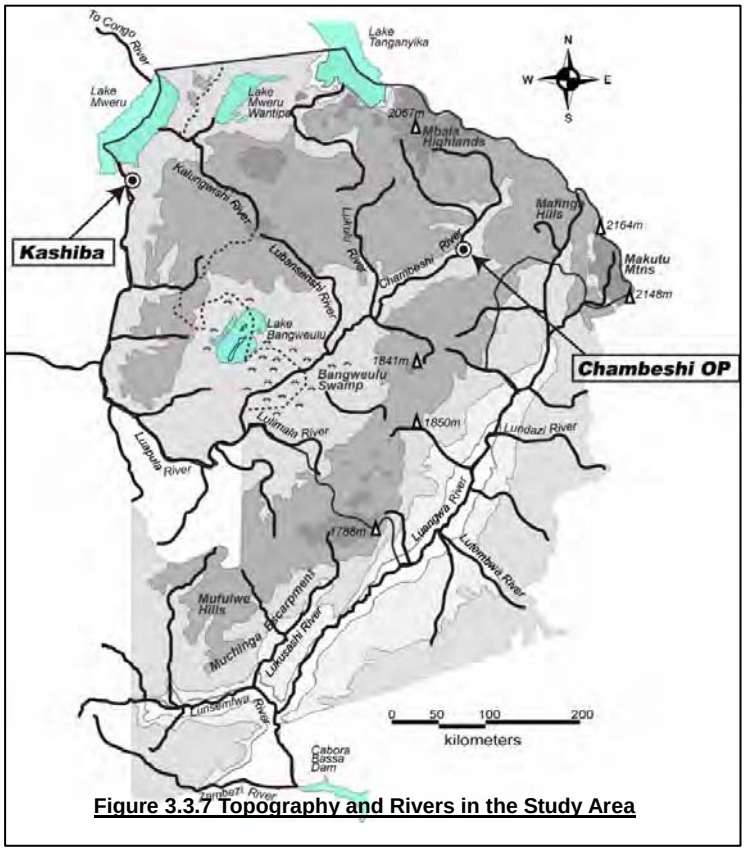


Figure 3.3.7 Topography and Rivers in the Study Area

As expected, the Northern and Luapula provinces are more blessed with rainfall than other parts of Zambia, thereby producing more water resources. Table 3.3.1 summarizes surface water resource potential by province and also for the two major rivers of the Study area, and Table 3.3.2 briefs the summary of the two major rivers. From the tables, following are pointed out:

1) As expected by the rainfall in Northern and Luapula provinces, the two provinces provide more surface water resources than other parts of Zambia, namely, 304 cum/day/sq.km for Northern and 357 cum/day/sq.km for Luapula in a 10-year return period, which are more than those of other provinces (see Table 3.3.1). Likewise, those of Chambeshi and Luapula river basins are 322 cum/day/sq.km and 338 cum/day/sq.km respectively, which are also more than those of other provinces.

2) Table 3.3.2 shows that high flow of Chambeshi river is 280 cum/s at the measuring station (Chambeshi OP) with a catchment area of 34,745 sq.km, while the low flow at the station is 55 cum/s. High flow of Luapula river at the measuring station (Kashiba) with a catchment area of 161,275 sq.km is 1,096 cum/s, while the low flow is 294 cum/s. The magnitudes between the high flow and the low flow are about 5 times for Chambeshi river and 3.7 times for Luapula river.

3) Runoff depths are 168 mm for Chambeshi river basin and 161 mm for Luapula river basin. Applying annual rainfalls in the catchment areas give runoff percentages; namely, 12.8% for Chambeshi river basin and 14.0% for Luapula river basin.

Table 3.3.1 Surface Water Resources Potential by Province and by Basin

Province Rover Basin	Province River Basin	C.A. : km2	Surface Water Resources Potential			
			(MCM/day)		cum/day/sq.km	
			Average Year	Drought Year (1/)	Average Year	Drought Year (1/)
By Province	**Northern**	**147,294**	**67.5**	**44.8**	**458**	**304**
	Luapula	**49,594**	**26.3**	**17.7**	**530**	**357**
	Central	94,684	33.6	11.0	355	116
	Copperbelt	31,217	13.0	6.6	416	211
	Eastern	69,146	21.5	13.4	311	194
	Lusaka	22,094	10.9	3.7	493	167
	North Western	125,280	38.9	21.5	311	172
	Southern	85,199	5.3	1.2	62	14
	Western	127,344	20.3	16.3	159	128
	whole country	751,852	237.3	136.2	316	181
By Basin	**Chambeshi**	**44,427**	**23.9**	**14.3**	**538**	**322**
	Luapula	**113,323 (2/)**	**54.1**	**38.3**	**477**	**338**

Source: National Water Resources Master Plan, 1995, 1/Drought Year: 10-year return period, 2/ Catchment area only in Zambia

Table 3.3.2 Summery of the Major Two Rivers; Chambeshi and Luapula Rivers

Particulars	Chambeshi	Luapula	Remarks
Whole catchment area, sq.km	44,427	173,396 (1/)	
Station	Chambeshi OP	Kashiba	See Figure 3.3.7
Catchment at the station, sq.km	34,745	161,275 (1/)	
Maximum flow, cum/s	582 (0.0168m^3/s/km^2)	2021 (0.0125m^3/s/km^2)	At the station
High flow, cum/s	280	1096	ditto
Usual flow, cum/s	108	606	ditto
Low flow, cum/s	55	294	ditto
Drought flow (10 years), cum/s	35	190	ditto
Minimum flow, cum/s	33	174	ditto
Average flow, cum/s	**185**	**741**	**ditto**
Runoff Depth, mm	168	161	ditto
Rainfall, mm	1,310	1,154	
Runoff percentage, %	**12.8**	**14.0**	

Source: National Water Resources Master Plan, JICA, 1995, 1/ Catchment area includes the extent in DRC.

Table 3.3.3 and Figure 3.3.8 show distribution of monthly average basis runoff discharge expressed in cubic meter per second and in litre per second per sq.km for the two major rivers; Chambeshi river and Luapula river, respectively at the measuring stations. The distribution of runoff is correspondent to the pattern of rainfall with a certain time lag. Runoff discharge of Chambesi river shows its peak in April with 471 cum/s and that of Luapula river in March with 1,758 cum/s. Lowest runoff discharge shows up in October to November; 40 cum/s for Chambeshi river and 195 cum/s for Luapula river.

Runoff discharge per sq.km catchment area is shown in the lower column of each river in Table 3.3.3 and also in Figure 3.3.8. The runoff for Chambeshi river varies from as low as 1.15 liter/s/sq.km to as high as 13.56 litre/s/sq.km. Luapula river gives its lowest runoff in November with only 1.21 litre/s/sq.km while the maximum one appears in March with 10.90 litre/s/sq.km.

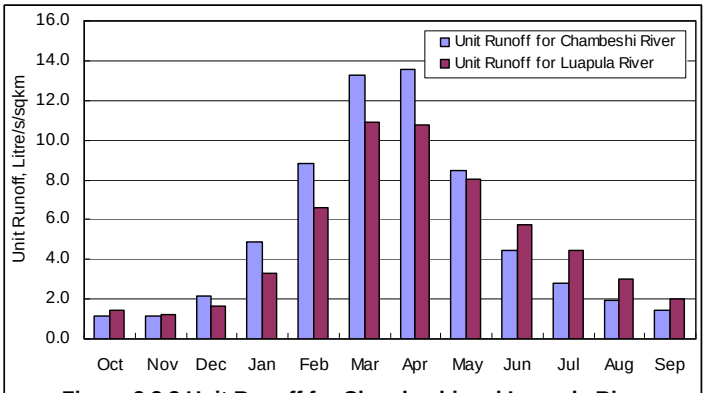


Figure 3.3.8 Unit Runoff for Chambeshi and Luapula Rivers

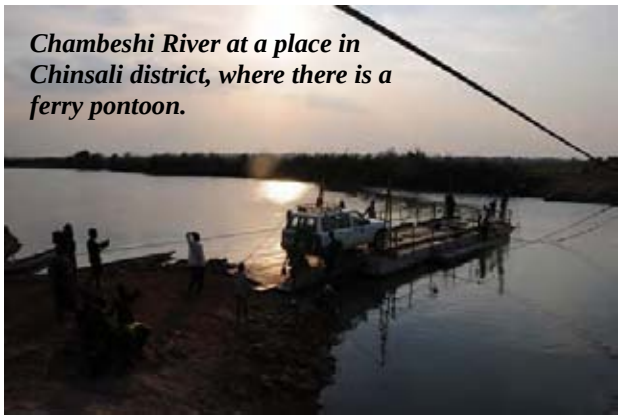
With the discharges per unit catchment area, we can estimate how much yield of runoff we can expect in a stream draining from certain extent of catchment area though it is very much dependent on vegetation and soil condition. Then, again with the expected yield of runoff, we can estimate how much hectare of farm land we can irrigate though this is also very much dependent on the efficiency of water abstraction/diversion.

An indication is that one litre per second of flow can irrigate about one acre of farm land if irrigated during day time only. This assumption implies that since lowest flow is in a range of 1 – 1.2 liter per second per sq.km, showing up in October – November, a stream draining from 10 sq.km of catchment area cannot irrigate more than 5 ha at the end of the season, 5 sq.km of catchment not more than 2.5 ha, and alike. This indication could be a guide to design irrigable area with a stream where discharge measurement has not been done.

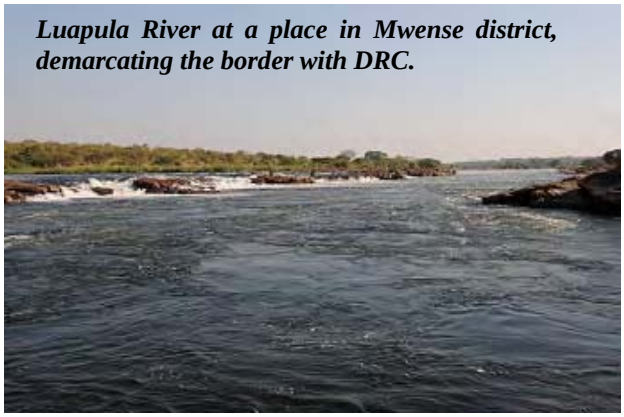
Table 3.3.3 Monthly Basis Flow for Chambeshi River and Luapula River

River	Station CA, sq.km	Unit	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Chambeshi	34,745	cum/s	40	40	75	170	307	461	471	294	155	96	68	51
		litre/s/sq.km	**1.15**	**1.15**	**2.16**	**4.89**	**8.84**	**13.27**	**13.56**	**8.46**	**4.46**	**2.76**	**1.96**	**1.47**
Luapula	161,275	cum/s	237	195	265	536	1,068	1,758	1,741	1,295	931	712	488	323
		litre/s/sq.km	**1.47**	**1.21**	**1.64**	**3.32**	**6.62**	**10.90**	**10.80**	**8.03**	**5.77**	**4.41**	**3.03**	**2.00**

Source: National Water Resources Master Plan, 1995



Chambeshi River at a place in Chinsali district, where there is a ferry pontoon.



Luapula River at a place in Mwense district, demarcating the border with DRC.

3.4 Rural Society in the Study Area

There are about 1,559,000 population and 967,000 population in Northern and Luapula provinces respectively estimated as of 2007[1]. The people are consisted of plural ethnic groups, of which the majority ethnic group is Bemba, followed by those of Mambwe, Namwanga, Ushi, Chishinga, etc. This sub-chapter discusses rural society of the people, starting with general description, followed by findings from a series of focus group interviews, village level workshops, and then by the results of a baseline survey.

3.4.1 People in the Study Area

Table 3.4.1 Ethnic Groups and the Share in Percentage

Northern Province		Luapula Province	
Ethnic Group	Share, %	Ethnic Group	Share,%
Bemba	50.6	Bemba	24.5
Namwanga	11.1	Ushi	20.8
Mambwe	10.6	Lunda	13.6
Bisa	8.3	Chishinga	10.2
Tabwa	4.4	Ngumbo	9.7
Others	15.0	Others	21.2

Source: National Census 2000

Most of the ethnic groups in the Study area originate in Luba land, once established in the south-eastern part of the present DRC. The people started migrating from the Luba land to northern parts of Zambia, where the Study area falls. They, through time, have formed sub-ethnic groups. As shown in the Table 3.4.1, the majority in Northern province is by far the Bemba people sharing about half of the population, and followed by Namwanga, Mambwe, and Bisa, each of whom consists of about 10% of the population. In Luapula province Bemba people still share the majority but to lesser extent of about 24%, and they are followed by Ushi (21%), Lunda (14%), Chishinga (10%), etc.

Historically the migration from the Luba land is said to have probably occurred in the mid-seventeenth century, which was also the time when people moved from southern Africa and the Congo into what is now northern Zambia. They established a centralized form of government with a senior chief named Chitimukulu or 'The Great Tree'. This form of traditional governance continues till today, with the Chitimukulu being a powerful and inherited position, now the Paramount Chief, which in accordance with Bemba traditions follows the matriarchal, or mother's, line[2].

The northern Zambia, thanks to relatively plentiful rainfalls, was covered with forests, trees, plateaus, and wooded savannas traversed by many rivers at that time when the people migrated. They started practicing slash-and-burn agriculture, aside from hunting. It is said that villages, consisting of about thirty huts, were abandoned every three or four years once the soil became exhausted. The slash-and-burn agriculture, called *Chitemene*, has been practiced to date, however the people nowadays rarely move. They are gradually sifting to conventional agriculture whereby they cultivate already demarcated farmlands, in cases even equipped with simple irrigation means called water furrow; a small canal withdrawing water from a nearby stream by gravity.

3.4.2 Structure and Norm in Rural Village

Field observations and interviews reveal that in every village, there is “village committee” chaired by village headman and the committee is the supreme decision making body in the village. Basically, village committee consists of 8 to 10 members such as chairperson (the village headman), vice chairperson, secretary, treasury and members. There are also female members in every committee, and it is learned that the female members are recognized mostly as active farmers in the villages and their opinions are important especially when they have to handle female villager related issues.

The village committee discusses various issues and topics wherein decision is basically made as the committee’s consensus under the chairpersonship of the village headman. Topics discussed are issues

[1] Latest national census in Zambia was carried out in 2000, and the estimated populations here are the ones based on the populations in the census year 2000 with the average annul population increase ratios recorded over a last decade.
[2] http://www.helium.com/items/1367829-history-of-the-bemba-tribe

relating to village development such as road & bridge maintenance, construction of school and health post, construction and maintenance of village shelter (a public meeting place), establishment of village community fields, etc. The committee meeting is usually conducted regularly, e.g. such as once a month. Information dissemination of the decision made in the meeting is done by calling the general meeting (all villager get together) or letting village spokesman go around the village.

Village committee shall take responsibility of making it sure that there is discipline in the village and welfare of the village, and also deal with settlement of land wrangles, dispute among villagers, preparation for chief's visit, etc. The committee makes sure that every villager participates in communal works as agreed. Disobedient villagers are punished by given tasks such as maintenance of village shelter, road and bridge or otherwise required fine (in cash and/or kind) in some villages. If the committee fails to handle the cases, they take him/her to the chief, senior chief and finally to the paramount chief as need arises.

Every village has experiences for communal work such as road clearance, construction of temporal bride, school, clinic etc., and the organizational activities are also recognized as communal work for villagers. There are very often communal fields maintained by cooperative or committee which support households who have orphans, elders and physically / mentally challenged villagers. Further, in Mayanga village, Mbala district, Northern province, there is a women group who sews and distributes school uniform to orphans for free. It is therefore learnt that there is a certain safety net built in village, and also villagers at least have some experiences for communal work.

3.4.3 Issues Identified at Focus Group Interviews and Village Analytical Workshop

In 2009, the JICA Study team conducted focus group interview and village analytical workshop at six villages in 3 districts of Northern province. The objective of the focus group interview was to understand overall situation of those villages on a first hand basis and then make necessary arrangement for the village analytical workshop. Participants of the focus group interviews were the ones basically who know general information of the villages such as village headman, cooperative representatives, members of other groups if any, elders, youth representatives.

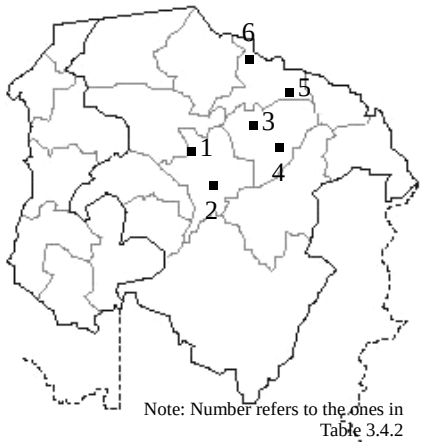


Figure 3.4.1 Location of the Villages
Source: JICA Study Team

The village level workshops were held in order to; 1) collect the basic information on the situation of the villages to know how smallholder irrigation can contribute to their livelihood improvement, 2) offer a venue for target villages to review their villages' activities / history / issues by themselves with the facilitation of the Team, and 3) think about themselves what kinds of countermeasures they can undertake. The villages where the group interviews as well as the WSs were held are shown in Figure 3.4.1 and Table 3.4.2:

Table 3.4.2 Target Villages for Focus Group Interviews and Analytical Workshop

Village name	Camp name	District	Distance from Major Town	Date of WS / Participants No.
1. Lunda	Lukulu North	Kasama	25km from Kasama	29 April, 2009 / 129(F63, M66)
2. Molwani	Chitambi	Kasama	16km from Kasama	20 May, 2009 / 75(F33, M42)
3. Kalemba Chiti	Ngulula	Mungwi	32km from Kasama, 1/	26 May, 2009 / 141 (F74, M67)
4. Chipapa	Misamfu	Mungwi	15km from Kasama, 1/	26 June, 2009 / 72 (F47, M25)
5. Saise	Lunzua	Mbala	192km fr. Kasama, 28 km from Mbala	28 May, 2009 / 55(F26, M29)
6. Mayanga	Luchacha	Mbala	176km fr. Kasama, 11.5 km from Mbala	4 June, 2009 / 78 (F25, M53)

Source: JICA Study Team, 1/ These villages are nearer from Kasama than from Mungwi center.

1) Village Profile

Table 3.4.3 summarizes the number of households, number of female-headed households, ethnicity, and the year the village was established. Size of village is not so big as recognized in the number of households ranging from as small as only 34 households to 150 households at most with an average of 72 households only. Female-headed household consists of 9% to maximum 29% of the whole households with an average of 21%, indicating as average one out of every 5 households is headed by a female. Major ethnicity is Bemba in three villages and Mambwe in two villages.

Table 3.4.3 General Information of Six Villages

Village name	No. of HHs	No. of Female-headed HH		Ethnicity	Year established
1. Lunda	57	8	14.0%	All Bembas	1947
2. Molwani	47	5	10.6 %	Bembas and other 3 tribes	1970
3. Kalemba Chiti	65	11	16.9%	All Bembas	1818
4. Chipapa	80	20	25.0%	Bembas and Mambwes	1930
5. Saise	34	3	8.8%	All Mambwes	1986
6. Mayanga	150	43	28.7%	Mambwes and other 3 tribes	1902
Total	433	90	20.8%		
Average	72	15			

Source: JICA Study Team, based on the focus group interviews to village headman, etc.

Village history started as early as in 1818 in the oldest village and the latest one in 1986. Though some of the villages are very old in their history, say more than 100 years, it is learnt that it can hardly become bigger and bigger[3]. The reason why they always maintain their village size as such is associated with their thrush-and-burn agricultural practice. Rural population in the Study area still practice *Chitemene* for some years, and they at the end find that the soils are already depleted and there are no longer much available virgin lands nearby. Then, this is the time some of the villagers start migrating to look for new *Chitemene* areas. Sometime after they have settled in the new area, one of the potential village leaders is now authorized as the village headman by the traditional authority[4]. In this way, villages have been kept at a handful size.

Main crops grown in the 6 villages are maize, cassava, ground nuts, beans, finger millet and sweet potato. Vegetables, such as rape, onion, cabbage, tomato are grown only in small scale either by bucket irrigation or personal furrow irrigation. *Chitemene* is also still practiced widely; preparation starts at the onset of dry season. Marketing is practiced either through middlemen who come to village or by villagers themselves who go to the nearest market mainly by bicycle. A village headman told that it takes 5 hours for him to reach the nearest market by bicycle and he cannot come back within the same day, therefore he normally sleeps near the market whenever he goes for marketing.

Three villages, Molwani, Chipapa and Mayanga, have cooperatives while the rest of three villages do not have. Joining cooperative is recognized as the only way for farmers to access the subsidized fertilizer (K 54,000 / 50kg bag, while market price is ZMK 170,000 to 180,000[5] during the period of subsidized fertilizer available and ZMK 240,000 to ZMK 250,000/ 50kg bag during other period of time in 2010).

[3] The size of Mayanga is relatively big, 150 households. The reason may be associated with job opportunities at Mbala which is located at around 12km from the village. In fact, there are many villagers who market their produce to the town, and this opportunity may drive them to stay in the village, engaged in cash crop cultivation, etc., thereby the village may have become so big. Another reason may be linked with the establishment of villages in Tanzania. The village borders with Tanzania where there are very big sized villages established under *Ujama* policy.

[4] When a new village is established, the village headman shall be authorized by chief, senior chief or otherwise the paramount chief. First, one among the new settlers is identified as potential village headman, and then in most cases the village headman in the original village refers him to the chief for seeking the authority.

[5] During the time around September-November, subsidized fertilizer is available so that the price of fertilizer without subsidy has to be lowered and otherwise farmers do not buy. However during the other time of period, fertilizer in market stay at as high price as ZMK 240,000 – 250,000 per 50kg of bag.

As a matter of fact, high price of chemical fertilizer was always one of critical issues identified in almost all the interviews to the villagers. Existence of cooperative also affects the extent of *Chitemene*. For example, Kalemba Chiti village, where there is no cooperative, heavily relies on *Chitemene* as all the households in the village actually do it for growing cassava, finger millet, beans and groundnuts, rather than maize.

2) Major Issues and Most Difficult Seasons of Year

Focus group interviews identified such issues as their problems; e.g., 1) water scarcity in dry season, 2) lack of money for fertilizer, and sending children to school, 3) distance to school is far, 4) distance to clinic is far, 5) livestock theft, 6) crop diseases, 7) diseases e.g. malaria, coughing, etc., 8) difficulty of transporting agricultural produce, and 9) orphans. Following the identification of these issues, the next question was when the villagers face difficulties the most in a year.

Many interviewees picked up both dry season and rainy season for different reasons. For example they face water shortage during dry season while in rainy season they face disease problems such as coughing, malaria, diarrhea, and malnutrition. In addition, it is very cold during rainy season for school children to go to school, and sometimes they get wet, feeling difficult of going to school. Further, pointing out the month of January, they stated that most parents face the problem of money for school (school in Zambia starts in January). The period from January to March was also identified as the time for food shortage, waiting for the harvest of rainy season crops.

There are coping measures for hunger taking place in late rainy season, or just before the harvest season. Many households experience hunger from January to March except bumper yield years and during this period some of them get only one meal per day or even almost nothing. To avert this hunger, they usually start drying cassava chips during the dry season for assuring their staple food (Nshima) even late in the rainy season. They also preserve leaves of pumpkin, cowpeas, beans, okra and sweet potato by drying them to make sure of food in rainy season available.

Some farmers go to work in other farmers' fields for food instead of cultivating their own fields, which very often creates vicious cycles for them. There are some cases farmers ask other farmers to "borrow" food. Wild food stuffs such as caterpillars, natural mushroom and wild & domestic fruits are also important produce which can attract urban market. Collecting and selling of these non-timber forest products (NTFPs) contributes to generating income for female because this is recognized as female activity.

3) Severe Hunger in the Village History

In all the six villages, after confirming the year the village was established, years of severe hunger they have faced were identified together with the reasons. Table 3.4.4 summarizes the results, and here pointed out is that there were heavy rainfalls which damaged or even devastated their crops than did drought. Examples are; Lunda village has had 3 times of year 1962, year 1963 and year 1972 after the village establishment of year 1947, Molwani village has had 2 times of year 1978 and 1997 after the establishment of year 1970, and Mayanga village did 3 times of year 1962, 1996 and 1997, during which their crops were severely damaged by heavy rainfalls, and thereby resulted in severe hunger.

As is the case in most African countries, there were times when they also faced drought, giving again damages to their crops. The years identified for drought are 1842 in Kalemba Chiti village, 1994 in Chipapa village, and 1995 and 2004 in Saise village. In addition, it was reported that wild animals in two villages, policy change wherein subsidized fertilizer distribution was changed, a pest of cassava mealie bug were causes of severe hungers they have faced in their histories.

Note is that though the Study area is well known blessed with rich rainfall as compared to other parts

of the country, the rainfall has on the other side caused heavy damages on their crops, resulting some cases in food relief. Another point is that such heavy rainfall and even drought have rarely caused damages on all the villages at the same time. In a year, a village was heavily damaged by heavy rainfall, however other villages were not; this is the case often observed in the Study area. This implies that climatic condition in the Study area is sporadic by area and also by time.

Table 3.4.4 Years of Village Establishment and Years of Severe Hunger

Village name	Year of the Village Establishment	Severe hunger year (reasons)
Lunda	1947	1962, 1963 and 1972 (heavy rainfall damaged crops)
Molwani	1970	1978 and 1997 (heavy rainfall damaged crops)
Kalemba Chiti	1818	1842(drought), 1957(wild animal destroyed cops) and 1983(policy change for fertilizer distribution affected maize production)
Chipapa	1930	1985 (Cassava mealie bug) and 1994 (short rainfall. Relief food was given)
Saise	1986	1995 (drought. Relief food was given), and 2004 (drought)
Mayanga	1902	1962 (heavy rain and wild animal attack), 1996 and 1997 (heavy rain. Relief food was given in 1996)

Source: JICA Study Team, referred to the village analytical workshop results, May-June 2009

4) Trend in Village Indexes

A simple trend analysis was conducted in the six villages where the villagers were divided into groups, and then the groups were given agricultural production, livestock production, water level of nearest stream, and diseases as main categories for the trend analysis. Followings are the findings;

i) Maize production: Government policy on fertilizer distribution has had much influence for the production of maize. Maize production was peaked at 1980 to 1990 when farmers had easier access to fertilizer and then started decreasing because government changed the policy for the provision of subsidized fertilizer and also the distribution timing became delayed. Though the fertilizer subsidy programme again resumed in 2002/03, the beneficiaries were limited, i.e. 125,000 farmers only in 2004/2005 and 200,000 farmers in the 2008/2009[6].

ii) Cassava production: Trend of the cassava production is generally related to maize production. In general, if the production of maize decreased, cassava production increased. This is mainly because farmers who cannot access fertilizer changed their production into cassava. There is, however, opposite case observed in Molwani village. Both cassava and maize productions were quite high and this is because there were abundant maize stock and farmers managed to take time to wait cassava matured (when there is nothing to eat or sell, farmers have to start harvesting cassava even when it is not mature).

iii) Finger millet: Trend differs by village. One trend is that finger millet production has been increased because the profit from finger millet was realized, thereby becoming popular. Another trend is decrease. This is mainly because trees for *Chitemene* have been decreased, and therefore farmers have shifted to winter ploughing applying manure where other crops than finger millet are cultivated, resulting the millet in lower production.

iv) Water level: Water level has been decreased in all the six villages because of drought and water being exploited for irrigation purposes by a means of furrow. In fact, there are villagers, we can observe, who are diverting or withdrawing water from *dambo* streams nearby, causing water decrease at downstream areas.

v) Livestock production: Production has been decreasing in most villages. One reason is disease.

[6] Available fertilizer under subsidy programme, called Farmer Input Support Programme (FISP), is 2 bags of Urea (100kg) and 2 bags of D-compound (100kg), recommended for 1/2 ha of farm land in Zambia.

Another reason is high incidences of livestock theft (thieves are not within the village but come from other villages according to the interviews).

vi) Diseases: Both diarrhea and malaria have been drastically decreased in every village. One reason is that villagers got knowledge for keeping their surrounding areas clean. They were encouraged to construct toilet and clearing the grasses, and in fact they have done so. Another reason is the mosquito net distribution from the Ministry of Health and NGOs.

5) Dry Season's Activities

During rainy season, most of the villagers are engaged in rain-fed agriculture, of course. It starts with land preparation and concludes in harvest. Harvest is carried out at the onset of dry season or some time after the onset of the dry season. Then, it was explored what activities the villagers engage in during dry season to know their extent of works. Dry season is commonly recognized as the best season for holding wedding because they can prepare plenty of foods for the participants. It is also good time for visiting remote relatives because road condition is better than that of rainy season.

In addition, they are engaged in such activities, though overall workload may be lighter than the counterpart activities during rainy season, as; 1) still harvesting rain-fed crops at an early time of dry season, 2) participating communal work such as road maintenance, construction of school etc., 3) construction of granaries, 4) house maintenance e.g. cutting grass for thatching, molding brick, digging pit latrines and waste pits, construction of dish rack, etc., 5) watering garden vegetables by bucket, and 6) preparation for *Chitemene* farming.

In fact, villages located near *dambo* area practice irrigated agriculture by digging shallow well, or just making hollow, and then with bucket. All the villages the JICA Study Team conducted focus group interviews are not an exception at all for this *dambo* utilization for irrigation. In those six villages, baseline survey was also carried out in 2009, where an average of 30 households each per village were covered. As shown in Figure 3.4.2, about 20 to as much as 80% of the sampled households have practiced *dambo* irrigated agriculture with bucket.

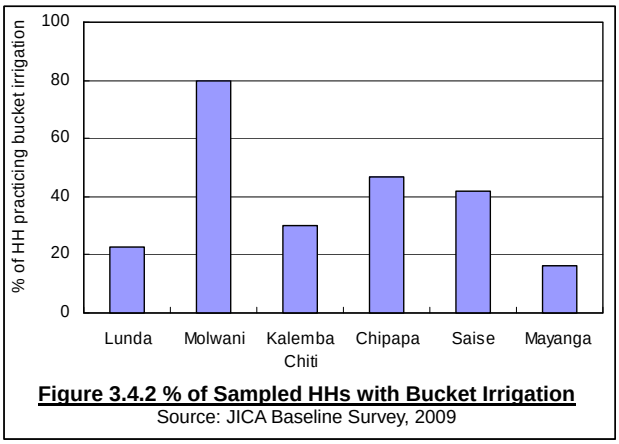


Figure 3.4.2 % of Sampled HHs with Bucket Irrigation
Source: JICA Baseline Survey, 2009

Left; A typical water source in dambo, and
Right: Bucket irrigation

6) Gender Role in Agriculture

According to the focus group interviews, there are some gender roles in agriculture activities though both husband and wife go to field together. For example, as to *Chitemene*, men cut the branches and women collect the branches and pile them together for drying and burning. Men do bush clearing as well. Men do land preparation including making of ridge, female does the planting, and both do the harvest in most of crops cultivated.

There are some activities, which are done together such as watering the garden vegetables. Both male

and female go fetch water for gardens, and do the watering. Both woman and man also do marketing of agricultural produce. Some women ride on bicycle for marketing their produce. However, if the distance to the market is quite far, male takes the charge of ferrying the produce by bicycle. Some widows do all the work by themselves or helped by relatives or children. If they ask neighbors, they often prepare local beer for them. Local beer brewing is recognized as female activity.

7) Advanced Farmers

In every village, 6 to 10 farmers are recognized as advanced farmers. Fellow villagers also recognize not only men but also female farmers as advanced. The features which other farmers recognize them as different from the rest of them are: 1) cultivation area is larger and hiring casual labor for intensive agriculture, 2) production pattern is diversified by crop, 3) possessing of many livestock, 3) larger amount of fertilizers applied, 4) being hard workers, 5) able to make sound plan, 6) high adaptation ability for new agricultural technologies, 7) possessing of fertile soil (many first settlers have larger and fertile soil).

As per making sound plan, for example, they can grow more surplus food and use them for payment of casual workers in kind during rainy season when most of villagers had run out of the food. Marketing can also be well planned by those advanced farmers; they know timing of selling the produce at high price, not selling just after the harvest. New technologies brought about by CEOs or donors can hardly be tried by ordinary farmers but by the advanced farmers; that is high adaptation ability. New technologies seem risky or too much challenging for the rest of farmers, but the advanced farmers can try such technologies inclusive of making use of *dambos* which other villagers may think those are useless.

These advanced farmers are recognized as rich and wealthy people in the village, and the symbols of rich according to the interviewed villagers are; house with iron sheet, having assets such as motor bike, radio, bicycle, TV, ploughing cattle, grinding mill, having money for fertilizer, sending “all” children to school, etc. They are often members of the village committee, members of the cooperative committee, and also stand as contact villagers, aside from the village headman, to whom CEOs and donors first approach for promotion of agriculture related activities.

8) Education Level

During registration of the participants to the village level workshop, simple questions were asked, one of which was to confirm their last educational level. In all the six villages where the workshops were held, participants who have finished grade 7 were the most amongst. Figure 3.4.3 summarizes the numbers of all the respondents, who have participated in the workshop, by the educational level they have finished. As shown in the figure, respondents who have finished the grade 7 were by far the most, followed by grade 9, grade 5, and then nil, etc[7].

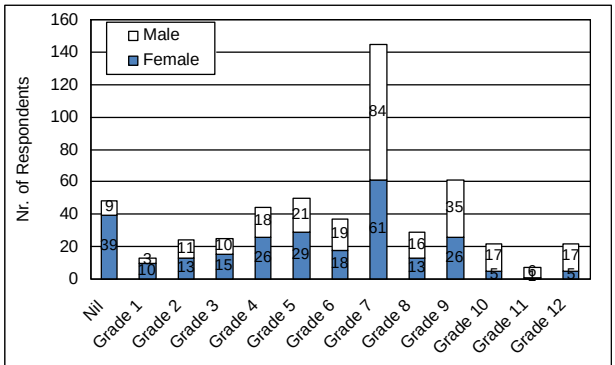


Figure 3.4.3 Last Educational Level by Gender

It is observed that there is a gender imbalance; e.g. 39 females responded they have not received any education while only 9 males not any, and its tendency that female respondents are more than male counterparts can be found in lower educational levels, say up to grade 5 while as going to higher educational levels beyond the grade 5, the tendency becomes reversed. More number of males can be

[7] Educational system in Zambia is; grade 1-7 for primary, grade 8-9 for secondary (also called basic) and grade 10-12 for high school. High school often covers from grade 8-12.

found in the higher educational levels than their female counterparts as 19 males vs. 18 females finished in grade 6, 84 males vs. 61 females in grade 7, 16 males vs. 13 females in grade 8, and so on.

9) Major Income Sources

Taking advantage of the workshop registration, their major income sources were also asked. Most income sources can be found in agricultural produces such as maize, cassava, beans, groundnuts, finger millet, vegetables, etc. In fact, it was only 6 % of the workshop participants who replied they had non-agricultural income source as their major source. In general, if a village can access FSP /FISP through their cooperative, they can and tend to produce maize. In this case, a part of the maize production can be sold, becoming one of their major income sources.

Above example can be found in Chipapa village and Mayanga village where 76% and 93% of the WS participants gave maize as one of their major income sources. Unique example is Saise village where there is no cooperative. They access subsidized fertilizer through neighbor village's cooperative, and therefore maize was identified as the top major income source for them. On the other hand, those villages of Lunda and Kalemba do not have cooperative and nor access to neighbor village's cooperative. In these villages, top two major income sources were beans and cassava, both of which do not require fertilizer.

Putting together all the major income sources listed from the WS participants of the six villages, Figure 3.4.4 summarizes the major income sources by percentage of who have replied them (in this question, plural answers were allowed if they have any). Top three income sources for the six villages are beans, maize, and cassava, all of which were listed by more than 50% of the WS participants. Followed were groundnuts (39%), finger millet (38%), and vegetables (23%), etc. Note is that the chart does not scale how much in monetary term they get from those income sources, but only indicate the kind of sources.

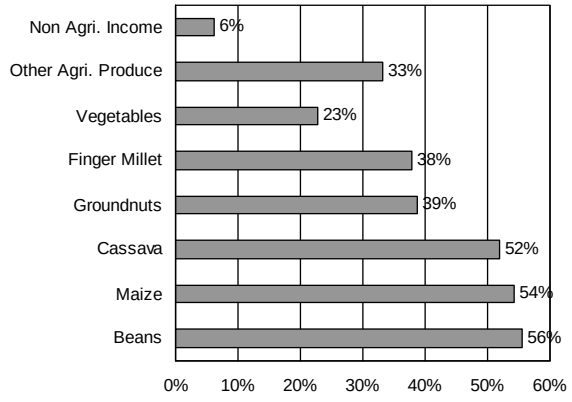


Figure 3.4.4 Major Income Source for the Six Villages
Source: JICA Study Team

10) Cash Income Level

During the registration for the workshop, annual income levels of the participants were roughly asked excluding Lunda village (this question was asked from the 2nd village, and therefore Lunda was excluded). The income here means only cash they have got, in that for example food production they have consumed is excluded. Figure 3.4.5 shows the cash income level by the cash range for the 5 villages while Figure 3.4.6 summarizes them by percentage of the shares according to the income levels.

Their income levels vary from village to village widely, however it can be said that more than half of the villagers annual income levels fall in a range of less than ZMK 1.0 million, equivalent to about US$ 190 as of May 2009. Modes show up in ranges of '0.5-1.0', '0.0-0.25', '0.0-0.25', '0.25-0.5', and '0.5-1.0' for Molwani, Kalemba Chiti, Chipapa, Saise, and Mayanga villages respectively. Average annual incomes arrived at about ZMK 1.66 million, ZMK 566,000, ZMK 1.15 million, ZMK 763,000, and ZMK 1.72 million for those villages respectively. For those villages whose average annual income is more than ZMK 1.0 million, the shares of lower income cadres such as less than 0.5 million earners are obviously lower as shown in the Figure 3.4.6 (see Molwani, Chipapa, and Mayanga).

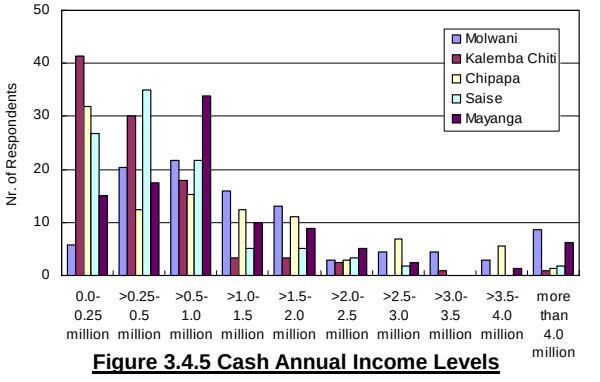


Figure 3.4.5 Cash Annual Income Levels

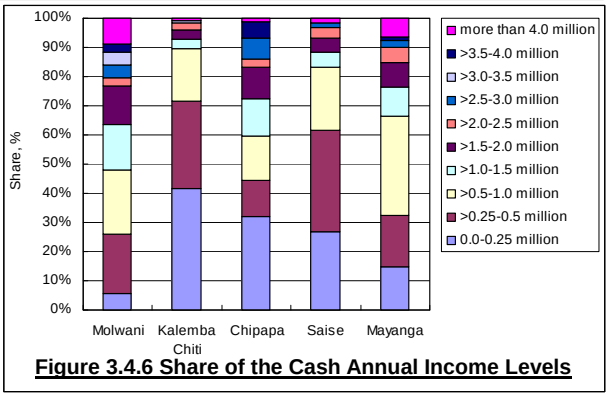


Figure 3.4.6 Share of the Cash Annual Income Levels

3.4.4 Issues Identified from Baseline Survey

A baseline survey was conducted in 2 dry seasons of 2009 and 2010. In fact, first batch of the baseline survey was carried out at the six villages where focus group interviews and village level workshops were also held. The additional batch of baseline survey was conducted to have further information especially for villages in Luapula province which were not covered in the first batch survey. The objective of the baseline survey was to set the baseline in order to measure the impact by smallholder irrigation. Section hereunder summarizes the baseline survey results.

1) Villages and Samples Covered by Baseline Survey

Basically, 30 households were covered[8] for the survey for both batches. The households were selected randomly covering different locations of the villages, and the survey team encouraged both husband and wife to join the survey together in order to get information as correctly as possible. Table 3.4.5 shows the villages covered by the baseline survey, indicating the name, number of households covered, and distance from the relevant district center (for the location, see the Figure 3.4.7).

Table 3.4.5 Villages Covered by Baseline Survey

District	Village name	No. of H/Hs	Distance from District Center	Remarks
Kasama	1. Lunda	30	25km	1st batch conducted in FY 2009 (181in total)
Kasama	2. Molwani	30	16km	
Mungwi	3. Kalemba Chiti	30	32km	
Mungwi	4. Chipapa	30	15km	
Mbala	5. Saise	31	28km	
Mbala	6. Mayanga	30	12km	
Luwingu	7. Mumba etc.	31	45km	2ndt batch conducted in FY 2010 (189 in total)
Mpika	8. Makashi etc.	30	20km	
Mporokoso	9. Kawikisha etc.	30	3km	
Kawambwa	10. Chisheta etc.	30	15km	
Mansa	11. Mutiti etc.	31	8km	
Nchelenge	12. Mulonda etc.	37	20km	
Total		370		

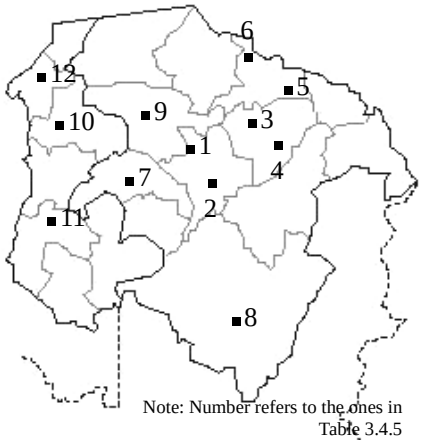
Source: JICA Study Team Note: More than 1 village were involved in the surveys carried out in Luwingu, Mpika, Mporokoso, Kawambwa, Mansa, and Nchelenge, for which the major village represents the others.

2) Family Structure

Figure 3.4.8 shows the demographic pyramid by 5-years strata of surveyed households. Number of male is slightly larger than that of female (F: 592, M: 605) and almost half of the population falls in under-15 years (46%). There is an indication that young villagers work outside the villages as shown in the population numbers in the ages of 25-29 and 30-34 for male and of 25-29 for female. According to some interviews, villagers often have their elder children working in district centers and even in

[8] Number of samples required for a statistical survey depends on the deviation of the parent population and its representativeness of the samples. However, if the parent population shows normal distribution, statistically significance number of samples is given by; number of samples = (level of significance ^2xP(1-P)/designed error where P is given 0.5. Given 5% of level of significance, required sample number is calculated at 384. Therefore, in this survey, approximately 370 – 380 samples were targeted taking into account resources available as well.

Lusaka and Copperbelt provinces.



Note: Number refers to the ones in Table 3.4.5

Figure 3.4.7 Location of the Villages
Source: JICA Study Team

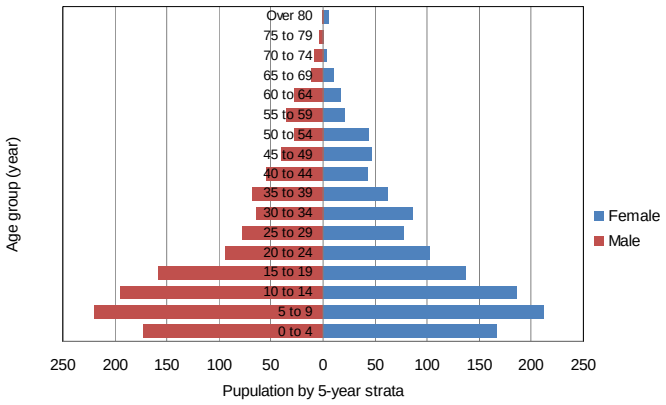


Figure 3.4.8 Demographic Pyramid of Surveyed HH
Source: Baseline Survey, JICA Study Team

One may see the population in 0 to 4 years old very less. Though the reason is not sure, one may say there is already low birthrate due mainly to family planning now promoted by the Ministry of Health. Or otherwise, since the baseline survey was administered to the members of irrigation schemes, they could be already older than those who are to have infant children. In fact, the average age of husbands interviewed is 45 years old while that of wives is 40 years old. From these average ages, there may be a possibility for them not to have infant children already.

Table 3.4.6 shows average number of family members per household, number of children under-15 years, dependent ratio and number of female-headed households interviewed. Number of the family members includes not only the blood related family members but also anybody who eats together in the same house, e.g. relatives, orphans taken care of by the household.

Number of family members per interviewed household ranges from 5.4 (Makashi, Mpika) to 8.9 (Molwani, Kasama) with an average of 7.0 members. Number of children under-15 years per household varies from 2.6 (Makashi, Mpika) to 4.0 (Mumba, Luwingu) giving a dependent ratio from 37% (Molwani, Kasama) to 58% (Mumba, Luwingu). Share for the female-headed households interviewed is from 3% (only one included) to as many as 23 % (7 households included) in Saise village of Mabala district.

Table 3.4.6 Summary of Family Structure

Village / district name	Average family members per H/H	Average family members under age 15	Dependent Ratio (% of U-15)	No. of F-HHs interviewed	
Lunda	7.5	3.8	51.3	5	(16.7)
Molwani	8.9	3.3	36.7	1	(3.2)
Kalemba Chiti	7.5	3.6	48.7	3	(10.0)
Chipapa	7.6	3.1	41.4	3	(10.0)
Saise	6.4	2.7	43.1	1	(3.2)
Mayanga	7.6	3.2	39.9	7	(23.3)
Mumba	6.9	4.0	58.2	1	(3.2)
Makashi	5.4	2.6	48.5	2	(6.7)
Kawikish	5.7	2.7	46.5	3	(10.0)
Chisheta	6.5	2.7	41.3	4	(13.3)
Mutiti	6.3	2.8	44.5	1	(3.2)
Mulonda	7.1	3.7	51.8	0	(-)
Average	7.0	3.2	46.0	2.6	(8.6)

Source: Baseline Survey, JICA Study Team. Note: Figures in parenthesis are %

3) Educational Level by Sex

Figures 3.4.9 and 3.4.10 show educational levels of the husband and wife by such categories as primary, basic, secondary and higher[9]. Share of the husbands in all the villages excluding Molwani who have received no education is lower than their spouses. Combined share of non-education and primary level for husbands is also lower than that of wives except for Saise village. This is to say, though it differs by village, educational level for husbands is generally higher than the wives.

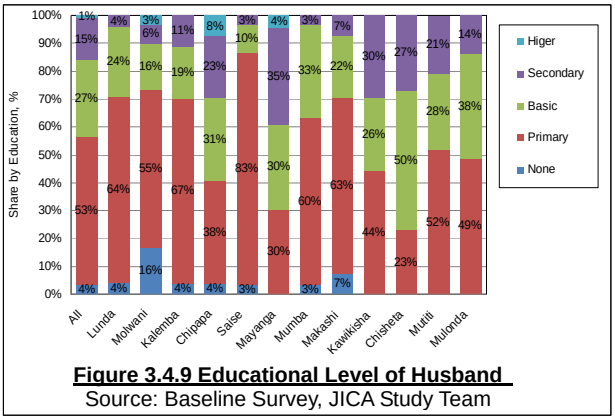


Figure 3.4.9 Educational Level of Husband
Source: Baseline Survey, JICA Study Team

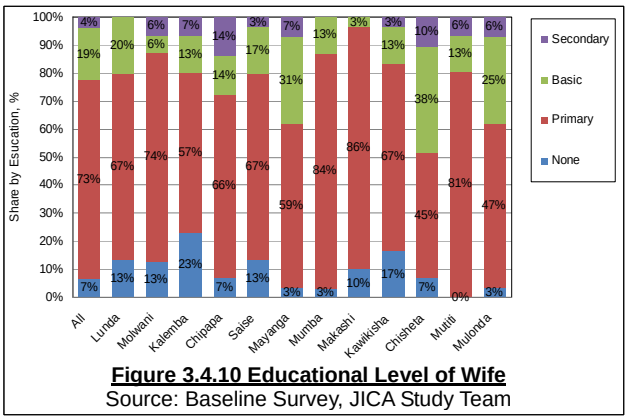


Figure 3.4.10 Educational Level of Wife
Source: Baseline Survey, JICA Study Team

Educational level in Higher can be found in the husbands of such 3 villages as Molwani (4%), Chipapa (7%) and Mayanga (4%), but none in wives. Molwani village is located at a place about 16km away from Kasama center, Chipapa about 15.0 km away from Kasama center and the Mayanga 11.5 km away from Mbala center. In addition, there is a secondary school within Mayanga village and in walking distance for Chisheta household. These situations seem to have contributed in raising their educational level but not much done same in the both sexes. The first who has received better education can be found in male.

4) Property and Asset Holdings

Table 3.4.7 shows property and asset holdings by village. It is learned that in all the villages more than 70% of the sampled households have radio, of which in 4 villages of Lunda, Molwani, Kalemba Chiti and Chipapa, more than 80% of the households have it. As for the TV, except for 3 villages namely, Kalemba Chiti, Saise, and Makashi, we can find out TVs. Kalemba Chiti, Makashi and Saise are located relatively deep in rural area where they have a difficulty of accessing the TV network, and this is the reason why we could not find out TV set.

There is a surprise, which is the high rate of possession of cell phone. Almost all the villages but Saise and Makashi are covered with constant cell phone network in fact. Cell phone has a function to receive text message when the person moves into the network area. By this reason and also thanks to the wide areas of network coverage, cell phone has become very popular in Zambia[10]. The ratio of the sampled households, who have cell phone, ranges from 9.7% (3 out of 31 sampled households in Saise village, Mbala district) to as high as 63% (19 out of 30 sampled households in Chisheta, Kawambwa district) with an average of 44%. Cell phone is used for communication with CEO and middleman etc. for the information on the fertilizer distribution, price of the produce, etc.

Bicycle is recognized as an important tool for agricultural marketing in those villages and more than half of the households interviewed own bicycle (average is 75%). Household without bicycle takes

[9] Primary education covers from Grade 1 to Grade 7, Basic from Grade 8 to Grade 9, and Secondly from Grade 10 to Grade 12 in Zambia. After the secondary, higher or called tertiary education starts for collage and university.
[10] As a matter of fact, all the CEOs who have participated in the kick-off training of smallholder irrigation development in April 2009 and also May 2010 have got cell phone.

their produce either by walk or hiring other farmers' bicycle, but it costs ZMK 5,000 / trip[11] for hiring it and not always available at their convenient time. Therefore villagers tend to own bicycle (bicycle costs them ZMK 250,000 to 450,000 according to the interview at Mansa center in July 2010).

Crop sprayer is also recognized as an important item for those farmers who cultivate vegetables. The ratio ranges about 3 % (only 1 household in Chipapa, Mumba and Chisheta) to 42% (13 out of 31 sampled households in Molwani village) with an average of 16%. Higher possession rate of crop sprayer corresponds to the higher application of agricultural chemicals in villages such as Molwani (Kasama district) and Mulonda (Nchelenge district) where possession rate of crop sprayer exceeds over 40 % (In fact, concerning tomato, 85% of Molwani and 95 % of Mulonda farmers applied agricultural chemicals to tomato). Nevertheless, the application ratio of agricultural chemical is not still so high in some villages. For example, concerning tomato, only 25% of Chipapa, 33% of Lunda and 42% of Chisheta tomato growers have applied the chemical while the overall average of those who applied the chemicals on tomato was 68%.

Houses with iron sheet roof are not so many except for Mumba (Luwingu district) where 12 (40%) of the surveyed households have it. It ranges from 3% (one household in Lunda, Kalemba, Saise and Makashi) to 19% (6 out of 30 sampled households in Chipapa, Mayanga and Chisheta) in the rest of the 11 villages. Houses with iron sheet roof are regarded as one of rich farmers' characteristics according to the interviews. It may seem strange that Mumba (Luwingu district) has the largest percentage because level of income and consumption there is estimated as one of the lowest among the 12 villages. Some sampled farmers who own the house with iron sheet roof in Mumba village explained that they bought it in Kitwe (in Copperbelt) where iron sheet is sold rather cheaper than Luwingu center when they went there for selling their produce with one of farmer's truck. They further explained that they had been troubled with grass-thatched houses by heavy rain or bush fire (it even damaged crops stored).

Table 3.4.7 Asset and Property Holdings

Village	Radio		TV		Cell Phone		Bicycle		Crop Sprayer		Iron Sheet Roof	
	Nr.	%	Nr.	%	Nr.	%	Nr.	%	Nr.	%	Nr.	%
Lunda	24	80.0	6	20.0	12	40.0	25	83.3	7	23.3	1	3.3
Molwani	29	93.5	9	29.0	17	54,8	23	74.2	13	41.9	5	16.1
Kalemba	25	83.3	0	0.0	8	26.7	22	73.3	5	16.7	1	3.3
Chipapa	24	80.0	8	26.7	16	53.3	18	60.0	1	3.3	6	20
Saise	19	61.3	0	0.0	3	9.7	17	54.8	3	9.7	1	3.2
Mayanga	19	63.3	5	16.7	11	36.7	24	80.0	3	10.0	6	20.0
Mumba	20	64.5	2	6.5	19	61.3	25	80.6	1	3.2	12	38.7
Makashi	19	64.3	0	0.0	7	23.3	21	70.0	4	13.3	1	3.3
Kawikish	18	60.0	9	30.0	15	50.0	26	86.7	2	6.7	2	6.7
Chisheta	20	66.7	11	36.7	19	63.3	22	73.3	1	3.3	6	20.0
Mutiti	22	71.0	10	32.3	16	51.6	26	83.9	6	19.4	4	12.9
Mulonda	28	75.7	4	10.8	23	62.2	30	81.1	15	40.5	4	10.8
Total (Average)	267	72.0	64	17.4	166	43.5	279	75.1	61	15.9	49	13.2

Source: Baseline Survey, JICA Study Team

5) Livestock Holdings

Livestock holdings differ by kind and also among villages. Most of the households in every village own chicken (60 % to 97 %) and its number per owned-household is around 11. Chickens are very often served in special occasions such as Christmas, New Year, wedding ceremony and for special guest visit for the household. In these occasions, a whole chicken is usually served.

[11] In a focus group interview in Kalemba Chiti village, participants explained that the price of hiring of the bicycle is ZMK 5,000 /trip, which is not cheap. With this reason also, villagers want to possess bicycle on his/her own.

As for cattle, such three villages as Lunda, Saise and Mayanga own some but not so many. In Lunda village, 7 households out of the 31 sampled households own cattle for beef purpose, in Saise only one household owns a pair of bull, that is for droughting purpose, and in Mayanga there are four households owing cattle for beef purpose. As for Makashi case, 6 households out of the 31 sampled household own cattle and they started to raise the cattle under the support of ZAWA (Zambia Wildlife Authority). Cattle is used for taking the produces to the market and for droughting for both of owners and other farmers in the village.

Goat can be found in all the villages except for Mtiti (Mansa district) with the owner households ranging from as low as only 2 in Chipapa (Mungwi district) to the maximum of 23 households in Mulonda (Nchelenge district). Number of goats owned by a typical household is not so many, ranging from only 3 to a maximum 7 heads only. Though no goats are found in Mtiti village (Mansa district), this is because villagers experienced crop damage by goats and stopped raising them.

Pigs are owned to a lesser extent than goats in most villages expect for Makashi village (Mpika district) and Mtiti village (Mansa district) and number of pigs owned by a typical household is 1 to 7 heads. Fishpond can be found out in five villages of Lunda, Molwani, Kalemba Chiti, Kawikisha and Mtiti. Fish ponds can be a very good venue which provides protein as well as being an income source.

Table 3.4.8 Livestock Holdings by Kind and by Village

Village name	Chicken		Cattle		Goat		Pig		Fish pond	
	Nr. (%)	Unit/HH	Nr. (%)	Unit/HH	Nr. (%)	Unit/HH	Nr. (%)	Unit/HH	Nr. (%)	Unit/HH
Lunda	18 (60.0)	10.8	7 (23.3)	2.6	3 (10.0)	4.7	1 (3.3)	1.0	4 (13.3)	3.8
Molwani	27 (87.1)	13.0	0	-	5 (20.0)	4.0	0	-	3 (9.7)	1.7
Kalemba Chiti	29 (96.7)	7.7	0	-	5 (16.7)	2.8	9 (30.0)	2.4	1 (3.3)	2.0
Chipapa	25 (83.3)	9.7	0	-	2 (6.7)	4.0	1 (3.3)	2.0	0	-
Saise	20 (64.5)	7.8	1 (3.2)	2.0	12 (38.7)	5.3	10 (32.3)	1.6	0	-
Mayanga	25 (83.3)	10.1	4 (13.3)	4.3	12 (40.0)	6.3	8 (26.7)	4.1	0	-
Mumba	27 (87.1)	10.8	1(3.2)	2.0-	14(45.2)	3.2	10 (32.3)	4.1	0	-
Makashi	25 (83.3)	13.0	6 (20.0)	5.3-	4 (13.3)	5.5	12 (40.0)	2.5	0	-
Kawikish	29 (96.7)	7.7	0	-	7 (23.3)	7.0	4 (13.3)	2.8	1 (3.3)	1.0
Chisheta	22 (73.3)	9.7	0	-	15 (50.0)	4.8	1 (3.3)	1.0	0	-
Mutiti	29 (93.5)	9.7	0	-	0	-	10 (32.3)	2.5	1 (3.2)	1.0
Mulonda	30 (81.1)	12.8	0	-	23 (62.2)	5.6	3 (8.1)	7.3	0	-
Total/average	162 (85.7)	10.6	7 (3.7)	3.7	63 (33.3)	5.2	40 (21.1)	3.4	2 (3.2)	1.0

Source: Baseline Survey, JICA Study Team. Note: Figures in parenthesis are %.

6) Drinking Water and Water Treatment

Source of drinking water and its treatment are summarized in Table 3.4.9 below. There are mainly two water sources; pond/ stream and dug well and averagely speaking, 65% of surveyed households utilize the pond /stream for drinking water. For water treatment, mainly two measures, e.g., chlorine and boiling are employed. Chlorine is nowadays available even in rural kiosks at a price of ZMK 1,000 per 350 ml bottle. An NGO also provided a sanitation improvement programme to Saise village together with the distribution of chlorine.

Table 3.4.9 Drinking Water Sources and Its Treatment

Village name	Source of drinking water				Water treatment					
	Pond/ stream		Dug well		Chlorine		Boiling		No treatment	
	Nr.	%	Nr.	%	Nr.	%	Nr.	%	Nr.	%
Lunda	23	76.7	7	23.3	4	13.3	4	13.3	22	73.3
Molwani	10	32.3	21	67.7	18	58.1	4	12.9	9	29.0
Kalemba Chiti	23	76.7	7	23.3	19	63.3	5	16.7	6	20.0
Chipapa	22	73.3	8	26.7	4	13.3	5	16.7	21	70.0
Saise	31	100	0	0	30	96.8	1	3.2	0	0
Mayanga	30	100	0	0	1	3.3	3	10.1	26	86.7
Mumba	29	93.5	2	6.5	2	6.5	0	0	29	93.5

Makashi	27	90	3	10	5	16.7	4	13.3	21	70.0
Kawikish	23	76.7	7	23.3	11	36.7	2	6.7	17	56.7
Chisheta	16	53.3	14	46.7	9	30	1	2.2	20	66.7
Mutiti	0	0	31	100	12	38.7	5	16.1	14	45.2
Mulonda	1	2.7	36	97.3	36	97.3	0	0	1	2.7
Average	235	64.6	136	35.4	151	39.5	34	9.3	186	51.2

Source: Baseline Survey, JICA Study Team. Note: Because some households utilized multiple water source/ treatment, the total is more than 100 % in some villages.

On the other hand, there are still many villagers who do not carry out any treatment. There are five villages which percentage exceeds 70%, namely Lunda (73%, Kasama), Chipapa (70%, Mungwi), Mayanga (87%, Mbala), Mumba (94%, Luwingu), and Makashi (70%, Mpika). These villages can access streams with a sizable flow volume. For those sources, they think it is not risky to take as it is. Therefore more than half of the sampled households for these villages do not carry out any treatment on the domestic water.

7) Information Source of Agricultural Knowledge and Technology

The baseline survey also asked their sources on agricultural knowledge and technology. The results for all the villages are summarized in Figure 3.4.11. Extension officer and family members are the most dominant information sources, followed by extension programme of donors, NGOs and the government, and radio programme. There are farmers who have sourced agricultural information from colleague farmers outside his/her village and also within the village. They have been counted at 49 and 48.

Figure 3.4.12 and Figure 3.4.13 show the frequency of CEO visit and listening to radio extension programme respectively. Almost half of the respondents (43%) answered that they have chance to see CEO more than once a month, and more than half of the respondents (55%) answered that they listen to the radio extension program almost every week. In fact, it reaches 70% of respondents listen to the radio extension programme if the responses of "seldom, none and NA" are excluded.

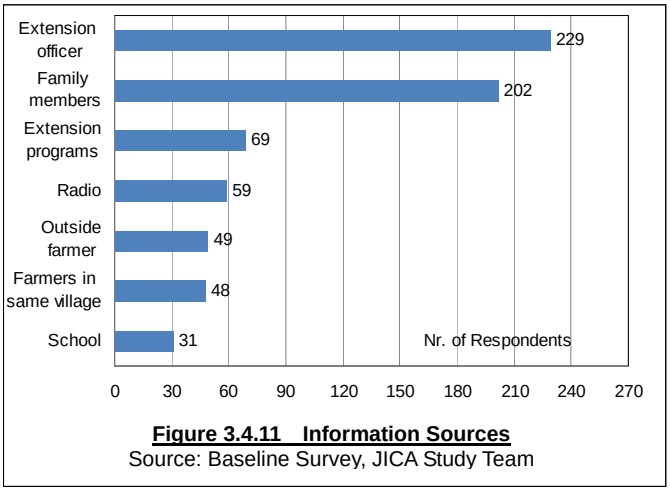


Figure 3.4.11 Information Sources
Source: Baseline Survey, JICA Study Team

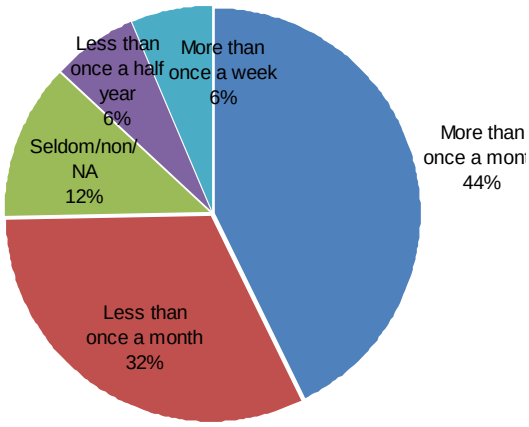


Figure 3.4.12 Frequency of CEO Visit
Source: Baseline Survey, JICA Study Team

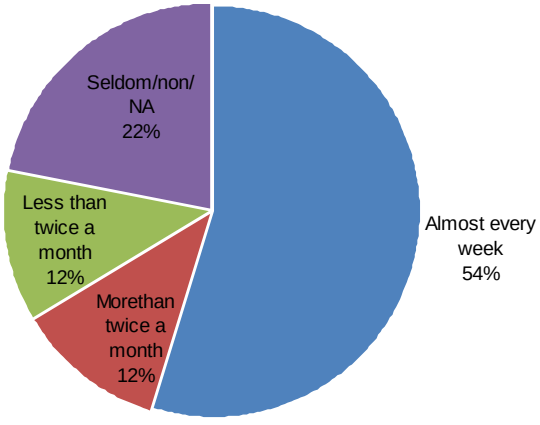


Figure 3.4.13 Frequency of Listening to Radio Program
Source: Baseline Survey, JICA Study Team

There are several regular radio extension programmes available not only managed by MACO's NAIS (National Agricultural Information Services) but also Zambian National Farmers' Union etc. These programs are broadcasted in farmers' convenient time (early morning or evening when farmers are in the house before / after the field work) and some are broadcasted more than once a week. These factors contribute to the high percentage of those listening to the radio programme.

8) Debt

In the latter part of the baseline survey, the situation of borrowing money was asked. Expect for Lunda village (Kasama district) and Mumba village (Luwingu district), more than 80% of the respondents answered that they do not have any debt as shown in the Figure 3.4.14. Next Figure 3.4.15 shows the sources of borrowing money. First contact person tends to be relatives and rather rich family in the same village. If fails, they resort to lender outside. Some of respondents borrow the money from cooperative, church and bank too. None of the borrower had to submit any mortgage when they borrowed money, though.

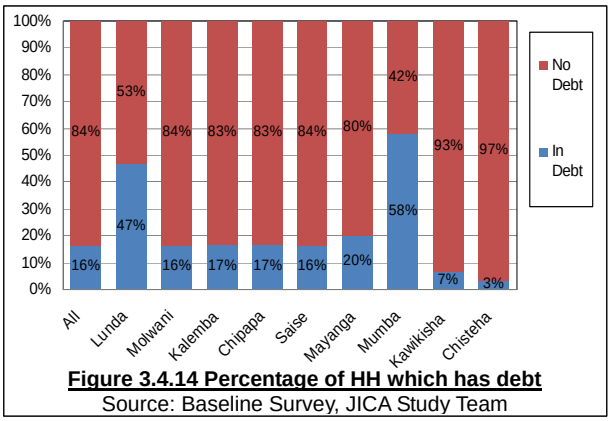


Figure 3.4.14 Percentage of HH which has debt
Source: Baseline Survey, JICA Study Team

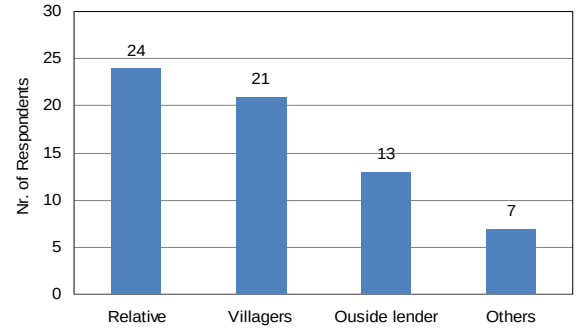


Figure 3.4.15 Source of borrowing money
Source: Baseline Survey, JICA Study Team

Figure 3.4.16 shows amount of money they have borrowed. Almost half of the respondents have debt more than ZMK 100,000. On the other hand, respondents with debt less than ZMK 60,000 is also more than one-third (36%) and many of the respondents (64%) who borrowed the money for the food falls in this category. Food is the most dominant reason for borrowing money, followed by for education as shown in the Figure 3.4.17. "Others" include house construction / maintenance, repair fee for radio / bicycle and clothing.

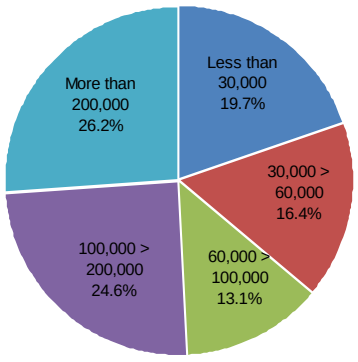


Figure 3.4.16 Amount of debt and its share
Source: Baseline Survey, JICA Study Team

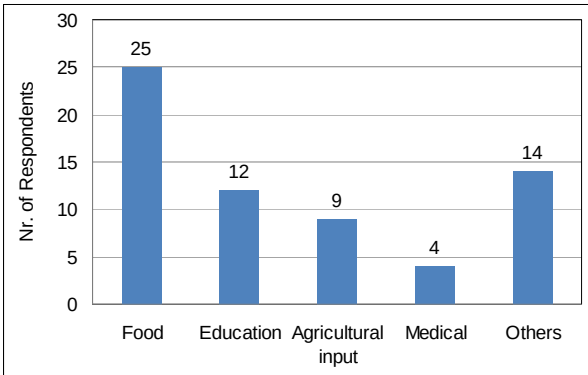


Figure 3.4.17 Purpose of Borrowing Money
Source: Baseline Survey, JICA Study Team

3.4.5 Income and its Distribution

Based on the results of the baseline survey, this sub-chapter examines the income level of the sampled households and also their distribution by examining Gini index. There should be inequality in

villagers' income. The inequality itself may be justified if it is not so big since it may spur people's competition towards economic vigorous activities. However, if the inequality between the rich and poor, or between the Haves and Have-nots, are considerably high, it may not be accepted socially and social security cost may arise. Here the villagers' income level as well as the magnitude of the inequality is examined.

1) Estimation of Income

Estimating a villager's income needs a bit of techniques. Here in this Study, the income is defined as the cash the household has got from any kind of economic activities and plus the monetary value of any kind of production converted with farm gate price less necessary inputs. The former is very simple, e.g. cash from vegetable selling, remittance, wage work, etc. and for the latter, for example, agriculture production is once valued with prevalent farm gate price at the area and its relevant gross income is subtracted by necessary input e.g. chemical fertilizers. Therefore the latter is counted as net agriculture profit, net livestock profit if she/he has sold a livestock, and alike.

Table 3.4.10 and Figure 3.4.18 summarize the annual income by village, and in addition the table shows the income only from food crop, which is the majority of all the income sources. Food crop here means any food either it is staple or relish produced. Then, the table further explores how much their disposable incomes are; the disposable income is defined here as the annual income less the monetary value of what the people have self-consumed. From the table and the figure, it is obvious that the income of Mulonda (Nchelenge district) is by far bigger than those of other villages. This is because the sampled village is blessed with market including buyers from DRC and the soil is fertile. Farmers there apply a lot of fertilizer and whereby they gain high yield, and of course can enjoy very high farm gate price. With this specific situation, the average, median, and the 1st quartile are examined by 2 cases, namely, with Mulonda and without Mulonda. Following are pointed out;

i) Annual income, including self-consumed food, ranges ZMK 2.92 million (Mumba, Luwingu district) to as much as ZMK 16.32 million (Mulonda, Nchelenge district). Village showing the least income is Mumba with ZMK 2.92 million, followed by Saise with ZMK 3.43 and Kalemba Chiti with ZMK 4.06 million. Mumba, Saise and Kalemba are located in relatively remote area; 45km from Luwingu center (farthest among the surveyed village), 28 km from Mbala center and 32 km from Kasama center respectively. Mulonda (Nchelenge district) shows the highest income of ZMK 16.32 million, followed by Mayanga (Mbala district) with ZMK 6.82 million and Chiesheta (Kawambwa district) with ZMK 5.80 million.

ii) Overall average annual income, including self-consumed food, for the total 12 villages arrives at ZMK 5.82 million while the average without Mulonda is ZMK 4.67 million. Median annual income is ZMK 3.98 million and ZMK 3.69 million respectively. First quartile annual income is ZMK 2.44 million and ZMK 2.27 million for the cases of with Mulonda and without Mulonda respectively.

iii) As is expected, food crop income shares the majority of the income. The food crop income ranges from ZMK 2.54 million at Saise to ZMK 10.98 million at Mulonda (excluding Mulonda is ZMK 4.22 million at Chisheta village, Kawambwa district), with an overall average of ZMK 4.11 million including Mulonda and ZMK 3.36 million excluding Mulonda. The food crop based income shares 53% at Mayanga (Mbala district) to as much as 92 % at Makashi (Mpika district) of the total annual income. The overall average share of the food crop income against the total income arrives at 71% including Mulonda and 72 % excluding Mulonda.

iv) Annual income extracting self-consumed crops, equivalent to disposable income, ranges from ZMK 2.29 million at Saise to ZMK 14.75 million at Mulonda (2nd biggest is ZMK 5.51 million at

Mayanga). The overall average is ZMK 4.39 million including Mulonda and ZMK 3.26 million excluding Mulonda. As compared with total annul incomes including self-consumed ones, which are ZMK 5.82 million (with Mulonda) and ZMK 4.67 million (without Mulonda), there found balance of ZMK 1.43 million and ZMK 1.41 million respectively. These balances are the monetary value of what the people self-consumed.

v) Disposable food crop income which comes actually from the crops sold shares about 37 % (Chipapa, Mungwi) to 88 % (Makashi, Mpika) with the average of 61% for with Mulonda and 60% for without Mulonda. This examination suggests us that approximately half the disposable income comes from the food crops sold while the rest, another half of the disposable income, comes from those other than food crops. The other income sources are carpentry, brick making, making charcoal, selling goods, wage labor, etc.

Table 3.4.10 Annual Total Income and Food Crop Income by Village

Village	Valid Sample Nr	Annual Total Income million ZMK	Food Crop Income		Annual Total Income (excluding self consumption) Million ZMK	Food Crop Income (excluding self consumption)		Remarks district
			M ZMK	%		M ZMK	%	
Lunda	29	**4.47**	2.61	58%	2.97	1.20	40%	Kasama
Molwani	29	**5.33**	3.92	74%	3.33	1.93	58%	Molwani
Kalemba Chiti	30	**4.06**	3.45	85%	2.60	1.99	77%	Mungwi
Chipapa	30	**5.85**	3.22	55%	4.20	1.57	37%	Mungwi
Saise	31	**3.43**	2.54	74%	2.29	1.38	60%	Mbala
Mayanga	30	**6.82**	3.64	53%	5.51	2.33	42%	Mbala
Mumba	31	**2.92**	2.58	88%	2.30	1.96	85%	Luwingu
Makashi	30	**4.27**	3.91	92%	2.90	2.56	88%	Mpika
Kawikisha	30	**4.30**	3.01	70%	3.11	1.83	59%	Mporokoso
Chisheta	30	**5.80**	4.22	73%	4.03	2.47	61%	Kawambwa
Mutiti	31	**4.56**	4.05	89%	2.86	2.35	82%	Mansa
Mulonda	36	**16.32**	10.98	67%	14.75	9.41	64%	Nchelenge
Total w/ Mulonda	367	**5.82**	4.11	71%	4.39	2.69	61%	
Median		**3.98**	2.96	74%	2.53	1.54	61%	
1st quartile		**2.44**	1.71	70%	1.44	0.58	40%	
Total w/o Mulonda	331	**4.67**	3.36	72%	3.26	1.95	60%	
Median		**3.69**	2.65	72%	2.26	1.43	63%	
1st quartile		**2.27**	1.58	70%	1.32	0.46	35%	

Source: Baseline Survey, JICA Study Team.

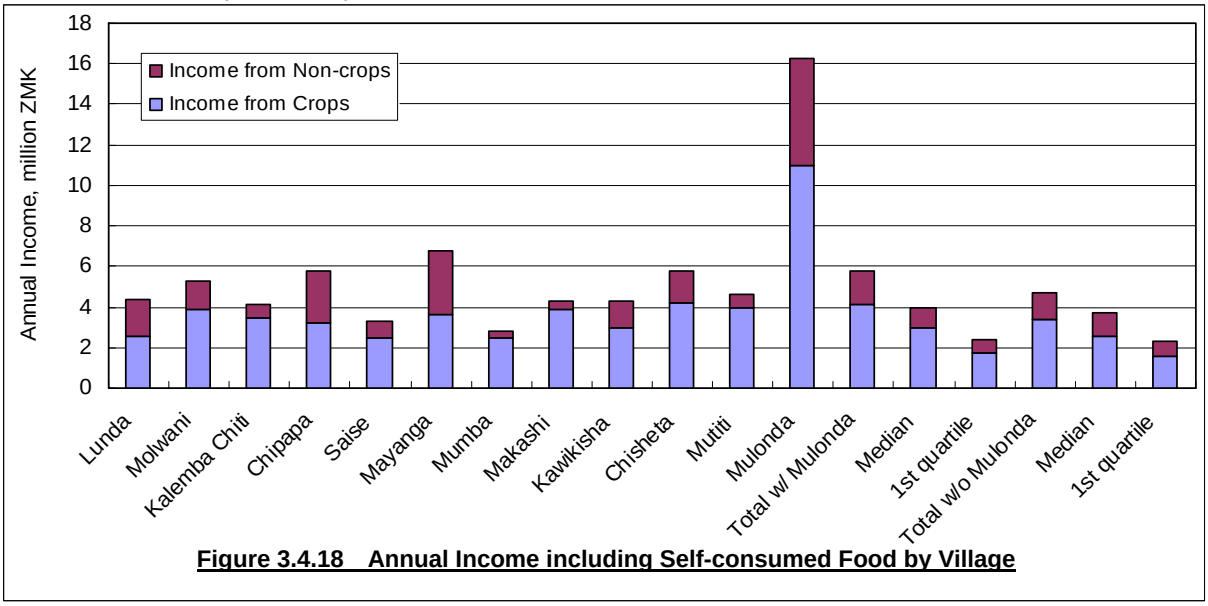


Figure 3.4.18 Annual Income including Self-consumed Food by Village

2) Measuring of the Inequality: Gini Index

To measure the inequality among the sampled households, Gini index is employed in this Study. Gini index is understood by the geometry definition "area enclosed by the Lorenz curve and the diagonal". If one takes the horizontal axis as the cumulative share of people from lower income and draw the cumulative share of income earned, then the curve becomes Lorenz curve, and the area between the curve and the straight line (diagonal = even distribution line) becomes Gini index (the triangular area composed of the axis and the diagonal is assumed to be 1.0).

Given the magnitude of the Gini index, one can understand the value of the Gini index as the degree of income inequality. The Gini Index is, for example, 0.3 in "the society where one king owns 30 % of the whole income and the other people have the others" and also in "the society where a powerful group consisting of 70% of the whole population gets all income and the rest population of 30% gets nothing"[12]. There is no clear definition of the difference in this case. Table 3.4.11 presents a standard to understand the degree of inequality according to the value of the Gini Index.

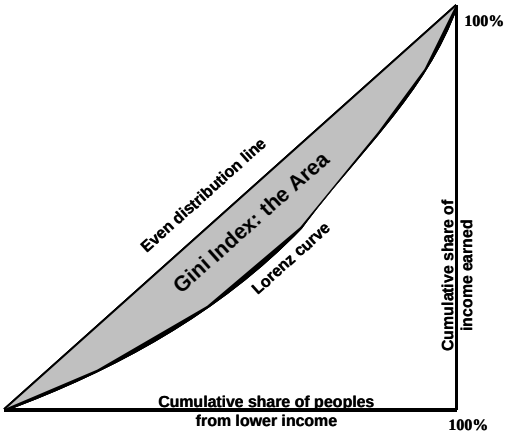


Figure 3.4.19 Gini Index on Lorenz Curve

Table 3.4.11 Standard Interpretation of Gini Index

Gini Index	Standard Interpretation of Gini Index
Less than 0.1	There is an artificial background for leveling.
0.1 – 0.2	Though considerably equal, there is an anxiety to obstruct the effort to the improvement.
0.2 – 0.3	Usual distribution type that exists in general in society.
0.3 – 0.4	Though there are some differences, there is also a desirable respect in the improvement through competition.
0.4 – 0.5	The difference is serious.
Over 0.5	The improvement is required except under special circumstances

Source: Wikipedia

Figure 3.4.20 shows the Lorenz curves for the 12 villages and also the total of them (because income of Mulonda village is far larger than others, Lorenz curve for total is calculated both by including / excluding Mulonda), based on which Gini indexes are calculated. In addition, Figure 3.4.21 illustrates the income distribution by village and by such levels as less than ZMK 2 million, 2 – 3 million, 3 – 5 million, 5 – 7 million and more than ZMK 7 million. Table 3.4.12 summarizes the aforementioned total income, food crop income (both including the self consumption and excluding it, namely cash income only) and corresponding Gini indexes by category and village. From the table, it is learnt that:

i) The Gini index for total income varies from 0.25 in Makashi (Mpika district) and Chipapa (Mungwi district) being the lowest to as much as 0.37 in Molwani villages (Kasama ditrict) with an overall average of 0.40 (0.35 excluding Mulonda). Gini index for food crop income also varies from 0.26 in Mpika to 0.45 in Molwani with an overall average of 0.41 including Mulonda and 0.37 without Mulonda. Gini indexes for both the annual and crop incomes for the total 12 villages are bigger than those Gini index excluding Mulonda. This is because the income in Mulonda village is by far higher than those of other villages (see Figure 3.4.18), raising the inequality of the income with higher Gini index.

ii) Gini index for food crop income is not much different from those for annual total income, ranging from 0.26 in Makashi (Mpika district) to o.45 in Molwani (Kasama district). The reason why the Gini index for food crop income is not much different from those of annual total income could be

[12] This Gini Index is decided by the area, and is not related to the shape of the Lorenz curve. Therefore, even if the ratio of a rich layer to the poor layer is different, the Gini Index may become the same in some cases.

derived from the fact that the share of food crop income occupies the most of the total income. In some villages, however, Gini index for food crop income is somewhat higher than that of annual total income, e.g. in Molwani village 0.45 vs. 0.37, in Chipapa 0.30 vs. 0.25, in Saise 0.40 vs. 0.34. In these villages, scale of the agriculture among the sampled farmers may vary to the extent more than their total income varies.

iii) Gini index for annual total income excluding the self-consumed food crop becomes higher than those Gini indexes including self-consumed food crops. It ranges from 0.29 in Makashi (Mpika district) to as high as 0.52 in Lunda (Kasama district). The overall average Gini index arrives at 0.47 with Mulonda and 0.42 without Mulonda. It means the disposable income for the sample households varies more than total income including the self-consumed food. This situation becomes severe when looking into the Gini index for the income from food crop excluding self-consumed food crop. It ranges from 0.30 in Makashi (Mpika district) to as high as 0.58 in Lunda (Kasama) and Saise (Mbala) with the average of 0.53 with Mulonda and 0.48 without Mulonda.

iv) In sum, as far as it is concerned to annual total income including self-consumed food crops, the inequality in the income of the sampled households is not quite big. The magnitude of the Gini index can be considered as only some differences in their total income, for which there is also a desirable aspect in the economic improvement through competition. However, when looking into disposable annual income, the difference is already more than 0.4 in about half of the villages, which means the inequality is somewhat already serious. In those villages, there may be different people who have fetched good income opportunities including agriculture while the others may not.

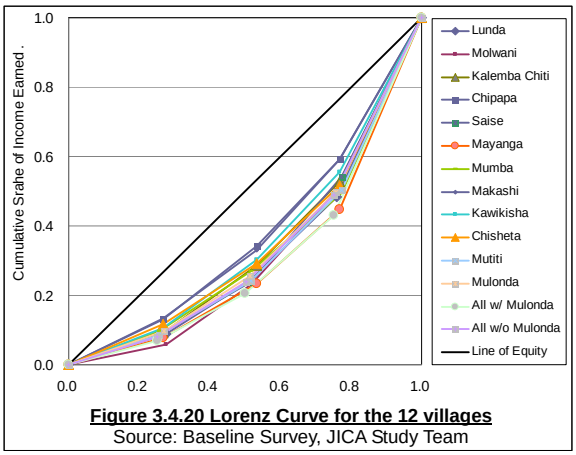


Figure 3.4.20 Lorenz Curve for the 12 villages
Source: Baseline Survey, JICA Study Team

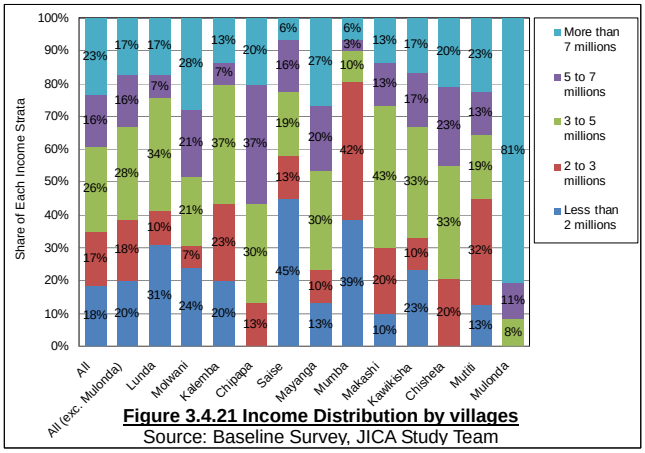


Figure 3.4.21 Income Distribution by villages
Source: Baseline Survey, JICA Study Team

Table 3.4.12 Annual Income and Its Distribution (Gini Index) Amongst Villagers

Village	Valid Sample Nr	Average Income / Household, million ZMK						Gini Index			
		Annual Total Income	Food Crop Income		Annual Total Income (excluding self consumption)	Food Crop Income (excluding self consumption)		Annual Total Income	Food Crop Income	Annual Total Income (excluding self consumption)	Food Crop Income (excluding self consumption)
Lunda	29	**4.47**	2.61	58%	2.97	1.20	40%	**0.36**	0.38	0.52	0.58
Molwani	29	**5.33**	3.92	74%	3.33	1.93	58%	**0.37**	0.45	0.43	0.54
Kalemba Chiti	30	**4.06**	3.45	85%	2.60	1.99	77%	**0.33**	0.34	0.40	0.47
Chipapa	30	**5.85**	3.22	55%	4.20	1.57	37%	**0.25**	0.30	0.31	0.47
Saise	31	**3.43**	2.54	74%	2.29	1.38	60%	**0.34**	0.40	0.44	0.58
Mayanga	30	**6.82**	3.64	53%	5.51	2.33	42%	**0.36**	0.38	0.49	0.55
Mumba	31	**2.92**	2.58	88%	2.30	1.96	85%	**0.35**	0.37	0.40	0.44
Makashi	30	**4.27**	3.91	92%	2.90	2.56	88%	**0.25**	0.26	0.29	0.30
Kawikisha	30	**4.30**	3.01	70%	3.11	1.83	59%	**0.30**	0.29	0.39	0.42

Chisheta	30	**5.80**	4.22	73%	4.03	2.47	61%	**0.32**	0.33	0.40	0.47
Mutiti	31	**4.56**	4.05	89%	2.86	2.35	82%	**0.36**	0.32	0.39	0.40
Mulonda	36	**16.32**	10.98	67%	14.75	9.41	64%	**0.34**	0.37	0.36	0.40
Total w/ Mulonda	367	**5.82**	4.11	71%	4.39	2.69	61%	**0.40**	0.41	0.48	0.53
Median		**3.98**	2.96	74%	2.53	1.54	61%	**-**	-	-	-
1st quartile		**2.44**	1.71	70%	1.44	0.58	40%	**-**	-	-	-
Total w/o Mulonda	331	**4.67**	3.36	72%	3.26	1.95	60%	**0.35**	0.37	0.42	0.48
Median		**3.69**	2.65	72%	2.26	1.43	63%	**-**	-	-	-
1st quartile		**2.27**	1.58	70%	1.32	0.46	35%	**-**	-	-	-

Source: Baseline Survey, JICA Study Team.

3.4.6 Expenditure and Poverty Line

This session explores the expenditure pattern for the sampled households in the baseline survey. The reason of examining the people's expenditure pattern is to know the poverty line based on Cost of Basic Needs method, and also to know the poverty ratio, how much percentage of people fall under the poverty line and how far they are from the line, whereby how much is needed to uplift them to the poverty line. This exercise provides us of how much smallholder irrigation can contribute to raising the poor people towards the poverty line. Quantitative indications are thus provided, which can refer to the impact of smallholder irrigation development in relation to poverty line.

1) Poverty Line under this Study

Under Cost of Basic Needs method, there are conventionally 3 poverty lines; 1) Food Poverty Line, 2) Non-food Poverty Line and 3) the Poverty Line. Food Poverty Line is the minimum food expenditure in monetary term necessary to pay for a consumption basket that will satisfy caloric requirements of a representative household's members. Poverty Line is defined as the sum of Food Poverty Line and reasonable non-food expenditure to meet basic human needs, which is the non-food poverty line. The non-food line is usually calculated as the non-food expenditure for those whose total food expenditures are at around the food poverty line.

1.1) Food Poverty Line

To establish the Food Poverty Line, we need to calculate the caloric requirement for an adult equivalent person for a representative household. This Study employs 2,750 kcal per adult equivalent per day as the basis of the requirement according to Living Conditions Monitoring Survey Report 2004, CSO, and also conversion factors on calorie requirement for child are those proposed by the Survey Report as: 0.36. 0.62, 0.78, 0.76 and 1.0 for 0-3 years, 4-6 years, 7-9 years, 10-12 years and over 12 years and adults.

Next step is to establish a food basket, based upon what the population actually consumes, in order to know how much food and also converted monetary value they need to meet the basic caloric requirement of 2,750 kcal per day per adult equivalent. To establish the food basket, this Study refers to the actual food composition for the sampled households of the baseline survey. Tables 3.4.13 and 3.4.14 show representative food items which are actually consumed by the sampled households, necessary food consumption scaled up to meet the basic requirement of 2,750 kcal per adult equivalent, calories contained in each food items[13], calorie contribution by food item, cost contribution by food item, etc. From the 2 tables, following are found:

i) Upon converting the food they consume into relevant calories, the sum of consumed calories arrives at 2,411 kcal per day per adult equivalent, which is 88% of the requirement of 2,750 kcal. It means a typical adult consumes food less 339 kcal per day than what he/she needs in order to

[13] Calorie values came from FAO calorie conversion table of 1985, and calorie recommendations by the Ministry of Agriculture of Japan, etc.

maintain his/her physical body. In order for them to meet the requirement of 2,750 kcal per day per adult equivalent, the contents in their food basket should be increased by 1.14 times (2,750/ 2,411).

ii) Most of the calorie comes from cereals and starch as they are called the energy source for human body. They consume about 203 kg of cereals per year per adult equivalent, composed of maize, cassava and millet. In addition, they consume sweet potatoes of 39 kg per day per adult equivalent which can also be a staple food. In Zambia, it is generally said that a typical adult needs about 200 kg of cereals per year. From this fact, one may say their staple food eaten almost meets what they have to consume from the calorie point of view and thereby food other than staples may not be enough to consummate the requirement of 2,750 kcal or otherwise the level of 2,750 kcal itself might be a concern[14]. In this sense, their diet may tend to be too much carbohydrate-oriented.

iii) The food poverty line now arrives at 'ZMK 1,192,226 per year per adult equivalent (US$ 228.6 at the rate of ZMK 5,215 as of July 2010)'. When we look at the composition to the calorie requirement of 2,750 kcal, what contributes the most is of course cereals such as maize, cassava and millet by 35%, 27%, and 7% respectively totaling as much as 69% of the requirement. By adding the sweet potato contribution of 5% in calorie, which can also work as a part of staple food, the total calorie comes to as much as 74% of the requirement. In terms of cost contribution, those staples altogether share 35 % of the total food expenditure, which is the food poverty line.

Table 3.4.13 Estimation of Food Basket and Food Poverty Line per Adult Equivalent per Year (as of July 2010), No.1

Consumption Item	Consumption per year/A.person , kg (Actual)	Consumption per year/A.person , kg (Ad'd)	Consumption per day/A.person, gram (actual)	Calorie per 100g	Received Calorie , Kc (Actual)	Adjusted Received Calorie	Calorie Contribution, %
Maize	85.5	97.5	234.2	360	843	962	35.0
Cassava	69.6	79.4	190.6	342	652	744	27.0
Millet	17.7	20.2	48.5	348	169	193	7.0
Total of above	**202.9**				1,664	1,898	**69.0**
Sweet Potato	38.7	44.1	106.0	114	121	138	5.0
Ground Nuts	21.1	24.0	57.7	332	192	218	7.9
Meat, Fish/Kapenta	22.0	25.1	60.2	175	105	120.	4.4
Other Food crops	4.1	4.7	11.3	201	23	26	0.9
Vegetables, Fruits	69.4	79.2	190.3	37	70.4	80	2.9
Sugar, salt, cooking oil	13.8	15.8	37.9	475	180.1	205	7.5
Beverage	18.2	20.7	49.8	32	15.9	18	0.7
Others	4.4	5.0	12.0	331	39.7	45	1.6
Total	364.5	415.8			**2,411 Kcal**	**2,750 Kcal**	100.0

Source: Baseline Survey, JICA Study Team.

Table 3.4.14 Estimation of Food Basket and Food Poverty Line per Adult Equivalent per Year (as of July 2010), No.2

Consumption Item	Received Calorie, Kc (Actual)	Adjusted Received Calorie	Calorie Contribution, %	Unit price/kg	Cost, ZMK/ Year (Actual)	Cost, ZMK/ Year (Adjusted)	Cost Contribution, %
Maize	843	962	35.0	2,400	205,176	234,051	19.6
Cassava	652	744	27.0	1,600	111,329	126,997	10.7
Millet	169	193	7.0	2,600	46,071	52,555	4.4
Total of Above	1,664	1,898	**69.0**			413,602	**34.7**
Sweet Potato	121	138	5.0	500	19,345	22,068	1.9
Ground Nuts	192	218	7.9	3,250	68,432	78,063	6.5
Meat, Fish/Kapenta	105	120.	4.4	13,556	297,780	339,687	28.5
Other Food crops	23	26	0.9	2,625	10,852	12,379	1.0
Vegetables, Fruits	70.4	80	2.9	2,100	145,840	166,364	14.0

[14] The required calorie of 2,750 kcal per day per adult equivalent is presented by the Ministry of Health, Zambia. When farmers are engaged in farm work and other laborious work, they need such calorie or even more. However, during off-agricultural season, they may need calorie less than that, whereby the 2,750 kcal itself may be counted at safer side.

Sugar, salt, cooking oil	180.1	205	7.5	6,600	91,358	104,215	8.7
Beverage	15.9	18	0.7	1,200	21,798	24,865	2.6
Others	39.7	45	1.6	6,200	27,160	30,982	1.7
Total	2,411 Kcal	2,750 Kcal	100.0	-	1,045,143	**1,192,226 US$ 228.6**	100.0

Source: Baseline Survey, JICA Study Team

1.2) Non-Food Poverty Line

To establish non-food poverty line, we should look into the people's non-food expenditures. Figure 3.4.22 shows the contents of the non-food items that the people actually consume or spend on. As we can notice, what comes first is the farm input especially chemical fertilizer, followed by education, clothing, cleansing, payment to farm labors, housing, telephone, transportations, lighting, etc. The total spending, as average of the sampled households in the baseline survey, arrives at ZMK 1,715,375 per household, of which farm input shares as much as 25%, say about one-quarter, education does 13%, clothing shares 12%, etc.

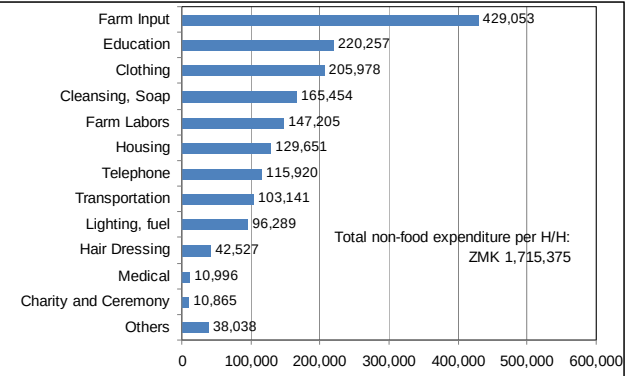


Figure 3.4.22 Non-food Items and Distribution by villages
Source: Baseline Survey, JICA Study Team

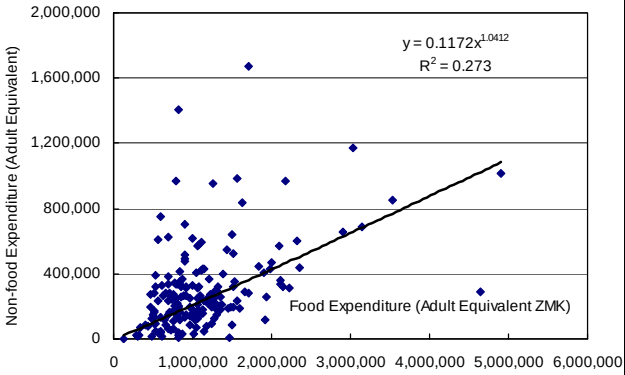


Figure 3.4.23 Estimation of Non-food Poverty Line

Figure 3.4.23 illustrates the relationship between food expenditure per adult equivalent on its horizontal axis and non-food expenditure per adult equivalent on the vertical axis. Non-food poverty line per adult equivalent per annum is estimated as the non-food expenditure that the people on the food poverty line spend for non-food items. Based on this assumption, the non-food expenditure on the food poverty line of ZMK 1,192,226 (US$ 228.6) arrives at ZMK 244,818 (US$ 46.9) per adult equivalent per year, which is the non-food poverty line undertaken under the Cost of Basic Needs method.

1.3) Poverty Line

The Poverty Line as aforementioned is the sum of Food Poverty Line and Non-food Poverty Line. The lines are summarized in 3.4.15, e.g.;

i) The poverty line per adult equivalent arrives at ZMK 1,437,044 (US$275.6) composed of ZMK 1,192,226 for food poverty line and ZMK 244,818 for non-food poverty line. The former shares as much as 83 % while the latter does 17 % only. The 83% corresponds to so-called Angel's coefficient, whereby we can see a very high share in food expenditure. In general, as a society moves to a developed one, the share of food expenditure, or the Angel's coefficient, becomes smaller and vice versa. From this point of view, one may say the rural population's life is still primary sector dominated.

ii) To establish the poverty lines for a typical household, we should take into account the average adult equivalent members per household. According to the baseline survey, the average adult equivalent member arrives at 5.7 per family. Multiplying this 5.7 into above poverty lines

established as per adult equivalent gives us the poverty lines per household. The poverty line is now ZMK 8,191,150 (US$ 1,570) composed of ZMK 6,795,688 (US$ 1,303) for food poverty line and ZMK 1,395,462 (US$ 267) for non-food poverty line.

iii) Table 3.4.15 shows poverty lines presented by LCMS 2006 as well, which were inflated to the values as at July 2010 according to the prevalent inflation ratios during those times. The lines presented by the LCMS 2006 are much bigger than what are presented by this Study based on the baseline survey. The reasons could be;

- ✓ The LCMS poverty lines are based on those ones established in 2006, 4 years ago, whereby those for latter years have been inflated according to the consumer price indexes presented by the CSO. This period, during which no poverty related household survey has been done, may have caused some difference from the current prevalent poverty line.
- ✓ The LCMS poverty line has not made any difference between the line in urban area and the one in rural area. In fact, it is a general consensus that urban residents require more money to make living, e.g. foods are relatively expensive as compared to their rural counterparts, some of them may need to pay house rental, etc. For example, an example in Kenya presents such poverty line for urban residents higher by about 30% of that for rural population. Therefore, the poverty line presented by LCMS may stand more for urban duelers but might not be for rural population.

Table 3.4.15 Poverty Lines per Adult Equivalent and per Typical Household

Poverty Line	Lines, ZMK	Rate in July 2010	Lines, US$	Share, %	Remarks
Per adult equivalent					
Food Poverty Line	1,192,226	ZMK 5,215	228.6	83	
Non-food Poverty Line	244,818		46.9	17	
Poverty Line	1,437,044		275.6	100	
Per typical Household					**5.7 adults**
Food Poverty Line	6,795,688	ZMK 5,215	1,303	83	
Non-food Poverty Line	1,395,462		268	17	
Poverty Line	8,191,150		1,571	100	
Based on LCMS 2006, CSO, as of July 2010 (refer to 2.3.1 Poverty Line in Zambia)					*5.7 adults*
Food Poverty Line	*8,580,712*	*ZMK 5,215*	*1,645*	*70*	
Non-food Poverty Line	*3,741,206*		*717*	*30*	
Poverty Line	*12,321,918*		*2,362*	*100*	

Source: JICA Study Team, based on baseline survey carried out 2009 & 2010.

In countries that poverty lines have not yet been established by carrying out household baseline survey, a simple methodology is often applied. The simple method estimates poverty line to be just US$ 1 per day per person. This gives us US$ 365 per person per annum. Given a typical number of adult equivalent family members of 5.7, the simple poverty line for a typical household comes to US$ 2,081. The poverty line per typical household shown above, US$ 1,571, is found to be about 75% of the simple poverty line of US$ 2,081. This fact may attribute to the low prices of the major commodities, especially staple foods in the rural area.

2) Poverty Ratio

Given the Poverty Lines in Table 3.4.15, poverty ratios are estimated by all the sample households and also by village. Figure 3.4.24 shows the cumulative adult equivalent headcount by all the sample households versus log of the annual expenditure per adult equivalent. The poverty line of ZMK 1,437,044 per adult equivalent per year is at the scale '6.157' in log. With the log scale, poverty ratio is calculated as summarized in Table 3.4.16, and pointed out are:

i) Poverty ratio by all the sampled households is 56.2%, and the ratio varies by village from 29% in

Mulonda (Nchelenge district) to 76% in Mumba (Luwingu district). The annual income in Mulonda is by far the highest among the surveyed 12 villages as ZMK 16.3 million against the average of ZMK 5.8 million only. This low poverty ration in Mulonda is correlated with the high income. On the other hand, Mumba village, Luwingu district is located in remote area (farthest from district center amongst 12 villages) and also their average household annual income level of ZMK 2.8 million is much lower as compared to the whole samples' average of ZMK 4.7 million excluding Mulonda. Also the villagers depend on cassava and finger millet much more than maize for their staple foods. Therefore it may be reasonable for the Mumba villagers to show the highest poverty ratio among the 12 villages.

ii) Chipapa and Lunda also show very high poverty ratios, 72.6% and 72.3 %. Lunda's annual total income is ZMK 4.4 million which is lower than the average and less than most of others. Therefore, the high poverty ration in Lunda village can be exploratory. However, annual income of Chipapa (ZMK 5.6 million) shows more or less same as the total average and even 4th amongst 12 villages. Food crop income of Chipapa shares only 59% of total income while the average of the 12 villages is 71%. It means they produce less food than others and thus they may have to spend more on food to be purchased. This possibility may have raised their poverty ratio despite the high annul income.

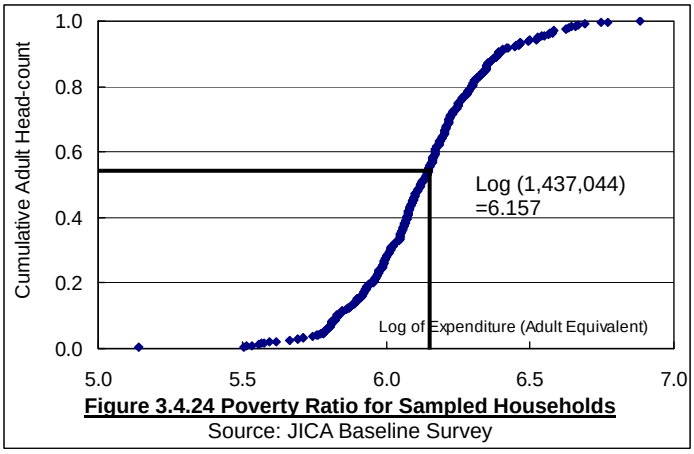


Figure 3.4.24 Poverty Ratio for Sampled Households
Source: JICA Baseline Survey

iii) There are three villages which show poverty ratio under 50%; Mulonda (29%, Nchelenge), Mayanga (49%, Mbala) and Kawikisha (49%, Mporokoso). The average household annual income of Mulonda is ZMK 16.3 million, which is the highest among the 12 villages whereby the least poverty ratio shown. Mayanga's annual income is ZMK 6.9 million, which is the second highest among the 12 villages. Therefore, the low poverty ratio for Mayanga village can be explanatory. As for Kawikisha village, the average household annual income (ZMK 4.3 million) is lower than average. However, Gini index is the 3rd lowest and poverty gap also shows third lowest. This implies income gap is smaller in the Kawikisha village and poorer people below the poverty line are relatively close to the poverty line with reference to the poverty gap ratio (see Table 3.4.16). These results must have contributed to the 3rd lowest lower poverty ratio despite the low annual income.

iv) Table 3.4.16 shows poverty gap ratio as well, indicating the depth of the poverty; corresponding to the distance between the poverty line and the average of expenditures for those who fall below the poverty line. In other words, adding the monetary value calculated by multiplying the poverty gap ratio into the poverty line, the person can be lifted up to the poverty line. The overall poverty gap ratio is 18.4%, and it ranges by village from 7.2% in Mulonda (Nchelenge district) to as high as 28.1% in Mumba (Luwingu district). We can see almost 4 times difference in the depth of the poor people between the richest and poorest villages. It means the poverty in Mumba is about 4 times deeper than that of Mulonda.

Table 3.4.16 Poverty Ratios by All Sample Households and by Village

Particular	Valid Sample No.	Poverty Ratio, %	Poverty Gap Ratio (%)	Poverty Square Gap Ratio (%)	Annual Income, M ZMK
Whole of 12 Villages	**370**	**56.2**	**18.4**	**8.1**	**5.8 (4.7*)**
Lunda	30	72.3	22.8	10.3	4.4

Molwani	31	59.9	16.5	6.9	5.3
Kalemba Chiti	30	58.4	23.6	11.4	3.9
Chipapa	30	72.6	19.5	7.2	5.6
Saise	31	50.2	17.3	8.8	3.3
Mayanga	30	48.7	14.9	5.8	6.9
Mumba	31	76.3	28.1	13.7	2.8
Makashi	30	52.0	16.6	7.0	4.3
Kawikisha	30	48.8	16.2	6.0	4.3
Chisheta	30	55.2	18.2	8.3	5.8
Mutiti	31	59.9	20.9	9.4	4.6
Mulonda	36	29.4	7.2	2.0	16.3

Source: JICA Study Team, based on baseline survey, Note; * average excluding Nchelenge

3) Necessary Sum of Raising the Poor to the Poverty Line

The poverty gap ratio is used to provide an estimate of the sums required to raise the consumption level of all poor families up to the poverty line. For example, at the average level for all the villages, the poverty gap ratio stands at 18.4% which means that the additional expenditure to raise the poor up to the poverty line equals to 18.4% of the poverty line as average. Poverty line already estimated for a typical household is ZMK 8,191,150. Therefore, if a project can produce an additional value of ZMK 1,507,172 (=0.184 x 8,191,150) per household, an average poor household who is below the poverty line can now be lifted to the poverty line.

Then, by multiplying the target households (or target population) with the additional expenditure, we can know how much total sum is required to raise all the poor people up to the poverty line. Table 3.4.17 calculates the necessary sum to raise all the poor in a typical village. To raise a typical poor household, there should be an additional expenditure of ZMK 1,507,172 as aforementioned. Multiplying the poor household number below the poverty line in a village into the additional expenditure arrives at ZMK 108,516,384 (US$ 20,809) per year provided that there are 72 households in the village, which is the average case of the 6 villages covered by village level workshop in 2009.

If the village is very small, e.g. composed of only 34 households corresponding to the case of Saise villages, the required sum arrives at ZMK 51,243,848 (US$9,826) per annum. On the other hand, big village like Mayanga where there are 150 households, there should be ZMK 226,075,800 (US$ 43,351) to raise all the poor households up to the poverty line. These estimations can be an indicator to which how much quantitatively smallholder irrigation should contribute. With these estimations, smallholder irrigation planning will provide practical cropping patterns, which can lift the poor people to the poverty line or otherwise recommend what kind of crops should be introduced to raise the poor people to meet the poverty line.

Table 3.4.17 Estimation of Necessary Sum of Raising the Poor Household to the Poverty Line

Particular	Estimation, ZMK	US$ (ZMK5,215/1US$)	Remarks
Poverty Line for household, ZMK	8,191,150	1,571	
Poverty Ratio, %	56.2		
Poverty Gap Ratio, %	18.4		
Required Amount per Poor Household, ZMK & US$	**1,507,172**	**289.1**	
Average HH number in a village	72 HHs		Average of 6 villages
Minimum HH number in a village	34 HHs		Referred to Saise village
Maximum HH number in a village	150 HHs		Referred to Mayanga village
Required sum to raise to the PL (average village)	**108,516,384**	**20,809**	
Required sum to raise to the PL (Minimum village)	51,243,848	9,826	
Required sum to raise to the PL (Maximum village)	226,075,800	43,351	

Source: JICA Study Team

3.5 Agriculture in the Study Area

This section provides an overview of the agricultural situation in the Study area. It starts with providing salient features of the agriculture, and then examines agriculture practices wherein some traditional practices such as *Chitemene* and *Fundikila* are reviewed, crop production and area planted, yields of major crops, crop production per household and its balance in consumption, and distribution and marketing of agricultural produces, etc.

3.5.1 Salient Features in Agriculture in the Study Area

The Study area is largely categorized in the agro-ecological zone III, where maize, cassava, and finger millet dominate with abundant annual rainfall reaching as much as 1,200mm in many places. Although this area is blessed with a plenty of water resources, the area is widely covered with acrisols, which is not very appropriate for agricultural production.

According to the FAO[1], acrisols is "extremely nutrient deficient and acid." As it is often with high level of exchangeable aluminum which fixes phosphorus in the soil, availability of phosphorus is generally low. In addition, this soil type is fairly susceptible to erosion unless sustainable measures are taken. Thus, in the Study area, soil fertility issues always underlay the agricultural practices.

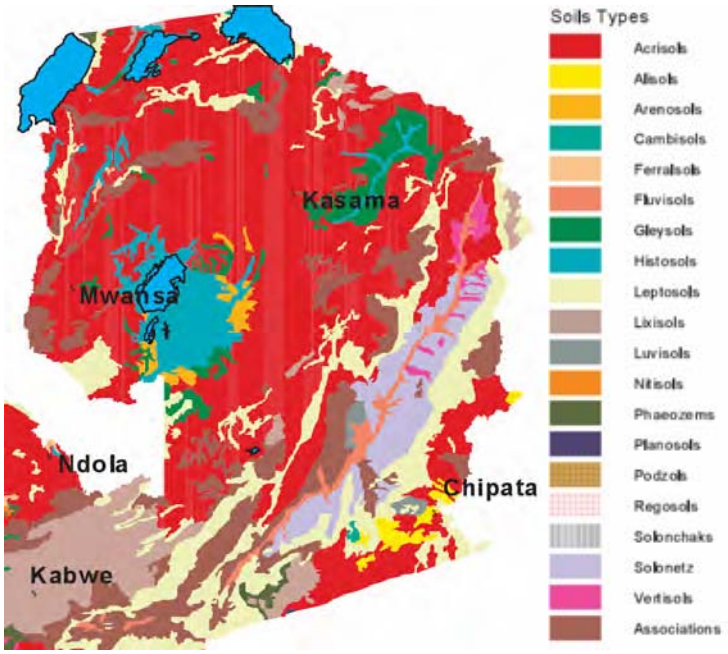


Figure 3.5.1 Soil Types of the Study Area

Source: Soil Survey Unit of Mount Makulu, ZARI (2003)

Majority of the farmers in the area depend on rainfed agriculture, whereby maize, cassava, beans, and finger millet are cultivated. For example, more than half of the interviewed farmers in the baseline survey carried out in 2009 answered cassava (52% of the respondents), maize (54%) and beans (56%) are parts of their major income source. Farming practices are generally primitive; farmers usually depend on hand hoe for the cultivation. For those who cannot buy enough amount of chemical fertilizer for hybrid maize, cassava comes to the alternative option as it requires little chemical fertilizer and it is relatively tolerant to drought condition.

3.5.2 Agricultural Practice

Majority of the farmers practice rain-fed cropping of maize in the rainy season. They usually start planting maize in mid of November and, after exposing the cob under the sun for a certain period of time, harvest it from May in the following year. Some farmers also practice irrigated farming in small scale during the dry season. However, common irrigation method is limited to bucket irrigation. It is noted that even when farmers get irrigated water by gravity to his/her farm plot, they often scoop water from the on-farm furrow because they usually make relatively large ridge for dry-season crops, which may not be well soaked out for the root zones of the big ridges by gravity.

[1] http://www.fao.org/ag/agl/agll/prosoil/acri.htm

Furthermore, although vegetables are given high appreciation in terms of profitability, there is a case reported that the price of tomato in the dry season became lower than that of rain season. Possible reason behind is that there are a considerable number of farmers who can grow tomato around *dambo* areas by applying bucket irrigation though scale of each farmer's plot is minimal. Another reason suggested is related to the cost of agricultural inputs in the rainy season; vegetable production in the rainy season is quite susceptible to disease due to high humidity and then, more agricultural inputs may be required.

Yet, irrigated agriculture is not a major farming practice and, even if it is available, on-farm irrigation method is still inefficient – bucket irrigation. Now, what characterizes the area is *Chitemene* shifting cultivation and *Fundikila* ridge, still practiced in a large extent of the Study area, as explained below:

1) *"Chitemene"* Shifting Cultivation

"*Chitemene*" is known as a form of shifting cultivation, or slash and burn agricultural system, widely practiced in northern Zambia. In this traditional system especially common amongst Bemba people, crops are planted in a plot after a heap of branches is burned. The land is used for a limited period of time, typically three to four cropping seasons, and the plot is abandoned for succession, reportedly for several years to some decades.

This *Chitemene* shifting cultivation is unique from the perspective that the actual planting plot is not same as, or far smaller than, the area for lopping; it is said that lopping area is five to eight times as much as the planted area (Stromgaard, 1984[2]). *Chitemene* farmers chop and collect branches from wider range of area so that s/he can enjoy the benefit from the concentrated organic matter to be incorporated into the plot as a form of ash.

In addition, *Chitemene* may be an indigenous wisdom that the forerunners had developed. As ash has an effect to neutralize the acidity in the soil, it should be suited to the acid soil that covers the most part of the Study area.

Branches are gathered in a center of the plot; they will be burned before the planting season.

According to some observations and interviews in the Study area, *Chitemene* usually starts right after the rainy season. In and around June, farmers cut branches and shrubs in a place near to the expected farm plot and leave them for drying. Then, by the time they are burned in October - November, those materials are carried and piled up in the center of the field. It is noted that many mentioned that cutting branches is a "man's work" while gathering those branches is a "women's work."

After burning, cultivation starts with maize or otherwise finger millet and cassava for one instance. In this example, the farmers cultivate groundnuts after the maize or finger millet, while cassava remains in the same plot for about two years. After cassava has been cultivated, one cycle of *Chitemene* cultivation ends. Every year, those farmers open new land for *Chitemene* and thus maintain six to seven places at the same time. *Chitemene* has been a sustainable agricultural practice in many parts of the area where population density is low and forest is still dense. However, urbanized area is no longer suitable for this kind of exploitative arrangement and farmers in those

[2] Stromgaard, P. (1984). Field studies of land use under *Chitemene* shifting cultivation, Zambia. Geografisk Tidsskrift 84, 78-85. Copenhagen. Available online at http://img.kb.dk/tidsskriftdk/pdf/gto/gto_0084-PDF/gto_0084_97460.pdf

area already gave up doing *Chitemene* notwithstanding they still prefer *Chitemene* shifting agriculture for its better production. Today, the government is discouraging farmers to continue *Chitemene* but there are still a lot of *Chitemene* areas in Northern and Luapula provinces.

2) *"Fundikila"*

"*Fundikila*," means "covering" in the local language. It is commonly practiced among the ethnic groups of Mambwe in Mbala, Lungu in Mpulungu, and Namwanga in Nakonde and Isoka. This is applied mostly when reclaiming a new farmland. Right after the rainy season, specifically during March to April, a virgin land covered with tall grasses, such as elephant grass, is ploughed and soils are piled up. In some cases it is created as a straight ridge and in other cases in a round shape especially at the northern part of the Study area. In so doing, grasses are put under the heap of soil so that they can be decomposed by the time rain season cultivation starts. As the biomass of tall grasses is massive and each cake of soils dug out by hoe is cohesive supported with the root complex, the ridge or heap naturally becomes large. Here is an example of round type *Fundikila* as shown in the photo below:

On the big heaps, farmers usually plant sweet potato, groundnuts and/or beans. Sometimes, these crops are planted altogether in the mound, reminding us of the "three sisters" farming system, which had been practiced by the Native American throughout North America.

"Fundikila," a huge and mound-shape ridge for the decomposition of biomass (50-60cm in height)

Then, at the beginning of the rainy season, November to December, mounds are pulled down and new ridges are formed with that soil, or sometimes just leveled. Note that the shape of new ridge is no longer round but straight, and the size is also not so big anymore, that is, the *Fundikila* is only applied for the first year of the reclamation as a part of composting process. By this time of the process, biomasses mixed into the *Fundikila* have been, supposedly, decomposed and the soil's fertility and physical structure are to be improved. For the new ridges, finger millet or maize is commonly planted and common type of farming system will continue for three to five years until the soil fertility becomes considerably low.

Inside of "Fundikila," before covered by soil

There are some variations of this farming practice. First, cassava is also planted for the first stage. In this case, farmers cannot fully pull down the mound as cassava's growing period is longer over a year. To cope with this, farmers plant only one or two cassava at the any part of the periphery of the mound so that they can pull down the main parts of the mound when time has come. Afterward, other crops like maize are planted in the space.

3) Mixed System of Extensive and Intensive Agriculture

One of the unique characteristics that well illustrate agriculture in the Study area is a mixture of

extensive and intensive agriculture. It was always a case in other countries that extensive and intensive farming practices are clearly located away from each other. For instance, irrigation agriculture, one of intensive farming practices, is widely developed in a particular area where condition allows, while rainfed farming practice may be found in upland area with disadvantaged condition—those areas are often separated from each other or clearly divided.

Yet, in the Study area, those intensive and extensive farming practices are located more closely to each other with mosaic-like arrangement. The point is that extensive practice, like *Chitemene* shifting cultivation, is still a major farming practice even in such areas where natural condition generally allows intensive farming practice. As a result, *Chitemene* shifting cultivation (left picture) can be sporadically found even along an irrigation canal (right picture).

A typical Chitemene shifting cultivation, wherein maize, cassava, and finger millet are mixed.

A personal irrigation furrow (canal) running right next to the Chitemene plot (this canal does not irrigate the Chitemene plot in the left photo.

Possible reason why irrigated agriculture did not become as common as in other countries notwithstanding the relatively rich water resources in the area is that it was not “necessary.” Due to an abundant rainfall, farmers were most likely able to produce their subsistence with their traditional farming system. Secondly, it might have been a drastic change for them to abandon their traditional farming style. Benefit of *Chitemene* shifting cultivation, for example, is to uphold soil fertility by changing their farm plots—staying at a same piece of farm plot means loosing this benefit. In this context, water was not the biggest single bottleneck. Rather, soil fertility is another critical factor that characterizes the agriculture in the area.

To be sure, social situation is gradually changing; in general, lifestyle is being more modernized and cash matters more in their daily life. For example, although primary education is for free, it costs the parents about ZMK 250,000 per student on board per term in secondary school. To gain more profit for cash, extensive farming practice is no longer the best solution. Now, once necessity is recognized, there should be much incentive for farmers to shift from dynamic and extensive farming style to static and intensive farming style - smallholder irrigation development has a good rationale in today’s context in the Study area.

4) Crop Calendar

Cropping pattern varies farmer by farmer and district by district but here is an example of a crop calendar derived from a group interview to some farmers who represented Molwani village in Kasama district, Northern province. As shown in Table 3.5.1, most of crops are grown in rainy season during November to March. Land preparation of maize, for example, starts in early September and maize is planted during November to December when the first rain of the rainy

season can be expected at a stable rain-falling pattern. Maize takes four months or more to harvest. Usually, grains are left on the field for a certain period of time after it matured so that they can get dried enough to harvest.

Sorghum and finger millet have similar seasonal characteristic; cultivated during the rainy season and harvested after the rainy season but have longer period of time for the growth. Cassava and sugarcane, on the other hand, have a longer growing period, which even go beyond a year. As of cassava cultivation, for example, it starts in the middle of the rainy season, that is, farmers prepare land for cassava after they finish planting maize. Then, cassava is grown for a year or so.

Although the Table 3.5.1 suggests that harvest of cassava can start as early as August, or 7 months after planting, main harvest usually start after a year or around, based on some supplemental interviews. The unique characteristic of cassava is its long harvesting period, lasting for a year. Farmers harvest as much as they need anytime in a year, and this is why statistical information is rarely available. Thus, cassava is given a credit of food security crop for its longer harvesting period coupled with its relative tolerance to low humidity.

In a general perception, maize, sorghum, finger millet as well as cassava are well observed under *Chitemene* shifting cultivation or in upland area, while sugarcane, sweet potato, and vegetables are often seen in a periphery of *dambo* area.

Table 3.5.1 Crop Calendar in Molwani Village in Kasama, Northern Province

Crop	Area (ha)	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Maize	1.0												
Sorghum	0.3												
Finger millet	0.5												
Cassava	0.8												
Sweet Potato	0.5												
Groundnuts	0.8												
Beans	1.0												
Sugar cane	0.8												
Onion	0.3												
Soya bean	0.3												
Tomato	0.8												
Total	6.8												

Land Prepration, Planting, Growing, Harvesting

Source: JICA Study Team (Baseline Survey),
Note: Tomato can be cultivated anytime in a year.
As the longer period of land preparation suggests, finger millet can also be cultivated in a wide range of period.

3.5.3 Agriculture Related Issues Identified from Baseline Survey

The baseline survey carried out in 2009 and 2010 has asked total 370 sample farmer households several issues with respect to agriculture, e.g. crops they have abandoned, crops they want to introduce, area planted by crop, production by crop and its yield, and also fertilizer usage, etc. This section elaborates the baseline survey results concerning agriculture.

1) Abandoned Crops and New Crops Expected

Figure 3.5.2 and Figure 3.5.3 show the crops which respondents abandoned in last ten years and crops which they wish to introduce in future with 'irrigation'. The figures are summarized on basis of the number of respondents out of the total 370 sample households. For the abandoned crops, soya bean, sorghum, local maize, hybrid maize and sunflower are the "top 5". Soya bean and sunflower were abandoned mainly because they could not find attractive market on them.

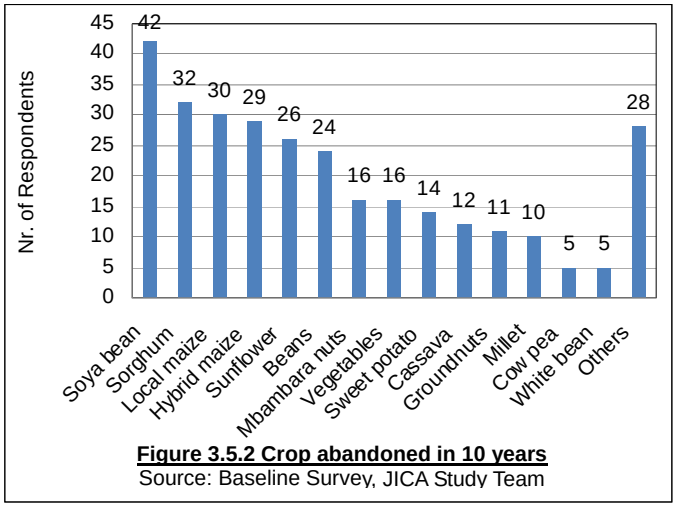


Figure 3.5.2 Crop abandoned in 10 years
Source: Baseline Survey, JICA Study Team

On the other hand, remaining 3 crops out of the top 5 were abandoned manly because yield was not high enough as they expected. Some of the respondents who abandoned the hybrid maize explained that they lacked fertilizer either due to lack of money or otherwise late delivery of FSP/FISP fertilizer. In addition, when they get the fertilizer from FSP/FISP, they have to buy seeds together and the variety of seed is pre-decided regardless they like it or not. With these conditions, there were some respondents who claimed the quality of the seeds as well.

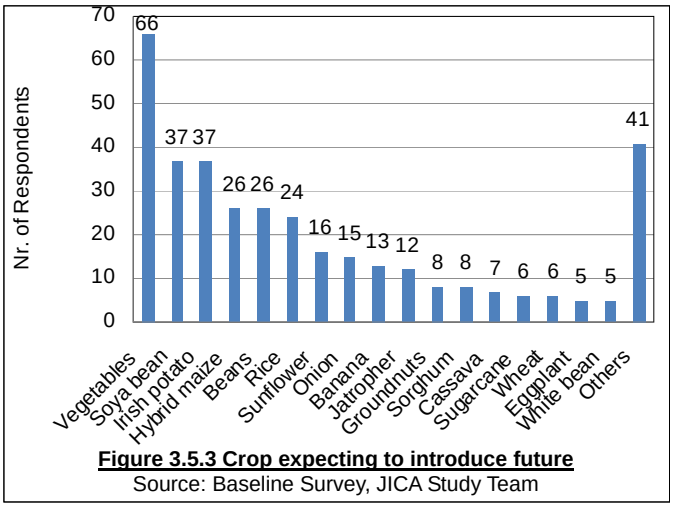


Figure 3.5.3 Crop expecting to introduce future
Source: Baseline Survey, JICA Study Team

As for the crops which they want to introduce in future with irrigation, vegetables (tomato, rape and cabbage in total), soya bean, Irish potato, hybrid maize and beans are the "top 5". Respondents showed the main reasons why they have not introduced yet as "water scarcity" for vegetables, "no availability of seed" for soya bean, Irish potato and sunflower and "no money for fertilizer" for hybrid maize.

2) Area Planted

Figure 3.5.4 summarizes the average area planted by crop per household. As indicated, the biggest area is occupied by hybrid maize, followed by cassava and then local maize as 2.99 lima (0.75ha), 2.07 lima (0.52ha) and 1.92 lima (0.48ha)[3]. Maize and cassava are the main staple food in the target provinces, and this fact is exactly endorsed by the baseline survey. Millet and sorghum are also cultivated to

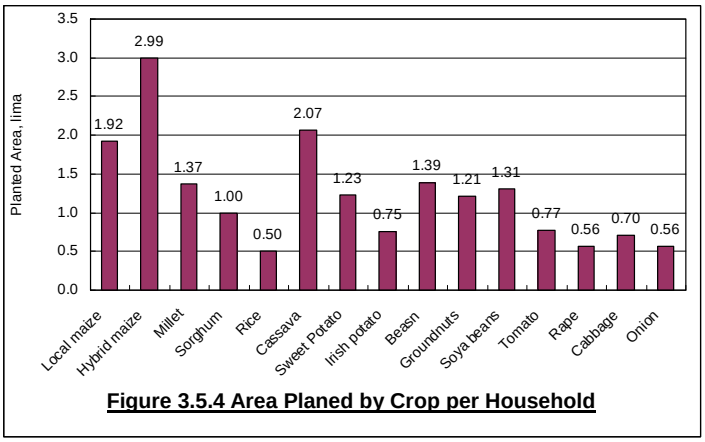


Figure 3.5.4 Area Planed by Crop per Household

[3] For the calculation of the area, the area planted for a crop was summated and then divided by the number of the households who have planted the crop.

some extent as part of staple food, e.g. 1.37 lima (0.34ha) and 1.00 lima (0.25ha) respectively. Sweet potato can also supplement their staple food, which is cultivated at 1.23 lima (0.31ha) of plot per household.

For pulses, major ones are beans, groundnut and soy beans which are cultivated at 1.39 lima (0.33ha), 1.21 lima (0.30ha) and 1.31 lima (0.33ha) respectively. For beans and groundnut, there are many farmers who intercrop them with maize, utilizing the land and fertilizer as much as possible. Vegetables are cultivated at not much large area as indicated by 0.77 lima (tomato), 0.56 lima (rape), 0.70 lima (cabbage), 0.56 lima (onion).

Table 3.5.2 shows the total area planted per household by village. The average arrives at 8.70 lima (2.17 ha) while the medium at 7.50 lima (1.88 ha). Lunda village shows the minimum planted area as 5.86 lima (1.47 ha) for average and 5.45 lima (1.36 ha) for medium. This is followed by Mutiti village as 6.23 lima for average and 5.5 lima for medium. Lunda village is located in Kasama district while Mutiti in Mansa district. Since these districts have the provincial capital, economic activities are relatively high, so that there may be little farm land to expand as compared with other areas.

On the other hand, the biggest area planted shows up in Mulonda village, Nchelenge district, and followed by Kalemba Chiti. Mulonda village used to be engaged in fisheries and has been shifting to agriculture. This may imply there were areas for the new farmers to open up till recently though the population density in the district is the highest among all the districts in the Study area. Kalemba Chiti village is located about 32 km away from Mungwi district center, a deep rural area. This situation may have contributed for the bigger area.

Table 3.5.2 Total Area Planted per Household by Village

Village name	Average, lima	Average, ha	Median, lima	Median, ha	Remarks
Lunda	5.86	1.47	5.45	1.36	
Molwani	8.80	2.20	7.50	1.88	
Kalemba Chiti	10.36	2.59	8.75	2.19	
Chipapa	7.33	1.83	6.63	1.66	
Saise	7.83	1.96	7.75	1.94	
Mayanga	8.43	2.11	8.00	2.00	
Mumba etc.	8.63	2.16	8.00	2.00	
Makashi etc.	9.45	2.36	7.63	1.91	
Kawikisha	9.38	2.35	7.75	1.94	
Chisheta	7.43	1.86	7.00	1.75	
Mutiti	6.23	1.56	5.50	1.38	
Mulonda	13.58	3.40	12.00	3.00	
Total	**8.70**	**2.17**	**7.50**	**1.88**	

Source: Baseline Survey 2009& 2010, JICA Study Team

3) Area Harvested and the Production by Major Crops

Production level of major crops interviewed in the baseline survey is summarized in Table 3.5.3 to Table 3.5.9. Table 3.5.3 summarizes the percentage of the farmer households who have harvested the crop, how much area they have harvested in terms of both average and median statistical value, weight produced and its yield by crop. This table 3.5.3 shows the overall average by crop, and the Table 3.5.4 to Table 3.5.9 shows the same but these are detailed by village.

In sums, availability of fertilizer (especially for maize and vegetables) / agricultural chemicals, good seed, planting timing, soil condition, existence of market (both distance and good price are important) and options of crops for growing are the main factors for creating the difference of production level among farmers and villages. It seems that these factors are not functioning alone but synchronized with other factors and resulting either positive or negative cycle.

For example, production level of farmers in Mumba village, Luwingu district, is lower than others for almost all crops. They live in remote area (far from market), and they do not have cooperative (means difficult to access subsidized fertilizer) in the village. Soils are not fertile either and heavily depending on *Chitemene*. As a matter of fact, surprisingly, no sampled farmers answered they are growing vegetables there.

On the other hand, farmers in Mulonda village, Nchelenge district, have benefited from strong demand from market including DRC, which offers them good price, and this motivates them to produce high quality crops constantly. Farmers in Mulonda village successfully turned their income source from fish to food/vegetable crops by investing money out of fish and now they are investing much more money to their fields from their crops. In fact, income level at Mulonda village is almost 3 times bigger than others, Followings are summary findings:

i) From Table 3.5.3, there is obvious tendency that more number of farmers produce food crops than vegetables. For example, hybrid maize is produced by half of the sample households, cassava by 84% of the sampled households, millet by 51%, beans by 72%, groundnuts by 71%, and sweet potato by 65 %, while tomato is produced by only 24 % of the sample households, rape by only 25%, cabbage by only 10% and onion by a meager 5% of the sampled 370 households.

ii) With respect to area produced in Table 3.5.3, food crops occupy bigger area of farm plot; say over 1 lima of plot to as much as 3 lima per household by crop while no vegetable occupies more than 1 lima of plot. For the production, hybrid maize comes first and followed by cassava, which are the major staple food in the 2 provinces. Overall average production of hybrid maize per household arrives at 1,779 kg as average and 1,400 kg as median. For the cassava, it is 1,481 kg and 1,000 kg per household respectively. Concerning yield, that of hybrid maize is 622 kg/lima (2,488kg/ha) as average and 700 kg/lima (2,800 kg/ha) as median, casaba is 747 kg/lima (2,988 kg/ha) and 500 kg/lima (2,000 kg/ha) respectively.

iii) In Lunda, Kalemba, Saise, Mayanga and Mumba, percentage of households who harvested local maize is larger than hybrid maize (see Table 3.5.4). Villages except for Lunda, Kalemba, Saise and Mumba have cooperative in their village and they have higher chance to access fertilizer under FSP/FISP at subsidized price. Nevertheless, some of the sampled households in Northern province planted local maize because timing of the seed delivery of hybrid maize was delayed than their expectation. Makashi shows the highest median yield (1,000kg per lima) of local maize and it is almost twice of the 12 villages' median (520kg per lima). One of the reasons is almost all local maize growers there (8 among 9) could apply fertilizer through FSP/FISP. On the other hand, farmers in Kalemba Chiti and Mumba suffered from low yield because of low availability of fertilizer and also varieties were not so good in terms of yield and disease tolerance. Same tendency is observed for hybrid maize in those villages.

iv) As for cassava, the yield in median shows much difference from 150kg (Mumba) per lima to 1,000 kg per lima (Mulonda and Chipapa) with an overall median of 587 kg per lima (see Table 3.5.5). One of farmers in Mulonda shared that they have abundant market both for local and for international, namely DRC where cassava is preferred to maize for their staple food. This situation encourages them to grow better cassava which is grown by proper farm management. Proper management here means planting of it at appropriate timing and also weeding done at the right time. for Chipapa village, one of farmers explained that they use high yield variety which they got from Misamfu Research Center. On the other hand, cassava planted in Mumba village is thought to be local variety and soils were not good there, resulting in the lowest yield.

v) Production level of millet is related to the practice of *Chitemene* and we did not find any farmers

growing millet in Mulonda village (Nchelenge district) where trees are no longer available for the slush and burn agriculture with a reason of being used up for drying fishes (see Table 3.5.5). Also other income sources are available there, which does no longer require them to do *Chitemene* low input agriculture. The overall median yield for 11 villages is 250 kg per lima, lowest is 150 kg per lima for Mumba village and highest is at Molwani village with 625 kg per lima where many farmers use the hybrid variety which is thought t to be major reason for the high yield.

vi) Beans production is smallest among selected main crops (see Table 3.5.6). Median yield varies from 75 kg per lima (Chipapa in Mungwi district) to 300kg per lima (Mutiti in Mansa district) with an overall median of 150kg per lima. Some farmers with high yield in Mutiti village explained the reason that they managed to reserve the seed for next planting from their production and others could not because others produced smaller than them and ate up most of them before the following planting season. Other reasons are same for other crops, depending on proper planting timing, high yield seed variety and fertility of the soils.

vii) As for groundnuts, median yield varies from 100 kg per lima (Saise and Mayanga) to 500 kg per lima (Mulonda) with an overall median of 220 kg per lima (see Table 3.5.6). Mulonda village has good yield because of good soil and high input supported by high demand of the produce. Groundnuts are recognized as one of highly labor intensive crops and some farmers in Mulonda village managed it by hiring cheaper laborers from DRC. Groundnuts in Makashi village were benefited from fertile soil.

viii) Farmers in Molwani and Kalemba got rather good yield for sweet potato (see Table 3.5.7). The yield in those villages is 1,000kg median per lima, while the smallest is 150kg per lima in Mumba. Total average median is 600kg per lima. Farmers there multiply the vines during dry season near their *dambo* area and they could start planting at right timing. On the other hand, not so many farmers in Lunda grow sweet potato because of poor soil condition and having difficulty in getting vines at right timing, resulting in giving them up after being discouraged by low yield.

ix) No farmers in Mumba (Luwingu district) and also in Kawikisha (Mporokoso district) produced tomato (see Table 3.5.7). In Mumba, no rape, cabbage and onion were found either. It is because of water scarcity in Mumba and non-availability of reliable seed supplier for Kawikisha. The median yield differs from 350 kg per lima in Saise to as high as 1,338kg per lima in Mulonda with an overall median of 663 kg. Tomato in Mulonda is highly demanded and farmers there started to grow it after knowing farmers from other districts were benefiting a lot from tomato. Every farmer in Mulonda who produced tomato applied the fertilizer with an average of 200kg per household and it is almost 6 times than that of Mutiti (Mansa district), which showed second highest yield.

x) Kalemba, Chipapa and Mayanga produced high median yields of rape (3,000kg, 3,500kg and 3,200kg per lima respectively) as compared with the overall median of 1,200 kg per lima (see Table 3.5.8). Some farmers explained that they got the high yield variety seed from Misamfu Research Center and germination rate was very high. Further, most farmers there managed to apply the fertilizer and agricultural chemical.

xi) As for cabbage, it demands rather longer period of time before harvest than other vegetables. Therefore, not so many farmers are found to grow it and we did not find any farmers growing it in Chipapa, Mayanga and Mumba (only 4 households per village averagely for the rest of 9 villages; see Table 3.5.8). Nevertheless, farmers in Mutiti are taking advantage of high demand of cabbage from the provincial center and grow it by getting high yield variety seed, applying

fertilizer and agricultural chemicals. Number of growers is still very small, though (2 households in the sampled 30 households). Other villages with high yield also use the high yield variety and well control the diseases.

xii) Onion is not grown many in the sampled villages for the same reason with cabbage except for Mulonda, where 11 of 36 sampled households grow, and the medium yield differs from 90kg per lima in Chisheta to 1,350 kg per lima in Mulonda (see Table 3.5.9). Farmers in Mulonda are benefited from the high demand of market. Also, they have other sources for getting income including fishing and merchant even with DRC side. Therefore, they can put up with the longer period of maturity of onion. Farmers in Lunda and Mutiti found the constant buyers and it encouraged them to produce good onion.

Table 3.5.3 Households by Crop, Area Harvested by Crop and Weight Produced and Yield by Crop

Crops	HH		Area (lima)/HH		Produced(kg)/HH		Yield(kg/lima)		Remarks
	No.	%(/370)	Ave	Med.	Ave	Med.	Ave	Med.	
Local Maize	140	38	2.0	1.3	956	520	483	416	
Hybrid Maize	187	51	2.9	2.0	1,779	1,400	622	700	
Cassava	309	84	2.0	2.0	1,481	1,000	747	500	
Millet	189	51	1.3	1.0	394	250	302	250	
Beans	268	72	1.4	1.0	215	150	153	150	
Groundnuts	262	71	1.3	1.0	343	200	268	200	
Sweet Potato	241	65	1.3	1.0	846	600	668	600	
Tomato	89	24	0.8	1.0	1,107	663	1,364	663	
Rape	93	25	0.6	0.5	999	600	1,621	1,200	
Cabbage	36	10	0.9	0.8	2,175	1,053	2,485	1,403	
Onion	20	5	0.6	0.5	886	455	1,576	910	

Source: Baseline Survey, JICA Study Team. Note: Both average (Ave) and median (Med) are given because the difference among the household is large for some crops.

Table 3.5.4 Area, Production and Yield of Major Crops (1/6) (Local and Hybrid Maize)

Name of village/ District	Local Maize								Hybrid Maize							
	HH		Area (lima)		Produced(kg)		Yield(kg/lima)		HH		Area (lima)		Produced(kg)		Yield(kg/lima)	
	No.	%	Ave	Med.	Ave	Med.	Ave	Med.	No	%	Ave	Med	Ave	Med	Ave	Med
Lunda	10	33	1.3	1.0	1,065	375	804	375	7	23	2.0	2.0	1,243	850	621	425
Molwani	8	26	1.5	1.0	988	550	658	550	20	65	3.0	2.0	1,758	1,450	581	725
Kalemba	17	57	1.3	1.0	447	200	358	200	4	13	2.3	2.0	1,150	1,125	511	563
Chipapa	18	60	1.5	1.0	876	875	584	875	8	27	2.3	1.8	1,100	1,125	476	643
Saise	20	67	2.6	2.0	670	520	263	260	10	33	3.4	4.0	1,548	1,340	462	335
Mayanga	19	63	1.9	2.0	1,170	700	618	350	14	47	2.9	2.0	1,916	1,400	654	700
Mumba	17	55	1.5	1.0	491	250	327	250	1	3	5.0		4,500		900	
Makashi	9	30	1.3	1.0	1,006	1,000	787	1,000	22	73	2.5	2.0	1,727	1,650	691	825
Kawikisha	–								29	97	2.8	2.0	1,934	1,500	680	750
Chisheta									29	97	1.9	2.0	1,934	1,500	680	750
Mutiti	8	26	1.1	1.0	595	550	559	550	20	65	2.0	2.0	1,313	1,175	673	588
Mulonda	14	39	5.1	4.0	2,443	1,750	479	438	23	64	5.2	4.0	3,315	2,500	638	625
Total/ave	140	38	2.0	1.3	956	520	483	416	187	51	2.9	2.0	1,779	1,400	622	700

Source: Baseline Survey, JICA Study Team. Note: Both average (Ave) and median (Med) are showed because the difference among the household is large for some crops.

Table 3.5.5 Area, Production and Yield of Major Crops (2/6) (Cassava and Millet)

Name of village/ District	Cassava								Millet							
	HH		Area (lima)		Produced(kg)		Yield(kg/lima)		HH		Area (lima)		Produced(kg)		Yield(kg/lima)	
	No.	%	Ave	Med.	Ave	Med.	Ave	Med.	No	%	Ave	Med	Ave	Med	Ave	Med
Lunda	20	67	1.8	1.3	1,890	1,175	1,062	940	11	37	1.7	1.5	500	300	293	200
Molwani	17	55	1.7	2.0	1,841	1,500	1,061	751	8	26	1.5	1.0	694	625	463	625
Kalemba	26	87	2.2	2.0	1,923	1,375	881	688	28	93	1.8	1.5	369	250	206	167
Chipapa	24	80	1.8	1.5	1,696	1,500	946	1,000	23	77	1.0	1.0	318	250	321	250
Saise	17	57	1.6	1.8	951	630	608	360	11	37	0.8	0.5	211	150	274	300

Mayanga	26	87	2.1	1.5	1,776	1,350	855	900	16	53	1.2	1.0	726	325	596	325
Mumba	30	97	1.7	2.0	433	300	363	150	15	48	1.2	1.0	180	150	154	150
Makashi	30	100	1.6	1.0	1,022	850	626	850	25	83	1.7	2.0	424	400	245	200
Kawikisha	28	94	1.6	1.0	759	525	467	525	24	80	1.3	1.0	335	225	264	225
Chisheta	26	87	1.9	1.5	1,244	750	660	500	14	47	1.0	1.0	518	400	537	400
Mutiti	31	100	1.9	2.0	1,084	750	565	375	14	45	0.8	0.5	232	150	289	300
Mulonda	34	94	3.4	2.0	3,076	2,000	905	1,000	-	-	-	-	-	-	-	-
Total /Ave	309	84	2.0	2.0	1,481	1,000	747	500	189	51	1.3	1.0	394	250	302	250

Source: Baseline Survey, JICA Study Team.

Table 3.5.6 Area, Production and Yield of Major Crops (3/6) (Beans and Groundnuts)

Name of village/ District	Beans								Groundnuts							
	HH		Area (lima)		Produced(kg)		Yield(kg/lima)		HH		Area (lima)		Produced(kg)		Yield(kg/lima)	
	No	%	Ave	Med.	Ave	Med.	Ave	Med.	No	%	Ave	Med	Ave	Med	Ave	Med
Lunda	18	60	1.5	1.0	254	104	164	104	18	60	1.1	1.0	233	155	210	155
Molwani	12	39	1.1	1.0	124	75	115	75	19	61	1.2	1.0	396	200	331	200
Kalemba	24	80	1.3	1.0	184	120	148	120	26	87	1.5	1.0	210	150	145	150
Chipapa	25	83	0.8	1.0	146	100	180	100	22	73	1.0	1.0	291	200	281	200
Saise	22	73	1.2	1.0	150	104	121	104	7	23	0.9	0.5	92	50	99	100
Mayanga	26	87	1.0	1.0	160	105	160	105	14	47	0.8	1.0	194	100	229	100
Mumba	29	94	3.1	2.0	320	250	105	125	29	94	1.8	1.0	215	150	119	150
Makashi	16	53	1.3	1.0	230	200	179	200	23	77	1.1	1.0	792	325	700	325
Kawikisha	24	80	1.5	1.0	178	150	117	150	26	87	0.9	1.0	243	225	257	225
Chisheta	24	80	1.2	1.0	140	100	114	100	28	93	1.6	1.0	155	150	97	150
Mutiti	21	68	0.6	0.5	194	150	313	300	23	74	1.0	1.0	522	400	545	400
Mulonda	27	75	1.6	1.0	423	200	264	200	27	75	1.7	1.5	993	750	584	500
Total/Ave	268	72	1.4	1.0	215	150	153	150	262	71	1.3	1.0	343	200	268	200

Source: Baseline Survey, JICA Study Team.

Table 3.5.7 Area, Production and Yield of Major Crops (4/6) (Sweet potato and Tomato)

Name of village/ District	Sweet Potato								Tomato							
	HH		Area (lima)		Produced(kg)		Yield(kg/lima)		HH		Area (lima)		Produced(kg)		Yield(kg/lima)	
	No.	%	Ave	Med.	Ave	Med.	Ave	Med.	No	%	Ave	Med	Ave	Med	Ave	Med
Lunda	5	17	0.6	0.5	490	300	817	600	9	30	0.8	1.0	1,500	750	1,929	750
Molwani	11	35	1.2	1.0	1,189	1,000	969	1,000	14	45	1.0	1.0	1,136	875	1,136	875
Kalemba	19	63	1.7	1.0	1,450	1,000	868	1,000	4	13	0.7	0.8	1,350	500	1,964	667
Chipapa	23	77	1.2	1.0	743	500	616	500	4	13	0.6	0.5	388	388	600	775
Saise	13	43	0.8	1.0	356	290	475	290	18	60	0.8	0.5	564	175	712	350
Mayanga	25	83	1.5	1.0	1,122	750	758	750	1	3	1.0		600		600	
Mumba	10	32	1.5	1.0	205	150	137	150	-	-	-	-	-	-	-	-
Makashi	27	90	1.1	1.0	1,019	700	902	700	5	17	0.9	1.0	400	525	444	525
Kawikisha	28	93	1.5	1.0	613	500	408	500	-	-	-	-	-	-	-	-
Chisheta	29	97	1.0	1.0	509	400	491	400	12	40	0.6	0.5	604	350	1,074	700
Mutiti	25	81	1.0	1.0	704	750	733	750	4	13	0.5	0.5	463	438	925	875
Mulonda	26	72	1.6	1.5	1,226	875	766	583	18	50	1.0	1.0	1,881	1,338	1,881	1,338
Total/Ave	241	65	1.3	1.0	846	600	668	600	89	24	0.8	1.0	1,107	663	1,364	663

Source: Baseline Survey, JICA Study Team.

Table 3.5.8 Area, Production and Yield of Major Crops (5/6) (Rape and Cabbage)

Name of village/ District	Rape								Cabbage							
	HH		Area (lima)		Produced(kg)		Yield(kg/lima)		HH		Area (lima)		Produced(kg)		Yield(kg/lima)	
	No.	%	Ave	Med.	Ave	Med.	Ave	Med	No	%	Ave	Med	Ave	Med	Ave	Med
Lunda	5	17	0.4	0.5	397	417	1,096	833	2	7	0.8	0.8	525	525	700	700
Molwani	16	52	0.5	0.5	910	650	1,664	1,300	3	10	0.6	0.5	1,057	150	1,811	300
Kalemba	7	23	0.5	0.5	2,333	1,500	4,667	3,000	4	13	1.1	1.0	2,075	1,000	1,844	1,000
Chipapa	4	13	0.4	0.3	1,313	875	3,000	3,500	-	-	-	-	-	-	-	-
Saise	10	33	0.6	0.5	965	425	1,755	850	3	10	0.4	0.5	403	420	968	840
Mayanga	3	10	0.7	0.5	1,363	1,600	2,045	3,200	-	-	-	-	-	-	-	-
Mumba	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Makashi	16	53	0.8	1.0	864	645	1,024	645	4	13	1.4	1.5	1,513	1,075	1,100	717

Name of village/ District	Rape								Cabbage							
	HH		Area (lima)		Produced(kg)		Yield(kg/lima)		HH		Area (lima)		Produced(kg)		Yield(kg/lima)	
	No.	%	Ave	Med.	Ave	Med.	Ave	Med	No	%	Ave	Med	Ave	Med	Ave	Med
Kawikisha	6	20	1.4	0.8	467	350	329	467	5	17	0.8	1.0	980	1,025	1,255	1,025
Chisheta	10	33	0.5	0.5	543	513	1,033	1,025	3	10	0.7	0.5	1,408	850	2,113	1,700
Mutiti	4	13	0.4	0.5	725	650	1,657	1,300	2	7	0.3	0.3	2.175		8,700	
Mulonda	12	33	0.4	0.5	1,342	1,038	3,355	2,076	10	28	1.1	1.0	4,503	1,630	4,094	1,630
Total/Ave	93	25	0.6	0.5	999	600	1,621	1,200	36	10	0.9	0.8	2,175	1,053	2,485	1,403

Source: Baseline Survey, JICA Study Team.

Table 3.5.9 Area, Production and Yield of Major Crops (6/6) (Onion)

Name of village/ District	Onion							
	HH		Area (lima)		Produced(kg)		Yield(kg/lima)	
	No.	%	Ave	Med.	Ave	Med.	Ave	Med.
Lunda	1	3	0.5		550		1,100	
Molwani	-	-	-	-	-	-	-	-
Kalemba	1	3	0.5		200		400	
Chipapa	1	3	0.5		250		500	
Saise	1	3	1.0		360		360	
Mayanga	-	-	-	-	-	-	-	-
Mumba	-	-	-	-	-	-	-	-
Makashi	2	7	0.75		775		1,033	
Kawikisha	-	-	-	-	-	-	-	-
Chisheta	2	7	0.5		45		90	
Mutiti	1	3	0.5		100		200	
Mulonda	11	31	0.5	0.5	1,325	675	2,650	1,350
Total /Ave	20	5	0.6	0.5	886	455	1,576	910

Source: Baseline Survey, JICA Study Team.

4) Application of Fertilizer to Maize

Figure 3.5.5 and Figure 3.5.6 show the percentage of household applying the fertilizer (by kind and source –through FSP/FISP or bought from the market) to local maize and hybrid maize respectively. There is a cooperative in the villages except for Lunda, Kalemba, Saise and Mumba. Basically, villages which have own cooperative (except for Lunda, Kalemba, Saise and Mumba) in the village show high percentage of fertilizer application than the rest especially for Makashi, Kawikisha and Chisheta as more than 70% of households have applied the fertilizer to the hybrid maize. Nevertheless, for the 6 villages in Northern province show smaller than Luapula except for Molwani and this is mainly because of delay of delivery of the fertilizer as mentioned earlier.

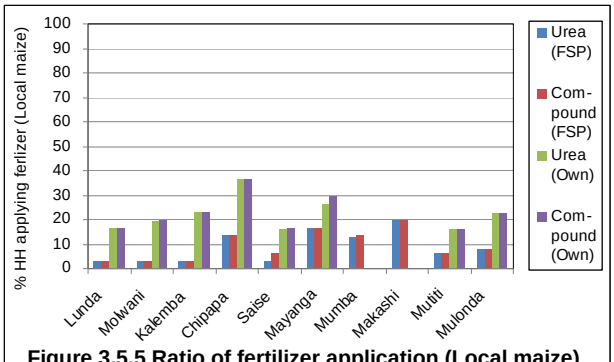


Figure 3.5.5 Ratio of fertilizer application (Local maize)
Source: Baseline Survey, JICA Study Team

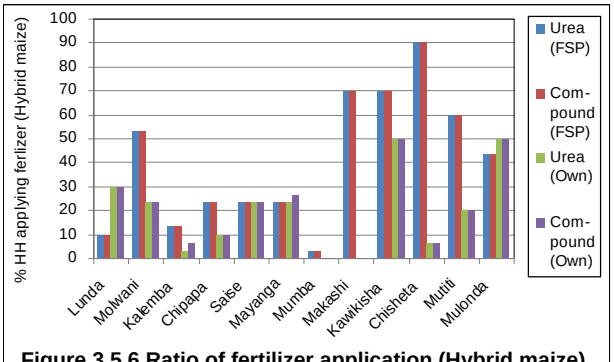


Figure 3.5.6 Ratio of fertilizer application (Hybrid maize)
Source: Baseline Survey, JICA Study Team

Figure 3.5.7 and Figure 3.5.8 show the fertilizer applied per lima for those plots to which fertilizer was applied. For local maize, an amount of 50 kg to about 120 kg of fertilizer was applied per lima of plot though most of the plots have received less than 100 kg per lima. On the other hand, at a glance is the more amount of fertilizer for hybrid maize as is expected. All the plots except for those

in Chipapa village have received more than 100 kg of fertilizer per lima of plot.

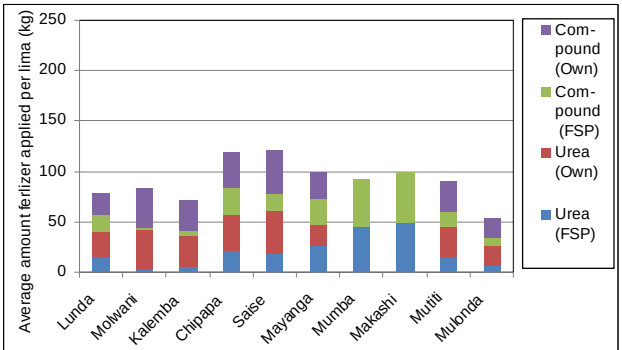


Figure 3.5.7 Amount of Fertilizer Applied per Lima (Local maize)
Source: Baseline Survey, JICA Study Team

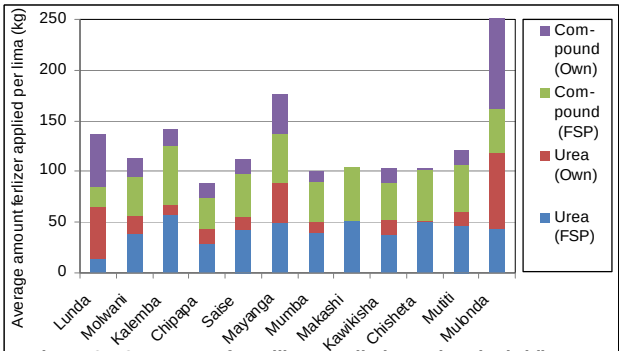


Figure 3.5.8 Amount of Fertilizer Applied per Lima (Hybrid)
Source: Baseline Survey, JICA Study Team

In Zambia, recommended fertilizer amount per lima of plot is 50 kg of D-compound and another 50 kg of Urea, totaling 100 kg per lima of plot. With these recommendations, it can be said that hybrid maize has received almost equal to or even more amount of fertilizer than the recommended ones. Note is that the fertilizer amount per lima was estimated only for those plots which were given fertilizer. As shown in the Figure 2.3.5 and Figure 2.3.6, more than half of the sampled households have not applied fertilizer in many villages, e.g. all the villages in case of local maize and 6 villages in case of hybrid maize. Therefore overall average fertilizer applied per lima of plot becomes much smaller than that of the recommended ones.

3.5.4 Crop Production and its Yield

Along with the national trend, maize production is a main form of agriculture in the Study area. As shown in Figure 3.5.9, planted area of maize in two provinces reached 144,981 ha (114,607 ha in Northern and 30,373 ha in Luapula) in the agricultural year 2009/10, which accounts for 29.9% of the total area planted in the two provinces in the same year (484,126 ha). The second major crop was cassava (120,335 ha), which is followed by groundnuts (70,856 ha) and mixed beans (59,080 ha).

It should be noted that cassava is one of the major crops in the two provinces, and actually seen widely in the area. The significance of cassava was also captured in the baseline survey as summarized in above Table 3.5.2 and Table 3.5.3. However, as its growing period exceeds more than a year and also it is harvested throughout the year, actual production of cassava is rarely available even in the CSO statistics. In fact, the CSO data of 2009/10 provide cassava production data based on the assumption that cassava can be harvested 11.7 ton/ha. Therefore, production of cassava in Figure 3.5.9 could be overestimated.

Looking at the maize plantation and production, furthermore, Northern province is superior to Luapula province as shown in Figure 3.5.10. Among all the districts in the two provinces, Mbala district has the largest planted area and production: 66,641 tons from the planted area of 29,414 ha in the year 2009/10. Those which follow are Mpika (43,026 tons in 12,926 ha), Isoka (37,750 tons in 15,469 ha), and Nakonde (31,306 tons in 11,976 ha). Top six districts in the production of maize are all in Northern province, which are located

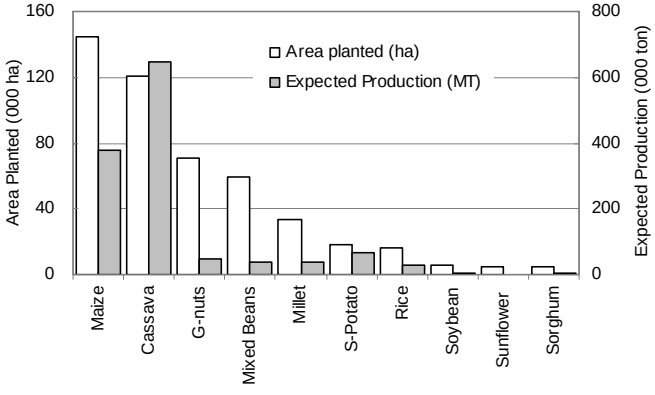


Figure 3.5.9 Production of Major Crops in the Study Area
Source: CSO crop data of 2009/10 cropping season
Production of cassava is converted into the dry weight.

relatively hilly area in eastern side of the province.

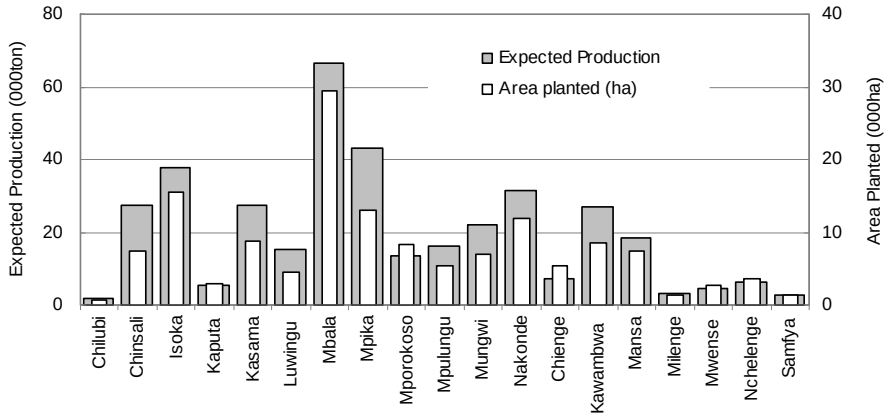


Figure 3.5.10 Maize Production and Area Planted by District in the Study Area

Source: CSO crop data for 2009/10 cropping season

Production level of maize corresponds to the amount of fertilizer inputs. As shown in Figure 3.5.11, the more fertilizer is provided by the FSP/FISP, the greater the production level is. For example, Mbala, the largest production district of maize, received the largest amount of fertilizer in 2009/10 at 2,790 tons, while Chilubi district that demonstrates the least production actually received the least amount of fertilizer (155 ton). It can be explained by the distribution policy of FSP/FISP, in which fertilizer is allocated in accordance with the size of the district. Accordingly the result suggests that the maize production in the Study area depends largely on the allocation of chemical fertilizer by FSP/FISP. The high cost of fertilizer in the market may further encourage this tendency as the farmers may not always able to purchase the fertilizer in the market.

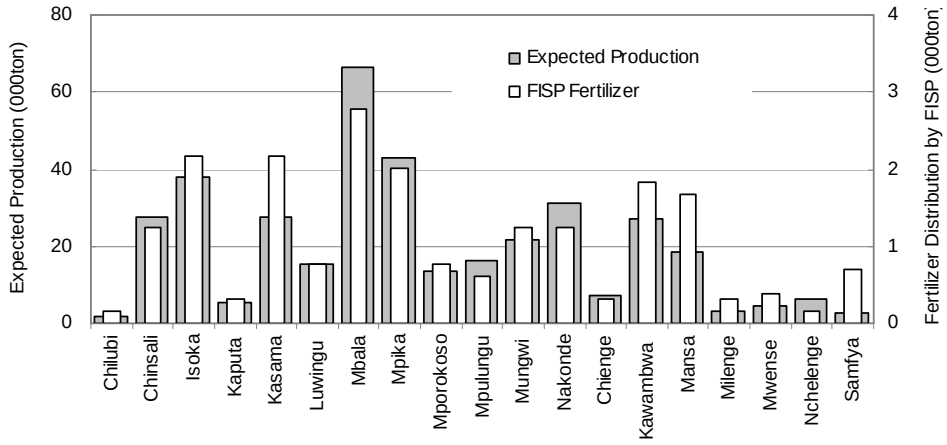


Figure 3.5.11 Maize Production and Distribution of Fertilizer by District in the Study Area

Source: CSO crop data of 2009/10 cropping season/ Implementation Manual of FISP for 2009/10

The yield of maize varies among the districts from 1.3 tons/ha in Nchelenge up to 3.7 tons/ha in Chinsali district as summarized in Figure 3.5.12. On average, the yield in Northern at 2.7 tons/ha is higher than that of Luapula at 2.3 tons/ha. Production was well correlated with the amount of fertilizer distributed as aforementioned. However, comparing the yield level to the FISP's fertilizer distribution, they do not necessarily correspond to each other; a large volume of fertilizer distribution does not guarantee high yield. It implies that the Study area is characterized by more extensive farming practice. In such area where production is large but yield level is low, it is assumed farmer apply a limited amount of fertilizer per unit of land but apply to a larger extent of land.

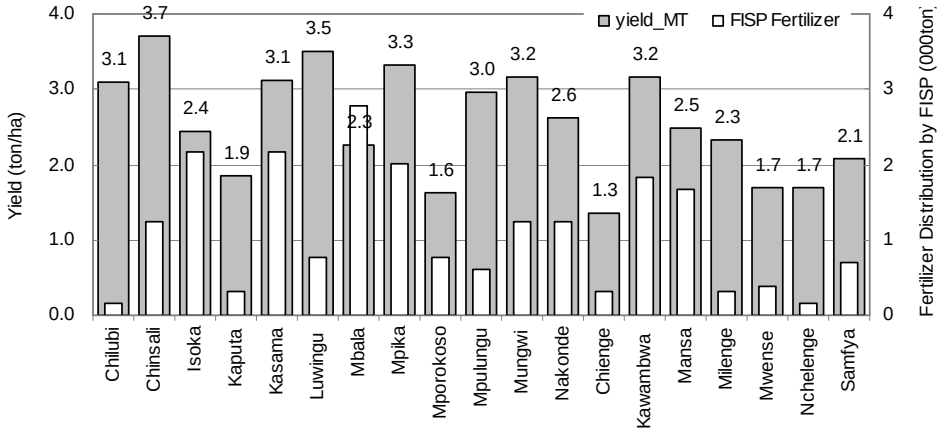


Figure 3.5.12 Yield of Maize and Distribution of Fertilizer by District in the Study Area

Source: CSO crop data of 2009/10 cropping season, Note: Yield is estimated from the expected production and the area harvested

The production of maize has changed significantly especially in the 2000s. As is shown in Figure 3.5.13, the production had been stagnant until 2002, and started increasing. The production in Northern province shows constant increase while Luapula province has not been as much. One of the possible contributors of this increase can be an increase in planted area as shown in Figure 3.5.14. The area planted maize had increased from 54,618 ha in 1999/00 to 114,607 ha 2009/10 in Northern province and 12,440 ha to 30,373 ha in Luapula province. Accordingly, the production had increased from 87,553 tons in 1999/00 to 308,078 tons in 2009/10 in Northern province and 40,282 tons to 69,363 tons in Luapula province. As the planted area had increased to 210% and 244% in Northern and Luapula provinces, the production had increased to 352% and 172% respectively.

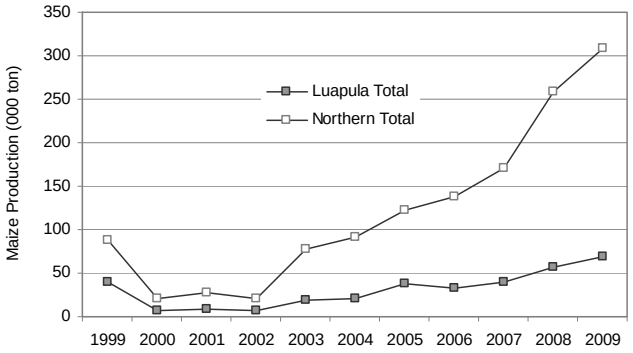


Figure 3.5.13 Maize Production by Year

Source: CSO Crop Data (1999/00 – 2009/10)

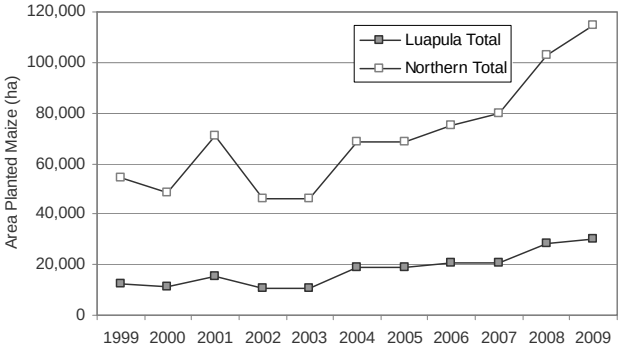


Figure 3.5.14 Maize Planted Area by Year

Source: CSO Crop Data (1999/00 – 2009/10)

Note: Because data for 2002 and 2004 are unavailable, dummy data were applied for drawing the graph.

When converting the total maize production shown in Figure 3.5.13 into per-capita production, one may see a level of self-sufficiency. Figure 3.5.15 shows the maize production per capita by year. As of 2009/10, maize production per capita per annum reached 196 kg and 72 kg in Northern and Luapula provinces. As aforementioned in Chapter 2.5.3, recent per capita food consumption in the country is roughly 200kg per capita, composed of 125kg of maize and 75kg of

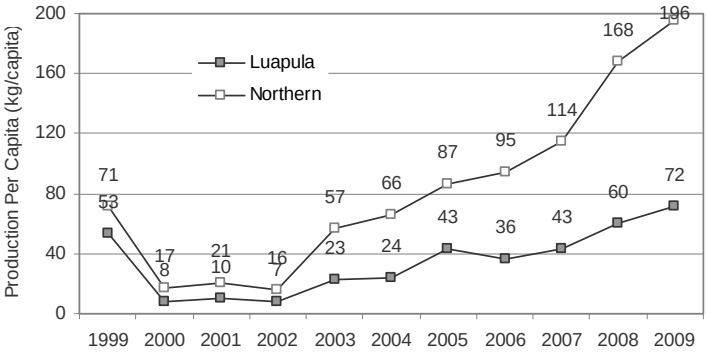


Figure 3.5.15 Per Capita Production of Maize (1999-2009)

Source: Production: CSO crop data (1999/00-2009/10)

Population: National Census 2000. 2001-2009 population estimated by the Study Team

cassava, suggesting almost satisfied level in food sufficiency. Though direct comparison between consumption and production cannot be made, it may suggest that the maize production in Northern province can be comparable to that of self-sufficiency level while that of Luapula province may not be yet that level.

3.5.5 Production of Major Staple Foods by Geographical Location

The production level of maize per capita varies within the Study area. As geospatial data in Figure 3.5.16 shows, there is a tendency that eastern and north-eastern sides of the Study area have relatively higher production per capita. For instance, Isoka district and Mbala district show the highest – more than 300kg/capita, while Mansa, Mwense, Nchelenge and others located in the western end of the Study area indicate the lowest – below 100kg/capita. This result generally corresponds with the topography of the Study area: higher in eastern and north-eastern sides and lower in western side. It is likely that maize is planted intensively under *Chitemene* shifting cultivation on hilly upland in the areas. With the help from the natural fertility from virgin soil or neutralized soil, farmers can enjoy higher productivity of maize in such areas.

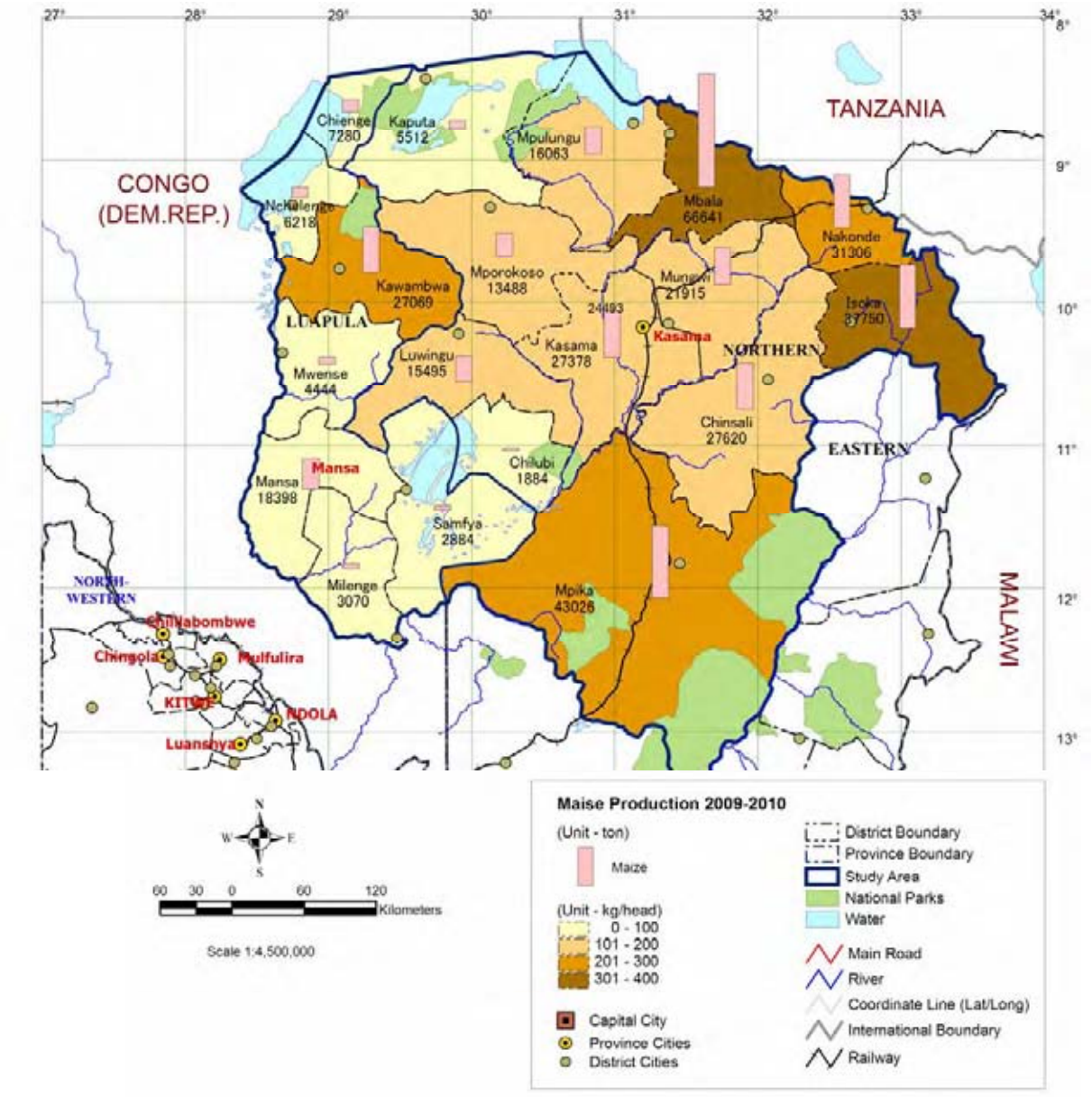


Figure 3.5.16 Maize Production Per Capita by District (2009/10)

Source: Production/ CSO crop data (2008/09), Population/ calculated based on CSO population data

Being a staple food, cassava production per capita is significant in both provinces. When looking into the cassava production by geographical location, the production level per capita shows completely opposite tendency against that of maize. As the geospatial data in Figure 3.5.17 shows, it is the highest at Kawambwa and Luwingu districts, the western side of the Study area. The first, 351-450 kg/capita, and the second highest group, 251-350 kg/capita, are concentrated in western sides of the Study area, and whereby mostly in Luapula province where there area a lot of low land areas along Luapula river. One possible scenario can be, not necessarily proved though, that farmers in those districts can have a great deal of access to the market in DRC, where the population prefer cassava as staple food, and thus they are motivated enough to produce cassava in stead of maize.

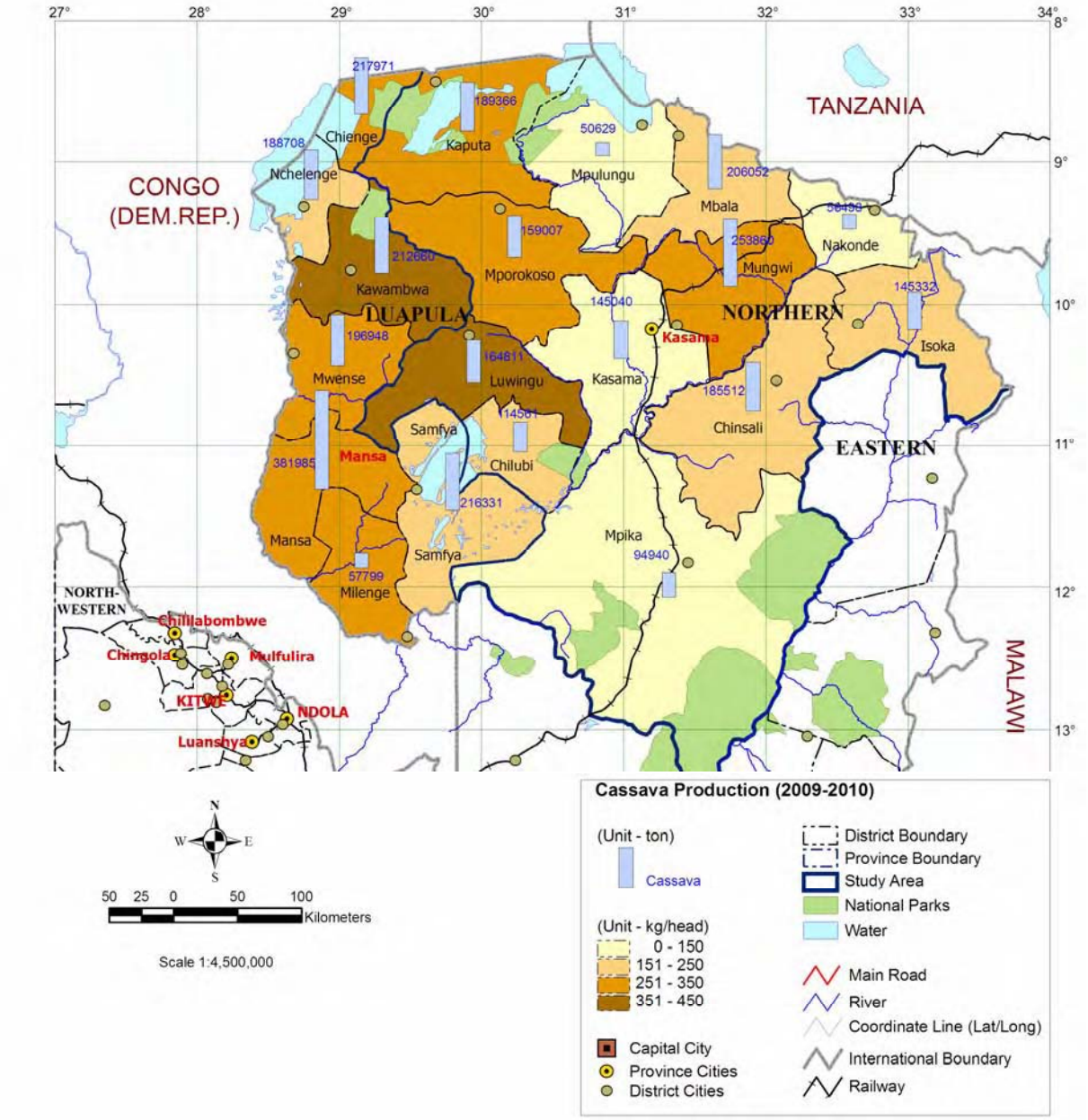


Figure 3.5.17 Cassava Production Per Capita by District (2009/10)

Source: Production/ CSO crop data (2008/09), Population/ calculated based on CSO population data

3.5.6 Balance in Crop Production and Consumption by District

Figure 3.5.18 shows the per capita production of cereal crops by district and province, which includes maize, sorghum, millet, and rice. On average, people in Northern province produces 226 kg/capita, while ones in Luapula province face a deficit; it reached only 72 kg/capita. As for the

districts, Mbala, Isoka, and Nakonde marked more than 300 kg/capita, suggesting that they have enough surplus to export to other regions including the neighboring countries.

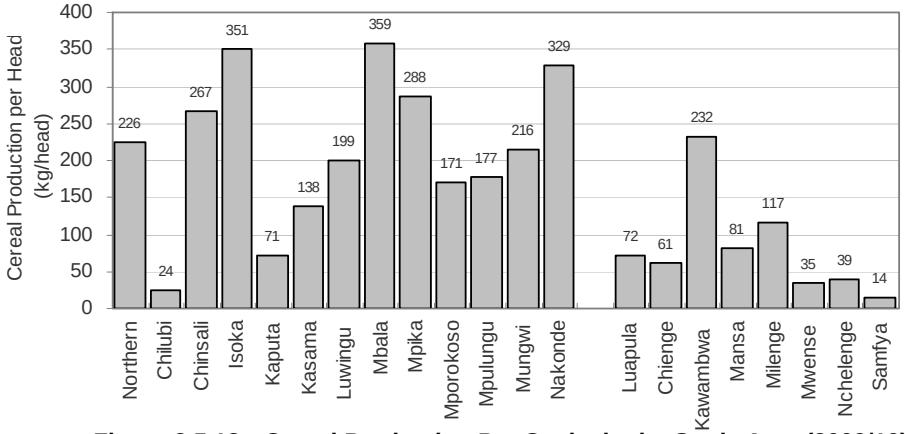


Figure 3.5.18 Cereal Production Per Capita in the Study Area (2009/10)

Source: Production/ CSO crop data of 2009/10 cropping season;
Population 2009/ Estimated based on the national census of 2000

On the other hand, Chilubi and Kaputa district in Northern province and most of districts in Luapula province except Kawambwa and Milenge encounter the shortage; they go under 100 kg/capita that is equal to approximately 1,000kcal/ day per capita[4]. As discussed, there are big differences in per capita cereal production among the districts.

A large number of rural populations in the area consume starch as a form of cassava, sweet potato, and some Irish potato. Based on CSO agricultural production data of 2009/10, per capita production of starch crops at dry weight (20% of fresh weight) averaged 219 kg/capita in Northern province and 289 kg/capita in Luapula province. By district, Luwingu, and Kawambwa demonstrate relatively good; more than 350 kg/capita (Figure 3.5.19). Note that the production of cassava is estimated based on 11.7ton/ha by the CSO and thus it could be overestimated.

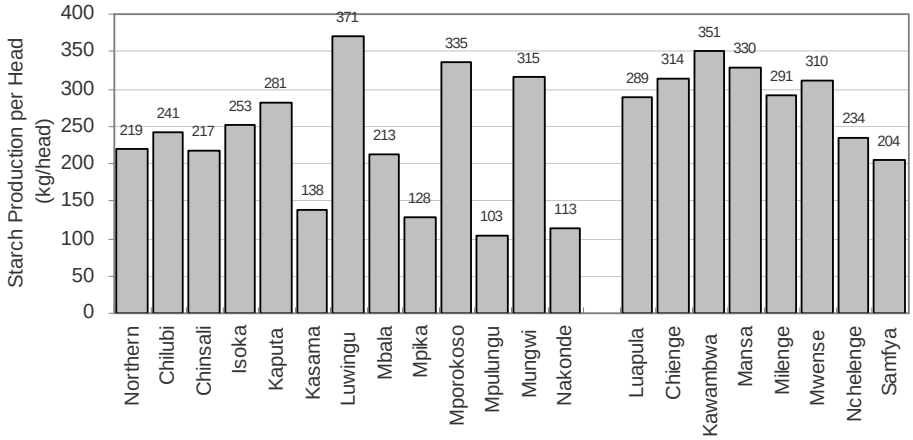


Figure 3.5.19 Starch Production Per Capita in the Study Area (2009/10)

Source: Production/ CSO crop data for 2009/10 cropping season;
Population 2009/ Estimated based on the national census of 2000
Note: Weight is converted to dry weight based on the water content of sweet potato (80%).

To obtain rough idea of energy consumption status in the area, Figure 3.5.20 illustrates the total production of cereals and starch per capita per annum. Although it is a simple combination of crop weights in different categories, it implies that the level of crop production in the area is quite satisfactory. On average, the production per capita reached 445 kg/capita in Northern and 362

[4] As maize shares 84% of the total cereal production, energy contents of maize was applied for the estimation. According to USDA, Agricultural Research Service, Nutrient Data Laboratory, energy content of maize is estimated at 365kcal/100g.

kg/capita in Luapula provinces. Among all the districts, six districts exceeded 500 kg/capita: Isoka (604 kg/capita), Kawambwa (583 kg/capita), Mbala (571 kg/capita), Luwingu (570 kg/capita), Mungwi (531 kg/capita), and Mporokoso (507 kg/capita). The minimum production per capita was found in Samfya (219 kg/capita), followed by Chilubi (265 kg/capita)—but they are still at a satisfactory level.

Although there was a significant difference in the production of cereal crops alone (Figure 3.5.18), the difference in a total production of cereal and starch is much moderate. For instance, while the maximum production per capita in cereal was 26 times as much as the one in minimum district, the difference between maximum and minimum in the total production is 2.8 times, suggesting that each district has different dieting pattern.

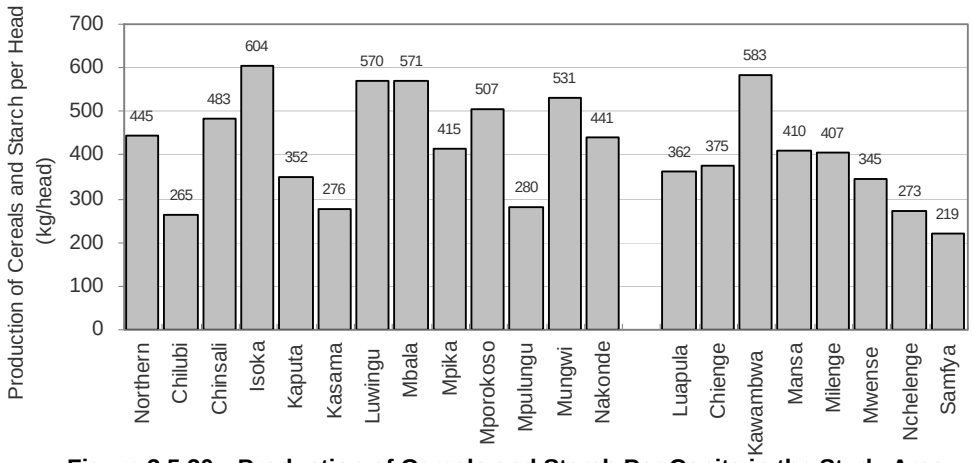


Figure 3.5.20 Production of Cereals and Starch Per Capita in the Study Area

Source: Production/ CSO crop data for 2009/10 season;
Population 2009/ Estimated based on the national census of 2000
Weight is converted to dry weight based on the water content of sweet potato (80%).

When summing up the production of maize and cassava per capita, the total production far surpasses the minimum requirement of the population in the Study area in terms of the total calories. It can be interpreted that farmers in the Study area is no longer in such situation as to pursue self sufficiency of staple food. Rather, they are in the stage to diversify their diet to improve their nutrition balance – enough rationality to start vegetable production under irrigation agriculture.

Moreover, groundnuts and mixed beans are major crops of pulse crops in the area. Different from that of cereal crops, Luwingu and Mporokoso are outstanding in per capita production of the pulses. According to an officer who had been a CEO in Luwingu district, the large production of pulses is associated with the allocation of fertilizer under the FSP/FISP. As shown in Figure 3.5.12, Luwingu is allocated a fewer amount of fertilizer from FSP/FISP and thus farmers in this area try to make up for the shortfall by cultivating pulses, which is believed to improve soil fertility at some point.

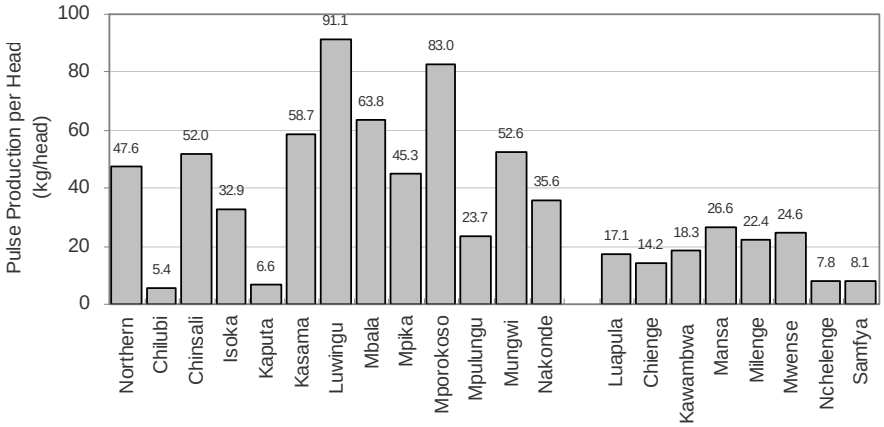


Figure 3.5.21 Pulse Production Per Capita (2009/10)

Source: Production/ CSO crop data for 2009/10 cropping season;

As discussed, a series of production per capita data make it clear the differences among the districts in the levels of production per capita. Thus, by taking surplus and deficit into consideration, general marketing strategy can be identified.

3.5.7 Distribution and Marketing of Agriculture Products

To see a general picture of the current marketing activities and thus its potential in the area, agricultural marketing survey was carried out during the dry season in 2009. As shown in the map, the survey covered nine districts: Kasama, Mbala, Nakonde, Mpika, Mporokoso, and Luwingu in Northern province, and Mansa, Kawambwa, and Nchelenge in Luapula province.

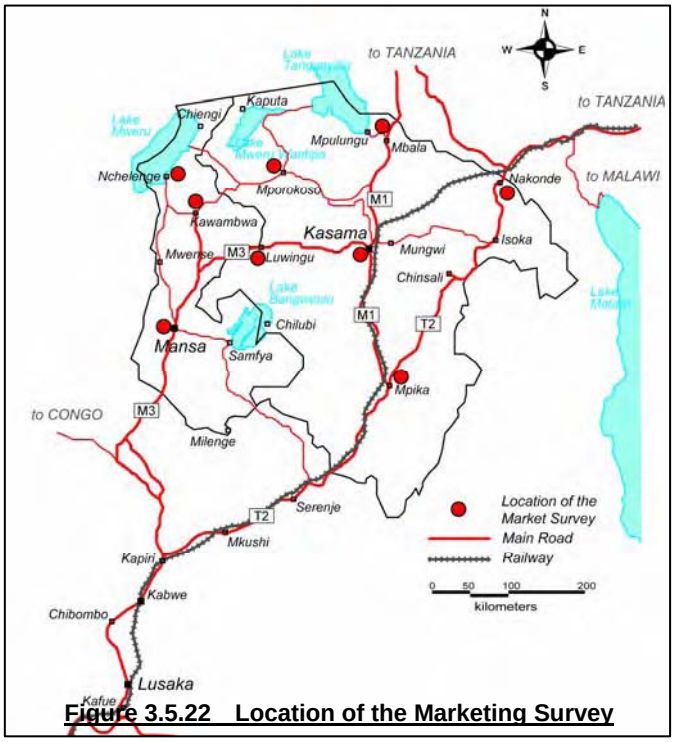


Figure 3.5.22 Location of the Marketing Survey

Firstly, a series of focus group interviews were carried out in nine villages in the nine districts with the ratio of one village per one district. The targeted villages were selected in such places along the main road and are near from district centers. For the focus group interviews, relatively advanced farmers were selected as they were considered more market-oriented than the others, that is, the picture described in this section does not necessarily represent whole population but reflect more the reality of progressive farmers.

Secondly, market survey was carried out in the same nine districts, in which profiles of major markets were identified: for example, type of facilities, market prices, and destinations where the commodity come from and goes to. The following describes general picture of the agricultural marketing in the Study area based on the findings from the survey, although there might be some limitations in the size of samples.

1) Agricultural Produces Marketed

With the condition mentioned above, it was found that more than half of farmers' produces, 73% on average, are sold in the market – about quarter is consumed at home. It seems that quite a good portion of produces are being marketed in the sample areas. Looking at each crop, most of the crops that are grown both in rain and dry seasons have a tendency that a more portion in irrigated agriculture is sold out than rainfed production. For example, 88% of irrigated maize is sold, while 67% of rainfed maize is sent to the market. On the other hand, only cabbage shows completely opposite result; rainfed cabbage (91%) is sold at more percentage than irrigated (85%) as shown in Table 3.5.10.

Table 3.5.10 Produces Marketed

Crops	Portion sold (%)
Maize (Irrigated)	87.65
Maize (Rainfed)	66.55
Cassava	60.39
Finger Millet	69.22
Sweet potato	57.86
Groundnuts	51.89
Soybeans	93.17
Beans (Irrigated)	50.47
Beans (Rainfed)	40.10
Onion (Irrigated)	86.78
Onion (Rainfed)	79.45
Tomato (Irrigated)	87.04
Tomato Rainfed)	80.23
Eggplant	75.45
Rape	77.89
Cabbage (Irrigated)	84.50
Cabbage (Rainfed)	90.95
Chinese Cabbage	78.66
Simple Average	73.24

Source: Agricultural Marketing Survey by the Study Team

Again, this data was drawn under a relatively advantageous condition where market access is preferable and the interviewees are seen as advanced. However, as shown in Table 3.5.11, result of the baseline survey has also thrown similar result. Although data are limited and thus a careful interruption is required, the percentages of produce sold are generally high. For example, 55% of hybrid maize is sold in Molwani village in Kasama district, while it reaches 65% in Kalemba Chiti village in Mungwi district. Those villages are located in 16km and 32km away from their district capital. This another source of results support the hypothesis that the food security is already at high level and the agriculture here in the Study area is more market oriented.

Table 3.5.11 Produces Marketed by Baseline Survey

Village	Molwani		Kalemba		Remarks
Distance from town	16 km		32 km		
Crop	Portion Sold	No. of Farmers Produced	Portion Sold	No. of Farmers Produced	
Local maize	40%	8	62%	17	
Hybrid maize	55%	20	65%	4	
Cassava	53%	17	59%	25	
Millet	65%	8	43%	28	
Sorghaum	56%	2	63%	2	
Beans	68%	12	75%	24	
Soya bean	75%	1	88%	1	
Sweet potato	52%	11	75%	19	
Irisht Potato	50%	1	30%	1	
Ground nuts	55%	19	63%	27	
Tomato	91%	13	88%	4	
Cabbage	81%	3	87%	4	
Onion			75%	1	
Rape	90%	16	14%	5	
Pumpkin	71%	2	0%	1	
Eggplant	88%	1			
Okra	88%	2	80%	1	
Banana			70%	1	
Citrus	97%	1	67%	1	
NTFPs	0%	1	68%	12	
Average	65%	8	62%	9	
No. of Samples		31		30	

Source: Baseline Survey by the Study Team (2009)

Note: Ratio of selling is calculated based on the total amount of produces sold per total amount produced among all the samples. Therefore, the result derived from less number of samples, such as eggplant, citrus, and soya beans, may be significantly biased.

2) Marketing Channels

With regard to the Study area, the extent of marketing channel is relatively wide; to the maximum extent, some of agricultural products produced in the area are delivered to major cities in other provinces including Lusaka and Copperbelt provinces, and even to other countries, e.g., Tanzania and DRC. This wide distribution channels generally provide farmers with a potential in marketing. That is to say, as far as cash crops are concerned, there are a variety of marketing opportunities. One may aim at higher selling price by selling his/her produce to a big city where potential demands is far bigger than the production area, while other may stick on the neighboring markets that may not require exaggerated arrangement for transportation.

As shown in Figure 3.5.23 from the agricultural marketing survey carried out in the Study, some percentages of agricultural produces go to other provinces including other countries. As shown in Table 3.5.12 and Figure 3.5.24, for example, on average 54.3 % is traded within the district while the 23.3 % goes towards other districts within the same province, and then surprisingly the rest, 22.5%, goes even outside of the original province. This result may draw such a practice in which though more than half of the farmers tend to choose local market in their own district there are on the other hand as much as over 20% of farmers who target high potential big markets in other provinces.

It further implies that if farmers are prepared with required conditions such as quantity of produce,

means of transportation, and funding for marketing arrangement, they target the best potential market in the mega-cities, while those who do not meet with those conditions stick on the nearest markets even though market prices are not preferable.

Yet, this situation actually varies depending on the types of produces. For example, Chinese cabbage is not shipped to other provinces at all, while more than 40% is marketed to outside provinces for maize (46%)[5], groundnuts (44%), beans (43%) and onion (40%). It looks that the perishable produces are marketed to nearer market, while non-perishable foods tend to go to big markets. However, it is too hasty to conclude; as much as 31% of tomato, one of perishable foods, is shipped to other provinces. A hypothesis from the findings: the actual marketing channels are, thus, more likely governed by the market mechanism of supply and demand rather than the level of perishability.

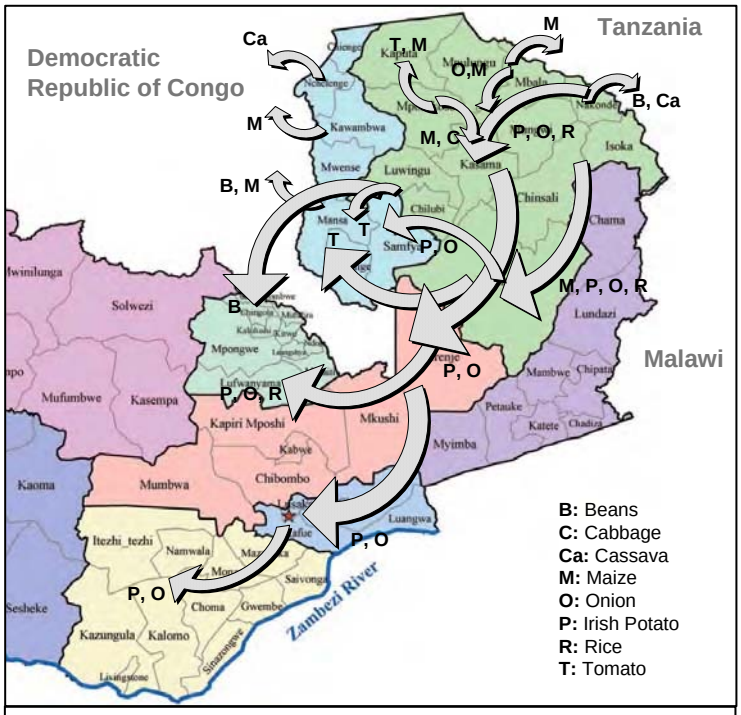


Figure 3.5.23 Major Market Channels of Selected Crops
Source: Agricultural Marketing Survey, 2009, JICA Study Team

Table 3.5.12 Share in the Destinations of the Produces

Crops	% of HH Selling Out	Share of Destination of Produce (%)			
		Outside the province	Within the province	Within the district (% to "within the province")	
Maize	74	46	52	40	(77)
Cassava	80	13	87	79	(91)
Finger Millet	N/A	N/A	N/A	N/A	N/A
Sweet Potatoes	100	17	83	82	(99)
Groundnuts	76	44	57	61	(91)
Soybeans	60	11	89	89	(100)
Beans	60	43	58	58	(100)
Cowpeas	28	20	80	58	(73)
Onion	100	40	60	48	(80)
Tomatoes	92	31	69	64	(93)
Impwa (egg plant)	98	8	93	88	(95)
Rape	97	6	94	91	(97)
Cabbage	94	13	87	67	(77)
Chinese Cabbage	100	0	100	84	(84)
Simple Average		22	78	70	(90)

Source: JICA Study Team (Agricultural Marketing Survey). Note: Due to rounding, total may not be 100%.

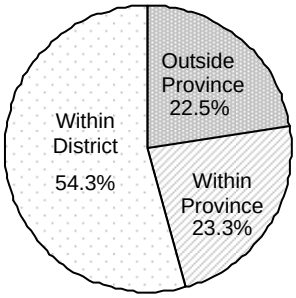


Figure 3.5.24 Share in the Destination of Produces

3) Types of Transporters

Because of its lower population density, markets are generally far from farmers' farmland. Thus, the means of transportation or marketing chain are important. It actually changes according to the types of crops. As shown in Table 3.5.13 and Figure 3.5.25, for example, soybean is sold completely by farmers themselves, while the least percentage, 55%, is sold by farmers in Chinese cabbage. In terms of the types of transporters, majority, or 75%, of the produces sent to market are carried by farmers

[5] Due to an involvement of FRA in the marketing of maize, the data may be biased. Therefore, data refinement is necessary.

themselves. Other than that, 12% of the produces are sold to someone who acts as a "middleman" in the same village and the rest, 13%, are to buyers from outside the village. It changes according to the types of crops.

Table 3.5.13 Type of Transporters of Produces

Crops	% of HH Selling Out	Carriers to Outside the Village (%)		
		Farmers themselves	Middlemen in the village	Buyers from other places
Maize	74	66	13	21
Cassava	80	62	15	23
Finger Millet	N/A	N/A	N/A	N/A
Sweet Potatoes	100	88	5	7
Groundnuts	76	59	16	25
Soybeans	60	100	0	0
Beans	60	68	33	0
Cowpeas	28	99	0	1
Onion	100	81	5	14
Tomatoes	92	71	9	20
Impwa	98	84	14	3
Rape	97	68	14	17
Cabbage	94	78	9	13
Chinese Cabbage	100	55	23	22
Simple Average		75	12	13

Source: JICA Study Team (Agricultural Marketing Survey). Note: Due to rounding, total may not be 100%.

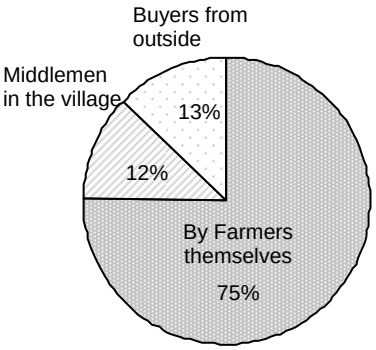


Figure 3.5.25 Types of Transporters

In the case of soybean, production in the Study area is not outstanding. Accordingly, there might be a limited number of buyers coming into those villages and therefore farmers may have to sell their produce by themselves. If it is the case, quantity of the produce may be one of decisive factors in the availability of buyers from outside.

4) Means of Transportation

Based on the agricultural marketing survey, of those carried by farmers themselves, 77% of the produces are carried by bicycle, 58% are on the head of farmer, and 20% are shipped by vehicle[6]. The use of vehicle is found mostly for transportation of bulky produces such as maize and, in some part, onion. For marketing, bicycle is usually improvised with the traditional large basket called '*umutonga'* to ferry tomatoes, cabbages, rape and any other produce. The size of the basket varies in size to carry weights of between 20 to 60 kg of produce. Farmers are able to cycle long distances to the market. Farmers in Katongo Kapala village, for example, carry their produces more than 30 km from the village centre to the market—this is not a special case.

Bicycle with a basket called "umutonga."
Farmers carry their produces as far as 30km

5) Market Price

Market prices change significantly along the timeline. Based on the lowest marketing price in a year, price increases by 112% on average of all the crops; it is more than twice as much as the lowest price. Specifically, tomato shows the largest rate of increase at 305%; it changes from ZMK 15,778/ 20kg to ZMK 63,889/ 20kg. The least price change is found in soybean, 28%, suggesting the relative

[6] Based on a multiple answer question. For rough understanding, percentage is estimated based on the aggregated number of crops that are carried by designated means of transportation in nine villages per aggregated number of all the crops sold in the nine villages.

stability of the price in this crop. In addition, prices generally rise during the wet season, November to March, when less supply is available on the market due to the difficulty in vegetable production under moisture condition. Then price hits the bottom when dry season produces appear in the market.

According to some interviews in the market, despite the seasonal price fluctuation of market price, prices do not generally change a lot within each of wet and dry season. As collective marketing is not major in the area, fluctuation of marketing price at the farm gate directly influences the marketability of the crops at the village level.

Table 3.5.14 Change in Market Price for Different Crops

Crop	Unit	Farm Gate Price (ZMK)		Increase (%)
		Lowest	Highest	
Maize	5kg	3,000	7,722	157%
Cassava	5kg	2,722	5,000	84%
Finger Millet	5kg	2,875	7,188	150%
Sweet potatoes	25kg	6,444	15,333	138%
Groundnuts	5kg	12,813	21,571	68%
Cowpeas	5kg	10,000	16,667	67%
Soybeans	5kg	12,500	16,000	28%
Beans	5kg	9,833	20,833	112%
Onion	5kg	9,625	21,786	126%
Tomatoes	20kg	15,778	63,889	305%
Impwa	5kg	6,700	16,100	140%
Okra	5kg	8,333	17,667	112%
Rape	25kg	9,056	19,389	114%
Cabbage	25kg	11,944	23,889	100%
Chinese Cabbage	25kg	10,944	19,313	76%
Simple Average				112%

Source: JICA Study Team (Agricultural Marketing Survey, 2009).

6) Market Demand

The agricultural marketing survey also focused on the marketing destinations in major markets. Based on the survey carried out in nine markets in a total of nine districts, difference of marketing channel in each crop was identified, although a limitation still remains. Table 3.5.15 shows major production area where the crops are from as well as the crops are shipped to.

Based on this result, a lot number of crops such as cassava leave, Chinese cabbage, cowpea, and cucumber are from the same district where the market is located. Of a total of 37 commodities listed in the table, 12 items are completely from the same district. In contrast, there are some crops more than half of which are from outside of the district: garlic (33.3% from the same district), groundnuts (48.6%), Irish potato (23.1%), onion (34.4%), and paprika (2.5%).

On the other hand, looking at the destination of the produces, there are also some varieties; some are mostly sold targeting to the same province and even to the same district, while the others are sold to other provinces, reportedly Lusaka and Copperbelt. The latter case includes beans (66.4%), chillies (50.0%), curry (60.0%), and groundnuts (56.4%). High percentage in shipping to other province implies higher demand from the big cities and thus higher potential for smallholder irrigation development.

Table 3.5.15 Origin and Destination of the Produces Traded in Major Markets in the Nine Districts

Crop	Major Production Area Where Crops Are Collected From (%)			Major Marketing Destinations Where The Crops Are Shipped To (%)		
	In the District	Outside of the District	Outside of the Province	Other Provinces (A)	Within Province (B)	of (B) within District
Maize	76.1	17.8	6.1	40.0	60.0	66.7
Cassava	67.5	40.0	4.4	28.8	68.8	88.8
Rice	**15.0**	22.9	62.1	42.9	57.1	76.4
Finger millet	66.7	21.7	11.7	31.7	68.3	74.2
Sweet potatoes	88.8	11.3	0.0	13.8	86.3	72.5
Irish potatoes	**23.1**	4.7	72.1	12.7	87.3	83.6
Pumpkins	100.0	0.0	0.0	16.7	83.3	83.3
Groundnuts	**48.6**	34.3	17.1	56.4	43.6	62.1
Beans	57.1	23.6	19.3	66.4	27.9	74.3
Cowpeas	100.0	0.0	0.0	0.0	100.0	100.0
Green Beans	100.0	0.0	0.0	0.0	100.0	100.0
Onion	**34.4**	28.0	37.6	35.3	64.7	55.2
Tomato	61.1	25.6	13.3	20.6	79.4	62.8
Impwa (local egg plant)	88.6	11.4	0.0	10.7	89.3	87.1
Carrot	85.0	0.0	15.0	0.0	100.0	90.0
Okra	55.0	45.0	0.0	25.0	75.0	100.0
Cucumber	100.0	0.0	0.0	0.0	100.0	100.0
Rape	100.0	0.0	0.0	0.0	100.0	91.7
Cabbage	86.1	12.8	1.7	3.3	89.4	79.4
Chinese cabbage	100.0	0.0	0.0	0.0	100.0	91.7
Cowpea leaves	100.0	0.0	0.0	0.0	100.0	100.0
Pumpkin leaves (chibwabwa)	100.0	0.0	0.0	0.0	100.0	100.0
Sweet potato leaves (kalembula)	100.0	0.0	0.0	0.0	100.0	100.0
Cassava leaves	100.0	0.0	0.0	0.0	100.0	100.0
Green maize	80.0	0.0	20.0	0.0	100.0	70.0
Sugarcane	50.0	37.5	12.5	18.6	91.3	100.0
Bananas	55.0	27.5	17.5	1.3	98.8	86.3
Mangoes	86.7	13.3	0.0	13.3	86.7	100.0
Water melons	55.0	45.0	0.0	25.0	75.0	75.0
Pineapple	50.0	50.0	0.0	0.0	100.0	80.0
Oranges	55.6	36.0	8.4	8.0	92.0	100.0
Curry	100.0	0.0	0.0	60.0	40.0	30.0
Garlic	**33.3**	33.3	33.3	0.0	100.0	100.0
Ginger	0.0	0.0	100.0	0.0	100.0	100.0
Paprika	**2.5**	47.5	50.0	0.0	100.0	100.0
Chillies	80.0	0.0	20.0	50.0	50.0	100.0

Source: JICA Study Team (Agricultural Marketing Survey, 2009).

7) Potential for Smallholder Irrigation

Gaining a quantitative understanding on agricultural marketing is extremely difficult because less is recorded in each market and boarders with other countries. However, the agricultural marketing survey generally provides some positive signs for marketing.

First, the extent of existing marketing channel is quite wide, including big cities in other provinces and neighboring countries. Thus, peripheral part of the Study area, such as Mbala, Mansa and Nakonde, can enjoy comparative advantages for wider marketing. On the northeastern side, for example, there is a good chance of marketing to Tanzania especially from the area near to Nakonde district where the boarder town exists. On the northwestern side, including some districts in Luapula province, farmers sell their produces like cassava to DRC. Furthermore, elsewhere along the main road or major cities can enjoy selling their produce to Lusaka and Copperbelt provinces.

For the best instance, an onion farmer in Mbala district located in northern part of Northern province delivers his produce to Copperbelt by himself. He takes a shuttle-truck by paying ZMK 60,000/bag (50kg) to reach there and then he can enjoy the higher price in Copperbelt, twice as much as the price in Mbala (ZMK200,000 /bag in Mbala to ZMK 400,000/bag in Copperbelt). After deducting

the transportation cost and storage cost in Copperbelt, the difference in two prices is estimated ZMK 335,000/bag. As a result, he can earn a net profit of ZMK 12,010,000/lima by selling at Copperbelt, while it is expected ZMK 6,610,000/lima when selling at local market.

In addition, some specific crops were found having more potential for marketing than the others. As of the price fluctuation, cassava, Chinese cabbage, cowpea, groundnuts, and soybean showed relative stability (less than 100% of price change), suggesting less risk in price change and thus easier to start producing them. Further, market demand is another key factor for the market potential. To measure market demand, extent of current market channel gives us a clue; the longer the market channel is, the more the market demand in the big cities may be. For example, while carrot, cucumber, and green maize are sold mostly within the district where they are produced, beans, curry, and groundnuts are shipped outside the province, implying a strong "pulling" power of the market from urban area. Therefore, those who would like to break into urban market, such commodities can be the first ones to consider.

Moreover, green maize is another potential crop during the dry season. Different from the dried maize produced in rainy season, the price of green maize stays high: ZMK 1,000-1,500/cob. As farmers are familiar with maize production itself, once irrigated water becomes available, farmers can easily start cultivating it in the dry season without much hesitation. In fact, according to an interview survey to TSB officers in six districts, average net profit can be around at ZMK 5.7 million/lima, while it is approximately ZMK 403,500/lima only in the rainy season.

As the market potential varies place to pace, time by time, and crop by crop, it should not be over generalized. However, the marketing survey revealed some evidences of market-oriented agriculture for some crops. At least, agricultural production is not just at the level of home consumption. Since people are scattered in the area, availability of transportation and distance to the market are the absolute factors for marketing. For those who are located in relatively advantageous situation in those regard, smallholder irrigation can be a strong contributor for them to improve their livelihood through market-oriented agriculture.

3.5.8 Soil Analysis

A total of 10 soil samples were collected and analyzed from four villages where pilot activities were carried out. As shown in Table 3.5.16, samples were collected in a total of four villages: Kalupa village in Mungwi and Lukulu North (project name), Molwani, and Mulenga Mulaka in Kasama district. Two samples were collected in each of the village except Molwani where four samples were collected as there was more diversity in the appearance of the soil surface.

Table 3.5.16 Location of the Samples Collected

Sample Code	Location	District
A	Kalupa Upper	Mungwi
B	Kalupa Lower	Mungwi
C	Lukulu North Upper	Kasama
D	Lukulu North Lower	Ditto
E	Molwani Upper (1)	Ditto
F	Molwani Upper (2)	Ditto
G	Molwani Middle	Ditto
H	Molwani Lower	Ditto
I	Mulenga Mulaka Upper	Ditto
J	Mulenga Mulaka Lower	Ditto

Based on the analysis, most of the soil samples were concluded low in their fertility. The most apparent feature of the soils can be found in their pH: an average of 10 samples is pH 4.2, ranging from 3.9 to 4.7, all of which are far below than recommended range for crop production (6.0-6.5). The traditional farming system of *Chitemene* shifting cultivation may have been developed to cope with this acidic soil; farmers may have found empirically that ash can neutralize the soil acidity.

Fortunately, maize, the dominant crop in the area, is of the most tolerant crops against low pH. Other crops relatively suited to lower pH are chili pepper, soybeans, rice, wheat, sorghum. Crops categorized in the least tolerant group include cabbage, tomato, and spinach; all of them are popular

in the area, claiming the necessity of appropriate soil management.

Table 3.5.17 Inventory of the Soil Properties of 10 Samples in the Study Area (1/3)

Sample	Water Content	pH (1:2.5) H2O	EC (1:5)	Effective Phosphoric acid (mg/100g dry soil)	Phosphoric acid Absorption coefficient	Exchangeable Potassium (mg/100g dry soil)	Exchangeable Lime (mg/100g dry soil)
	%	6.0 - 6.5	<0.2	>20	>200	>15	>200
A	0.87	**4.7**	0.07	**30**	393	**11.5**	**86**
B	0.74	**4.3**	0.10	**31**	388	**8.0**	**69**
C	0.80	**4.5**	0.03	12	330	**8.8**	**44**
D	0.80	**4.2**	0.05	16	328	**11.8**	**22**
E	1.00	**4.1**	0.06	14	380	**11.1**	**38**
F	1.47	**3.9**	0.20	12	455	19.1	**55**
G	0.90	**4.0**	0.06	16	258	**8.4**	**32**
H	0.34	**4.1**	0.05	10	**192**	**6.9**	**7**
I	0.27	**4.1**	0.06	8	**111**	**5.2**	**24**
J	0.37	**4.5**	0.02	12	204	**4.2**	**9**
Ave.	0.76	4.2	0.07	16	304	9.5	39
Min.	0.27	3.9	0.02	8	111	4.2	7
Max.	1.47	4.7	0.20	31	455	19.1	86

Source: JICA Study Team (2009)

Also, all the exchangeable ions, potassium, lime, and magnesium, appeared to be low as compared to the standard recommended values in Japan. For instance, an average value of exchangeable potassium was 9.5 as compared to the standard at “more than 15.” Of all the samples, only one sample from Molwani village surpassed the standard. In such soils, application of potassium is highly recommended. For instance, chicken droppings are recommended as a material for making organic fertilizer. Exchangeable lime is also quite low; an average value resulted in 39 as compared to the standard at “more than 200.”

Low values in exchangeable irons are likely to be caused by low Cation Exchange Capacity (CEC). CEC is known as a measure of nutrient retention capacity of the soil. Therefore, low CEC value usually leads to lower fertility of the soil. Looking at the CEC of the samples, as expected, it is generally low. An average of 10 samples was 4.3 mg/100g dry soil, although it is supposed to be more than 20. The minimum value was even lower than 2.0 in Molwani and Mulenga Mulaka.

Table 3.5.18 Inventory of the Soil Properties of 10 Samples in the Study Area (2/3)

Sample	Exchangeable Magnesium (mg/100g dry soil)	CEC (mg/100g dry soil)	Basic Saturation (%)	Magnesium/ Potassium Ratio	Lime/ Magnesium Ratio	Free iron oxide (%)
	>25	>20	60 - 80	>2	<6	
A	**10.8**	**4.8**	79.4	2.2	5.7	0.21
B	**8.3**	**5.5**	**55.7**	2.4	5.9	0.25
C	**7.7**	**4.4**	**48.6**	2.1	4.1	0.33
D	**6.8**	**3.7**	**37.0**	**1.3**	2.3	0.31
E	**10.5**	**5.4**	**39.8**	2.2	2.6	0.14
F	**15.9**	**7.9**	**39.9**	2.0	2.5	0.12
G	**8.2**	**5.2**	**33.8**	2.3	2.8	0.09
H	**3.0**	**1.9**	**28.7**	**1.0**	1.7	0.03
I	**6.1**	**1.9**	66.6	2.8	2.9	0.10
J	**3.2**	**2.1**	**27.2**	**1.8**	2.0	0.15
Ave.	8.0	4.3	45.7	2.0	3.2	0.17
Min.	3.0	1.9	27.2	1.0	1.7	0.03
Max.	15.9	7.9	79.4	2.8	5.9	0.33

Source: JICA Study Team (2009)

Other notable elements of the soil include fusible boron; an average 0.09 is far less than the standard (0.5-1.0). Low value in fusible boron often causes damage on the top of leaves making the color blackish. Crops prone to low fusible boron include eggplant, tomato, bell pepper, and sunflower, while grass plants (poaceous) is relatively sustainable against low fusible boron. Therefore, maize,

sorghum and finger millet are relatively suited in that condition.

Table 3.5.19 Inventory of the Soil Properties of 10 Samples in the Study Area (3/3)

Sample	Ammonium Nitrogen (mg/100g dry soil)	Nitrate Nitrogen (mg/100g Dry soil)	Humic Substance (%)	Exchangeable Manganese (ppm)	Fusible boron (ppm)	Zinc (ppm)	Copper (ppm)
			>3	>3	0.5 - 1.0	8 − 40	1 − 3
A	2.2	1.8	3.93	**1.52**	**0.12**	**0.09**	**0.20**
B	1.3	2.4	5.43	5.25	**0.19**	**0.35**	**0.10**
C	1.3	0.7	3.29	27.78	**0.08**	**0.39**	**0.10**
D	1.9	0.8	3.41	21.82	**0.09**	**0.93**	**0.09**
E	1.5	2.5	5.28	**1.82**	**0.20**	**0.59**	**0.10**
F	5.7	6.1	7.68	4.04	**0.10**	**0.68**	**0.05**
G	1.5	1.8	5.61	**1.82**	**0.10**	**0.53**	**0.05**
H	2.1	0.8	3.31	**0.40**	**0.01**	**0.62**	**0.08**
I	1.3	2.2	**2.65**	7.07	**0.01**	**0.26**	**0.07**
J	1.3	1.2	3.41	**0.81**	**0.01**	**0.79**	**0.06**
Ave.	2.0	2.0	4.40	7.23	0.09	0.52	0.09
Min.	1.3	0.7	2.65	0.40	0.01	0.09	0.05
Max.	5.7	6.1	7.68	27.78	0.20	0.93	0.20

Source: JICA Study Team (2009)

As briefly discussed above, chemical characteristics of the soil in the sampled area are generally not supportive to crop production. A number of important elements showed lower value as compared to the recommended values in Japan. It is therefore understandable why this area is a granary of maize; comparatively, maize is tolerant to such environment where acidity is high and fusible boron is low. However, this result strongly suggests that, if cultivating other vegetable crops, any measurement has to be taken to cope with those negative factors of the soil condition.

3.6 Irrigation in the Study Area

This section elaborates overall irrigation situation in the Study area. It starts with irrigation type in the Study area, and followed by an inventory of existing irrigation schemes, designing and construction of those schemes, and mode of operation and maintenance. The inventory focuses on such issues as; area being irrigated, water source, type of irrigation scheme, state of irrigation facilities in place, water abstraction and application methods, crops grown, market available, level of management, potential areas of these schemes and the factors constraining expansion of these schemes.

3.6.1 Irrigation Type in the Study Area

Irrigated agriculture by smallholder farmers has been practiced during dry season, typically from April to November, where water sources are available from river, streams, *dambos*, groundwater (mostly dug well), lakes, etc. For the establishment of irrigation schemes suitable to the area where it is to be located, key factors due considered should be: 1) topographical condition, 2) farmland distribution, 3) simple water abstraction method, and 4) flood condition in rainy season.

Topography in the Study area, in view of irrigated agriculture, can be basically divided into four types; namely, 1) mountainous area, 2) transition area from mountain to upstream *dambo* area, 3) upstream of *dambo* areas and 4) middle – downstream of *dambo* area. Mountainous areas and transition areas are physically not suitable for building large-scale irrigation schemes due mainly to its hilly and undulating topography.

On the other hand, however, those areas can provide a lot of potentials for small-scale gravity irrigation scheme from the viewpoint of easy water abstraction. In contrast to them, upstream and mid stream *dambo* areas, where large wetlands extend alongside the river/stream, can be developed for medium to in some cases large-scale irrigation schemes.

Figure 3.6.1 illustrates typical irrigation schemes located along river/stream in the Study area. They are categorized into eight irrigation types, Type 1 – Type 8, as described below:

1) **Mountain Stream Diversion:** This is located at the most upstream of rivers where the longitudinal slope of river is steep. Irrigation scheme is normally at small-scale as water flow is small. Key factors to make a plan of this type of irrigation scheme are water abstraction to be easy by gravity, farmlands to be situated near the water source, and mountain/hill slope to be at least somewhat gentle so that farmlands can be developed under irrigation. Since most of the Study area extends to plateau areas, not many of this irrigation scheme can be found.

2) **Stream Diversion at Transition Area between Mountain and Upstream *Dambo*:** This type of irrigation scheme is located at transition area between mountainous areas and upstream of *dambo* areas. The slope of river/stream is still somewhat steep. This irrigation scheme can be relatively at middle size because the amount of water flowing in the river/stream is richer than the diversion point of type 1 above. The conditions for the establishment of this irrigation scheme are almost same as the type 1, which means that the water abstracted from river/stream should be conveyed to the farmland by gravity.

3) **Stream Diversion located at Upstream of *Dambos*:** This is situated at an upstream area of *dambos* where surrounding areas are still somewhat hilly topography. Pumping devices like motorized/engine pump, treadle pump may be utilized to supplement water flowing in the furrow and/or to irrigate upper lands which cannot be covered by gravity from the furrow. At present, bucket irrigation with dug-well is often applied in this area.

4) **Stream Diversion located at Mid-down Stream of *Dambos*:** Similar to the type 3 above,

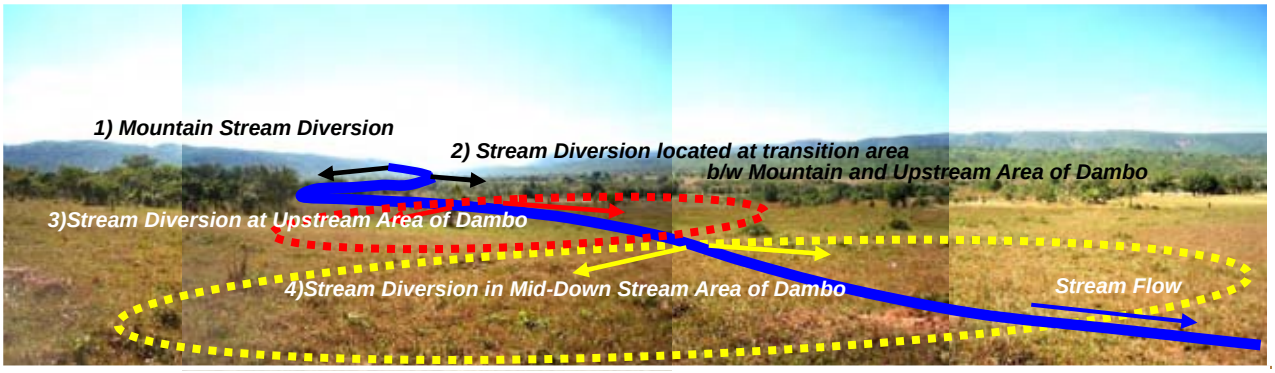
river/stream diversion sites are found at river course within *dambo* area. Diversion weirs are to be located inside *dambo* area, say mid to downstream areas of *dambos*, thus weir length becomes long to cross the *dambo*. In order to gain larger area to irrigate, the furrow (canal) tends to have longer distance. The irrigable area is set in between the stream and the furrow. Due to the gentleness of the stream, the furrow cannot run away from the stream, thereby making it difficult to develop wider irrigable area within a limited distance from the diversion point. For designing this irrigation scheme, floods must be taken into account. As same as the type 3, pump equipment and/or bucket could be utilized to take water from the furrow in order to irrigation farm lands spreading along the higher side of the canal.

5) **Dam for Water Impounding:** This type is usually built at upstream to midstream of rivers providing relatively large-scale dams to impound river/stream water together with a gravity canal system for water delivery. Irrigable areas can become large-scale involving large number of beneficiaries, however in the Study area only small earth dam type of impounding water can be found. The points to make this scale of irrigation schemes sustainable are operation and maintenance of irrigation facilities and equipment, water distribution management, and organizing and establishment of the water users association.

6) **Surface Engine / Motorized / Treadle Pump based Irrigation including Bucket:** In order to irrigate hillside from mid to downstream *dambo* areas except places which can introduce gravity irrigation scheme, lifting of water from rivers/ stream cannot be avoided and either engine/ motorized pump or treadle pump are considered as water lifting device. Treadle pumps will also be used at very small-scale, say about 0.3 ha of irrigable area per treadle pump. The capacity of pumps depends on required pump head and designed irrigable area. In addition to the water lifting devices mentioned, bucket irrigation is often practiced at the smallest scale in such areas by using the water from dug-wells.

7) ***Dimba* Farming at Dambo Area:** Traditional *dimba* farming is practiced at *dambo* areas at both middle and downstream of *dambos*. Also this farming is sometimes found at right downstream of earthen dam where farmers utilize seepage water from the dam. Unless it is covered by any of the gravity diversion irrigation schemes, cropping is done with help of bucket irrigation or under residual moisture.

8) **Sprinkler Irrigation Scheme:** This irrigation scheme occupies a quite small number of existing irrigation schemes in the Study area, and in fact no this kind of scheme exists under smallholder farmers. This scheme is rather owned by private large-scale farmers, equipped with in most cases center-pivot irrigation facility. This type usually involves motorized pumps for water abstraction and pressure pipes for water delivery. Location of pumping sites must be carefully studied where water is tapped from streams/rivers taking into account the magnitude of floods.



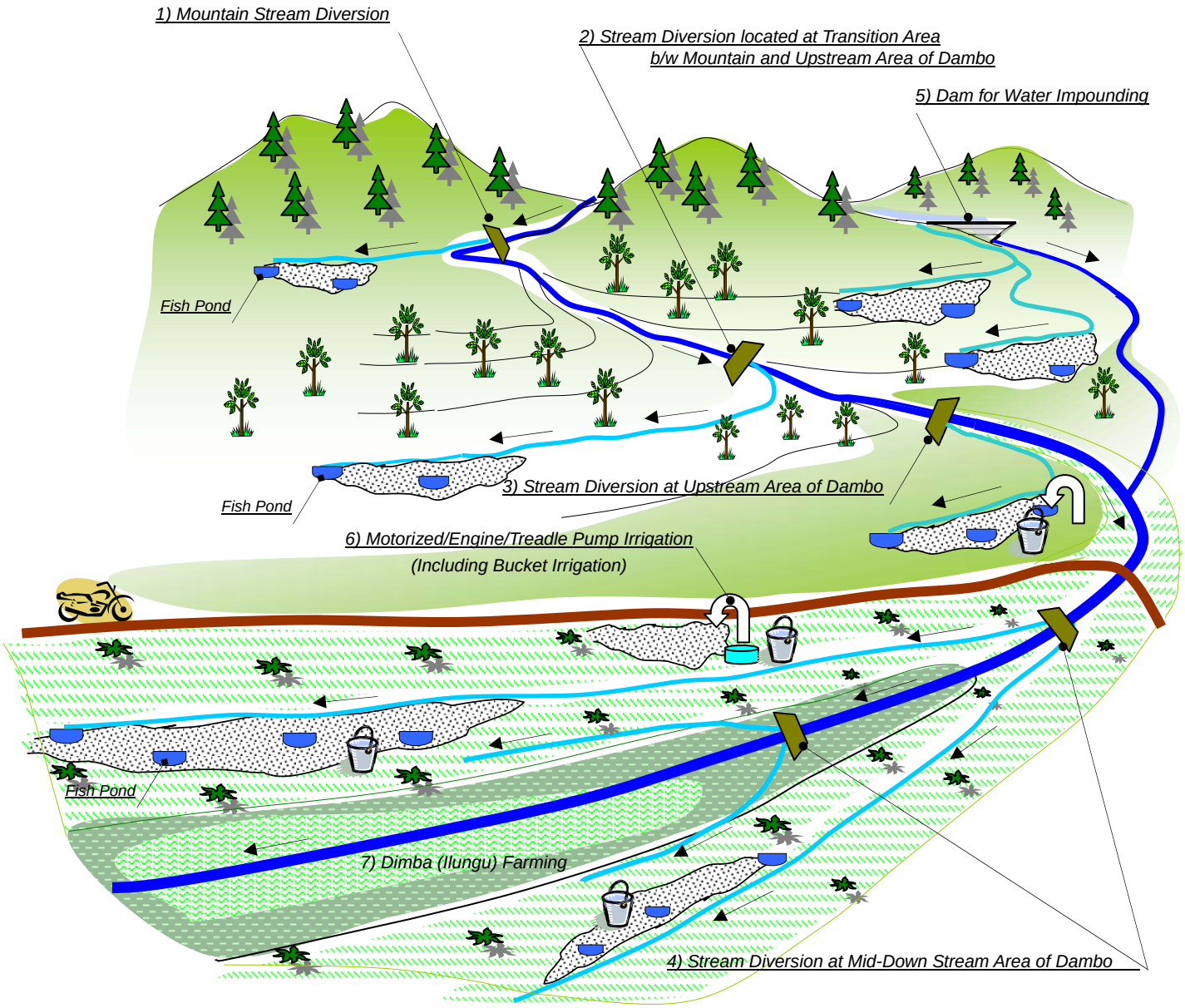


Figure 3.6.1 Typical Irrigation Schemes in the Study Area

3.6.2 Existing Irrigation Schemes in the Study Area

Existing irrigation schemes in the Study area are categorized in two types by its nature as; 1) permanent irrigation scheme and 2) temporary irrigation scheme. The former one is established with permanent structures like concrete diversion weir, dam reservoir to impound river/stream water, etc. The latter irrigation schemes are in most cases constructed by farmer themselves by utilizing locally available materials such as grass, clay soil, twigs, bamboos, or by just digging a water furrow to which stream water is withdrawn by gravity.

To identify irrigation schemes in the Study area, an inventory survey was administered in the dry season of year 2009. The inventory survey was to identify number of permanent irrigation schemes, number of temporary irrigation schemes with those present situation, water sources, type of the facilities, number of irrigators engaged, potential to expand, crops cultivated, etc. Permanent irrigation schemes were surveyed mainly by the help of district TSBs and temporary irrigation schemes mainly by the help of CEOs.

1) Inventory of Existing Irrigation Schemes

Table 3.6.1 summarizes the existing irrigation schemes by permanent or temporary, and also by province. From the table, following are identified:

i) There are 104 permanent irrigation schemes in the two provinces, composed of 67 sites in Northern province and 37 sites in Luapula province. The total irrigated area by these permanent schemes is reported at 441 ha, composed of 361 ha in Northern province and 80 ha in Luapula province. From these figures, an average irrigated area per scheme arrives at only 4.2 ha for the both provinces; 5.4 ha in Northern province and 2.2 ha in Luapula province.

ii) As for farmer beneficiaries for the permanent irrigation schemes, there are as many as total 3,727 farmers under these irrigation schemes; divided into 2,780 beneficiaries in Northern province and 947 beneficiaries in Luapula province. As per average number of beneficiaries per site, it is found to be only 36 farmers for the both provinces. Average number of beneficiaries per site in Northern province is a little big as 41 members against 26 members in Luapula province. This is attributable to the fact that average irrigated area per site in Northern province is bigger than that of Luapula province, 4.1 ha vs. 2.2 ha.

iii) For temporally schemes, we can find many sites in total of 1,024 sites, composed of 850 sites in Northern province and 174 sites in Luapula province. Since these schemes were constructed by farmer themselves, there could be some more sites which are not counted here. It is a fact, anyway, that farmers in the Study area have constructed already great number of temporary irrigation schemes to date.

iv) The temporally irrigation schemes altogether irrigate a total area of 1,772 ha, composed of 1,564 ha for Northern province and 208 ha for Luapula province. This total area of 1,772 ha counts at almost 4 times of permanent ones. As expected of course, irrigated area per site is not big, say just 1.7 ha as the overall average for the two provinces. The irrigated area per site in Northern province is a little bigger as 1.8 ha comparing to 1.2 ha in Luapula province. A typical temporary scheme accommodates an average of 17 farmer beneficiaries; by province it is 18 members in Northern province and 15 members in Luapula province. It can be said that a typical temporary irrigation scheme accommodates about half of the members of permanent irrigation scheme.

Table 3.6.1 Number of Existing Irrigation Scheme and Area

Province		No of Site	Present Irrigated Area		No. of Irrigators	
		(Sites)	(ha)	(ha/site)	(person)	(person/site)
Existing Permanent Scheme		104	441	4.2	3,727	36
Existing Temporary Scheme		1,024	1,772	1.7	17,712	17
Total		1,128	2,213	2.0	21,439	19
Breakdown						
Category of Scheme	**Province**	**No. of Site**	**Present Irrigated Area**		**No. of Irrigators**	
		(Sites)	(ha)	(ha/site)	(person)	(person/site)
Existing Permanent Scheme	Northern	67	361	5.4	2,780	41
Existing Temporary Scheme		850	1,564	1.8	15,144	18
Total of Northern province		917	1,925	2.1	17,924	20
Existing Permanent Scheme	Luapula	37	80	2.2	947	26
Existing Temporary Scheme		174	208	1.2	2,568	15
Total of Luapula province		211	288	1.4	3,515	17

Source: Inventory Survey by JICA Study Team, done during 2009 dry season.

Figure 3.6.2 shows the number of permanent irrigation schemes by district: left figure for Northern province and the right one for Luapula province. Likewise, Figure 3.6.3 shows the irrigated area by those permanent irrigation schemes summarized by district. Figure 3.6.4 illustrates the water source of irrigation schemes by *dambo*, river/stream, spring, and shallow well (dug well), while Figure 3.6.5 identifies the irrigation methodology such as surface/furrow, pump/sprinkler, and others including dug-well, bucket irrigation, etc. From these figures, following are observed:

i) Except few districts, most districts have some permanent irrigation schemes. In Northern province, Munguwi district has the largest number of permanent schemes, that is 14 sites followed by Isoka district (12 sites), and Kasama (9 sites) and Nakonde (9 sites). In Luapula province, the district having maximum number of permanent sites is Kawambwa (18 sites), followed by Samfya (8 sites) and Mansa (7 sites).

ii) Irrigated areas by permanent schemes are correlative to the number of the sites in the districts. Figure 3.6.3 shows us that in Northern province Mbala district has the biggest irrigated area with a total of 125 ha, followed by the irrigated area of 124 ha in Mungwi district. In Luapula province, Kawambwa shows the largest irrigated area of 46 ha. In addition to these districts, those which have more than 10 ha of irrigated area by permanent schemes are; Isoka (32ha), Nakonde (23ha), Chinsali (20ha), Kasama (19ha) in Northern province, and Samfya (17ha) in Luapula province.

iii) Source of irrigation schemes is similar between the two provinces; namely river/ stream occupies the largest share, e.g. 90% in Northern province and 78% in Luapula province. These are followed by *dambo*, as 7% in Northern province and 11% in Luapula province. In Northern province, spring shares 3% as irrigation source while it is not reported in Luapula province. Instead, shallow wells (dug wells) were reported in Luapula province as one of water source, sharing 11%.

iv) As per irrigation methodology, surface/ furrow comes first by far as expected. This irrigation method shares as much as 94% in Northern province and 73 % in Luapula province. There are pump/ sprinkler irrigation schemes both in Northern and Luapula province, though this irrigation method shares minimal, e.g. 3% in Northern province and 5% in Luapula province. Others include well irrigation and bucket irrigation, which are found more in Luapula province.

Figure 3.6.6 shows the number of temporary irrigation schemes by district: left figure for Northern province and the right one for Luapula province. Likewise, Figure 3.6.7 shows the irrigated area by those temporary irrigation schemes summarized by district. Figure 3.6.8 illustrates the water source of irrigation schemes by *dambo*, river/stream, spring, and shallow well (dug well), while Figure 3.6.9

identifies the irrigation methodology such as surface/furrow, pump/sprinkler, and others including dug-well, bucket irrigation, etc. From these figures, following are observed:

i) Number of the temporary irrigation schemes varies very much from district to district. This may be attributed to topographic condition, namely, too gentle or almost flat plain area is obviously associated with difficulty of developing simple gravity irrigation scheme while hilly areas are ideal to withdraw water by gravity even without diversion structure. In Northern province, Mungwi (229 sites), Mbala (186 sites), Mporokoso (162 sites) are the top three districts where there are great number of temporary irrigation sites, followed by Luwingu (97 sites), Kasama (57 sites) and Chinsali (35 sites). For Luapula province, Mansa district identified more than 100 temporary sites, followed by Kawambwa district (32 sites).

ii) Irrigated areas by temporary schemes are somewhat correlative to the number of the sites in the districts. Figure 3.6.7 shows that in Northern province Mporokoso district has the biggest irrigated area with a total of 435 ha, followed by the irrigated area of 313 ha in Luwingu district. In Luapula province, Mansa district shows the largest irrigated area of 122 ha. In addition to these districts, those which have more than 50 ha of irrigated area by temporary schemes are; Mungwi (293ha), Mbala (125ha), Nakonde (123ha), Kasama (122ha), Chinsali (55ha), and Isoka (52ha), all of which fall in Northern province.

iii) As for source of irrigation schemes, river/ stream occupies the largest share, e.g. 87% in Northern province and 56% in Luapula province. These are followed by *dambo* as 8% in Northern province and 24% in Luapula province, by shallow well as 4% in Northern province and 11% in Luapula province and then by spring as 1% in Northern province and 6% in Luapula province. It is noted that Luapula province has many temporary irrigation schemes sourced by *dambos*, sharing 24%. This high share is attributed by those temporary irrigation schemes developed around Mansa town. There are many *dambos* around Mansa town where the farmers produce vegetables, e.g. cabbage, marketed at Mansa township. These temporary schemes in *dambo* area contributed to raising the share.

iv) As per irrigation methodology, surface/furrow comes first as expected. This irrigation method shares as much as 88% in Northern province and 55 % in Luapula province. There are pump/sprinkler irrigation schemes both in Northern and Luapula province, though this irrigation method shares minimal, only 1% in Northern and 4% in Luapula province. Others include well irrigation, bucket irrigation, which are found very much more in Luapula province. As much as 41% of the temporary irrigation schemes in Luapula province depend on mostly bucket irrigation and to a lesser extent well irrigation with help of bucket or otherwise engine pump though this case is very few. The bucket irrigation, one of 'Others' mentioned here, is the one mostly practiced in those temporary irrigation schemes in the *dambo* areas around Mansa town.

v) By comparison between the 2 provinces, temporary irrigation schemes are found more in Northern province. This might be associated to data inaccuracy to some extent because there is a difficulty of identifying all the temporary irrigation schemes constructed by farmer themselves. However, it is still likely because there are many fishery based rural population in Luapula province, especially along Luapula river, and around Lake Mweru and Lake Bangweulu. This fishery-based livelihood must have contributed to developing less number of temporary irrigation schemes in Luapula province as compared with Northern province.

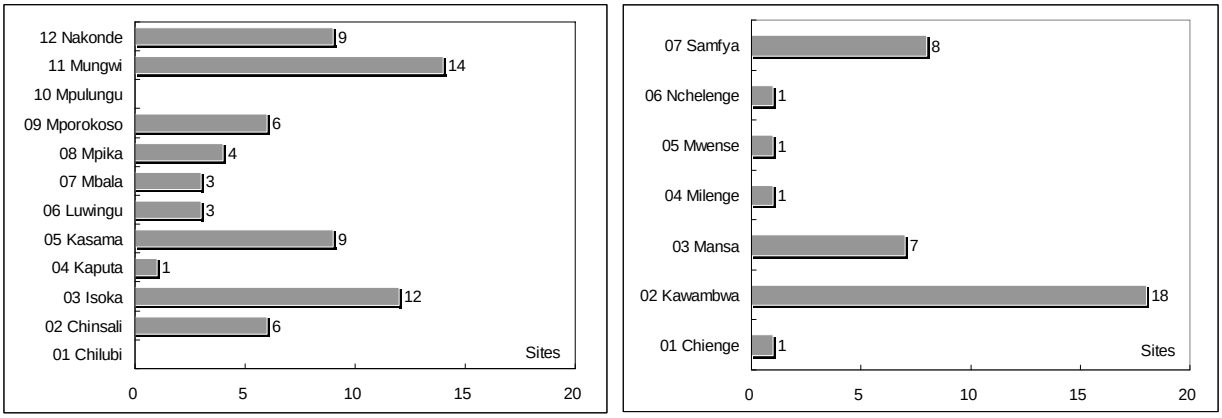


Figure 3.6.2 Number of Permanent Irrigation Schemes by District: Left (Northern), Right (Luapula)
Source: Irrigation Scheme Inventory Survey, 2009, JICA Study Team

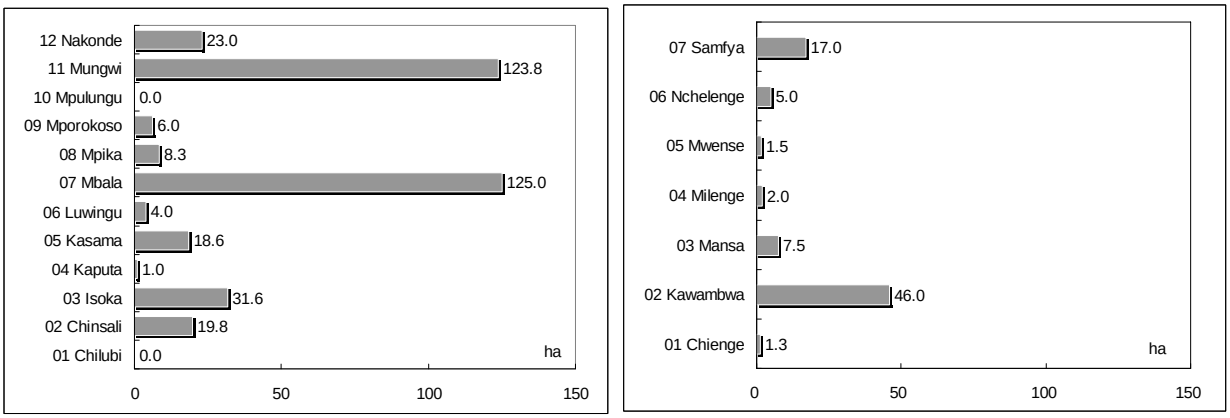


Figure 3.6.3 Areas Irrigated by Permanent Irrigation Schemes by District: Left (Northern), Right (Luapula)
Source: Irrigation Scheme Inventory Survey, 2009, JICA Study Team

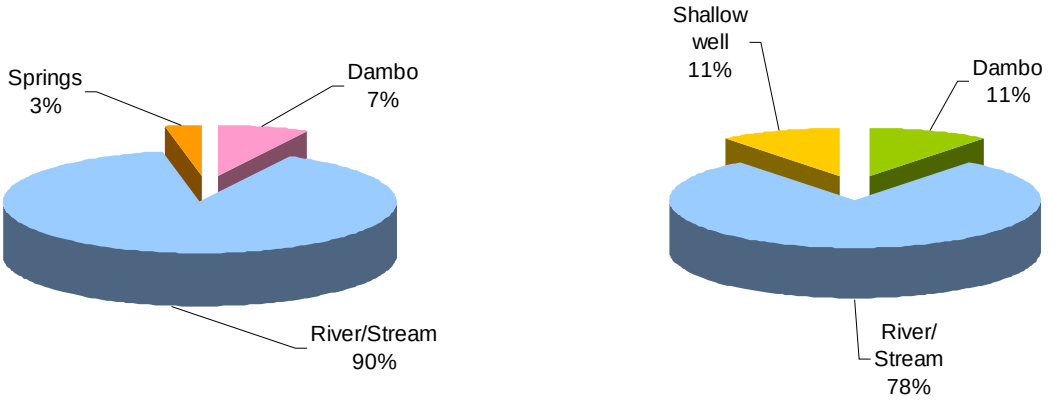


Figure 3.6.4 Water Sources for Permanent Irrigation Schemes: Left (Northern), Right (Luapula)
Source: Irrigation Scheme Inventory Survey, 2009, JICA Study Team

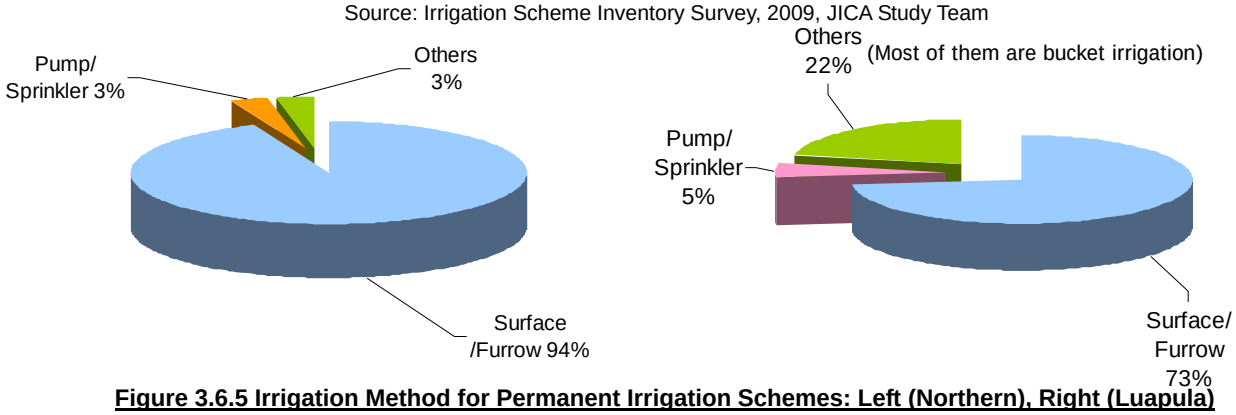


Figure 3.6.5 Irrigation Method for Permanent Irrigation Schemes: Left (Northern), Right (Luapula)
Source: Irrigation Scheme Inventory Survey, 2009, JICA Study Team

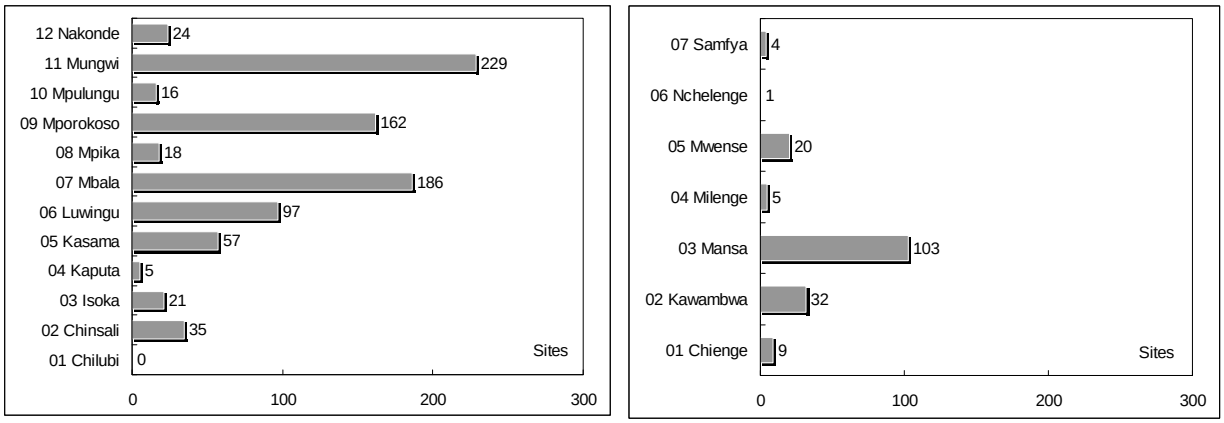


Figure 3.6.6 Number of Temporary Irrigation Schemes by District: Left (Northern), Right (Luapula)
Source: Irrigation Scheme Inventory Survey, 2009, JICA Study Team

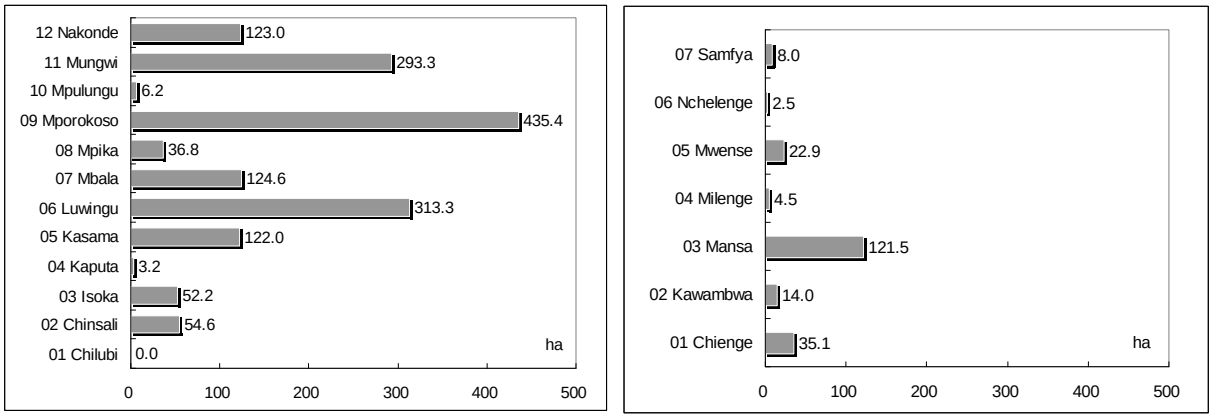


Figure 3.6.7 Areas Irrigated by Temporary Irrigation Schemes by District: Left (Northern), Right (Luapula)
Source: Irrigation Scheme Inventory Survey, 2009, JICA Study Team

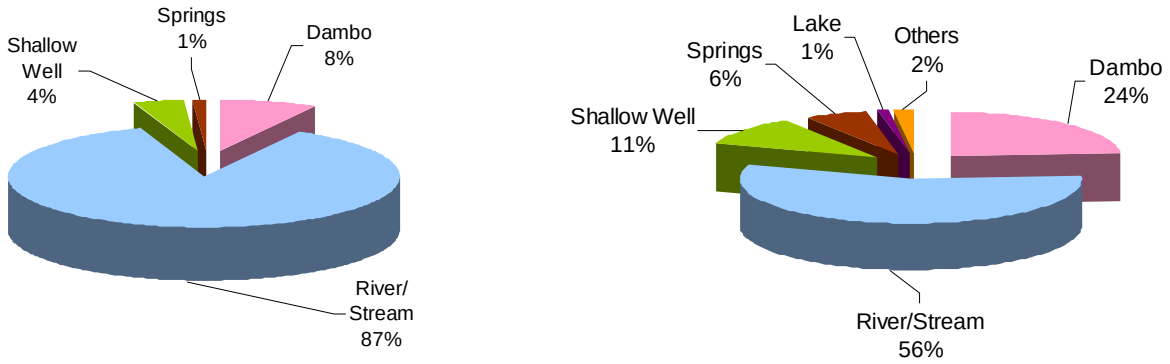


Figure 3.6.8 Water Sources for Temporary Irrigation Schemes: Left (Northern), Right (Luapula)
Source: Irrigation Scheme Inventory Survey, 2009, JICA Study Team

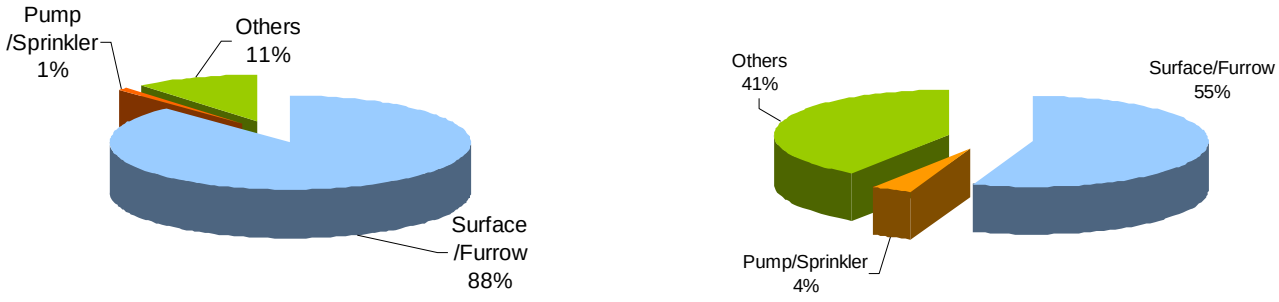


Figure 3.6.9 Irrigation Method for Temporary Irrigation Schemes: Left (Northern), Right (Luapula)
Source: Irrigation Scheme Inventory Survey, 20009, JICA Study Team

4) Soil Condition

The inventory survey further explored the degree of soil fertility in a level of 'good', 'fair' and 'poor', and extent of acidity problem and salinity problem in a level of 'almost nil', 'a little appeared', 'fairly appeared', and 'very much appeared'. Figure 3.6.10 shows the results of Northern province (left side figure) and Luapula province (right side figure) composed of both permanent and temporary schemes, from which following are identified:

i) As for soil fertility, percentage of the irrigation schemes, wherein the soil was reported as 'poor', is very minimal, only 3% in each province. Percentage that irrigation schemes replied 'soils are good' is 50% and 46 % in Northern province and Luapula province respectively. Though one may say this result is not corresponding to the acidity problem mentioned below, the officers engaged in the inventory survey hardly observed salinity problem and also existence of sandy soil. This observation may have contributed to the reports, for which soil fertility is relatively good. It is therefore indicated that most of the irrigation schemes have hardly faced soil depletion so far.

ii) As per acidity problem for soils, 37% of the irrigation schemes in Northern province reported almost nil in acidity, while it was only 16% in Luapula province. This means about two-thirds of the irrigation schemes in Northern province and more than 80% of the irrigation schemes in Luapula province have shown acidity problem at least to some extent. This is very much relevant to the acidity issue well known in the Study area. Of them, 13% of irrigation schemes in Northern province reported that there is already 'very much appeared' for the acidity problem. These irrigation schemes are mostly in Isoka district.

iii) On the other hand, salinity problem was reported only to a very limited extent. 77% of the irrigation schemes in Northern province and 84% in Luapula province reported 'almost nil' in salinity problem. Though there are irrigation schemes which reported 'a little appeared' or 'fairy appeared' in terms of salinity problem, no 'very much appeared' was reported in both provinces.

5) Crops Cultivated

Under the conditions mentioned above, several kinds of crops are cultivated under irritation. As far as permanent schemes are concerned, the inventory survey explored what kinds of crops are cultivated (for the temporary schemes, the inventory survey was carried out by camp but not by scheme, and therefore did not cover). Figure 3.6.11 shows the results, and following are identified:

i) Dominant crops cultivated in both Northern and Luapula provinces are tomatoes and cabbage. Tomato is cultivated in 54 % and 51 % of the permanent schemes in Northern and Luapula provinces respectively. Cabbage is very much cultivated in Luapula province as it is as high as 68% while that of Northern province is 48%.

ii) These two vegetables are followed by rape, maize, and onion which accounts from 30 % to 50 % of all the permanent irrigation schemes. Although the share is not much big (9% of all the schemes), fruit tree like banana, citrus are also cultivated in some districts especially in Nakonde district, Isoka district of Northern province. Other crops are of course grown, but the percentage of them are less than 10% excluding such crops in Luapula province as sugarcane, Chinese cabbage, Irish potatoes and carrot. These crops are cultivated in about 10 – 15% of the irrigation schemes in Luapula province.

iii) Palm oil tree is cultivated in Luapula province while it is not reported in Northern province. With support from the Government, Luapula province has recently promoted oil palm cultivation. In fact, around 40,000 seeds of exotic variety came to hand from República de Costa Rica in March 2009, and they have been brought into farm institutes to pre-germinate them as preparation for

selling them to farmers. Actually, the oil palm requires irrigation water throughout a year.

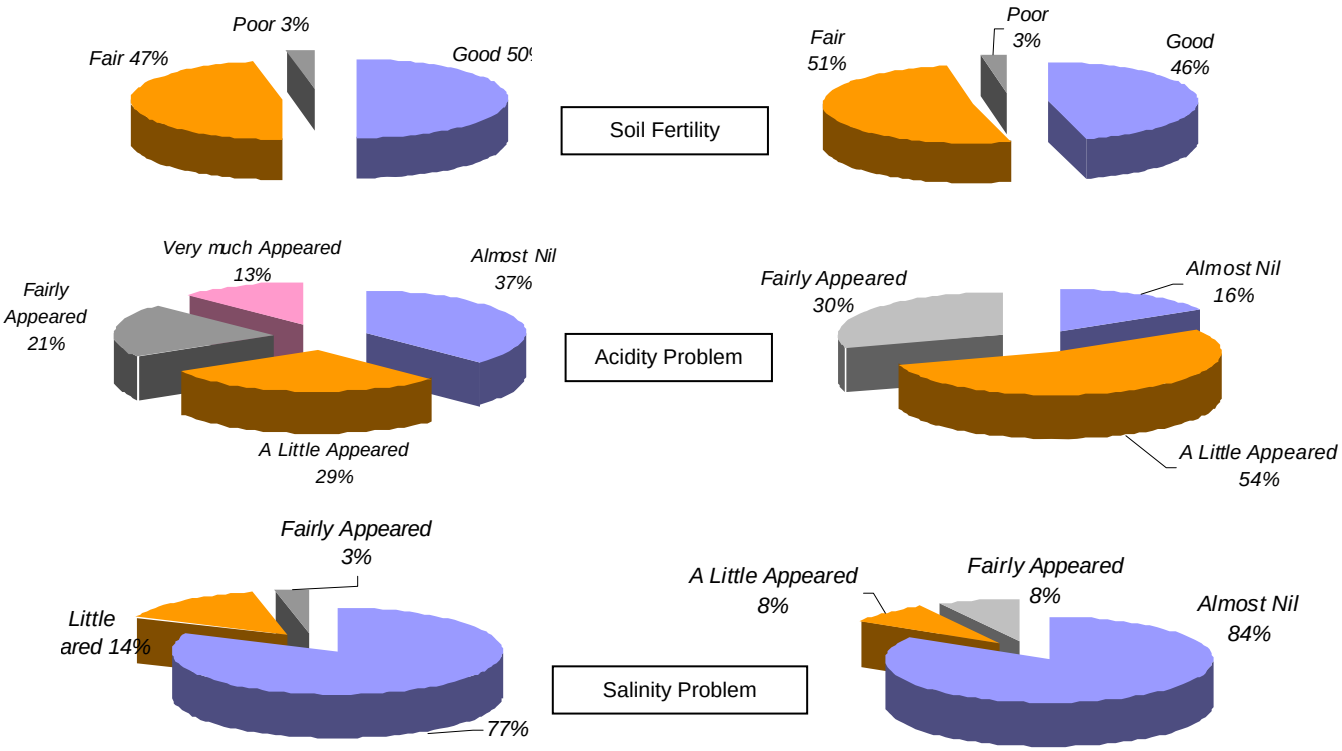


Figure 3.6.10 Soil Condition of Existing Irrigation Schemes: Left (Northern), Right (Luapula)

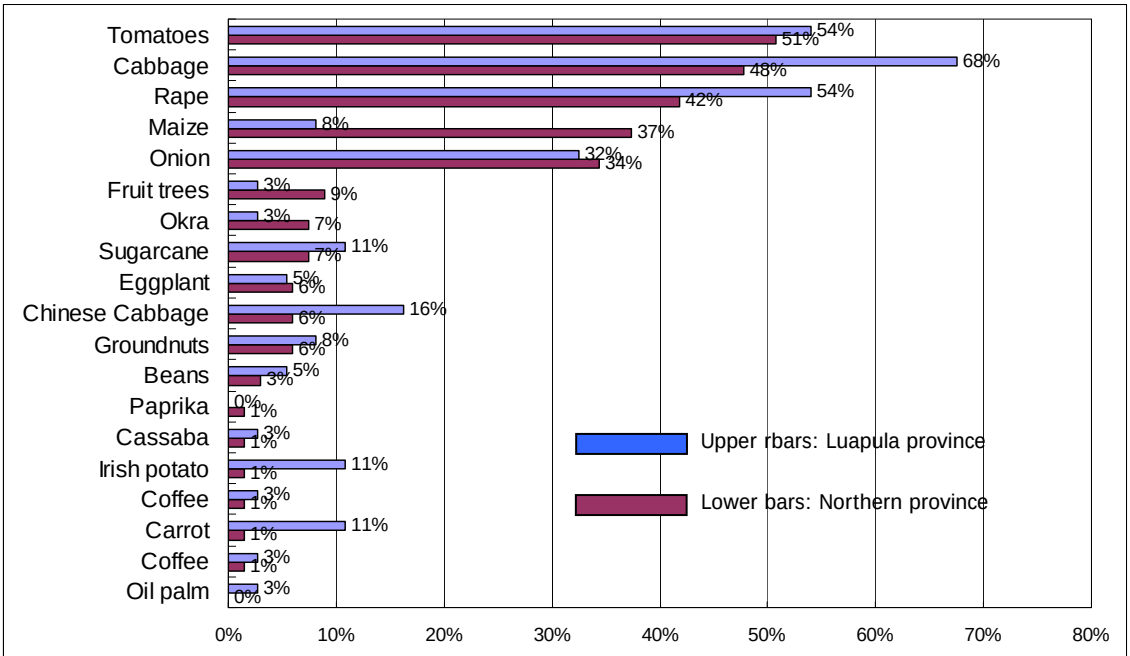


Figure 3.6.11 Crops being cultivated in the Existing Permanent Irrigation Schemes
Source: Inventory Survey, JICA Study Team

6) Fish Pond Use of Irrigation Water

In the Study area, there are fish ponds established either independently or combined with irrigation scheme. Table 3.6.2 summarizes the irrigation schemes established with fish pond. It can be observed that sizable number of existing irrigation schemes are already providing water to fish ponds; for example, 35 schemes out of 67 permanent ones in Northern province and 20 schemes out of 37

permanent ones in Luapula province, and 308 temporary irrigation schemes out of 850 in Northern province and 128 temporary irrigation schemes out of 174 in Luapula province.

Table 3.6.2 The Number of Irrigation Scheme with Fish Pond

Province	Permanent Irrigation Scheme			Temporary Irrigation Scheme			Total		
	No. of Site	With Fish Pond	Ratio	No. of Site	With Fish Pond	Ratio	No. of Site	With Fish Pond	Ratio
Northern	67	35	53%	850	308	36%	917	343	37%
Luapula	37	20	32%	174	128	78%	211	148	70%
Total	104	55	46%	1,024	436	42%	1,128	491	44%

Source: Inventory Survey by JICA Study Team, 2009

Summing the permanent and temporary irrigation schemes which have fish ponds, the percentage arrives at a ratio of 37% in Northern province and surprisingly as much as 70% in Luapula province. This implies there are lot of farmers who explore fish-farming aside from irrigated agriculture in Luapula province. For the both provinces, the ratio of the irrigation schemes having fish ponds arrives at 44%, equivalent to about one in every two irrigation schemes with fish pond.

3.6.3 Designing and Construction of Irrigation Schemes

There are number of temporary irrigation schemes and permanent schemes in the Study area. As aforementioned, the inventory survey carried out in 2009 identified about 1,000 temporary schemes and 104 permanent schemes. Temporary schemes have been solely constructed by farmer themselves, while permanent irrigation schemes were by the government, in cases with donors, and NGOs including faith based organizations. Following discussion reviews on the designing and also construction modality of those irrigation schemes:

1) Temporary Irrigation Schemes

Temporary schemes have been constructed by farmer themselves. Though no one can be sure when the 1st temporary scheme in the Study area was constructed, it can get back to at least 1940s. An example is a temporary irrigation scheme established in Kalupa village in 1948, Misamfu camp, Mungwi district, Northern province (see photo below). In this village, there is a water furrow withdrawing water from a stream by gravity, namely, no diversion structure is put up in the stream. For these kinds of temporary schemes, the farmers are the designer as well as the contractor. By experience or by seeing other fellow farmers' irrigation practice, they have been developing such temporary irrigation schemes bit by bit in the history.

Individual small-scale irrigation schemes and in some cases community based schemes have been established since long time ago. Some of the intakes have very primitive temporary diversion facilities (see left photo), but mostly withdrawing water by gravity without any structure.

One thing unique character pertaining to such temporary schemes is the fact that a large number of the schemes have been constructed personally, meaning constructed by a family or families who are

relatives each other. In fact, so-called village based, or communal based, irrigation schemes in the Study area might not share more than half of the schemes though no accurate data exists. The reason behind this may be attributed to the rich rainfall in the Study area; namely, rich rainfall must have contributed to in not promoting irrigated agriculture as a village since most of the villagers can be fed on rain-fed crops.

Another unique character is found in government extension activities. In fact, promoting temporary irrigation schemes have rarely been put into the extension activities by BEOs/CEOs. They have promoted irrigated 'agriculture' but not been engaged in the promotion of irrigation itself. It means that BEOs/CEOs have, to some extent, promoted irrigated agriculture like vegetable cultivation in *dambo* areas by a help of bucket irrigation. However, as far as their extension activities are concerned, no programme, which aims at promoting irrigation itself, has been in the sight, or simply saying the government has not undertaken the promotion of such simple irrigation schemes as an official mode of extension.

2) Permanent Irrigation Schemes

Permanent irrigation schemes have been designed by the government officers in most cases and to lesser extent by NGOs or consultants employed by such NGOs. The government officers are the ones posted in the Technical Services Branch (TSB) at different levels, mainly at provincial level and district level, which are the counterpart offices to this Study on the field. They carry out topographic survey, designing including the preparation of drawing, bill of quantities, cost estimation, etc.

Based on the cost estimated, TSB at provincial level incorporates necessary project cost in the next year's budget proposal. Once it is approved, disbursement of the fund starts sometime after the new financial year has started. With the fund disbursed, the provincial TSB together with district TSB start procuring necessary materials, e.g., cement, iron bars, timbers if needed for formwork, etc. At the same time, BEOs/CEOs in charge of the area, where the funded permanent irrigation scheme is to be constructed, are now starting the mobilization of the farmers concerned.

In the Study area, there are mainly two types of permanent irrigation structures in river/stream diversion schemes. One is the main structure, the diversion weir, constructed with wet-masonry and the other one by concrete wall, with the latter being the majority. Though concrete wall-type structure requires formwork to pour concrete, the construction work can be finished in shorter period than that of masonry type weir. Concrete wall-type entails higher project cost, but it is durable than masonry-type weir.

There are mainly two types of permanent diversion structures, e.g. concrete wall-type structure (left), and masonry type-wall structure (right). The former is the majority. In fact, the government started constructing such irrigation schemes in 2000s supported by donors or otherwise by utilizing the government fund.

In addition, there are sites where a mixed type of masonry and concrete structure has been established. In this construction work, they use formwork to pour concrete but do use neither iron bars nor coarse aggregates. Instead, after pouring cement mortar, sizable stones are placed one after another making a sort of layer and rammed in, and thereon another layer of cement mortar is placed. This process is repeated until it reaches the designed height. The appearance of this kind of structure looks like concrete wall-type but inside is more or less same as that of masonry-type wall.

Construction of such permanent structures is basically carried out by the farmer beneficiaries under the supervision of provincial and district TSBs. Since almost all the permanent irrigation structures in the Study area are small in their size, no civil contractors, except few cases, have been engaged. TSB together with BEO/CEO in charge mobilize the farmer beneficiaries and have a series of site meetings until reaching a consensus wherein arrangement of the construction, e.g. defining of the government parts and the farmers' parts, is agreed. Also, rule of the operation and maintenances of the irrigation scheme is discussed and agreed at this stage. Basic mode of the construction dominant in the Study area is as follows:

i) Foreign materials such as cement, iron bars, timbers for formwork are provided by the government including transportation to the site. Farmers are not required to bear such costs.

ii) Local materials, as far as available in their locality, should be prepared by the beneficiary farmers. For example, sand, stones/cobbles, and even coarse aggregate shall be prepared by the beneficiaries as far as available. To collect river sand, stones, and to make coarse aggregate from stones/rocks/cobbles, they may need some tools such as shovel, spade, wheel barrow, big hummer, etc. These tools are in most cases provided by the government though it is dependent on how much budget is available.

iii) Labors have to be provided by the farmer beneficiaries as a part of their contribution in principal. In fact, the arrangement pertaining to this labor participation differs from site to site. If the construction of a permanent structure is not big and therefore can be managed by the beneficiaries, they are requested to participate in the work voluntarily. Or, they may be paid for a short period of time only, and the money paid can be the seed to start up their irrigated agriculture. In case that the construction work lasts so long, say over a couple of months, they are usually paid according to the minimum wage rate or so specified in the law.

iv) There are construction works which need skilled labors. Typical examples are masonry work and carpentry work. These skilled labors are hired within the village or from nearby villages, and paid with market prevalent rate or a little lower than that if they happen to be the member of beneficires.

v) In a past project called RIF (Rural Investment Fund, sponsored by the World Bank), the farmer beneficiaries are requested to bear 25% of the total project cost. This does not mean that they had to pay in cash but they could pay in kind. As far as they could provide local materials such as sand, stones, etc. with unskilled labor force voluntarily, they were exempted from paying cash. In this sense, the arrangement made under RIF is more or less similarly to that of above-mentioned arrangement whereby no cash contribution from the beneficiary farmers is required.

3.6.4 Operation and Maintenance in Irrigation Schemes

Construction of small-scale irrigation schemes in the Study area became popular since late 1990s, as supported by RIF and JSPRF (Justice and Solidarity for Poverty Reduction Fund, a Catholic Fund). These projects had constructed number of small-scale irrigation schemes aside from rural infrastructure, e.g. road. Then, in year 2004 the Government utilized HIPC fund to establish some small-scale irrigation schemes, and thereafter since year 2005 PRP fund became available to establish

small-scale irrigation schemes to a greater extent. Taking those schemes altogether with the ones constructed ever before, there are now over 100 small-scale permanent irrigation schemes in the Study area.

Some of them are well operated and maintained since its commissioning. In most of the existing irrigation schemes, clearing, mowing weeds, de-silting are identified as major items of maintenance works in and around the diversion weir and the furrow. In many cases, farmer groups regularly carry out those works through contributing their own labors. It seems that such kinds of maintenance works are technically easy for the farmers, even from the viewpoint of financial aspect (for some examples, refer to Table 3.6.3).

In comparison with the tasks mentioned above, however, it seems that carrying out mending works of facilities is rather problem for the farmers due to technical and financial difficulties under the present circumstances. There is a site, for which the farmers gave up to practice irrigation due to serious damage on the concrete diversion weir constructed under a donor-funded project (see photo right). The project was completed in 1997 and then the facilities were handed over to the farmers group.

A weir abandoned, now covered over with grasses (June 2009, Luwingu district, Northern province).

The concrete weir, however, had gradually shown seepage underneath the weir, which at the end led to the weir sinking down because of muddy foundation being eroded. The farmers had been coping with that problem by using soil/grasses. In fact, there was difficulty for them to purchase even a little amount of cement to plug the seepage path. They had finally abandoned the irrigation scheme and no more irrigated agriculture is practiced since year 2007. It happened 10 years after the weir was constructed.

Maintenance of furrows (canal) is rather easier than that of the diversion weir. However there are still cases wherein the farmers face difficulties of maintaining the furrows. As is often the case of unlined canal, most of the furrows in the Study area have leakage/seepage problem along its reach. Rat holes very often show up along a certain reach of furrow. In such occasion, farmers usually cram clay soils into the holes in order to minimize the water leakage. Even if it is a lined furrow, there are cases in that a part of the furrow is breached (see photo right), letting water running away from the furrow. Lining is usually done with wet-masonry and the thickness of these cases is about 15-25 cm only. With this very thin structure, masonry structure can hardly stand over a long period of time.

A part of wet-masonry wall is breached; water running away (June 2009, Mungwi district)

As for water control, most of the small-scale irrigation schemes do not have any control devices except few. An example is shown in the photo below left where there is no flow control device at the intake point. When the water level at the intake point comes up more than that of designed, big volume of water starts flowing into the canal, causing even flooding over some parts of the farmland. There are, however, irrigation schemes which have water control devices, though they are not many. An example is shown in the photo right, which is a simple wooden stop log. This kind of simple structure is at least recommended to introduce for easy water control.

A permanent weir without any water control devices at the intake. The farmers usually put stones at the intake so as to control the amount of water flowing into the furrow. (June 2009, Mungwi District)

A permanent weir equipped with stop-log gate made of timber board. The farmers operate the gate to adjust water volume for meeting water requirement (June 2009, Chinsali District)

Table 3.6.3 Summary and Lessons from Existing Irrigation Schemes in the Study Area

District/Scheme	Summary & Current O&M Status
Mungwi/ Shangila Cooperative Irrigation Scheme	Summary: The scheme was established in 1980s for coffee growers. In mid 1990s, the government brought to the scheme materials for coffee cultivation under LINTCO programme. The farmers, however, lost their interest to growing coffee due mainly to difficulty of finding good market, and also the government support became no longer available either. In 1997, RIF was applied to construct a dam for water impounding. MACO-TSB played a major role as the supervisor in the dam construction and carried out survey for furrow alignment. Current O&M: The scheme has a maintenance committee (MC), and all the 55 members are engaged in the O&M works according to an annual action plan formulated by the MC. Although the potential irrigable area is estimated at around 100 ha, current area irrigated is estimated at only 10 ha due mainly to facilities problems. There are some parts giving water leakages and also improper longitudinal slope along the furrow is found. The bed slope of furrow is not proper because the digging work was done by the farmer themselves without technical support. It can be difficult for the farmers to continuously rehabilitate breached parts of the facilities because of technical and also financial difficulties.
Mungwi/ Daudi Mulusa Irrigation Scheme	Summary: The irrigation scheme introduced concrete diversion weir in 2000 under RIF programme. At present, 10 farmers enjoy irrigated farming to cultivate 1.5 ha of the irrigable farmlands. Potential irrigable area is estimated at 15 ha while the current irrigated area is only 1.5 ha due to few membership. Current O&M: Same as the other schemes; the members formed the maintenance committee to properly conduct O&M of facilities. Although all the users of abstracted water are expected to participate in the O&M works, some of them who are using water for home domestic chore don't attend the O&M works. A committee member complained it.
Mungwi/ Ngulla Farmers Group	Summary: The scheme started abstracting stream water for irrigation farming back in 1952 with a temporary diversion weir. The weir was constructed with sand bags at that time. In 1987, a catholic donor funded them to construct wet-masonry diversion weir. The furrow was lined in 2001 under RIF programme. Present irrigated area is estimated at around 10 ha, while potential irrigable area is supposed to be around 25 ha. Current O&M: The MC composed of 12 members sits together to make an action plan of annual O&M together with a fish farmers club, and the plan is informed to ordinal farmers. Once the scheme members tried to repair the furrow by using cement, which was contributed by themselves, but they couldn't manage it due to lack of technical knowledge required for cement work. It also seems that the farmers tend to wait for support from outside because of lack of financial ability.
Mungwi/ Muwashe Irrigation Scheme	Summary: The scheme has been practicing irrigated farming since 1980s. A concrete diversion weir was introduced in 2008 with a government technical support and donor's financial support under JSPRF (Justice and Solidarity for Poverty Reduction Fund, Catholic Fund). Actual irrigated area is estimated at 8 ha, while potential one is expected to be around 20 ha. Current O&M: Maintenance works of the scheme area limited to the furrow for the time being because the weir is still new. The major items of works are cleaning, de-silting, and re-shaping of the furrow, which is carried out twice a year. In connection with maintenance, they are struggling for seepage pertaining to the non-lined earth furrow. Furthermore, there are some sections which were dug with improper alignment, which causes soil erosion and seepage associated with the softness of the soils. The scheme members want to receive technical assistance for re- alignment of the furrow to make irrigation water flow properly and protection from the seepage.

Kasama/ Chitambi Pump Irrigation Scheme	Summary: The scheme was originally established for the purpose of vegetable growing in early 1990s, but the activity didn't so function for several years. In 1996, the members of scheme re-started their farming with 50 members. In the following year, the scheme was accepted to receive RIF assistance. They got 2 potable pumps, and some materials including the construction of a water tank for storing pumped water. The pump irrigation, however, was suspended in 2002 due to shortage of water volume at the water source. Current O&M: As mentioned above, the pumps are not fully utilized as compared to the original plan because water source has been decreasing since 2002. In addition to this, a hike in price of petrol, which is almost two to three times as compared with that of year 2002, is considered as the major reason of the dormant operation of the pumps. Cost and benefit analysis should be carried out when they re-start their pump irrigation in future.
Mbala/ Chinenke Irrigation Scheme	Summary: The scheme was opened in 1977 by farmers' initiative. From 2000 to 2003 and 2009, the scheme was reinforced under RIF and with government budget as well. The latter was about ZMK 600 million. As at 2009 dry season, the government carries out canal lining, supervised by Northern Provincial TSB office. The scheme is one of the largest ones in terms of its operating area. The present irrigated area is around 15 ha while potential irrigable area is around 50 ha. With the present irrigated area of 15ha, the unit development cost arrives at ZMK 40 million per ha, equivalent to about US$ 8,000. This development cost, as small-scale scheme, falls under relatively higher side. Current O&M: The scheme members once repaired damaged parts in the furrow by contributing their capital for purchasing some packets of cement. While the members think of themselves that they are able to manage easier repair works, they need technical assistance and financial support too from the TSB and the government. There are some trained users, but the farmers eagerly want to have a training course to acquire know-how for operation and maintenance.
Luwingu/ Muchinka Irrigation Scheme	Summary: The scheme started irrigation farming back in 1997 when RIF was introduced. The farmers suspended irrigation farming because plenty of water leakage took place from the underneath of the concrete weir since 2007. Although there were 35 irrigators at that time, the number has been decreasing to say around 25 irrigators. Current O&M: Since 2007, maintenance works have not been carried out at all. The members think that water leakage occurring at underneath of the weir may be caused by a low quality of construction done by a local contractor. They say that they need a training to carry out repair and maintenance works properly too. On top of this, they like to have financial support as well.
Chinsali/ Ilonfiu Farmers Group	Summary: The intake structure was constructed in 2001 under RIF. The furrow is lined with 20 m of distance from the intake, and the rest is unlined. Under irrigation, tomatoes, onion, cabbage, rape, and so on have been planted. The number of irrigators is 15 members. Current O&M: The masonry diversion weir and the furrow have been well maintained. The members carry out maintenance work once a year under the guidance of the maintenance committee. There is no damage on the facilities so far. The weir has stop-log gate made of wooden board to control water. Having water control device is very rare in the Study area.
Chinsali/ Milenge Irrigation Scheme	Summary: The system of this irrigation scheme is gravity operated through masonry dam reservoir with furrow. It was constructed from 1999 to 2000 under RIF for the purpose of promoting coffee growing. However, the scheme has not fully been operated due to several reasons like not cohesive organization of the farmers, soils unsuitable for coffee growing, etc. Although 100 HHs were supposed to be the beneficiaries, only 3 farmers are using the impound water for gardening at present. The furrow dug on left bank of the area is completely abandoned because of the soil problem being too soft. The dam structure has no any damages so far. Current O&M: Under the situation, the farmers intend to re-start the operation of the dam and then expand the irrigable area, but they little know technical know-how for extension of the furrow, especially technique to cross a road. Also, coffee market in the world is not as attractive as every before. Therefore, even if they are to revitalize the irrigation scheme, they may have to start with fewer members.
Isoka/ Kawandama Irrigation Scheme	Summary: The construction of the dam structure was carried out twice in the last 10 years; the previous dam and the present one were constructed in 2000 and 2007 respectively. The former one was destroyed a couple of years later since the construction by a flood. Present irrigated area is estimated at about 5 ha and the potential one is expected to be around 20 ha. Current O&M: The amount of irrigation water taken from the dam is controlled by using a slide gate made of wood. In rainy season, the outlet of dam leading to the furrow is closed so as to avoid flood on the field downstream. The inlets established at each of the farm entrances are also closed in order to prevent the field from being eroded by flood during rainy season. TSB is promoting to plant Vertiver grass along both sides of the furrow.

Isoka/ Mpando Irrigation Scheme	Summary: A concrete river diversion weir was constructed in 1997 under RIF programme. After that, the furrow was lined in 2007 under JSPRF. The members were trained for a capacity development to improve their livelihood and by large their economic status. This was carried out under a Swedish fund, undertaking civil construction method, farm management, costing and pricing of coffee, nursery of coffee and orange, etc. Current O&M: The weir has no serious problem so far. The farmers have repaired cracked portions along the furrow by using cement in 2008. It was contributed by themselves, ZMK 150,000 in total as at 2008. They practice rotational irrigation to evenly share very much limited water at on-farm level, particularly during the peak irrigation period.
Kaputa/ Talwakalimo Irrigation Scheme	Summary: The scheme was established back in 1980s. Following the years, the water tank made of concrete under RIF and the pump house with diesel pump and sprinkler were constructed under RIF and a USAID fund in 1998 and 2005 respectively. The farmland belongs to a government resettlement scheme under Office Vice resident, Department of Resettlement. At the beginning time, the irrigation system was planned as pump with gravity distribution system. However, it did not fully function because of lack pf capacity of the pump installed. At present, sprinkler sets are directly connected to the diesel pump. Even this system is not effectively functioning because this gives the pump facility overload in order to operate the sprinklers. Likewise, the sprinkler sets have also an issue; lack of apparatus equipment to be attached. Current O&M: The portable pump, water tank and the furrow are not in use any longer. The diesel pump has been maintained by mechanic hired by the members when need arises. Wage of the mechanic is ZMK 100,000 per time. The farmers are burdened with rise in price of diesel to operate the pump at present, too. Under the current situation, some farmers, 4-5 members, introduced treadle pump, though the others remain with bucket irrigation or otherwise no longer irrigation.

Source: JICA Study Team, based on the field observations and interviews to the farmer beneficiaries.