STUDY FOR THE FORMULATION FOR IRRIGATION PROJECTS IN AFRICA

MAIN REPORT

1. **Uganda**
2. **Zambia**
3. **Mali**
4. **Ghana**

October 2010

JAPAN INTERNATIONAL COOPERATION AGENCY

NTC International Co., Ltd.

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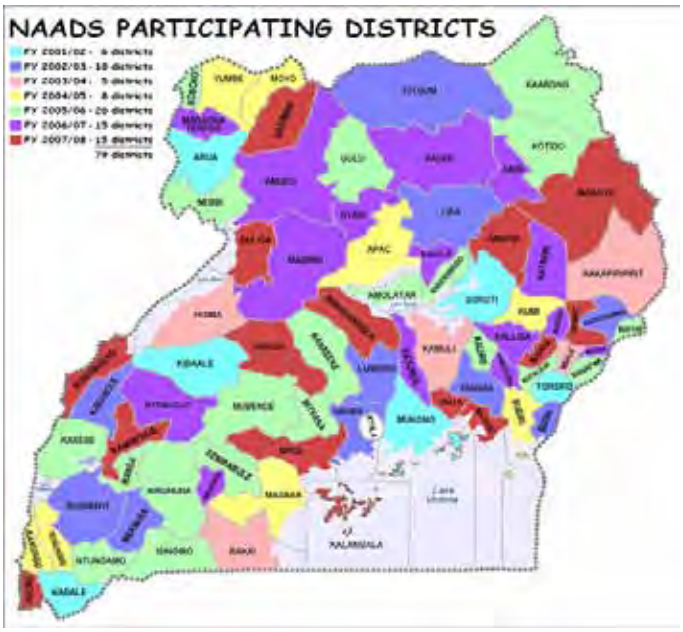
MALI

UGANDA



LOCATION MAP OF 4-COUNTRIES

GHANA

ZAMBIA

Soft Copies of Collected Information and Documents （DVD 1 piece）

Part I CARD and CAADP Related Documents
Part II Collected Information and Documents for Uganda
Part III Collected Information and Documents for Zambia
Part IV Collected Information and Documents for Mali
Part V Collected Information and Documents for Ghana

Summary

"The Yokohama Declaration" has been adopted to provide a road map for support of African growth and development under the TICAD IV (4th Tokyo International Conference on African Development) on May, 2008. In the sector of the agriculture and rural development, the promotion of development, rehabilitation and maintenance of water resources management infrastructure has been committed aiming at expanding the irrigated area within five years. The Government of Japan (GOJ) has proposed construction and rehabilitation works of 100 thousand ha for the irrigation systems including small-scale irrigation schemes in the Yokohama Action plan. Based on this understanding, the Japan International Cooperation Agency (JICA), in partnership with the Alliance for a Green Revolution in Africa (AGRA), launched an initiative now known as the "Coalition for African Rice Development" (CARD).

The African countries have been improving the productivity of the agriculture under the Comprehensive Africa Agricultural Development Programme (CAADP). Improvement of access to irrigated agriculture is recognized in "sustainable land management and water control", which is one of four specific thrusts in the CAADP.

Under this circumstance, the GOJ has been taking an initiative to launch rehabilitation of the irrigation facilities in the SAA in cooperation with other donor countries, however insufficient information, such as irrigation development policy and strategy of each country, on-going and planning schedule of related irrigation projects by international donor hinders proper project formulation of the irrigation development. In this regard, the Study aims at 1) formulation of rehabilitation of irrigation facilities taking cooperation with donor support into consideration and 2) selection of relevant irrigation project implemented under a Japan's loan and grant aid programs. The study includes Uganda, Zambia, Mali and Ghana.

The objectives of the Study are as follows:

1) Study of present situation of the irrigation sector of target countries. (Irrigation development policy, responsible organizations, development plan, supporting conditions by donors, etc.)
2) Selection of significant projects required through Japan's Official Development Assistance taking study results of 1) above into account.
3) Feasibility of the selected projects in the process of 2) above, on the basis of field survey.

In accordance with information obtained related authorise and international donors, priority projects have been selected and project sites have been investigated. Based upon selection criteria for the best selection of proposed recommended projects in each country, 2 sites have been selected to be proposed for co-financing projects. The following table shows the list and outline of the projects which have been finally selected to be studied F/S under Japanese Government assistance.

List and Outline of Proposed Recommended Irrigation Projects in the 4 Countries

Country	Project Name	Irrigation Area (ha)	Main Crops	Crop Intensity (%)	Additional Purposes	Project Condition	Expected Co-financing	Major Water Resources Facilities	Project Cost Million US$	Cost/ha US$/ha	EIRR (%)
Uganda	Doho Integrated Irrigation and Flood Mitigation Project	Exist 1,000 Exp 2,000 Total 3,000	Paddy	200	Flood Mitigation	Rehabilitation and Expansion	AfDB	New Head-works Rubber Dam	23,370	7,790	20.0
	Namatara Irrigation & Drainage Project	3,800	Paddy	200		New Development	–	New Dam Head-works	46,634	12,272	17.0
Zambia	Kanakantapa Expansion Irrigation & Drainage Project	2,000	Upland Crops • Paddy	200		Expansion of AfDB Implemented Area	AfDB/ Finnish	AfDB Implemented Dam Pump Station	14,233	7,116	26.0
	Chambesi River Basin Integrated Multi-purpose Development Project	5,000	Paddy	200	Hydro-power; 3,000KW Flood Control	New Development	–	New Dam Head-works	43,793	8,758	20.0
Mali	M'Bewani-Papam Irrigation Development Project	4,400	Paddy Upland Crops	130	Social Infrastructure	Expansion of WB Implementation	WB	Markala Weir Diversion	36,907	8,388	14.6
Ghana	Tono - Vea Irrigation Project	Tono Area Exist 1,400 New 400 Total 1,800	Paddy	184		Rehabilitation	JICA Grant Aid	Existing Dam	18,025	10,014	11.4
		Vea Area Exist 400 Re-devel382 Total 782	Paddy	174		Rehabilitation	JICA Grant Aid	Existing Dam	31,217	39,919	1.6
	Kpong-Accra Plain Irrigation & Drainage Project	Exist 3,000 New 7,000 Total 10,000	Upland Crops • Paddy	200	Flood Control	Rehabilitation and New Development	WB	Existing Dam New Dam	112,677	11,267	16.4

PART – I

Work Plan of the Study

Part I Work Plan of the Study

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GLOSSARY OF ACRONYMS

Acronyms	Orthography
AGRA	Africa Green Revolution Alliance
AgWA	Partnership for Agricultural Water in Africa
CAADP	Comprehensive African Agriculture Development Program
CARD	Coalition for African Rice Development
EIRR	Economic internal rate of return
FAOSTAT	Food and Agriculture Organization of United Nations Statistical Data
FOB	Free on Board
F/S	Feasibility Study
JICA	Japan International Cooperation Agency
NRDS	National Rice Developemen Strategy
TICAD-IV	Tokyo International Conference on African Development IV

Chapter 1 Introduction

1.1 Background of the Study

"The Yokohama Declaration" has been adopted to provide a road map for support of African growth and development under the TICAD IV(4th Tokyo International Conference on African Development) on May, 2008. In the sector of the agriculture and rural development, the promotion of development, rehabilitation and maintenance of water resources management infrastructure has been committed aiming at expanding the irrigated area within five years. The Government of Japan (GOJ) has proposed construction and rehabilitation works of 100 thousand ha for the irrigation systems including small-scale irrigation schemes in the Yokohama Action plan. Based on this understanding, the Japan International Cooperation Agency (JICA), in partnership with the Alliance for a Green Revolution in Africa (AGRA), launched an initiative now known as the "Coalition for African Rice Development" (CARD). The CARD promotes the three major agro-ecology approach for rice cultivation in Africa, "irrigated field", "rain-fed lowland" and "rain-fed upland". The CARD prioritizes the rehabilitation of existing irrigation facilities for rain-fed lowland.

The African countries have been improving the productivity of the agriculture under the Comprehensive Africa Agricultural Development Programme (CAADP). Improvement of access to irrigated agriculture is recognized in "sustainable land management and water control", which is one of four specific thrusts in the CAADP.

Under this circumstance, the GOJ has been taking an initiative to launch rehabilitation of the irrigation facilities in the SAA in cooperation with other donor countries, however insufficient information, such as irrigation development policy and strategy of each country, on-going and planning schedule of related irrigation projects by international donor hinders proper project formulation of the irrigation development. In this regard, the Study aims at 1) formulation of rehabilitation of irrigation facilities taking cooperation with donor support into consideration and 2) selection of relevant irrigation project implemented under a Japan's loan and grant aid programs.

1.2 Objectives of the Study

(1) Objectives of the Study

The objectives of the Study are as follows:

1) Study of present situation of the irrigation sector of target countries. (Irrigation development policy, responsible organizations, development plan, supporting conditions by donors, etc.)

2) Selection of significant projects required through Japan's Official Development Assistance taking study results of 1) above into account.

3) Feasibility study of the selected projects in the process of 2) above, on the basis of field survey.

(2) Related organizations

1) Governments and related organizations/agencies of the target countries

2) International Donor Organizations

1.3 Target Countries

(1) Position of 4 counties in CARD

The Study includes four countries of Mali, Ghana, Uganda and Zambia.

These four countries are categorized with the following two groups of the CARD:

1st Group	Cameroon, Ghana, Guinea, Kenya, Madagascar, Mali, Mozambique, Nigeria, Senegal, Sierra Leone, Tanzania, Uganda
2nd Group	Benin, Burkina Faso, Central African Republic, Côte d'Ivoire, DR Congo, Ethiopia, The Gambia, Liberia, Rwanda, Togo, Zambia

Mali, Ghana and Uganda belong to the 1st group, and Zambia is in the 2nd group.

(2) Rice cultivation in the African countries and target countries

Table - 1 indicates rice cultivation to date in the 54 African countries including four target countries of the Study in reference to FAOSTAT data. The table includes cropping area, production, productivity, rice consumption per capita, self-sufficient rate, import and export value of recent five year records (2003 – 2007). The table shows following characteristic points of the target four countries:

1) In Mali, cropping area and production of rice are in the higher rank, say within higher ten countries in total 54 African countries, and rice consumption is also high about 66 kg per capita. Rice import of about 250 thousand tons caused often outflow of foreign currency while self-sufficient rate was relatively high. As the demand of rice increases, rice cultivation should be strongly promoted to reduce rice import in Mali.

2) **In Ghana**, cropping area and production of rice are around tenth ranking or less. Comparing this higher potential, rice import of 670 thousand tons per annum ranks higher 6 countries in total 54 African countries due to poor rice productivity of two ton/ha and lower self-sufficient rate of 37%. As rice has been increasingly consumed about 29kg in recent year, improvement of self-sufficient rate is expected by promoting rice cultivation. Since further potential of 1.9 million ha, as shown in Table 1.4.1, can be converted to an irrigable area compared to that of present 0.12 million ha, **increase of rice cultivation area and rice production may achieve higher self-sufficient rate in Ghana.**

3) **In Uganda**, rice cultivation area has rapidly increased to approximately 100 thousand ha and rice production also 140 thousand ton in recent two decades. However, since rice productivity of 1.4 ton per ha was still in a low level, rice production could not meet with domestic demand. Import of rice was about 140 thousand ton and rice consumption was in low amount of 6.2kg per capita per annum. In this present situation, **rice cultivation is still being developed in**

Uganda. Uganda is blessed with **suitable climate condition for rice cultivation** and annual rainfall reaches 1,300mm, **thus rice promotion is expected to promote by governmental policy in the agricultural sector in Uganda.**

4) **In Zambia**, cropping area and production of rice are middle ranking or less in total 54 African countries, and lowest among the target four countries. Rice productivity of 1.3 ton per ha was still in a low level. As rice is not staple food, rice consumption is in quite low amount of 2.4kg per capita per annum. Import of rice of less than 30 thousand ton is lowest rank among the target four countries. Zambia has entered to 2nd group of the CARD in 2009. Third General Meeting of the CARD was scheduled in Tanzania in 18 to 19 May, 2010, and rice promotion for 2nd group countries was taken up during the meeting. **Further rice promotion activities are anticipated in Zambia as a member country of the CARD.**

The following Table 1-1 indicates specific country profile and agricultural information, such as land area, population, economical situation, and agricultural information, irrigation potential, rice cultivation, etc.

Table 1-1 Information of Rice Related Conditions of Four Target Countries

	Uganda	Ghana	Zambia	Mali
Land area(1000ha)******	24,104	23,946	743,400	124,000
Population（1000people）(2007)*****	30,638	22,871	12,314	12,409
Rural population（% of population）(2007)*****	87	51	65	68
GDP per capita (2009) US$******	1,100	1,500	1,500	1,200
Percentage of Agriculture in GDP(%) (2009)******	29.0	37.3	16.7	45.0
Agricultural land(1000ha) (2007)*****	5,500	4,100	5,260	4,850
Irrigation potential(1000ha) (2007)*****	90	1,900	523	2,200
Irrigated area(1000ha) (2007)*****	30.9	235.8	9.1	236.0
Actually irrigated area(1000ha)*****	27.9 (2000)	175.8 (2000)	5.9 (1998)	155.9 (2002)
Paddy field area avg 5years （ha）*	102,600	120,278	12,445	415,003
Yield avg 5yeas (tonnes)*	144,400	251,923	15,661	946,291
Yield per area avg 5years (tonnes/ha)*	1.41	2.09	1.27	2.30
Rice consumption per person avg 5years (kg/person/year)**	6.2	28.8	2.4	66.4
Self sufficiency ratio（USDA）avg (tonnes)***	-	29.1	36.3	87.2
Self sufficiency ratio（FAOSTAT） avg 5years (tonnes)**,*	71.2	36.7	50.4	109.5
Importation avg (tonnes)*	84,249	665,080	29,238	246,299
Exportation avg 5years (tonnes)*	16,920	1,230	1,028	290

* *FAOSAT average 2003-2007*
** *FAOSAT average 1999-2003*
*** *World Food Statistics, Professor Ito, Faculty of Agriculture, Kyushu University (average data 2005-2009)*
**** *World Population Prospects: The 2008 Revision*
***** *aquastat*
****** *CIA World Factbook*
Inside of () is reference year

Table－1 Ranking of rice production and consumption data in African countries.

Order	Population ****		Rice cultivation acreage*		Production*		Unite production*		Rice consumption per capita**		Self-sufficient rate,USDA***		Self-sufficient rate FAOSTAT*,**		Amount of import*		Amount of export*	
	Countries	2009 (thousand)	Countries	avg 5years (ha)	Countries	avg 5years (tonnes)	Countries	avg 5years (tonnes/ha)	Countries	avg 5years (kg/Capita/year)	Countries	avg 5years (%)	Countries	avg 5years (%)	Countries	avg 5years (tonnes)	Countries	avg 5years (tonnes)
1	Nigeria	154,729	Nigeria	2,445,600	Egypt	6,457,153	Egypt	9.99	Madagascar	144.0	Egypt	123.3	Morocco	162.9	Réunion	0	Egypt	1,317,128
2	Egypt	82,999	Madagascar	1,259,680	Nigeria	3,449,000	Morocco	6.53	Guinea-Bissau	130.0	Swaziland	100.0	Egypt	130.1	Eritrea	364	Senegal	81,374
3	Ethiopia	82,825	Guinea	724,386	Madagascar	3,260,800	Somalia	6.03	Sierra Leone	125.8	Madagascar	93.6	Rwanda	123.5	Central African.R	3,811	South Africa	23,301
4	Congo, D.R *****	62,400	Sierra Leone	698,000	Guinea	1,273,808	Mauritania	4.22	Guinea	113.8	Mali	87.2	Central African.R	119.3	Chad	3,811	Uganda	16,920
5	South Africa	50,110	Tanzania	679,184	Tanzania	1,084,277	Rwanda	4.14	Senegal	111.4	Congo	86.3	Madagascar	115.4	Sao Tome and Principe	3,896	Tanzania	13,507
6	Namibia	50,020	Egypt	646,348	Mali	946,291	Niger	3.44	Côte d'Ivoire	95.8	Malawi	84.2	Tanzania	112.7	Malawi	4,712	Niger	10,121
7	Sudan	42,272	Congo, D.R	417,854	Sierra Leone	717,591	Kenya	3.42	Mauritius	89.0	Chad	83.8	Guinea	111.2	Morocco	5,617	Côte d'Ivoire	9,935
8	Tanzania *****	40,430	Mali	415,003	Côte d'Ivoire	673,497	Swaziland	3.40	Comoros	86.2	Tanzania	83.6	Mali	109.5	Burundi	6,244	Djibouti	7,941
9	Kenya	39,802	Côte d'Ivoire	352,092	Congo, D.R	315,480	Burundi	3.33	Liberia	78.8	Sierra Leone	76.3	Burundi	105.5	Equatorial Guinea	7,208	Namibia	2,599
10	Algeria	34,895	Mozambique	172,519	Ghana	251,923	Sudan	3.32	Cape Verde	78.0	Guinea	75.4	Sierra Leone	100.1	Seychelles	7,621	Nigeria	2,380
11	Uganda	32,710	Liberia	130,000	Senegal	219,300	Benin	2.59	Gambia	68.6	Morocco	72.5	Chad	78.3	Namibia	10,962	Malawi	1,895
12	Morocco	31,993	Ghana	120,278	Liberia	152,120	Madagascar	2.58	Mali	66.4	Nigeria	65.2	Malawi	71.8	Lesotho	13,839	Benin	1,556
13	Ghana	23,837	Uganda	102,600	Mozambique	151,137	Senegal	2.52	Egypt	59.8	Mauritania	51.3	Uganda	71.2	Rwanda	18,071	Liberia	1,528
14	Mozambique	22,894	Chad	91,902	Uganda	144,400	Zimbabwe	2.41	Mauritania	58.0	Guinea-Bissau	45.4	Congo, D.R	68.3	Botswana	19,978	Ghana	1,230
15	Côte d'Ivoire	21,075	Senegal	86,486	Chad	115,752	Mali	2.30	Djibouti	53.2	Zambia	36.3	Nigeria	58.7	Tunisia	25,568	Swaziland	1,209
16	Madagascar	19,625	Guinea-Bissau	66,017	Guinea-Bissau	101,832	South Africa	2.29	Gabon	44.8	Liberia	35.5	Sudan	57.1	Zambia	29,238	Togo	1,066
17	Cameroon	19,522	Burkina Faso	52,966	Burkina Faso	100,042	Togo	2.25	Sao Tome and Principe	40.6	Burkina Faso	35.5	Zambia	50.4	Zimbabwe	29,931	Zambia	1,028
18	Angola	18,498	Malawi	51,215	Mauritania	76,798	Ghana	2.09	Nigeria	38.0	Togo	35.0	Liberia	48.8	Swaziland	31,977	Madagascar	838
19	Burkina Faso	15,757	Cameroon	40,119	Malawi	76,758	Central African.R	2.05	Seychelles	35.6	Côte d'Ivoire	33.1	Guinea-Bissau	48.6	Ethiopia	36,158	Kenya	737
20	Niger	15,290	Togo	31,470	Togo	70,910	Gabon	2.04	Togo	33.6	Ghana	29.1	Mozambique	45.2	Egypt	37,129	Zimbabwe	564
21	Malawi	15,263	Benin	26,273	Niger	68,672	Réunion	2.00	Burkina Faso	30.4	Mozambique	27.2	Mauritania	40.2	Comoros	41,742	Cameroon	531
22	Mali	13,010	Niger	20,155	Benin	68,229	Côte d'Ivoire	1.91	Ghana	28.8	Benin	25.5	Ghana	36.7	Congo	44,858	Burkina Faso	523
23	Zambia	12,935	Burundi	20,000	Burundi	66,591	Burkina Faso	1.90	Benin	23.8	Niger	23.3	Côte d'Ivoire	33.4	Djibouti	45,596	Botswana	490
24	Senegal	12,534	Mauritania	18,305	Kenya	52,914	Ethiopia	1.81	Niger	23.8	Senegal	18.1	Benin	32.1	Cape Verde	48,385	Mauritius	432
25	Zimbabwe	12,523	Central African.R	16,500	Rwanda	51,842	Guinea	1.76	Tanzania	23.8	Kenya	13.1	Togo	31.9	Gabon	51,902	Gambia	364
26	Chad	11,206	Kenya	15,901	Cameroon	50,808	Tanzania	1.59	Libyan Arab.J	23.8	Gambia	11.7	Comoros	29.2	Mauritania	60,725	Mali	290
27	Tunisia	10,272	Gambia	15,762	Central African.R	33,760	Guinea-Bissau	1.54	Cameroon	23.2	Cameroon	9.2	Burkina Faso	20.9	Guinea-Bissau	79,519	Gabon	235
28	Guinea	10,069	Comoros	14,000	Morocco	31,278	Algeria	1.50	South Africa	20.6	Sudan	8.2	Gambia	19.4	Uganda	84,249	Mozambique	230
29	Rwanda	9,998	Zambia	12,445	Sudan	24,150	Gambia	1.49	Congo	20.6	Angola	3.7	Niger	18.9	Mauritius	88,105	Rwanda	133
30	Somalia	9,133	Rwanda	12,346	Gambia	22,691	Malawi	1.47	Swaziland	18.6	Algeria	1.4	Kenya	18.0	Algeria	89,382	Guinea	109
31	Benin	8,935	Angola	11,597	Comoros	17,000	Uganda	1.41	Mozambique	14.6	Somalia	0.8	Senegal	15.7	Sudan	91,024	Libyan Arab J	52
32	Burundi	8,303	Sudan	7,312	Somalia	16,400	Nigeria	1.41	Chad	13.2	Gabon	0.0	Angola	11.8	Congo, D.R	98,853	Morocco	39
33	Togo	6,619	Ethiopia	6,572	Zambia	15,661	Zambia	1.27	Botswana	12.6	Cape Verde	0.0	Cameroon	11.2	Gambia	115,732	Congo	39
34	Libyan Arab J	6,420	Morocco	4,720	Ethiopia	11,898	Cameroon	1.27	Burundi	7.6	Djibouti	0.0	Zimbabwe	3.8	Sierra Leone	125,281	Algeria	32
35	Sierra Leone	5,696	Somalia	2,720	Angola	9,568	Chad	1.26	Kenya	7.4	Libyan Arab.J	0.0	Congo	1.8	Tanzania	166,079	Tunisia	8
36	Eritrea	5,073	Congo	1,940	South Africa	3,200	Comoros	1.21	Congo, D.R	7.4	Mauritius	0.0	Gabon	1.5	Angola	170,605	Seychelles	6
37	Central African.R	4,422	South Africa	1,400	Congo	1,328	Liberia	1.15	Malawi	7.0	Réunion	0.0	Swaziland	0.8	Somalia	180,259	Cape Verde	4
38	Liberia	3,955	Gabon	500	Gabon	1,020	Sierra Leone	1.02	Central African.R	6.4	Rwanda	-	Algeria	0.4	Libyan Arab Jamahiriya	197,033	Angola	0
39	Congo	3,683	Zimbabwe	274	Zimbabwe	660	Angola	0.87	Uganda	6.2	Central African.R	-	South Africa	0.3	Togo	201,143	Burundi	0
40	Mauritania	3,291	Algeria	200	Algeria	300	Mozambique	0.87	Angola	4.4	Burundi	-	Botswana	0.0	Liberia	201,328	Central African.R	0
41	Lesotho	2,067	Swaziland	50	Swaziland	170	Congo, D.R	0.75	Rwanda	4.2	Uganda	-	Cape Verde	0.0	Burkina Faso	208,372	Chad	0
42	Botswana	1,950	Réunion	40	Réunion	80	Congo	0.69	Namibia	4.0	Congo, D.R	-	Djibouti	0.0	Mali	246,299	Comoros	0
43	Gambia	1,705	Mauritius	0	Mauritius	0	Mauritius	0.00	Zambia	2.4	Comoros	-	Lesotho	0.0	Niger	276,678	Congo, D.R	0
44	Guinea-Bissau	1,611							Algeria	2.2	Zimbabwe	-	Libyan Arab.J	0.0	Madagascar	296,029	Ethiopia	0
45	Gabon	1,475							Tunisia	1.8	South Africa	-	Mauritius	0.0	Guinea	302,949	Guinea-Bissau	0
46	Mauritius	1,288							Lesotho	1.8	Botswana	-	Namibia	0.0	Kenya	322,741	Lesotho	0
47	Swaziland	1,185							Zimbabwe	1.4	Lesotho	-	Sao Tome and Principe	0.0	Mozambique	413,655	Mauritania	0
48	Djibouti	864							Sudan	1.0	Namibia	-	Seychelles	0.0	Cameroon	456,084	Sierra Leone	0
49	Réunion	827							Morocco	0.6	Sao Tome and Principe	-	Tunisia	0.0	Ghana	665,080	Somalia	0
50	Comoros	676							Eritrea	0.0	Seychelles	-	Equatorial Guinea	-	Benin	689,428	Sudan	0
51	Equatorial Guinea	676							Ethiopia	0.0	Tunisia	-	Eritrea	-	Côte d'Ivoire	1,102,607	Equatorial Guinea	-
52	Cape Verde	506									Equatorial Guinea	-	Ethiopia	-	South Africa	1,128,244	Eritrea	-
53	Sao Tome and Principe	163									Eritrea	-	Réunion	-	Senegal	1,207,063	Réunion	-
54	Seychelles	84									Ethiopia	-	Somalia	-	Nigeria	1,589,249	Sao Tome and Princip	-

Source

* FAOSTAT average between 2003 - 2007 data (Calculated by paddy rice weight)

** FAOSTAT average between 1999 - 2003 data

*** World Food Statistics, Professor Ito, Faculty of Agriculture, Kyushu University (average data between 2005 -2009)

**** World Population Prospects : The 2008 Revision

***** World Bank 2007

Self-sufficient rate=(Production/Rice consumption per capita×Population)×100(%)

Weight of milled rice=Weight of paddy rice×0.80×0.90(Milled raice rate) (FAOSTAT2003-2007)

1.4 Scope of the Study

The Study aims to evaluate several irrigation projects from the point of the appropriateness to implement them under the Japan's ODA program, i.e., ODA loan, grant aid and follow-up cooperation programs. The projects include both new construction and rehabilitation works related to the irrigation development scheme. It is notable points that the project evaluation include sustainability of the project, thus operation and maintenance ability by the Government of the recipient country and farmers' organizations, especially after project implementation, is well studied during the Study. Irrigation project of rice cultivation may be preferentially selected considering possible relation to the CARD initiative as mentioned in the Sub-chapter 1.1.

1.5 Major Considerations in the Study

The following two points are mainly considered during the Study:

(1) Relation to the framework of CARD

As described in Sub-chapter 1.1, the CARD is an initiative to support the efforts of African countries to increase rice production, and also it pointed out the importance of the maintenance and rehabilitation of the irrigation facilities. In this regard, feasibility of the selected new and/or rehabilitation irrigation project is mainly studied in the Study in conformity to the implementation process of the CARD/NRDS of each target countries as the 1st Group and Zambia as the 2nd Group countries of CARD.

(2) Cooperation with other donors

Currently, the World Bank has agreed to support the irrigation development under the CARD initiative. In addition, the African Development Bank (AfDB) has intention to co-finance the project implementation. The Study team will visit local offices of related international organizations to discuss the possibility of co-finance system. Since the World Bank has been implementing Partnership for Agricultural Water in Africa (AgWA) initiative, the Study team needs to study the trend of the initiative.

Recently, the process of Comprehensive Africa Agriculture Development Programme (CAADP) has been accelerated, and CAADP compacts were signed in all the target countries of the study (to be signed by the end of this June in Zambia), therefore, we should take into account the alignment of the projects to be formulated by the study, with the agricultural development strategies and the investment plans made through the CAADP process.

Chapter 2 Basic Approach of the Study

2.1 Basic Strategies of the Study

According to the study result of position of rice farming promotion strategies as shown in Para 1-3 (2) based upon the statistical data for 54 African countries, present conditions of rice farming and direction of the strategies for rice promotion policy will be somewhat different from each country. Major strategies of rice growing promotion for 4 countries will be summarized as shown below.

1) **Mari**: Demand of rice is quite high. Therefore, productivities of rice yield should be improved. Rice cultivation should be strongly promoted to reduce rice import in Mali to save foreign currency expenditure.

2) **Ghana**: It is expected that expansion of rice cultivation area and increasing of rice unit yield and improvement of a rice self-sufficiency ratio and reduction of amount of rice import.

3) **Uganda**: As seen from present situation, rice cultivation is still being developed in Uganda. The country is blessed with suitable climate condition for rice cultivation and annual rainfall reaches 1,300mm, thus rice growing promotion is expected to promote by governmental policy in the agricultural sector in Uganda.

4) **Zambia:** Governmental policy to promote rice production will be expected. Small-scale irrigation schemes are mainly operated but the government is interested in cultivating rice in lowland area. Taking account of this situation, it shall be considered correspondence to the expected result of third CARD general meeting held on May 17 to 18 this year in Tanzania.

As mentioned above, characteristics of rice growing conditions are different from each country .Therefore, selection of target areas will be made to meet with requirement of not only facilities but also soft components as well, such as improvement of marketing and farmers organization etc.

These nominated areas are included by other donors, so through meetings with the government and the donors, existing condition is recognized by the team. Finally two (2) target areas will be selected in line with JICA indication as ODA of JAPAN. These two (2) target areas are extracted from next three (3) steps.

Step 1: To list up existing irrigation area and irrigable potential area through information obtained from related Government Authorities and other donors.

Step 2: Grasp the outline of the project area and its present conditions from the above list. The project executed or decided to execute by other donors were excluded from this project. But about the project decided to execute by the donor, JICA team investigate the possibility of co-finance with the donor. Un-cleared document and place of the project are excluded from the list, confirmed by the government. And the about 10 target areas are listed as a new nominated cooperation project for Japanese Governmental assistance

Step-3: On the basis of the Step-2, reliable and possible implementation sites will be

nominated. Along with the list of the nominated projects, these projects will be categorized and grouped in accordance with donors, progress stage, new/existing rehabilitation, size of project scheme, kind of water resources, types of intake (head-works, pump station, dam etc.), irrigation method (open channel with lined canal, unlined canal, pipeline, etc.), water users association, kind of crops and other necessary components to be considered for project implementation, such as extension services, marketing improvement etc. In accordance with the following selection criteria to finalize projects to be financed by Japanese Government, 3 to 5 projects will be selected. These selected projects will be investigated at the sites in detail and on the basis of discussion with JICA Office, 2 projects will be finally selected.

1) To select preferentially the rehabilitation of existing projects in which saving effect of investment and rapid expression of effects can be predictable with no or limited land problems, compared to developing new projects.
2) To select preferentially gravity irrigation requiring neither electricity nor energy.
3) To select preferentially the areas where adequate amount of river flow can be accessible and where farmers can practice irrigation throughout a year.
4) To consider reservoir planning, represented as storage reservoirs, in order to address the issue of fluctuation of rainfall and river flow. Hence, this Study Team preferentially selects areas with efficiently operating reservoir sights at the upstream of rivers.
5) In terms of facility management, this project selects areas where it enjoys abundant vegetation with less soil erosion.
6) To select preferentially the areas where farmers practice paddy cultivation in the targeted irrigation so that those who have experienced paddy cultivation are included.
7) To prioritize the projects in the larger irrigation areas, given that the larger area of targeted farms have a greater impact on recipient farmers and influence more on socio-economic situation of the project areas in question.
8) To select preferentially the areas where whether farmers' associations (Water Users' Committee) are in good operation or farmers are considered to be motivated to practice irrigation.

Finalizing the selection of the project site, construction of irrigation facilities will be main components, however to attain self reliance of the project operation and maintenance should be considered. For example, where farmers' organization will not be well functioning, supporting to the farmers organization to strengthen the function will be included in the project implementation. Also, naming of the project will be proposed on the basis of the selected components.

2.2 Work Plan and Schedule

The study will be executed over six (6) months from May 2010 to October 2010. The team will be divided into two teams for smooth execution of the Study.

The work items to be conducted are as follows. Moreover, the work schedule table of"Table-5"

shows detailed work plan.

Stage	Period	Activities
Preparation Work in Japan	May. 2010.	Collection and analysis of the existing information
Field works	June ～ August. 2010.	・ Presentation and explanation of inception report to JICA's office and Ministries related to the project ・ Preparation of candidate project list and selection of high priority project ・ Site survey in selected projects ・ Discussion of feasibility of the project and preparation of field survey report ・ Presentation of field survey report to JICA office
Preparation of Final Report in Japan	September .2010.	Preparation of draft final report Presentation, explanation and discussion of draft final report Amendment and modification of draft final report
	October. 2010.	Preparation and presentation of final report

2.3 Staffing, Duties and Assignment Schedule

The Study team consists of the following two irrigation engineers.

Position	Name
Team Leader : Irrigation Development In charge of East/South Africa	Toshimasa Kobayashi
Irrigation Development In charge of Middle/West Africa	Manabu Masaki

The following figure presents the assignment schedule.

Assignment schedule

	Position	Name	2010 Country	5	6	7	8	9	10	11	12	Total Field	Total Japan
Field work	Leader (Irrigation development／east and south Africa)	Tosimasa KOBAYASI	Total			2.90						2.90	
			Uganda										
			Zambia										
			Ghana										
			Mali										
			Senegal										
	(Irrigation development／central and west Africa)	Manabu MASAKI	Total			3.10						3.10	
			Uganda										
			Zambia										
			Ghana										
			Mali										
			Senegal										
												(6.00)	
Home work	Leader (Irrigation development／east and south Africa)	Tosimasa KOBAYASI		0.50				0.90	0.70				2.10
	(Irrigation development／central and west Africa)	Manabu MASAKI		0.20				0.70					0.90
													(3.00)
Reports				IC/R					DF/R	F/R		(6.00)	(3.00)
												(9.00)	

IC/R: Inception report　　DF/R: Draft final report　　F/R: Final report

Chapter 3 Basic Methods for Estimate of Project Cost and Economic Analysis

3.1 Method of Project Cost Estimation

3.1.1 Necessary major Facilities for the Project

- Layout, length, size, numbers, etc. of the major facilities are estimated on the basis of field investigation and available topographic maps.
- The capacity of main irrigation and drainage canal will be estimated on the basis of a design standard of the country, if available, and referring similar projects and topographic conditions.
- As for secondary, tertiary canal networks and on-farm development, the construction costs have been estimated referring similar type of projects.

3.1.2 Unit costs of the major construction works

- Major unit costs have been estimated referring standard costs in the country and recent irrigation projects.
- If similar types of projects are implemented near by the proposed project site, the unit costs can also be utilized for project cost estimation.
- If unit construction costs will not be available, similar types of costs or international standard costs have been utilized.

3.1.3 Rough Estimation of Project Cost

- If the project implementation will be expected to finance by loan through international donor, direct construction cost on the basis of the unit costs prevailing in the country, contingency, and design and supervising engineering costs have been included. The prises escalation of costs have not been considered.
- For loan projects, engineering consultants cost has been estimated at 5% of the construction cost.
- For grant aid project by Japanese Government, the project will be constructed by Japanese contractor, so that the project const has been included in accordance with cost estimation by Japanese standard including indirect const.
- As for the contingency, 10% of direct construction cost has been estimated.

3.1.4 Operation and Maintenance Costs

- Operation and Maintenance cost has been considered at 3% of direct construction cost annually.
- Replacement const for usual steel facilities such as steel gate has been considered the life time span is 30 year. Since economic analysis is for 30 year duration, the replacement cost will be neglected.

3.2 Method of Project Benefit Estimation

Production cost for agriculture crops will be similar conditions between with and without project condition. The following values have been used for benefit estimation.

(1) Price of rice in the international market

The price of international rice has been estimated referring pink sheet prepared by WB in the milled rice with 5% to 25% broken rice in August and September 2010 on FOB Bangkok price. As seen from the price list of rice in the pink sheet in October 2010 as shown in the following table, US$ 450.0/ton has been adopted for project benefit. The production cost for rice is estimated about 20% of the adopted rice price, accordingly net benefit of rice has been estimated 80% of the price of rice, the US$ 450 x 0.8 = US$ 360/ton has been used for net benefit of the project.

COMMODITY PRICE DATA

			Annual averages			Quarterly averages					Monthly averages		
			Jan-Dec	Jan-Dec	Jan-Sep	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Jul	Aug	Sep
Commodity		**Unit**	2008	2009	2010	2009	2009	2010	2010	2010	2010	2010	2010
Food													
Fats and Oils													
Coconut oil	b/	$/mt	1,224	725	984	711	734	834	955	1,162	1,031	1,170	1,284
Copra		$/mt	816	480	654	469	491	557	634	772	689	772	854
Groundnut oil	b/	$/mt	2,131	1,184	1,335	1,133	1,152	1,359	1,352	1,296	1,300	1,334	1,253
Palm oil	b/	$/mt	949	683	831	679	732	808	813	873	807	905	906
Palmkernel oil		$/mt	1,130	700	1,040	700	761	922	1,034	1,164	1,059	1,165	1,268
Soybean meal	b/	$/mt	424	408	363	431	412	369	342	377	356	383	393
Soybean oil	b/	$/mt	1,258	849	925	856	921	917	876	981	907	1,002	1,033
Soybeans	b/	$/mt	523	437	425	454	439	417	409	451	429	457	466
Grains													
Barley	b/	$/mt	200.5	128.3	150.8	122.0	145.5	143.6	146.9	161.9	156.4	161.2	168.1
Maize	b/	$/mt	223.1	165.5	167.4	151.3	167.8	162.7	157.7	181.7	163.8	175.6	205.9
Rice, Thailand, 5%	b/	$/mt	650.2	555.0	481.7	539.0	542.3	535.3	452.4	457.2	441.8	452.8	477.0
Rice, Thailand, 25%		$/mt	n.a.	458.1	431.5	441.4	462.8	477.0	399.1	418.5	395.6	412.0	448.0
Rice, Thailand, 35%		$/mt	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Rice,Thai, A.1		$/mt	482.3	326.4	370.6	309.7	346.1	400.7	333.8	377.1	349.8	369.0	412.5
Sorghum		$/mt	207.8	151.1	151.0	139.3	163.8	156.9	142.6	153.6	132.4	143.4	184.9
Wheat, Canada		$/mt	454.6	300.5	288.7	271.2	283.4	279.0	260.9	326.1	287.5	326.0	365.0
Wheat, US, HRW	b/	$/mt	326.0	224.1	203.6	208.8	205.4	195.4	177.4	237.9	195.8	246.2	271.7
Wheat, US SRW		$/mt	271.5	186.0	211.3	165.2	195.6	193.5	186.9	253.4	222.3	261.6	276.3

(2) Unit Yield of paddy rice and milling rate

Unit yield of paddy rice, un-milled rice, has been estimated at 6.0 ton/ha according to the average yield with fully irrigated conditions in Africa. The milling rate has been adopted at 65 %.

3.3 Method of Project Economic Analysis

3.3.1 Economic Analysis

Project economic analysis has been made on the basis of economic internal rate of return (EIRR) analysis. As for the estimation of EIRR, project construction cost and operation and maintenance cost to the net benefit of agricultural crops have been analysed. The construction cost for economic analysis has been adopted a standard conversion factor at 85%. The currency exchange rate among the countries has been adopted on the basis of recent tendencies

of the average exchange rate as shown the Table 3-1.

Table 3 - 1 Currency Exchange Rate among Countries

Countries	Japan	USA	Euro	Uganda	Zambia	Mali	Ghana
Currency	YEN	US $	€	UGX	ZMK	FCFA	GHC
US $	85.000	1.000	0.739	2,000.000	4,800.000	484.817	1.400
Euro	115.000	1.353	1.000	2,706.000	6,494.400	655.957	1.894

3.3.2 Conditions for Analysis of EIRR

1) Project life time

Project economic life time has been set at 30 year considering life time of major facilities.

2) Construction Period

- For large scale of loan based projects, the construction period has been considered for 6 years duration.
- For grant aid projects, the construction period has been adopted for 2 years duration.
- Distribution of construction costs has been considered equality for 6 years or increased gradually toward the end of construction period. As for the grant aid project, the construction costs has been distributed equally for 2 years.

3) Operation and Maintenance Costs and Duration of Reaching Target Yield

- Operation and maintenance cost will be born after 4 years from the end of construction up to the end of the project life.
- The net benefit will be born just after the end of project construction period.

In accordance with the above mentioned conditions, the estimated EIRR has been shown in the Chapter 5 for each country report.

ANNEX

A-1 List of Collected Data and Documents

A-1 List of Collected Data and Documents

No.	Name	Source	Format	Size	Page	Remarks
CAADP Related Documents						
001	THE SUCCESSFUL IMPLEMENTATION OF THE AGRICULTURAL SECTOR DEVELOPMENT STRATEGY AND INVESTMENT PLAN(DSIP)	CAADP	PDF file	A4	9	
002	STATUS OF LEVEL CAADP IMPLEMENTATION JUNE2009	CAADP	Power Point File		6	
003	CAADP Post Compact Review GHANA Tchnical Review Report	CAADP	PDF file	A4	44	
004	ECOWAS AGRICULTURAL POLICY (ECOWAP)/COMPREHENSIVE AFRICAN AGRICULTURE DEVELOPMENT PROGRAMME(CAADP)	CAADP	PDF file	A4	18	
005	Investment Plan Documents-Mali	CAADP	PDF file	A4	18	
006	Mali CAADP Compact	CAADP	PDF file	A4	12	
007	POST COMPACT GUIDELINE-English	CAADP	PDF file	A4	29	
CARD 3rd General Meeting						
008	Information Sheet of Rice Related Project/Program in CARD First Group Countries	CARD	Power Point File			
009	SYNTHESIS OF CAADP NATIONAL AGRICULTURAL INVESTMENT PLANS(NAIP) IN WEST AFRICA (CARD 2TH Group Countries NRDS Development Workshop)	CARD	Power Point File		23	
010	Fiche d'Information concernant projet/ Programme Riz dans le Premier Groupe de pays CARD	CARD	EXCEL file			
011	Information Sheet of Rice Related Project/Program in CARD First Group Countries	CARD	EXCEL file			
012	Coalition for African Rice Development Overview of the Process of National Rice Development Strategies	CARD	WORD file	A4	4	
013	Co-Chairs' Summary of Third General Meeting of CARD Arusha,Tanzania,18-19May, 2010	CARD	PDF file	A4	6	
014	CAADP documents		WORD file	A4	1	
015	NATIONAL RICE DEVELOPMENT STRATEGY(GHANA)	CARD	Power Point File		13	
016	Mali GM3 MAL 04-May	CARD	Power Point File		11	
017	NATIONAL RICE DEVELOPMENT STRATEGY IMPLEMENTATION STATUS IN UGANDA 3rd CARD GENERAL MEETING 18th-19thMay2010,Arusha,Tanzania	CARD	Power Point File		12	

PART – II

Republic of Uganda

Uganda Project Site Location Map

Part II Uganda

Table of Contents

GLOSSARY OF ACRONYMS

Acronyms	Orthography
AfDB	African Development Bank
ATAAS	Agriculture Technology, Agri-business Advisory Services Project
CARD	Coalition for African Rice Development
CAADP	Comprehensive Africa Agriculture Development Program
DSIP	Agriculture for Food and Income Security Development Strategy and Investment Plan
DWfP	Department of Water for Production
EIA	Environment Impact Assessment
EIRR	Economic Internal Rate of Return
FAO	Food and Agriculture Organization of the United Nations
FIEFOC	Farm Income Enhancement and Forest Conservation Project
F/S	Feasibility Study
IFAD	International Fund for Agricultural Development
IMP	Irrigation Master Plan
JICA	Japan International Cooperation Agency
KOICA	Korea International Cooperation Agency
MAAIF	Ministry of Agriculture Animal Industry and Fisheries
MWE	Ministry of Water Environment
NEMA	National Environmental Management Agency
NIMP	National Irrigation Mater Plan
NRDS	National Rice Development Strategy
S/C	Sub County
SFIPA	Study for the Formulation for Irrigation Projects in Africa
SIAD	Sustainable Irrigated Agriculture Development Project in Eastern Uganda
UNDP	United Nations Development Programme
WB	World Bank
WfP	Water for Production

Chapter 1 Irrigated Agriculture in Uganda

1.1 Investigation in Uganda

1.1.1 Related Organizations

(1) Governmental Organizations

In Uganda, the Ministry of Water Environment (MWE) and the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) are engaged in the irrigation sector. MWE is responsible for water resources development as water for production: irrigation water for crops, water for livestock animals, fish culture, drinking water, and industrial water. Also, the Department of Agricultural Lands in MAAIF is in charge of issues related to irrigation.

Recently, both ministries have respectively announced their policies on irrigation and agriculture. MWE proposed the *National Irrigation Master Plan for Uganda, 2009-2032* in August 2009, and MAAIF announced the *Agriculture for Food and Income Security Development Strategy and Investment Plan, 2010/11 - 2014/15* (DSIP) and the *Uganda National Rice Development Strategy (NRDS)* in March 2010.

This study is conducted through discussions with both ministries as the targeted governmental organizations. Figure 1.1 shows the proposed reform of MAAIF in DSIP.

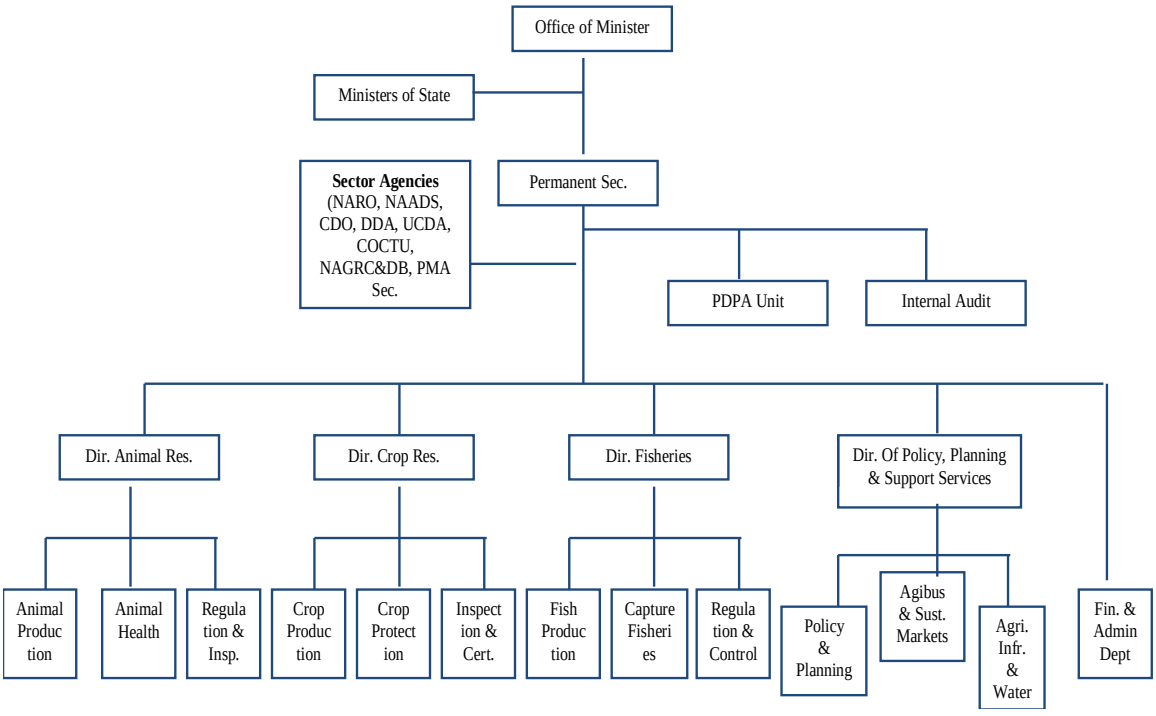


Figure 1.1 Organization Structure of MAAIF after Reform

The organizational chart of the department in charge of water for production in MWE is shown in Figure 1.2. There are 25 staff members allocated to this department, but none of them have any specialized skills in irrigation.

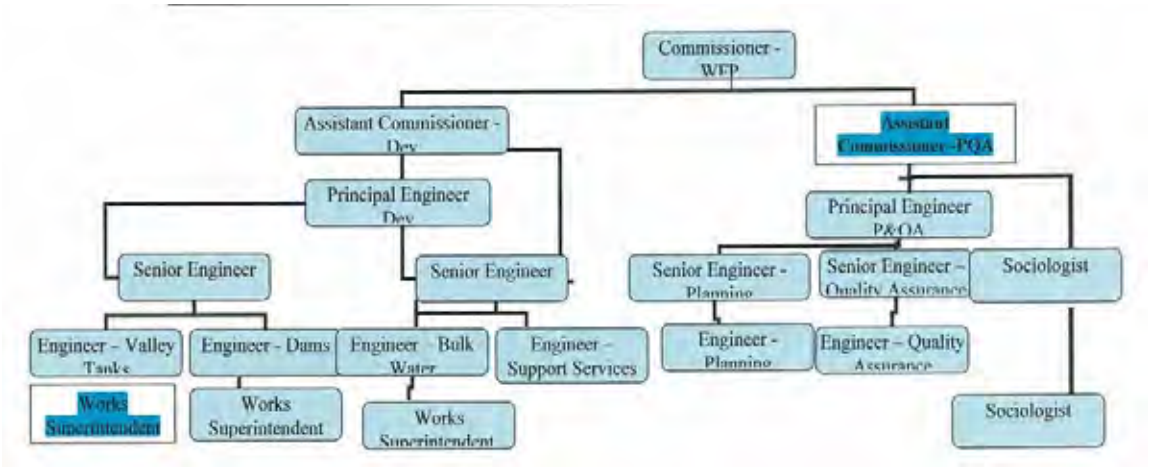


Figure 1.2 Organization Structure of Water for Production Department/MWE-July 2007

(2) Other Related Donors

Other donor organizations such as the African Development Bank (AfDB) and World Bank (WB) were visited to collect information/data. The contact address of the respective organizations is shown below.

AFDB Uganda Field Office;
Uganda field Office
African Development Bank Group, Uganda Country Office (UGFO), 14th Floor, Crested Towers Building
Hannington Road, P.O. Box 28509, Kampala - Uganda
Tel: (+256-414) 236 166/7
Fax: (+256-414) 234 011
Ext. 6760-6790

World Bank;
The World Bank, Rwenzori House, 1 Lumumba Avenue, P.O. Box 4463, Kampala, Uganda
Tell: (256) 414-230-094/ 256-312-221-416/7
Fax: (256) 414-230-092

1.1.2 Data Collection and Analysis

(1) Collection and Analysis of Meteorological Data

From 1940 to 1975, rainfall measurement was conducted at 102 sites and the data was utilized to analyze rainfall patterns in each 16 meteorological zone. Currently, meteorological observation is conducted at 24 sites. Nationwide meteorological data on a daily basis from 2006 to 2009 has already been obtained and the data are copied in the DVD attached in a separate volume.

(2) Collection and Analysis of Meteorological Data

There are six watersheds in Uganda, namely, Kyoga, Albert, Edward, Victoria-Nile, Albert-Nile, and Aswa. Discharge measurement is conducted at each river basin. A total of 65

observation sites are scattered around the country. In order to evaluate the water resources, such data will be utilized in the study. The discharge data at the Namatala river, the Manafwa river, the Sipi river and the Sironko river from 2003 to 2009 on a daily basis are shown in the afore said DVD. Moreover, in order to analyse a relationship between the stream flow pattern of the Manafwa river and the rainfall pattern of the Tororo Station, column charts are shown in Annex U-2.

(3) Collection and Analysis of Topographic Data

National large scale maps on a scale of 1:50,000 cover the whole country. For smooth site investigation, necessary maps of the potential irrigation areas have been collected and layout plans of priority projects have been prepared on the basis of collected topographic map.

(4) Collection and Arrangement of Data on Irrigation Projects

Information on existing irrigation areas and potential irrigation areas were mostly collected from *Increasing Incomes Through Exports: A Plan for Zonal Agricultural Production, Agro-processing and Marketing in August, 2004*. The list and location map of irrigation projects, which are also presented in the master plan, were shown in Chapter 4 of this report.

In the course of this study, an inventory list of candidate irrigation projects for future stage was prepared based on the collected information for a start. Then the list was reviewed through data/information collection and discussions with the agencies concerned about. Finally, two projects were selected as potential targeted irrigation projects.

1.2 Progress of CARD

In January 2009, MAAIF held a committee meeting on technical matters to decide the content of NRDS. The first draft of NRDS was completed in March and was presented at an FAO workshop. The contents were further modified and the finalized version of CARD was announced in June 2009.

According to NRDS, annual rice production in 2008 was 160,000 tons and 60,000 tons were imported. Therefore, CARD aims to increase rice production to 500,000 tons, eliminate imports and increase exports by 2018. In order to fulfil this aim, the following four policies need to be achieved.

- Improvement of seeds and seed production by the private sector;
- Research and dissemination of technical skills and human resource development of farmers;
- Dissemination of utilization of fertilizer and land conservation;
- Improvements in irrigation and water management;

Based on the above mentioned policies, agricultural land agricultural land of 110,000 ha including rainfed upland rice fields, rainfed paddy fields and irrigated zones will hopefully be enlarged to 240,000 ha by 2018.

1.3 Present Status of Irrigated Agriculture in Uganda

1.3.1 Governmental Policy on Implementing Irrigation Projects

The current concern in Uganda is the situation regarding differently allocated irrigation works between the two ministries (MWE and MAAIF), which may be a problem when enforcing irrigation projects. MWE currently has an on-going *Irrigation Master Plan* and the final results will be presented at the end of this year. However, no concrete plans for implementing irrigation projects have been announced yet. The finalized content of the *Irrigation Master Plan* and the cooperation of MAAIF will be the main keys for future development in irrigation.

Figure 1.3 illustrates the current demarcation of irrigation works between MWE and MAAIF.

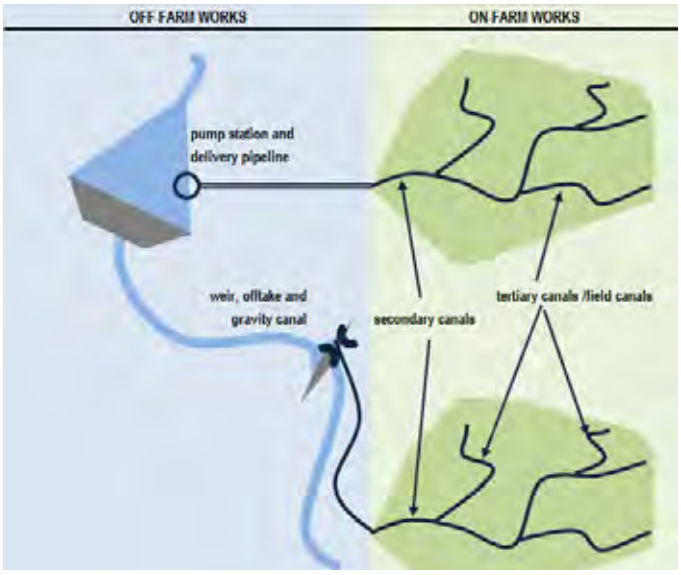


Figure 1.3 On-farm and Off-farm Irrigation Works

MWE is responsible for the development, regulation and overall management of water for production. As far as irrigation is concerned, however, its role is limited to off-farm functions which include:

- Assessment of water resources availability and economic analysis of water usage;
- Design and construction of off-farm infrastructure (dams, weirs, pump stations and delivery canals/pipelines and all related structures within the delivery system);
- Support for the operation and maintenance of hydraulic works and major water infrastructures and reservoirs;

MAAIF is responsible for on-farm works including:

- Provision of technical assistance with respect to the design and construction of on-farm irrigation systems (including tertiary canals, distribution/field canals, control structures and drainage canals);

- Promotion of appropriate technologies for efficient and effective use in irrigation (as well as livestock watering and aquaculture);
- Establishment of efficient and effective management structures;
- Support for the operation and maintenance of the on-farm systems;
- Promotion of efficient water use, provision of extension services and advice to farmers on irrigation systems;
- Supervision and monitoring in management and operation of water users' group;

MAAIF is currently on in consultation with WB and plans to select a specialized consultant to further decide how to proceed with the demarcation of irrigation projects. However, this has not yet been carried out. Thus the next move by MAAIF needs to be carefully observed. Accordingly, in order to conduct the survey on the project smoothly, the Japanese Government needs to schedule meetings with the respective ministries and include them as part of the counterpart organization with respect to their fields of specialization.

1.3.2 Plans for Irrigation Projects Supported by International Organizations

AfDB currently has an on-going FIEFOC project to improve the existing irrigation schemes, which is scheduled to be completed by December 2012. The project has already started, utilizing the budget of ADF-10 with the estimated cost of approximately UA 12 million (US$ 18 million). The next budget cycle, ADF-13, is from January 2011 to December 2013 and approximately UA 90 million (US$ 135 million) will be allocated to the agricultural sector; however, the budget will mainly be allocated for farm roads, storage facilities, and post harvest facilities, and not for irrigation projects. On the other hand, WB is currently preparing for a major shift to ATAAS (*Agriculture Technology, Agri-business Advisory Services Project*), in order to better reform NAADS which is responsible for agricultural extension services.

A specialized consultant on demarcation between the two ministries needs to be selected. This has been discussed, but a proper request has not yet been announced. MAAIF is deciding on the DSIP and is willing to strategically undertake organizational reform of the ministry in order to better improve the irrigation projects.

WB also supports irrigation projects, but there has not been any successful outcome yet. From the budget of IDA16 (2010-2012), WB plans to provide US$ 100 million to ATAAS and the remaining US$100 million to other DSIP, and irrigation is included in this.

Today in Uganda, there are not many medium to large-scale irrigation projects. However, recent climate change and shortages of water have considerably affected domestic agricultural production, thus the need for irrigation projects is on the increase. In particular, the nationwide need for rice is significantly increasing and thus the market price of rice is expected to rise. Due to this growing demand for rice, requests for irrigation projects by private enterprises to MAAIF are rising. In order to implement a large scale irrigation project, KOICA also plans to conduct a survey in the Eastern Provinces of Uganda.

Chapter 2 Summary of Discussions with Related Agencies

Records of interviews with related organizations are outlined here (see *Annex U-1* for more details).

2.1 Schedule of Field Survey

In order to collect the required information, the first half of the field survey was spent on meetings with the related organizations. Based on the information obtained, field survey was conducted focusing on rice production projects.

In *The Study on Sustainable Irrigation in Eastern Uganda (2007-2008)*, Lira District in the north and the western regions were investigated and the results are described here for reference. The mountainous western region and dangerous north-eastern region (Karamoja region) were excluded from the survey. The following Table 2-1 shows schedule of the field survey.

Table 2-1 Schedule of Field Survey

Date	Place	Content of Investigation
June 8-16	Kampala	Meetings with related organizations
June 17（Thu）	Kampala⇒Mbale	Busitema University
June 18 (Fri)	Mbale	Doho site investigation
June 19（Sat）	Mbale	Sipi/Sironko site investigation
June 20 （Sun）	Mbale	Manafwa/Nankwasi site investigation
June 21（Mon）	Mbale⇒Lira	Palisa/ Kumi District site investigation
June 22 (Tue)	Lira	Lira District site investigation
June 23 (Wed)	Lira⇒Apac⇒Gulu	Apac District site investigation
June 24 (Thu)	Gulu	Meeting with JICA Office in Gulu District , Gulu District site investigation
June 25（Fri）	Gulu⇒Amru	Amru District site investigation
June 26（Sat）	Gulu →Kampala	Luwelo District site investigation
June27 - 30	Kampala	Additional meeting with related authorities
July 1 - 11	Kampala	Field report preparation and submission and explanation of report to the related authorities.

2.2 Meetings with Related Government Organizations

Information was obtained from MAAIF as it is the main authority responsible for implementing irrigation projects. Also, a meeting was held with MWE, which is responsible for projects on water resources development and the environment, to further discuss the current situation of irrigation projects and to set up favourable priority areas. DWD of MWE is currently developing reservoirs; however, the purpose of utilization of them is not clear and thus efficient use cannot be expected. Moreover, use of wetlands is necessary for developing rice cultivation , thus data was collected from NEMA with respect to wetland conservation.

In Uganda, there are hardly any irrigation engineers, thus this will be a major obstacle to implementation in future stage of irrigation projects. Therefore, it is absolutely important to set up an irrigation and drainage courses at an university. Concerning this matter, more information was collected from Busitema University. See *Annex U-1* for more details on the meetings with the respective organizations.

2.3 Meetings with Related International Donors

Today, financial assistance by WB is mainly allocated to promote the NAARDS project, thus there has not been any support for irrigation projects. Conversely, AfDB is currently taking over the FIEFOC project with irrigation component. Initially, this irrigation component was supposed to be used to implement small-scale irrigation projects. However, in 2009, there was a change in the plan and improvement was carried out of rehabilitation of four existing irrigation projects.

In this context, future plans for investment formulated by international organizations were collected. According to the plans, AfDB considered that providing financial assistance for irrigation projects by loans is not a major prospect. Conversely, WB proposed a possible supply of financial assistance for irrigation projects in the next stage.

Additionally, information on the current support situation for NERICA rice was obtained from FAO and IFAD. (See *Annex U-1* for more details on the meetings with the respective organizations.)

2.4 Progress of CAADP

The CAADP Compact was signed for Uganda at the end of March 2010. Simultaneously, MAAIF announced the DSIP 2008/9-2014/15 for sustainable food access and incomes, which became the basis of the new national development plan 2008-2012. The DSIP implies the absolute importance of agriculture under the CAADP, and aims to increase agricultural development by 6% annually and allocate more than 10% of the government budget to agriculture. In the DSIP, as investment in increased water use for crop production, irrigation of 6,535 ha is included to be implemented by rehabilitating the facilities at five sites, new irrigation areas are developed at four sites and information is provided to the private sector on large and small-scale irrigation facilities.

Chapter 3 Results of Field Survey

3.1 Regional Rice Cultivation Conditions

(1) Eastern region

Concerning the rice cultivation in the eastern region, the *Development Study* conducted from 2003 to 2006 and the *Study on Sustainable Irrigation Project in Eastern Uganda* have shown the quantitative use of seasonal wetlands. According to the study results, about 80,000ha of seasonal wetlands have been developed as paddy fields. It seems that development of paddy fields has been increasing since the study period, as demand of rice grows .

In order to confirm the development potential of the wetlands of each river, information of the potential area has been collected through field survey with the District Agricultural Officer (DAO). As a result of field survey, it was found that major private companies had submitted an application to develop irrigation projects in Igogero wetlands of about 2000ha and Lumbuye wetlands of about 1000ha, which are considered to be high potential areas. It is said that the application was already approved by MAAIF. Accordingly, these sites are excluded from the candidate areas of the study.

However, there are only a few irrigation engineers in Uganda, the technical level for implementation of large-scale irrigation projects by a private base might be insufficient for sustainable management. In addition, there are so many small farmers cultivating rice in the wetlands. It is not clear how small-scale farmers will be treated after implementation of the irrigation project by the private company. If the small-scale farmers are hired as unskilled labourers just for works in the paddy fields like a private company doing in Kibimba, corporate profit will be given priority which will be quite inappropriate for the benefit of farmers. It is necessary to watch the responses of MAAIF and MWE to promote private sector in the wetlands development.

According to information from MAAIF, the private company has submitted an application to expand the development area in Kibimba wetlands to 10,000 ha and has already obtained approval. Moreover, the Korea International Cooperation Agency (KOICA) is planning to assist an irrigation development project in Mopologoma wetlands. Consequently, large scale irrigation projects are promoting in Eastern Region.

(2) Northern Region

The utilization of wetlands in the northern region is not as progressed as in the eastern region. However, farmers' interest in paddy rice cultivation is gradually spreading in the region and NERICA is promoted in the region.

In general, rice cultivation are not very common in the seasonal wetlands. It can be said that the small population of the northern region is one of the factors accounting for local unfamiliarity with rice cultivation. Upland crops such as maize, cassava, sorghum and millet are the main produce in this region. Moreover, livestock raising is predominant in the region.

The seasonal wetlands are considered to have a relatively high potential due to the vast meadows and abundant water resources. Thus significant development can be expected. Especially in the vast wetlands in Apac District, there are hardly any bulrushes and the huge expanse of land extends the length of 50 - 60 km and the width of 2 - 3 km.

For smooth introduction of rice cultivation on a large scale, introduction of small-scale paddy irrigation is necessary as a initial activity. In particular, it is considered necessary to introduce rice cultivation techniques developed in the SIAD-Project, which is now being executed in eastern Uganda. Moreover, because of the small population, there is a possibility that measures on local migration may be needed, if large-scale development is to be executed. From a long-term point of view, it is a region with great potential and thus successful future development can be expected.

(3) Western Region

In general, the western region has hilly and mountainous topographic conditions. The wetlands with enough area for irrigated paddy field are very limited. Irrigated paddy field are hardly found in this region. For example, the Mubuk Irrigation Project, which is managed by MAAIF, mainly cultivates vegetable and fruit. As for upland rice cultivation, NERICA is rapidly expanding due to growing demand of rice.

3.2 Existing Irrigation Scheme

The following Table 3-1 shows the existing irrigated areas carefully surveyed by MWE. Four pilot projects conducted in the *Study on Sustainable Irrigation in Eastern Uganda (2003-2006)* are listed in the table as existing irrigation areas. Additionally, several farm land consolidation projects on a pilot basis are also listed.

Moreover, the FIEFOC projects of AfDB are included in the list. Irrigation techniques obtained in these existing irrigation projects will play key roles in a new development of large scale irrigation project.

During the site survey period, four AfDB project sites were investigated, and the survey results are summarized herein after.

Table 3-1 List of Existing Irrigation Scheme

Existing Irrigation in Uganda (2008)								
Scheme Name	District	Infrastructure	Source	Crops	Actual	Potential	Longitude	Latitude
					[ha]	[ha]		
Ara	ADJUMANI	Pumping	Nile	Vegetables	1	5	31.80	3.53
Atari	KAPCHORWA	Checks (M)	Atari		0	102	34.45	1.51
Bukatuba	MAYUGE	Bunds	Nukikote swamp	Rice	2	4	33.43	0.40
Bumbobi	MBALE	Checks (L)	Wantsira	Rice, beans	2	9	34.17	0.99
Bunamono	SIRONKO	Checks (L)	Chebonet	Rice	22	200	34.29	1.38
Bupala	BUGIRI	Checks (M)	Kasolwe	Rice	11	30	33.65	0.55
Busakira	MAYUGE	Checks (L)	Kabere	Rice	6	18	33.50	0.42
Busitema	BUSIA	Bunds	Namukombi	Rice	3	14	34.03	0.56
Butongole	KALIRO				0	8	33.51	0.91
Buwunga	MASAKA	Checks (L)	Katalazi	Coffee	1	4	31.81	-0.40
Buwuni	BUGIRI	Checks (L)	Naitosi	Rice	7	15	33.84	0.53
Doho	BUTALEJA	Checks (m)	Manafwa	Rice	965	965	34.03	0.94
Igogero	IGANGA	Bunds	Naigombwa swamp	Rice	5	800	33.67	0.61
Itek	LIRA				0	350	33.01	2.21
Jami	PALLISA	Checks (M)	Sekulo	Rice, maize	2	50	34.06	1.06
Kajamaka	KUMI	Checks(m)	Kobukol	Rice	11	18	33.87	1.34
Kakira	JINJA	Pumping	L.Victoria	Sugarcane	1500	2000	33.30	0.50
Kaliro1	KALIRO				0	30	33.50	0.88
Kaliro2	KALIRO				0	40	33.50	0.88
Kariabi	PALLISA	Checks (L)	Mpologoma swamp	Rice,maize	85	150	33.75	1.16
Kibimba	BUGIRI	Checks (m)	Mpologoma swamp	Rice	665	1500	33.89	0.53
Kitumbezi	BUGIRI	Bunds	Mpologoma swamp	Rice	23	1500	33.63	0.55
Lugazi	MUKONO	Pumping	Musamya	Sugarcane	322	322	33.09	0.36
Lumbuye	KAMULI	Dams & Checks	Lumbuye Swamp	Rice, maize	0	7686	33.37	0.84
Luubu	MAYUGE				0	2	33.45	0.42
Magola1	BUGIRI	Checks (L)	Kadoma	Rice	10	0	33.72	0.55
Magola2	BUGIRI	Checks (L)	Kadoma	Rice	2	8	33.70	0.55
Minsanvu	MASAKA	WH & Pumping		Coffee, avocado	5	5	31.65	-0.25
Mubuku	KASESE	Diversion Weirs	Sebwe	Vegetables	672	2000	30.13	0.22
Nabongo	SIRONKO	Checks (L)	Nabbongo	Maize, sugarcane	7	30	34.30	1.34
Nahigande	BUTALEJA	Bunds	Manafwa swamp	Rice	9	21	33.95	0.89
Nakiga	BUTALEJA				0	86	33.94	0.86
Namawondo	IGANGA	Bunds	Nawaibete Swamp	Rice	2	11	33.64	0.75
Namwiwa	KAMULI	Bunding	Wakoyeyo	Rice	4	8	33.54	1.08
Nangeye	PALLISA				0	650	34.03	1.03
Nawangis	IGANGA	Bunds	Nawanga	Rice	10	25	33.57	0.72
Ndokero1	MAYUGE	Bunds	Nukikote swamp	Rice	0	5	33.44	0.39
Ndokero2	MAYUGE	Bunds	Nukikote swamp	Rice	0	3	33.44	0.39
Nyanza	PALLISA				0	300	34.11	1.06
Olia	ADJUMANI	Pumping	Odraji	Vegetables	2	2	31.91	3.35
Olweny	LIRA	Pumping	Alwenyi	Rice	55	55	33.01	2.00
Osupa	PALLISA	Checks (L)	Mpologoma swamp	Rice, maize	18	0	33.73	1.17
Saaka	KAMULI	Pumping	Mpologoma Swamp	Rice, maize	7	60	33.59	1.12
Tabagony	SIRONKO	Checks & Bunds	Kaprokwol	Rice, sugarcane	3	114	34.40	1.47
Tarar2	ADJUMANI	Pumping	Opi	Vegetables	1	5	31.76	3.27
Wangobo	IGANGA	Bunds	Naigombwa swamp	Rice	30	66	33.62	0.72
Total					4470	19276		

3.2.1 Doho Rice Scheme

Doho area expands over Butaleja and Tororo districts. Irrigation water is taken in from the Manafwa River. The basin area covers 494.2.km^2 at the gauging station on Tororo Road and more than 500.km^2 at the location of headworks. The scheme was established with aid from China in 1978 and it is now being run by the government. However, China withdrew from the scheme without completion of construction works, and without transferring the appropriate rice cultivation techniques to the local farmers. Therefore, the farmers know little about the operation and maintenance of the irrigation facilities. The irrigation association is not

functioning properly, and the amount of collected irrigation fees, which are necessary for operation and maintenance (25,000 shillings/year/ha), is very low. The collection rate of irrigation fee is about 30% and the maintenance has not been managed well.

For these reasons, flow capacity of the diversion canal and main canal of the scheme has decreased because of accumulated sedimentation. In addition, frequent flooding problems happen in paddy fields due to direct inflow of river water at flooding times. As a result, the irrigation and drainage system is not functioning properly.

Furthermore, large-scale private farmers from outside the scheme are developing paddy fields without rules by taking in irrigation water through illegal intake facilities constructed at upstream reach of the Doho headworks.

Even worse, it seems impossible to perform orderly water management because of the widely developed paddy fields found in the surrounding area, and the lack of restrictions or order in the use of the limited river water.

Doho scheme is the only one large-scale paddy irrigation project managed by small-scale farmers. Judging from important role of the scheme, rehabilitation of existing facilities and reconstruction of water management system including surrounding areas would be necessary.

Spillway at Doho Headworks

Intake at Doho Headworks

Main canal diversion works downstream have been swept away

Meeting between the Minister of MAAIF and stakeholders in Doho

3.2.2 Olweny (Itek/Okile) Seamp Irrigation Project

(1) Background

Olweny Swamp Rice Irrigation Project is located at Agwata Sub-County (S/C) in Lira District. The project was scheduled to commence along with the Kibimba Rice Scheme (Tilda) in Bugiri District based on the Feasibility Study conducted through agreement between the Ugandan government and the Chinese government in 1964.

These two projects were designed expanding to both upstream and downstream sides of the main road in order to exhibit Chinese cooperation. The construction works in Kibimba scheme began in 1972/73 and was completed in 1976. However, the Olweny scheme is still unsure when construction will start.

(2) Activities

The basin area of Olweny wetlands, where the Olweny Rice Scheme is located, covers 930 km^2. Within the wetlands in Agwata S/C, 400ha was planned to allocate upstream and downstream areas respectively across the Soroti-Lira main road. Thus a total area of 800ha was scheduled to develop as paddy fields with surrounding embankments.

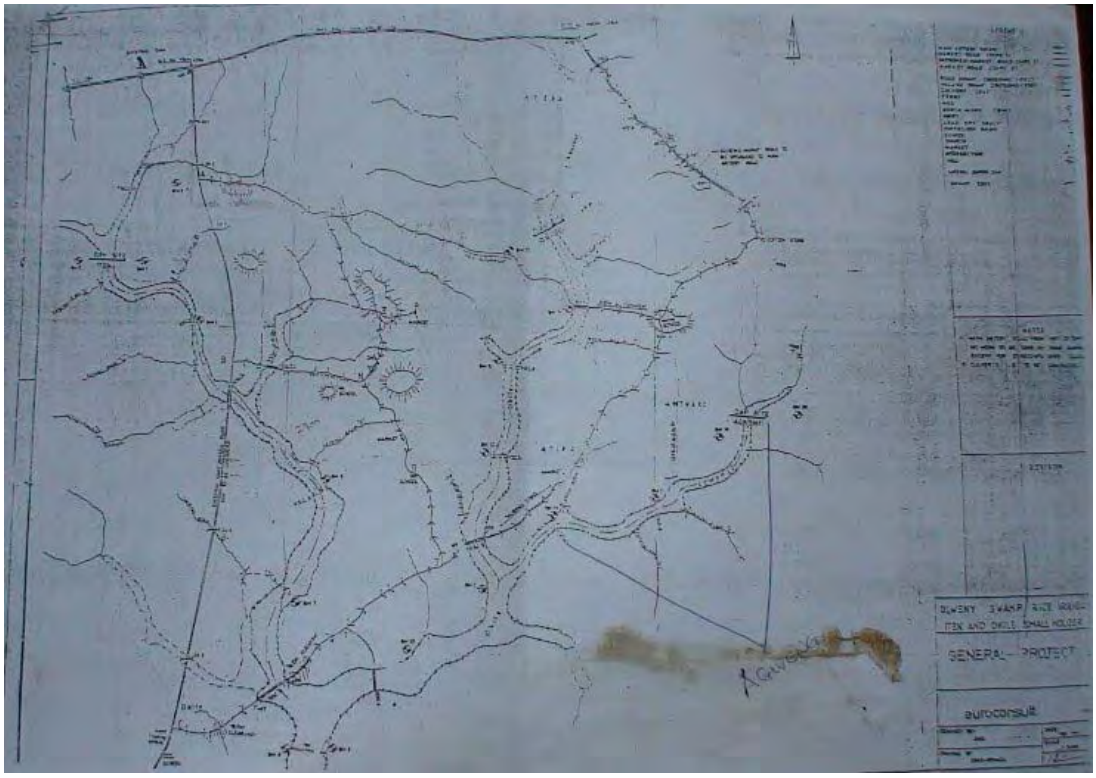
Because the wetlands are very flat, irrigation water was designed to be pumped from Lake Kwania, about 6km away. This project was originally scheduled to start in 1982 as a $24 million loan project financed by AfDB and the Kuwait Fund. However, it was delayed because of political instability (NRA versus UPC) within the country.

In May 1991, the review mission of AfDB decided to abandon the original Olweny scheme for a reason of high operation cost of the pumping irrigation and drainage system. Instead, new Olweny schme by gravity system using small ponds found in upper reaches of the Itek and Okile Rivers were chosen.

(3) Launch of Itek/Okile irrigation project

Construction of the core paddy fields of 50ha in Agwata District began in 1992/93 and was completed in 1995/96. Construction works in Itek/Okile were started in 1997/98 and were completed in 2002/03. The basin area of the Itek River is 40 km^2 and 450 ha of paddy fields were irrigated. The basin area of the Okile River is 28 km^2 and 150ha of paddy fields in downstream reach were also irrigated.

The main purpose of the two dams is flood control instead of irrigation. The dam temporarily stores peak floodwater and mitigates flooding in downstream areas.



Overall Plan of Itek/Okile Project

Unused management office

Pump rusting from lack of use

Outlet works for Itek Dam

Outlet works and paddy fields downstream

3.2.3 Mubuku Irrigation Project

The Mubuk Irrigation Project is located at Kasese District in the western region. In 1970, the irrigation system was constructed under the supervision of MAAIF in collaboration with FAO and UNDP. Like Doho scheme, the system management was undertaken by the farmers' union, under the supervision of MAAIF.

The project is developed applying a phasing approach as shown below.

Phase 1 : The main canal has a pipeline system, and irrigation water is supplied from the diversion system by an open canal. The irrigated area of 400ha is divided into 7 blocks.

Phase 2-A: The main canal is an open canal. 116ha is divided into 5 blocks for irrigation.

Phase 2-B: 100ha will be irrigated by an open canal

Phase 3 : 400ha is planned to be developed by the Nyakatasi Growers Union.

In the current irrigation system, 8 acres are provided per farmer and 158 farmers are now members of the farmers' union. The farmers pay a membership fee of 50,000 shillings annually. The collection rate is about 70%. Onions and vegetables are grown in the irrigated fields. Moreover, rice cultivation is booming recently. NERICA is grown in the irrigated fields and the yield is excellent. Therefore, private rice millers are also starting to operate outside the district.

Mubuku headworks

Intake at Mubuku headworks（pipeline）

Irrigated area（NERICA cultivation）

Onion cultivation

3.2.4 Agoro Irrigation Project

Agoro Irrigation Project is located at Agoro S/C in Kitgum District. The Agoro Irrigation Project began in 1966 with 20 acres for horticulture (fruit trees and vegetables). In the 1970s, the Ministry of Natural Resources expanded the irrigation project to 400 acres. However, the irrigation canal is currently barely functioning due to sedimentation coming from the Okura River. Moreover, the gates and division works were swept away due to floods and thus irrigation as a whole is not functioning.

A rehabilitation project will be executed under the FIEFOC Project, financed by AfDB. The selection of a consultant to be in charge of the detailed design has been. From now on, detailed design and preparation of tender documents will be executed, and the construction work will commence in February 2011. It is scheduled to be completed in December 2012.

Broken gate

Main canal and intake

Beneficiary area

Secondary canal（full of sediment）

Chapter 4 Development Potential Area

4.1 Criteria for Selection of Target Development Areas

With respect to the target development areas, the Study Team created a list of target areas grouped on the basis of an analysis of the following components: donor, stage of progress, type of work (new construction or rehabilitation of facilities), irrigation area, type of water resources, type of intake facilities (headworks, pumping station, dam, etc.), irrigation method (lined open canal, unlined open canal, pipeline, etc.), existence of water users' association, and crops. As an initial analysis, three to five potential development areas were selected applying the selection criteria. Finally, the Study Team then conducted a field study of the selected areas in order to choose the final two target areas in consultation with the JICA field office.

(1) The rehabilitation of existing projects is given high priority because of relatively low investment cost, their immediate effects, and less land acquisition problem in comparison with a new development project.

(2) Priority is given to gravitational irrigation requiring neither electricity nor energy.

(3) Priority is given to areas where an adequate river flow can be accessed and where farmers can practice irrigation throughout the year.

(4) For stable water supply against fluctuated rainfall and river flows, storage reservoir would be necessary. Hence, priority is given to areas having existing reservoir and/or efficient reservoir sites in the upper reaches.

(5) In terms of facility management, areas with abundant vegetation and little soil erosion are preferentially selected.

(6) Priority is given to areas where farmers already practice some form of rice cultivation in the target irrigation area, so farmers with experience in rice cultivation are included among the beneficiaries.

(7) Projects in larger irrigation areas are prioritized, given that the number of beneficiary farmers is higher and the impact on the socio-economic situation is greater.

(8) Priority is given to projects which will contribute to improve farmers' living conditions.

(9) Priority is given to areas where farmers' associations (water users' committees) are functioning or farmers are considered to be motivated to practice irrigation.

Flow chart of the selection criteria for the target areas is shown in the following Fig. 4-1.

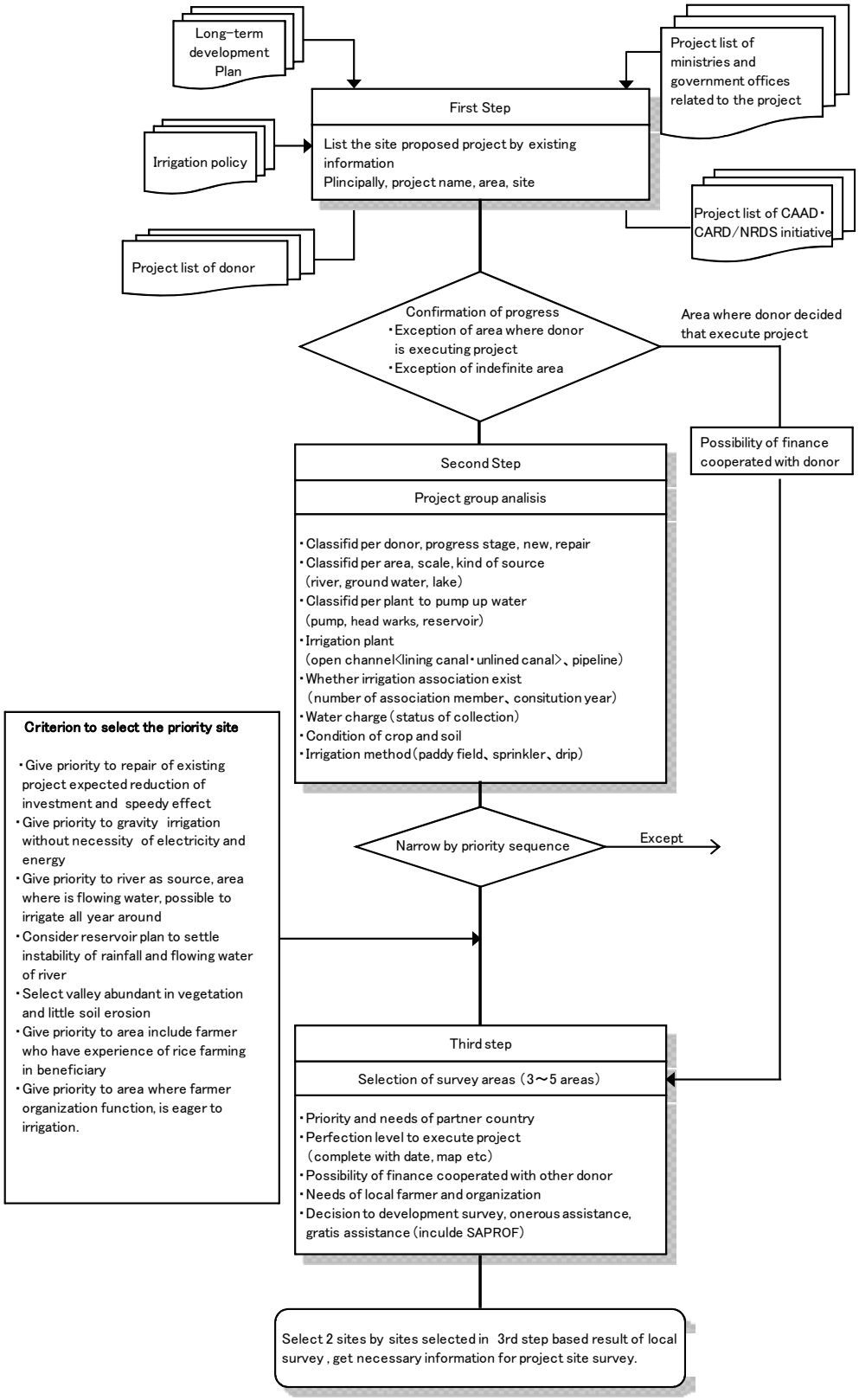


Fig.4-1 Flow Chart of Selection Criteria for Potential Irrigation Site

4.2 Current Situation of Potential Irrigation Development Areas

From the results of the study on the target irrigation areas, the Study Team categorized the projects for paddy cultivation irrigation into three types from the viewpoint of prioritizing gravitational irrigation.

a) Projects for extension of existing irrigation areas

b) Development of new irrigation areas

c) Rehabilitation of existing storage reservoirs and creation of irrigation project in downstream area

4.2.1 Projects for Extension of Existing Irrigation Areas

The FIEFOC Project assisted by AfDB is currently reconstructing four major existing projects. While this project exclusively targets the original development areas for reconstruction, it ignores the currently expanding surrounding irrigation areas. Also, the scale of the four reconstruction projects in total is only US $ 18 million. However, the current situation is that substantially large areas of irrigated land are randomly spreading around the original areas. Therefore, development of an orderly water use system and reconstruction of the drainage system for more systematic and efficient water management need to be implemented in the entire project area, including the subsequently extended irrigation areas. In particular, the Doho irrigation area has been identified as one of the areas in which the extended area is larger than the original area. Also, as in the Mubuku area, there are some areas where phasing development is practicing. The table below shows the extended regional area in the above four areas and the overall potential development area in relation to the whole.

Therefore, it is possible for Japan to establish an appropriate irrigation and drainage system by executing the rehabilitation of these areas.

Table 4-1 List of Major Existing Irrigation Projects and Potential Expansion Area

Area	Target Crops	Initial Development Area (ha)	Potential Expansion Area (ha)	Overall Development Area (ha)
Doho Rice Scheme	Paddy Rice	1000	2000	3000
Itek/Okile Irrigation Scheme	Paddy Rice	600	50(Nucleus Farm)	800
Mubuku Irrigation Scheme	Crops・Paddy rice	516	500	2000
Agoro Irrigation Scheme	Crops・Paddy rice	130		200

4.2.2 Development of New Irrigation Areas

Currently in Uganda, a limited number of existing irrigation projects are in progress; in particular, medium to large-scale development projects are concentrated in a few irrigation areas. Owing to the recent high demand for rice and its stable price, farmers are cultivating seasonal wetlands randomly in the east of Uganda. On the other hand, dissemination of NERICA in the northern region seems to suggest the popularity of rice. In this region, however, paddy cultivation is not so popular, due to the difficulty of acquiring the techniques for rice cultivation and rice seeds in the low wetlands. Hence, it is essential to implement policies not only to efficiently use wetlands, but also to disseminate high-yield and productive rice cultivation, taking advantage of the multiple functions of paddy fields. Paddy irrigation seems to be greatly desired by people in the region, since it can realize both wetland conservation and food production. Against this background, new paddy field irrigation development in the northern region and small-scale rice cultivation in the east are being advanced in a disorganized manner. Therefore, it is of importance to execute irrigation projects, for the purpose of installing medium and large-scale irrigation facilities, in order to achieve effective and sustainable use of wetlands.

In order to evaluate the potential of the nationwide target areas, availability of the water resources, potential land resources, human resources to be engaged in agriculture, and farming experience in rice cultivation should be analysed at a master plan level, and then, feasibility studies should be executed according to the priority order given as a result of the analysis. This enables technical selection of highly prioritized areas. MWE is currently formulating an 'Irrigation Master Plan', and the result will be published in September, 2010. Also, it is said that WB has requested MAAIF to draw up a Master Plan on Water for Agriculture Production. This indicates that the respective ministries (i.e. MWE, and MAAIF) are drawing up Master Plans.

(1) Candidate Irrigation Areas Recommended by the Government of Uganda

A location map and a list of potential irrigation areas for the whole of Uganda have been presented in the Master Plan. According to the list, the project covers 64 areas in total, with an overall area of 233,083 ha. The following table and figure show the list of potential areas (Table 4.2) and the location map (Figure 4.2). These list and location map are quoted from the outcome of the Hydromet study for the baseline survey on the potential irrigation projects.

Table 4.2 List of Potential Irrigation Areas（Hydromet:1982）

Potential Irrigation According to Hydromet 1982

Object ID	Scheme Name	Serial No.	Potential Area	Water Source
			[ha]	
2	Laropi	1	858	WL
3	Oya (Rhino Camp)	2	1,350	WL
4	Alinga	3	1,500	D U
8	Acha	4	1,400	D WL
5	Anyau	5	3,128	D WL
6	Waki swamp	6	5,907	D WL
7	Lower Anyawa	7	2,385	D WL
24	Kitgum	8	1,249	D U
25	Lakara	9	400	D U
26	Kaabong	10	1,892	D U
9	Ala	11	1,048	D WL
10	Ora	12	4,392	D WL
12	Oceke (Pakwero)	13	956	D WL
27	Adilang	14	1,200	D U
28	Labwor	15	900	D U
29	Katabok	16	417	D U
30	Moroto	17	1,600	D U
13	Panyimur	18	4,951	P N
16	Koli Valley	19	6,742	WL
22	Arocha	20	5,206	WL
17	Aganga (Ibuje)	25	6,653	P N
23	Adip (Olweny)	21	6,039	WL
31	Bokora (Usuk)	22	3,764	WL
32	Akokoroi	23	14,766	WL
39	Nabilatuk	24	1,077	D U
20	Kafu	26	7,250	P N
18	Akokoro	27	8,200	P N
21	Nabiswera	28	3,325	P N
61	Katinge	29	2,685	WL
62	Okapel	30	1,155	WL
33	Omunyal	31	7,664	WL
67	Opurei	32	1,426	WL
65	Kadungulu	33	1,300	WL
37	Agu (kapiri Valley)	34	11,407	WL
34	Komolo	35	5,392	WL
35	L. Salisbury N.	36	4,300	WL
36	L. Salisbury S.	37	3,026	WL
40	Namalu	38	895	D U
47	Nakasongola	39	7,070	WL
48	Sezibwa	40	4,762	WL
60	Namasagali (Dupenere)	41	7,616	WL
56	Byero	42	900	WL
57	Malima	43	1,967	WL
66	Labori	44	2,695	WL
68	Pigire	45	1,581	WL
55	Nawaikoke	46	7,014	WL
69	Lwere Valley	47	570	WL
70	Sironko	48	1,950	D WL
71	Namatala	49	2,349	D
53	Malaba	50	2,178	D U
42	Hima (Mubuku)	51	4,215	D U
46	Kibimba Valley	52	6,012	WL
49	Biemba	53	4,273	P LV
50	Kityerera	54	9,306	P LV
51	Idokwe Bay	55	4,198	P LV
52	South Bukoli	56	9,176	P LV
41	Nyakatonzi	57	5,250	D U
43	Kihihi Flats	58	7,067	D U
45	L. Mburo	59	462	WL
44	Orichinga Valley	60	2,082	WL
14	Ayila	61	1,124	P N
72	Bugisu (sebei)	62	5,713	D WL
19	Atera	63	2,806	P N
15	Tochi Valley	64	6,285	WL
54	Doho	65	800	D WL
	TOTAL		233,083	

WL = wetland
P LV = pumping from Lake Victoria
D U = dam - upland
D WL = dam - wetland
P N = pumping from Nile

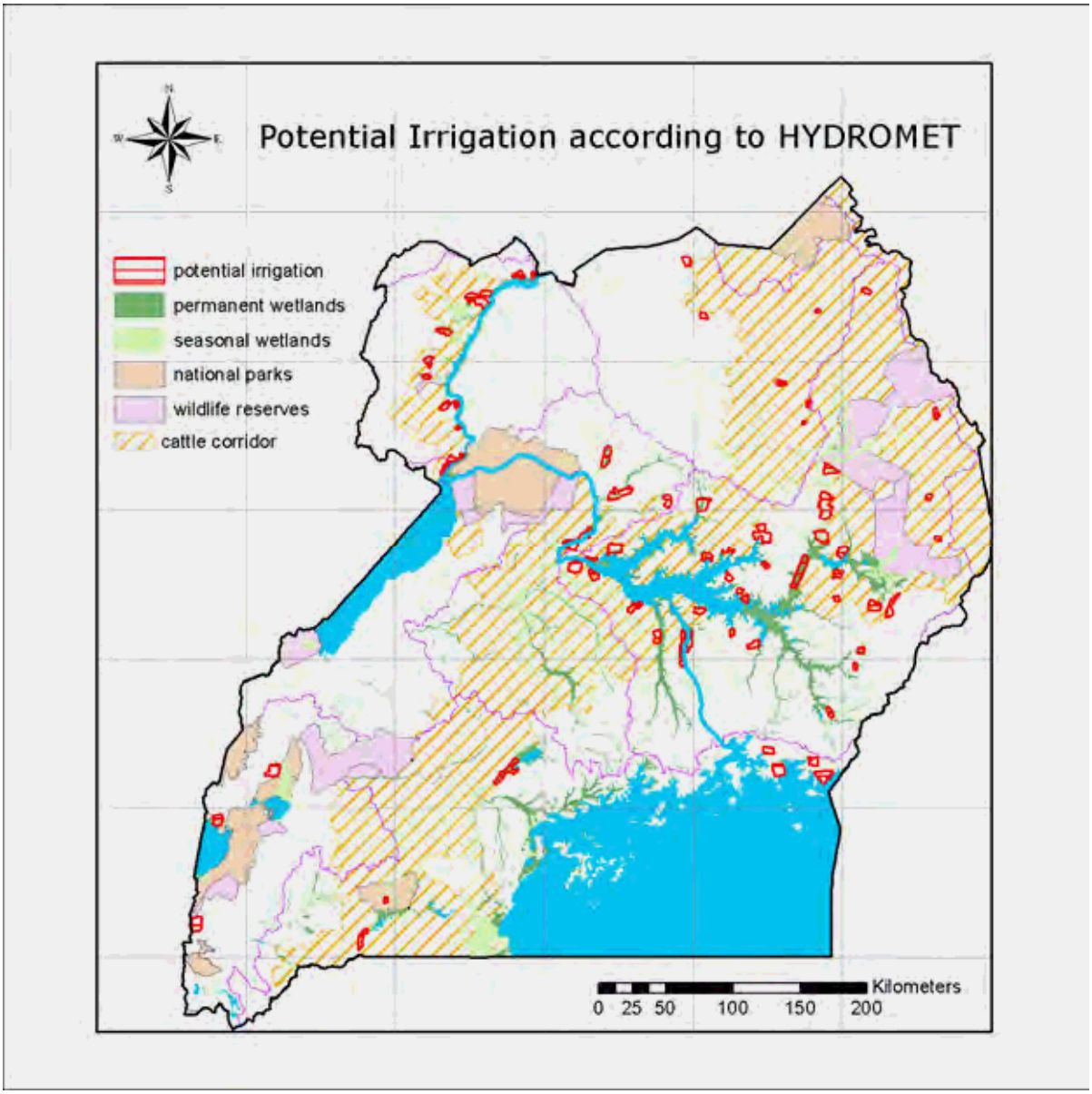


Fig. 4-2 Location Map of Potential Irrigation Areas （Hydromet）

(2) Candidate Irrigation Areas for Paddy Field Irrigation in this Study

The following Fig. 4.3 shows the list of high-potential irrigation areas. As a result, 16 schemes were selected as candidate areas with a total area of 46,080 ha.

Of these 16 schemes, this report discusses the final candidate areas in the next chapter, ‘Chapter 5 Selection of Target Candidate Areas’.

Table 4.3 Potential Irrigation Areas Surveyed by the SFIPA Team

No.	Proposed Project Site	District	Present Land Use	Estimated Acreage (ha)	Proposed Water Resources	Present Status
1	Lumbuye Swamp	Iganga	Rice	700	Dam	Private Sector
2	Igogero Swamp	Iganga	Rice	2,000	Dam	Private Sector
3	Mopologoma Swamp	Tororo/Palisa	Rice	5,000		KOICA
4	Nankwasi Swamp	Tororo/Mbale	Rice	2,500	Dam	
5	Doho Rice Scheme	Butaleja	Rice	3,000	Intake	AfDB
6	Namatala River	Mbale/Budaka	Rice	3,800	Dam	
7	Sironko River	Bukedea	Rice	800	Intake	
8	Sipi River	Sironko	Rice	400	Intake	
9	Luwere Swamp	Palisa	Rice	300	Dam	
10	Itek/Okile	Lira	Rice	650	2-Dams	AfDB
11	Aroca Swamp	Apac	Grass	10,000	Dam	
12	Okole Swamp	Apac	Grass	5,000	Dam	
13	Agoro Irrigation Project	Kitgum	Rice Vegetables	130	Intake	AfDB
14	Mubuku Irrigation Scheme	Kasese	Upland Crops	2,000	Intake	AfDB
15	Tochi River	Oyam	Grass	3,800	Intake	
16	Larwodo River	Gulu	Grass	6,000	Dam	
Total				**46,080**		

Note: SFIPA; Study for the Formulation of Irrigation Projects in Africa
The location of these Proposed Potential Irrigation Sites is shown on the front page of this report as the "Uganda Project Sites Location Map".

(3) Guidelines for Development of New Projects

Most of the paddy irrigation areas in Uganda are located in the seasonal wetlands. The wetlands are relatively narrow, in the shape of an elongated rectangle 50~60 km in length and 2~3 km in width. Due to this shape, if the irrigation canals are installed in such a way that they cover the entire irrigation area from upstream to downstream, shrinkage of the section of the irrigation canals may gradually decrease, given that the section of the irrigation canals in the uppermost reaches is large. This is not economically sound, given that the construction cost of the canals will increase especially if the project installs large culverts and bridges crossing the river tributaries. As shown in the following Fig. 4-3, in order to avoid such long and large scale development, irrigation area can be divided into several blocks at the main tributaries to reduce the irrigation water capacity of the canals. This contributes to downsizing the canal section and reducing the construction cost and enabling proper management of irrigation water and the facilities. Moreover, farmers can set up a Water Users' Association for each block, thereby not only dividing large WUCs into several medium-sized ones, but also facilitating smooth water resource management. A Water Users' Committee can be organized to manage the entire irrigation areas by selecting a representative from each block.

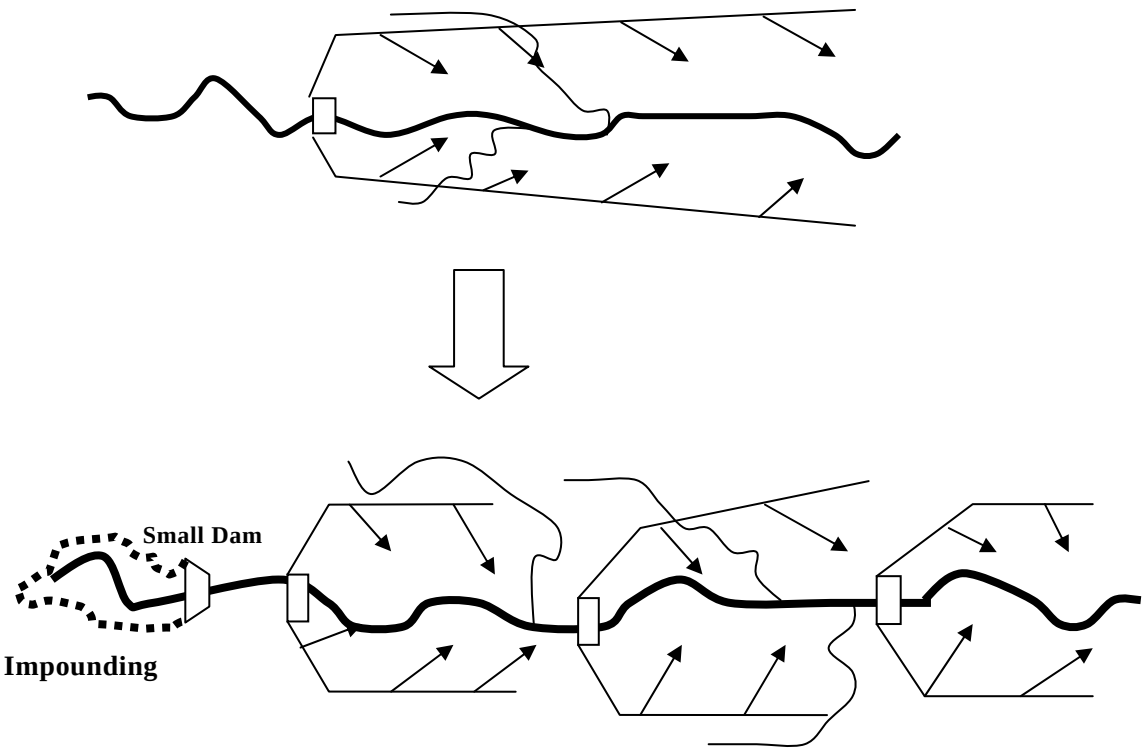


Fig. 4-2 Development Method of Wetland Area for Irrigation

(4) Measures to Install Buffer Zones for Wetland Development

One of the possible constraints in wetland development is the installation of buffer zones. As for newly developed areas, paddy fields can be cultivated so that they are outside the buffer zone. However, as in the wetlands in the eastern region of Uganda, small-scale farmers have already cultivated fields near the river. Therefore, it may be necessary to take over part of the paddy fields in order to install a buffer zone against the river. Hence, it is often said that local farmers disagree with establishing buffer zones.

When installing irrigative facilities, the irrigation canal is usually constructed higher than the wetlands, as the river level is raised by headworks and catchment dams. In this case, the irrigation canal is laid along the slope surrounding the wetlands. This makes it possible to develop a belt of agricultural land for irrigation between the edge of the wetlands and the irrigation canal. By utilising this land as an alternative for a buffer zone, it will be easier to obtain consent for the project from local farmers.

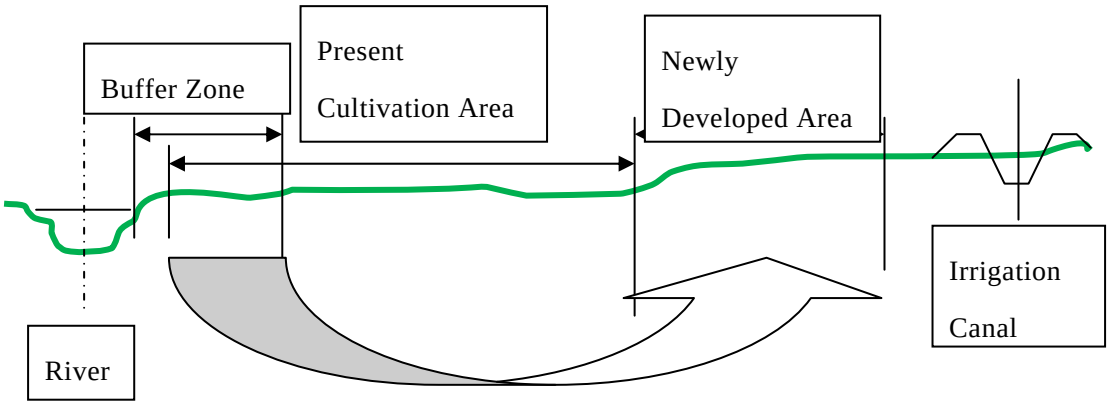


Fig. 4-3 Setting Method of Buffer Zone in Already Cultivated Wetland Area

(5) Other Checkpoints for Development of Irrigation Areas

1) Reservoir Development Program

It is difficult to predict the precipitation pattern in Uganda, since there are frequent changes in the duration of the wet and dry seasons. Hence, reservoirs should be set up in order to cover this uncertainty in rainfall, stabilize food production, and improve farmers' motivation for reliable vegetable cropping. Also, the Study Team plans to develop reservoirs including small-scale water tanks upstream for the purpose of securing a stable volume of water for wetland conservation, streamline land usage by means of the introduction of double cropping, and restrict further farming activities in the wetlands. It is therefore important to conduct a Feasibility Study (F/S) including a survey of the reservoir project, geological conditions, and socio-economic situation as well as Environmental Impact Assessment (EIA).

The following functions are expected for multipurpose use of reservoirs;

a) Flood adjustment capacity by cutting the peak flow of flood water into the reservoirs

b) Utilizing the reservoirs to supply water to surrounding communities and ensure an adequate volume of water during the dry season, and enable double cropping in the paddy fields by the supply of irrigation water.

c) Introduction of ecological hydraulic power generation utilizing the reservoir head

d) The reservoir prevents illegal intrusion into the wetlands by farmers, owing to the increased depth of water in the reservoir and substantial water level fluctuation.

e) Supply of protein by fish in the reservoirs. Especially as a social safeguard for those farmers who practice farming around the reservoir area, the reservoir offers fish cultivation as an alternative means of income generation.

2) Human Resources Development for Irrigation Technology

a) Establishment of Department of Irrigation and Drainage in University

Currently, there is no formal irrigation and drainage department in any Ugandan university, although some universities, such as Makerere University, seem to be moving towards introducing such a course. Although Busitema University offers a course in irrigation technology, there appears to be no established system for organizing a formal curriculum. Considering these circumstances, establishment of an irrigation and drainage department is required from the perspective of medium to long-term development of irrigation projects. The course should offer structural mechanics, hydrology, geological dynamics, meteorological hydrology and surveying, at the minimum, with the necessary installation of experimental facilities.

b) Training of District Irrigation Officials

Currently, there are extremely few irrigation engineers working in Uganda. There is a pressing need to train irrigation engineers who will serve as district officials and NAADS and NGO staff. Assuming that each irrigation engineer will administer some 200ha of irrigation area, 10 engineers need to be trained to administer 2,000ha. Planning of irrigation areas, consensus building among farmers, and supervision of construction by a participatory approach will be required through the project.

c) Irrigation Engineers at MAAIF/MWE

As one of the roles of the central ministry, officials should acquire higher education and technology; hence they shall be dispatched to IRRI in the Philippines, Tanzania, Kenya, and Japan when necessary. These officials shall be responsible for irrigation development both in the field and in the central government in cooperation with district officers when executing the relevant projects.

4.2.3 Existing Reservoir Rehabilitation Packages and Development of New Irrigation Projects

Most of the existing reservoirs were created to provide drinking water for livestock animals. Also, the majority of the reservoirs can store as much as 10,000 tons of water as “valley tanks”. They were originally created as small-scale reservoirs by shutting off the uppermost reaches of the wetlands. According to DWfP of MWE, some 1,000 valley tanks and 400 small-scale reservoirs are currently found in Uganda. DWfP is currently implementing rehabilitation projects and new reservoir development projects as shown in the Table 4-5.

However, the problem is insufficient collaboration between MWE and MAAIF. In line with the ministry-wide demarcation of irrigation projects, MWE undertakes construction of reservoirs while MAAIF is responsible for their use. Farmers rarely use reservoirs since they are poorly maintained. Problems of sedimentation and excessive growth of weeds in the reservoir areas prevent people from using them. An intake structure was not commonly necessary for a reservoir, because the water is mainly used as drinking water for livestock

animals, therefore farmers in the downstream area have difficulty in obtaining water from the reservoir.

Considering this situation, it may be necessary to rehabilitate or improve reservoirs with a certain storage capacity. The storage capacity might be more than 500,000 m^3 for example.

The rehabilitation works would consist of:

a. rehabilitation of dam bodies for security purposes,

b. installation of intake facilities for gravitational irrigation,

c. construction of a spillway, and

d. construction of sediment control facilities (gabions) to prevent sand from the upstream basin.

Development of irrigated farmland for both paddy and upland crops would be made possible by rehabilitating and constructing of reservoirs. Also, it would be possible to introduce fish culture in the reservoir and to utilize the water for the rural water supply when necessary.

The Study Team prepared a new list of reservoirs with a capacity of more than 300,000 m^3, extracted from the list of existing reservoirs surveyed by DWfP of MWE as shown in the Table 4-4.

In connection with reservoir rehabilitation works, detailed information of dam such as design drawings, work quantities (BOQ) and construction cost of the Leye Dam in Lira District, which was constructed last year, were collected. The data on the dam is filed in DVD attached as the separate volume.

As for future plan, there is a possibility to organize reservoirs with a storage capacity of more than 1 million m3 into one package for a grant aid project. According to the list, approximately 1,500 ha would be irrigable by rehabilitation works of 14 packaged reservoirs in Lira District.

Table 4-4 List of Existing Reservoirs With a Capacity of More than 300,000 tons

District	County	Sub-count	Facility Typ	Facility Nam	Water Volume (m3	Construction Year	Functionality	Reason for Reduced Functionality
LIRA	OTUKE	OLILIM I	Dam	Aluga	3,000,000	0	Non- functional	Silted
LIRA	OTUKE	ADWARI I	Dam	Okwongo	300,000	0	Partially functional	Silted
LIRA	ERUTE	ADEKOKWOK I	Dam	Ojungu	500,000	0	Partially functional	Other
LIRA	OTUKE	OLILIM I	Dam	Aluga	300,000	1932	Non- functional	Silted
LIRA	ERUTE	ADEKOKWOK I	Dam	Aturi	1,500,000	1940	Non- functional	Other
LIRA	ERUTE	ADEKOKWOK I	Dam	Anyira	1,000,000	1944	Non- functional	Silted
LIRA	ERUTE	AROMO I	Dam	Otara	1,200,000	1945	Non- functional	Silted
LIRA	ERUTE	BARR I	Dam	Agweng	500,000	1947	Non- functional	Silted
LIRA	ERUTE	BARR I	Dam	Alochero	2,200,000	1947	Non- functional	Silted
LIRA	ERUTE	BARR I	Dam	Aboti	2,000,000	1947	Non- functional	Silted
LIRA	MOROTO	APALA I	Dam	Awali	1,200,000	1948	Partially functional	Silted
LIRA	ERUTE	OGUR I	Dam	OPIMU	2,000,000	1948	Partially functional	Silted
KABERAMAIDO	KABERAMAIDO	KABERAMAIDO I	Dam	Agulu	1,000,000	1948	Partially functional	Silted
LIRA	ERUTE	OGUR I	Dam	Agweng	2,400,000	1950	Non- functional	Silted
DOKOLO	DOKOLO	DOKOLO I	Dam	Adagmon	1,000,000	1952	Non- functional	Silted
LIRA	MOROTO	ALOI I	Dam	Aloi ongom	3,000,000	1953	Partially functional	Pump breakdown
LIRA	MOROTO	OMORO I	Dam	Omarari	1,000,000	1958	Non- functional	Other
LIRA	MOROTO	OMORO I	Dam	Ocana	2,300,000	1958	Non- functional	Silted
LIRA	ERUTE	AROMO I	Dam	Odocha dam	1,000,000	1959	Partially functional	Silted
KABERAMAIDO	KALAKI	ANYARA I	Dam	Ojama	2,000,000	1960	Non- functional	Silted
KABERAMAIDO	KABERAMAIDO	ALWA I	Dam	Oriamo	400,000	1960	Non- functional	Abandoned
SOROTI	SOROTI	TUBUR I	Dam	ATACIA	750,000	1960	Partially functional	Other
SOROTI	SOROTI	ASURET I	Dam	OMODOI	450,000	1960	Partially functional	Silted
SOROTI	SOROTI	ARAPAI I	Dam	ARABAKA	394,000	1960	Partially functional	Other
SOROTI	KASILO	PINGIRE I	Dam	ONGIA	405,000	1960	Partially functional	Other
SOROTI	SOROTI	TUBUR I	Dam	OBILOI	625,000	1961	Partially functional	Other
SOROTI	SOROTI	ARAPAI I	Dam	OLOCHO	540,000	1961	Partially functional	Other
SOROTI	SERERE	KYERE I	Dam	OJAMA	300,000	1961	Partially functional	Other
SOROTI	KASILO	BUGONDO I	Dam	OGOLAI	562,500	1961	Partially functional	Silted
LIRA	MOROTO	ABAKO I	Dam	Ogogoro	1,200,000	1963	Partially functional	Other

Table 4-5 List of Existing Water Reservoirs and Currently Developed Water Reservoirs

No.	District	County	Sub-county	Facility	Facility Name	Water Volume (m3)	Construction Year
	OLD PROJETCS						
1	Bugiri	Bukooli	Bulesa I	Dam	Kibimba	5,000,000	0
2	Lira	Erute	Adekokwok I	Dam	Ojungu	500,000	0
3	Lira	Otuke	Olilim I	Dam	Aluga	3,000,000	0
4	Abim	Labwor	Alerek I	Dam	Kuludwong	400,000	0
5	Lira	Otuke	Olilim I	Dam	Aluga	3,000,000	0
6	Lira	Otuke	Adwari I	Dam	Okwongo	300,000	0
7	Lira	Erute	Adekokwok I	Dam	Ojungu	500,000	0
8	Lira	Otuke	Olilim I	Dam	Aluga	300,000	1932
9	Lira	Erute	Adekokwok I	Dam	Aturi	1,500,000	1940
10	Lira	Erute	Adekokwok I	Dam	Aturi	1,500,000	1940
11	Lira	Erute	Adekokwok I	Dam	Anyira	1,000,000	1944
12	Lira	Erute	Adekokwok I	Dam	Anyira	1,000,000	1944
13	Lira	Erute	Aromo I	Dam	Otara	1,200,000	1945
14	Lira	Erute	Aromo I	Dam	Otara	1,200,000	1945
15	Lira	Erute	Barr I	Dam	Aboti	2,000,000	1947
16	Lira	Erute	Barr I	Dam	Alochero	2,200,000	1947
17	Lira	Erute	Barr I	Dam	Agweng	500,000	1947
18	Lira	Erute	Barr I	Dam	Agweng	500,000	1947
19	Lira	Erute	Barr I	Dam	Alochero	2,200,000	1947
20	Lira	Erute	Barr I	Dam	Aboti	2,000,000	1947
21	Kaberamaido	Kaberamaido	Kaberamaido I	Dam	Agulu	1,000,000	1948
22	Lira	Erute	Ogur I	Dam	Opimu	2,000,000	1948
23	Lira	Moroto	Apala I	Dam	Awali	1,200,000	1948
24	Lira	Moroto	Apala I	Dam	Awali	1,200,000	1948
25	Lira	Erute	Ogur I	Dam	Opimu	2,000,000	1948
26	Kaberamaido	Kaberamaido	Kaberamaido I	Dam	Agulu	1,000,000	1948
27	Lira	Erute	Ogur I	Dam	Agweng	2,400,000	1950
28	Kiruhura	Kazo	Buremba I	Dam	Bihembe	600,000	1950
29	Kiruhura	Kazo	Rwemikoma I	Dam	Bugaya	808,000	1950
30	Kiruhura	Nyabushozi	Kikatsi I	Dam	Kanyanya	500,000	1950
31	Kiruhura	Nyabushozi	Kinoni I	Dam	Rwoburondo	480,000	1950
32	Lira	Erute	Ogur I	Dam	Agweng	2,400,000	1950
33	Dokolo	Dokolo	Dokolo I	Dam	Adagmon	1,000,000	1952
34	Dokolo	Dokolo	Dokolo I	Dam	Adagmon	1,000,000	1952
35	Lira	Moroto	Aloi I	Dam	Aloi ongom	3,000,000	1953
36	Lira	Moroto	Aloi I	Dam	Aloi ongom	3,000,000	1953
37	Lira	Moroto	Omoro I	Dam	Ocana	2,300,000	1958
38	Lira	Moroto	Omoro I	Dam	Omarari	1,000,000	1958
39	Lira	Moroto	Omoro I	Dam	Omarari	1,000,000	1958
40	Lira	Moroto	Omoro I	Dam	Ocana	2,300,000	1958
41	Lira	Erute	Aromo I	Dam	Odocha da	1,000,000	1959
42	Lira	Erute	Aromo I	Dam	Odocha da	1,000,000	1959
43	Soroti	Kasilo	Pingire I	Dam	Ongia	405,000	1960
44	Soroti	Soroti	Arapai I	Dam	Arabaka	394,000	1960
45	Soroti	Soroti	Asuret I	Dam	Omodoi	450,000	1960
46	Soroti	Soroti	Tubur I	Dam	Atacia	750,000	1960
47	Kaberamaido	Kaberamaido	Alwa I	Dam	Oriamo	400,000	1960
48	Kaberamaido	Kalaki	Anyara I	Dam	Ojama	2,000,000	1960
49	Kiruhura	Kazo	Burunga I	Dam	Kiguma Da	850,000	1960
50	Kiruhura	Kazo	Kazo I	Dam	Kamugogo	450,000	1960
51	Kiruhura	Kazo	Rwemikom	Dam	Buhembe	360,000	1960
52	Kiruhura	Kazo	Rwemikom	Dam	Katengeto	450,000	1960
53	Kiruhura	Nyabushozi	Kenshunga	Dam	Rwabigyer	600,000	1960
54	Kiruhura	Nyabushozi	Kenshunga	Dam	Rwakitura	525,000	1960
55	Kiruhura	Nyabushozi	Kikatsi I	Dam	Kiziramere	650,000	1960
56	Kaberamaido	Kalaki	Anyara I	Dam	Ojama	2,000,000	1960
57	Kaberamaido	Kaberamaido	Alwa I	Dam	Oriamo	400,000	1960
58	Soroti	Soroti	Tubur I	Dam	Atacia	750,000	1960
59	Soroti	Soroti	Asuret I	Dam	Omodoi	450,000	1960
60	Soroti	Soroti	Arapai I	Dam	Arabaka	394,000	1960
61	Soroti	Kasilo	Pingire I	Dam	Ongia	405,000	1960
62	Soroti	Kasilo	Bugondo I	Dam	Ogolai	562,500	1961
63	Soroti	Soroti	Arapai I	Dam	Olocho	540,000	1961
64	Soroti	Soroti	Tubur I	Dam	Obiloi	625,000	1961
65	Soroti	Soroti	Tubur I	Dam	Obiloi	625,000	1961
66	Soroti	Soroti	Arapai I	Dam	Olocho	540,000	1961
67	Soroti	Serere	Kyere I	Dam	Ojama	300,000	1961
68	Soroti	Kasilo	Bugondo I	Dam	Ogolai	562,500	1961
69	Lira	Moroto	Abako I	Dam	Ogogoro	1,200,000	1963
70	Lira	Moroto	Abako I	Dam	Ogogoro	1,200,000	1963
71	Kiruhura	Kazo	Buremba I	Dam	Kintagany	700,000	1997
72	Isingiro	Isingiro	Birere I	Dam	Kyera Dan	900,000	1998
73	Isingiro	Isingiro	Masha I	Dam	Katereera	1,080,000	1998
	COMPLETED						
74	Mbarara	Kashari	Rwanyamahemb	Dam	Mabira	400,000	2006
75	Ssembabule	Lwemiyaga	Ntusi I	Dam	Kakinga	5,000,000	1950 /2008
	ONGOING PROJECTS (CAPACITY >300,000m3)						
	District	**County**	**Sub-county**	**Facility**	**Facility Nam**	**Storage / Capacity (M3)**	**Year of Construction**
76	Lira		Adwari	Dam	Akwera	1,070,000	Ongoing
77	Moroto	Matheniko	Rupa	Dam	Kobebe	2,300,000	Ongoing
78	Moroto	Bokora	Matany	Dam	Arechet	5,000,000	Ongoing
79	Kaabong	Dodoth	Kaboong	Dam	Longorimit	400,000	Ongoing
80	Apac	Kole	Ayer	Dam	Leye	1,300,000	Ongoing
81	Abim	Labwor	Alerek	Dam	Kawomeri	1,200,000	Ongoing
82	Isingiro	Bukanga	Ngarama 1	Dam	Rwenjubu	358,802	Ongoing
83	Kumi	Ngora	Mukura 1	Dam	Ajamaka	470,433	Ongoing
84	Mubende			Dam	Dyangoma	346,750	Ongoing
85	Lyantonde			Dam	Makukulu	759,538	Ongoing

Chapter 5 Selection of Target Areas

5.1 Rationale for Selection of Targeted Areas

5.1.1 Selection of Candidate Project Sites

(1) Preliminary Selection

The candidate project sites are preliminary selected from the 16 sites in Table 4-2 shown in the previous section. First, judging from the selection criteria explained in Chapter 4.1-(6), areas No. 11 to No. 16, with the exception of the Agoro Irrigation Project (No.13), where the present land use is not rice cultivation, are excluded. Next, No.1 Lumbwe Swamp, No.2 Igogero Swamp and No.3 Mopologoma Swamp, where the private sector or other donors are already planning implementation of irrigation projects, are also excluded. Therefore, the initial candidates are eight (8) sites, Nos. 4 to 10 and No. 13.

(2) Existing Project Sites

Among eight (8) candidate projects, existing projects would be suitable as candidate sites because of low risk of land acquisition problems and the familiarity of the beneficiaries and government officials. Moreover, it would be easier to create an operation and maintenance (O&M) system for a rehabilitation project than that for a newly developed project.

Four (4) major existing sites have already been selected as rehabilitation project sites for the FIEFOC Project by AfDB. As discussed in previous section (1), Mubuka (No.14) project is excluded from candidate sites, the following three (3) projects are studied.

a. Agoro site

b. Itek/Okile sites

c. Doho site

In this study, higher priority is placed on larger developing areas. In this connection, the Agoro site has lower potential because of its small area and watershed

The Itek/Okile sites are used for rice cultivation with a reservoir in the upstream reach. However, the main function of the reservoir is flood control; therefore, sufficient storage capacity for irrigation cannot be expected. In addition, proposed expansion area is located in a flood prone swamp area with a poor drainage problem.

On the other hand, Doho site has the largest rice cultivation area. It requires urgent flood control measures, because of the damage caused by floods once every few years. MAAIF also strongly requests a comprehensive plan including extension area development and flood control measures.

Consequently, Doho site is selected as a candidate project site for the Feasibility Study, including area extension and flood control.

Details of this evaluation are shown in the Table 5-1.

(3) New Project Sites

As a result of evaluation of rehabilitation projects, only one project is selected. Therefore, another candidate site is selected among new project sites.

The newly developed project candidate sites are, Nos. 4, 6, 7, 8 and 9. Of these, three sites, Nos. 4, 6 and 9, have high potential with large irrigable areas as well as suitable sites for a reservoir. The order of priority is No. 6, 4 and 9 according to the size of each area, thus No.9 gets the lowest priority due to its small area. The remaining No. 4 (Nankwasi Swamp) and No.6 (Namatala River) sites are located in the south and the north of Doho site respectively. As an appropriate site for a reservoir, Nankwasi Swamp has the larger storage capacity and stable water resources. The irrigable area of each site is 2,500 ha in Nankwasi and 3,800 ha in Namatala, so Namatala has higher potential in terms of land size. High demonstration effects can be expected in Namatala, because of its location near to Mbale, the biggest city in the east. Jami/Kakoli Irrigation System, which was developed as a pilot project site under the Sustainable Irrigated Agriculture Development Project in Eastern Uganda, is located downstream of Namatala siteIrrigation water supply to the Jami/Kakoli site by gravity is possible from the Namatala River because of its elevation. The area of the Jami/Kakoli site is 20 ha, making it the biggest among the pilot projects. However, cultivation during the dry season is extremely difficult due to the poor water resources, therefore an additional water supply is greatly desired. Accordingly, No.6 Namatala River site is selected as a candidate site for the feasibility study on newly developed projects. The comparison of these potential sites are shown in the Table 5-1.

(4) Selected Project Sites

The following 2 promising potential sites are selected for nominating F/S under Japanese Government assistance.

1) Doho Integrated Irrigation Development and Flood Mitigating Projects

2) Namatala River Irrigation and Drainage Project

5.1.2 Other Potential Schemes

Apart from the potential sites discussed above, there are medium-sized paddy fields with high potential on the right side of the Sipi River, a branch of the Sironko River. Farmers' motivation is relatively high, as they have developed the area and constructed the canals by themselves. The area covers approximately 400 ha, thus the improvement works can be completed in a short time. However, there is no suitable site for a reservoir because of the steep geography upstream. Since the irrigation area is limited in proportion to water resource availability, the potential in terms of land size is not very high.

There are other existing paddy fields on the left side of the Sironko River, and farmers' hopes of irrigating the vast plains are also very high. The Sironko River has the potential to irrigate a large area because of its large catchment area. However, like the Sipi River mentioned above, it does not have a suitable site for a reservoir. Therefore, the natural flow is estimated to be capable of irrigating only 1,000 ha. The Sironko and Sipi Rivers are located in

the watershed of Lake Opeta and Lake Bisina, listed under the Ramsar Convention, so adequate EIA must be conducted.

The Larwodo River site in Gulu District is a site with high potential in the northern area. Two rivers, the Larwodo and the Lawiny, merge and flow into the Achwa River. Potential sites for a reservoir exist on both the Larwodo and Lawiny Rivers. The potential irrigation area is about 6,000 ha. The two reservoirs may be employed as water sources when necessary. However, considering that agricultural activities are hardly practiced in the area at present, it is still early to introduce irrigated rice cultivation . It is worthwhile to note that in the long run, the site in the northern region has high potential for rice cultivation .

MAAIF requested human resources development during the work on site selection. They have already submitted a request to the Japanese Government to set up a department of irrigation and drainage in Arapai College. Arapai College is under the umbrella of Busitema University. The Ministry strongly requested the establishment of such a department, as reported in the meeting records. Chapter 5.4 further describes the request.

Table 5-1 List of Candidate Projects (The Republic of Uganda)

	Candidate Project (Location)	Project Site	Budget (100million yen)	Development Organizations	Implementing Agencies	Progress	Objectives and Outcomes: Irrigation area (ha)	Objectives and Outcomes: Targeted Crops	Objectives and Outcomes: Yields	Input	Basic Condition: New/ Reconstruction/ Improvement	Basic Condition: Irrigation Methods/Facilities at the Water Resources	Basic Condition: Collaboration with WB	Basic Condition: Consistency	Basic Condition: Urgency	Basic Condition: Water Resources	Basic Condition: Management and Operation System	Basic Condition: Farmers' Associations	Basic Condition: Access	Advantages	Concerns
1	Doho Integrated and Flood Mitigation Project	Butaleja District Tororo District	20 IRR=26%	AfDB	MAAIF	AfDB/ FIEFOC	3,000	Paddy Crop	Currently 2t/ha Plan 6 t/ha	Reconstruction of approximately 1,000 ha of irrigation areas will be executed by AfDB. Newly constructed head works for integration in reservoir district at the upstrem. New driving channels, settling basins and cocrete lining are required.	Reconstruction	Gravity Irrigation・(totally controled) Newly constructed integrated head works ◎	Collaboration with WB	◎	◎	◎	◎	◎	○	By integrating Luoba district, where people currently catch water from the upstream of Doho district, the project can solve issues around water-intake. The project can mitigae influence of flood drascally, and contributes to stabilize regional agricultural yields.	It might be required to confirm the implementing conditions for reconstruction, due to unclear reconstruction components of the initial project site executed by AfDB.
2	Namatara River Irrigation and Drainage Project	Mbale District Budaka District	62.3 IRR=17%	Undecided	MAAIF/ MWE		3,800	Paddy Crop	Currently 0.5t/ha Plan 5 t/ha	Newly constructed dams (storage capacity: 25million tons) at upstrem and new head works. Construction of irrigation water canals on the both sides of embarkments, major drainage canals, and experimental fields at the end of the stream are required.	Newly construction	Gravity Irrigation・(totally controled) Newly constructed dam Newly constructed head works ◎	×	○	◎	◎	○	○	○	It is relatively facile to introduce paddy crops in Mubare, a major city of Uganda, since paddy fields have already been spread in the region.	Namatara River holds rich flow from Mt. Elgon. On the other hands, the river frequently overflows in flood. It is therefore prerequisite to construct flood control levees along the river. Construction of drainages and levees shall be executed as bufferzones in parallel.
3	Nankwasi Swamp Irrigation and Drainage Project	Tororo District		Undecided	MAAIF/ MWE		2,500	Paddy Crop	Currently 0.5t/ha Plan 5t/ha	Development of new dams (storage capacity: 50million tons) at the upstream of rivers and new head works are constructed. Irrigation water canals on the both sides of embarkments, major drainage canals, and experimental fields at the end of the stream are constructed.	Newly construction	Gravity Irrigation・(totally controled) Newly constructed dam Newly constructed head works ◎	×	○	○	○	○	○	◎		
4	Sipi River	Sironko District	2.4	Undecided	MAAIF		400	Paddy Crop	Currently 0.5t/ha Plan 5t/ha	Construction of newly constructed head works, major irrigation water canals and drainage canals are required.	Newly constructed	Gravity Irrigation・(totally controled) Head works ◎	×	○	○	○	○	○	×		
5	Sironko River	Sironko District	5.0	Undecided	MAAIF		800	Paddy Crop	Currently 0.5t/ha Plan 5 t/ha	Newly constructed head works/ introduction of major irrigation water canals anddrainage canals and flood control levees are required.	Newly construction	Gravity irrigation・flood control levee Head works ○	×	○	○	△	○	○	×		

Note;
MAAIF : Ministry of Agriculture, Annimal Industry and Fisheries
MWE : Ministry of Water and Environment
FIEFOC : Farm Income Enhancement and Forest Conservation project by AfDB
AfDB : Africal Development Bank
IRR : Internal Rate of Return

5.2 Development Plan of Candidate Sites

5.2.1 Doho Integrated Irrigation and Flood Mitigation Project

(1) Present Situation

The project has various problems such as irrigation facilities, operation and farmers' organization as mentioned in the chapter 3, section 3.2.1.

Recent field survey revealed that the water users' association was reorganized and the problem of the chairman was also solved. A new chairman was elected and he started to reorganize the association. He first divided the existing 6 blocks into 10, each with a chairman and administrative unit. The aim is to organize a users' association for each block and ensure that it functions well. The farmers around the Doho have also organized a chairman and administrative unit. Therefore, efforts to solve the problems related to water use are being made through the creation of a committee of all the users' associations and the involvement of farmers' groups.

On the other hand, farmers are interested in rice cultivation since it offers high productivity. Thus, they tend to randomly develop land and use water without any permission. The Doho Irrigation System is the only large-scale irrigation system owned by small-scale farmers in Uganda. Therefore, It is extremely important to rehabilitate the project along with the surrounding area ,giving the Doho area a position as a model project of paddy field irrigation. The Study Team proposes the following project with additional training programs, in the hope of achieving proper management and improving rice cultivation techniques.

Given that there is no land map with an adequate level of accuracy which covers the entire target area, the project will create a contour map with 1m contour intervals on a scale of 1:5,000 by aerial survey before conducting the F/S. The survey area shall cover around 5,000ha, including the area subject to flooding.

(2) Points of Concern for F/S

1) In order to avoid future conflict over water usage and to efficiently use water resources, a work plan shall be designed to reorganise the facilities for an integrated area including not only Doho District but also Luoba District.

2) In order to achieve this, the Study Team will attempt to consolidate intakes, and improve irrigation efficiency by installing a settling basin along the head race and constructing a lined main canal to reduce both maintenance costs and labour.

3) The area of the target irrigation area shall be determined by referring to the results of the hydrological balance study according to the flow data of the Manafwa River. The project might cover an irrigation area of approximately 3,000ha.

4) The Study Team shall conduct a survey of the severity of flooding by the Manafwa River in order to take measures for mitigation of flood damage.

5) As for the farmers' associations and water users' associations, the project will support consolidation of the existing associations and formulation of an enforceable contract

for water users' associations in the integrated target areas. Also, for the purpose of environmental preservation of the wetlands, this project shall draw up a CWMP and establish a Wetland Management Association to be registered with NEMA.

6) An aerial survey shall be conducted to grasp the entire land conditions for creation of a cadastral map, and EIA shall also be conducted. At the same time, the required documents shall be prepared to acquire permission from NEMA to implement the project so that the WUC can register their rights of water usage.

7) In order to implement water management within the project area and efficient management of the water users' association by the farmers, O&M office shall be constructed and a water management centre shall be established in the office.

8) For the purpose of training and disseminating techniques to farmers and irrigation engineers in the project area, training in irrigation and drainage shall be implemented by constructing a training room with AV facilities in the water management centre. Training shall also be provided for students who take the irrigation and drainage course to be established at an university.

(3) Work Content

1) Collection of basic data and study of present conditions:

An additional survey shall be conducted, utilizing the aerial survey results of the target area. Based on the survey map, a cadastral map shall be created and the current state of the irrigation and drainage system shall be investigated and grasped. Referring to the cadastral map, the Study Team shall study detailed information on the landowners, tenant farmers and arable area, and the amount of water users' fees collected. Also, rainfall stations and gauging stations shall be established. In addition, monitoring of suspended sediment shall be carried out continuously.

2) Agro-economy survey by scale of land ownership

3) Water balance study:

The potential irrigable area for double cropping would be estimated as a result of water balance study conducted between irrigation water demand and available water supply which is calculated by probability analysis utilizing discharge records of the Manafwa River and rainfall records. To evaluate the influence of irrigation on the surrounding environment, a monitoring system, and the required equipment necessary for execution of the project shall be considered by conducting water and soil surveys. Also, a legal system for water rights shall be considered and water rights in the newly developed irrigation area shall be registered. The irrigation area shall be confirmed and the extent of the beneficiary area clarified by the registration of water rights.

4) Food damage survey:

A study shall be conducted of the severity of damage to agricultural land, residences, and roads downstream caused by flooding of the Manafwa River.

5) Plan of flood mitigation measures

The Study Team shall formulate a rehabilitation plan for flood prevention measures for the Manafwa River, and measures to mitigate flood damage, taking into consideration flood channels and the effects to downstream area. Also, the possibility of construction of flood control dams in upstream reaches shall be considered.

6) Comprehensive layout plan for irrigation:

A new layout shall be drawn up for comprehensive measures against floods and an orderly irrigation system, taking into account the existing headworks and intake structure, the head race of the Doho, the channels in the surrounding .

7) Environmental Impact Assessment (EIA) :

A plan for wetland use shall be drawn up and a Wetland Management Committee shall be set up. And then, EIA shall be conducted and the Wetland Management Committee shall be registered with NEMA.

8) Plan for development of an irrigation drainage system and Estimation of the design and construction cost of the facilities

9) Support for establishment of Water Users' Committee (WUC)

A Water Users' Committee shall be established and rules drawn up; in particular, punitive clauses shall be decided with the water users. The management structure of the entire district and demarcation of the roles of the officials shall be established. With respect to the reorganization of the Water Users' Association, a participatory workshop for farmers shall be held to create agreement on the management structure and management regulations.

10) Training in water management for WUC personnel responsible for water management and also for irrigation engineers in charge of management of Doho District

11) Cost-benefit estimation and economic and fiscal analysis shall be conducted, and a feasibility study shall be carried out.

12) A database on water management within the project area and the situation of collection of water users' fees shall be created. Also, the management offices shall be reconstructed taking into consideration the construction of an audio and training rooms.

13) Human resources development and strengthening of the related associations shall be continuously conducted mainly through *On the Job Training* during the proposed study period.

(4) Allocation of Study Members and Input of Equipment and Facilities Input by Japan Side:

Dispatch of Consultant Team:

1) Project Manager (Irrigation Planning), 2) Hydrology (Hydrological balance),

3)Agriculture/Paddy crop cultivation, 4) Agro-economy, 5) Farmers Association/ Institution building, 6) Environmental Impact Assessment, 7) Construction (Water Management Offices with training rooms) 8) River engineering and planning of measures against floods, 9) Construction of facilities and cost estimation, 10) Project Assistant

Equipment and facilities:

Equipment for rainfall observation, equipment for water level observation, equipment for monitoring water quality, GPS system, and lease of transportation

Input by recipient country:

Supply of data required for the project, establishment of steering committee, organization of stakeholder conference, allocation of counterparts, coordination with related organizations and private firms, provision of field office for the study team, provision of various administration services (telephone line, driver, secretary), and coordination among related agencies and stakeholders.

(5) Estimated Project Cost

The estimated project cost is roughly divided into an irrigation component and a flood mitigation component:

1) Irrigation Component
   - Construction of new headworks
   - Construction of settling basin for new head race in upper reaches of the river (length: approx. 4km)
   - Installation of water channel to headworks on main canal in Luoba (length: 1km)
   - Lining of main canal with concrete (length: 10km)
   - Construction of 20 diversion gates for secondary canals
2) Flood Mitigation Component
   - Widening of existing head race as a flood way of the Manafwa River, and construction of a spillway at an upstream site of the diversion works (length: 5km)
   - Construction of a wasteway and a diversion channel to take peak floodwater from upstream reaches of the new headworks to lower reaches (approx. 11km)
3) Construction of project management office with training rooms

(6) Estimated project cost

The cost estimation was carried out for the two major components, the irrigation component and the counter-flood component, respectively.

The direct construction costs were estimated at the equivalent of two billion yen, as shown in the table below, on the basis of the construction unit prices of similar projects in the surrounding area.

The foreign exchange rates used in the project cost estimation are:

US$ 1 = Yen 85 = UGX 2,000.

Table 5-1 Cost Estimation for the Doho Irrigation Project

Expenditure item	Amount (US$)	Remarks
I Irrigation component 1. Head works	596,371	
2. Construction of a water channel to the main canal on the right bank (4 km)	1,047,123	
3. Settling basin	21,162	
4. Main canal on the right bank (10 km)	1,083,690	
5. Installation of diversion works	36,000	
6. Water channel to the main canal on the left bank (1 km)	220,275	
7. Paddy development	2,250,000	
II. Counter-flood component 1. Repair of the existing channel	1,080,000	
2. By-pass Drainage (11 km)	5,227,200	
3. Diversion gates	808,875	
4. River channel widening	6,969,600	
III. Administration Building	135,000	
Sub-total (Direct construction costs)	19,475,295	
Contingency	1,947,530	10% of the direct construction costs
Construction supervision costs	973,765	5% of the direct construction costs
Sub-total	2,921,295	
Engineering costs	973,765	5% of the direct construction costs
Total	23,370,354	2 billion yen

Note: Estimated by the Study Team

(7) Operation and maintenance costs

In the estimation of the operation and maintenance costs, the annual expenditure was assumed at 3 % of the direct construction costs. In addition, it was assumed that an additional expenditure of 1% of the direct construction costs was required every 30 years as the replacement costs.

Table 5-2 Operation and maintenance costs (Unit: US$)

	Direct construction costs	Ratio	Maintenance costs
Annual expenditure	19,475,295	3.0 %	584,259
Replacement costs		1.0 %	194,753

Note: Prepared by the Study Team

(8) Project benefits

Agricultural income from the paddy fields of 1,000 ha to be developed, the existing paddy fields of 2,000 ha, and flood-prevention effects expected from the improvement of drainage were assumed as the benefits of this project.

The design yield of 6.0 ton/ha and the rice polishing ratio of 65 % were used in the estimation. It was assumed that rice would be raised twice a year in all paddy fields. The current yield of the existing paddy fields was assumed at 2.0 ton/ha and the yield was expected to increase to 6.0 ton/ha after the completion of the construction works.

It was assumed that the improvement of drainage would increase the yield of the rainy season crops by 1.0 ton/ha.

Meanwhile, the price of rice in the international market and the production costs were assumed at 450 US$/ha and 20 % of the price, respectively, in the estimation of the economic internal rate of return (EIRR).

Table 5-3 Economic benefit estimation (Unit: US$)

	Planted area (ha)	Uield of polished rice (ton/ha)	Harvest of polished rice (ton)	Price of rice	Benefits
Rainy-season paddy rice	3,000	3.9	11,700		4,212,000
Dry-season paddy rice	3,000	3.9	11,700		4,212,000
Rainy-season paddy rice in the existing paddies	2,000	1,3	2.600	360	-936,000
Dry-season paddy rice in the existing paddies	2,000	1,3	2,600		-936,000
Effects of the flood-prevention	3,000	0.65	1,950		702,000
Total					7,254,000

Note: Prepared by the Study Team

(9) Internal rate of return

The internal rate of return was calculated with the following assumptions:

- The project life was assumed at 30 years in consideration of the actual situation.
- The construction period was assumed at six years.

- Achievement of 100 % of the benefits was assumed immediately after the completion of the construction work.
- In the estimation of EIRR, the economic costs were calculated by multiplying the amount obtained by deducting the contingency from the finance costs by an arbitrary conversion rate of 0.85.

For this project, only EIRR was estimated because of the large proportion of the contingency for price increase. The result of the estimation is shown below:

EIRR = 20 %

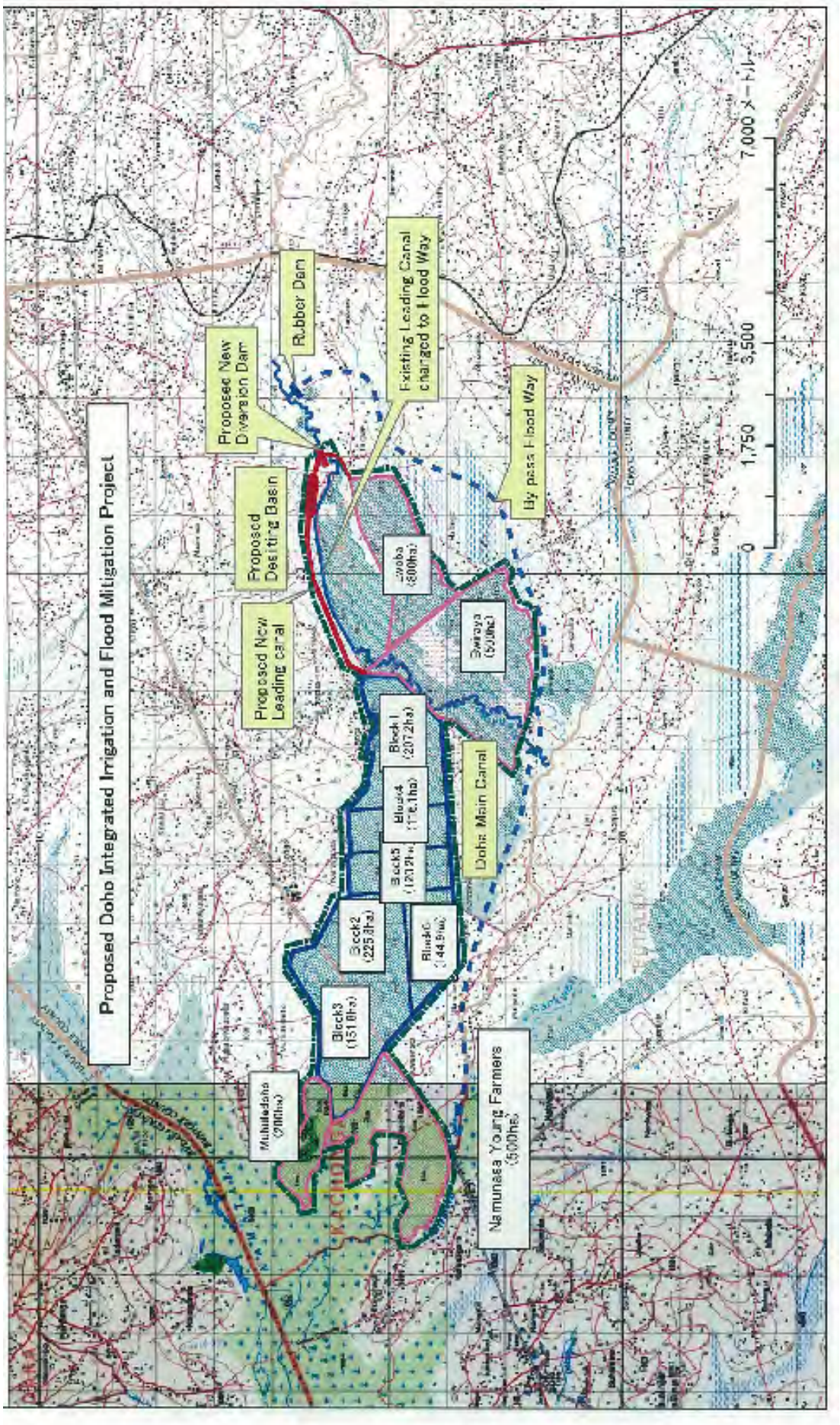


Figure 5-1 Proposed Doho Integrated Irrigation and Flood Mitigation Map

5.2.2 Namatala River Irrigation and Drainage Development Project

The Namatala River enjoys abundant water resources from Mt. Elgon (peak elevation: 4,321m). The catchment area at the gauging station at Kumi Road is 123.6 km^2. However, at a candidate point for the headworks located downstream, there is a substantial volume of water coming into the headworks from the rest of the basin (approximately 200sq.km). A considerably large rice cultivation area extends in the upper reaches of the Nalamata River, indicating that rice cultivation techniques acquired in the Jami/Kakoli Pilot Project have been diffused over an extensive area. The Study Team expects early effects from the introduction of rice cultivation techniques in future.

There is a narrow section of river suitable for the dam site in the upper reaches. Proposed dam this site would have a high potential for hydroelectric power generation due to its prospective high dam height. Estimated amount of power generation would be approximately 750 KW.

The headworks would be located at downstream reaches from the railway line, and irrigation canals would be taken from both banks. Proposed project works are summarised below.

(1) Outline of the project

The area benefiting from the project is estimated at approx. 3,800 ha.

Water resource facilities

Dam: H = 60m, Storage capacity: V = 25 million m^3

Head works

Main canal on the left bank: Length: 22.3 km

Main canal on the right bank Length: 13.4 km

Construction of drainage for establishment of a buffer zone: 15.0 km

Paddy Development: 3,800 ha

(2) Total project cost

The direct construction costs were estimated at an equivalent of four billion yen, as shown in the table below, on the basis of the construction unit prices of similar projects in the surrounding area.

The foreign exchange rates used in the project cost estimation are

US$ 1 ＝ Yen 85 = UGX 2,000

Table 5-4 Cost estimation for the Namatala Irrigation Project

Expenditure item	Amount (US$)	Remarks
1. Dam	25,902,000	
2. Head works	1,547,247	
3. Construction of the main canals (13.4 km)	526,500	
4. Construction of the main canal on the left bank (22.3 km)	3,586,950	Including perforated flumes
5. Construction of drainage and embankment (15 km)	2,079,000	
6. Paddy development (3,800 ha)	3,420,000	
7. Hydropower generation facilities (750kW)	1,800,000	
Sub-total (direct construction costs)	38,861,697	
Contingency	3,886,170	10% of the direct construction costs
Construction supervision costs	1,943,085	5% of the direct construction costs
Sub-total	5,829,255	
Engineering costs	1,943,085	5% of the direct construction costs
Total	46,634,036	4 billion yen

Note: Estimated by the Study Team

(3) Operation and maintenance costs

In the estimation of the operation and maintenance costs, the annual expenditure was assumed at 3 % of the direct construction costs. In addition, it was assumed that an additional expenditure of 1% of the direct construction costs was required every 30 years as the replacement costs.

Table 5-5 Operation and maintenance costs (Unit: US$)

	Direct construction costs	Ratio	Maintenance costs
Annual costs	38,861,697	3.0 %	1,165,851
Replacement costs		1.0 %	388,617

Note: Prepared by the Study Team

(4) Project benefits

Agricultural income from the existing paddy fields of 3,800 ha, flood-prevention effects expected from the improvement of drainage and the revenue expected from the hydropower generation (750 kW) were assumed as the benefits of this project.

The design yield of 6.0 ton/ha and the rice polishing ratio of 65 % were used in the estimation. It was assumed that rice would be raised twice a year in all paddies. The yield in the existing

paddies was estimated at 0.5 ton/ha only for the rainy-season crops and it was expected to increase to 6.0 ton/ha after the completion of the construction works.

It was assumed that the improvement of drainage would increase the yield of the rainy-season crops by 1.0 ton/ha.

Meanwhile, the price of rice in the international market and the production costs were assumed at 450 US$/ha and 20% of the price, respectively, in the estimation of the economic internal rate of return (EIRR).

It was assumed that hydropower was to be generated 300 days per year and the rate was assumed at 0.1 $/kWh.

Table 5-6 Economic benefit estimation (Unit: US$)

	Planted area (ha)	Yield polished rice (ton/ha)	Harvest of polished rice (ton)	Price of rice	Benefit
Rainy-season paddy rice	3,800	3.9	14,820		5,335,200
Dry-season paddy rice	3,800	3.9	14,820	360	5,335,200
Existing paddies	3,800	0.325	1,235		-444,600
Flood-prevention effects	3,800	0.65	2,470		889,200
Revenue from the hydropower generation	750kW		5,400,000 kWh	0.1$/kWh	540,000
Total					11,655,000

Note: Prepared by the Study Team

(5) Internal rate of return

The internal rate of return was calculated with the following assumptions:

- The project life was assumed at 30 years in consideration of the actual situation.
- The construction period was assumed at six years.
- Achievement of 100 % of the benefits was assumed immediately after the completion of the construction work.
- In the estimation of EIRR, the economic costs were calculated by multiplying the amount obtained by deducting the contingency from the finance costs by an arbitrary conversion rate of 0.85.

For this project, only EIRR was estimated because of the large proportion of the contingency for price increase. The result of the estimation is shown below:

EIRR = 17 %

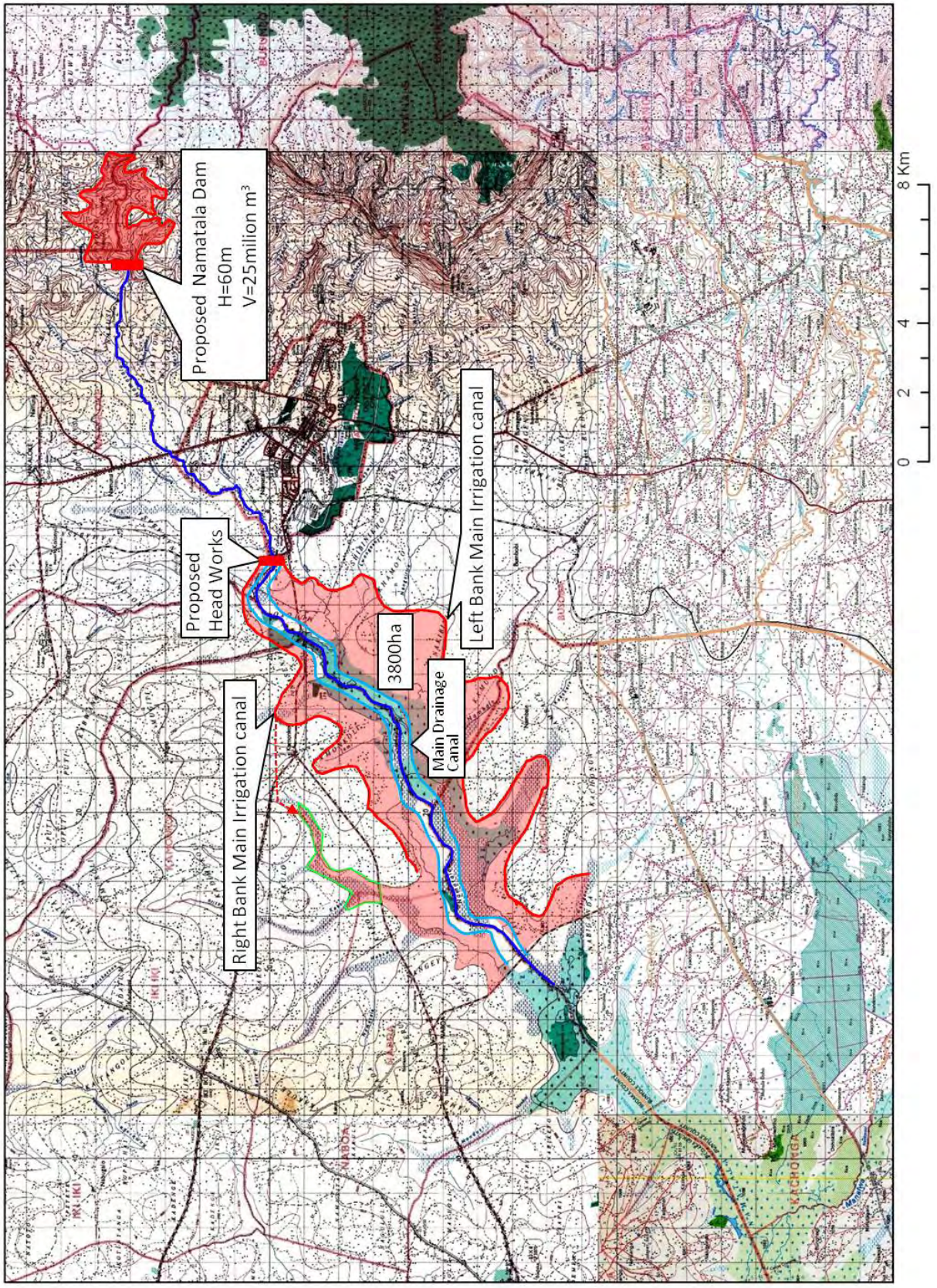


Figure 5-2 Proposed Namatala Irrigation and Drainage Project Map

5.3 Plans for Projects in Other Potential Irrigation Areas

5.3.1 Nankwasi River Irrigation and Drainage Development Project

The Nankwasi River, which originates from Mt. Elgon, provides an abundant amount of water throughout the year. There is a suitable site for a dam upstream of the Mbale-Tororo Road.

Paddy fields already extend downstream and farmers excavated irrigation canals in some places to implement small-scale irrigation. The volume of water increases during the wet season and therefore the Study Team is considering adding a flood control function to the reservoir to mitigate flood damage. The target irrigation area is approximately 2,500ha.

Proposed project works are as follows and the layout plan is presented in Fig. 5-3.

Water Resource Facilities
Dam (length: 1.5 km, height: 10m)
Headworks (2 nos.)
Irrigation drainage facilities
Main irrigation canal on the left bank
Main irrigation canal on the right bank
Development of main drainage canal to create a buffer zone

Figure 5-3 Layout Plan of the Nankwasi River Project

5.3.2 Sipi River Right Bank Irrigation and Drainage Development Project

Bunamono irrigation area located on the left bank of the Sipi River in Muyembe Sub-county was a pilot site with an area of 17 ha for the Sustainable Irrigated Agriculture Development Project in Eastern Uganda in 2003-2006., Construction of the irrigation facilities was completed with farmers' participation when the area was developed. Farmers who established paddy fields by themselves were also included among the participants in the work. They played a central role in developing the 80 ha irrigation area on the right bank of the Sipi River. They dug about 100 m of irrigation canals and surrounded the paddy fields with dykes.

The Sipi River can supply water for irrigation throughout the year, and the potential irrigation area is approximately 254 ha. Water intake facilities will be installed with a 100 m-wide buffer

zone from the river, and the farmers who are currently cultivating fields in the zone will shift inland.

The Sipi River needs a 100m-wide buffer zone because the river is designated as a specific river to be protected by the standards of NEMA. The Sipi River is located in the basin of Lake Opeta and Lake Bisina which are listed under the Ramsar Convention held in Uganda. It is important to clarify the impact of irrigation development on the environment.

5.3.3 Sironko River Left Bank Irrigation and Drainage Development Project

The basin area of the Sironko River is 265.0 sq.km^2 at the water gauging station which was set up at the end of Moroto Road. Rice cultivation is already practiced in the flood plain located in Bukedea District on the left bank of the Sironko River.

The Sironko River discharge would be able to irrigated approximately 1,000 ha because of its large catchment area. The following Fig. 5-4 shows the possible irrigation area map, which covers roughly around 2,700 ha. In a future study stage, it is necessary to select a suitable location for new headworks and irrigable area of 1,000 ha.

The Sironko River is also designated according to the standards of NEMA and it requires the setting up a buffer zone of 100 m in width. Like the Sipi River, the Sironko River is located in the basin of the two lakes, which are listed under the Ramsar Convention. Taking this into account, EIA should be implemented.

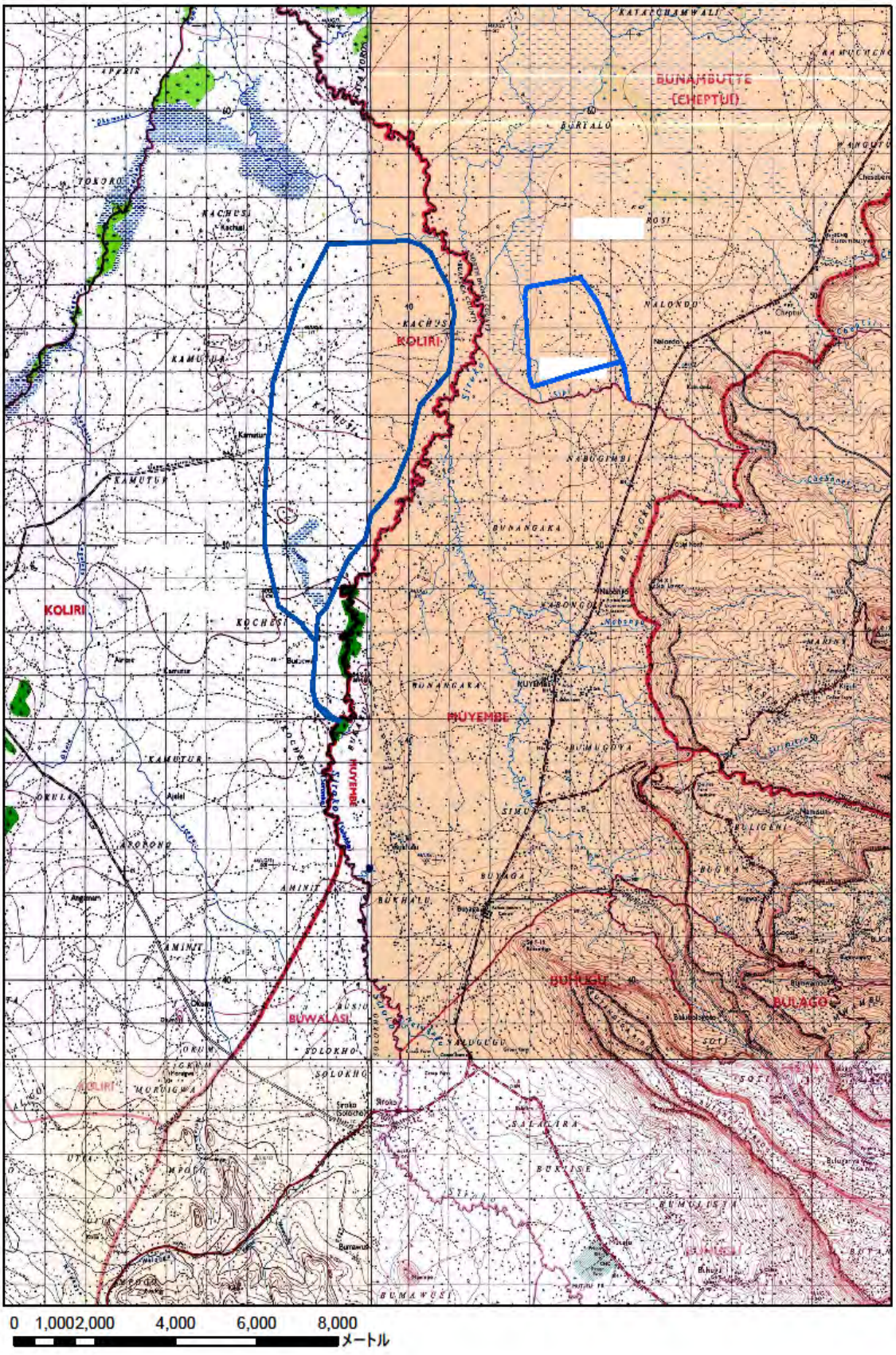


Figure 5-4 SIRONKO District SIRONKO RIVER & SIPI RIVER

5.4 Establishment of Irrigation and Drainage Course in Busitema University

Busitema University, as recorded in the meeting report, is the largest agricultural university in Uganda. It is a multi-campus university affiliated with Arapai Agricultural College in Soroti City. MAAIF also desires the setting up of an irrigation and drainage course. The request for the establishment of the course in Arapai College was already submitted to Japanese government in July 2009.

Under this circumstances, an interview survey was conducted on the status of Busitema University and the scale of workshops. Based on the results of this survey, the Study Team exchanged opinions with Mr.Okasai, the Director of Crop Production of the MEA.

While Arapai College only confers diplomas, Busitema University can confer academic degrees. Besides, Busitema University has ample space for a workshop building and it stands on an extensive site. Therefore, the irrigation and drainage course including supply of equipment and experiment facility would be set up in Busitema University, and the students who graduate from the course would receive a degree. Moreover, an irrigation and drainage course would also be set up in Arapai College to train technicians, and students who graduate from the course would receive a diploma or certificate.

JICA can support the dispatch of three experts to the university and college for 2~3 years to transfer knowledge and skills as shown below.

- Formulation of curricula, training of teachers, proposal of course content, preparation of textbooks, installation of experiment facilities and equipment, and instruction in how to use them
- Basic courses: hydraulics, soil mechanics, structural mechanics, climate hydraulics and surveying. Applied engineering courses: irrigation engineering, drainage engineering, river engineering, hydrologic analysis, water management, water source facility design (dams, water intake structures, pumps, drainage pumps), canal engineering, field maintenance, field irrigation, pipelines, etc.

  A system of practical education will be established in the university and the college.
- For experiments and training, equipment for surveys, triaxial compression tests, concrete compressive strength tests and hydraulic experiments will be installed, and lectures on methods of using the equipment will be provided.
- After finishing the improvement project for the Doho irrigation area, training in water management in end-fields will be given to students.

ANNEX

U-1 Summary of Discussions with Related Agencies

1.1 Ministry of Agriculture Animal Industry and Fisheries（MAAIF）

Date and Time	June 10, 2010　15:00 - 18:00
Place	MAAIF
Interviewee	Mr. Okaasai Opolot (Director of Crop Resources) Mr. Sanday Mutabazi (Commissioner Farm Development) Mr. Torachi H. Ben (Principal Irrigation Officer)
Interviewer	Toshimasa Kobayashi (JICA Team Leader), Yusuke Haneishi (MAAIF Expert)
Interview purpose	Potential irrigable area
Submitted material	Inception Report, Outline layout of irrigation candidate site（1/50,000 topographical map）
Obtained material	Efficient Water Use for Agricultural Production (EWUAP) Project (4 books)
Contents of the interview	
1. MAAIF and MWE	1. The Study team explained the content of Inception Report about the Objectives of the Study and the schedule, etc. 2. How is the irrigation program of FIEFOC of AfDB executed? ✧ We execute it as the Agriculture Component Irrigation Sub-sector. ✧ Original area in four districts of Doho, Mubuku, Olweni (Itek & Okile), and Agoro shall be rehabilitated in the Rehabilitation Projects. ✧ Both of MAAIF and MWE are engaged as the executing organization of FIEFOC. NARO and NAADS are cooperating with them. 3. How is the demarcation between MAAIF and MWE regarding to the irrigation project? ✧ It is considered that MWE manages from the water resource facilities to the main canal as the Off-farm, and on the other hand, MAAIF manages the canals inside the farm and the farm as the On-farm. ✧ MAAIF is applying for the organizational reformation at present. The department for agricultural facilities and water that takes charge of the irrigation project will be established. ✧ MAAIF executes rehabilitation in six places and medium-scale irrigation projects in five places according to the content shown in the five-year plan of DSIP (Development Strategy and Investment Plan 2010/11 to 2014/15). 4. What extent of the content does the FIEFOC execute for the rehabilitation concretely? ✧ The rehabilitation of the existing part and the improvement of the irrigation association are scheduled to be executed in the Doho district. ✧ The personal district in the upstream and peripheral out-grower will be excluded. ➢ Is it possible for JICA to execute F/S intended for the whole including the personal district in the upstream and peripheral out-grower? Moreover, should JICA obtain the approval of AfDB for this? ✧ If JICA executes it, it is very welcome. Because FIEFOC Project is Loan Project and MAAIF decides the content of execution, AfDB's approval is not needed. ✧ In Doho district, the flood is the big problem. To solve this problem, it is necessary to construct an artificial lake to preserve the floodwater in the part of upstream.

	Moreover, the president plans to visit the Doho district on June 19. ➢ It is necessary to set up the O&M office in the Doho district. JICA proposes the training for the irrigation engineers as the capacity building using the facilities there. ✧ It is a good idea to introduce the irrigation course in the university, and to execute the site training in Doho. 5. JICA Study Team indicated Iganda District: Igogero wetland (2,000 ha), Iganga District: Lumbwye wetland (550 ha), Sironko District Sipi River (300 ha), and Bukedea District: Sironko River Left Side (2,700 ha) as the new irrigation candidate area. ✧ It is very timely to include Sironko District, because the president and ministers have indicated to prepare the irrigation area in the area. ✧ In Iganga District, The Pearl Rice and the construction company Spencom are applying the rice cultivation at present, so it is necessary to check the site. If they are the same sites as JICA's indication, it is necessary to exclude them.（According to the information from MAAIF dated on June 15, Igogero wetland and Lumbwye wetland in Iganga District are the same as they are applying. Therefore, these wetlands should be excluded from the candidate irrigation area.） ➢ JICA has a little uneasiness in the execution of F/S without judging the priority of the target area, because these areas shall be newly developed. ➢ Therefore, as the Ugandan government has suggested in the application form, M/P study that targets the whole state should be executed first, and in the process, the high priority area shall be selected and F/S study should be planed. ✧ Because MWE has already submitted the Irrigation Master Plan, it may not be suitable to use the word of Master Plan. MAAIF plans to execute the study as "DSIP Implementation Plan for Water for Agriculture Production" to promote DSIP execution. ➢ JICA is examining the water balance of water resources in each water system in the management plan of Lake Kyoga catchment area now. Including this result to the entire irrigation master plan that will be made by the ministry of agriculture, it is possible to examine the water balance of the water resources concerning the agricultural water of a nationwide base including other catchment area than the Kyoga lake valley. High priority area shall be selected from among them, and the F/S to them shall be considered. ✧ Regarding setting up the irrigation course in the university as the capacity building, the Alapai Collage of Soroti is now being on the consideration. However, because the Alapai Collage is not a university, it can grant only the diploma certification. However, the degree can be granted in Busitema Agricultural University that exists in Tororo.

1.2 Ministry of Water and Environment（MWE）

Date and Time	June 11, 2010 09:00 - 11 :00
Place	Ministry of Water and Environment – Directorate of Water Development, Department of Water for Production (WfP)
Interviewee	Eng. Richard Cong(Commissioner of WfP)

	Mr. John Twinomujuni (Assistant Commissioner of WfP)
Interviewer	Toshimasa Kobayashi (JICA Team Leader), Yusuke Haneishi (MAAIF Expert)
Interview purpose	Irrigation potential area
Submitted material	Inception Report,
Obtained material	1. Approved Structure of the Ministry of Water and Environment (25th June 2007) 2. Cabinet : Mandates, Functions and Structures of the New and Reorganized Office, Ministries and Department 3. Organization structure of Water for Production Department/MWE-July 2007
Contents of the interview	
Potential Irrigation Area	✧ Concerning Agriculture and Infrastructure, following sites are being considered. ✧ AfDB is planned to execute rehabilitation in the Mubuku Irrigation Scheme (Phase-II) at present, however, because there is area, which can be expanded around the site, other donors can execute the scheme as Phase-II. ✧ Because the safety hazard has disappeared in Karamoja – Kumi Area, WfP is planning to construct reservoir and execute the gravity irrigation as the Pilot Project as the first step of the future development. ✧ Regarding the demarcation between MAAIF and MWE regarding to Water for Production. ✧ It is indicated clearly in the minutes of Cabinet Meeting of 2007 and the letters from the president that MWE manages from the water resource facilities to the main canal as the Off-farm, and on the other hand, MAAIF manages the canals inside the farm and the farm as the On-farm. ✧ As a result, 25 personnels are working in the Water for Production Department at the moment. ✧ Regarding the irrigation project, both ministries will work in cooperation in future. ➢ How will WfP respond to NEMA's environment conservation policy on irrigation development in wet land? ✧ As for construction of the reservoir or development of wet land, EIA should be conducted beforehand. ✧ The issue of using wetland as the irrigation site shall be examined in the Water for Production Sector Working Group in the Committee consisted of MWE and MAAIF. Because the irrigation project is the important for the food production, it will not be the big issue. ✧ MWE is preparing the Irrigation Master Plan now, and the final version of it will be completed by September, 2010 ✧ The Presentation by the consultant who is preparing the Irrigation Master Plan will be held at 11:00 today, and please join in.
Date and Time	June 11, 2010 11:00 - 14:00
Place	MWE-DWD Board Room
Interviewee	Eng. Richard Cong Mr. John Twinomujuni Mr. Philip J Riddell（Consultant） , and other 15 persons

Interviewer	Toshimasa Kobayashi (JICA Team Leader), Yusuke Haneishi (MAAIF Expert)
Interview purpose	Contents of the Irrigation Master Plan
Submitted material	
Obtained material	A National Irrigation Master Plan for Uganda (2010 – 2035) Preliminary Report
Contents of the interview	
Presentation from Mr. Philip on the Irrigation Master Plan	1. Detailed explanation was given by Mr. Philip on Irrigation Master Plan using Power Point. ✧ The size of the potential area is 55,000ha. Within it, the formal irrigation area, which needs rehabilitation, is 14,000ha. 40,000ha needs irrigation as wetland Management. ✧ The Chapter on "Agriculture Water Management" should be inserted. ➢ The title of this paper is "Irrigation Master Plan." However, the character of the paper is policy or strategy, therefore, it might be better to change the title . ✧ **MAAIF and** MWE were instructed to prepare the Irrigation Master Plan by the Cabinet decision, therefore the title should be the Master Plan. We understand that the contents are not enough to be called as the Master Plan, but it will be enriched by September. ✧ This Irrigation Master Plan shall be revised again in July, and finalized by September.

Date and Time	June 15, 2010 11:30 -12:30
Place	MWE DWRM(Directorate of Water Resources Management)
Interviewee	Eng. Mugisha Shillingi (Director DWRM) Pule Hohnson (Senior Hydrogeologist) Sewaguddle Sowed (Acting Principal Water Officer)
Interviewer	Toshimasa Kobayashi (JICA Team Leader),
Interview purpose	Grounds of 240,000ha of Irrigation Master Plan
Submitted material	
Obtained material	Map of 240,000ha and the soft copy of the list of the Potential Irrigation Area
Contents of the interview	
On the contents of the Irrigation Master Plan	➢ What is the grounds of 140,000ha indicated in the Irrigation Master Plan that is being prepared by NEW? ✧ We have the figure of 240,000ha instead of 140,000ha based on the data indicated in the Hydro-met Study. Basically, main potential irrigation area is the development of the wetland. ✧ Having the data, we can show the concrete grounds of 240,000ha The soft copy of the list of the Potential Irrigation Area made by Arc GIS was obtained.

1.3 African Development Bank（AfDB）

Date and Time	June 12, 2010 10:30 -11:30
Place	AfDB
Interviewee	Mr. Asaph Nuwagira (Agriculture & Rural Development Specialist)
Interviewer	Toshimasa Kobayashi (JICA Team Leader), Yusuke Haneishi (MAAIF Expert)及び Mr.

	Daniel Rutabingwa (JICA Staff)
Interview purpose	FIEFOC Project
Submitted material	Inception Report,
Obtained material	
Contents of the interview	
On AfDB's Rehabilitation Project	1. The purpose and the outline of the Study were explained by Mr. Haneishi, MAAIF Expert. 2. The Rehabilitation Project of FIEFOC Project is being executed by two engineers from MAAIF and two engineers from MWE. Mr. Okaasai （MAAIF）and Eng. Cong （MWE）are giving instructions to them. ✧ The budget is 12 million UA=18million US$, and executing period is by December 2012. The budget is from ADF-10. The budget cycle of ADF-13is from January 2011 to December 2013. Among them, 90million UA=135million US$ shall be allocated to the agricultural sector. At the moment, this budget is not planned to be allocated to the irrigation projects, but to the projects for farm roads, Storing facilities, Processing agricultural products ✧ The concrete contents of Rehabilitation are to be decided by MAAIF and MWE. ✧ Detailed design shall be prepared by the consultant engineers, and the construction shall be conducted by the selected contractor. ✧ As for EIA for four areas will be conducted by other consultants selected. ✧ Rehabilitation of Doho District shall be conducted on the original area and other area will not be included. ➢ How about JICA's F/S of the entire expansion development where the district in the surrounding is included in parallel with this Rehabilitation Project? ✧ The budget of AfDB is limited, therefore, JICA's entire F/S including expanded Doho District is welcome. We want to cooperate in execution together by all means.

1.4 Food and Agriculture Organization of the United Nations（FAO）

Date and Time	June 14, 2010 11:30 - 12:30
Place	FAO
Interviewee	Mr. Percy W. Misika (FAO Representative in Uganda)
Interviewer	Toshimasa Kobayashi (JICA Team Leader)
Interview purpose	The contents of project executed by FAO and the possibility of co-financing
Submitted material	Inception Report,
Obtained material	

Contents of the interview	
Contents of the project executed by FAO	1. FAO is now executing projects on Potato, Pineapple, Mango, Milk, Rice, Cassava 2. As for NERICA project、490ha in 2008, 700ha in 2009, and 2nd Crop 1000ha were executed. ➢ These areas are cultivated area. Do data of harvested area exist? ✧ The person in charge is not present at the moment. The answer will be given later. ✧ Harvest of NERICA is about 1.3 – 3 ton /ha. ✧ Because of the lack of the budget, irrigation projects are not executed at the moment. ✧ Irrigation projects will be possible, if co-financing with Japan is feasible in future.

1.5 National Environment Management Authority（NEMA）

Date and Time	June 15, 2010 09:00 - 11:00
Place	National Environment Management Authority(NEMA)
Interviewee	Mr. Waiswa Ayazika Arnold (Director, Environmental Monitoring & Compliance)
Interviewer	Toshimasa Kobayashi (JICA Team Leader), Yusuke Haneishi (MAAIF Expert)
Interview purpose	About environmental preservation on the medium and large-scale irrigation project
Submitted material	Inception Report,
Obtained material	The National Environment (Wetlands, River Banks and Lake Shores Management) Regulations, 2000
Contents of the interview	
On AFD's project	1. The purpose and the outline of the Study were explained 2. About the method of executing EIA ➢ How long does it take to execute and examine EIA? ✧ Usually it takes 30-working days. After that, revision will be needed according to questions and comments. ✧ There is no example of executing EIA of the irrigation program now. Moreover, the guideline etc. of EIA to the irrigation program are not maintained. ✧ It is better to ask Department of Wetland Management of MWE about the method of execution of the irrigation projects. ✧ Main support donor for NEMA is the Government of Uganda basically. Besides this, there is Norwegian Oil & Gas. WB's support has finished already. 3. When the medium and large-scale irrigation project is executed in the seasonal wetlands, it is necessary to install the buffer zone. ✧ Usually, the buffer zone should be installed 30m from the river channel in both shores of the river respectively. ✧ It provides 100m at the selected rivers. 20 Selected rivers are shown in the above material. ➢ Installing the buffer zone may be objected by the local farmers in the irrigation project. ➢ To solve this problem, new farmland that will be developed between the canal and the wetland that can be exchanged to the buffer zone as the alternative. When the irrigation canal is constructed, the canal will be arranged in the diversion works and the alignment of the canal can be installed around the wetland of the slope part.

1.6 International Fund for Agricultural Development（IFAD）

Date and Time	June 16, 2010　14:50- 15:30
Place	IFAD
Interviewee	Mr. Pontian Muhwezi (Country Officer- Uganda)
Interviewer	Toshimasa Kobayashi (JICA Team Leader)、Mr. Ogawa (JICA Programme Advisor)
Interview purpose	Possibility of co-financing with Japan
Submitted material	Inception Report,
Obtained material	
Contents of the interview	
On Contents of the Irrigation Master Plan	1. IFAD is executing the Government-affiliated loan project cooperating with other various donors. 2. The loan project that IFAD is now doing are; supporting NAADS in the 3 years budget cycle began since 2010. We also support Agri-business project such as Vegetable Oil Project. This 3-year cycle will end in 2012. 3. Next Loan shall support both of extending activity （NAADS）and research activity （NARO） as ATAAS（Agriculture Technology, Agri-business Advisory Services Project） in the 3 year budget cycle from January 2012. This funding is from WB, DANIDA, IFAD, and EU. By this Loan project, agricultural research activity and extending activity can be tied.

1.7 World Bank（WB）

Date and Time	June 17, 2010　08:30-09:30
Place	World Bank,　Unanda Office
Interviewee	Mr. Wilson Odwongo (Senior Rural Development Specialist)
Interviewer	Toshimasa Kobayashi (JICA Team Leader), Yusuke Haneishi (MAAIF Expert)
Interview purpose	The possibility of co-financing on irrigation facilities and the Irrigation Master Plan
Submitted material	Inception Report,
Obtained material	
Contents of the interview	
Possibility of financing to irrigation project	The purpose , schedule, and the outline of the Study and co financing on irrigation project that is being considered at the headquarters level were explained by Mr. Haneishi, MAAIF Expert. The application for irrigation M/P from the MAAIF with its progress was also explained. ➢ Is there any instruction from World Bank's headquarter to examine the possibility of co-financing with JICA on irrigation project? ✧ An e-mail from the sector manager of Washington headquarter has instructed us to discuss with JICA. However, we will reread it because we have not understood the detail and not discussed about it yet.

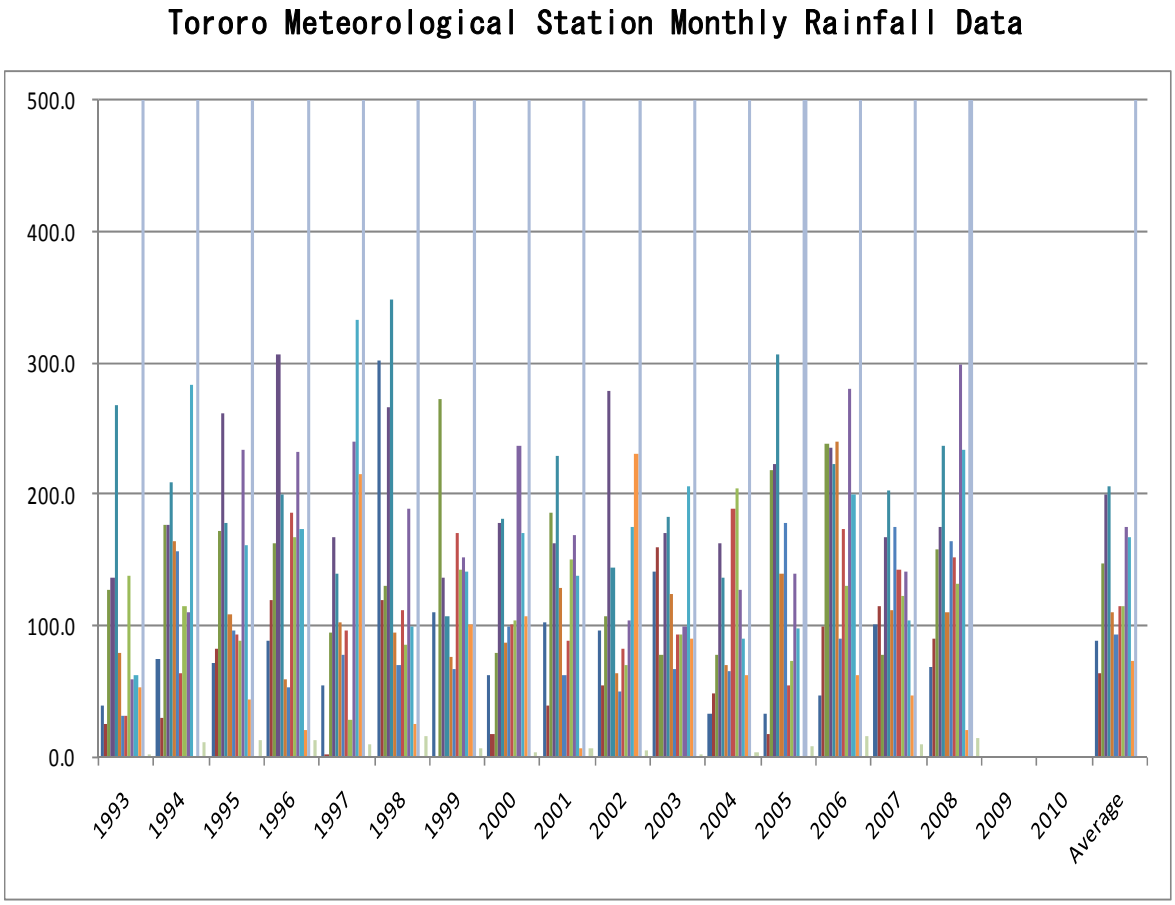
Making of the Irrigation Master Plan	➢ We hear that World Bank is also interested in the irrigation /agricultural water sub-sector in Africa very much. How about the situation in Uganda? ✧ I do not know much about AgWA because a person in charge of water is taking care of it in our office. ✧ We are now discussing with MAAIF about hireling consultants for the demarcation between MAAIF and MWE on the irrigation project. However, there has not been the official application from MAAIF yet. ✧ We have heard that JICA has received the request for the master plan. All donors related to agriculture are interested in and waiting for a clear policy of MAAIF to be shown, because the irrigation development is highlighted in DSIP. ✧ In the sector working group, it is necessary to talk about the clear direction on which donor takes which support in what scope. ✧ Anyway, the situation in an agricultural ministry without the irrigation policy and the strategy continues. It is a situation not advanced ahead easily though World Bank also was supporting the irrigation policy decision. ✧ The master plan should be settled on based on these policies and strategy, then the F/S object should be led from it. We want the JICA expert who belongs to MAAIF to back this up. ✧ First of all, we shall begin to examine the demand for irrigation. There remain many things to do. It is very preferable that JICA can cooperate with us. ✧ According to IDA16 (2012 to 2010), it is planned to distribute 100 million dollars to ATTAS (integrated program of supporting extension and the research), and the remaining 100 million dollars to the fields of other DSIP. Irrigation is the one of them. ✧ We would like to discuss about it again after the site investigation. The person in charge of water will join then, we would like to discuss more detail about the M/M and AgWa. ✧ Further, we would like to include the development direction of the irrigation field to the agenda during today's meeting with the undersecretary of MAAIF and donors. ✧ In addition, we would like to examine about the project execution of the F/S that Japan executes in the direction of our cooperation.

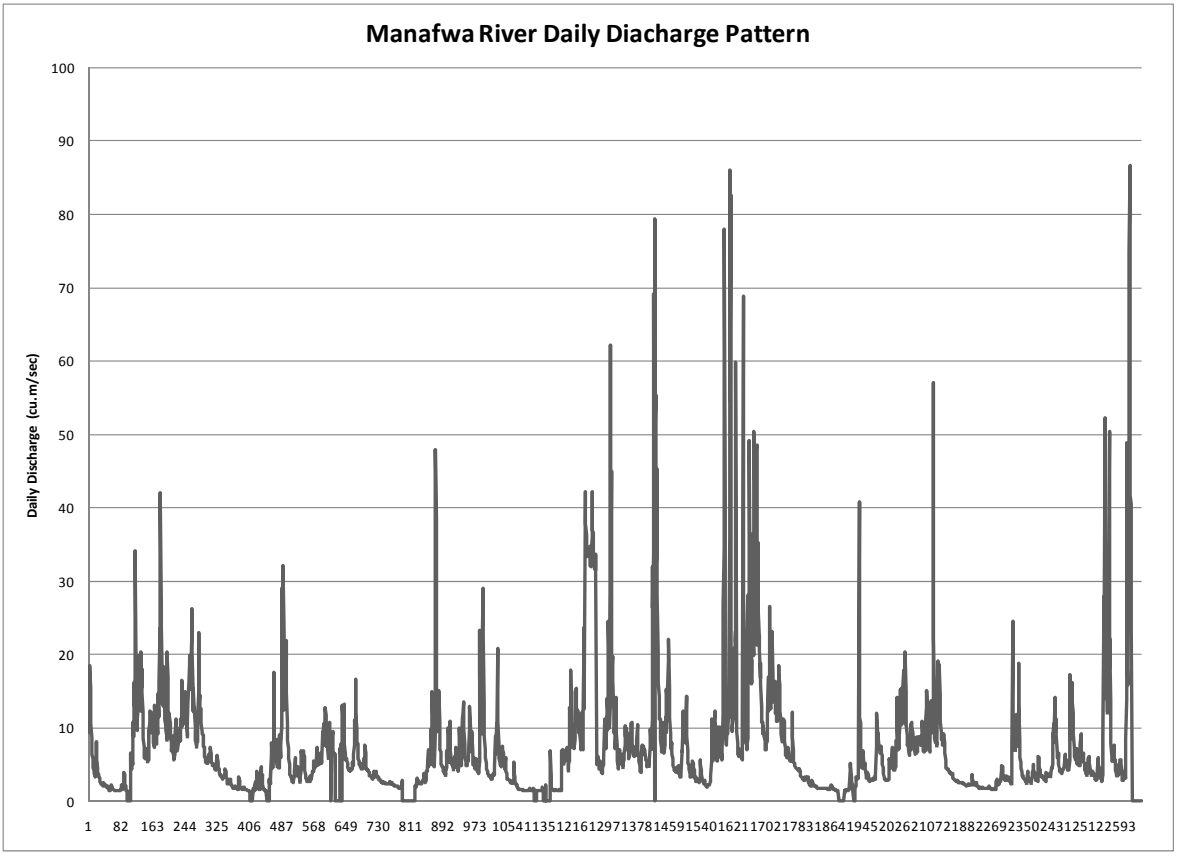
1.8 Busitema University

Date and Time	June 17, 2010 15:00-17:30
Place	Busitema University
Interviewee	Prof. Mary Okwakol(Vice Chancellor) Eng. Wilfred Odongo(Head, Mechanization & Irrigation Department) Dr. Maurice Muhwezi-Murari(University Secretary) Mr. Elisha Obella(Academic Registrar) Eng. Johnnie Wandera(Lecture Textile Eng.)
Interviewer	Toshimasa Kobayashi (JICA Team Leader)、Mr. Ogwang, Mr. Kato (MAAIF)
Interview purpose	Setting up the Irrigation course in the University
Submitted material	Inception Report,
Obtained material	Busitema University Panflet

Contents of the interview	
	1. Outline of Busitema University ✧ The university established with the Diet approval on May 10, 2007 as a public university that consisted of many campuses. The member of the inaugural class plans to graduate in 2011. The university is located where the Agricultural Mechanization Centre was established by Russia in 1971. ✧ There are farm machinery and irrigation, and water resource engineering as the subject of the university, and the subject of water for the agricultural production strengthening is being prepared now. The student of the fourth year exercise the practical training for ten weeks、on the job training as a internship for ten weeks, and take the classes related to the irrigation for the reminder. ✧ The following four campuses are operating under Busitema University. 1) Busitema Campus : Engineering 2) Nagongera Campus : Science and Education 3) Arapai Campus : Agriculture and Animal Production and Water for Production 4) Namasagari Campus : Natural Resources and Environmental Engineering ✧ Besides these campuses, there are Palisa (Management Science), Karilo (Vocational Training), and Mbale (Health Science) as the candidate campus. ✧ Busitema Campus is 1,309 Acres and Arapai Campus are 625 acres .Busitema and Nagongera have 541 students and 200 staff. Arapai has 60 students and 50 staff. ➢ Which campus is suitable to establish the Irrigation and Drainage course? ✧ Because the Irrigation and Drainage course is the Engineering section, it is suitable to establish it in Busitema Campus. Arapai is also capable for it.、However, Busitema is more suitable because it has the facility for workshop and the land is larger. ✧ After the interview, they showed us the workshop in the Campus. In the Workshop, machines of the welding, the lathe, and the electric wiring, etc. were set up. Most of them are made by the Soviet Union and are not in operation, because spare parts are not available. There was a considerably big cotton refinement machine, too, and the student was practicing with it.

U-2 Climate and Hydrological Data





U - 3 List of Data/Information Collected in Uganda

No.	Title of Document	Source	File Type	Size	Pages	Remarks
AGRICULTURAL POLICY						
001	THE SUCCESSFUL IMPLEMENTATION OF THE AGRICULTURAL SECTOR DEVELOPMENT STRATEGY AND INVESTMENT PLAN(DSIP)	REPUBLIC OF UGANDA	pdf File	A4	9	
002	Agriculture Sector Development Strategy and Investment Plan:2010/11-2014-15	MAAIF	pdf File	A4	149	
MAINTENANCE PLAN and RESULTS						
003	Annual Workplan July 2009 to june 2010	MWD,DWRM	pdf File	A4	75	
IRRIGATION PLAN						
004	A National Irrigation Master Plan for Uganda (2010-2035) Preliminary Report June 2010	MWE	pdf File	A4	52	
Plan for Agricutural Production, Agro-Processing and Marketing						
005	INCREASING INCOMES THROUGH EXPORTS:A Plan for Zonal Agricultural Production,Agro-processing and Marketing	National Task Force	pdf File	A4	118	
RELATED to WATER BALANCE						
Uganda Rainfall 2006-2009						
006	2006 WEATHER DATA ALL STATION Uganda		Excel File	A4	117	
007	2007 WEATHER DATA ALL STATION Uganda		Excel File	A4	77	
008	2008 WEATHER DATA ALL STATION Uganda		Excel File	A4	78	
009	2009 WEATHER DATA ALL STATION Uganda		Excel File	A4	81	
Uganda River Discharge data						
010	Manafwa Discharge Graph		Excel File			
011	Manafwa_Flow(2003-2010)		TXT File			
012	Namatala_Flow(2003-2009)		TXT File			
013	Sipi_Flow(2003-2010)		TXT File			
014	Sironko_Flow(2003-2009)		TXT File			
015	Summary Location of Water discharge sites		TXT File			
NATIONAL PLAN						
016	SUPPORT TO NEPAD-CAADP IMPLEMENTATION TCP／UGA／2910(I)(NEPAD Ref.04/03E)	NEPAD	pdf File	A4	36	
017	FARM INCOM ENHANCEMENT AND FOREST CONSERVATION PROJECT APPRAISAL REPORT	REPUBLIC OF UGANDA	pdf File	A4	63	

U - 3 List of Data/Information Collected in Uganda

No.	Title of Document	Source	File Type	Size	Pages	Remarks
018	UGANDA NATIONAL RICE DEVELOPMENT STRATEGY(UNRDS)	GoU MAAIF	pdf File	A4	36	
019	UGANDA NATIONAL RICE DEVELOPMENT STRATEGY 2009-2018	MAAIF	pdf File	A4	16	
020	5-year National Development Plan for Uganda PEAP Revision Process 2007/8 Concept Note on the Revision Process	Ministry of Finance,Planning and Economic Development	pdf File	A4	14	
ENVIRONMENT						
021	LIST OF CERTIFIED AND REGISTERED ENVIRONMENTAL PRACTITIONERS IN UGANDA,2010	NEMA	pdf File	A4	25	
STATISTICS						
MWE Uganda Exisiting and Potential Irrigation List						
022	Dams 300000 or more		Excel File	A4	7	
023	Existing Irrigation		Excel File	A4	3	
024	Flower Farms		Excel File	A4	3	
025	Potential Irrigation_Hydromet 1982		Excel File	A4	3	
OTHERS						
Leye Dam Soft Copy DWD						
026	Front Cover Leye Dam		Word File	A4	1	
027	Drawing Index		pdf File	A4	1	
028	Cattle Trough Bending Schedule		pdf File	A4	1	
029	Cattle trough Plan Details		pdf File	A4	1	
030	Cattle Trough Sections		pdf File	A4	1	
031	Floating Intake Details		pdf File	A4	1	
032	Inlet Pipe Section		pdf File	A4	1	
033	Leye Dam BoQ-Summit Construction Co.Ltd		Excel File	A4	11	
034	Leye Dam BoQ(Without cost)		Excel File	A4	9	
035	Leye Dam Section Details		pdf File	A4	1	
036	Leye Dam Site Layout Plan		pdf File	A4	1	
037	Manhole Details		pdf File	A4	1	

U - 3 List of Data/Information Collected in Uganda

No.	Title of Document	Source	File Type	Size	Pages	Remarks
038	Monitoring Equipment		pdf File	A4	1	
039	Plan of Outlet Pipes		pdf File	A4	1	
040	Section of Outlet Pipes		pdf File	A4	1	
041	Site Elevation		pdf File	A4	1	
042	Spillway Details		pdf File	A4	1	
043	Upstream Details		pdf File	A4	1	
044	VIP Latrine		pdf File	A4	1	

PART – III

Republic of Zambia

Location Map of the Potential Irrigation Areas in Zambia

Part - III Zambia

Table of Contents

GLOSSARY OF ACRONYMS

Acronyms	Orthography
AASB	Agricultural Advisory Service Branch
ADF	African Development Fund
AfDB	African Development Bank
AgWA	Partnership for Agricultural Water in Africa
CARD	Coalition for African Rice Development
CDC	Central Depository Company
CPB	Crops Production Branch
DBZ	Development Bank of Zambia
DOA	Department of Agriculture
DWA	Department of Water Affaires, MEW
EC	European Commission
EIA	Environment Impact Assessment
EIRR	Economic internal rate of return
F/S	Feasibility Study
FAO	Food and Agriculture Organization of the United Nations
FSP	Fertilizer Support Program
FISP	Farmers Inputs Support Program
IDF	Irrigation Development Fund
IDSP	Irrigation Development Support Project（WB）
IFAD	International Fund for Agricultural Development
JICA	Japan International Cooperation Agency
KSHC	Kaleya Small Holders Company
MACO	Ministry of Agriculture and Cooperative
MD	Meteorological Department
MEW	Ministry of Energy and Water Development
MOD	Ministry of Land
NGO	Non-Governmental Organizations
NIP	National Irrigation Plan
NIRS	National Irrigation Research Station
PACO	Provincial Agriculture Coordinator
PAO	Provincial Agricultural Office
PPP	Public Private Partnership
RIF	Rural Infrastructure Fund
SAO	Senior Agricultural Officer
SF	Smallholder Fund
SIP	Small-Scale Irrigation Project（AfDB）
SNDP	Stratégie National Développement Plan
TAF	Technical Assistance Fund
TSB	Technical Service Branch, ; MACO

Acronyms	Orthography
UA	Unit of Account
USAID	United States Agency for International Development
WB	World Bank
WP	Water Department
WfP	Water for Production
ZG	Zambian Government
ZIPS	Zambia Irrigation Policy and Strategy

Chapter 1 Irrigated Agriculture in Zambia

1.1 Investigation in Zambia

1.1.1 Related Organizations

(1) Governmental Organizations

The organization responsible for irrigation and agriculture in Zambia is the Ministry of Agriculture and Cooperatives (MACO). The Department of Agriculture (DOA) in MACO is composed of the following three branches:

1) Agricultural Advisory Service Branch (AASB)
2) Crop Production Branch (CPB)
3) Technical Services Branch (TSB)

At the provincial level, the Provincial Office takes charge of the execution of central agricultural policy, and all the divisions of the Provincial Office are under the management of the Provincial Agricultural Coordinator (PACO). Like MACO, PACO has three branches and the Provincial Agricultural Officer (PAO) is responsible for execution. The actual practices are conducted by PACO and the Senior Agricultural Officer (SAO). In addition, agricultural extension officers are assigned to extend agricultural technology and they work in areas called blocks or camps. Each block is generally composed of several camps and has a number of Block Extension Officers and Camp Extension Officers. The Technical Services Branch (TSB) under the DOA takes charge of planning and implementation of all the projects regarding irrigation and water management.

In addition, some government agencies other than MACO and also NGOs execute works related to irrigation. Such agencies include the Ministry of Energy and Water Development and the Water Resources Development Committee which are responsible for water use and water rights in Zambia. On the other hand, the Ministry of Lands is in charge of land use and has the authority to grant land ownership. The organization charts of MACO and PACO are shown in *Figures 1.1* and *1.2* respectively.

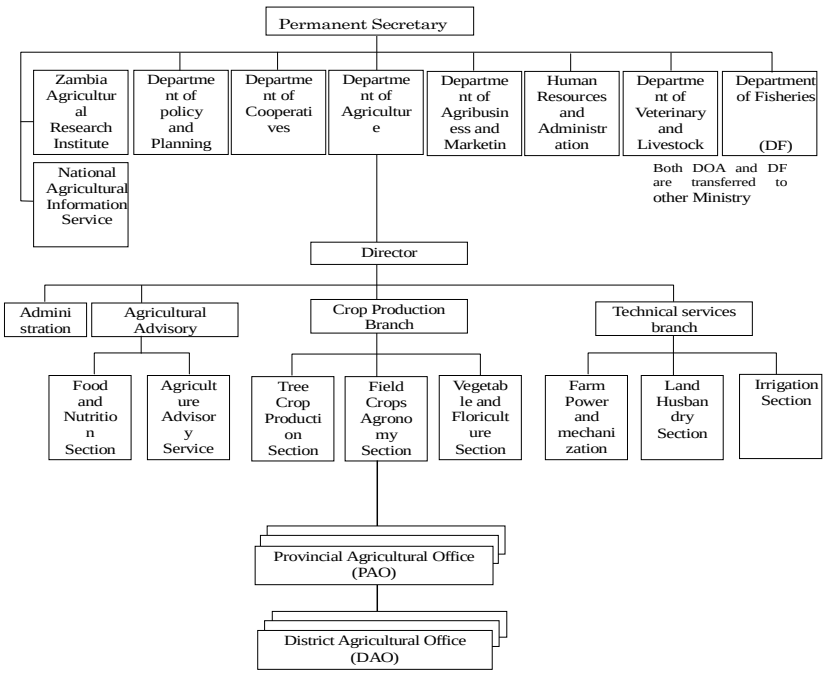


Figure 1-1 Organization chart of MACO

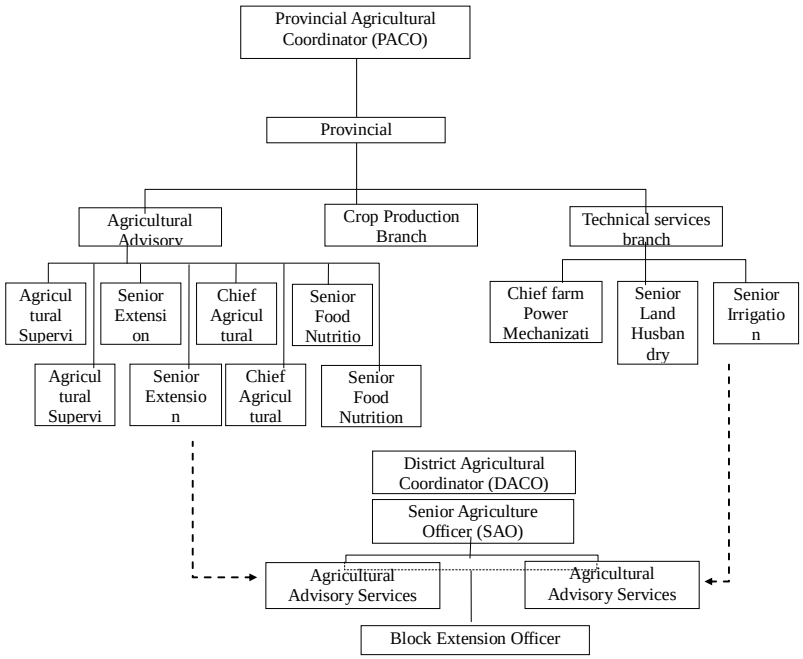


Figure 1-2 Organization chart of PACO

(2) Other Related Donors

Information on the target survey area was collected from the African Development Bank (AfDB) and World Bank (WB). Below is the address of each agency.

AFDB Zambia field office :

African Development Bank Group, Zambia Country Office (ZMFO), Pyramid Plaza
746B Church Road , Cathedral Hill, P O Box 51449, Ridgeway, Lusaka, Zambia
Tel: (260) 21 1257868/869/874 Ext. 6400-6429
Fax: (260) 21 1257872

World Bank:

Pyramid Plaza, 746B Church Road, P.O. Box 35410, Lusaka, Zambia
Tel: 260 211 254811/253219/253225
Fax: 260 211 254283
E-mail: kkapoor@worldbank.org

1.1.2 Data Collection and Analysis

(1) Collection and Analysis of Meteorological Data

There are 35 meteorological observation stations in Zambia and the necessary observation items for the calculation of irrigation water requirements are observed at each station. Generally, it is possible to obtain such information from the Meteorological Department of the Ministry of Energy and Water Development. However, this is considered time-consuming due to the long procedures required.

(2) Collection and Analysis of Data on Stream Flow

The Water Department of the Ministry of Energy and Water Development observes the river flow and manages the observed data. Zambia is divided into six river basins: Zambezi, Kafue, Luangwa, Chambeshi, Luapula, and Lake Tanganyka. Many gauging stations were established during the 1950s and 1970s near the main rivers and branch rivers. However, more than half of the stations are closed now and thus the necessary information for the study is only available through the observed data from each station along the main rivers. In order to estimate river discharge, a correlation analysis is applied utilizing available neighbouring flow data.

(3) Collection and Analysis of Topographic Data

One topographic map on a scale of 1:250000 covers over the whole of Zambia. Topographic maps on a scale of 1:50000 are also available, with the exclusion of some areas. Basically, these maps are available from the Survey Department of the Ministry of Lands. The 1:50000 topographic maps will be utilized as the basic maps in this study and, in addition, in order to execute the study smoothly, the available maps that can be obtained at an early stage will be utilized.

(4) Collection and Arrangement of Data on Irrigation Projects

1) Small-Scale Irrigation Project (SIP)

SIP was drawn up as an assistance program for the transfer of residents of the Tonga community, which occurred following the construction of Kaliba Lake in 1958. This project started as a six-year project financed by the AfDB. The purpose of the project was to secure food for 1,613 families and the target farm land covered 1,890 ha. *Table 1.1* shows details of the SIP.

Table 1.1 List of SIP

	Project name	Province	County	Beneficial area (ha)
1.	Kanakantapa	Lusaka	Chongwe	620
2.	Nega-Nega	Southern	Mazabuka	595
3.	Buleya Malima	Southern	Sinazongwe	275
4.	Simumpande Village	Southern	Sinazongwe	150
5.	Nzenga Fishing Camp	Southern	Sinazongwe	98
6.	Chief Sinazongwa Village	Southern	Sinazongwe	100
7.	Kanakanpata dam	Lusaka	Chongwe	---

As shown in Table 1.1, MACO requested an additional project, namely the Kanakantapa dam project. The reservoir capacity was extended from the original 5.0 million m^3 to 25.0 million m^3. The concepts underlying the project are: 1) irrigation development, 2) rural finance, and 3) capacity building of farmers. Table 1.2 shows the project cost of the SIP. The total cost was 8.04 million UA.

Table 1.2: Project Cost of SIP by Financial Source

Financial Source	Amount in UA	Percentage (%)
African Development fund (ADF)	5,290,000	65.8
Technical Assistance Fund (TAF)	760,000	9.5
Zambian Government	1,310,000	16.3
Beneficiaries' contribution	680,000	8.4
Total project cost (in UA)	8,040,000	100.0

2) Irrigation Development Support Project (IDSP)

(Currently the WB plans to conduct project appraisal.)

Although the IDSP aims to increase the income of small-scale farmers, the project areas were selected from the perspective of technical feasibility and high market potential and targeted emergent farmers. The project components are: 1) irrigation development, 2) small commercial farming, and 3) project management. The duration of the project is estimated to be seven years. The project area is now under review, but the pre-F/S for the following seven projects have been completed, as shown in Table 1.3. The projects will be financed by the WB.

Table 1.3: Pre-F/S completed areas

	Project name	County	Province	Agricultural land*[1] (ha)
1.	Kalungwish Sugar Irrigation Project	Kasama	Northern	2,000 (800 ha is owned by a sugar plant)
2.	Lumwana Mine Smallholder project	Solwezi	North-western	2,000
3.	Mwomboshi Dam Project	Chibombo	Central	1,000
4.	Mwinilunga Smallholder Pineapple Project	Mwinilunga	North-western	400 (including Ikelenge Pineapple project, 50 ha)
5.	Musanje Irrigation Project	Kafue	Lusaka	100
6.	Lusaka Peri-Urban Smallholder Irrigation Project			
6.1	Chipapa Dam Smallholder Project	Kafue	Lusaka	100
6.2	Katoba Dam Smallholder Project	Chongwe	Lusaka	500

Source: Edited by Study team based on Interim report IDSP by FAO Investment Centre, January 2009

*[1] The project area is the potential area, thus the beneficial area the project is smaller than the project area.

Kanakantapa Dam Irrigation Project was not included in the able because the project was implemented in the SIP.

1.2 Progress of CARD

From 18th -19th, May 2010, the 3rd general assembly of CARD was held in Arusha, Tanzania. Zambia and Ethiopia were both allocated to Group-2. In March 2010, the Zambian Government formulated the NRDS. Rice growing areas in Zambia are in the Eastern at Chama area, in the Northern at Kasama, Isoka and Chinsari areas and in the Western at Mongu and Kalabo areas. The annual production, however, is about 16 thousand tons, production yield is limited at 1.2 ton/ha and rice consumption per capita is about 2.5 kg. The annual average

importing rice amount is not so high about 30 thousand tons. However, demand of rice is growing very quickly especially in the urban regions. MACO is now promoting rice growing projects to eradicate poverty in rural areas. It can be expected to promote rice production in quite near future.

1.3 Status of Irrigation Projects

1.3.1 Government Policy on Irrigation Projects

The Zambian Government is planning to execute the irrigation projects according to the SNDP as soon as possible.

1.3.2 Plans for Irrigation Projects Supported by International Organizations

International organizations are planning to undertake the IDSP by the WB, especially the three schemes in Group-1. The WB plans to be in charge of all the projects, from F/S until completion. Thus, by March 2010, US$ 100 million will be prepared as a loan agreement. The duration of the whole project is approximately seven years.

On the other hand, the AfDB plans to execute the currently on-going SIP at five sites with support from the Finnish Government. Currently, the dam project in the Kanakantapa area is at the phase of selecting a consultant company. Thus, once it is decided, actual construction work will take place.

1.4 Relevance of Medium to Large-scale Irrigation Development

1.4.1 Reasons for Failure of Former Irrigation Schemes

(1) Content and Implementation of Former Irrigation Schemes

Former irrigation schemes focused on construction of irrigation facilities, although they were not used effectively or sustainably. The reasons are: 1) lack of technical skills, responsibility and management skills of the governmental agencies; 2) lack of advance explanation to the potential beneficiaries; and 3) lack of guidance and training in farming, maintenance and water management for the beneficiaries.

The staff responsible for the irrigation projects did not have enough time for the irrigation scheme or receive enough training to guide the farmers. Therefore, the water users' associations did not have enough capacity or budget for management of the irrigation facilities.

(2) Kanakantapa Scheme

The Kanakantapa scheme is one of JICA's assisted irrigation projects aimed at developing an immigration area for retired governmental employees. The agency for implementing this project was the Vice President's Office. Therefore, the officials were not familiar with agriculture and thus could not provide any technical advice on farming or operation and maintenance of the irrigation facilities to the settlers. The settlers did not have any knowledge of irrigated agriculture or any intention to live there permanently. The most crucial reason for the failure was the lack of support for the beneficiaries after completion of

the construction.

(3) Sefula Scheme

The Sefula irrigation scheme was also implemented with aid from JICA. Even though the local government was in charge of “training” the beneficiaries, adequate training was not provided. Also, the irrigation fees were not properly collected from absentee landowners. Therefore, operation and maintenance of the facilities failed miserably.

The first director of the water users' association collected ZMK 4 million in irrigation fees through proper water management. However, the second director was ineffective and thus less irrigation fees were collected. The scheme gradually fell into malfunction. The canal needed frequent cleaning to remove sediments.

1.4.2 Successful Cases of Recent Irrigation Schemes

(1) Kaleya Scheme

The Kaleya irrigation scheme was the first to introduce the Private Public Partnership (PPP) method in management. A private company, which was established for operation and management of the irrigation system, constructed the irrigation facilities based on a contract with Zambia Sugar to provide an irrigation water supply by pipeline and an immigration plan for small-scale farmers in 1980. Small-scale farmers immigrated to the area after completion of a furrow irrigation system. They cultivated sugarcane on 2,207 ha of irrigated farmland and four associations were formulated by the 400 farmers.

This PPP method functions well because the trained technical staff manage the project very well. Another reason is that the simple cropping of sugarcane is strongly connected with Zambia Sugar.

(2) Introduction of Operation and Management Fund

Improvement plans for sustainable pump irrigation in the Buleya Malima irrigation scheme include the assignment of permanent staff for operation of the irrigation facilities and reliable collection of the irrigation water fees. Most of the other pump irrigation schemes have difficulty managing pump irrigation because of unskilled and inexperienced farmers operating and managing the facilities on their own.

The WB, AfDB, FAO, IFAD and other agencies have prepared financial assistance for small-scale farmers and irrigation schemes to strengthen the support system for irrigation schemes. They have created an Irrigation Development Fund (IDF), Smallholder Fund (SF), and Rural Infrastructure Fund (RIF) since the 2000s, and these funds can now be used.

1.4.3 Upcoming Activities of MACO

(1) Establishment of Governance of Public Agencies

MACO assigned three full-time staff to the on-going SIP to work with the contract-based consultants to monitor the projects, contracts with the consultants and construction. MACO implements environmental impact assessment (EIA) on dam construction to prepare resettlement plans for potential reservoir areas.

(2) Advance Consensus with Residents

In order to obtain a consensus on the project, the government has already explained the details to the residents of the Kanakantapa area. The director of the cooperative has a good understanding of the resident resettlement plan.

(3) Training for Farmers

The government prepared the “Farmers Training Plan September 2005" for the SIP in order to provide technical training in farming to the beneficiaries. The government also plans to introduce the PPP method to promote technical support by private companies.

1.4.4 Operation and Maintenance System (Introduction of PPP Method)

(1) PPP Method for Management of Mwomboshi Irrigation Scheme

The WB proposed implementation of the PPP method for the management of IDSP for irrigation schemes in large scale commercial farming of the three irrigation schemes in Group-1 of the IDSP.

After completion of the IDSP schemes, asset management of the irrigation facilities by an experienced private company shall be introduced. The proposed system is composed of: 1) establishment of three water users' associations for three tiers of farmers, and 2) introduction of irrigation and management methods suitable for each tier (See *Chapter5*).

1.4.5 Validity of Upcoming Medium and Large-scale Irrigation Projects

Accordingly, international organizations such as the WB and AfDB are already executing large-scale irrigation projects as loan projects. Due to the failure of large-scale commercial farming in Zimbabwe, Zimbabwean farmers have immigrated into Zambia and are implementing large-scale centre pivot irrigation and commercially cultivating sugarcane, wheat, maize and coffee. Lately in supermarkets, good quality foods from South Africa are often sold. In a recent trend in big cities, residents’ needs have shifted from quantity to quality.

Likewise, management knowledge and investment in irrigation projects are actively being implemented at the level of large-scale farms. Such “know-how” seems to have been passed on to ordinary small-scale farmers for their group management system. The whole shift itself has just started, so how these grouped-together small-scale farmers will influence commercial agriculture and help relieve poverty in the country is unknown.

Considering the ample availability of water and land in Zambia, not only a shift from small-scale farming, but also from medium to large-scale farming is now expected as a new upcoming trend.

Chapter 2 Summary of Discussions with Related Organizations

This chapter provides a summary of the meetings with the related organizations. Further details are provided in *Annex Z-1*.

2.1 Discussions with Governmental Agencies (MACO/SIP/MEW)

A meeting with TSB (responsible for irrigation programs) in MACO was held to further study the on-going large-scale irrigation projects. The outcome was that the SIP under the AfDB is implementing six irrigation schemes, though one of the six is considered to have low economic validity and was thus excluded. At present, two irrigation schemes are under implementation as the 1st phase. The other three schemes will be implemented as the 2nd phase with a grant of €10 million from the Finnish government. In addition, the WB supports the IDSP in Group-1 (3 schemes), Group-2 (4 schemes) and Group-3 (14 schemes), which are soon to be initiated. The TSB has great interest in the study by JICA, and promised to hold another meeting to confirm the study results.

At the project office of the SIP located in the PACO Lusaka office, Mr. Goege Phiri, the project officer, took part in the meeting on possible cooperation by JICA in the SIP. According to Mr. Phiri, the AfDB and the Finnish government will implement a dam and an irrigation area of 620 ha in the Kanakantapa scheme; however, no donor has yet been found to support the extension area. The storage capacity of the dam can be assured up to 25 million m^3 by using the excavated earth from the spillway as embankment material. As a conclusion, it was confirmed that possibility of a feasibility study by JICA on the potential irrigation area (excluding 620 ha) and on the irrigation extension plan by estimating the water balance of the incremental reservoir capacity. Another meeting was then held with those responsible for the NRDS in order to grasp the progress of the CARD.

The Study Team visited the DWA in the MEW, which is in charge of water resources development, to discuss the matter of the dam project. At the meeting, the Study Team obtained the records on the discharge of rivers and meteorological data. The Study Team also requested information on small-scale reservoirs which are not being effectively used. In connection with reservoir construction, a national geological map on a scale of 1/1,000,000 and reports on a geological survey covering Kanakantapa and Mwomboshi areas were obtained from the Geological Survey Department,

On August 10, a second meeting with TSB in MACO was held to report the results of the field survey and to discuss three possible projects, namely Mwomboshi Site, Kanakantapa, and Klungu in the Chambeshi River basin. At this meeting, MACO received the survey results and decided to further cooperate with JICA.

2.2 Discussions with International Agencies (WB/AfDB/FAO/IFAD)

(1) WB

The WB is preparing the IDSP. An appraisal of the three schemes in Group-1 will be carried out in November 2010, and the council will decide on the loan amount of US$100 million in March 2011. The WB is willing to cooperate if there are any possible sites within

the three schemes for Japan to execute the F/S. Accordingly, the Study Team decided to conduct a field survey of Lumwana site in Group-2 and Mwomboshi area in Group-1, where small-scale farmers would gain benefits and sufficient water for irrigation can be supplied from the proposed dam.

(2) AfDB

A meeting with the AfDB was held to discuss the progress of the SIP, future plans, and possible large-scale irrigation projects to be co-financed with Japan.

Kanakantapa area has a dam with a large water storage capacity and possible irrigation area of 2,000 ha. It was agreed that JICA should execute the F/S on this extension scheme, which is to be implemented with support from the Finnish government in the form of an additional grant of €9 million. Since December 2008, the Finnish government has shifted its main focus to support for the agricultural sector. Therefore, they are highly motivated to support the agricultural sector in Luapla province and also to promote co-financing with the AfDB.

(3) FAO

The FAO implements water resources development projects in Zambia through the *"Water for Agriculture and Energy Development"* under AgWA. At the moment, the draft final report of the project is in our possession, but we have received notice that the final report will be completed in August. To date, there has been no announcement of such.

2.3 Progress of CAADP

(1) Reason for delay in signing CAADP Compact

The CAADP Compact in Zambia was scheduled to be signed by the donors in May 2010; however, it was suddenly and indefinitely suspended by political decision. This was because some of the general budget support donors were unwilling to sign, demanding improvement of the *Fertilizer Support Programme* (FSP). Under the FSP, the government provided maize seeds and fertilizer to 250,000 small-scale farmers at a subsidy rate of 75% in 2008/09. With the success of the harvest in 2009/10, the project was renamed the *Farmer Input Support Programme* (FISP). The FISP was further increased in scale and provided maize and rice seeds, fertilizer and limestone to 500,000 small-scale farmers. The government is preparing to support over 900,000 farmers in 2010/11 and to provide 30 m^3 of NERICA seeds.

As for FISP, however, an internal audit revealed improper operation of the bidding and provision processes. Despite demands for improvement of the problem by the donors, the government did not take any measures. At the moment, a large portion of the budget of MACO is allocated to the FISP. Therefore, other development plans cannot be prepared or implemented in the agricultural subsector.

An investment plan for the agricultural subsector needs to be prepared in order to promote the CAADP. More than 10% of the entire national budget should be allocated to the agricultural subsector. This situation is achievable since in 2009 the Zambian government managed to allocate 9% of the total budget to the agricultural subsector.

The donors' meeting decided that USAID, the EU and the Swedish government should

take the initiative in the Zambian agricultural sector. At the moment, the Swedish government is taking the leading role. Regarding the CAADP Compact, the USA, EU, UK and Japan decided to sign, but Sweden and Norway refused because of the lack of accountability on the FISP. Consequently, it is unclear how the Zambian government will act in future and also whether all the donors will commit themselves to the CAADP Compact or not.

(2) Position of CAADP in SNDP

The Sixth National Development Plan (SNDP) will be announced in August 2010. The JICA team has obtained a draft report of the chapter on agriculture, which clearly notes that the Study Team and vision of the agricultural subsector in the SNDP have been harmonized with the framework of the CAADP Compact. The SNDP sets the annual growth rate of the agricultural subsector at 6%, which could be achieved by allocating more than 10% of the national budget. In the long run, the SNDP plans to alleviate poverty through the framework of the CAADP. They anticipate becoming a medium-developed country by 2030.

Chapter 3 Field Survey Results of Potential Areas

3.1 Selection of Survey Areas

3.1.1 Existing Irrigation Areas

A list of the numerous existing irrigation areas is attached in the Annex. *Figure 3.1* shows the location map of the respective irrigation areas. The map was obtained from the report on *"Water for Agriculture and Energy Development"* which was prepared by the FAO as material related to the AgWA.

Source: WATER FOR AGRICULTURE AND ENERGY DEVELOPMENT BY FAO

Figure-3.1 Location Map of Irrigation Areas in Zambia

The following *Table-3.1* below shows the large-scale irrigation area planned by MACO.

Table-3.1 Bulk Water Transfer Schemes

Name Of Scheme	Location of scheme	Proposed area under irrigation	Out-grower/Contract/Crop
Muvuma Valley smallholder infrastructure project	Mazabuka	4,600 ha	Nyati milling (wheat) Munali coffee (coffee)
Chiansi smallholder expansion project	Kafue	1,000 ha	Chiansi Project (wheat, maize, sugar)
Nansanga farm block bulk water supply	Serenje	10,000 ha	Core venture
Mkushi dam project	Mkushi	5,000 ha	Commercial farmers
Kalumwange farm block bulk water supply	Kaoma	3,000 ha	Core venture
Luena farm block bulk water supply	Kawambwa	5,000 ha	Core venture (sugar)
Copperbelt (Chapula Scheme, Mufulira Scheme, Maposa Kitwe Scheme)		1,000 ha	Stravensdale, Copperbelt mines DRC Border Lumwana and Kansanshi mines
Rehabilitation of smallholder irrigation schemes in Southern Province		500 ha	Livingstone tourism market
Institutional support for improved technical and advisory services in irrigation	Nanga, ZIAHT, UNZA, NRDC, ZCA	500 ha (100 ha each)	Institutional farming Irrigation training Technology demonstration Processing and value adding Agri-business
Sub-total		30,600 ha	

3.1.2 On-going Projects by World Bank and African Development Bank

(1) WB Projects

There are a number of on-going projects financed by international organizations such as the WB and AfDB. The Study Team selected the target areas for the IDSP supported by the WB in Group-1 (3 schemes) and Group-2 (4 schemes). *Table 3.2* shows a list of the irrigation areas in Groups 1 and 2. Currently, the WB is preparing three loan projects under the IDSP. Three schemes in Group-1 with high priority will be implemented as full plans (from F/S to implementation). Concerning these schemes, the WB will undertake an appraisal study in November 2010. The implementation plan with a budget of €100 million will be approved by the board date in March 2011. The project is expected to last for seven years. Concerning the four schemes in Group-2, F/S on one scheme and Pre-F/S on three schemes will be carried out with a budget of US$ 1.5 million from the WB. The above potential areas are grouped according to non-pump irrigation, small-scale farmers and possible water sources for a proposed dam. Therefore, the field surveys were carried out in high priority areas in Group-2 (Lumwana site) and Group-1 (Mwomboshi site). For the other 14 schemes in Group-3, there is no concrete plan yet.

(2) AfDB Projects

Additionally, as shown in *Table 3.3*, five schemes under the SIP with assistance from the AfDB were also selected as target areas.

(3) MACO Projects

As for the survey areas recommended by TSB in MACO, 14 schemes were chosen, including Muvuma Hills in the Southern Province and Kaleya area which was a successful case of PPP in establishing the Kaleya Smallholders Company. Furthermore, the Western, Northern and Eastern Provinces were recommended by NRDS in MACO as good quality rice-producing zones. The soil in the Western Province is very sandy with high water permeability. Therefore, it may be difficult to reclaim lowland paddy fields. According to FAO-STAT, rice production in the Western Province is smaller in scale than that of the Northern and Eastern Provinces. Consequently, the JICA Team decided to survey the paddy fields along the Chambeshi River in the Northern Province.

Table-3.2 List of Irrigation Areas in Group-1 and Group-2 of IDSP

Table 1:List of site (Group 1 to 3) to be considered based on priority and financing availability

Project Site	Location	Description	River Basin	Intervention Type	Expected Acreage	Indicative Seasonal Vol. Consumption	Existing Crops
Group 1							
Lusitu site	Siavonga – Southern Province	Currently under technical and environmental and socio-economic feasibility study. Mainly smallholder farmers, Phase 1.	Zambezi River	Direct abstraction from Zambezi River	250 to 750 ha	2.5 million m^3	Banana and horticulture
Mwomboshi site	Chhibombo – Central Province	Currently under technical and environmental and socio-economic feasibility study. Both large commercial and small-scale farmers, Phase 1	Luangwa River	Dam on perennial tributary stream/ river	4,000 to 5,000 ha	45 million m^3	Mixed crops, but mainly wheat, tobacco, horticulture
Musakashi site	Mufulira – Copperbelt Province	Currently under technical and environmental and socio-economic feasibility study. Medium commercial and small-scale farmers Phase 1	Kafue River	Direct abstraction from Kafue River	500 to 2,000 ha	45 million m^3	Mixed crops, but mainly horticulture, maize and wheat.
Group 2							
Lumwana site	Solwezi – North western Province	Earmarked for study under Phase 2.	Zambezi River	Dam on perennial tributary stream/ river	>1,000ha	>10 million m^3	Mixed crops, but mainly horticulture.
Nansanga Farm block	Serenje – Central Province	Earmarked for study under Phase 2. Large scale commercial enterprise driven.	Chambeshi River	Dam on perennial tributary stream/ river	>1,000ha	>10 million m^3	Wheat, soya beans, maize and horticulture
Msandile site	Chipata – Eastern Province	Earmarked for study under Phase 2.	Luangwa River	Dam on perennial tributary stream/ river	>500ha	>5 million m^3	Tobacco, maize. Groundnuts, sunflower
Nyamphande	Petauke – Eastern Province	Earmarked for study under Phase 2. Large scale commercial enterprise driven.	Luangwa River	Dam on perennial tributary stream/ river	>5,000ha	>45 million m^3	Wheat, soya beans, maize and tobacco

Table-3.3 List of Irrigation Areas in SIP of AfDB/Finland

	Project name	Province	County	Benefit area (ha)
1.	Kanakantapa	Lusaka	Chongwe	620
2.	Nega-Nega	Southern	Mazabuka	595
3.	Buleya Malima	Southern	Sinazongwe	275
4.	Nzenga Fishing Camp	Southern	Sinazongwe	98
5.	Chief Sinazongwa Village	Southern	Sinazongwe	100
6.	Kanakanpata dam	Lusaka	Chongwe	Water resources for Kanakantapa

Note: Simupande Village is excluded.

(4) Target areas for field survey

As shown in *Table-3.4*, through discussions with the donors and the governmental agencies, the following six areas were selected for the field survey.

Table-3.4 List of Candidate Areas for Potential Irrigation Development Sites

No.	Proposed Project Site	Province District	Present Land Use	Estimated Acreage (ha)	Proposed Water Resources	Present Status
1	Muvuma Hills	Southern Province Mazabuka District	Wheat Coffee Small & large-scale farmers	4,600	Water from Kafue River through pump and pipeline	Under Pre-F/S recommended by MACO
2	Kaleya Smallholders	Southern Province Mazabuka District	Sugarcane PPP-small farmers company	2,207	Water from Zambia Sugar main pipeline through pipeline	Completed
3	Kanakantapa	Lusaka Province Chongwe District	Small-scale farmers	620 Potential (2,000)	20m dam 25 million m^3	AfDB/Finland SIP Phase-2 Pre-F/S
4	Mwomboshi	Central Province Chibombo District	Small & large-scale farmers	5,000	20m dam Storage: 45 million m^3	WB IDSP Group-1 Pre-F/S
5	Lumuwana Mining	North-western Province Solwezi District	Copper and uranium mining	1,000	40m dam Storage: 20 million m^3	WB IDSP Group-2 Pre-F/S
6	Chambeshi River Flood Plain (Kalungu River)	Northern Province Kasama District	Rice	2,000	20m dam with mini-hydro power 1.5 MW Storage: 20 million m^3	Newly proposed by JICA Study Team

Note: The no. indicates the location in the following map.

Figure-3.2 Location Map of Candidate Areas for Large-scale Irrigation Development

3.2 Schedule of Field Survey

Table 3.5 shows the schedule of the field survey for the six selected areas. In addition, the paddy fields in Chanyanya area located in the suburbs of Lusaka were surveyed. On the same day, the National Irrigation Research Station in Kafue was also visited.

Table-3.5 Schedule of Field Survey

Month/date	Site Visited	Stay
7/16 (Fri)	Kaleya Smallholders Muvuma Hills	Lusaka
7/17 (Sat)	Kanakantapa	Lusaka
7/22 (Thu)	Lusaka => Solwezi	Solwezi
7/23 (Fri)	Lumuwana Mining => Kitwe	Kitwe
7/24 (Sat)	Kitwe => Kasama	Kasama
7/25 (Sun)	Kasama - Chambesi River	Kasama
7/26 (Mon)	Kalungu River, Chambesi Flood Plain	Kasama
7/27 (Tue)	Kasama => Lusaka	Lusaka
7/28 (Wed)	Mwomboshi	Lusaka
8/13 (Fri)	Chanyanya Site, NIRS	Lusaka

3.3 Results of Field Survey

3.3.1 Muvuma Hills Scheme

In July 2004, the Pre-F/S of the Mvuma Hills area was completed. The irrigation area is relatively large, covering 4,600 ha. Irrigation water will be pumped from the Kafue River and supplied through pipelines. The amount of irrigation water is estimated at 3.810m^3/sec. The landowners are composed of 50% smallholders, 10% medium-scale farmers and 40% of large-scale farmers. The project will cost US$ 23.4 million, redeemable in 25 years with IRR of 8.3%. MACO is planning to include this area in the sixth development plan.

Large-scale coffee fields with centre-pivot irrigation

Washing and sun-drying yard for coffee beans

3.3.2 Kaleya Smallholder Scheme

As mentioned in Chapter 1, the Kaleya irrigation scheme was the first to introduce the PPP method in management. The immigrated 400 households currently cultivate 2,207 ha of sugarcane. The average farm land size is 6.5 ha including the house plot and fields for crops for domestic consumption. The contract on cultivation rights is effective for 14 years and then it needs to be renewed. The company is financed by organizations such as Barclays Bank, Zambia Sugar, DBZ and CDC (currently withdrawn).

The yield of sugarcane is about 115 ton/ha and the produce is sold to Zambia Sugar. The Kaleya Smallholders Company takes 55% of the profit. This is used for operation and management of the irrigation facilities, the cost of irrigation water from Zambia Sugar (US$ 0.165/m^3), and the salaries of the company employees. The remaining 45% is given to the farmers. The company employs staff in the safety, accounting and agricultural sections. For maintenance of the irrigation facilities, management of the irrigation water, agricultural extension, and farm input supply, there are five agricultural staff who are in charge. Additionally, implementation of social infrastructures like schools, playgrounds, health centres and markets are considered important in order to help the immigrants to settle down satisfactorily.

Similarly in Chianshi area near Chanyana village on the right bank of the Kafue River, there are three centre-pivot irrigated fields and one movable sprinkler irrigated field producing wheat and soybeans.

Irrigation pipeline from Zambia Sugar

Large-scale sugarcane field under furrow irrigation

3.3.3 Kanakantapa Scheme

Of the six surveyed sites, only Kanakantapa site holds the possibility of co-financing with the Japanese government. The original SIP plan was to irrigate 620 ha by constructing a reservoir with a 5 million-m^3 capacity. However, the potential irrigation area is 2,000 ha. Therefore, it would be possible to irrigate an extra 1,380ha. The construction of the dam for the 5 million- m^3 reservoir would create a huge volume of excavation for the spillway. The excavated soil can be used as embankment material and thus the volume of the reservoir can be enlarged to 25 million m^3. A reservoir with such a large capacity can supply irrigation

water to the additional 1,380 ha. However, due to budgetary limitations, the SIP decided to implement irrigation only of the original 620 ha. Accordingly, they are willing to cooperate if the Japanese government executes the F/S on the extension area.

3.3.4 Mwomboshi Site

The Mwomboshi area belongs to Group 1 of the WB project. It is located near the Mwomboshi River in Chisamba District, about 50 km north of Lusaka. The main feature of the project is the construction of a dam with a height of 20 m, storage capacity of 20 million m^3, and irrigation area of 1,713 ha. The composition of the stakeholders is 273 ha for small-scale farmers, 360 ha for medium-scale farmers and 1,080 ha for large-scale farmers. The irrigation area is located around the reservoir. Irrigation water will be supplied to small-scale farmers by furrow irrigation, to middle-scale farmers by sprinkler irrigation, and to large-scale farmers by centre-pivot system.

This scheme is recognized as a high-priority project based on the pre-F/S. The total project cost is about US$ 27.8 million (consisting of US$ 3.8 million for the dam and US$ 24 million for the irrigation area).

Currently the WB is preparing an appraisal study for the three schemes in Group-1. The study is scheduled be concluded in November 2010 and approved in March 2011. Therefore, if the Japanese government is willing to carry out the F/S for these schemes according to the schedule planned by the WB, JICA needs to dispatch the S/W mission by March 2011. According to MACO, the loan agreement has not been signed yet and thus further discussion is necessary before the official meeting in Washington in March 2011.

3.3.5 Lumwana Mine Scheme

Lumwana Mine belongs to Group-1 of the WB project. It is located in the Northwestern Province which lies 60 km west of Solwezi city. In 2004 an Australian mining company began to prospect for copper and uranium in this area, and in 2008 the Lumwana Mining Company was founded. However, the mine which covers 35,000 ha is expected to close by 2043. Therefore, it is crucial to prepare and implement sustainable social development for after the closure.

There already exists a dam 40 m in height and 600m in width. An enlargement project is planned, bringing the storage capacity to 50 million m^3 with an extended height of 85m and width of 1,500m. There are no mining points upstream of the dam; they are all concentrated downstream. Both upstream and downstream of the dam, the water quality is monitored and there are no problems. At the moment, commercial aquaculture is carried out in the existing reservoir. The stored water in the reservoir is used for mining management and for domestic use by 2,800 families. Nevertheless, there is sufficient surplus water to irrigate 5,000 ha, mainly for rice paddies, pineapples, legumes, maize and cassava. As for the wetlands in Maheba Camp, there are already paddy fields yielding 6 - 7 ton/ha using the transplantation method. The Mining Company has provided the site for the reservoir and they have high expectations of the F/S and implementation of the irrigation scheme by the WB. It may be economically efficient considering that only the irrigation system needs to be planned.

Existing dam and reservoir (aquaculture)

Extensive Dambo area

3.3.6 Kalungu Scheme

Kalungu is a newly proposed irrigation scheme. Paddy rice is widely produced in the Northern Province, especially in the Chambeshi River basin. Therefore, rice production in the Northern and Eastern Provinces is greater than in the Western Province. There is a potential dam site for irrigation and hydropower generation on the Kalungu River, which is a tributary of the Chambeshi River. Paddy fields are spreading downstream of the proposed dam site. There is a possibility to conduct a development study since MACO is highly interested in this proposal.

The potential beneficial area of the scheme is the Chambeshi Flood Plain, which is a flat plain with an area of about 40,000 ha between the Chambeshi and Kalungu Rivers. During the rainy season, the area is substantially inundated. Thus it requires construction of a flood protection dike. It is recommended to develop the upper area of 5,000 ha first and then to expand to the lower area along with flood dike construction.

3.3.7 Chanyanya Existing Irrigation Area

Currently, the Chanyanya area is a highly politically-charged region and therefore it is controlled by the military. The irrigation facilities were installed between 1972 and 1975 with support from North Korea. 800 ha of paddy fields were originally developed mainly for young soldiers in the military. Nowadays, the existing pumps work properly and wheat is produced on 60 ha irrigated by the centre pivot system. Judging from the pump capacity, it is possible to irrigate 180 ha. There may also be moves to restart paddy rice production in the area. Nevertheless, this scheme is unfortunately not suitable for Japanese ODA because of military involvement.

3.3.8 National Irrigation Research Station

The National Irrigation Research Station is located in Nanga area and its focus is on research of farm irrigation rather than irrigation engineering. The irrigation water is first taken from the Kafue River into a farm pond by pump and then supplied to the respective fields using a second pump. The institute mainly conducts research on the relationship between irrigation methods and yield rates of maize, wheat and bananas. The major irrigation method is sprinklers followed by drip tubes. Neither gravitational irrigation nor open canals were found.

The area of the institute is 50 ha and the number of staff is 53 (7 researchers, 5 technicians, 4 administrators, and 37 workers). In order to implement medium- or large-scale irrigation projects in future, a substantial number of irrigation engineers will be required to enable reorganization of the institute. The layout of the existing institute is shown in *Figure 3.3*.

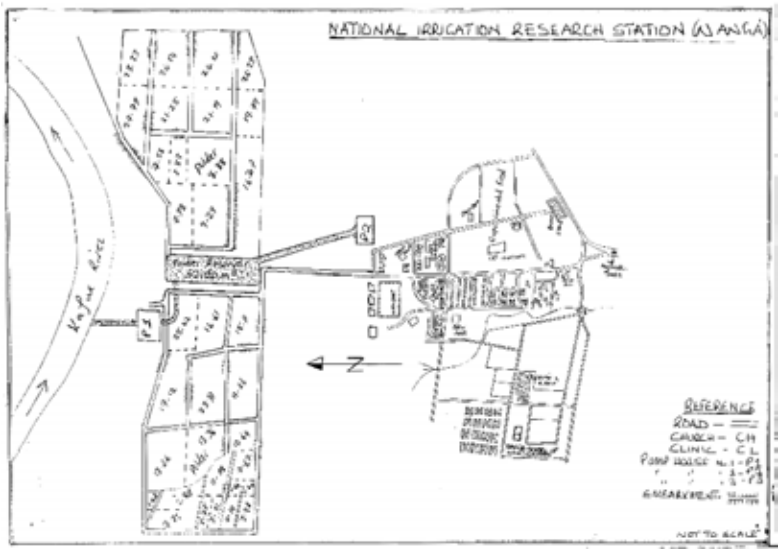


Figure 3-3 Layout of National Irrigation Research Station

Chapter 4 Potential Development Area

4.1 Criteria for Selection of Targeted Priority Development Areas

With respect to the target development areas, the Study Team created lists by grouping the projects based on analysis of the following components: donor, stage of progress, type of work (new construction or rehabilitation of facilities), scale of area, type of water resources, type of catchment facilities (headworks, pumping station, or dam), irrigation method (lined open canal, unlined open canal or pipeline), existence of water users' committees, crops and content of the project.

Three to five potential development areas were selected according to the selection criteria showing following 8 criteria. Then potential sites have been investigated in detail to identify not only physical conditions of the projects but also capacity and abilities of local governments and farmers' organization for sustainable use of irrigation facilities through self reliance of operation and management. Finally, in consultation with the JICA field office and related government authorities and donors, two promising potential sites to be supported under Japanese Government assistance corroborating with international donors will be selected on the basis of results of study and field investigations.

(1) To select preferentially the rehabilitation of existing projects in which saving effect of investment and rapid expression of effects can be predictable with no or limited land problems, compared to developing new projects.
(2) To select preferentially gravity irrigation requiring neither electricity nor energy.
(3) To select preferentially the areas where adequate amount of river flow can be accessible and where farmers can practice irrigation throughout a year.
(4) To consider reservoir planning, represented as storage reservoirs, in order to address the issue of fluctuation of rainfall and river flow. Hence, this Study Team preferentially selects areas with efficiently operating reservoir sites at the upstream of rivers.
(5) In terms of facility management, this project selects areas where it enjoys abundant vegetation with less soil erosion.
(6) To select preferentially the areas where farmers practice paddy cultivation in the targeted irrigation so that those who have experienced paddy cultivation are included.
(7) To prioritize the projects in the larger irrigation areas, given that the larger area of targeted farms have a greater impact on recipient farmers and influence more on socio-economic situation of the project areas in question.
(8) To select preferentially the areas where whether farmers' associations (Water Users' Committee) are in good operation or farmers are considered to be motivated to practice irrigation.

4.2 Current Situation of Irrigation Projects in Zambia

In Zambia, irrigation projects implemented by MACO have been the mainstream. Hence, the Ministry of Energy and Water Development (MEWD) is predominantly in charge of

reservoir development. The MEWD is supposedly responsible for dams with a height of more than 4m. Thus MACO is usually in charge of those with a smaller than 4m.

4.2.1 National Irrigation Plan

Within this overall framework and taking into account the vulnerability of Zambia's agricultural sector to weather and climatic vagaries, MACO has recently designed a National Irrigation Strategy that would provide guidance to all levels and types of investments in irrigated agriculture. It is therefore, now logical for MACO to develop a National Irrigation Plan (NIP) as part of the National Development Plan (NDP) that would run from 2006 to 2011 and to specify a quoted strategic investment and activities required to initiate and operate a competitive and sustainable agricultural sector.

Within the framework of the NAP and as part of the emerging FNDP, this NIP has the objective to promote the use of irrigation to accelerate sustainable agriculture development. For the purposes of designing this plan, the interventions proposed are analyzed and presented tailored to the resolution of constraints. In this regard, the NIP is organized around resolving four sets of constraints categorized as: 1) Finance and Investment, 2) Policy and Legal, 3) Institutional and Social and 4) Market Linkages.

Table 4-1 Budget for the NIP

Strategy	Budget (1,000 US$)
Irrigation Development Fund (IDF)	113,020
Infrastructure Development (public)	18,000
Institutional and Social	
Capacity building of MACO Extension	13,736
Capacity Building - Farmers' Organizations	2,813
Capacity Building - Out Grower Promoters	115
Strengthen Irrigation research capacity	1,836
Capacity building -Technology Development and Advisory Unit – UNZA	480
Grand Total	150,000

Source: NIP

4.2.2 Irrigation Development and Farmers' Type

In Zambia farmers can be categorized into the following three types;

- Small-scale farmers:

  Small-scale farmers produce food crops and vegetables mainly for domestic consumption, and can only afford minimal fees for operation and maintenance. Furrow irrigation is utilized.

- Emergent farmers:

  Emergent farmers produce cash crops as well as food crops. They have the technical capacity to produce high quality food. Sprinkler irrigation is mainly utilized.

- Commercial farmers:

  Large-scale commercial and collective farms are aiming to produce market oriented farming products. Irrigation facilities and farm mechanization are well provided.

According to the above farmers types, outline of the NIP aims are shown in the following Table 4-2. As seen from the table, development areas for small holders and peri-urban areas in the NIP cover almost 65 % of the total areas.

Table 4-2 Outline of NIP

Farm Size	Aims of NIP		Development Area in the NIP
1)Traditional Farmers	Capacity development of Extension Worker Capacity Development of Farmers' Organizations		Small-holder in Rural Area : 30,000ha Peri-urban Area : 15,000ha Contracted Areas : 5,000ha
2)Emergent Farmers	Cost reduction of irrigation facilities	Market development of farm products. Promotion of contracted Farm products. Efficient publishing of Water Right. Operation cost saving.	
3)Commercial Farmers	Facilitating of irrigation facilities and Financial support for Private Sector by IDF		Large scale Commercial Farmers : 5,000ha （Others 15,000ha）
			Total 70,000ha

Chapter 5 Development Plan for Target Priority Areas

5.1 Selection of Final Targeted Priority Areas

According to the criteria explained in Chapter 4, following priority areas have been examined for selection of final promising potential 2-sites.

5.1.1 Muvama Hills

Muvama Hills is one of the highest priority areas due to its large area and location near Lusaka. Thus MACO is highly interested. However, it requires a substantial energy supply since the only way to obtain water is by pumping. Furthermore, there are already large-scale commercial farmers near the Kafue River, thus it may be difficult to obtain water during the dry season. Also, about 40% of the land is owned by large-scale farmers, so readjustment of the water distribution for small-scale and emergent farmers may be necessary. The F/S was executed in 2004; however, no international donors willing to support the project have been found. Based on the above situation, due to financing and land ownership problems, the area is excluded from the final targeted priority area.

5.1.2 Kaleya Site

The field study that took place in Kaleya Site is an example of a successful case; it is a good reference site to study irrigation facilities and management.

5.1.3 Kanakantapa Site

There are currently two on-going projects under the SIP in Kanakantapa Site. Also, as Phase-2, the Finnish Government decided to support financially for construction of a dam and to irrigate an area of 620ha. However, no donor has been found to take over the enlargement of the project area. The storage capacity of the dam is 25 million m^3, thus it promises a huge return on investment by enlarging the irrigation area. The dam is the water source and an enforcement system by MACO has been well prepared. The area surrounding the irrigation area also has good potential for implementing the gravitational irrigation system. At the moment, 25 million m^3 of storage capacity is not included in the calculation of the possible irrigation area. Therefore, by Japan implementing the F/S, including the paddy fields downstream and taking into consideration of the reservoir storage capacity and possible irrigation area, more efficient management of the dam would be possible.

Moreover, upon completion of the F/S, the Finnish Government is further interested in supporting the construction with an additional grant. Consequently, due to its high potential, it is no problem to execute F/S for this site.

5.1.4 Mwomboshi Site

Mwomboshi Site is listed in Group 1 of the ISDP of the WB and it is one of the areas with the highest potential. The storage capacity of the dam is 45 million m^3 and thus the irrigation area is huge, with 2,000 ha for small-scale farmers and 3,000 ha for large-scale commercial farmers. The area is attractive because PPP and companies with specialist knowledge in agriculture, management and administration will be introduced after completion of the project.

Large-scale farmers will be expected to construct the facilities on their own and buy irrigation water at commercial cost. The benefits will then be used for sustainable management of small-scale farms. The problems are suitability of the system and quality of the management by such companies.

Up to now, water-users' associations have been formed by small-scale farmers to sustain the management of the irrigation facilities; however, the outcome has not been satisfactory. Currently, the Zambian Government is trying to further invest in agriculture and infrastructure. In August 2009, the Ministry of Finance and National Planning enacted the *Public-Private Partnership Act, 2009*. This includes electricity, communications, water, administration and waste disposal. Accordingly, they are already involved in implementing PPP for water use, especially for irrigation, and successful outcomes have been achieved in both Kaleya and Chianshi areas. They can be used as reference for future management of irrigation facilities, and thus it will be possible to make good use of Japan's knowledge of asset management in the irrigation facilities.

The WB is also considering possible co-financing with Japan, and thus the area has the highest priority. Unfortunately, the final decision of the WB will be made in March 2011. Thus, at this point their schedule does not correspond with that of Japan. The Japanese government therefore has no choice but to exclude the area from the project.

5.1.5 Lumuana Mining Site

The field study confirmed that copper and uranium mining are found in Lumwana Site (Group-2) and are excavated by the open-cut method, and the mining company believes that their activities comply perfectly to the related laws of environmental conservation. However, unforeseen accidents may considerably affect the environment. The target area for irrigation is developed for mainly small-scale farms, but part of the private mining area may also be included. Therefore the area is considered not to satisfy the requirement of the projects to be implemented by the Japanese Government.

5.1.6 Chambeshi River Basin and Kalungu River Site

Both the Chambeshi River Basin and Kalungu River sites are newly investigated areas. With high potential for paddy cultivation, gravitational irrigation can also be implemented in the area. In particular, development of 40,000ha is possible in the Chambeshi River Flood Plain. The area may become one of the major paddy cultivation areas in Zambia and it has very high potential in the long term. Consequently, with the possibility of implementing large-scale paddy cultivation, the area has been chosen as a strong candidate.

5.1.7 Chambeshi River Basin and Kalungu River Site

Consequently, the following two sites are the most promising candidates for the F/S to be conducted by the Japanese Government . Further details are shown in the following Table 5-1.

1) The enlargement project of the SIP in Kanakantapa site, which is currently run by the AfDB and the Finnish Government.
2) A new irrigation project of the Chambeshi River Basin and Kalungu River Site in the Northern Province.

Table 5.1 List of Candidate Projects (Republic of Zambia)

List of Candidate Projects (The Republic of Zambia)

	Candidate Project	Project Site (Location)	Budget (100million yen)	Development Organizations	Implementing Agencies	Progeress	Objectives and Outcomes			Input	Basic Condition								Advantages	Concerns
							Irrigation Area (ha)	Targeted Crops	Yields		New/Reconstruction/Implevement	Irrigation Methods/Facilities at the Water Resources	Collaboration with WB	Consistency	Urgency	Water Resources	Operation and Management System	Farmers' Associations	Access	
1	Kanakantapa	Lusaka Province Chongwe District	10.0	AfDB/ Finland	MACO (SIP)	F/S: Completed Execusion Design of Dams: Ongoing Layout of Irrigation Areas: Completed	620 Potential Area 2,000	Upland Crop Paddy Crop	5 t/ha	Approximately 25million m3 of reservoirs shall be consturcted due to the topographical limitation. While developable areas is estimated to be approximatgely 2,000ha, 620ha of irrigation area will be developed due to the budget constraints. Any donors have not undertaken the rest of extension areas as of today. Irrigation drainage facilities and on-farm development are required for development of extended areas.	Newly construction	Pumpup from dams △ Gravity Irrigation can be partially Newly constructed dam H=20m, (Storage capatiy : some 25million tons)	x (Collaboration with AfDB/	◎	◎	◎	◎	◎	◎	Given that large-scale reservoirs shall be implemented by AfDB/Finland, large volume of water can be secured. Relocation plan at upstream has been already explained to rural residents. Environment Impact Assessment is being under consideration.	It is required to estimate possible irrigation areas for 25 million tons of storage capacity by hydrological calculation. As a result, F/S shall be conducted on the rest of extension areas, deducing 620 ha of implementing areas. Due to the fact that the Study Team has not consider gravity irrigation, it might be necessary to consider catchment methods and introduction of paddy irrigation. Currently, irrigation areas are located on the left side of the river exclusively; however, the Study Team considers to extend the irrigation areas on the right hand side of the river, especially by means of gravity irrigation.
2	Chambeshi River Basin Munti-purpose Development Project	Northern Province Kasama District	46.9 IRR=25%	WB IDSP	MACO	The project is planned to be integrated into the group of IDSP, WB.	Phse-1 5,000 Total Potential Area 40,000ha	Paddy Crop	5 t/ha	Installation of small hydroelectoric generation (3MW) is feasible. Flood control embarkment construction is required.	Newly construction	Gravity Irrigation ◎ Newly constructed dams H=25m, (Storage voume: some 150milloion tons	◎	◎	◎	◎	◎	◎	◎	△	Construction of hydroelectric generation is undergone in Chambeshi Dam. Catchment works is under construction to drive water by gravity irrigation in the irrigative areas. As for the entire development plan, multi-purpose large-scale development of the dams described above and one in Kalungu River (hydroelectric generation, 50million tons of volume of water) shall be possibly constructed, targeting at 40,000 ha.	While Chambesi River Flood Plain holds approximately 40,000ha of potential irrigation, levee should be consructed in order to controll flood. 5,000ha of irrigation areas, being rather high in latitude and by scarcely affected by flood influence, shall be developed as pilot site in Phase-1.
8																				

Note;
IDSP : Irrigaiton Development Support Project by World Bank
SIP : Small Irrgation Project by AfDB/Finnish
MACO : Ministry of Agriculture and Cooperatives
AfDB: Africal Development Bank
WB: World Bank
IRR: Intenal Rate of Return

5.2 Project Plan for Final Target Priority Areas

In order to obtain approval of the two final target priority areas, a meeting was held on Tuesday, August 10th, with Mr. Sichembe (Deputy Director) and Mr. Shukuleka (Chief Irrigation Engineer) from TSB in MACO. Furthermore, in order to make clear the agreement with MACO, a letter was sent to the vice minister and a reply was received. See the Annex for details.

The outlines of the project plans for the two areas are described below. As mentioned above, despite its high potentiality, Mwonboshi site was excluded from the priority area due to the non-corresponding schedule with the WB. As mentioned previously, however, the area has attractive potential for further extension of large-scale commercial farming by means of PPP. Therefore, for reference, details are given later in this chapter in 5.3.

5.2.1 Kanakantapa Site

(1) SIP run by AfDB/Finland in Kanakantapa area

The dam construction and irrigation development (620 ha) will be implemented by the AfDB and the Finnish Government. The storage capacity of the reservoir is about 25 million m^3 and it is estimated that this would enable irrigation of about 2,000 ha. The H-V curve of the reservoir is shown in *Figure-6*. The proposed high water level is set at EL 1,116 m.

In the expected F/S, irrigation development of the extended irrigation area utilizing proposed reservoir would be studied, including planning of different cropping patterns for efficient water use and calculation of the water balance to estimate the possible irrigation area. The Finnish government is willing to provide an additional €9 million for the expansion. In the end, as a possible project with support from the AfDB and Finland, Kanakantapa area is selected.

According to the topological map (1:50,000), the possible reservoir area can be enlarged more than expected. Thus, the storage capacity can be increased to 30 million m^3. Besides irrigation of the 620 ha planned by the AfDB, additional area of 2,000 ha would be probably irrigated with the increased storage capacity of the reservoir. During the F/S, the total area of 2,620 ha would be carefully examined by accurately estimating the storage capacity, as well as limiting the irrigation area and selecting the best suited crops. Implementation of the gravitational irrigation system will also be considered, in order to reduce the total cost as much as possible.

The overall layout of the plan is shown in *Figure-5*.

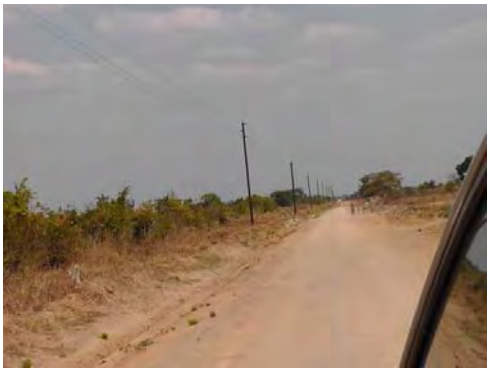
Dam site view from upstream

Kanakantapa River upstream of dam site

View of right abutment from left abutment

Stones on right abutment of dam site

Stones on left of dam axis



Electricity supply for pump operation

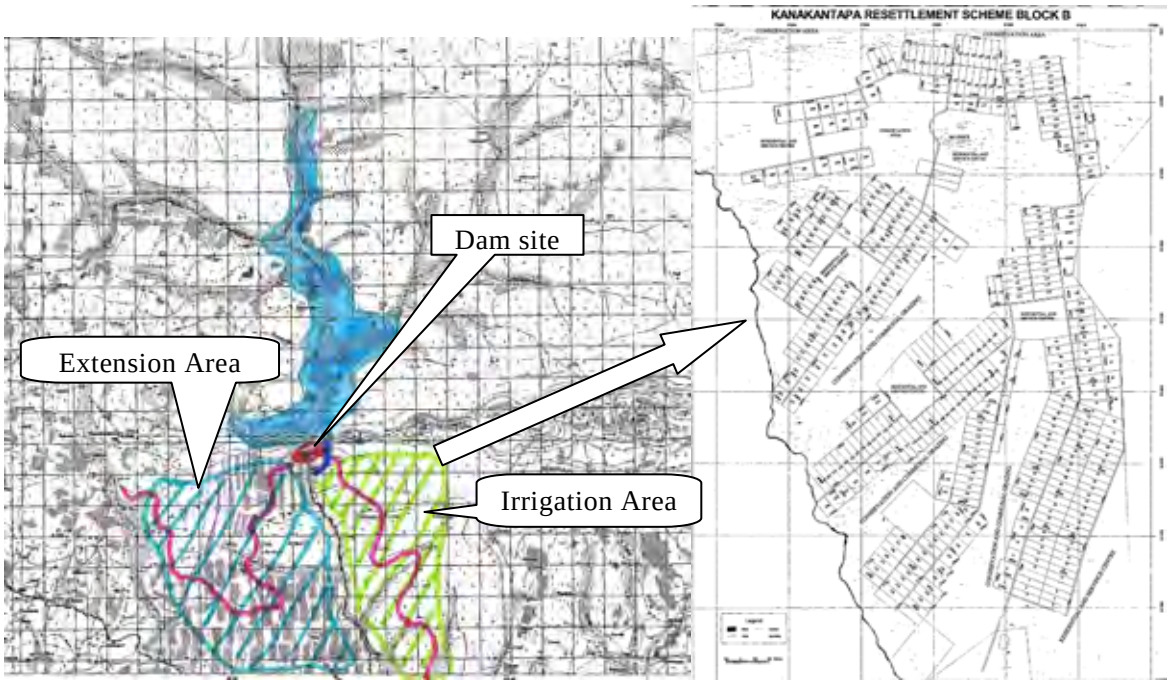


Figure 5.1 Layout of Kanakantapa Scheme

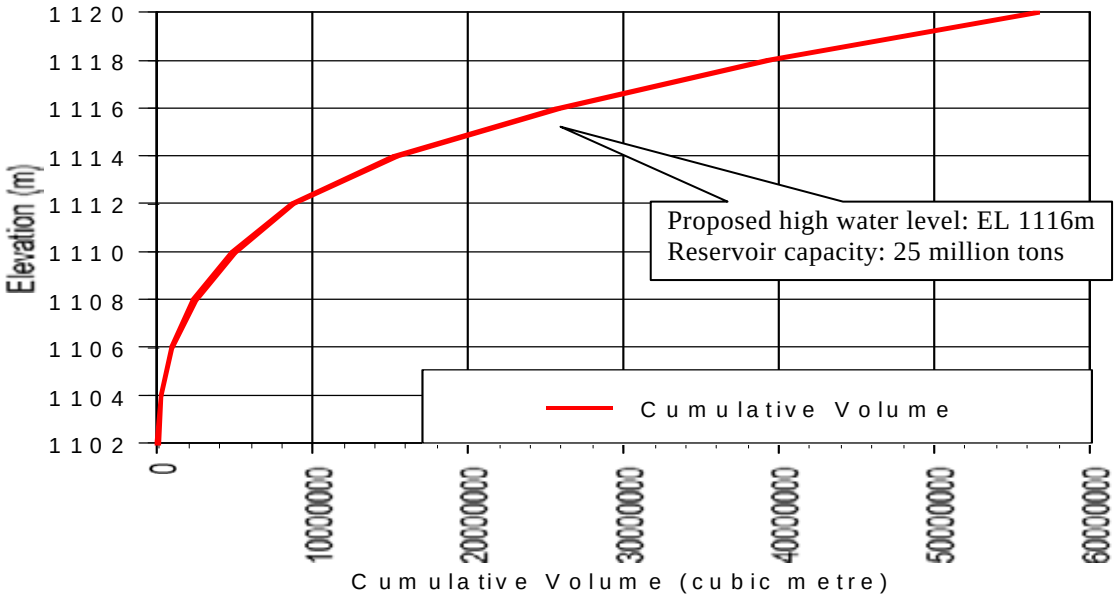


Figure 5.2 Height-Capacity Curve of Kanakantapa Reservoir

(2) Estimation of Cost and Benefit of New Expansion Area

1) Project Cost

As mentioned above, the total irrigation beneficial area would be 2,620ha, and the irrigation area implemented by the AfDB/Finnish Government is estimated at 620ha with construction of the Kanakanpata Dam. Therefore, in the case of Japanese Government involvement, the remaining irrigation area of 2,000ha would be studied.

In this cost estimate, the cost of pumping irrigation project is calculated corresponding with AfDB project. This cost needs to be reviewed at the expected F/S in consideration of gravitational irrigation.

a) Project Outline

Irrigation beneficial area : 2,000 ha

Water resource facilities

Dam : H = 12m, Reservoir capacity : V = 25 million m^3

Pump station: 2 Total capacity 3.00m^3/s、450kw

Right main canal for pumping up：Length 8.0 km

Right main canal for gravitational irrigation : Length 8.0 km

Left main canal for pumping up：Length 8.0ｋｍ

Left main canal for gravitational irrigation : Length 8.0 km

Regulating reservoir： 2 Capacity : 260,000 m^3

Main drainage canal with flood protection dike：Length 14.0 km

Field development：2,000 ha

b) Total Project Cost

The direct construction costs is estimated on the basis of similar nearby project costs. The estimated amount is shown in Table 5-1 below and the total cost is estimated at US$14 million.

The currency exchange rate is shown below.

US$ 1 ＝ Yen 85

Table 5-2 Kanakantapa Irrigation Project Construction Cost

Items	Cost (US$)	Remarks
1. Dam	3,191,400	
2. Pump stations	2,700,000	
3. Regulating reservoirs	1,516,500	
4. Right main irrigation canal（8.0km）	841,500	
5. Left main irrigation canal（8.0ｋｍ）	841,500	
6. Drainage canal with flood protection dike（14ｋｍ）	970,200	
7. Field development（2,000ha）	1,800,000	
Sub - total（Direct cost）	11,861,100	
Contingency	1,186,110	10% of the direct construction costs
Supervision cost	593,055	5% of the direct construction costs
Sub - total	1,779,165	
Engineering Fee	593,055	5% of the direct construction costs
Total	14,233,320	1.2 billion yen

Note：Estimated by the Study Team

c) Operation and Maintenance Cost

The cost of operation and maintenance is estimated at 3% of the direct construction cost for each year. The replacement cost of the steel facilities is estimated at 1% of the direct construction cost for each 30 year period.

The electricity cost for operation of 450 kw pumps is estimated at a unit price of 0.1 $/kwh for one-crop season of 4 months as shown in the following equation.

0.1 $/kwh × 450 kw× 4 month/crop ×30 days/month × 24 hours/day× 2 crops/year

= 259,200 $/year

Table 5-3 Operation and Maintenance Cost（Unit: US$）

	Direct construction costs	Ratio	Maintenance costs
Annual cost	11,861,100	3.0 %	355,833
electricity			259,200
Total of Annual cost			615,033
Replacement cost		1.0 %	118,611

Note：Estimated by Study Team

2) Project Benefit

The project benefit is estimated for the production of 2,000 ha of paddy rice.

The target yield is estimated at 5.0ton/ha and the milling rate at 65% with double cropping every year.

For EIRR analysis, the price of milled rice is estimated on the basis of FOB Bangkok at 450 US$/ton and the production cost of rice is estimated at 20% of the price.

Table 5-4 Economic Benefit （Unit: US$）

Production	Acreage （ha）	Yield of milled rice （ton/ha）	Total production （ton）	Net production	Benefit
1st crop	2,000	3.25	6, 500	360	2,340,000
2nd crop	2,000	3.25	6, 500		2,340,000
Total					4,680,000

Note ：Estimated by Study Team

3) Economic Internal Rate of Return (EIRR)

The calculation of EIRR is estimated based on the following conditions;

- The project lifetime is estimated at 30 years taking into consideration the related facilities.
- The construction period is estimated at 2 years.
- The target yield will be reached just after construction.
- EIRR is calculated for 85% of the direct construction cost allowing for the conversion factor.

The result of EIRR analysis is shown below;

EIRR = 26%

5.2.2 Chambeshi River Basin Comprehensive Multi-purpose Development Plan

The Chambeshi River basin, which has a catchment area of 44,427 km^2, is the second smallest of the six river basins in Zambia. The Chambeshi River merges with the Luapula River at Chambeshi village on national route T2. The upper part of the basin is mountainous and is a potential dam construction site. Preparation of a long-term water resources development plan for the Chambeshi River basin is recommended. As the river basin is located within the national territory and has plenty of water from an annual rainfall of about 1,500 mm, an integrated regional development plan for hydropower generation, irrigation development, domestic water supply and flood control in the Northern, Eastern and Luapula Provinces would be very attractive.

The beneficiary area is the extensive 40,000-ha (20 km x 20 km) named as Chambeshi Flood Plain. The flood plain lies between the upper reaches of the Chambeshi River and the parallel Kalungu River. As seen on the 1/50,000 topographic map, there are potential dam sites on both the Chambeshi River and the Kalungu River and hydropower generation seems to be possible due to their sufficient base flow. From the viewpoint of long-term development, a master plan for regional development of the Chambeshi River basin would be formulated. The main components would be irrigation with an area of 40,000 ha, hydropower generation, and flood control.

As for water resources development, there is a dam site at Nusunka village in the middle reaches of the Chambeshi River. The Chambeshi Dam is designed with a height of 25 m and a reservoir capacity of 150 million m^3. Further, there is a proposed dam site on the upper reaches of the Kalungu River, which is the most advantageous of the several potential dam sites on the river. The Kalungu Dam is designed with a height of 20 m and a reservoir capacity of 50 million m^3. Their location is shown in Fig.5-3

The Study Team conducted a field survey at the proposed dam site on the Kalungu River, which is a tributary of the Chambeshi River. The slope at the dam site is relatively gentle. There is a suitable abutment to support a 20 m to 30m dam in height. The water in the river is very clear in the dry season. The base flow amount of the river is estimated at about 20 m^3/sec on the basis of measurements at the downstream bridge site at the end of July. Assuming a base flow of 20 m^3/sec and a dam height of 20 m, hydropower generation of about 3,000 kW would be possible. Similarly, the proposed dam on the Chambeshi River can also generate electricity. Such hydropower generation would solve the shortage of electricity in the Kasama city area.

The lower flood plain will be developed into 40,000 ha of irrigated paddy fields for double cropping of rice. However, the present technical level of rice production is judged to be low because the yield of rice is not more than 1.0 ton/ha. Further study of the farm households, post-harvest facilities, and marketing system is necessary to form a stepwise agricultural development plan.

In Phase-1, irrigation development shall be implemented of about 5,000 ha in the relatively suitable part, and the Chambeshi Dam shall be constructed for hydropower generation of 3,000 kW. The headworks shall be constructed 15 km downstream of the dam or 5 km upstream of the bridge in Chichisela village, and the 25-km main canal with a headwater level of EL 1,230

m shall be constructed along the existing road. In the southern part of the beneficial area, the main canal shall be placed at a height of EL 1,230 m to EL 1,225 m to irrigate 5,000 ha. The main drainage canal shall be installed in the lower reaches of the beneficial area, and the excavated material shall be used for construction of the flood dike.

In future plans, flood dikes shall be constructed along the Chambeshi River and the Kalungu River to prevent flooding from the Chambeshi River. Drainage by pumps might be necessary during the rainy season. The electricity for the pumps shall be supplied from the hydropower plant at the dam.

Figure-5-3 shows the Phase-1 development area and overall multi-purpose development plan.

According to the latest information, the Zambia office of the World Bank intends to incorporate this Chambeshi River basin development scheme into Group-2 of the IDSP. Co-financing of Group-1 by the Japanese government and the World Bank is difficult due to the tight schedule. In the case of Group-2, there is a greater possibility of co-financing due to enough time being available for the preparation.

(1) Outline of the project

The area benefiting from this project is estimated at approx. 5,000 ha.

Water resource facilities

Dam: H = 25 m, Storage capacity: V = 1,500 million m^3

Head works

Water channel to the main canal: Length 24.5 km

Main canal: Length 16.0 km

Drainage from the main canal/embankment: 25.0 km

Paddy development: 5,000 ha

Hydropower generation: 3,000 kW

(2) Total project cost

The direct construction costs is estimated at the equivalent of 3.7 billion yen, as shown in the table below, on the basis of the construction unit prices of similar projects in the surrounding area.

The foreign exchange rates used in the project cost estimation are:

US$ 1 = Yen 85 = ZKW 4,500

Table 5-5 Cost estimation for the Chambeshi Irrigation Project

Expenditure item	Amount (US$)	Remarks
1. Dam	20,286,000	
2. Head works	1,972,947	
3. Construction of the water channel to the main canal (24.5 km)	3,943,400	
4. Construction of the main canal (16.0 km)	673,200	
5. Construction of drainage/embankment (25 km)	618,750	
6. Paddy development (5,000 ha)	4,500,000	
7. Hydropower generation facilities (3,000Kw)	4,500,000	
Sub-total (Direct construction costs)	36,494,297	
Contingency	3,649,430	10% of the direct construction costs
Construction supervision costs	1,824,715	5% of the direct construction costs
Sub-total	5,474,145	
Engineering costs	1,824,715	5% of the direct construction costs
Total	43,793,156	3.7 billion yen

Note: Estimated by the Study Team

(3) Operation and maintenance costs

In the estimation of the operation and maintenance costs, the annual expenditure is assumed at 3 % of the direct construction costs. In addition, it is assumed that an additional expenditure of 1% of the direct costs was required every 30 years as the replacement costs.

Table 5-6 Operation and maintenance costs (Unit: US$)

	Direct construction costs	Ratio	Maintenance costs
Annual costs	36,494,297	3.0 %	1,094,829
Replacement costs		1.0 %	364,943

Note: Prepared by the Study Team

(4) Project benefits

Agricultural income from of the paddies to be developed (5,000 ha) and the revenue from the hydropower generation (750 kW) are assumed as the benefits of this project.

The design yield of 5.0 ton/ha and the rice polishing ratio of 65 % are used in the estimation. It is assumed that rice would be raised twice a year in all paddies.

Meanwhile, the price of rice in the international market and the production costs are assumed at 450 US$/ha and 20 % of the price, respectively, in the estimation of the economic

internal rate of return (EIRR).

It is assumed that the hydropower is to be generated 300 days per year and the rate is assumed at 0.1 $/kWh.

Table 5-7 Economic benefit estimation (Unit: US$)

	Planted area (ha)	Yield polished rice (ton/ha)	Harvest of polished rice (ton)	Price of rice	Benefit
Rainy-season paddy rice	5,000	3.25	16,250	360	5,850,000
Dry-season paddy rice	5,000	3.25	16,250		5,850,000
Revenue from the hydropower generation	3,000kW		21,600,000 kWh	0.1 $/kWh	2,160,000
Total					13,860,000

Note: Prepared by the Study Team

(5) Internal rate of return

The internal rate of return is calculated with the following assumptions:

- The project life is assumed at 20 years in consideration of the actual situation.
- The construction period is assumed at three years.
- Achievement of 100 % of the benefits is assumed immediately after the completion of the construction work.
- In the estimation of EIRR, the economic costs are calculated by multiplying the amount obtains by deducting the contingency from the finance costs by an arbitrary conversion rate of 0.85.

In this project, only EIRR is estimated because of the large proportion of the contingency for price increase. The result of the estimation is shown below:

EIRR = 20 %

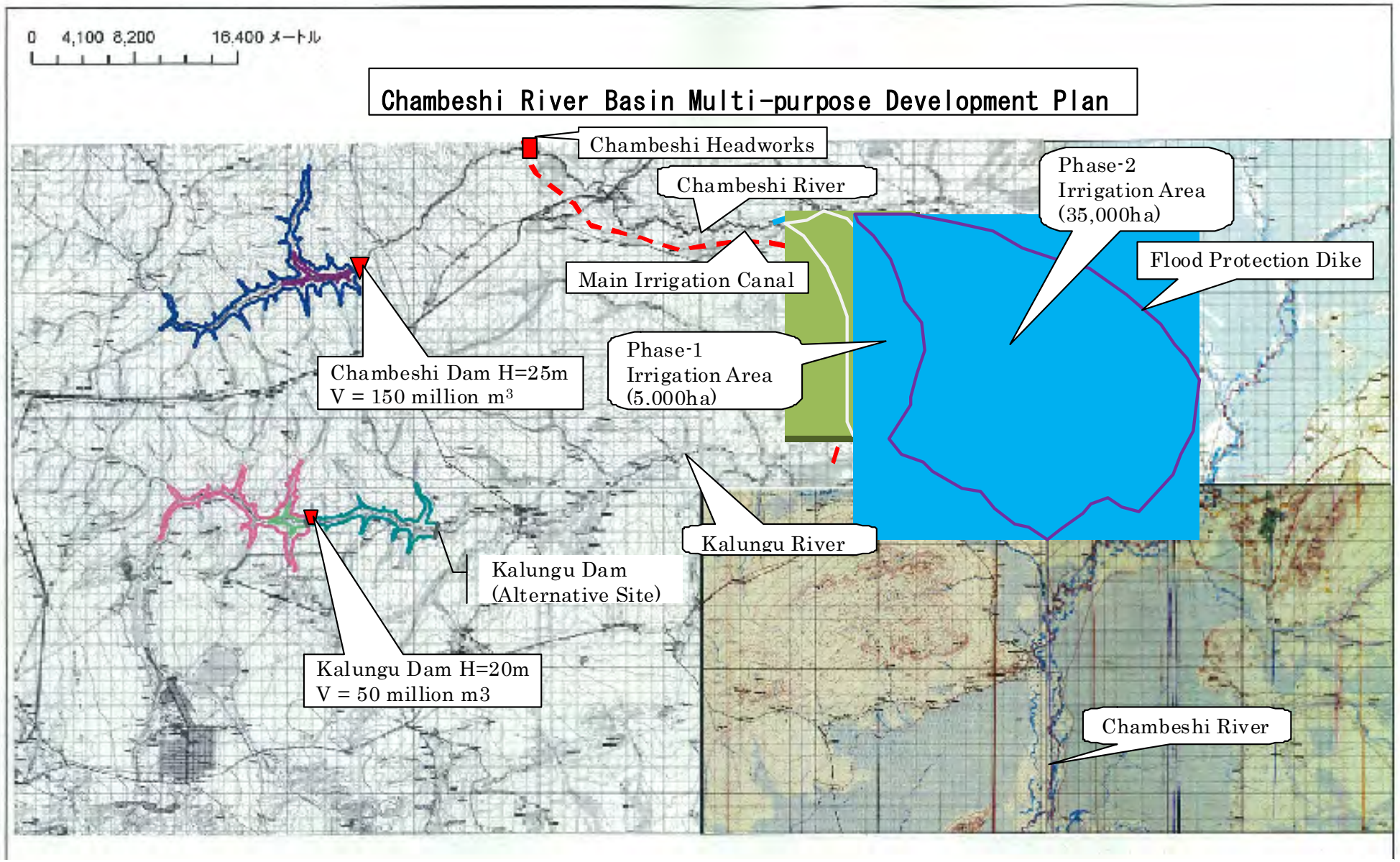


Figure 5.3 Chambeshi River Basin Multi-Purpose Development Plan

Kalungu River at dam site

Clear water at downstream bridge in dry season

Right abutment upstream of dam site

Left bank view from right abutment

Rice cultivation by direct sowing

Roots of rice plants

Interview survey of farmers

Proposed irrigation area

Proposed irrigation area

Bridge in lower reaches of Kalungu River

Ferry at junction of Chambeshi River

Chambeshi River and national route T-2

5.3 Project Plans for Other Potential Sites

5.3.1 Mwomboshi Site

Mwomboshi site is one of the three schemes in Group 1 of the IDSP under the WB. According to the WB schedule, the investigation should be completed by March 2011. As this does not correspond with our schedule, we have had to forgo cooperation with the WB. Nevertheless, implementation of PPP is proposed upon completion of the project. Therefore, the area has attractive potential to further extend large-scale commercial farming. For reference, further details are given here.

(1) Co-finance between WB and Japanese Government

Mwomboshi site includes small and medium-scale farmers as well as large-scale farmers. Thus it is necessary to judge if the large-scale farmers in the beneficial area will hinder the F/S conducted by JICA.

In terms of paddy cultivation, the wetlands in the area have high potential. According to small-scale farmers in the area, they own 10 ha on which they grow maize, groundnuts and tomatoes. If an irrigation system is implemented, they hope to use 5 ha for growing rice and the rest for high quality green maize and tomatoes. Accordingly, demand for rice in Zambia is relatively high and if irrigation water is provided, it will not be very difficult to introduce paddy cultivation. Although the consent of MACO and the farmers is needed, the conditions are good for Japan to conduct the F/S especially for implementing paddy cultivation. The Pre-F/S is already completed in Group-1; of the three schemes in Group-1, Mwomboshi site has the largest area and considering the water storage capacity, it will be possible to enlarge the area even more.

(2) Schedule of JICA F/S

The WB appraisal is scheduled in November 2010 and the final decision on project implementation would be concluded in March 2011. Subsequently, the F/S would be carried out by a contract-based consultant. If Japan is to conduct the F/S, JICA needs to conclude the S/W with the Zambian Government by the end of 2010, and the F/S needs to be started by early 2011. The WB says that seven years would be required to complete the projects in the three areas. Judging from the necessary planning for the dam and topographic survey of the irrigation area, the F/S would take around two years. Another year would be required for selection of a new consultant company utilizing from the WB fund, and for detailed planning of the design, preparation of the contract documents and bidding. Thus the actual construction period would be 4 years. Therefore, in order to complete the project on time, simultaneous construction of the dam and the irrigation system by several contractors would be necessary. *Figure 5.4* shows the draft schedule for implementation of the scheme.

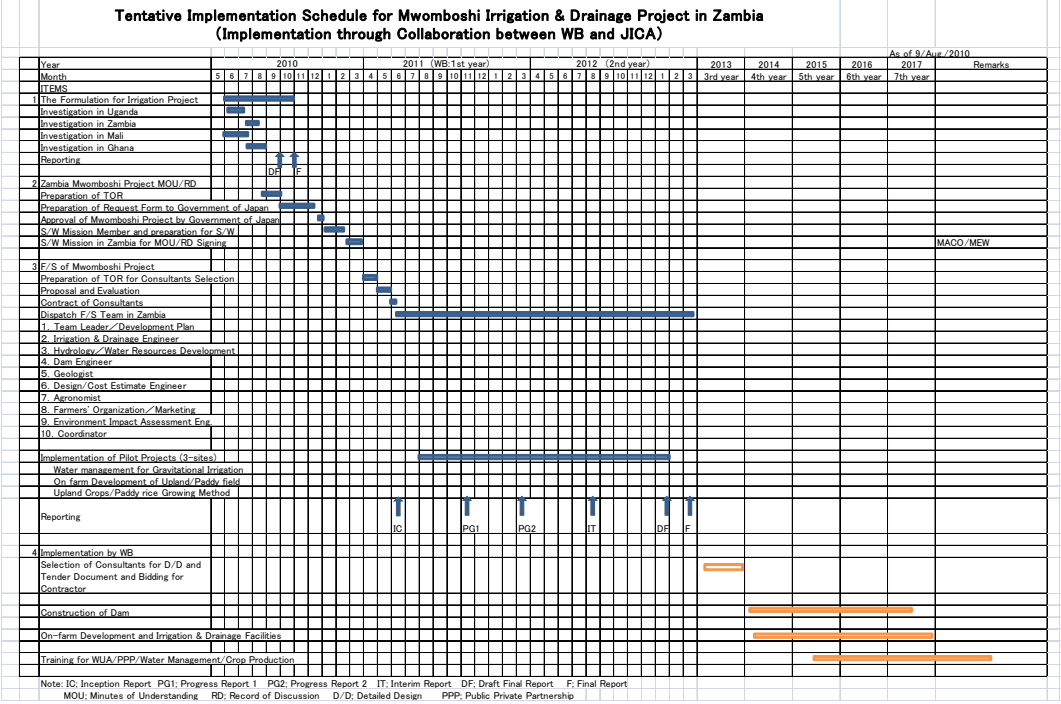


Figure-5.4 Draft Schedule of Mwomboshi Irrigation Scheme Implementation

(3) Outline of the Project

Irrigation development of the Mwomboshi site would be implemented based on three tiers of small-scale farmers. The small-scale farms are located in the north of the reservoir, and the southern part belongs to large-scale commercial farmers. *Figure-5.5* below shows the layout of the scheme.

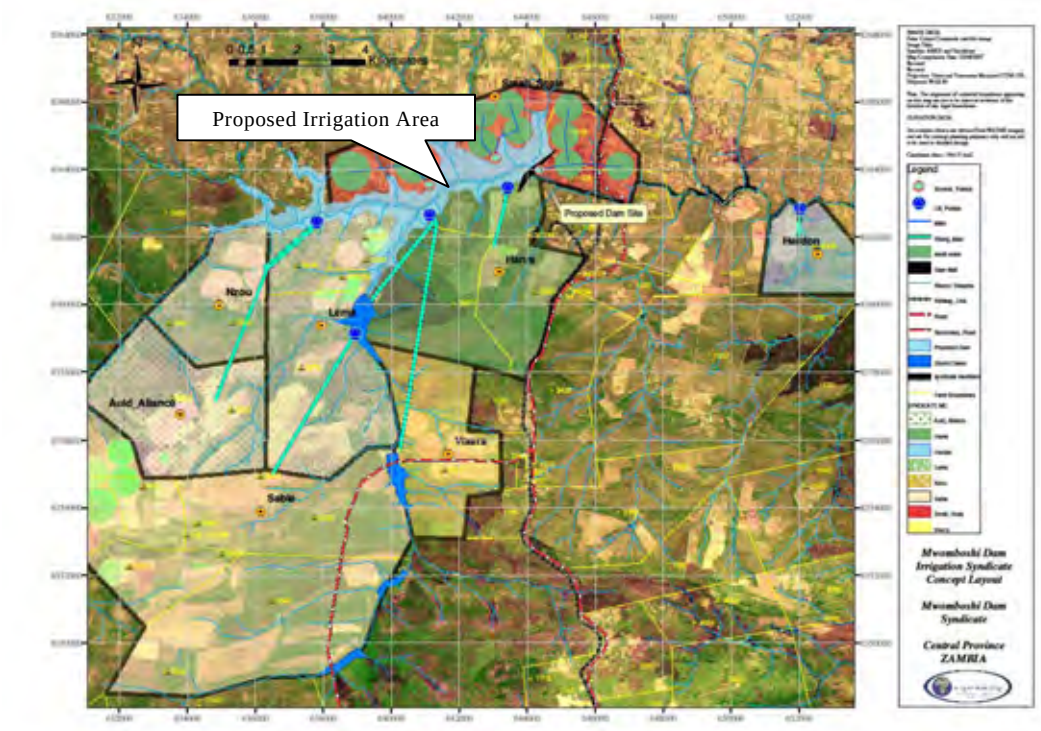


Figure-5.5 Mwomboshi Irrigation Scheme

(4) Introduction of PPP Management Approach in Mwomboshi Site

With regard to the 3 schemes in Group-1 of the IDSP by the WB, introduction of PPP is recommended for better project management. Thus in March 2010 the WB made a contract with a British consultant for *"Consultancy Services for the Establishment of the Public Private Partnership (PPP) Options in the Irrigation Infrastructure Development and Management"*. In Mwomboshi site, which is the largest project scheme, management may be carried out by a private company.

After the completion of the Mwomboshi scheme, PPP and asset management by an experienced private company are expected to be implemented for better irrigation facility management. By grouping the small-scale farmers into three tiers and re-establishing three water users' associations, appropriate irrigation and management may be provided to each tier.

- Tier-1: Small-scale farmers: 279 ha
  Small-scale farmers produce food crops and vegetables mainly for domestic consumption, and can only afford minimal fees for operation and maintenance. Furrow irrigation is utilized.
- Tier-2: Emergent farmers: 360 ha
  Emergent farmers produce cash crops as well as food crops. They have the technical capacity to produce high quality food. Sprinkler irrigation is mainly utilized.
- Tier-3: collective farmers: 1,080 ha
  A large-scale collective farm is managed by a private company and organized by a group of small-scale farmers. Under the supervision of the Farm Co., cash crops are mainly produced. Centre pivot irrigation system is mainly utilized. The Farm Co. also provides technical advice on farming, farm inputs, harvesting and marketing to Tiers 1 and 2.

In addition to the 3 tiers, there are eight large-scale commercial farms covering about 3,000 ha. They only need irrigation water because they already have technical knowledge of land reclamation and commercial crop production. The scheme plans to primarily irrigate the farmland of the 3 tiers, and surplus water from the maximized reservoir shall be sold to the large-scale farmers in the southern part. The irrigation water fees shall be used for operation and maintenance of the irrigation system developed for the small-scale farmers.

Furthermore, the Utility Co. will be established for supervision of the irrigation scheme, including project management, operation and maintenance of the irrigation facilities, water management, collection of irrigation fees, and payment of the profit to farmers. The Utility Co. shall reduce the cost of the irrigation scheme and maximize the profit of member farmers in collaboration with the Farm Co.

This PPP method shall aim at bringing the farming techniques of tier-1 up to the level of tier-2, and the farm management skills of tier-2 up to the level of tier-3.

The farming plan for the entire Mwomboshi scheme will be prepared and promoted with the cooperation of the Farm Co., including the layout of diversified crops, crop rotation,

quality improvement of crops, and marketing.

MACO is the governmental agency responsible for contracts with private companies and the entire asset management of the scheme. Other benefits of the PPP method are higher accountability of asset management and reduction of government staff.

Mwonboshi River downstream of dam site

Relatively clean river water

Mwonboshi River at dam site

Abutment on left bank of dam

Farmland of small-scale farmers north of reservoir

(5) Technical Issues of Mwomboshi Dam

As a result of a review of the Pre-F/S on the Mwomboshi dam, an additional two issues need to be examined carefully.

1) Sedimentation:

The catchment area covers 1,000 km^2 and in August the water was relatively clear, but the amount of sedimentation during the rainy season needs to be further explored. Assuming a sedimentation rate of 300 m^3/km^2, the annual volume of sedimentation will be 300,000 m^3, amounting to 30 million m^3 over the estimated 100-year lifespan of the dam. Therefore, in order to minimize sedimentation, a sand trap dam and paddy fields need to be implemented.

2) Minimum flow release from the dam:

The minimum water flow from the proposed dam to the lower reaches should be estimated through a survey of water rights for the irrigated areas and other water users downstream.