

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

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

**FINAL REPORT
(PILOT PROJECT)**

JULY 2011

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

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An example of an inclined weir: a large log is laid across the river and, to raise the water level, branches, grasses, and clay soil are placed in front of it, which is further supported by supporting logs from behind.



An upgraded permanent weir in Chibolya site, Kawambwa, Luapula Province (length 24m and height 2m): with this weir, more stabilized water is now running in the concrete-lined furrow.



A double-lined simple weir: two lines of single weir are installed in parallel and clay soil is fulfilled in between the two, by which seepage can be minimized and thus water level can be raised easily.



Wet-masonry-type permanent weir, upgraded in 2010 from a temporary one: originally, only the right bank of the stream was being irrigated, but through upgrading, intakes were installed at both sides so that farmers on the left bank can also enjoy the irrigation.



Cash crops like vegetables and green maize instead require high input cost. Thus, for those who cannot afford to buy fertilizer, it is good to start irrigated agriculture with pulses as in the left field, and then move to, e.g., green maize as in the right field.



By putting a detour canal, irrigated agriculture can be continued even during the construction of permanent weir. In Mpika district, for example, plenty of cabbage are being cultivated even during the construction of permanent weir.



Young plants of cabbage are being protected by maize against wind, dust, and bird—an example of strategic intercropping. When plants receive physical damage in young age, quality of final produces would be badly affected.



A unique example of intercropping of tomato and cassava is tried in this field. Cassava plays a role of stakes supporting tomato plants, while it enjoys irrigated water applied primarily for tomato.



Linkage with conservation agriculture was also pursued. Furrow irrigation was applied in this particular field where irrigated water is gradually conveyed under the plant residue (mulching) spread thoroughly in between the ridges.



Taking advantage of harnessed water, a number of fish ponds were also constructed especially in Luapula province. In the two-year period, a total of 183 fish ponds have been newly constructed.



An extension officer explains the procedure of a simple weir construction using a poster prepared by the Study team. Four illustrations in an A-3 sheet well describe the major construction process step by step.



Follow-up training was organized at the end of dry season both in 2009 and 2010. Number of sites developed and the area newly irrigated were reported. Also, problems/challenges encountered and those countermeasures were shared by the participants.

CONTENTS

COMPOSITION OF THE REPORT

MAIN REPORT (English Version, Japanese Summary Version)

PILOT PROJECT (English Version: This Volume)

APPENDIXES (English Version)

TECHNICAL MANUALS (English Version)

GIS ATLAS (English Version)

PREFACE	1-1
CHAPTER 1	RATIONALE AND DESIGNING OF THE PILOT PROJECT.....	1-1
1.1	Rationale	1-1
1.2	Designing of the Pilot Project	1-1
CHAPTER 2	PILOT PROJECT IMPLEMENTATION IN YEAR 2009	2-1
2.1	Potential Districts for Smallholder Irrigation Development	2-1
2.2	TOT (Training of Trainers) for Simple Diversion Schemes.....	2-1
2.3	Kick-off Training for Simple Diversion Schemes.....	2-2
2.3.1	Training Programme	2-2
2.3.2	Training Module.....	2-2
2.3.3	Training Participants	2-3
2.3.4	Achievement of the Training Objectives.....	2-8
2.3.5	Participants' Satisfaction by Session.....	2-9
2.3.6	Participants' Satisfaction by Different Aspects	2-10
2.3.7	Participants' Comments to Improve.....	2-10
2.3.8	Targets for Year 2009 Dry Season for Simple Smallholder Schemes	2-11
2.4	Follow up Training for Simple Diversion Schemes.....	2-12
2.4.1	Training Programme	2-12
2.4.2	Training Module.....	2-12
2.4.3	Training Participants	2-13
2.4.4	Achievement of the Training Objectives.....	2-17
2.4.5	Participants' Satisfaction by Session.....	2-17
2.4.6	Participants' Satisfaction by as a Whole, Logistics, Theory, Practice, and Own Participation ...	2-18
2.4.7	Participants' Comments to Improve.....	2-19
2.5	Achievement in 2009 Dry Season.....	2-19
2.5.1	Achievement on TOT.....	2-19
2.5.2	Achievement on Improved Sites	2-20
2.5.3	Achievement on New Development Sites.....	2-21
2.5.4	Difficulty in Developing Area.....	2-23
2.5.5	Difficulties facing the BEOs/CEOs.....	2-23
2.5.6	Proud Achievement	2-24
2.6	Change in 2010 Dry Season for the 2009 Pilot Project.....	2-25
2.6.1	Change in 2010 Dry Season for the 2009 Pilot Project of New Development .	2-25
2.6.2	Weir Status over 2009/2010 Rainy Season	2-26

CHAPTER 3	PILOT PROJECT IMPLEMENTATION IN YEAR 2010	3-1
3.1	Potential Districts for Smallholder Irrigation Development	3-1
3.2	TOT (Training of Trainers) for the Pilot Project in 2010 Season	3-1
3.2.1	Participants	3-1
3.2.2	Overall Schedule and Topics Undertaken	3-1
3.2.3	Permanent Weir (new in 2010 Season)	3-2
3.2.4	Selection Criteria for the Kick-off Training	3-3
3.2.5	Criteria for Selecting Permanent Site	3-3
3.2.6	Site Visit	3-4
3.2.7	Session Allocation	3-4
3.3	Kick-off Training for the Pilot Project in 2010	3-4
3.3.1	Training Programme	3-4
3.3.2	Training Module	3-5
3.3.3	Training Participants	3-6
3.3.4	Achievement of Training Objectives	3-10
3.3.5	Participants' Satisfaction by Session	3-11
3.3.6	Participants' Satisfaction by Different Aspects	3-12
3.3.7	Participants' Comments to Improve	3-13
3.3.8	Target for Year 2010 Dry Season for Simpole Smallholder Schemes	3-15
3.4	Follow up Training for the Pilot Project in 2010	3-17
3.4.1	Training Programme	3-17
3.4.2	Training Module	3-18
3.4.3	Training Participants	3-18
3.4.4	Achievement of the Training Objectives	3-23
3.4.5	Participants' Satisfaction by Session	3-24
3.4.6	Participants' Satisfaction by as a Whole, Logistics, Theory, Practice, and Own Participation	3-24
3.5	Achievement in 2010 Dry Season (Simple Diversion Scheme)	3-25
3.5.1	Achievement on TOT	3-25
3.5.2	Achievement on Improved Sites	3-26
3.5.3	Achievement on New Development Sites	3-27
3.6	Achievement in Permanent Scheme in 2010 Dry Season	3-30
3.6.1	Chaiteka site, Luwingu District, Northern Province	3-30
3.6.2	Malashi Site, Mpika District, Northern Province	3-31
3.6.3	Kasonde Site, Mporokoso District, Northern Province	3-32
3.6.4	Chilala Site, Mporokoso District, Northern Province	3-33
3.6.5	Nseluka Site, Mungwi District, Northern Province	3-34
3.6.6	Chibolya Site, Kawambwa District, Luapula Province	3-35
3.6.7	Kakose Site, Mansa District, Luapula Province	3-36
3.6.8	Mililwa Lower Site, Mansa District, Luapula Province	3-37
CHAPTER 4	AGRICULTURAL TRIALS	4-1
4.1	Contents of the Agricultural Trials	4-1
4.2	Intercropping of Different Set of Crops	4-1
4.2.1	Green Maize and Climbing Bean	4-2
4.2.2	Green Maize and Standing Bean	4-3
4.2.3	Cabbage and Tomato	4-3
4.2.4	Maize and Cowpea	4-4

4.2.5	Maize and Soybean	4-5
4.3	Wheat as a New Crop.....	4-5
4.4	Introduction of NERICA under Irrigation.....	4-7
4.5	Comparative Trial of BOKASHI Compost	4-8
CHAPTER 5	EVALUATION OF THE PILOT PROJECT	5-1
5.1	Output Achievements under Pilot Project Implementation.....	5-1
5.1.1	Output Achievements for Simple Diversion Scheme.....	5-1
5.1.2	Output Achievements for Permanent Diversion Schemes	5-3
5.2	Economic Impact (Based on 2009 Pilot Project Harvest Result).....	5-4
5.2.1	Cost and Benefit of Major Crops under Irrigation	5-5
5.2.2	Profitability per Household and Comparison to Original Income	5-6
5.2.3	Disposable Benefit of Major Crops.....	5-8
5.2.4	Composition of Input Cost	5-9
5.3	Economic Impact on Poverty Line.....	5-9
5.4	Re-investing in Year-round Agriculture	5-10
5.4.1	Investing in Rain-fed Maize Production Based on Harvest Survey	5-10
5.4.2	Change in Income-Expenditure identified from In-depth Interview	5-11
5.5	Investing in Area under Rain-fed Maize Production.....	5-15
5.6	Effects on <i>Chitemene</i>	5-15
5.7	Investing out of Irrigated Agriculture	5-16
5.8	Cascaded Extension	5-17
5.9	Extension of Simple Smallholder Irrigation Schemes through Posters	5-18
CHAPTER 6	CAPACITY DEVELOPMENT AND BUILDING.....	6-1
6.1	Capacity Development for Officers	6-1
6.2	Capacity Development for Farmers	6-3
6.3	Learning by the JICA Team	6-4

ACRONYMS AND ABBREVIATIONS

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

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

UNIT CONVERSION

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

CURRENCY EQUIVALENTS (AS AT MARCH 2011)

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

ZAMBIA FINANCIAL YEAR

January 1 to December 31

LIST OF TABLES:

Table 2.1.1	Summary of District Ranking in Smallholder Irrigation Development Potential	2-1
Table 2.3.1	Summary of the Participants for the Kick-off Training Course	2-3
Table 2.3.2	Definitions of Smallholder Irrigation	2-4
Table 2.3.3	Experience in the Past Irrigation Project Operated by Farmers	2-5
Table 2.3.4	Experience in Smallholder Irrigation Projects	2-5
Table 2.3.5	Types of Irrigation System Observed/Known under Smallholder Irrigated Projects	2-5
Table 2.3.6	Problems to the Participants	2-6
Table 2.3.7	Countermeasures Taken by the Officers.....	2-6
Table 2.3.8	Best Practices of the Participants	2-6
Table 2.3.9	Contribution of SH Irrigation to Livelihood Improvement.....	2-7
Table 2.3.10	Roles of Government Officers	2-7
Table 2.3.11	Expectation from the Training.....	2-8
Table 2.3.12	Sessions Undertaken by Training.....	2-9
Table 2.3.13	Planned TOT (Training of Trainers; Fellow CEOs) by District.....	2-11
Table 2.2.14	Targets for Improvement & New Development for 2009 Dry Season.....	2-12
Table 2.4.1	Summary of the Participants for the Follow-up Training in 2009.....	2-13
Table 2.4.2	Expectations to the Training listed by Participants	2-14
Table 2.4.3	Participants' Needs in Assistance from the Government	2-14
Table 2.4.4	Participants' Experiences on Problems	2-15
Table 2.4.5	Participants' Efforts to Solve the Problems Above	2-15
Table 2.4.6	Participants' Best Experiences	2-16
Table 2.4.7	Sessions Undertaken by Training.....	2-17
Table 2.5.1	Planned TOT and Actually Implemented TOT by District.....	2-19
Table 2.5.2	Summary of Improvement for Existing Sites in 2009 Dry Season	2-23
Table 2.5.3	Summary of New Development in 2009 Dry Season	2-23
Table 2.5.4	Comparison between Targets and Achievements	2-24
Table 2.5.5	Difficulties BEOs/CEOs have Faced during Dissemination	2-25
Table 2.5.6	Proud Achievements by District.....	2-25
Table 2.6.1	Change in 2010 Dry Season for the 2009 Pilot Project of New Development	2-26
Table 3.1.1	Summary of District Ranking in Smallholder Irrigation Development Potential	3-1
Table 3.3.1	Summary of the Participants for the Kick-off Training Course	3-6
Table 3.3.2	List of the Trainers (included in the above table).....	3-6
Table 3.3.3	Definition of Smallholder Irrigation	3-7
Table 3.3.4	Experience in the Past Irrigation Project Operated by Farmers	3-7
Table 3.3.5	Types of Irrigation System Observed/Known under Smallholder Irrigated Projects	3-8
Table 3.3.6	Problems to Extension Agents.....	3-8
Table 3.3.7	Countermeasures to the Problems	3-8
Table 3.3.8	Best Practices of the Participants	3-9
Table 3.3.9	Type of Compost Participants Know and Demonstrated	3-9
Table 3.3.10	Function of Compost Defined.....	3-9
Table 3.3.11	Difficulty in Disseminating Compost Manure	3-10
Table 3.3.12	Expectation from the Training.....	3-10
Table 3.3.13	Level of Achievement to Each Objective.....	3-11
Table 3.3.14	List of Training Modules/Items	3-12
Table 3.3.15	Participants' Satisfaction Level by Category	3-13

Table 3.3.16	Participants' Satisfaction Level by Category	3-13
Table 3.3.17	Participants' Satisfaction Level by Category	3-14
Table 3.3.18	Participants' Satisfaction Level by Category	3-14
Table 3.3.19	Participants' Satisfaction Level by Category	3-14
Table 3.3.20	Participants' Satisfaction Level by Category	3-14
Table 3.3.21	Planned TOT (Training of Trainers; fellow CEOs) by District	3-16
Table 3.3.22	Target Number of Improvement Sites for the Year 2010 Dry Season	3-16
Table 3.3.23	Target Number of New Development Sites for the Year 2010 Dry Season	3-17
Table 3.4.1	Summary of the Participants for the Follow-up Training in 2010.....	3-18
Table 3.4.2	Expectations to the Training listed by Participants	3-19
Table 3.4.3	Participants' Needs in Assistance from the Government	3-19
Table 3.4.4	Participants' Best Experiences	3-21
Table 3.4.5	Projects to Improve Farmers' Livelihood.....	3-21
Table 3.4.6	Measures to Improve Farmers' Livelihood (Yourself and Farmers)	3-22
Table 3.4.7	Measures to Improve Farmers' Livelihood (Government and Donors)	3-22
Table 3.4.8	Felts Thoughts which Touched on Participants	3-23
Table 3.4.9	Sessions Undertaken by Training	3-24
Table 3.5.1	Summary of the Achievements in 2010 Pilot Project in Comparison with Targets	3-25
Table 3.5.2	TOT and Participants done in Field in 2010	3-25
Table 3.5.3	Summary of Improvement for Existing Sites in 2010 Dry Season (Simple Scheme). 3-28	
Table 3.5.4	Summary of New Development Sites in 2010 Dry Season (Simple Scheme)	3-29
Table 3.6.1	Profile of the Permanent Diversion Schemes for the 010 Pilot Project Implemet'n...	3-39
Table 4.1.1	Basic Profile of Agricultural Trial.....	4-1
Table 4.2.1	Price Trends of Tomato and Cabbage.....	4-4
Table 4.3.1	Major Activities of a Farmer for the Wheat Production Trial	4-6
Table 5.1.1	Achievement of Simple Diversion Weir Irrigation Schemes in 2009 and 2010.....	5-2
Table 5.1.2	Fiscal Achievement of Simple Diversion Weir Irrigation Schemes in 2009 and 2010 .	5-3
Table 5.1.3	Achievement of Permanent Diversion Weir Irrigation Schemes in 2010.....	5-4
Table 5.2.1	Profile of Harvest Survey Sites	5-4
Table 5.2.2	Cost and Benefit of Major Crops under Irrigation, ZMK per lima	5-5
Table 5.2.3	Average Profit of Irrigated Agriculture Per Household.....	5-6
Table 5.2.4	Impact of Irrigated Agriculture	5-7
Table 5.2.5	Disposable Cash Income, ZMK per lima	5-8
Table 5.2.6	Disposable Cash Income per Household, ZMK per 0.873 lima.....	5-8
Table 5.2.7	Composition of Input Cost, ZMK per lima	5-8
Table 5.3.1	Poverty Indicators per Household and Impact from Irrigated Agriculture	5-10
Table 5.4.1	Change in Rain-fed Maize Production After Starting Irrigated Agriculture	5-11
Table 5.4.2	Change in Fertilizer Use After Starting Irrigated Agriculture	5-11
Table 5.5.1	Change in Cultivated Area	5-15
Table 5.6.1	Change in Chitemene Area After Starting Irrigated Agriculture	5-15
Table 5.7.1	Items Income from the Irrigated Agriculture is Spent for	5-17
Table 5.8.1	Summary of the Sites Undertaken by Fellow BEOs/CEOs.....	5-18
Table 5.9.1	Places where a Poster Promoting Nutrition Improvement was Posted.....	5-20
Table 6.1.1	Summary of the Trainings Carried out in Years 2009 and 2010	6-2
Table 6.2.1	Summary of the Farmers in Smallholder Irrigation Devel't in 2009 & 2010 Seasons	6-3

LIST OF FIGURES;

Figure 1.2.1	Modus Operandi of Pilot Project Implementation over 2 Years.....	1-3
Figure 1.2.2	Demonstration to Extension/Upgrading by Involving Government Officers	1-4
Figure 2.3.1	Distribution of Years in Government	2-4
Figure 2.3.2	Achievement in a Level of 1-5 by Objectives	2-8
Figure 2.3.3	Participant Satisfaction in a level of 1-5 by Session	2-9
Figure 2.3.4	Participants' Satisfaction by Issues	2-10
Figure 2.4.1	Achievement in a Level of 1-5 by Objectives	2-17
Figure 2.4.2	Participant Satisfaction in a level of 1-5 by Session	2-18
Figure 2.4.3	Participants' Satisfaction by Issues	2-18
Figure 2.6.1	Weirs Collapsed by Floods in 2009/10.....	2-27
Figure 3.3.1	Distribution of Years in Government	3-7
Figure 3.3.2	Level of Achievement by Objective.....	3-11
Figure 3.3.3	Participants' Satisfactory Level by Training Module (Level 1-5).....	3-12
Figure 3.3.4	Level of Satisfaction by Category	3-13
Figure 3.4.1	Participants Experiences on Problems	3-20
Figure 3.4.2	Participants' Efforts to Solve the Problem Above	3-20
Figure 3.4.3	Achievement in 1-5 by Objectives	3-23
Figure 3.4.4	Participants' Satisfaction in a Level of 1-5 by Session	3-24
Figure 3.4.5	Participants' Satisfaction by Issues	3-24
Figure 5.2.1	Net Profit as Compared to Original Income	5-8
Figure 5.4.1	Re-investment in Rain-fed Maize	5-11
Figure 5.4.2	Income of before-after (Sample A)	5-12
Figure 5.4.3	Expenditure of before-after (Sample A).....	5-12
Figure 5.4.4	Income of before-after (Sample B)	5-13
Figure 5.4.5	Expenditure of before-after (Sample B).....	5-13
Figure 5.4.6	Income of before-after (Sample C)	5-13
Figure 5.4.7	Expenditure of before-after (Sample C).....	5-14
Figure 5.4.8	Income of before-after (Sample D)	5-14
Figure 5.6.1	Change on Chitemene Area.....	5-16
Figure 5.7.1	Items Spent For from Irrigated Agriculture.....	5-16

PREFACE

In 2009, the Study Team drafted an action plan of the community based smallholder irrigation schemes in the target two provinces. Parts of the action plan were carried out over 2 dry seasons of the year 2009 and 2010. The pilot project started with simple diversion weirs during the dry season 2009, and the simple diversion schemes were extended in 2010 season. In the 2010 season, permanent diversion schemes were also undertaken by upgrading of the simple ones tried in 2009.

This Report elaborates pilot project implementation including rationale and mechanism/ institutions of the implementation, design of the project components, achievements done, evaluation and lessons learnt, etc. The lessons mentioned hereunder are somewhat specific, coming directly from what were observed during the implementation of the pilot projects. Generalized, or in other words deduced, lessons that can be of good references in disseminating the smallholder irrigation schemes are presented as ‘Implementation Disciplines’ in the Main Report.

CHAPTER 1 RATIONALE AND DESIGNING OF THE PILOT PROJECT

1.1 Rationale

Rationale why we need to carry out pilot project under this Study lies on knowing “limit”, “how” and “preview”. The Study has a mandate of formulating an action plan of smallholder irrigation development in Northern and Luapula provinces. Here, it is envisaged to identify a “limit” of current government institutional frame prior to the regular implementation of the formulated action plan. The best way to know the limit(s) is to test the plan under an arrangement of pilot project. The Study further requires us to identify concrete implementation methodologies e.g. *modus operandi*. The *modus operandi* should be verified through a trial implementation; that is to know so-called “how”.

To know the limit(s) and to know the how will contribute to formulating workable action plan because it has been tested through the pilot project. There will be a lot of lessons learnt through the implementation of pilot project. By feeding back the lessons, the action plan will be improved to be more workable on the ground, and thereby can be a practical one which will smoothly be implemented by those concerned officers at provincial and district TSBs, BEOs and CEOs.

Lastly, implementation of pilot project will lead us to an indication of “preview” of the Study area developed with the means of smallholder irrigation development. We have to know to what extent smallholder irrigation scheme can uplift the beneficiaries’ livelihood by actually implementing irrigation project; a sort of preview we would see. To know the three elements, limit, how and preview, before regular implementation of the action plan is the rationale of implementing the pilot project.

1.2 Designing of the Pilot Project

As aforementioned, the pilot project undertakes simple diversion schemes and also permanent schemes. In 2009, this Study put first priority on the simple irrigation schemes. The Team, in collaboration with provincial TSB, district TSB and also BEOs/CEOs selected, implemented pilot project for simple diversion weir irrigation schemes as early as from May 2009. The pilot project in 2009 was limited in scale and covered only selected districts, and its extension was carried out in 2010 season including additional TSB officers, and BEOs/CEOs from extended districts.

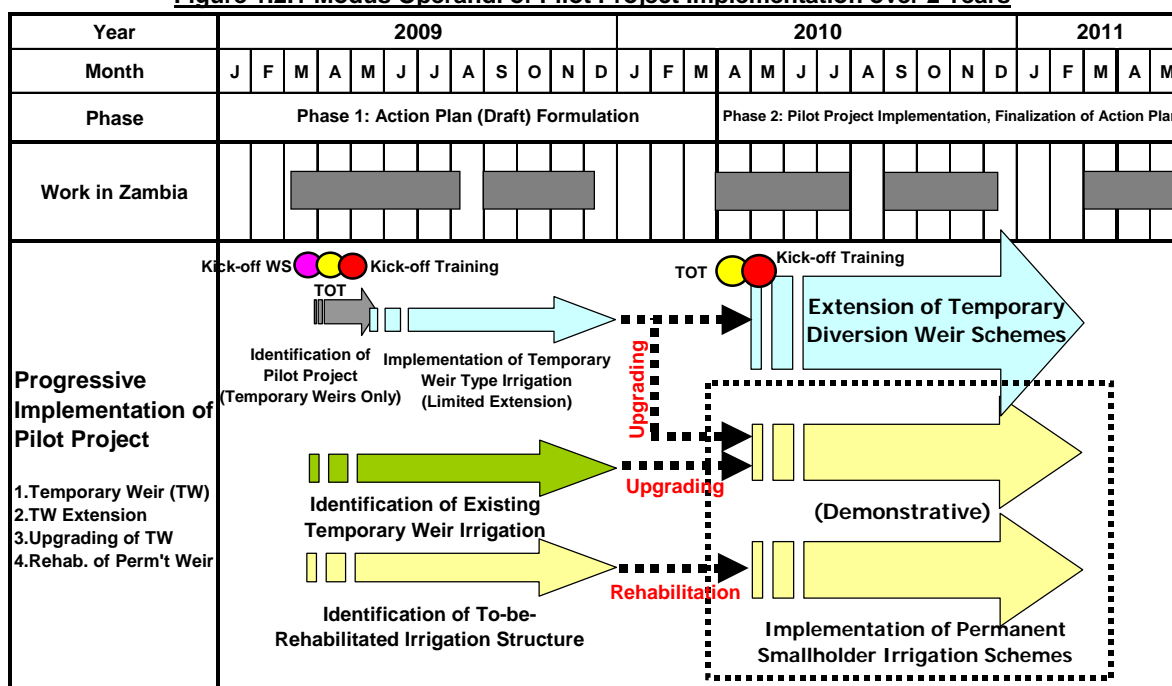
In 2010, another type of pilot project came up, that is an upgrade from the temporary ones tried in 2009 to permanent ones, e.g. wet-masonry/concrete ones. Of the temporary irrigation schemes done in 2009, those sites which had potential of expanding the irrigation areas as well as farmers who were well organized were selected for the upgrading.

Figure 1.2.1 shows the overall *modus operandi* of the pilot project implementation over 2 years of

2009 and 2010. Following are the details:

- 1) A kick-off workshop, as a first step, was held where one of the activities was to identify smallholder irrigation potential in the districts. This workshop called all the concerned officers from all the districts in the two study provinces. The participants were to identify districts endorsed with high irrigation potential for smallholder farmers. Based on that work, the districts where the Team carries out pilot project for simple diversion weir were decided.
- 2) Second step administered a TOT, training of trainers, where the trainers were JICA team while the participants were government irrigation officers selected, who were then to train fellow district TSBs and extension officers for the districts aforementioned. Here, there is a cascaded training system; training from the Study team to the potential trainers who are the government irrigation officers selected, and then from the trained officers to fellow officers who are to actually implement the pilot smallholder irrigation projects on the ground. The training in 2009 centered only on simple diversion irrigation schemes, plus some agricultural issues like compost promotion.
- 3) Third step was to hold the kick-off training, or a sort of planning training, for smallholder irrigation development for simple diversion irrigation schemes in 2009 dry season. Trainers were the trained irrigation officers by the Team as above-mentioned, and the participants came from the high irrigation potential districts, composed of district TSB officers and BEOs/CEOs, the frontline extension officers.
- 4) As the officers engaged in the pilot project implementation in 2009 dry season was limited in number, the Study made the extension of the simple diversion schemes in 2010 dry season. Kick-off training was once again carried out this time for 2010 dry season where there were more officers who came from more districts than those of 2009 dry season. Trainers were mostly the same as those who administered the training in 2009, and joined by those who had actively participated in the implementation of the pilot project in 2009 dry season.

Figure 1.2.1 Modus Operandi of Pilot Project Implementation over 2 Years



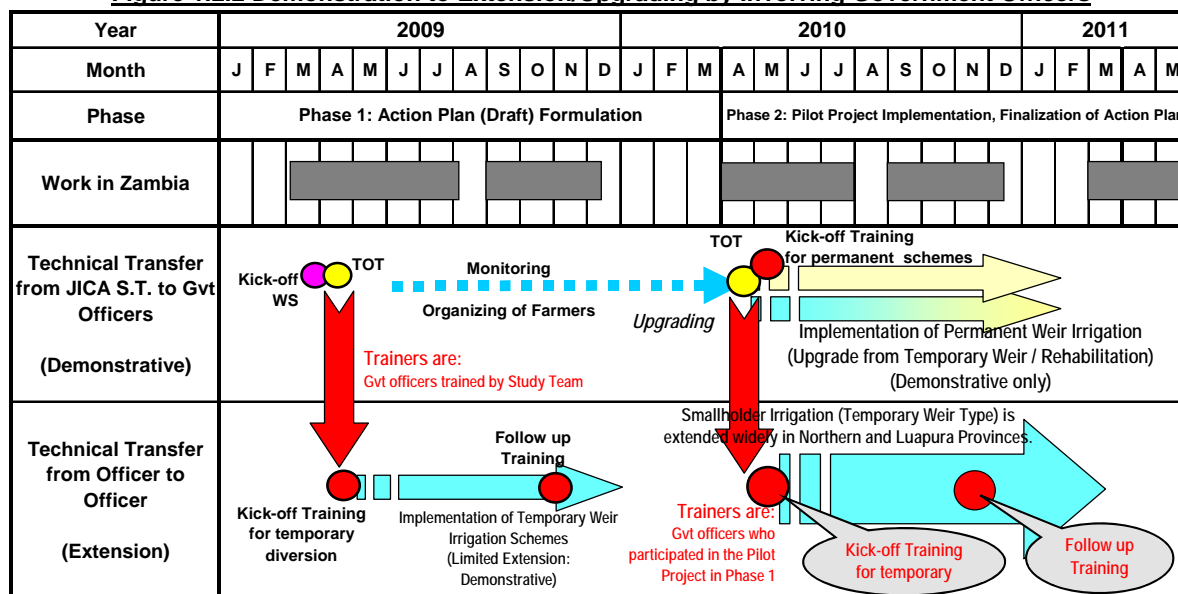
- 5) Apart from the pilot project for simple diversion weir irrigation schemes, this Study carried out permanent irrigation schemes. The permanent irrigation schemes were the ones upgraded from

temporary ones. The upgrading basically centered on the temporary diversion schemes constructed under the pilot project in 2009. The identification for the potential upgrading sites was partly started in 2009, almost in parallel with the pilot implementation of the simple diversion schemes. However the final selection was done during the kick-off training in 2010 by the relevant participants in consultation with the provincial TSB and the JICA team.

- 6) No permanent structures were undertaken in 2009 dry season. This is because it takes certain time to identify potential sites for permanent structures and also construction needs a couple of months at least and in some cases construction may extend over half a year. For this kind of construction work, preparation should be well done prior to the implementation, and therefore the year 2009 was devoted only for the identification of the ideal sites. The final decision of the permanent sites was done at the beginning of year 2010 season by the concerned officers in consultation with provincial TSB and JICA team.

As mentioned above, there is a series of capacity building throughout the implementation of the pilot project. Figure 1.2.2 rearranges the pilot project implementation from the viewpoint of capacity building. TOTs was carried out at the beginning of each dry season of 2009 and 2010; where trainers were the Study team members while the participants were those who are to be the trainers for fellow government officers. The trained government officers were to carry out kick-off training at the beginning of each dry season to cascade the technology to their fellow government officers.

Figure 1.2.2 Demonstration to Extension/Upgrading by Involving Government Officers



As for the technologies for simple diversion weir schemes, it is cascaded two times over 2 years of pilot implementation; one in 2009 was from the Study team to trainers and then the trainers to fellow officers but still limited in number, and the other in 2010 from the trainers who included new ones out of those who actively participated in the pilot implementation in 2009 in addition to those trainers in 2009.

For the permanent irrigation schemes, the training course was carried out at the beginning of 2010 dry season which was in fact incorporated in the kick-off training for simple weir diversion schemes. The pilot project for permanent structures was meant not to engage contractors but to be implemented by TSB officers, BEOs/CEOs in charge of the area, and the beneficiaries, the farmers. Therefore, the main actor for the capacity building is the district TSB officers with back-stopping from provincial TSB officers.

There should be a follow-up venue where the participating officers can give a feedback of what they have achieved and also to share their experiences amongst the officers. This follow-up venue can enrich their knowledge and experiences based upon peer-to-peer learning. In fact, peer-to-peer learning works as a very motivating factor since fellow officers can be teacher as well as student, visa versa. There were two times follow-up trainings for the 2-year period. These were held in November when the participants were ready to report what they had done in that season.

CHAPTER 2 PILOT PROJECT IMPLEMENTATION IN YEAR 2009

Pilot project in 2009 started with a kick-off workshop, during which potential districts for smallholder irrigation development were identified. After that, TOT and then kick-off training were carried out, which had trained the government officers concerned for simple diversion schemes together with some agricultural aspects. Given the trainings, the officers started promoting smallholder irrigation schemes. This sub-chapter presents the pilot project carried out in the dry season 2009.

2.1 Potential Districts for Smallholder Irrigation Development

Kick-off workshop was held on March 31, 2009 and we invited about 70 participants from all the districts of the two provinces. The participants examined attributes, which gave comparative advantages in developing smallholder irrigation schemes. Upon listing up all the attributes, the participants started ranking the districts according to their potential (for the detail procedure, refer to the discussion of 4.5.1 Raking of District of Irrigation Potential by Government Officers in the Main Report). Following are the priority ranking by district, and the top six districts for Northern province and top 2 districts in Luapula province, with a mark of 'x' are the districts where pilot project in 2009 dry season had been carried out:

Table 2.1.1 Summary of District Ranking in Smallholder Irrigation Development Potential

Rank	Northern Province		Luapula Province		Remarks
1	Mbala district	X	Kawambwa district	X	
2	Mpika district	X	Mansa district	X	
3	Mungwi district	X	Mwense district		
4	Kasama district	X	Milenge district		
5	Mporokoso district	X	Nchelenge district		
6	Luwingu district	X	Chiengi district		
7	Isoka district		Samfya district		
8	Nakonde district				
9	Chilubi district				
10	Chinsali district				
11	Mpulungu district				
12	Kaputa district				

Source: JICA Study Team, based on the kick-off workshop held on March 31, 2009 at Kasama

2.2 TOT (Training of Trainers) for Simple Diversion Schemes

BEOs and CEOs, the frontline extension officers, backstopped by district TSB officers could be the best agent to promote simple diversion weir schemes. The technologies pertaining to the simple schemes are not sophisticated and therefore, could be disseminated as a part of recurrent extension activities. However, to promote the schemes by BEOs/CEOs they have to be equipped with the required knowledge, skills, attitude, hand-on experiences, etc. This arrangement can be done through a training course to the BEOs/CEOs. Then, before the training, what is required is a TOT; Training of Trainers.

The participants, trainees of the TOT, were expected to be the trainers of the kick-off training course which came right after the TOT, where BEOs/CEOs together with their relevant district TSB officers gathered. Therefore, the participants should at least have some experiences on smallholder irrigation or irrigated agriculture. Taking this pre-condition into account, the Team in consultation with



TOT is now on-going: given first-hand tips from the JICA team. The participants are clarifying topic by topic.

the counterpart personnel selected a total number of 7 officers including the Provincial Irrigation Engineer, Northern province, as the overall coordinator.

The TOT was carried out on April 7 and 14, 2009 in the JICA Study Team's office located at PACO offices of Northern province. At first, the topics to be undertaken during the kick-off training were proposed by JICA Team, and discussed and it was agreed between the Team and the TOT participants. Basically, technologies to be implanted in BEOs/CEOs/district TSBs should be so simple and easy that farmers could apply, without engaging civil contractor. With this in mind, the following 12 topics were undertaken during the TOT;

- 1) Identification of Potential Gravity Diversion Sites
- 2) A Diversion Weir; Inclined Weir
- 3) A Diversion Weir; Single-line Weir
- 4) A Diversion Weir; Double-line Weir
- 5) A Diversion Weir; Trigonal Prop Weir
- 6) A Diversion Weir; Clay Soil Masonry Weir
- 7) Canal Alignment and Construction (by a simple tool, split line level)
- 8) Ancillary Facilities
- 9) Organizing of Farmers
- 10) Land Allocation (dividing the land into members)
- 11) On-farm Irrigation Method
- 12) Compost Making

2.3 Kick-off Training for Simple Diversion Schemes

Upon completion of the TOT above, a kick-off training for the simple diversion weir schemes was carried out from April 16 to 18, 2009. The training course invited a total number of 35 participants, which included the BEOs/CEOs stationed where there was a high potential for smallholder irrigation development and their supervisors, namely, district TSB officers, from 6 districts of Northern province and 2 districts of Luapula province.

2.3.1 Training Programme

The overall objective for the kick-off training was for the participants to acquire the skills, knowledge and attitude necessary in discharging their duties and responsibilities of promoting smallholder irrigation schemes in their responsible areas. The participants were expected to be able to achieve the following by the end of the training course, which themselves are the specific objectives:

- 1) Internalize the concept of smallholder irrigation development being promoted under the Study,
- 2) Enumerate and discuss smallholder irrigation facilities and structures (mainly for simple diversion weir scheme under the programmed training),
- 3) Acquire basic on-farm irrigation methods,
- 4) Organize farmers in developing smallholder irrigation schemes,
- 5) Acquire basic ideas of extending irrigation benefit to most of the villagers,
- 6) Acquire basic knowledge of compost manure making utilizing aerobic bacteria,
- 7) Prepare a district basis entry program for 2009 dry season, and
- 8) Discuss way-forward for smallholder irrigation development in Zambia.

2.3.2 Training Module

The training was a net tree-day live-in and live-out activity course held at Kasama Farm Institute. Methodologies employed were lecture-interactive discussion, brainstorming, practices on the field

such as weir construction and canal alignment with spirit-line level, and small group task preparing 2009 dry season entry program. Also, conducted during the course was provision of dissemination materials such as manuals, leaflet, picture story-like illustrations, all of which was used during a entry meeting of smallholder irrigation development with farmers concerned. Following are the modules undertaken:

- Module 1 Program Orientation
- Module 2 Smallholder Irrigation Facilities and Structures (in Lecture)
 - Identification of Potential Gravity Diversion Sites
 - Weir Type and Construction Method (Inclined Weir)
 - Weir Type and Construction Method (Single-line Weir)
 - Weir Type and Construction Method (Double-line Weir)
 - Weir Type and Construction Method (Trigonal Prop Weir)
 - Weir Type and Construction Method (Clay Soil Masonry Weir)
 - Canal Alignment and Construction
 - Ancillary Facilities
- Module 3 Smallholder Irrigation Facilities and Structures (Practice in Field)
 - Practice of Construction of a Weir in the Field
 - Practice of Canal Alignment
- Module 4 On-farm Irrigation and Agriculture Aspects (in Lecture)
 - Organizing of Farmers
 - Land Allocation (dividing the land into members)
 - On-farm Irrigation Methods
 - Compost Making
- Module 5 Entry Planning (in Workshop)
 - Entry Planning Orientation
 - Entry Planning and Output Presentation by CEO/ District (WS)
 - Dissemination Materials (Technical Manual, Illustrations, Leaflet)

2.3.3 Training Participants

Table 2.3.1 shows the participants who attended the kick-off training. 13 BEOs/CEOs from Northern province and 7 BEOs/CEOs from Luapula province came to the training, totaling 20 BEOs/CEOs; 8 female and 12 male participants. In addition, 9 district TSB staff also attended the training course as the CEOs' back-stopper as well as supervisor. At the provincial level, 5 officers attended from Northern province, all of whom were trainers, and one officer from Luapula province, who was the provincial irrigation engineer.

Table 2.3.1 Summary of the Participants for the Kick-off Training Course

Particulars	Participants	Remarks
Northern Province		
Mbala district	4 (3F, 1M)	BEOs/CEOs
Mpika district	2 (1F, 1M)	do
Mungwi district	2 (2F, 0M)	do
Kasama district	2 (1F, 1M)	do
Mporokoso district	1 (0F, 1M)	do
Luwingu district	2 (0F, 2M)	do
Luapula Province		
Kawambwa district	4 (1F, 3M)	do
Mansa district	3 (0F, 3M)	do
BEOs/CEOs total	20 (8F, 12M)	
District	8+1 (0F, 9M)	2 from Mbala District (one is trainer)
Northern Province	5 (1F, 4M)	Overall Management (cum trainer)
Luapula Province	1 (0F, 1M)	Provincial Irrigation Engineer
Total	35 (9F, 26M)	Excluding JICA Members
Trainers	Office	

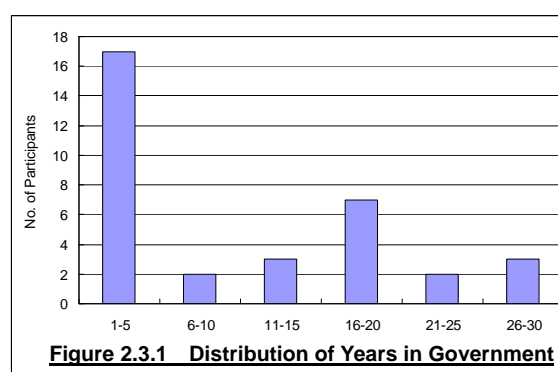
1. Mr. Kelvin Simukoko	Northern P.	Included in the above
2. Mr. Freddy Banda	Mungwi	ditto
3. Mrs. Annie Bulaya	Northern P.	ditto
4. Mr. Rodgers Phiri	Mbala	ditto
5. Mr. Frank Mporokoso Mwansa	Northern P.	ditto
6. Mr. Kaira Machua	Mbala	ditto
7. Mr. Kenneth Zulu	Northern P.	Overall coordinator
Back support: JICA Study Team		

Note: At first 4 districts were planned for Northern province, but through the discussion with the overall coordinator, it was increased to total 6 districts.

At the beginning of the training, a questionnaire was distributed to all the trainees so as to study their knowledge, experience and the view to irrigation development, etc. Items asked were, among others, years in the government services, definition of smallholder irrigation, past experiences, type of irrigation system they have known or seen, problems they have faced and countermeasures taken, best practice ever experienced, etc. Following are the details:

1) Years in Government Service

Figure 2.3.1 shows years in the government service for the participants. The mode falls in the category of 1-5 years, and then followed by a group of 16-20 years in the government service. This shows about half of the participants fall in the newly recruited groups like within 5 years, corresponding to the recent MACO's recruitment policy¹. The average year in the government service is 10.7 years.



2) Definition of Smallholder Irrigation

Participants may have different views to what the smallholder irrigation was. For example, one may consider it as “easy and simple in operation and maintenance,” while the other may think as “irrigated by small scale farmers in a small piece of land.” Other examples may include, “using *dambo* or stream,” “agriculture in dry season,” and “using locally available materials.”

Yet, there were some statements in common among the different opinions as summarized in Table 2.3.2. In general, participants defined it based on the scale of beneficiary farmers, type of irrigation facilities, and seasonality. The most popular is the ones defined by the scale of farmers; beneficiaries are small scale (59%). The second popular was the ones defined by the type/level of facility (18%); they considered smallholder irrigation as what was made with locally available materials. This result showed that their views to smallholder irrigation were basically in line with what the Study meant.

Table 2.3.2 Definitions of Smallholder Irrigation

Definition	Number	%
Small scale farmers	20	59%
Locally available materials	6	18%
Dry season	2	6%
Others	6	18%
Total	34	100%

Source: Pre-training knowledge inventory, JICA Team

3) Experience in the Past Irrigation Projects Operated by Farmers

In terms of the experience of the participants in irrigation developments, which were facilitated by the government, NGOs, or donors and mostly operated and maintained by farmers, nearly half of the participants did not have any experience. As shown in Table 2.3.3, a total of 15 participants in the 2 provinces had some experiences in such irrigation project, while the other 18 participants did not have.

¹ The Government reached HIPC completion point in 2004, and thereafter the government including MACO started newly recruiting government officers as endorsed by the World Bank and also IMF. Before that point, the government had little employed their staff, or almost stopped recruiting, since early 1990s.

Looking at the situation of the participants, same tendency is found in all stations: provincial, district, and camps. One exception is the CEOs in Northern province, out of 13 participants, nine officers did not have any experience in such irrigation projects facilitated by outsiders but operated by the farmers. As far as the defined type of projects was concerned, these results indicated that the pilot project of the Study would be the first experience for a half of the participants.

Table 2.3.3 Experience in the Past Irrigation Project Operated by Farmers

Items	Northern			Luapula			Total
	Province	District	Camp	Province	District	Camp	
YES	2	4	3	1	1	4	15
NO	2	3	9	1	0	3	18
N/A	0	0	1	0	0	0	1
Total	4	7	13	2	1	7	34

Source: Pre-training knowledge inventory, JICA Study Team

4) Experience in Smallholder Irrigation Projects

A similar but another definition was applied to survey the participants' experience in a type of irrigation project. The question was: "which smallholder irrigation project(s), if any, have you been involved in and for how many years?" The result shows that a total of 18 officers did not have any experience in smallholder irrigation scheme. The others, a total of 16 officers, listed 26 specific names of the projects in which they had been engaged. Most of the officers have only one project, while four officers had experience in three or more projects.

Again, the pilot project in the Study was the first experience of smallholder irrigation for around half of the participants. Among the participants who had experience in smallholder irrigation, their years of experience vary a lot from less than one year to the maximum 25 years, averaging 4.8 years. Although a number of projects for each person is limited, mostly one project, they had a considerable length of experience in a project.

Table 2.3.4 Experience in Smallholder Irrigation Projects

Items	Northern			Luapula			Total
	Province	District	Camp	Province	District	Camp	
Nr. of officers who have no experience	2	3	9	1	0	3	18
Number of Project reported	4	6	6	3	3	4	26

Source: Pre-training knowledge inventory, JICA Study Team

5) Types of Irrigation System under Smallholder Irrigation

The participants had ever seen or known some types of irrigation systems under smallholder irrigation projects. Among the ones listed in Table 2.3.5, the most popular was gravity river diversion at the ratio of 70%, that is, 70% of the participants have ever seen, or know the fact about it; that gravity river diversion is practiced under smallholder irrigation projects. Almost same popularity, 67%, is canal and the third is treadle pump (45%).

Table 2.3.5 Types of Irrigation System Observed/Known under Smallholder Irrigated Projects

Province	None	Canal	Gravity River Diversion	Treadle Pump	Motorized Pump	Dam (pond/Reservoir)
Northern	1 4%	16 70%	18 78%	8 35%	5 22%	5 22%
Luapula	1 10%	6 60%	5 50%	7 70%	3 30%	2 20%
Total	2 6%	22 67%	23 70%	15 45%	8 24%	7 21%

Source: Pre-training knowledge inventory, JICA Study Team

Looking at each of the two provinces, similar result could be found. In Northern province, 78% of the participants had seen or known that gravity river diversion is used under smallholder irrigation, and

70% for canal. On the other hand, in Luapula province, treadle pump is the highest, 70%, and canal is the second. Interestingly, there were two officers who had never seen any of those under smallholder irrigation scheme. They may have different type of irrigation system in their mind, i.e., bucket irrigation, or they just simply do not know much about smallholder irrigation.

6) Problems to the Government Officers as Extension Agents

As government technical officers or extension officers, the participants may have faced a range of problems. These problems can be summarized as shown in Table 2.3.6. The absolute number one problem is the ones associated with transportation, which is the limited means of transportation (vehicle, motorcycle, and bicycle), lack of spare parts for the motor bikes and vehicles, and less availability of fuel. It shares 38% of all the problems they listed. With respect to the issue of transportation, as one extension worker covers about 5,550 km² (about 23 km square) or more area (in a case of Northern province), it can be a bottleneck to any government-led extension activities including the promotion of smallholder irrigation development.

Table 2.3.6 Problems to the Participants

Definition	Total	Portion
1. Transportation	24	38%
2. Funding	9	14%
3. Training	5	8%
4. Equipment	4	6%
5. Technical Know How	2	3%
6. Technical Advice	2	3%
7. Road	2	3%
8. Others	15	24%
Total	63	100%

Source: Pre-training knowledge inventory, JICA Study Team

Understandably, the second is funding; it may be a root cause of lacking materials and equipments. In addition to those tangible problems, they also faced some constraints related to technological arrangement. Some considered a lack of their technical capability was a primary problem, while the others claimed for a lack of technical advices from the upper level offices. Some complained that they did not have enough technical know how to teach farmers.

7) Countermeasures Taken by the Participants to Deal with the Problems

It is not the case that government officers are reconciled just to look at the problems. To cope with those problems listed in Table 2.3.6, they have made a lot of efforts in different ways as shown in Table 2.3.7. Some of the officers take an alternative means of transportation, for example bicycle or even walking as substitute to motorbike, while others self-educates them by reading textbooks. Furthermore, some extension officers consult with upper class staff like provincial officers for district officers, or district officers for BEOs/CEOs.

To cope with a lack of funding, for another example, some officers ask farmers to pay for fuel cost or trainings. It is noteworthy that three officers use/used their own money to buy fuel to meet the fuel problem. In addition, officers sometimes collaborate with other departments of MACO or NGOs so that they can mobilize themselves or borrow necessary equipments from the partners. These countermeasures that the participants have taken are summarized in Table 2.3.7 (numbers are correlated with the ones in Table 2.3.6).

Table 2.3.7 Countermeasures Taken by the Officers

Countermeasures Being Taken	Total	Portion
1. Alternative for Transportation	8	17%
1. Ask farmers a favor	7	15%
2. Consult with upper staff	7	15%
3. Self-education	3	7%
4. Get equipment from other dep.	2	5%
5. Collaborate with other party	3	6%
6. Educate/train/organize farmers	9	20%
7. Self-reliant on transportation	3	7%
8. Others	4	9%

Source: Pre-training knowledge inventory, JICA Study Team

8) Best Practices

Aside from the difficulties and the struggle against those problems, participants, as government officers, have successful or memorable experiences as the best practices. One CEO specifically

remembered his best practice that his client farmers had a very good harvest from a *dambo* irrigation he supported, and some others were also proud of their successful performance of their client farmers. Other best practices were more related to their own experiences in a project or alike. For example, one mentioned an engagement in FINNIDA project in 1997 as one's best experience and other mentioned an attendance for a training course offered by PaViDIA project. These best practices are summarized in Table 2.3.8.

Table 2.3.8 Best Practices of the Participants

Items	Numbers
Exposure to a new activities	13
Observing Farmers' good performance	7
Co-working with farmers	5
Completion of the task	2
Total	27

Source: Pre-training knowledge inventory, JICA Study Team

9) Contribution of Smallholder Irrigation to Improving Livelihood of Smallholder Farmers

It was asked during the training course to the participants on how they thought smallholder irrigation could improve the livelihood of smallholder farmers. About the question, two different types of answers were given to the Study team. One was about a means and the other was about an impact or contribution of smallholder irrigation to improve livelihood of smallholder farmers. For example, training and/or assistance of inputs were pointed out as necessary arrangements to promote smallholder irrigation for improving livelihood of beneficial farmers.

On the other hand, for the outcome or an impact of smallholder irrigation, it was claimed that smallholder irrigation could improve food security and income level; in fact, 22 out of a total of 28 answers fell into this category. Also, increase in production areas and type of crops in the dry season was second popular opinions. It was suggested that participants believed that smallholder irrigation scheme could improve water availability in the dry season, increase production, and eventually enhance the food security of the smallholder farmers.

Table 2.3.9 Contribution of SH Irrigation to Livelihood Improvement

Items	Numbers
Food security and income will be increased	22
Dry season crops become available	6
Increasing area of production	4
Financial stability (i.e., school and health fees)	2
Intensify water flow in rural community	1
Having training on irrigation and assist with inputs	3
Total	38

Source: Pre-training knowledge inventory, JICA Study Team

10) Roles of Government Officers

Participants consider their own roles in various ways as shown in Table 2.3.10. Basically, as for the smallholder irrigation development, many of them, 14 out of 34, thought themselves as facilitator who organized and mobilized smallholder farmers in irrigation and agricultural development.

In addition, provision of technical advises was the other important role that they considered. Precisely, giving training, providing some financial resources or even implementing smallholder irrigation was considered as their primary roles. As majority of the participants considered that their roles was to facilitate farmers and providing advises, there should be some needs of trainings for them to equip themselves with technical capacity and facilitation skills; the kick off workshop training was a good opportunity for them.

Table 2.3.10 Roles of Government Officers

Items	Numbers
Facilitation and mobilization, guidance	14
Technical advise	13
Monitoring	5
Training	6
Implementation of smallholder irrigation	5
Finance (construction, resources)	3
Improve living condition/food security	3
Deployment of staff where vacant	1
Data collection	1
Educate the importance of growing irrigated crops	1
Total	52

Source: Pre-training knowledge inventory, JICA Study Team

11) Expectation from the Training

Expectations from the training course were also asked, by listing 2 from the top. As expected, participants actually anticipated a lot about new knowledge and skills from the kick-off training. What the participants were expecting the most is to acquire knowledge on irrigation systems in general; 18 officers expected it. Sixteen officers specifically considered this training as an opportunity to learn construction and management skills of irrigation facilities. Including new technologies were placed as the top three expectations.

Others also expected sharing ideas and knowledge with other participants from different districts or province. As it was also addressed above, some participants, four participants, were willing to acquire some skills on facilitating and organizing farmers. There were also participants who were expecting some logistical support from the Study team. It implied that they may have expected some financial support from the Study so that one of their serious constraints, a lack of fund, could be somehow tackled.

Table 2.3.11 Expectation from the Training

Items	Total
Acquire knowledge on irrigation systems	18
Construction and management of irrigation facilities	16
New technologies	10
Sharing ideas & knowledge/ challenges & experiences	6
Logistics support	6
Facilitation skills	4
Cultural technologies	2
Get certificate	1
Know selected camps for the pilot project	1
Make action plan	1
Total	65

Source: Pre-training knowledge inventory, JICA Study Team

2.3.4 Achievement of the Training Objectives

At the end of the training course, the participants were asked on how much they have achieved the training objectives in a level of 1 to 5; level-1 is least achieved while level-5 is most-achieved. There are a few participants who gave less than level-3 achievement, however, most of the participants gave more than that, and in any of the objectives, level-5 achievement marked the most highest participants as shown in Figure 2.3.2. The percentage of the participants who gave level-5 achievement ranges from say 50% to as high as 80%. Objectives which marked higher percentages of level-5 achievement were Objective No.1 and No.4. Objective No.1 dealt with 'internalization of the smallholder irrigation' while Objective No.4 undertook 'Organizing of farmers in developing smallholder irrigation schemes'.

Relatively lower percentage in level-5 achievement is shown in Objectives No.3 and No.6, though not lower than 50%. Objective No.3 was to "acquire basic on-farm irrigation methods including discharge measurement". On-farm irrigation methods were not difficult for most of the participants but the concept of discharge, its measurement and also relevant to how much acreage can be irrigated with it was difficult, which required repeated explanations. Also,

Objectives are by the end of the training the participants are able to:

1. Internalize the concept of smallholder irrigation development being promoted under the Study,
2. Enumerate and discuss smallholder irrigation facilities and structures (mainly for temporary diversion weir system under the training),
3. Acquire basic on-farm irrigation methods including discharge measurement,
4. Organize farmers in developing smallholder irrigation schemes,
5. Acquire basic ideas of extending irrigation benefit to most of the villagers,
6. Acquire basic knowledge of compost manure making utilizing aerobic bacteria,
7. Prepare a camp basis entry program for 2009 dry season, and
8. Discuss way-forward for smallholder irrigation development in Zambia.

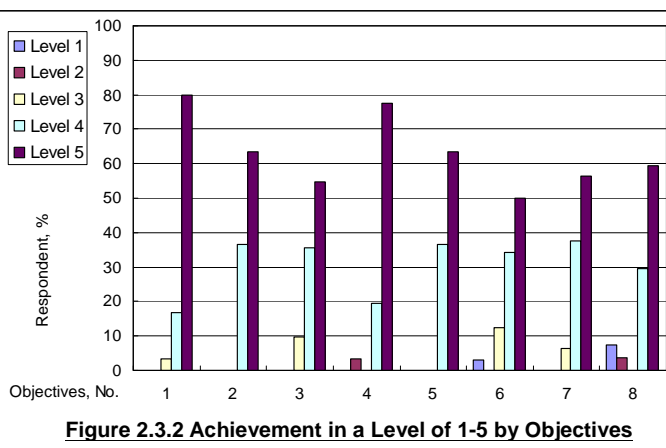


Figure 2.3.2 Achievement in a Level of 1-5 by Objectives

trainer's explanation could have been clearer.

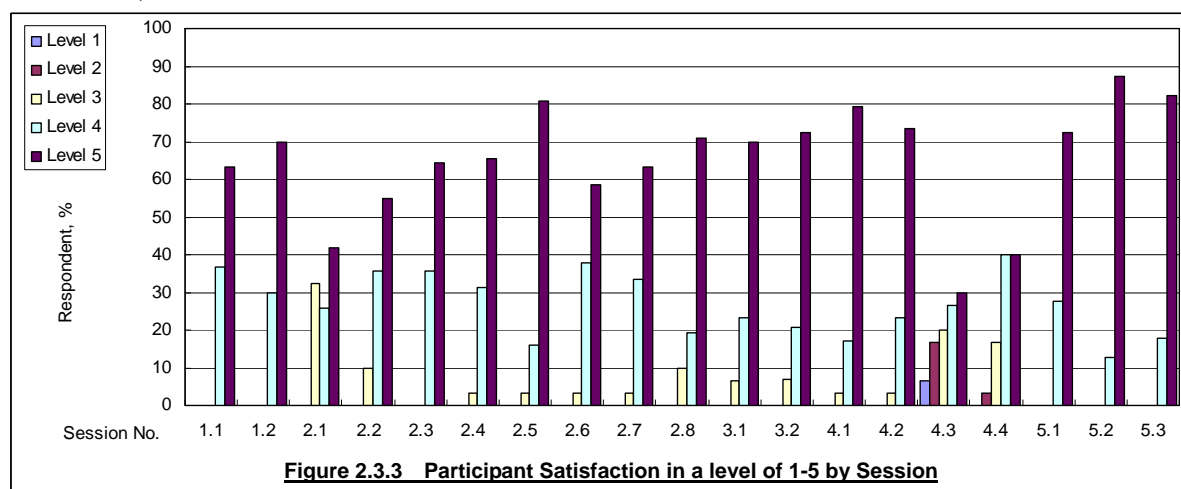
Objective No. 6 dealt with compost making with a help of aerobic bacteria. The process of making the compost is a bit cumbersome to understand, not as simple as conventional compost. In fact, there were no practice session but only theoretical lecture due to limited time allocation. Without practice, most of the participants found it difficult to fully understand since compost making by using aerobic bacteria incorporated many steps than conventional one, resulting in a relatively lower percentage of level-5 achievement.

2.3.5 Participants' Satisfaction by Session

At the end of each session, the participants were asked to what extent he/she was satisfied: level 1 is the least satisfied while level 5 is the most satisfied. Table 2.3.12 shows the sessions undertaken during the net 3-day training, and Figure 2.3.3 summarizes the level of satisfaction of the participants. The highest satisfaction can be seen in such sessions as '2.5 Trigonal prop type weir', '5.2 Entry planning and output presentation', '5.3 Dissemination materials', '4.1 Organizing of farmers', etc. In fact, all the sessions marked highest percentage in level-5 satisfaction, though session No.2.1, session No.4.3 and session No.4.4 included such lower satisfactions as level-4, level-3, and level-2 for No.4.3 and No.4.4, and even level-1, the least satisfaction, for No.4.3.

Table 2.3.12 Sessions Undertaken by Training

Session	
1.1	Program orientation
1.2	JICA presentation (Introduction & Overview)
2.1	Identification of potential gravity diversion sites
2.2	Weir type & construction method (Inclined weir)
2.3	Weir type & construction method (single line weir)
2.4	Weir type & construction method (double line weir)
2.5	Weir type & construction method (trigonal prop)
2.6	Weir type & construction method (soil masonry)
2.7	Canal alignment and construction
2.8	Ancillary facilities
3.1	Practice of construction of weir(s)
3.2	Practice of canal alignment
4.1	Organizing of farmers
4.2	Land Allocation
4.3	On-farm irrigation method & Discharge
4.4	Compost making
5.1	Entry planning and Orientation
5.2	Entry planning and output presentation (WS)
5.3	Dissemination materials



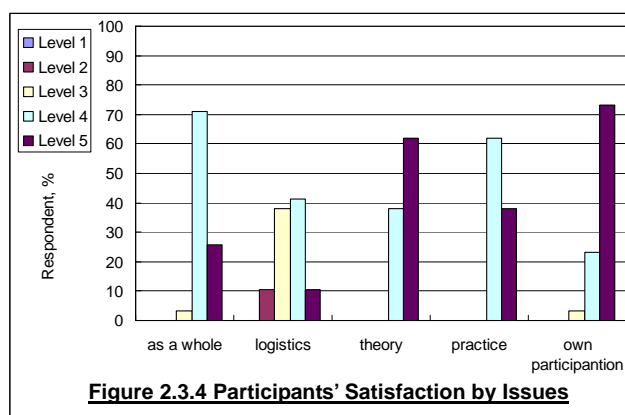
Session No.2.1 was for 'identification of potential gravity diversion sites', which included topography contour map reading. Potential gravity diversion sites can be easily found in villagers' footpaths, which cross shallower perennial streams, and also at just upstream of natural drops (small fall). To find these places was not difficult to understand for the participants. However, when the session came on how to read topographic counter maps, most of the participants were not cumbersome for it and required further clarification, resulting in lower level of satisfaction.

Session No.4.3 undertook 'on-farm irrigation methods and discharge'. As stated in the achievement of training objectives already, the participants had difficulties of concept of discharge/ flow of the stream, and also how to measure it. This had led some of the participants to the least satisfaction level such as level-2 and level-1. As per Session No.4.4, participants also had difficulties of understanding somewhat cumbersome process of compost making by utilizing aerobic microorganisms. Some

participants could hardly understand the whole process of utilizing aerobic microorganisms, showing some lower satisfaction levels.

2.3.6 Participants' Satisfaction by Different Aspects

In addition when asked the participants of their satisfaction by session, satisfaction by as a whole, logistics, theory, practice and own participation in a level of 1-5 were also asked. Figure 2.3.4 shows the satisfactions for the participants by those issues. Issues which marked highest level-5 satisfaction was 'own participation' and then followed by 'theory'. More than 70% participants in fact gave level-5 satisfaction in their 'own participation' and more than 60% participants in the 'theory' taught. Such issues as 'as a whole' and 'practice' also marked high level of satisfactions as the summated percentage of level-4 and level-5 satisfactions can arrive at almost 100%.



As per 'logistics' however, there were participants who gave satisfaction level-3 and also level-2, both of which together account for almost half, 48 % of the participants. They felt some difficulties in lodging where they were accommodated in Kasama Farm Institute. The institute is located in the neighborhood of Kasama town, causing a little difficulty of commuting from the town without pre-arranged transportation. Also, most of the difficulties were associated with water problem, causing sanitation problem. This situation led the participants to mark such lower satisfaction.

2.3.7 Participants' Comments to Improve

In addition to rating the satisfactions above, the participants were asked to make comments to improve if any with respect to: 1) as a whole, 2) logistics, 3) theory, 4) practice, 5) own participation, and 6) how best to improve the training course in future. Following are some of the comments and probable measures to be taken in future trainings:

- 1) Some participants said that there should be more practices, say for two days. They raised some concerns about compost making which requires a set of complete explanations and also practices (in fact, such practice was undertaken during the follow-up training held on November 5, 2009). Also, given enough days for the training, some participants expected to use almost full day for action plan formulation.
- 2) Four participants raised an issue of trainer, saying the presentation should be improved. These were mainly related to topographic map reading and discharge measurement. These issues require more time to thoroughly explain than that actually allocated.
- 3) About one third of the participants raised an issue on lodging. Problem was reticulation system in the ablution. Some requested to improve the facilities of the institute and even suggested a change of the venue as well. Some participants from Luapula province commented that the training could be held in a venue in Luapula province, e.g. in Mansa. In fact, some participants from Luapula province had to stay one more night in Mansa, and they came to Kasama on the following day.
- 4) To further improve the training, 8 participants raised that the training should be done only in 5 weekdays. They complained the last day of the 3-day training was on Saturday, and had to travel back to their area on Sunday. Another ideas to improve were, for example, increase of practices (6

participants), change of the venue to be sifted to Luapula province (4 participants), more exposure visit (3 participants), increase of allowance (3 participants), including of experienced staff which can enrich the share of the experiences (2 participants), etc.

2.3.8 Targets for Year 2009 Dry Season for Simple Smallholder Schemes

The climax of the kickoff training was the action planning of each district. Based entirely on the experience and learning in the past two and a half days, the participants were encouraged to plan their own action plan for the 2009 dry season. The plans consisted of; 1) TOT to be carried out at district level, 2) number of sites targeted, 3) number of farmers to be organized, 4) areas to be developed, and 5) canal length to be constructed. These targets, except for TOT, were set both for improving existing irrigation scheme, “Improvement,” and for the development of new irrigation scheme, “New Development.”

BEOs/CEOs together with their district officers were asked to set his/her own target according to the potential of their extension areas. In addition, districts had also set the targets to be implemented by fellow BEOs/CEOs who did not attend the training but are expected to learn the technology by the participants through the TOT. These figures were then placed at the front wall of the training room and presented to all the participants for their comparison and adjustment when so needed.

Table 2.3.13 summarizes the targets of TOT by district. There was an issue raised by many participants, saying that it was hardly possible to carry out TOT at the district level since CEOs were to meet only at an occasion of annual meeting. Otherwise, they reported to their district offices only on ad-hoc basis. They discussed and made a consensus of when the trained participants were to develop smallholder irrigation schemes they should invite the neighboring CEOs. This was the reason why only handful number of fellow CEOs, totaling 78 only, were to be trained in spite of the frequency of the TOT which was to be carried out 26 times. One TOT was therefore to call on 3 fellow CEOs only as average.

Table 2.3.13 Planned TOT (Training of Trainers; Fellow CEOs) by District

District	Mbala	Mpika	Mungwi	Kasama	Mporokoso	Luwingu	Kawambwa	Mansa	Total/Ave.
Times	3	6	4	2	2	3	2	4	26
Participants	15	26	5	6	3	6	5	12	78
Participants/TOT	5	4	1	3	2	2	3	3	3

Source: JICA Study Team, from the Kick-off Training held from April 16 – 18, 2009.

Table 2.3.14 summarizes the target for improvement of existing sites in the upper rows and also the target for new development in the lower rows. Participated 21 BEOs/CEOs decided to improve 53 existing sites while through TOT another 84 existing sites were set to be improved, totaling 137 sites for the ‘improvement’ in 2009 dry season. As for ‘new development’, the participated BEOs/CEOs planned to develop 41 new sites while they expected fellow BEOs/CEOs were to develop another 74 new sites, totaling 115 sites for ‘new development’ in 2009 dry season.

With respect to farmer beneficiaries to be organized, they targeted a total of 3,069 members in ‘improvement sites’ and 2,708 members for ‘new development sites’. Though these numbers were only indications, they thought one scheme should accommodate 22 members and 24 members respectively. These assumptions could be in a reasonable range based on the membership for existing schemes though new sites may promote more membership at the beginning stage due to the farmers’ high expectation to irrigation.

As per targeted areas to be irrigated, they planned to put a total of 507 ha under irrigation in case of ‘improvement’ and another 368 ha in case of ‘new development’. These figures arrived at an average area of 3.7 ha and 3.2 ha per scheme respectively. According to experience of similar programme, these areas could be overestimated especially in case of ‘new development’ since it could take over

one year to fully develop the expected area with irrigation. With regard to canal, they expected to dig a total length of 280 km in case of ‘improvement’ and 228 km in case of ‘new development’. A typical scheme would therefore have an average canal length of 2km for the both cases; they planned.

Table 2.3.14 Targets for Improvement & New Development for 2009 Dry Season

Items	Mbala	Mpika	Mungwi	Kasama	Mporokoso	Luwingu	Kawambwa	Mansa	Total	Average
Improvement										
Total No. of Site	39	25	27	10	13	8	11	4	137	
Total No. of Farmers	585	1,004	170	120	260	380	495	55	3,069	22
Total Area, ha	146	103	15	92	65	16	55	15	507	3.7
Total Canal Length, km	97	51	12	24	34	32	25	6	280	2.0
New Development										
Total No. of Site	36	10	6	7	8	6	12	30	115	
Total No. of Farmers	540	533	80	90	175	475	385	430	2,708	24
Total Area, ha	135	52	5	57	40	23	19	38	368	3.2
Total Canal Length, km	90	33	8	36	19	9	18	16	228	2.0

Source: JICA Study Team, from the Kick-off Training held from April 16 – 18, 2009.

2.4 Follow-up Training for Simple Diversion Schemes

Upon completion of the kick-off training, the participants started promoting Simple diversion schemes in their areas with their fellows. The pilot project provided them with fuel for their mobility and they have extended what they had learned during the kick-off training throughout the 2009 dry season. When it came to almost end of the dry season, a follow-up training was held on November 4 and 5, 2009 to report and share their achievements.

2.4.1 Training Programme

Prime objective of this training was to report their achievement they had done since they were trained during the kick-off training. Also, this training course aimed at having the participants to acquire the collective knowledge and experiences based upon what and how they had done on the ground. With this overall objective, following specific objectives were laid down for the follow-up training:

- 1) To share the progress and achievement of the pilot project in each district,
- 2) To identify issues/problems and those causes/effective countermeasures related to promotion of the smallholder irrigation development,
- 3) To gain and internalize collective lessons to further disseminate smallholder irrigation development, and
- 4) To know the effect of compost manure and also the method of how to make a quick making compost², *Bokashi*.

2.4.2 Training Module

The training was a net two-day live-in and out activities at Kasama Farm Institute. Methodologies employed were participatory assessment of their achievement, peer-to-peer learning through interactive presentation and discussion, and lecture-interactive discussion as well as practice on *Bokashi*, etc. Following are the original programme and due to an unforeseeable situation some modifications were made³. The programme was changed by undertaking Module-4 ‘A Quick Making

² Taking advantage of the training which invited as many as 49 participants, a quick making compost manure was lectured and also practiced. Since irrigation results in 2 times cultivation of same land per annum in most cases, soil fertility would be exploited quite rapidly unless it has to be well taken care of. Therefore, quick making compost, called *Bokashi*, was undertaken as one of the training modules of this follow-up training.

³ There was fuel shortage almost the whole Country at that time, such that Luapula group failed to start off Mansa town as planned, and thereby could not attend the Day 1 activities. They arrived at Kasama Agriculture Institute on the evening of Day-1 (they were supposed to arrive one day before the Day-1).

Compost: *Bokashi*' after the lunch of Day 1. Thereafter, Module 3 and Module 4, the most important parts of this training, followed:

Day 1 (November 4, Wednesday):

Module 1 – Program Orientation

Registration, Pre-WS Questionnaire, Opening, and Overview of the WS
Contribution from the JICA Team
Surfacing of the Participants' Expectation

Module 2 – Output Presentation of Smallholder Irrigation Development

Output Preparation by District (Form 1&2, & on Billboard)
Output Presentation by District

Module 3 – Lessons Sharing among Participants

Problems arisen & Actions taken (Form 3, group preparation)
Proud Achievements and Events (Form 4, group preparation)

DAY 2(November 5, Thursday):

Module 3 – Lessons Sharing among Participants (Continued)

Problems arisen and Actions taken (workshop discussion)
Proud Achievements and Events (workshop discussion)

Module 4 – Quick Making Compost: *Bokashi*

Bokashi Compost (Lecture), and the Practice

Module 5 – Training Evaluation

Training Evaluation

2.4.3 Training Participants

This follow-up training invited the officers who had participated in the kick-off training, together with some newcomers. They were; replacements to those who had participated in the kick off training due to staff movement, fellow CEOs who have been actively participating in the smallholder irrigation development, and TSB officers for districts which will additionally be included in the next year's pilot project. Additional districts were; Nakonde, and Isoka in Northern Province and Nchelenge and Milenge in Luapula Province. There were altogether 49 participants (36 male and 13 female) as below:

Table 2.4.1 Summary of the Participants for the Follow-up Training in 2009

Particulars	Participants	Remarks
Districts under Northern Province	30 (20M, 10F)	District TSBs, BEOs, CEOs
Districts under Luapula Province	13 (11M, 2F)	District TSBs, BEOs, CEOs
Northern Provincial TSB	5 (4M, 1F)	Overall Management (cum trainer)
Luapula Provincial TSB	1 (1M, 0F)	
Total	49 (36M, 13F)	Excluding JICA Members
Back support: JICA Study Team	3 (3M, 0F)	

Source: JICA Study Team.

At the beginning of the training, a questionnaire was distributed to all the trainees so as to study their expectations from the training, experiences during the extension activities of smallholder irrigation, e.g. difficulties and also effort to solve them, and proud achievement they have had, etc. Following are the excerpts from the answers:

1) Expectation from the Training

The participants were asked what they expected from the follow-up training by listing the most 2 expectations. As this was a follow up training, many participants expected 'sharing successes and challenges of the colleagues (13 votes)' as the top expectation. Followed the 'sharing successes and challenged of the colleagues' were 'plan way forward for next season (9 vote)', 'learn more progress with other districts (7 votes)', 'evaluation of seasonal activities that occurred in phase 1 (6 votes)',

‘gain more knowledge in smallholder irrigation development (4 votes)’ and so on.

Of them, ‘plan ways forward for next season’ was not the topic, which is undertaken in this follow up training though it acquired 2nd top expectation as 9 votes. This was explained to the participants during the surfacing session of the expectations. Logistic issues were also mentioned as ‘improve logistical support (fuel and allowances), 3 votes’, and ‘get allowances at the end of the training (2 votes)’. In sum, all the expectations but 2, namely ‘plan way forward for next season’ and ‘logistical support’ were not undertaken as the training was of follow up.

Table 2.4.2 Expectations to the Training listed by Participants

Expectations	Total
Sharing successes and challenges (of the colleagues)	13
Plan way forward for next season	9
Learn more progress with other districts	7
Evaluation of seasonal activities that occurred in phase 1	6
Gain more knowledge in smallholder Irrigation Development	4
Improve logistical support (fuel and allowances)	3
Be fully knowledgeable in the implementation	3
Know exactly if at all irrigation schemes will be funded	2
Get allowances at the end of the training	2
Know how to make <i>Bokashi</i> practically	2
Learn how the programme is going to be effective	2

Source: Pre-training questionnaire survey, JICA Study Team

2) Felt-Needs in Assistance from the Government

Participants were asked in the questionnaire on ‘What assistance they needed from the Government in implementing the smallholder irrigation, and list two assistances’. The following table summarizes the needs with which they thought they could better extend smallholder irrigation schemes. ‘Transport e.g. motorbike’ was the top-need by far among others. It obtained as many as 35 replies, followed by ‘allowance (17 replies)’, ‘improvement in fuel (8 replies)’, ‘working equipment (6 replies)’, ‘logistics support (5 replies)’ which is relevant to the 1st and 2nd needs, and ‘funding of smallholder irrigation schemes (4 replies), etc.

Since a BEO or CEO operates in a wide area, say about 23km x 23km square as average in the 2 provinces, it could be natural that they listed ‘transport (e.g. motorbike)’ as the top-need. Allowance, they thought, would work as very good incentive according to interviews made to some of the participants. The amount is now ZMK 50,000 as lunch allowance, and it seems it working as incentive rather than substitute of lunch they are to miss out during their field operation.

3) Problems and Efforts to Solve during the Implementation

The pre-training questionnaire asked the participants ‘On your experiences as a CEO/BEO/TSB staff: describe the problem(s) you have faced or are facing in implementing smallholder irrigation this season’. Foremost problem was ‘transport’ listed by 22 participants as shown in the following table. This was very much relevant with the above-mentioned felt-needs in assistance from the government. The 2nd problem was ‘lack of financial assistance (11 replies)’ as it was also pertinent to the above-mentioned ‘allowance’. The 3rd problem was ‘inadequate logistics (9 replies)’, which was in fact a way-around of statement of the top 2 problems.

Table 2.4.3 Participants’ Needs in Assistance from the Government

Assistance from the Government	Reply
Transport (e.g. motorbike)	35
Allowances	17
Improvement in fuel	8
Working equipments e.g. protective clothing, cement	6
Logistics support	5
Funding of smallholder irrigation schemes	4
Training	3
Plan for the year 2010	3
Considering irrigated crops under FSP as rain fed maize	2
Holding Training at least each quarter	1

Source: Pre-training questionnaire survey, JICA Study Team

‘Low turn up by farmers’ was a problem listed as 4th problem (5 replies). During dry season, farmers

are usually engaged in repair of houses, establishment of village infrastructure such as community school, village road, village gathering place (a relatively big round thatched house), etc. These activities sometimes collided with smallholder irrigation development, it was learnt from interviews made with the participants.

Some of the participants had a problem in 'organizing farmers who had hopes of being paid after work done and inputs', as listed by 3 replies. Some programmes have provided minimum wage level of payment to participant farmers and also, upon completion of work, gave out input e.g. improved seeds with chemical fertilizer. Some farmers have experienced these arrangements, and therefore by nature they expected same arrangement in this smallholder irrigation development. Since this pilot project does not provide any input or wage to the participant farmers, such tendencies when occurred resulted in a difficulty of motivating them onto smallholder irrigation development.

Table 2.4.4 Participants' Experiences on Problems

Problem (s) having faced them	Reply
1. Transportation for moving to the project site	22
2. Lack of financial assistance	11
3. Inadequate logistics e.g. fuel, late distribution of fuel,	9
4. Low turn up by farmers	5
5. Working long hours without meal allowances	3
6. Seepage on the weir	3
7. Organizing farmers with hopes of being paid and inputs	3
8. Identification of site to do new development was difficult	2
9. Women participation poor and communication was poor	2
10. No protective attire	2
11. CEOs no implementing programs in good time	1
12. Farmers wanted permanent weir instead of temporal	1

Source: Pre-training questionnaire survey, JICA Study Team

In conjunction with the problems above, the participants were also asked, 'what kind of efforts they have exercised to solve the problems'. To cope with transport problem, most of them borrowed bicycle and in some cases hired it (16 replies) as summarized in Table 2.4.5. There were participants who sourced out of their pockets to supplement fuel (8 replies). There were 2 participants who prepared packed lunch to cope with long-hour field work forcing them to miss out lunch. This is an encouraging attitude, learnt by other participants.

Table 2.4.5 Participants' Efforts to Solve the Problems Above

Efforts to solve the problems above	Reply
1. Use of borrowed and hired bicycle	16
2. Using personal resources to buy fuel	8
3. Organize meetings with farmers	6
7. Encourage them that it is their community	6
1. Servicing of the motorbikes	4
5. I go with packed lunch	2
6. Putting sand bags and using clay soil	2
7. Demonstrating how effective the technology is	2
8. Involvement of Chiefs and TSB staffs	2
7. Facilitated to buy their own inputs and make manure	1
8. Moved through the whole stretch of stream	1
9. Encouraging women to participant	1
10. Wearing canvas as protective clothing	1
11. Inviting far away farmers to see the others	1
11. Coordinated the relevant authority to work together	1
12. Construction of temporal weirs	1

Source: Pre-training questionnaire survey, JICA Study Team

Note: Numbers are corresponding to the ones in Table 2.4.4.

On difficulty of dealing with farmers, they emphasized that the work is for community, involved local authority such as chiefs, asked assistance from district TSB officers, invited farmers to see the fellow farmers' activities, etc. With these efforts and arrangement, they have proceeded.

4) Best Experiences in Implementing Smallholder Irrigation Development

They have faced many problems on the course of promoting smallholder irrigation schemes as stated above, but on the other hand they have had proud achievements, impressive events, best experiences, etc. through working together with the farmers, by overcoming their difficulties, by achieving the targets set in their action plans, etc. Following table summarizes the best experiences they have had during the extension.

Twelve (12) participants took as the best experiences 'seeing the farmers able to constructing temporal weirs with locally available materials'. Farmers are their clients, so that the farmers' achievement as

was planned and also by overcoming difficulties gave the extension officers a happiest moment. Second best experience is also quite in line with the first one, that is ‘seeing farmers who welcomed the project and eager to work no matter how difficult the task was and seeing them plant crops in their schemes’.

What came at 3rd position is ‘furrow pegging and thereafter digging of the canal’. As the pilot project introduced a simple way of aligning canal that was “progressive line leveling with spirit line level”, even CEOs/BEOs and farmer themselves could align canal. Using spirit line level enabled them to carry on the canal aligning without waiting for dumpy level, a sophisticated survey equipment.

As stated by 4 participants, there was ‘high demand for smallholder irrigation even from some communities who do not have perennial streams. This demand from such communities endorses high opportunity in extending the smallholder irrigation development over the Study area. Also, 4 participants stated that ‘we are now an expert for smallholder irrigation development’, and very much similar one as ‘constructed the trigonal weir and other simple weirs for the first time in my own’.

Table 2.4.6 Participants’ Best Experiences

Best experiences	Reply
Farmers have been able to construct temporal weirs with locally sourced materials successfully.	12
Farmers welcomed the project eager to work no matter how difficult the task is. Seeing them plant crops in their schemes	8
Furrow pegging and thereafter digging of the canals	6
High demand for smallholder irrigation even from some communities who do not have perennial streams	4
Now an expert in selecting potential sites for smallholder irrigation development	4
When I constructed the trigonal weir and other temporary weirs for the first time on my own	4
Coordination between TSB and extension staff, chiefs and farmers	3
Discovering of a water source and taping water to the canal	2
Farmers have developed interest on implementing smallholder irrigation	2
A group was stopped by one farmer who has a water furrow down. He complained but I explained to and convinced him.	1
Mungwi river water bridge and its success was my best experience.	1

Source: Pre-training questionnaire survey, JICA Study Team

5) Experiences on Compost Manure

Taking advantage of the training where about 50 participants were called on, a compost manure was lectured and also practiced. Since irrigation results in 2 times cultivation of the same land per annum in most cases, soil fertility would be exploited quite rapidly unless it has to be well taken care of. Therefore, quick making compost, called *Bokashi*, was undertaken as one of the training modules. In this regard, the pre-training questionnaire asked the participants about their knowledge and experiences on compost. Following are the summary of the replies:

- 5.1) What they know most was ‘pit compost’. 40 participants replied they knew the pit compost and 30 reported that they had demonstrated so far. This pit compost was followed by ‘*Bokashi*’. In fact, *Bokashi* was preliminary introduced by JICA study team during the kick-off training held in early April 2009, and demonstrated in 2 sites of 2009 dry season. Those who replied ‘They knew and demonstrated *Bokashi*’, 12 participants and 4 participants respectively, are therefore all associated with the activity by JICA study team.
- 5.2) Heap compost is also popular to some extent in Zambia as known by 6 participants and demonstrated by 6 participants. Heap compost here was very simple one whereby; 1) all the materials are piled up with watering, 2) 2 weeks after the preparation; it is once turned up with watering, and then 3) left over for about 3 months for decomposition. The heap is not covered by mud or plastic sheet, thereby allowing nitrogen to evaporate in air (if it is covered by mud, it is called *Chimato* compost which can retain nitrogen in the decomposed material).
- 5.3) All the participants knew the role of compost manure as replied to the question of ‘In what way do you think compost manure works?’ Primary role of compost was to improve physical soil

texture as replied by 29 participants. In addition, 23 participants replied ‘fertilization of the soil’ as one of the roles, which is also quite correct. However, the effect of fertilization may not be as expected if it is prepared in conventional heap compost. This is because most of the nitrogen could easily be evaporated without any covering of the heap.

5.4) Difficulties they faced in disseminating compost manure are ‘materials for *Bokashi* (9 replies)’, followed by ‘farmer prefers chemical fertilizer than compost (7 replies)’, ‘laborious work and the long time to be decomposed (5 replies)’, etc. It may be automatic that the farmers prefer chemical fertilizer because as far as effectiveness is concerned, conventional compost manures cannot compete with chemical fertilizer. However, since compost improves soil texture, chemical fertilizer can be better retained in such improved soil. This context, if given to farmers, may better contribute to promoting compost.

2.4.4 Achievement of the Training Objectives

At the end of the follow-up training, the participants were asked how much they have achieved the objectives of the training in a range of 1 to 5; level-1 is the least achieved while level-5 is the most achieved. There was no participant who gave either level-1 or level-2 achievement. More than 80% of the participants replied that they have achieved the training objectives by a level of either 4 or 5. In fact, more than 50 % of the participants replied they have achieved the Objective-1 and Objective-2 at the level-5, and nearly about 70% of them did so for the Objective-5. In Objective-4, ‘To gain and internalize collective lessons to further disseminate smallholder irrigation development’, those who replied level-4 achievement was more than that of level-5. Some participants said the training was a bit short in terms of discussion time, which may have resulted in the achievement.

Objectives are by the end of the training the participants are able to:

1. To share the progress and achievement of the pilot project in each district,
2. To identify issues/problems and those causes/effective countermeasures related to promotion of the smallholder irrigation development,
3. To gain and internalize collective lessons to further disseminate smallholder irrigation development, and
4. To know the effect of compost manure and also the method of how to make a quick making compost, *Bokashi*.

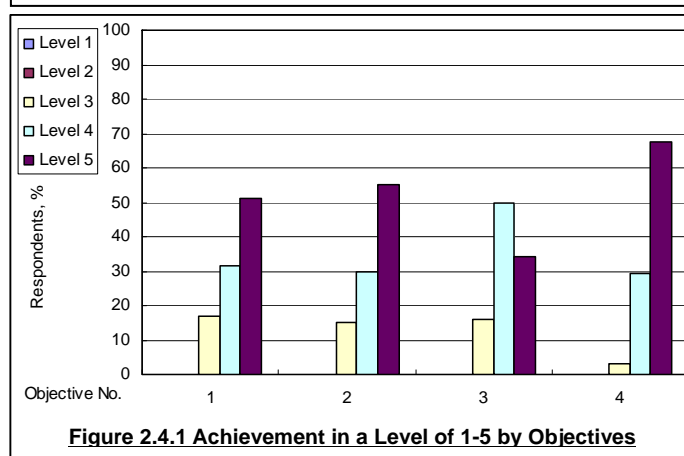


Figure 2.4.1 Achievement in a Level of 1-5 by Objectives

2.4.5 Participants' Satisfaction by Session

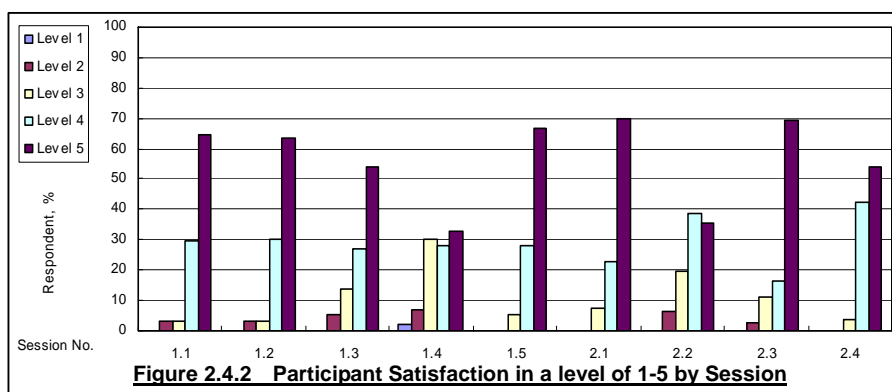
At the end of each session, the participants were asked to what extent he/she was satisfied: level 1 being the least satisfied while level 5 being the most satisfied. Table 2.4.7 shows the sessions undertaken during the net 2-day training, and Figure 2.4.2 summarizes the level of satisfaction by the participants in conjunction with the sessions. The highest satisfaction can be seen in such sessions as ‘1.1 Programme Orientation’, ‘1.2 Contribution from JICA Study Team’, ‘1.5 Problems arisen and Actions taken (group preparation) and 2.1 those

Table 2.4.7 Sessions Undertaken by Training

Session	
1.1	Program orientation
1.2	Contribution from JICA Study Team
1.3	Surfacing of the Participants' Expectation
1.4	Output Preparation & Presentation by District
1.5	Problems arisen and Actions taken (Group Preparation)
2.1	Problems arisen and Actions taken (WS discussion)
2.2	Bokashi Compost (lecture)
2.3	Bokashi Compost (Practice)
2.4	Training Evaluation

presentation’, and ‘2.3 Practice on *Bokashi* compost’.

Two sessions marked relatively lower satisfaction, which were ‘1.4 Output preparation & presentation by district’, and ‘2.2 Lecture on *Bokashi* compost’. Why ‘1.4 Output preparation & presentation by district’ marked relatively lower



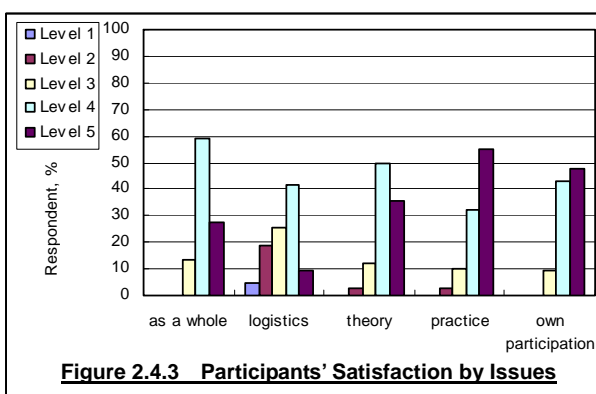
satisfaction may have come from the difference between what had been reported by some of the districts as midterm achievements before the training and what was finally reported during the training. A typical example was Kasama district. Kasama TSB had once reported that they improved 6 existing sites and newly developed 10 sites as at mid September 2009. However, their real achievements by the time of the training were 0 site in terms of ‘improvement’ and 5 sites in ‘new development’.

According to them, they had reported ‘projected’ sites that they were to improve or develop by the time of the follow-up training. This kind of reporting was seen in some other districts as well. To clarify between what they had reported before and what they reported during the training took quite long time which was in fact a kind of wasting of time for others. This situation may have resulted in the relatively lower satisfaction for the session of ‘1.4 Output preparation & presentation by district’.

Bokashi compost requires many materials than conventional composts, and the process of making is also a bit complicated including regular turning up. In addition, lecture on aerobic and anaerobic bacteria may have been not so familiar to most of the participants. Therefore, satisfaction marked on the session of ‘2.2 Lecture on *Bokashi* compost’ may have been lower than the others.

2.4.6 Participants’ Satisfaction by as a Whole, Logistics, Theory, Practice, and Own Participation

In addition when the participants were asked of their satisfaction by session, satisfaction as a whole, logistics, theory, practice and own participation were also asked in a level of 1-5. Figure 2.4.3 shows the satisfactions for the participants by those issues.



The issue which marked highest level-5 satisfaction was ‘practice’ and then followed by ‘own participation’. More than 50% participants gave level-5 satisfaction to the ‘practice’ and close to 50% participants in the ‘own participation’. Such issues as ‘as a whole’ and ‘theory (on *Bokashi* compost)’ also marked high level of satisfactions as the summated percentage of level-4 and level-5 satisfactions can arrive at close 90%. As per ‘logistics’, however there were participants who gave satisfaction level-2 and even level-1, both of which account for almost a quarter (10 out of 43 valid replies). They felt some difficulties in lodging where they accommodated in Kasama Farm Institute. Some of the difficulties are associated with either bedding and/or water problem, causing trouble on them. There were 8 participants who requested to improve water supply.

2.4.7 Participants' Comments to Improve

In addition to rating the satisfaction above, the participants were asked to present comments to improve if any with respect to; 1) as a whole, 2) logistics, 3) theory, 4) practice, 5) own participation, and 6) how to best improve the training course in future. Following are the excerpt of the comments and probable measures to take for future trainings:

- 1) Three participants raised an issue that the duration should be longer than the net-2 days in order to fully undertake all the topics including interactive discussions and brainstorming. Similar comment was given by 10 participants, saying 'time was too short'.
- 2) Fourteen (14) participants suggested that the venue be changed to Luapula. As aforementioned, participants from Luapula province arrived in late afternoon of Day-1, missing almost all the sessions of that day. It was due to a nation-wide fuel shortage. Faced with this problem and also taking into account the long distance between Mansa, the capital of Luapula province, and Kasama, those who came from Luapula province recommended the change of the venue to Luapula province.
- 3) Learning materials were also requested to improve the training. The materials requested were such as pen, notebook, and box files. Box files in fact facilitates good keeping of record and materials provided, e.g. handouts. Therefore provided that there is enough budget, it should be considered.
- 4) Allowance issue was raised by some participants; e.g. to raise the amount to the government recommended level, give some down payment upon the arrival of the participants, etc.

2.5 Achievement in 2009 Dry Season

Numerical targets for smallholder irrigation development were set at; TOT, sites to be improved, and sites to be newly developed. Sites to be improved and newly developed included not only the target number of sites, but also expected canal length, expected area to be irrigated, expected farmers to be organized. However, those except for the target number of the sites were reference only. The following discussion presents the achievements in the 2009 dry season in comparison with the targets:

2.5.1 Achievement on TOT

Table 2.5.1 summarizes the achievement for TOT in comparison with the target. It shows the targets in upper rows and the actual achievements in the lower rows such as how many times of TOTs they have carried out and how many fellow CEOs have been trained during the 2009 dry season:

Table 2.5.1 Planned TOT and Actually Implemented TOT by District

District	Mbala	Mpika	Mungwi	Kasama	Mporokoso	Luwingu	Kawambwa	Mansa	Total/Ave.
Target									
Times	3	6	4	2	2	3	2	4	26
Participants	15	26	5	6	3	6	5	12	78
Participants/TOT	5	4	1	3	2	2	3	3	3
Achievement									
Times	10	6	6	2	3	3	0	15	45
Trained BEOs/CEOs	13	10	36	2	25	7	0	36	129
BEOs/CEOs/TOT	1.3	1.7	6.0	1.0	8.3	2.3	-	2.4	3

Source: JICA Study Team, from the Kick-off Training on April 16 – 18, and Follow up Training on Nov. 4 & 5, 2009.

In total, 45 TOTs were carried out as compared to 26 TOTs planned. It was to train a total of 78 fellow BEOs and CEOs while the number of actually trained staff reached 129 personnel. Most of the districts carried out TOT as planned or rather exceeded their targets except for Kawambwa district. The district has not carried out any TOT. In Kawambwa district, the participated TSB officer in the kick-off training was transferred soon after he went back to his station, and handing over of the

programme to the successor was not properly done.

Looking into the trained BEOs/CEOs per TOT, it ranges from only one personnel to 8 personnel. In fact, there were difficulties in inviting many fellow BEOs/CEOs to a TOT. BEOs/CEOs are supposed to attend every quarterly meeting held at district level. If the quarterly meeting were to be held as supposed to be, a TOT to which all the BEOs/CEOs can attend could have been arranged. However, faced with financial difficulties, this sort of plenary meeting at district level is not carried out regularly but only once a year in most of the districts where all the BEOs/CEOs together with district staff are to review the year's activities and plan for the next year.

Therefore except for some of the TOTs carried out at Mungwi and Mporokoso districts, most of the TOTs mentioned above were carried out at site inviting neighbor CEOs only. Mungwi and Mporokoso districts took an advantage of a quarterly meeting which was held by chance. Otherwise, trained BEOs/CEOs invited fellow CEOs who are in most cases their neighbors during the construction of weir, pegging of canal, digging of canal, etc. By so doing, sort of on-site TOT has been carried out and a total of 129 fellows were trained.

2.5.2 Achievement on Improved Sites

Most of the existing simple schemes constructed by farmer themselves do not have diversion structure, and simply withdraw stream water to their canal by gravity. Therefore, amount of water withdrawn to the canal can hardly meet crop requirement especially during late irrigation season when water level in the stream gets lower. Smallholder irrigation development in 2009 dry season therefore undertook the improvement of these existing simple schemes as one of the major activities. Table 2.5.2 summarizes the achievement for improved sites, from which following are found:

- 1) A total of 100 existing sites have been improved in 2009 dry season, against the target of 137 sites. This shows achievement ratio of 73%. By district, Kasama has done nothing in improvement, while Mbala district has improved as many as 22 sites, followed by Mansa district (19 sites), Luwingu district (17 sites), Mporokoso district (16), and so on so forth.
- 2) In terms of farmers concerned, there are total 4,060 members who participated in the construction, composed of 2,553 male members and 1,507 female members⁴. A typical site has 41 participants (26 male members and 15 female members) as average. On the other hand, average number of land owners per site is only 5, which means one out of about 8 participant members has the land ownership. Those members share the land by mutual agreement.
- 3) Original canal length in total was 194 km summated for the 100 sites, under which a total area of 149 ha had been irrigated before the improvement. The improvement altogether has done an additional canal digging of 27 km. With the canal additionally dug, a total of 177 ha have been newly opened. However, not all of the 177 ha was irrigated and planted in the 2009 dry season. Some areas were found it was too late to plant crop whereby those areas were left unplanted in the season. Out of the 177 ha newly opened, area actually irrigated and planted was 98 ha in total. Thus the average irrigated/planted area newly added in the 2009 dry season arrives at 0.98 ha per site. Summing up the original irrigated area of 149ha, the improved sites altogether irrigate 247 ha, giving an average irrigated area of 2.47ha per site.
- 4) As per irrigated are per participant member, original average area was 0.037ha (0.15lima). The

⁴ In fact, all the participant members may not be necessarily beneficiary farmers. This is because that though construction can attract many villagers, including then non-beneficiary farmers, also instructed by village headman, some may have dropped off from the membership in later dates due to, for example, not enough plot, not enough water, etc. In 2009, unfortunately final membership was not confirmed. In 2010, on the other hand, ratio of those who actually irrigated was checked and it was 58% of all the participant members. With reference to this data, only about 60% of the participant members may have benefited from the irrigation.

improvement opened an area of 0.044ha (0.17lima) per member, out of which 0.024 ha (0.097lime) per member was irrigated and planted in 2009 dry season. Therefore, a typical member may enjoy irrigated agriculture at a land of 0.061ha (0.24lima). There is however a possibility that not all the participant members were able to irrigate. In 2009, such data was not assessed but in 2010, it was learned that only 58% of all the members have arrived at the stage of irrigation. With this ratio applied, one probable irrigator may have irrigated 0.063 ha originally and may have had an additional irrigated area of 0.042ha, totaling 0.105ha as shown at the bottom of Table 2.5.2.

2.5.3 Achievement on New Development Sites

Table 2.5.3 summarizes the achievement on new development sites. The target in terms of site was 115 while BEOs/CEOs with district TSBs together developed a total of 94 sites in the 2009 dry season. Mbala district has developed as many as 25 sites, followed by Mansa district (22 sites), Mpika district (12 sites), Kawambwa district (10 sites), Luwingu district (9 sites), etc. Following are the findings:

- 1) Ninety four (94) sites newly developed consist of 82% of the target of 115 sites. Though it had not reached the target, it can be still said that all the concerned officers had worked well given just 3-day kick-off training plus fuel for motorbike. Out of the 94 newly developed sites, those which had started irrigation/planting in the 2009 dry season were 63 sites while the rest, 31 sites, have not yet started irrigation. They are still engaged in canal digging, canal extension, land opening, land demarcation, etc. or otherwise it was already too late to plant dry season crops in the 2009 dry season although the scheme was completed. The 31 sites are expected to start irrigated agriculture in the following 2010 dry season.
- 2) Under the development of 94 new sites, concerned officers altogether have organized as many as 3,118 farmers (2,095 male members and 1,023 female members). Out of whom, in the 2009 dry season, 1,680 farmers may have been benefited by irrigated agriculture with reference to the members for the 63 sites which had in fact reached the stage of irrigation. Or otherwise, farmers benefited from irrigation may be 1,185 only with reference to the data of 2010 pilot implementation; ratio of those who actually irrigated against those who just participated in the construction (see the 2nd bottom row of Table 2.5.3). A typical new site was established with 33 farmers, 22 male and 11 female members, as the average participant members for all the 94 sites. As for landowners, there are 536 owners in total for the 94 sites, arriving at an average of 6 landowners per site.
- 3) Canal excavated in the 2009 dry season reached a total stretch of 71km. A typical site is therefore given an average length of 0.75km. The area opened has arrived at 104 ha in total, and the average area opened per site is estimated at 1.1 ha. This means that an average area of 0.0333 ha (0.133 lima) was opened per participant member. All the opened areas have not been put under irrigation in this 2009 dry season, but the areas can be referred to as the expected one to be irrigated in the following years.
- 4) Out of the 104 ha newly opened, area actually irrigated and planted in the 2009 dry season reached 52ha. It means about half of the opened area could start irrigated agriculture in 2009 dry season, while it was too late for the other half area to plant crops this season. This half of the area was to start irrigated agriculture in the following years. Average irrigated area per site arrives at 0.55 ha (2.2 lima) when divided by all the 94 sites and 0.82 ha (3.28 lima) when divided by those sites which actually started irrigation this year, 63 sites. As per irrigated area per farmer beneficiary, it is 0.017 ha (0.07 lima) and 0.031 ha (0.12 lima) respectively. This irrigated area per irrigator may have come to 0.044 ha (0.18 lima) with reference to the irrigators ratio, 38% only, available in 2010 pilot project (see the bottom of Table 2.5.3).

Table 2.5.2 Summary of Improvement for Existing Sites in 2009 Dry Season

District	No. of Sites	Nr. of member farmers			No. of Land Owners	Original		Additional with Improvement			Original + Newly Irrigated, ha	Original + Opened, ha	Command Area, ha	Nr. of Fish Pond
		Total	Male	Female		Original C. Length, km	Originally irrigated Area, ha	Canal Length newly dug, km	Opened Area in 2009, ha	Area newly irrigated in 2009, ha				
Kasama	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	
Mbala	22	555	362	196	56.60	42.75	33.50	18.50	33.50	18.50	76.25	91.14	NA	
Average		25	16	9	2.57	1.94	1.52	0.84	1.52	0.84	3.47	4.14	NA	
Mpika	7	217	152	62	22.50	14.75	23.53	22.40	23.53	22.40	38.28	65.50	NA	
Average		31	22	9	3.21	2.11	3.36	3.20	3.36	3.20	5.47	9.36	NA	
Mporokoso	16	1,347	786	561	22.95	31.05	28.55	2.00	28.55	2.00	59.60	75.20	25	
Average		84	49	35	1.43	1.94	1.78	0.13	1.78	0.13	3.73	4.70	2	
Mungwi	5	182	120	62	15.30	0.00	17.50	8.00	17.50	8.00	17.50	27.50	8	
Average		36	24	12	3.06	0.00	3.50	1.60	3.50	1.60	3.50	5.50	2	
Luwingu	17	1,138	745	393	45.65	11.50	22.25	6.00	22.25	6.00	33.75	168.00	13	
Average		67	44	23	2.69	0.68	1.31	0.35	1.31	0.35	1.99	9.88	1	
Kawambwa	14	359	219	140	14.85	13.38	7.60	3.27	7.60	3.27	20.98	48.00	80	
Average		26	16	10	1.06	0.96	0.54	0.23	0.54	0.23	1.50	3.43	6	
Mansa	19	262	169	93	16.00	35.35	44.00	38.00	44.00	38.00	79.35	164.25	NA	
Average		14	9	5	0.84	1.86	2.32	2.00	2.32	2.00	4.18	8.64	NA	
Grand Total	100	4,060	2,553	1,507	193.85	148.78	176.92	98.17	176.92	98.17	325.70	639.59	126	
Per Site		41	26	15	1.9385	1.4878	0.2668	0.9817	1.7692	0.9817	3.2570	6.3959	2.42	
Per Member					0.0477	0.0366	0.0066	0.0242	0.0436	0.0242	0.0608	0.1575	0.06	
Expected Irrigators(58%)		2,355	irrigators in total											
		24	irrigators per site				0.0751		0.0751					

Table 2.5.3 Summary of New Development in 2009 Dry Season

Nr.	No. of Sites	Nr. of member farmers			No. of Land Owners	Done in 2009 Dry Season			Plan for Next 2010 Dry Season			Command Area, ha	Nr. of Fish Pond
		Total	Male	Female		Canal Length dug in 2009, km	Opened Area in 2009, ha	Irrigated Area in 2009, ha	Canal Length to be dug, km	Additional Area to be irrigated, ha	Area to be irrigated, ha		
Kasama	5	220	159	61	28	2.90	0.63	0.38	13.30	8.25	8.63	65.00	0
Average		44	32	12	6	0.58	0.13	0.08	2.66	1.65	1.73	13.00	0
Mbala	25	903	654	249	323	13.30	14.30	5.80	29.10	21.75	27.55	17.06	NA
Average		36	26	10	13	0.53	0.57	0.23	1.16	0.87	1.10	0.68	NA
Mpika	12	355	234	121	16	19.81	8.15	6.65	15.30	33.13	39.78	59.86	12
Average		30	20	10	1	1.65	0.68	0.55	1.28	2.76	3.31	4.99	1
Mporokoso	5	228	126	102	14	1.60	14.15	1.25	8.20	13.90	15.15	15.50	2
Average		46	25	20	3	0.32	2.83	0.25	1.64	2.78	3.03	3.10	0
Mungwi	6	265	142	123	0	9.12	11.30	1.30	7.50	16.75	18.05	16.75	2
Average		44	24	21	0	1.52	1.88	0.22	1.25	2.79	3.01	2.79	0
Luwingu	9	447	327	120	25	3.55	5.00	0.50	63.55	65.00	65.50	80.00	4
Average		50	36	13	3	0.39	0.56	0.06	7.06	7.22	7.28	8.89	0
Kawambwa	10	225	155	70	61	3.01	8.71	4.71	2.91	6.45	11.16	29.00	0
Average		23	16	7	6	0.30	0.87	0.47	0.29	0.65	1.12	2.90	0
Mansa	22	475	298	177	69	17.56	41.50	31.25	14.35	42.25	73.50	105.50	NA
Average		22	14	8	3	0.80	1.89	1.42	0.65	1.92	3.34	4.80	NA
Grand Total	94	3,118	2,095	1,023	536	70.84	103.74	51.84	154.21	207.48	259.32	388.67	20
Per Site		33	22	11	6	0.7536	1.1036	0.5515	1.6405	2.2072	2.7587	4.1347	0.43
Per Member						0.0227	0.0333	0.0166	0.0495	0.0665	0.0832	0.1247	0.01
	31	not irrigated yet at all in 2009 dry season out of the total 94 sites											
	63	actually irrigated in 2009 dry season out of the total 95 sites											
Members irrigated for 63 sites		1,680	1,081	599	332								
Expected Irrigators(38%)		1,185	irrigators in total										
		13	irrigators per site										

2.5.4 Difficulty in Developing Area

Table 2.5.4 compares targets set during the kick-off training and actual achievements by item, not only number of sites improved/developed but also others such as number of farmers, canal length to be dug, area to be improved/developed, etc. Of course, those targets other than number of sites were just based on assumptions or based on their past experiences, but it may imply that what the extension officers could plan was very much relevant to their site situation or not and if not so what areas have to be put right. The table indicates:

- 1) In terms of improvement, there was not much difference between what they had targeted and what they have actually achieved except for 'area'. They targeted a total of 507 ha to be irrigated with improvement, including the original area. They have opened an additional area, with which a total area of 326 ha became either under irrigation or ready for irrigation. Out of the 326 ha, area actually irrigated was 247 ha as against the target of 507ha. We may say the extension officers tend to overestimate 'area' to be opened/irrigated.
- 2) As for new development, there is a big difference between the targeted area and achieved area. The targeted area to be irrigated was 368 ha while actually opened area was 104 ha (28%). Out of the opened area, actually irrigated area was only 52 ha, equivalent to only 14 % of what was targeted. Accordingly, big gap took place in terms of irrigated area per site. They targeted they were to irrigate an average area of 3.2 ha per site while the actual irrigated area per site was 0.55 ha only. Canal excavation was also overestimated; a total of 71 km was dug against targeted 228 km. Therefore, they obviously overestimated area and also canal length manageable in a season. The targets of the area and canal length are still within achievable ranges according to existing examples, but should not be set as the targets in just one season.

Table 2.5.4 Comparison between Targets and Achievements

Particulars	Improvement		%	New Development		%
	Target	Achievement		Target	Achievement	
No. of sites	137	100	73	115	94	82
No. of farmers	3,069	4,060	132	2,708	3,112	115
No. of farmers per site	22	41	186	24	33	138
Area, ha	507	326*	64	368	104*	<u>28</u>
		247**	49		52**	<u>14</u>
Area per site, ha	3.7	3.3*	89	3.2	1.1*	<u>34</u>
		2.5**	68		0.55**	<u>17</u>
Canal length, km	280	221	79	228	71	31
C. length per site, km	2.0	2.2	110	2.0	0.75	38

Note: * means area opened and ** denotes area irrigated/planted in 2009 dry season.

Source: JICA Study Team, follow up training held on November 4&5, 2009

2.5.5 Difficulties facing the BEOs/CEOs

During the follow up training, after the participants have presented and shared the above achievements, they were once again divided into groups by district, and asked to report, as district, what problems/issues they have faced during the extension of smallholder irrigation development, causes of the problems, measures they have undertaken, lessons, etc⁵. Table 2.5.5 summarizes the problems by category; and major ones are as follows:

- 1) 'Logistics' issues were the commonest problem, which was lack of motorbike, shortage of fuel, lack of spare parts, no protective cloths, and these hindering have resulted in de-motivating some

⁵ In fact, these issues were asked in the pre-training questionnaire to each participant. Here they were asked to reply as district group.

BEOs/CEOs as 'staff motivation' was stated following the logistics problem. These issues were reported to have been a problem also in relation to monitoring and follow-up.

- 2) With respect to farmers, there was an expectation for handout. They expected, for example, chemical fertilizer and seeds upon completion of the construction work. This expectation made CEOs' work difficult to move ahead in some cases.
- 3) Land issue was reported by 3 districts as; 1) a landowner did not allow canal passing through his land, 2) some farmers felt fear of land being given to other farmers, 3) a landowner demanded payment to let the canal passing through, etc.
- 4) There were 2 districts they have faced difficulty during canal construction. One site had exposed rock on its route of canal, and in the other site farmers altered the alignment towards higher side, trying to get the water to nearby his house, but resulted in vain.

Table 2.5.5 Difficulties BEOs/CEOs have Faced during Dissemination

Problems/ Issues	No.	Remarks
Logistics	15	Lack of motorbike, fuel shortage, no protective cloth, etc.
Staff motivation	5	No allowance, No remuneration
Farmers	5	Not motivated, expect free hand-outs, etc.
Land issue	3	Do not allow canal passing, asking money for canal passing by
Canal construction	2	Rock on the rote of canal, slow work pace
Monitoring & follow-up	1	Due to lack of mobility
Between sites	1	Upper site came up, hence downstream site lost water.
Communication b/t farmers & CEOs	1	No means of communication
Not enough production	1	

Source: JICA Study Team, follow up training held on November 4&5, 2009

2.5.6 Proud Achievement

During the follow up training, the participants reported as district their proud achievements, the reason, and ways of disseminating such proud achievements to other fellow extension officers. Table 2.5.6 summarizes the achievements, and typical ones among others are:

- 1) Four (4) districts reported, as their proud achievement, 1) irrigation started and increased area under irrigation, 2) construction or accomplishment of the simple weirs, 3) targets were met or even exceeded, and 4) farmers becoming better in their participation, responses, etc. They recommended that exposure visit and exchange visit together with some training could be a good way of extending these achievements to fellows.
- 2) Mpika district has already started facilitation of acquisition of Water Rights and registration of groups by the Registrar of Societies. One group had its file opened for Water Rights at Water Board under the Ministry of Energy and Water Development. Mpika district is taking care of the irrigation groups, which has to be followed by other district TSBs as well.

Table 2.5.6 Proud Achievements by District

Proud Achievement	No.	How it can be extended to fellow BEOs/CEOs
Irrigation started, Increased area under irrigation	4	Encourage colleagues to set up demos. Exchange visits
Construction of Simple weirs	4	Expose them to the site. Training of fellow CEOs (TOTs), Exchange visits
Targets achieved or exceeded	4	During monthly meetings and field visits conduct TOTs. By inviting them for training at a constructed site
Farmers improved their participation, response, etc. Farmers able to organize the up fronts in construction.	4	To hold sensitization meetings in the camps and blocks Through COBSI Weekly Bulletins and site field days
Trained all district staff	1	Through exposure visits to sites

Furrow able to cross a stream	1	Exposure visits
Started facilitation of acquisition of Water Rights and registration of groups. One group had its file opened.	1	Through trainings
Good relationship b/t CEOs & TSBs	1	Conducting TOTs
Trained 5 schemes in <i>Bokashi</i> Compost making	1	Exposure visits
No land disputes amongst the farmers	1	To provide training in <i>Bokashi</i> making
Crop diversification	1	Field trips, reports/meeting and field days
Food security	1	

Source: JICA Study Team, follow up training held on November 4&5, 2009

2.6 Change in 2010 Dry Season for the 2009 Pilot Project

Pilot project carried out in 2009 has improved 100 existing simple schemes and also newly developed 94 simple schemes. Of the 94 newly constructed sites, only 63 had succeeded in irrigation in the same year. The rest, 31 sites, were expected to start irrigation in the following year. Likewise, the newly constructed sites are supposed to expand irrigated areas in the following years since it takes more than one year for them to fully develop the potential areas according to the land available as well as to accommodate all the potential beneficiaries⁶. In 2010, a follow up was therefore carried out to assess to what extent the newly developed sites in 2009 have been expanded. At the same time, weir condition was also confirmed by correspondences to relevant BEOs/CEOs, and this survey covered both improved sites and newly developed sites in 2009.

2.6.1 Change in 2010 Dry Season for the 2009 Pilot Project of New Development

Table 2.6.1 summarizes the change of the simple scheme sites newly developed in 2009 in terms of No. of sites irrigated, membership, canal length, and irrigated area. From this table, though only 63 sites out of total 94 sites could start irrigation in 2009, there are 88 sites irrigating the farmland in 2010. There are still 6 sites which have not yet started irrigation; however these sites are possibly not able to start irrigation due to topographic condition. For the membership, there were 3,118 members who participated in the construction of the scheme and now the membership was reduced to 2,595. This is because some of the members could not be accommodated in the irrigable area whereby they dropped off.

Total 70.84 km length of canal was dug in 2009, and another 73.10km was dug in 2010, totaling 143.94 km for the 94 sites. Since number of sites already irrigated has increased from 63 to 88, the irrigated area was also increased. In 2009, total 51.84 ha was wetted and in 2010 there is additional wetted area of 70.28ha. Now total irrigated area comes to 122.12 ha by 88 sites. A typical site therefore irrigates 1.388ha.

Table 2.6.1 Change in 2010 Dry Season for the 2009 Pilot Project of New Development

District	Year	No. of Sites Irrigated	Membership	Canal, km	Irrigated Area, ha	Remarks
Kasama (5 sites)	2009	2	220	2.90	0.38	
	2010	4	136	5.40	3.88	
	Change	2	-84	2.50	3.50	
Mbala (25 sites)	2009	15	903	13.30	5.80	
	2010	25	844	37.85	18.38	
	Change	10	-59	24.55	12.58	
Mpika (12 sites)	2009	10	355	19.81	6.65	
	2010	12	276	33.96	21.80	
	Change	2	-79	14.15	15.15	
Mporokoso (5 sites)	2009	2	228	1.60	1.25	
	2010	5	137	5.95	5.25	
	Change	3	-91	4.35	4.00	
Mungwi (6 sites)	2009	3	265	9.12	1.30	
	2010	4	190	13.02	6.43	
	Change	1	-75	3.90	5.13	

⁶ According to field observations, one may say it takes at least 4 years to develop the full potential area.

Luwingu (9 sites)	2009	1	447	3.55	0.50	
	2010	8	343	5.00	3.13	
	Change	7	-104	1.45	2.63	
Kawambwa (10 sites)	2009	8	225	3.01	4.71	
	2010	8	183	8.01	7.76	
	Change	0	-42	5.00	3.05	
Mansa (22 sites) (G. total 94 sites)	2009	22	475	17.56	31.25	
	2010	22	486	34.76	55.50	
	Change	0	11	17.20	24.25	
Total	2009	63	3,118	70.84	51.84	0.8229 ha/site
Total	2010	88	2,595	143.94	122.12	1.3877 ha/site
Change of Total		25	-523	73.10	70.28	

Source: JICA Study Team, Correspondences to concerned BEOs/CEOs engaged in 2009 pilot project

2.6.2 Weir Status over 2009/2010 Rainy Season

BEOs/CEOs engaged in 2009 pilot project implementation were once again corresponded to know the status of the simple diversion weirs. Since these simple diversion weirs were made out of locally available materials, breach, and/or flush-away of the weirs could be anticipated. The inquiry was done to both improved sites and newly developed sites by asking how much percent of the weir along the longitudinal axis had been broken during the rainy season of 2009/10. Surprisingly, most of the weirs e.g. 83% of the weirs, have lost less than 10% of their body along the longitudinal axis. There were only 2 cases in which more than 50% of the weir body had been washed away.

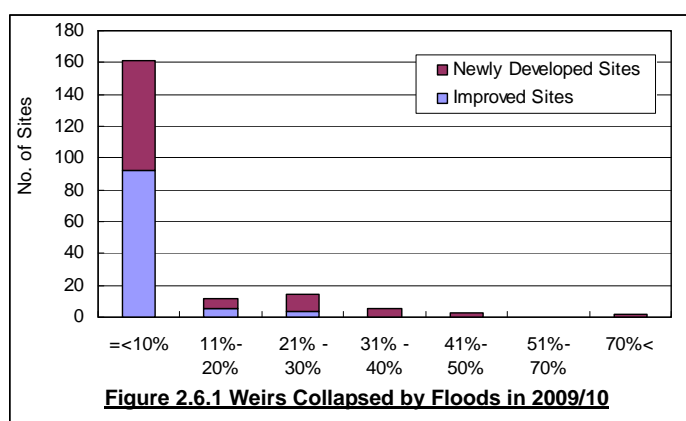


Figure 2.6.1 Weirs Collapsed by Floods in 2009/10

According to the reports by BEOs/CEOs, mostly damaged weirs were single-line weirs which tended to be the weakest due to its simplicity. In case of the single-line weir established in a stream having very large width, much of the body had been damaged. On the other hand, double-line weir and inclined weir were strong enough to stand against flood though a little parts were breached through which flood went through preventing the weir body from being further damaged.

Generally speaking, there are many forests in the two provinces whereby runoff is not as strong as those in other parts of Zambia. This is one of the reasons why most of the temporary weirs were able to stand against flood. In addition, weirs were very often strengthened with clay soil patched in front of the weir body. Thanks to this strengthening, not much re-construction at the onset of the 2010 dry season was required.

CHAPTER 3 PILOT PROJECT IMPLEMENTATION IN YEAR 2010

Pilot project in 2010 started with a TOT and then kick-off training was carried out, which had trained the government officers concerned for both simple and permanent diversion schemes together with some agricultural aspects. Given the trainings, the officers started promoting smallholder irrigation schemes. This sub-chapter presents the pilot project carried out in this dry season 2010.

3.1 Potential Districts for Smallholder Irrigation Development

Kick-off workshop held on March 31, 2009 invited about 70 participants from all the districts of the two provinces. The participants examined attributes, which gave comparative advantages in developing smallholder irrigation schemes. Upon listing up all the attributes, the participants started ranking the districts according to the potentials. Following are the priority ranking by district, and the top six districts for Northern province and top 2 districts, with a mark of 'x' were the districts where pilot project in 2009 dry season was carried out. Then, in 2010 season, another 2 districts and 3 districts were added for pilot project implementation for Northern province and Luapula province respectively.

Table 3.1.1 Summary of District Ranking in Smallholder Irrigation Development Potential

Rank	Northern Province			Luapula Province			Remarks
	No.	District	2009	2010	District	2009	
1	Mbala district	X	X	Kawambwa district	X	X	
2	Mpika district	X	X	Mansa district	X	X	
3	Mungwi district	X	X	Mwense district		X	
4	Kasama district	X	X	Milenge district		X	
5	Mporokoso district	X	X	Nchelenge district		X	
6	Luwingu district	X	X	Chiengwe district			
7	Isoka district		X	Samfya district			
8	Nakonde district		X				
9	Chilubi district						
10	Chinsali district						
11	Mpulungu district						
12	Kaputa district						

Source: JICA Study Team, based on the kick-off workshop held on March 31, 2009 at Kasama

3.2 TOT (Training of Trainers) for the Pilot Project in 2010 Season

The TOT in 2010 season was held from April 13 – 16, 2010. The participants of the TOT were expected to be the trainers of the BEO/CEO training course, who were to gather in the beginning of May. Therefore, the objectives of the TOT were set as: 1) To come up with detailed course contents for the kick-off training (scheduled on May 3 – 7), and 2) To equip trainers (the participants) with necessary skills to lead the sessions of kick-off training.

3.2.1 Participants

Under the above objectives, those who came to the TOT were expected to have some experiences on smallholder irrigation and irrigated agriculture preferably through last year's operation. Taking this pre-condition into account, the Team in consultation with the provincial counterparts nominated 10 officers. They are the ones who in fact actively participated in the last year's pilot operation:

3.2.2 Overall Schedule and Topics Undertaken

The TOT was a net 3-day course; composed of lecturing and interactive discussions for the first 2 days including session allocation of the BEO/CEO kick-off training course to come at the beginning of May, and also field observation. Major topics undertaken were:

Day 1 (April 13, Tue, 2010)

- ✓ COBSI Overview, Last Year's Achievement and This Year's Operation
- ✓ Potential Diversion Site
- ✓ Simple Diversion Weir System
- ✓ Canal Alignment by Spirit Level
- ✓ Ancillaries mainly for Canal
- ✓ Irrigation Water Requirement and Water Management
- ✓ On-farm Irrigation (sunken bed and furrow)
- ✓ Organizing of Farmers
- ✓ Cropping Patterns,
- ✓ A Quick Making Compost/Liquid Fertilizer

Day 2 (April 14, Wed, 2010)

- ✓ Permanent Diversion Weir (Type and Construction Method)
- ✓ Construction Arrangement (Budget, Logistics, Responsibility, etc.)
- ✓ Criteria for the Permanent Site Selection
- ✓ Manuals/Materials to be used during the Kick-off Training
- ✓ Form Finalization
- ✓ Implementation and Reporting Mechanics (for Simple Scheme)
- ✓ Criteria for Kick-off Training Participant Selection (for BEO/CEOs)
- ✓ Kick-off Training Schedule Finalization and Session Allocation



The TOT, after prayer, self-introduction and overview of the training, started with the overview of the COBSI study and the review of the last year's achievements by the JICA team leader.



Total 10 TOT participants and JICA Team members gathered at Kasama Farm Institute for the net 3-day training, composed of live-in lecturing, interactive discussion, brainstorming, field visit, etc.

Day 3 (April 15, Thu, 2010)

- ✓ Site Observation (Chipapa site and Nseluka site)
- ✓ Material Preparation for the Kick-off Training
- ✓ Self/small-group practice of leading the sessions

3.2.3 Permanent Weir (new in 2010 Season)

Simple irrigation schemes were already undertaken last year at demonstrative basis. It means that the Study has already built up materials enough to share and finally to show the participants of the BEO/CEO kick-off training. However, as to the permanent schemes, there were no live-materials but technical manuals only. To this issue, contribution came from one of the participants. The participant was once engaged in the construction of Chinenke irrigation scheme, one of permanent schemes in Mbala district rehabilitated in 2009, together with some of the TOT participants from the district.

He processed pictures of the important construction stages in a kind of step-by slide show, similar to process description method employed in the technical manuals. It was a live material for a permanent diversion weir construction so that all the participants, of course including the study team members, had learned a lot and equipped us with the necessary techniques and arrangement in constructing a permanent scheme.



Mr. K. SIMUKOKO shows how to construct a permanent weir by referring to the photos he took during the construction of Chinenke irrigation scheme, which has become the live-material for this topic.

3.2.4 Selection Criteria for the Kick-off Training

The TOT discussed, aside from technical issues, the criteria for the participants who were to come to the BEOs/CEOs kick-off training. Discussion arrived at the following criteria; namely, those kick-off training participants:

- 1) should come from an area where potential streams for water abstraction (perennial) exist,
- 2) should come from an area where irrigated agriculture is being practiced on a small scale, and
- 3) should not be those that attended the 1st kick-off training held in the last year 2009.

The motorbike issue was discussed whether we should invite only those who have motorbike. The issue was however dropped from the criteria since even the BEOs/CEOs who at moment did not have the bike could access it since the Government had procured many bikes and distributed them to relevant provinces and districts.

There was a long discussion whether 'commitment' should also be included in the criteria. This was however dropped too since the participants thought it could be difficult to measure the level of commitment, and also those who were disqualified may automatically be looked down as non-committed extension officer, which is not the intension at all. Therefore, the above 3 simple criteria had arrived at the consensus in selecting the kick-off training participants.

3.2.5 Criteria for Selecting Permanent Site

In the season 2010, the pilot project was to construct permanent diversion weirs at demonstration basis. Since permanent structure needs certain investment, we shall not fail in the construction, operation, maintenance, etc. The first step of leading the permanent scheme to success is, of course, to select ideal site. Therefore there was a session of establishing the criteria of selecting ideal sites for permanent diversion weir. After sometime discussions, the following criteria were established:

- 1) Community contribution should be ready to prepare up-fronts¹, e.g. sand, masonry, crushed stone, etc.
- 2) 50 percent plus of temporal canal should be utilized (Note: we deal with upgrading from existing ones to permanent ones).
- 3) Site condition should be maximum depth being less than 2.5 meters,
- 4) BOQ equal or less than the budget ceilings,
- 5) Should be constructed on perennial steams,

¹ Up-front here means all the necessary materials available in their locality, e.g. sand, stones, crushed stones, etc. Once all these materials have been prepared by the beneficiary farmers, we are to come with foreign materials such as iron bars, cements, etc. to put up the permanent structures.

- 6) Should not be in deep *dambos*, and
- 7) Potential irrigation area should be economically viable, e.g. minimum should be 4 – 5 hectares.

3.2.6 Site Visit

During the coming kick-off training, participant BEOs/CEOs will practice simple diversion weir construction, spirit line-leveling, on-farm irrigation, etc. To make sure the field practices well organized, the TOT participants visited some ideal sites to make pre-arrangement. One of the sites visited is Chipapa irrigation scheme, Mungwi district. In fact, the site was the one where the JICA team organized the field practice during the last year's kick-off training. Since this site was an improved site under the last year's operation, farmers have been practicing irrigation already for sometime.



Farmers in Chipapa irrigation scheme have already started this year's irrigation. Therefore this site could be an ideal one where kick-off workshop participants can learn and practice on-farm irrigation.

When we visited the site this year, farmers have already started irrigation despite that it is still early in this dry season. It means the site could be ideal one for learning and practicing on-farm irrigation. There were plots already irrigated as shown in the photo above. There were various types of on-farm irrigation in this scheme, e.g. bucket irrigation, sunken bed-irrigation, furrow-like irrigation, and some modified (or deformed) ones. All those practices could be ideal live learning materials, so that the TOT members confirmed the site for the practice during the kick-off training.

3.2.7 Session Allocation

A critical session of the TOT was the finalization of the kick-off training schedule and also session allocation among the TOT participants. The JICA team presented the draft schedule of the kick-off training, and started confirming one by one. In parallel with the confirmation, the TOT participants allocated them to sessions s/he wants to undertake. By this way, whole schedule with all the sessions were finalized and got ready for the training of BEOs/CEOs who were to promote smallholder irrigation in this 2010 season.

3.3 Kick-off Training for the Pilot Project in 2010

Upon completion of the TOT above, a kick-off training undertaking both simple diversion weir and permanent diversion weir schemes was carried out from May 3 to May 7, 2010. The training course invited a total number of 60 participants, who were the BEOs/CEOs stationed where there was a high potential for smallholder irrigation development and their supervisors, namely, district TSB officers, from 8 districts of Northern province and 5 districts of Luapula province.

3.3.1 Training Programme

The overall objective for the kick-off training meant for the participants to acquire the skills, knowledge and attitude necessary in discharging their duties and responsibilities of promoting smallholder irrigation schemes in their responsible areas. The participants were expected to be able to achieve the following by the end of the training course, which themselves are the specific objectives:

- 1) Internalize the concept of smallholder irrigation development being promoted under the JICA Study,
- 2) Enumerate and discuss smallholder irrigation facilities and structures,

- 3) Acquire the knowledge of basic on-farm irrigation methods,
- 4) Organize farmers in developing smallholder irrigation schemes,
- 5) Acquire basic ideas of extending irrigation benefit to most of the villagers,
- 6) Acquire basic knowledge of irrigated agriculture development including quick making compost,
- 7) Prepare a district basis entry programme for 2010 dry season, and
- 8) Discuss a way-forward for community based smallholder irrigation development in Zambia.

3.3.2 Training Module

The training was a net five-day activity held at Kasama Farm Institute (KFI) and the filed. Methodologies employed were lecture-interactive discussion, brainstorming, practices on the field such as weir construction and line-leveling practice, and small group discussion for the preparation of 2010 dry season entry program. Also, dissemination materials were provided to the participants: manual, leaflet, picture-story illustrations. Following are the modules undertaken:

DAY 1 (May 3, Mon):

Module 1 - Program Orientation

Module 2 – Overview of Community Based Smallholder Irrigation (COBSI) Development

Irrigation Development in Zambia, and Northern and Luapula Province

Introduction to the COBSI Development Study

Module 3 – COBSI Scheme (Simple Diversion Weir)

Identification of Potential Gravity Diversion Sites

Weir Type and Construction Method (Inclined Weir)

Weir Type and Construction Method (Single-line Weir)

Weir Type and Construction Method (Double-line Weir)

Weir Type and Construction Method (Trigonal Prop Weir)

Weir Type and Construction Method (Others, e.g. Soil Masonry)

DAY 2 (May 4, Tue):

Module 4 – COBSI Scheme (Canal, Ancillaries and On-farm Irrigation)

Canal Alignment by Sprit Line Level

Ancillary Facilities mainly for Canal

Irrigation Water Requirement and Water Management

On-farm Irrigation Method (Sunken bed and Furrow)

Organizing of Farmers

Recommended Cropping Patterns

Module 5 – Irrigated Agriculture Development

Bokashi Compost (A quick Making Compost)

Liquid Fertilizer

Practice of Making Bokashi Compost

DAY 3 (May 5, Wed):

Module 6 – COBSI Scheme (Simple Diversion Weir and Canal Alignment, Practice in Field)

Construction Practice of a Simple Diversion Weir in Field

Practice of Canal Alignment with Sprit Line Level

DAY 4 (May 6, Thu):

[For BEOs/CEOs]

Module 6 – COBSI Scheme (Simple Diversion Weir and Canal Alignment, Practice in Field)

Construction Practice of a Simple Diversion Weir in Field

Practice of Canal Alignment with Sprit Line Level

[For Provincial and District TSBs]

Module 7 – COBSI Scheme (Permanent Diversion Weir, TSB Officers Only)

Type of Permanent Weirs and Construction Method

Type of Permanent Weirs and Construction Method (con'd)

Selection Criteria, and Implementing Districts

Implementation Arrangement

DAY 5 (May 7, Fri):

Module 8 – Entry Planning

Last Year’s Achievement and Associated Problems

Reporting Mechanics

Pro-forma of Monitoring, Site Profile, etc.

Logistics Support

Entry Planning by District

Entry Plan Presentation and Adjustment by District

Distribution of Dissemination Materials (Manuals, Posters, etc)

Module 9 – Programme Evaluation and Closing

3.3.3 Training Participants

There were a total of 60 participants from 13 districts: 8 districts of Northern province and 5 districts of Luapula province. Table 3.3.1 shows the participants by their station and cadre; 22 BEOs/CEOs from Northern province and 15 BEOs/CEOs from Luapula province were invited, totaling 37 BEOs/CEOs; 7 female and 30 male participants. In addition, 13 and 5 district TSB staff attended the training course from Northern province and Luapula province respectively as the CEOs’ back-stopper. At the provincial level, 4 officers attended from Northern province all of whom were the trainers, and one officer from Luapula province, also the trainer and the provincial irrigation engineer.

Table 3.3.1 Summary of the Participants for the Kick-off Training Course

Province/ District	Province	District TSB	BEO/CEO	Remarks
Northern Province	4 (1F, 3M)			
1. Mbala		2 (0F, 2M)	3 (0F, 3M)	
2. Mungwi		2 (0F, 2M)	3 (1F, 2M)	
3. Luwingu		1 (0F, 1M)	3 (1F, 2M)	
4. Kasama		2 (1F, 1M)	2 (1F, 1M)	
5. Nakonde		1 (0F, 1M)	3 (1F, 2M)	
6. Isoka		1 (0F, 1M)	3 (0F, 3M)	
7. Mpika		2 (1F, 1M)	2 (1F, 1)	
8. Mporokoso		2 (0F, 2M)	3 (0F, 3M)	
Sub-total	4 (1F, 3M)	13 (2F, 11M)	22 (5F, 17M)	
Luapula Province	1 (0F, 1M)			
1. Kawambwa		1 (0F, 1M)	3 (0F, 3M)	
2. Mansa		1 (0F, 1M)	3 (1F, 2M)	
3. Mwense		1 (0F, 1M)	3 (1F, 2M)	
4. Milenge		1 (0F, 1M)	3 (0F, 3M)	
5. Nchelenge		1 (0F, 1M)	3 (0F, 3M)	
Sub-total	1 (0F, 1M)	5 (0F, 5M)	15 (2F, 13M)	
Total of Northern/Luapula	5 (1F, 4M)	18 (2F, 16M)	37 (7F, 30M)	
		60 (10F, 50M)		

Note: Trainers are included in the participants below

Table 3.3.2 List of the Trainers (included in the above table)

Name	Station	Remarks
1. Mr. Kelvin SIMUKOKO	Northern P.	
2. Mrs. Annie BULAYA	Northern P.	
3. Mr. Frank Mporokoso MWANSA	Northern P.	
4. Mr. Freddy BANDA	Mbala, Northern P.	
5. Mr. Machua KAIRA	Mbala, Northern P.	
6. Mr. Rodgers PHIRI	Mungwi, Northern P.	
7. Mr. Collins CHININGA	Mporokoso, Northern P.	
8. Mr. Kellys NKANDA	Mansa, Luapula P.	
9. Mr. Kenneth ZULU	Northern P.	
9'. Mr. Francis KANGWA	Northern P.	
10. Mr. Emmanuel SIWALE	Luapula P.	

At the beginning of the training, a questionnaire was distributed to all the trainees to identify their

knowledge, experience and the view to irrigation development. Following are the summary of the survey: “Pre-Training Knowledge/ Experiences Inventory for the Training.”

1) Years in Government Service

Figure 3.3.1 shows years of participants’ experience in the government service. The majority, 62%, of the participants, or 28 officers out of 45 respondents, fell in the category of 1-5 years. The second most frequency can be found in the category of 16-20 years (13%). This figure simply shows that the majority of the participants were those who were newly recruited officers, who may not have much experience in irrigation development. An average year of experience among all the participants was 9.0 years.

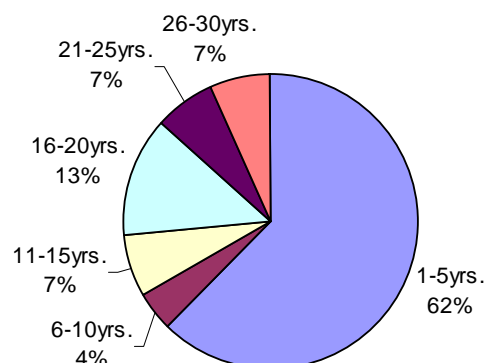


Figure 3.3.1 Distribution of Years in Government

2) Definition of Smallholder Irrigation

Participants had different views of what the smallholder irrigation was. As shown in Table 3.3.3, 37% of respondents thought smallholder irrigation as “small scale farmers, community based,” which was followed by “simple, low cost, and local resource” at 28%. Those two definition shares more than half of the participants’ definition. From the first definition, it was implied that participants define this type of irrigation scheme by the agent who implement it, while the second definition suggest that it was defined based on the composition, cost and type of weirs.

The third most frequently answered was “agricultural sustainability, food security, and livelihood;” and it seems to be so broad concept. Other two definitions “gravity furrow,” and “dry season” also did not seem to be distinguished from other irrigation schemes. In any case, the majority of the participants shared common idea of what the smallholder irrigation development is that the Study Team also agrees.

Table 3.3.3 Definition of Smallholder Irrigation

Definition	Number	%
Small scale farmers, Community based	17	37%
Simple, Low cost, Local resources	13	28%
Agricultural sustainability, Food security, Livelihood	5	11%
Gravity furrow	3	7%
Dry season	2	4%
Others	6	13%
Total	46	100%

Source: JICA Study Team, from the Kick-off Training for FY 2010

3) Experience in the Past Irrigation Projects Operated by Farmers

On experience of the participants in irrigation development which are facilitated by the government of Zambia, NGOs, or donors and mostly operated and maintained by farmers, more than half of the participants did not have any experience. As shown in Table 3.3.4, a total of 22 out of 48 respondents had some experience in such irrigation project, while 25 participants did not have. Similar tendency can be found in each province, 12 respondents had such experience in Northern province, while 18 did not and 10 and 7 in Luapula province respectively. For about half of the participants, therefore, this pilot project will be the first experience of irrigation development to be managed by farmers.

Table 3.3.4 Experience in the Past Irrigation Project Operated by Farmers

Items	Northern			Luapula			Total
	Province	District	Camp	Province	District	Camp	
Yes	2	4	6	0	3	7	22
No	1	4	13	0	1	6	25
N/A	0	0	1	0	0	0	1
Total	3	8	20	0	4	13	48

Source: JICA Study Team, from the Kick-off Training held from May 3-7, 2010

4) Types of Irrigation System under Smallholder Irrigation

Participants of the training had knowledge or experience to see some types of irrigation systems under smallholder irrigation projects. Among the ones listed in Table 3.3.5, the most popular one was furrow and treadle pump at 24.1%, which were followed by motorized pumping irrigation at 14.8%. Gravity river diversion with temporary facilities came to the next, which was less than the Study Team expected as around 70% of the participants in the last year's kick-off training had knowledge about gravity river diversion regardless of temporary or permanent. Therefore, it can be said that participants in this year had relatively less knowledge in irrigation systems.

Table 3.3.5 Types of Irrigation System Observed/Known under Smallholder Irrigated Projects

None	Furrow	Gravity w/ Permanent	Gravity w/ Temporary	Treadle Pump	Motorized Pump	Dam	Others	Total
1	13	6	7	13	8	5	1	54
1.9%	24.1%	11.1%	13.0%	24.1%	14.8%	9.3%	1.9%	100.0%

Source: JICA Study Team, from the Kick-off Training held from May 3-7, 2010

5) Problems to the Government Officers as Extension Agents

As government's technical officers or extension officers, participants may face a range of problems. For example some complain that they do not have enough technical know how to teach farmers, while others point out that they do not have enough funding for the activities. These problems are summarized in Table 3.3.6.

Needless to say, lack of means of transportation, logistics and funding came to the primary problem; out of 48 respondents, 63% of the officer pointed out this issue as their prime problems. Although number of motorbikes have been provided to extension officers in the Study Area, majority of extension officer still face the lack of means of transportation in a broad sense including spare parts, and fuel. It has been a big issue since the beginning of the Study. In the pilot project, therefore, fuel was to be provided to provincial/ district TSB officers, BEOs and CEOs, including some for their fellow BEOs/CEOs.

Table 3.3.6 Problems to Extension Agents

Definition	Number	%
Lack of Transportation, Logistics, Funding	30	63%
Lack of knowledge (both officer and farmer)	13	27%
Water shortage in dry season (seepage, stream water)	3	6%
Others	2	4%
Total	48	100%

Source: JICA ST, from the Kick-off Training for FY 2010

In addition, lack of knowledge came second; 27% of the respondents have this problem. Knowledge is an essence of what extension workers are supposed to provide for farmers. Without the knowledge, they may lose the value of themselves. Now, their awareness to this problem could be a good starting point for them to learn technologies of smallholder irrigation development.

6) Countermeasures Taken by the Participants to Deal with the Problems

Government officers are not always reconciled to leave the problems as they are; they are making their best efforts to tackle with those problems. Table 3.3.7 shows major countermeasures they are taking. The most popular countermeasure was "training/organizing farmers," to which 39% of the respondents answered. Attending any training should be able to improve their skills and by organizing farmers, extension officers should be able to deal with more farmers at once.

Table 3.3.7 Countermeasures to the Problems

Definition	Number	%
Training, Organizing farmers	17	39%
buying fuel by myself, using my means, borrowing bikes from others	16	36%
Report to Dist office	5	11%
Attending WS to get knowledge	2	5%
Others	4	9%
Total	44	100%

Source: JICA Study Team, from the Kick-off Training for FY 2010

The second popular one was "buying fuel using my means/ borrowing bikes from others," that shared

36% of the respondents. It was also observed during the phase 1 pilot project in 2009 dry season. Many, if not at all, are struggling to reach out their service using their own spending. The third one (11%) was “reporting to district office.” This is legitimate path way to let the organization understand the real situation.

7) Best Practices

Apart from the difficulties and the struggle against those problems, participants, as government officers, have successful or memorial experience as the best practices. To the question what the best experience is for them, 33% of the respondents answered that it was a best time when observing farmers’ good performance. Yes, consequence of extension officers’ every effort is only materialized by the performance of farmers. Thus, it must be a pleasurable moment for them to see a good performance of farmers. As the second most popular answer was “completion of the task.” Given all the difficulties of transportation and lack of knowledge, it must be a happy moment for them to complete what might have been a big challenge.

Table 3.3.8 Best Practices of the Participants

Definition	Number	%
Observing farmers' good performance	15	33%
Completion of the task	12	27%
Training farmers	6	13%
Co-working with farmers	4	9%
Others	8	18%
Total	45	100%

Source: JICA Study Team, from the Kick-off Training

8) Knowledge on Compost Manure

As the training addressed some aspects of agricultural practice, their understanding on compost manure was confirmed. First, it was asked what kind of compost manure they know and what kinds of compost manure they have ever demonstrated. As shown in Table 3.3.9, pit compost (25%) and heap compost (24%) shared nearly half of the respondents who had knowledge of any types of compost manure. As such, pit compost (24%) and heap compost (24%) were also the most popular types of composts among the others that participants had ever demonstrated.

To a great delight, there were some officers who said they had knowledge on Bokashi compost (11 respondents) and who actually had ever carried out demonstrations of Bokashi making (7 respondents). They were the participants to the phase 1 pilot project during 2009 dry season. Unexpectedly, this pre-training knowledge inventory showed a good outcome of the pilot project.

Table 3.3.9 Type of Compost Participants Know and Demonstrated

Type of compost	Have Knowledge		Demonstrated	
	No.	%	No.	%
Pit Compost	25	25%	14	24%
Heap Compost	24	24%	14	24%
Animal Manure	12	12%	10	17%
Green Manure	11	11%	7	12%
Liquid manure	10	10%	2	3%
Bokashi	11	11%	7	12%
Others	7	7%	5	8%
Total	100	100%	59	100%

Source: JICA Study Team, from the Kick-off Training for FY 2010

Note: Results of multiple answer question

Furthermore, it was asked what the participants thought the function of compost. As shown in Table 3.3.10, 89%, majority of the respondents, defined the function of compost as to “improve the soil condition.”

Table 3.3.10 Function of Compost Defined

Definition	No.	%
Improve the soil	42	89%
Grow crops well	5	11%
Total	47	100%

Source: JICA Study Team, the Kick-off Training

Some also defined as to “grow crops well.” So, it was confirmed that the participants had a proper knowledge on the basic function of compost. As extension officers are usually general agriculturalists, not irrigation engineers, who graduated from agricultural college, they are in fact equipped with the

knowledge on basic agricultural practice.

Lastly to the agricultural aspect, it was asked what the participants thought as difficulty of disseminating the technique of any types of compost manure. As shown in Table 3.3.11, 30% of respondents raised “lack of knowledge/ legacy that farmers maintained” as the difficulty. As repeated many times, lack of necessary knowledge continued to be a dreadful state that extension officers need to avoid.

Secondly most popular difficulty was the “long process required for compost making.” Especially for dry season agriculture, farmers do not have much time to prepare compost. This result suggested that quick method was needed for a practical use of the compost. It was a preferable analysis for the Study Team as Bokashi compost was the one that requires relatively less period of time for the preparation process.

Table 3.3.11 Difficulty in Disseminating Compost Manure

Definition	No.	%
Lack of knowledge, legacy (Farmers side)	12	30%
Long process to mature	11	28%
Much material & labor needed	8	20%
Relying much on chemical	5	13%
Transportation (Officer side)	4	10%
Total	40	100%

Source: JICA Study Team, from the Kick-off Training for FY 2010

9) Expectation from the Training

At the end of this section describes what the participants were expecting from the training. It was quite important to clarify what this opportunity is for before starting without clear direction. Now, what the participants were expecting from the training the most was to improve knowledge in irrigation; 20 participants chosen it. The second most popular expectation was to know how to construct temporal weirs with 11 respondents. As shown in Table 3.3.12, it seemed clear what the training was for; majority of the participants were expecting knowledgeable experience related to irrigation in general and some typical skills in construction including temporal and permanent weirs.

Table 3.3.12 Expectation from the Training

Expectations	No.
Improve knowledge in irrigation	20
To know how to construct temporal weirs	11
To share knowledge, skills and ideas	8
To learn how to construct a permanent weir	6
To know how make Bokashi practically	5
To know different methods of irrigation	5
Training materials to be given	3
To go and implement lessons learnt	3
To go and train farmers in SHI Development	2
Learn how to peg a furrow	2
Learn more on site selection for temporal weir construction	1
DSA to be given	1
Learn what JICA is doing in SHI Development	1
To know officers from different districts	1
Provision of protective clothing	1

Source: JICA Study Team, from the Kick-off Training for FY 2010

It was also noted that some participants were willing to share their experience with the others. In the Study area where population density is quite low, they do not have much opportunity to meet and discuss with their colleagues what the others are doing. For instance, a CEO confessed that he had not met one particular colleague for a year. Thus, for such officers who are looking for a peer-to-peer learning opportunity, kick-off training was the one what they wanted. Interestingly, on the other hand, an officer answered that he/she was expecting DSA to be provided. As the level of their salary is not always preferable, DSA plays a very important role in their financial arrangement.

3.3.4 Achievement of Training Objectives

At the end of the training, participants were asked to how much level they have achieved the objectives with a range from “the least” to “the most” showing with a level from 1 (least) to 5 (most). As shown in Figure 3.3.2, there were no participants who chosen level one and two. And there are only a few participants who gave a neutral score of “3.” To each of the eight objectives set in the training, level “5” shared the majority.

The percentage of the participant who gave level-5 achievement ranges from 56% in objective 1 to 87% in objective 6. Specifically, objective 6 “Acquire basic knowledge of irrigated agriculture development (+Bokashi),” received the highest share. As shown in Table 3.3.13, average score to each objective was from 4.5 to 4.9, averaging 4.7 as a whole. It can be concluded that participants generally achieved the objectives at high rate and there were no particular objective participants achieved less.

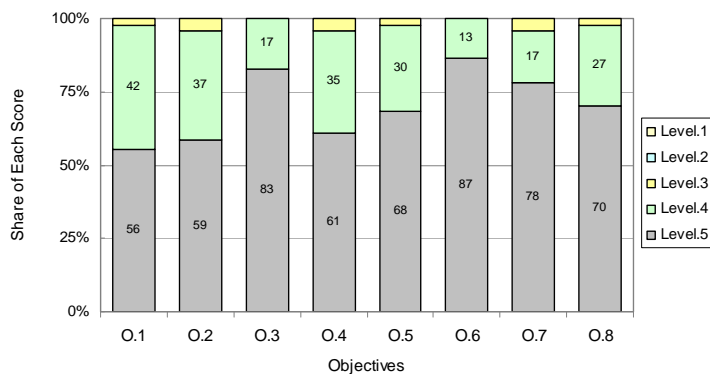


Figure 3.3.2 Level of Achievement by Objective

Source: JICA Study Team, from the Kick-off Training for FY 2010

Table 3.3.13 Level of Achievement to Each Objective

Objectives to Achieve	Number of Respondents to Each Score					Total	Ave.	Min.	Max.	
	L.1	L.2	L.3	L.4	L.5					
O.1 Internalize the concept of smallholder irrigation development	0	0	1	19	25	45	4.5	3	5	
O.2 Enumerate and discuss smallholder irrigation facilities and structures	0	0	2	17	27	46	4.5	3	5	
O.3 Acquire the knowledge of basic on-farm irrigation methods,	0	0	0	8	38	46	4.8	4	5	
O.4 Organize farmers in developing smallholder irrigation schemes,	0	0	2	16	28	46	4.6	3	5	
O.5 Acquire basic ideas of extending irrigation benefit to most of the villagers,	0	0	1	13	30	44	4.7	3	5	
O.6 Acquire basic knowledge of irrigated agriculture development (+Bokashi),	0	0	0	6	39	45	4.9	4	5	
O.7 Prepare a district basis entry program for 2010 dry season, and	0	0	2	8	36	46	4.7	3	5	
O.8 Discuss a way-forward for COBSI development in Zambia.	0	0	1	12	31	44	4.7	3	5	
							Ave.	4.7	3.3	5.0
							Min.	4.5	3.0	5.0
							Max.	4.9	4.0	5.0

Source: JICA Study Team, from the Kick-off Training held from May 3-7, 2010

Note 1: Level of satisfaction is the lowest with “Level 1” and the highest with “Level 5”

Note 2: Numbers of effective responses are different among the objectives

3.3.5 Participants’ Satisfaction by Session

Participants’ level of satisfaction to each session was also monitored. At the end of each session, participants were asked of what extend he/she was satisfied ranging from the level 1, satisfied the least, to the level 5, satisfied the most. Table 3.3.14 shows the list of training modules/items carried out during the 5-day training: a total 29 training modules including sub-modules.

In conjunction with the table, the levels of their satisfaction to each training module are shown in Figure 3.3.3. Generally, all the training modules were given level 3-5 from more than 90% of the respondents and thus it can be said that all the training modules were generally satisfactory. However, there were some variations in the share of level 3, 4 and 5 in each module. For instance there are some training modules which received level-5 from the majority of respondents, while the others were given level-5 from only a limited number of the respondents.

The most satisfied module was “8.1 Last year’s achievement and associated problems” that was given level 5 from 83% of the respondents. The second popular module was “5.4 Practice of Bokashi” that was given level 5 from 72% of the respondents, and the third was “8.5 Dissemination materials,” with 71%. As it was a time just about to start this year’s pilot project, lessons from the last year seemed most valuable for the participants.

Concerning the high score in Bokashi practice, the background of the participants well explains it; most of participants were not necessarily “irrigation engineer” but general agriculturalist. They usually cover a wide range of topics in agricultural practices. Therefore, it is quite understandable why participants got higher satisfaction from the practical training of compost making. And, finally, it is needless to say that participants felt high level of satisfaction when they received materials necessary

for the promotion of smallholder irrigation development in the pilot project.

On the other hand, some training modules were given less number of level-5. For instance, training module “3.6 Weir type & construction method (soil masonry)” was given level-5 only from 6% of the respondents. In this module, 47% and 43% were level-4 and 3 respectively. As participants tended to give higher scores in the evaluation, this result can be interpreted that the module was relatively less satisfactory. Other modules that were found less favored were “3.4 Weir type & construction method (double line weir)” in which 24% of the respondents give level-5. And “3.3 Weir type & construction method (single line weir)” also got relatively low score, resulting in 27% of level-5.

Lower share of level-5 were found mostly in the trainings coded with 3.X and 4.X. Those training starting with the code number 3 and 4 are associated with weir construction methods (3.2-3.6) and other irrigation technologies (4.1-4.4). There could be two ways of interpretation of these results. First, those training were too technical for them to fully understand the contents and thus the level of satisfaction was kept moderate. In the second scenario, participants did not appreciate so much about simplified structures. To be sure, results in other modules give further implication; 59% of the respondents gave level-5 to the training module “6.1 Practice of simple diversion weir.” It suggests that simple weir structures were given relatively low score in theory but given high score in practice.

Table 3.3.14 List of Training Modules/Items

Training Module/ Item
1.1 Program orientation (Opening, Expectation, etc.)
2.1 Irrigation development in Zambia (Mr. Zulu)
2.2 JICA presentation (Introduction to COBSI)
3.1 Identification of potential gravity diversion sites
3.2 Weir type & construction method (Inclined weir)
3.3 Weir type & construction method (single line weir)
3.4 Weir type & construction method (double line weir)
3.5 Weir type & construction method (trigonal prop)
3.6 Weir type & construction method (soil masonry)
4.1 Canal alignment by sprit line level
4.2 Ancillary facilities mainly for canal
4.3 Irrigation water requirement & water management
4.4 On-farm irrigation method (sunken-bed & furrow)
4.5 Organizing of farmers
5.1 Recommended cropping patterns
5.2 Bokashi compost (lecture)
5.3 Liquid fertilizer (lecture)
5.4 Practice of Bokashi
6.1 Practice of simple diversion weir
6.2 Practice of canal alignment by sprit line level
7.1 Type of permanent weir and construction
7.2 Selection criteria and implementing districts
7.3 Construction arrangement
8.1 Last year's achievement and associated problems
8.2 Entry planning orientation
8.3 Entry planning by district
8.4 Entry plan presentation and adjustment by district
8.5 Dissemination materials
9.1 Training programme evaluation

Source: JICA Study Team, from the Kick-off Training

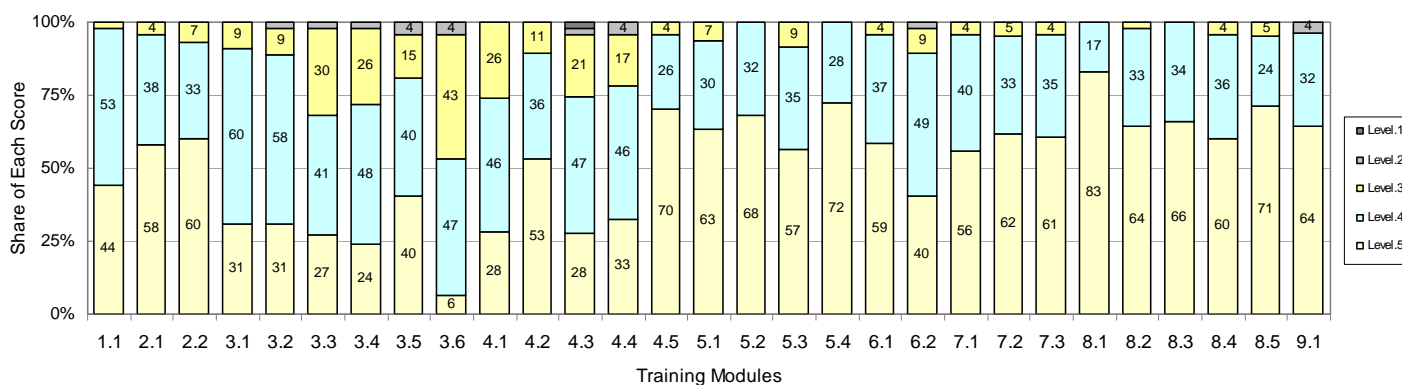


Figure 3.3.3 Participants' Satisfactory Level by Training Module (Level 1-5)

Source: JICA Study Team, from the Kick-off Training held from May 3-7, 2010

In short, all the training modules were given good satisfaction level from the participants. However, the level of their “excitement” had some variations among the modules. Especially, participants showed higher level of their satisfaction to the entry planning sessions.

3.3.6 Participants' Satisfaction by Different Aspects

In addition to direct evaluation of each training module, the training was evaluated based on five categories: as a whole, logistics, theory, practice, and own participation. As shown in Figure 3.3.4,

level 3-5 shared more than 95% of the respondents. Except logistics, more than 90% of respondents answered level 4 or 5.

The category that enjoyed the biggest share of level-5 was “participation;” 63% of the respondents satisfied the most (level-5). The category “theory” and “practice” were almost the same in which 62% and 59% gave level-5. The category “as a whole” received slightly lower share (51%) of level-5. In any case, those four categories were quite satisfactory.

Those scores were also shown in Table 3.3.15. Three categories of “theory,” “practice,” and “participation” resulted in the weighted average score of 4.6, while “logistics” was 4.1. Although those scores were generally preferable, it seemed there were some problematic issues associated with logistics. As to see background of these results, the following introduce some typical comments from the participants.

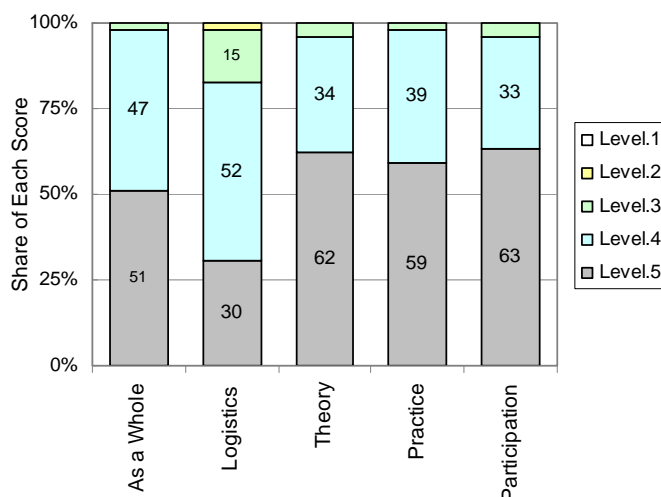


Figure 3.3.4 Level of Satisfaction by Category

Source: JICA ST, from the Kick-off Training for FY 2010

Table 3.3.15 Participants' Satisfaction Level by Category

Module/ Item	Number of Respondents to Each Score					Total	Ave.	Min.	Max.
	L. 1	L. 2	L. 3	L. 4	L. 5				
C.1. As a Whole	0	0	1	23	25	49	4.5	3	5
C.2. Logistics	0	1	7	24	14	46	4.1	2	5
C.3. Theory	0	0	2	17	31	50	4.6	3	5
C.4. Practice	0	0	1	19	29	49	4.6	3	5
C.5. Participation	0	0	2	16	31	49	4.6	3	5
						Ave.	4.5	2.8	5.0
						Min.	4.1	2.0	5.0
						Max.	4.6	3.0	5.0

Source: JICA Study Team, from the Kick-off Training held from May 3-7, 2010

Note 1: Level of satisfaction is the lowest with “Level 1” and the highest with “Level 5”

Note 2: Numbers of effective responses are different among the objectives

3.3.7 Participants' Comments to Improve

1) As a Whole

Participants' comments on the overall evaluation of the training are summarized in Table 3.3.16. The most frequently described comments were “well organized/ presented;” 13 participants responded something like this. The second most common comments, five respondents, were summarized as “learned a lot/ it was educative.”

Most of the comments were generally preferable but there were also several issues to be improved: “material for practice was not enough/ delayed.” This comment was probably related to the practical training of trigonal prop weir, in which farmers did not prepare woods and grasses. A bit discouraging comments was “at least handouts were given.” If this person really meant it, preferable outcomes would not be expected from him/her.

Table 3.3.16 Participants' Satisfaction Level by Category

Comments "as a Whole"	No.
Well organized/ presented	13
Learned a lot/ it was educative	5
Good/ excellent	3
Satisfactory	3
Some topics were too fast	3
Contents were good	2
Okay with theory and practices	2
It was practical	2
Materials for practice was not enough/ delayed	2
Facilitators should be more active	1
More participation needed	1
More time was needed for some session	1
Some were very summarized	1
At least handouts were given	1
Others	3
N/A	8

Source: JICA Study Team, from the Kick-off Training 2010

2) Logistics

There were two major comments on logistics: “satisfactory” and “venue should be changed.” In terms of the venue, there may be two different implications. First, it may be about location. There were a number of officers who traveled all the way from Luapula province. Those officers recommended changing the location of the next workshop to Mansa or anywhere in Luapula province. Another reason of change probably may have come from the lower satisfactory level of the facility. As four respondents pointed out, toilet had a problem in their accommodation that may have created a negative feeling to the venue. Some comments also addressed the quality of meals; some asked to change the menu every time..

Table 3.3.17 Participants' Satisfaction Level by Category

Comments on “Logistics”	No.
Satisfactory	13
Venue should be changed	12
Meal should be improved	6
Excellent/good	5
Facilities were old/ not enough	5
DSA and meal allowance should be increased	4
Toilet had a problem	4
Transportation arrangement should be improved	3
Need entertainment	2
Others	6
N/A	6

Source: JICA ST, from the Kick-off Training FY 2010

3) Theory

Comments on “theory” are summarized in Table 3.3.18. Major comments were: “beneficial,” “expectations were achieved,” and “well organized and presented.” From those comments it can be said that participants generally enjoyed the lectures and gained something. On the other hand, five respondents pointed out that “facilitation skill should be improved.”—TOT should be improved more for the next time.

Table 3.3.18 Participants' Satisfaction Level by Category

Comments on “Theory”	No.
Beneficial	9
Expectations were achieved	8
Well organized and presented	8
Facilitation skill should be improved	5
Knowledgeable/ understandable	3
More time should be allocated	2
Timing of handout distribution should be changed	2
It was difficult to understand some of the topics	1
Need follow-up	1
Others	2
N/A	10

Source: JICA ST, from the Kick-off Training FY 2010

Timing of handout distribution was also raised as an issue. In fact, it was discussed during the preparation meeting among the trainers if the teaching materials should be distributed first or later. Trainers were afraid that if trainees have manuals in their hands, they may not listen carefully to the lecturer. Then, it was decided to distribute the teaching materials first so that trainers can refer to the manual during the lecture.

4) Practice

As shown in Table 3.3.19, there were several different comments on the level of practice. First, “well organized/presented” got the highest number of respondents, which was followed by “interesting/educative,” “excellent/good,” and “preparation should be improved.”

The comments were generally preferable but preparation was not always satisfactory for them.

As stated earlier, preparation of construction materials was not well organized. So, for the next time, more careful discussion should be carried out with farmers prior to the training.

Table 3.3.19 Participants' Satisfaction Level by Category

Comments on “Practice”	No.
Well organized/ presented	7
Interesting/ educative	6
Excellent/good	5
Preparation should be improved	5
Expectation was achieved	4
Satisfactory	4
Well participated	3
Others	9
N/A	8

Source: JICA ST, from the Kick-off Training FY 2010

5) Participation

The last comments were on participation. Majority of the participants were proud of their full and

Table 3.3.20 Participants' Satisfaction Level by Category

Comments on “Participation”	No.
Fully participated	25
Excellent/ good	4
Satisfactory	1
Others	9
N/A	10

Source: JICA ST, from the Kick-off Training FY 2010

active participation in the training; 25 respondents commented “fully participated”, which was followed by “excellent/ good”. Other comments categorized in “others” were somehow not directly related to “participation.”

3.3.8 Target for Year 2010 Dry Season for Simple Smallholder Schemes

The 5-day training was completed with the formulation of action plan for each district. Based on the knowledge and experience gained through the training, the participants set their own target of smallholder irrigation development schemes in their districts/camps. A session “entry-planning” commenced with an orientation, explaining the objective of the action planning and contents of the plan to be formulated. Followed was the reporting mechanics including format of site profile and logistical arrangement.

After the introductory plenary session, participants had a group discussion with the members of their own districts to set targets on: 1) number of TOT to be carried out at district level, 2) number of sites for improvement of existing schemes, or “Improvement,” and 3) number of sites for construction of new schemes, or “New Development.”



All the targets set by district was posted on the front wall, and the participants shared their colleagues' targets and also some modifications were made.

Targets of sites were set in accordance with two different categories: 1) improvement of existing irrigation scheme and 2) construction of new irrigation scheme. As it has been discussed, there are a number of existing smallholder irrigation sites established by farmers. Most of the facilities withdraw stream water to their canals by gravity without diversion structure. Thus, amount of water withdrawn to the canal can hardly meet crop requirement especially during the late dry season. Taking this situation into account, the participants decided to improve those existing facilities by introducing simple diversion facilities made out of locally materials.

As for smallholder irrigation schemes at the district level, targets were set separately for district TSBs, CEOs, and fellow CEOs. First, district TSB develops their own sites exclusive of what are to be developed by the CEOs and fellow CEOs in the same district. CEOs who participated in this kick-off training are to develop their own sites. Furthermore, those CEOs are also responsible to carry out TOTs for their fellow CEOs. Fellow CEOs are then expected to develop their own sites.

After the group discussion, all the targets were then placed on the front wall of the conference room and presented to all the participants for comparison and adjustment. In fact, some CEOs reduced their target number of sites after observing the others' targets; they might have thought they were too ambitious.

1) Target for TOT

Table 3.3.21 summarizes the targets of TOT by district, showing how many times trained CEOs are to carry out TOT and how many fellow CEOs are to be trained. As a whole, 113 times of TOT was set as the target of year 2010 with a total of 133 fellow CEOs to be trained. The maximum number of TOT among all the districts, 13 times, was set in Kasama and Mwense, while the minimum, 3 times, was set in Nchelenge. The targeted number of trainees was also the largest in Kasama at 15 and the second largest was in Mwense at 13. The smallest number of trainees was set in Nchelenge.

On the other hand, number of expected trainees per time was averaged at 1.1 CEOs per time with a range of 1.0 to 2.2 CEOs. As compared to the results in the last kick-off training for the year 2009, number of target trainees per time decreased from an average of 3.0 to 1.1. In fact, one may think why so small number of fellow CEOs can only be trained per TOT. The reason is very simple because most of the CEOs are stationed alone covering over a square of 20 km x 20km, they can invite only a handful neighboring fellow CEOs during, for example, they are to construct diversion weir. As the achievement in the year 2009 did not reach the target, it can be concluded that the participants in this year is more realistic.

Table 3.3.21 Planned TOT (Training of Trainers; fellow CEOs) by District

District	No. of TOTs (times)	No. of Trainees (trainees)	Trainees /time
Northern Province			
ISOKA	5	11	2.2
KASAMA	13	15	1.2
LUWINGU	9	9	1.0
MBALA	9	9	1.0
MPIKA	6	12	2.0
MPOROKOSO	8	9	1.1
MUNGWI	10	11	1.1
NAKONDE	8	8	1.0
Sub Total	68	84	1.2
Luapula Province			
KAWAMBWA	10	10	1.0
MANSA	11	11	1.0
MILENGE	8	9	1.1
MWENSE	13	13	1.0
NCHELENGE	3	6	2.0
Sub Total	45	49	1.1
Total/ Average	113	133	1.1

Source: JICA ST from the Kick-off Training held from May 3-7, 2010.

2) Target for Improvement of Existing Sites

Table 3.3.22 summarizes the target number of improvement sites. The CEOs who participated in the training set a target to improve 75 sites, or 2.0 sites per CEO. In addition, through the TOTs to the expected 133 fellow CEOs, another 122 sites, or 0.9 sites per fellow CEO, are to be improved. Furthermore, district TSBs of the 13 districts are to carry out the improvement scheme a total of 20 sites or 1.5 sites per TSB office, totaling 215 sites to be improved in the year 2010 dry season.

It is noted that no target was set in Milenge and Nchelenge as of the improvement site. It was probably because they did not have any particular existing sites in their minds. Given this discouraging number of target, some participants from the other districts criticized and finally it was accepted with a condition that the officers from those two districts try identifying potential sites and do the improvement at their best effort.

Different from the last year's kick-off training, irrigated area, canal length, and expected number of beneficiaries were not set as part of targets. Because it took so much time to discuss several sets of targets in 2009. For the participants to concentrate to the most important items, the Study Team suggested them to focus only on the number of the sites in 2010. Based on the achievement accomplished in 2009 season, an average of 0.27 km of canal length per site was improved, suggesting that a total canal length to be extended can be estimated at 58.1km for a total of 215 sites this year.

As of the irrigated area, an average of 0.98 ha/site was improved last year and thus a total of 210.7 ha can be expected from the improvement of 215 sites in this 2010 season. Similarly, number of beneficiary farmers can be also estimated based on the year 2009 achievement. As an average of 40.6 farmers per site benefited in 2009, expected number of beneficiary farmers can be 8,729 in 2010 season.

Table 3.3.22 Target Number of Improvement Sites for the Year 2010 Dry Season

CEOs/District	KSM	MBL	MPK	MRK	MGW	LWG	NKD	ISK	Total	MNS	KWB	MLG	NCG	MWS	Total	Grand Total
CEO 1	2	2	1	3	2	3	3	1	17	2	3	0	0	2	7	24
CEO 2	1	1	1	3	4	2	2	2	16	2	3	0	0	4	9	25
CEO 3	2	2	2	3	2	1	2	3	17	1	3	0	0	3	7	24
Sub Total	5	5	4	9	8	6	7	6	50	5	9	0	0	9	23	73

Fellow CEOs	18	8	11	18	26	3	5	6	95	8	6	0	0	13	27	122
District TSB (D)	2	2	2	2	2	2	3	0	15	2	1	0	0	2	5	20
Total (A-D)	25	15	17	29	36	11	15	12	160	15	16	0	0	24	55	215

Source: JICA Study Team, from the Kick-off Training held from May 3-7, 2010.

Average per district (CEO only)	5.62
Average per district (Fellow CEO only)	9.38
Average per district (district TSB only)	1.54
Average per district (total)	16.54

3) Target for New Development Sites

Table 3.3.23 summarizes the target of new development sites in simple diversion schemes for the year 2010 dry season. The CEOs/BEOs who participated in the training are to develop 80 new sites, another 127 new sites by the fellow CEOs, and 31 sites by the district TSBs, totaling 238 sites for the 2010 dry season. That is, 2.1 sites per trained CEO, 1.0 site per fellow CEO, and 2.4 sites per TSB officer.

Although the number of beneficial farmers was not set as a target, it is estimated roughly 4,236 farmers based on the last year's actual average numbers per site as 17.8 farmers per site. In addition, expected irrigated area can be also estimated; as 0.55 ha per site was newly irrigated in 2009, approximately 130.9 ha can be expected for the year 2010, respectively.

Table 3.3.23 Target Number of New Development Sites for the Year 2010 Dry Season

CEOs/District	KSM	MBL	MPK	MRK	MGW	LWG	NKD	ISK	Total	MNS	KWB	MLG	NCG	MWS	Total	Grand Total
CEO 1	2	3	2	2	3	2	3	1	18	1	2	1	2	1	7	25
CEO 2	2	3	2	2	2	2	2	2	17	3	2	2	2	2	11	28
CEO 3	1	2	2	2	4	2	3	2	18	3	2	3	1	1	9	27
Sub Total	5	8	6	6	9	6	8	5	53	7	6	6	4	4	27	80
Fellow CEOs	10	9	12	8	20	9	10	10	88	11	9	7	4	8	39	127
District TSB (D)	4	1	2	2	2	2	3	2	18	2	2	2	2	5	13	31
Total (A-D)	19	18	20	16	31	17	21	17	159	20	17	15	10	17	79	238

Source: JICA Study Team, from the Kick-off Training held from May 3-7, 2010.

Average per district (CEO only)	6.15
Average per district (Fellow CEO only)	9.77
Average per district (district TSB only)	2.38
Average per district (total)	18.31

3.4 Follow up Training for the Pilot Project in 2010

Upon completion of the kick-off training, the participants have started promoting simple and permanent diversion schemes in their areas. The pilot project provides them with fuel for their mobility and they have extending what they had learned during the kick-off training in dry season 2010. When it comes to almost end of the dry season, a follow-up training was carried out from November 16 to 17, 2010 to report and share their achievements.

3.4.1 Training Programme

Prime objective of this training is to report their achievement they have done since they were trained during the kick-off training. Also, this training course aimed at having the participants to acquire the collective knowledge and experiences based upon what and how they have done on the ground. With this overall objective, following specific objectives are laid down for the follow-up training:

- 1) To share the progress and achievement of the pilot project in each district,
- 2) To identify issues/problems and those causes/effective countermeasures related to promotion of the smallholder irrigation development,
- 3) To gain and internalize collective lessons to further disseminate smallholder irrigation development, and
- 4) To know the effect of compost manure and also other agricultural aspects with irrigation.

3.4.2 Training Module

The training was a net 3-day live-in and out activities at Kasama Agriculture Institute. Methodologies employed are participatory assessment of their achievement, peer-to-peer learning through interactive presentation and discussion, and lecture-interactive discussion, etc. Following are the programme:

Day 1:

Module 1 – Program Orientation

Registration, Pre-WS Questionnaire, Opening, and Overview of the WS

Contribution from the JICA Team

Surfacing of the Participants' Expectation

Module 2 – Site Observation and Learning

Site visit

Day 2:

Module 3 – Output Presentation of Smallholder Irrigation Development

Output Preparation by District

Output Presentation by District

DAY 3:

Module 4 – Lessons Sharing among Participants

Problems arisen & Actions taken

Proud Achievements and Events

JICA and CP's Contribution

Module 5 – Training Evaluation

3.4.3 Training Participants

This follow-up training invited the same officers who had participated in the kick-off training, together with some newcomers. They are replacements to those who had participated in the kick off training due to staff movement, and fellow CEOs who have been actively participating in the smallholder irrigation development. There were 67 participants invited in the follow up training. Of them, 16 participants were the newcomers.

Table 3.4.1 Summary of the Participants for the Follow-up Training in 2010

Particulars	Participants	Remarks
Districts under Northern Province	37 (27M, 10F)	District TSBs, BEOs, CEOs
Districts under Luapula Province	25 (21M, 4F)	District TSBs, BEOs, CEOs
Northern Provincial TSB	4 (3M, 1F)	Overall Management (cum trainer)
Luapula Provincial TSB	1 (1M, 0F)	
Total	67 (52M, 15F)	Excluding JICA Members
Back support: JICA Study Team	4 (3M, 1F)	

Source: JICA Study Team.

At the beginning of the training, a questionnaire was distributed to all the trainees so as to study their expectations from the training, experiences during the extension activities of smallholder irrigation, e.g. difficulties and also effort to solve them, and proud achievement they have had, etc. Following are the excerpts from the answers:

1) Expectation from the Training

The questionnaire asked the participants what they expect from the follow-up training by listing the most 2 expectations. As this was a follow up training, many participants expected 'share successes and challenges in the implementation (23 replies)' as the top expectation, followed by 'learn what others have done in different districts (15 replies)', 'know the way forward to extend the programme (14 replies)', 'learn solutions to constraints that led to low achievements (12 replies)', 'know if everyone

was successful or not in weir construction, and so on.

Concerning ‘know the way forward to extend the program’, JICA team leader explained that there should be another discussion between the two governments of how to proceed into the implementation stage based upon the achievement of the pilot project implementation which is to be reviewed in this follow up training.

There has been an issue of allowance as stated by ‘clarify on unpaid allowances encored during the operation (4 replies)’, and by ‘get allowance (1 vote)’. In fact, the GRZ allocated for this smallholder based irrigation development programme, so called COBSI programme, an amount of about ZMK 97 million and ZMK 70 million for Northern and Luapula provinces respectively. These allocations were mostly meant for allowance for the officers engaged. However, the disbursement was very slow and not fulfilled as at November 2010. For the both provinces, only about 20% of the budget has been disbursed by then.

2) Felt-Needs in Assistance from the Government

Participants were asked in the questionnaire by ‘What assistance they needed from the Government in implementing the smallholder irrigation, list two assistances’. Table 3.4.3 summarizes the needs by category e.g. funding, goods/ equipment, training, monitoring/ supervision, programme/ coordination, and assistance for farmers, with which they think they can better extend smallholder irrigation schemes.

Funding issue came first as expected. ‘Transport and fuel’ was the top-need by far among others. It obtained as many as 42 replies, followed by ‘allowance (26 replies)’, ‘funding for irrigation programme/ permanent weirs (15 replies)’, which are all related to funding issue. Under good/equipment, they listed equipment for smallholder irrigation development by 3 replies, protective cloths by 3 replies and timely logistical support in places by 2 replies. Training was also a need for the participant as listed by total 8 replies.

Table 3.4.2 Expectations to the Training listed by Participants

Expectations	Reply
Share successes and challenges in COBSI Implementation	23
Learn what others have done in different districts	15
Know the way forward to extend the program	14
Learn solutions to constraints that led to low achievements	12
Know if everyone was successful or not in weir construction.	5
See progress on those weirs constructed	4
Earn more skills in weir construction	4
Know about smallholder irrigation	4
Clarify on unpaid allowances encored during the operation	4
Have reports on the improvements	3
See if the program has been adopted by farmers	3
Get experience in the permanent weir construction	3
Know the way forward of the constructed temporary weirs	2
Assess/evaluate activities done by CEO/TSB	2
Learn how the programme is going to be effective	2
Learn more on the implementation of community projects	2
Exposure visits to newly constructed sites	2
Get allowances	1

Source: Pre-training questionnaire survey, JICA Study Team

Table 3.4.3 Participants' Needs in Assistance from the Government

Assistance from the Government	Reply
Funding	84
Transport/ fuel	42
Allowance	26
Funding for irrigation program/ permanent weirs	15
Sponsoring for further studies	1
Goods/ Equipment	9
Equipment for smallholder irrigation	3
Protective cloths	3
Timely logistical support in place (as agreed)	2
Stationary	1
Training	8
Training (incl. fellow CEO at district level)	5
Irrigation course for farmers	2
Learning materials for farmers in local languages	1
Monitoring/ Supervision	7
Backstopping/ support (incl. district)	4
Strengthen monitoring sheet	1
Provision of full data even to those in remote area	1
Physical monitoring	1
Programme/ Coordination	4
Coordination with agencies	1
COBSI to continue	1
Harmonize programme to avoid interference	1
Inclusion of the program in activity plans	1
Assistance for Farmers	4
Grants to farmers	2
Input for farmers	2
Total	107

Source: Pre-training questionnaire survey, JICA Study Team

3) Problems and Efforts to Solve during the Implementation

The pre-training questionnaire asked the participants ‘problems they have faced in implementing smallholder irrigation development. The problems were categorized by such groups as funding/equipment, farmers’ participation/attitude, natural/physical condition, working arrangement and technical issues. Figure 3.4.1 summarizes the results, and the foremost problem was ‘funding/equipment’, followed as aforementioned order. Funding/equipment means earned 53 replies composed of no/inadequate allowance (16 replies), lack/breakdown of transport (16 replies), inadequate fuel and oil (15 replies), inadequate funding (3 replies) and no protective cloths (3 replies).

Problems ranked at 2nd position was farmers’ participation/attitude identified by 28 replies. In detail, this problem elaborates farmers’ poor participation (9 replies), land ownership dispute among farmers (4 replies), farmers’ poor understanding (4 replies), difficult to organize farmers (2 replies), farmers did not want to provide labor (2 replies), too much reliance on the donors’ support (2 replies), and others. On natural/physical condition, again logistics related problems were identified as long distance (3 replies), wide coverage area (3 replies), and inadequate water in streams (2 replies).

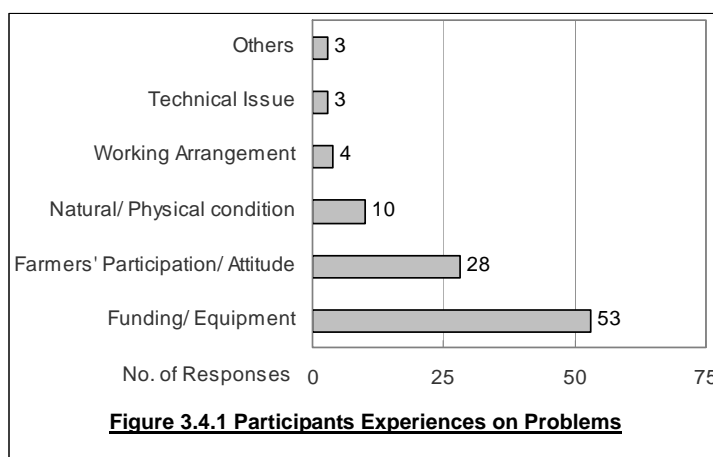


Figure 3.4.1 Participants Experiences on Problems

In conjunction with the problems above, the participants were also asked by ‘what kind of efforts they have exercised to solve the problems’. To cope with funding/equipment problem, they have sacrificed themselves elaborated as ‘used own fund/resources (15 replies)’, ‘used own cloths (2 replies)’, ‘sacrificed lunch (3 replies)’, and ‘used bicycle instead of motorbike (2 replies)’. Against the problem of farmers’ participation/ attitude, most of them facilitated the farmers (20 replies) in one way or the other. The replies were elaborated by ‘advised and sensitized the farmers (16 replies)’, ‘formed a farmers group and by-laws (3 replies)’ and ‘helped farmers to make weir (1 reply)’. What came next were ‘collaborating with colleagues (15 replies)’, ‘getting help from others (12 replies)’ and ‘changing strategies (6 replies), etc.

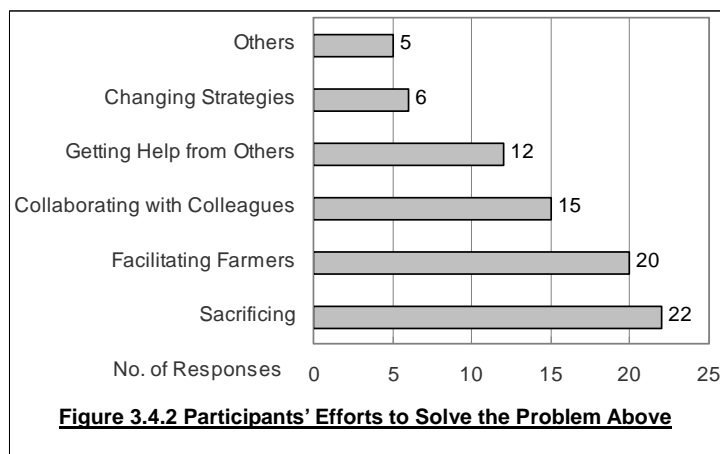


Figure 3.4.2 Participants' Efforts to Solve the Problem Above

4) Best Experiences in Implementing Smallholder Irrigation Development

They have faced many problems on the course of promoting smallholder irrigation schemes as stated above, but on the other hand they have had proud achievements, impressive events, best experiences, etc. Following table summarizes the best experiences they have had during the extension into 4 groups as Change in Farmers Attitudes/ Performance/ Lifestyle, Smallholder Irrigation Development, Own Performance in Extension, and Logistics.

Under the category of ‘change in farmers attitude/ performance/ lifestyle, 11 participants took as the best experiences ‘more farmers are adopting irrigation farming to increase food production’, and followed by ‘constructed weirs which are being used by farmers’ with 10 participants. In the same category, what comes third position is ‘farmers welcomed the project very well’.

With respect to ‘smallholder irrigation development’, 8 participants raised ‘constructing a weir and having a furrow up to the expected area, followed by ‘managed to mobilize farmers and constructed simple schemes’ with 3 participants. Under Own Performance in Extension, what comes first is ‘Learning new technologies of constructing weirs and formation of compost’.

5) Way Forward on Livelihood Improvement for Smallholder Farmers

Following the inquiry about the participants’ experiences with respect to problems, effort to solve them and best experiences, way forward to improve livelihood of smallholder farmers was asked. The questions were; 1) what activities are needed to improve the smallholder farmers’ livelihood, and 2) to improve the life of the farmers: what you yourself have to do, what your clientele farmers have to do, what your government has to do, and what donors have to do.

Table 3.4.5 summarizes the projects/activities which the participants think are needed to improve the farmers’ livelihood. What came first is ‘construction of permanent weir (16 replies)’, followed by ‘distribution of agricultural input (14 replies)’, ‘establishment of fish farming (12 replies)’, ‘conduct training (8 replies)’, ‘provision of small scale loan /link with loan provider (7 replies)’, ‘conduct training on irrigation (7 replies)’, so on.

There is a bit of surprise. Simple scheme promotion gained only 4 replies while ‘construction of

Table 3.4.4 Participants’ Best Experiences

Best experiences	Reply
Change in Farmers Attitudes/ Performance/ Lifestyle	36
More farmers are adopting irrigation farming to increase food production.	11
Constructed weirs which are being used by farmers	10
Farmers welcomed the project very well	5
Farmers appreciates the knowledge, technologies, and assistance	3
Seeing farmers starting to grow different types of crops.	3
Farmers already made money out of irrigation where I supported.	2
To see my group have constructed furrow and made weir,	2
Smallholder Irrigation Development	15
Constructing a weir and having a furrow up to the expected area.	8
Managed to mobilize farmers and constructed simple schemes	3
Constructed the weirs in Mpulungu district; the spill over effect of COBSI.	1
There is an increase in area under irrigation.	1
There is an increase in area under irrigation.	1
Managed to tap water and refill a pond which was abandoned by JSPPR due to a lack of funds.	1
Own Performance in Extension	13
Learning new technologies of constructing weirs and formation of compost.	7
The technologies have been good for community to implement within the limits of resources and know-how.	4
Reached my target.	2
Logistics	2
COBSI has added a power of extension service provision.	1
Fuel came on time.	1

Source: Pre-training questionnaire survey, JICA Study Team

Table 3.4.5 Projects to Improve Farmers’ Livelihood

Activities/ Projects	Reply
Construction of permanent weir	16
Distribution of agricultural inputs	14
Establishment of fish farming	12
Conduct training (topic was not specified)	8
Provision of small scale loan /link with loan provider	7
Conduct training on irrigation	7
Selection of marketable crops to grow	5
Development of market	4
Increase the simple weir	4
Poultry / Chicken farming	3
Lining of furrow	3
Construction of dam	3
Conservation farming	3
Conduct training on crop diversifications	3
Installation of demonstration plot	3
Meeting with farmers regularly	2
Increase agriculture production	2
Facilitate good farming practice	2
Others	22

Source: Pre-training questionnaire survey, JICA Study Team

permanent weirs' came first gaining 16 replies. This could be because participants have already constructed simple weirs whereby they may have thought the next step, which is the construction of permanent weirs. Another issue is pertinent to the 'distribution of agricultural inputs', ranked at 2nd with 14 replies. Permanent weir construction requires investment and also the distribution of the agricultural input costs a lot. There might be still a tendency wherein they resort to outside supports.

Table 3.4.6 comparatively summarizes the measures to improve farmers' livelihood by themselves on the left column and by the farmers on the right column. The first measure the participants think was 'to provide farmers (new) farming knowledge/ technology (10 replies) while what came first in the right column is 'to adapt the knowledge/ technology learned (20 replies)'. These two are very much correspondent, one may notice there is a bit of top-down style in their extension norm as stated by 'to adapt the knowledge/ technology learned'.

Table 3.4.6 Measures to Improve Farmers' Livelihood (Yourself and Farmers)

What do you think yourself have to do?	No.	What do you think your farmers have to do?	No.
To provide farmers (new) farming knowledge / technology	10	To adapt the knowledge / technology learned	20
To conduct necessary training / give appropriate advices (topic was not specified)	10	To work hard to increase production/area	9
To impart knowledge on irrigation / water utilization and practice irrigation	8	To embark on furrow irrigation	6
To encourage farmers to increase area /production	5	To commit the irrigation activity	5
To facilitate farmers in the process of the project	4	To participate in the activity	3
To work hand in hand with farmers	3	To have village development plan	2
To encourage farmers' participation	3	To work as group	2
To visit farmers more often to share ideas	2	To get interest what they were taught	2
To promote integrated farming	2	To work hand in hand with officers	2
Not to give up even we face the difficulties	1	To find out own problems	2
To conduct exposure visit	1	To take irrigation as business	2
To organize interest group	1	To understand project concept well	2
To facilitate irrigation facility construction	1	To establish demonstration plot	1
Others	13	Others	6

Source: Pre-training questionnaire survey, JICA Study Team

Table 3.4.7 comparatively summarizes the measures to improve farmers' livelihood, which require the government to do on the left column and require donors to do on the right column. The participants think the government should provide necessary support for CEO/TSB activities in terms of logistics and allowance by far the most. The statement gained 26 replies, and followed by 'to provide fund for irrigation schemes (8 replies)', 'to support agricultural input for farmers (7 replies)', 'to provide necessary support to farmers (7 replies)', etc. On the donor side, they think that the donors should do necessary financial/ technical supports for government the most (43 replies), followed by 'to assure logistics (13 replies)', 'to assure the allowance (10 replies)', etc. It is noticed that financial issues as a whole and specifically logistics issue including allowance could be always an issue.

Table 3.4.7 Measures to Improve Farmers' Livelihood (Government and Donors)

What do you think your government has to do?	No.	What do you think donors have to do?	No.
To provide necessary support (logistics, allowance) for CEO/TSB activity	26	To do necessary financial / technical supports for Government	43
To provide fund for irrigation schemes	8	To assure logistics	13
To support agricultural input for farmers	7	To assure the allowance	10
To provide necessary support to farmers	7	To conduct the trainings for officers and farmers	10
To develop /find market	3	To provide agricultural input for farmers	2
To provide farmers small loan	3	To support market development	1
To take agricultural /irrigation more seriously	3	To monitor the activity	1
To improve policy which can boost agriculture production	2		

Source: Pre-training questionnaire survey, JICA Team

To support fish fingerling	2
To give training for officers and farmers	2
To fund the project	1

Source: Pre-training questionnaire survey, JICA Study Team

6) Felt Thoughts through the Implementation of Smallholder Irrigation Development

The last question for the pre-training questionnaire was ‘elaborate whatever the participant has felt, thought and touched on through the implementation of the pilot projects. There are, of course, positive and rather negative opinions. For the positive opinions, 10 participants replied that ‘the programme helped to improve the livelihood of farmers’, and then followed by ‘the concept is very good, farmers changed & they appreciated it (4 replies). Also, 3 participants replied that ‘the technology made them easy to involve farmers because materials were locally available and technology was easily introduced’. This is the basic concept for simple scheme. On the negative side, what came first was ‘I could have been better if enough logistic support (fuel) was given (8 replies)’ and same number of participants stated allowance issue again as ‘It could have been better if allowance was given’.

Table 3.4.8 Felts Thoughts which Touched on Participants

Positive Opinions	No.	(Rather)Negative Opinions	No.
COBSI helped to improve livelihood of farmers.	10	I could have been better if enough logistic support (fuel) was given.	8
The concept is very good, farmers changed & they appreciated it, the program should be continued.	4	It could have been better if allowance was given.	8
COBSI technology made us easy to involve farmers because materials were locally available and technology was easily introduced.	3	Duration is rather short, if more time, it would be better.	3
If capacity building training was given to committed farmers, we could establish "successful farmers".	1	It could have been better if motorbike was given.	2
COBSI helped a lot to those who are willing to advance in irrigation.	1	It could have been better if supportive items (not specified).	2
I felt happy when I managed to peg furrow and block water as well as see it flowing.	1	Our farmers face problems when constructing the weir because they did not receive any support such as protective clothing and tools.	2
It was good that fuel was provided on time.	1	Farmers should be provided with resources to construct the permanent weir.	1
The farmers are able to increase irrigate land.	1	Marketing issue was not taken into consideration properly.	1
Others	15	Others	6

Source: Pre-training questionnaire survey, JICA Study Team

3.4.4 Achievement of the Training Objectives

At the end of the follow-up training, the participants were asked how much they have achieved the objectives of the training in a range of 1 to 5; level-1 is the least achieved while level-5 is the most achieved. There was only one participant who gave either level-1 or level-2 achievement. More than 90% of the participants replied that they have achieved the training objectives by a level of either 4 or 5 (see Figure 3.4.3). In fact, about half the participants replied they had achieved all the objectives at the level-5. Since this training is a follow up in order to share what they have achieved on the ground, not requiring them to equip with new technologies, this high level of achievement was attained.

Objectives are by the end of training, the participants are able to:

- 1) To share the progress and achievement of the pilot project activities in each district,
- 2) To identify issues/problems and those causes/effective countermeasures related to promotion of the smallholder irrigation development, and
- 3) To gain and internalize collective lessons to further disseminate smallholder irrigation development.

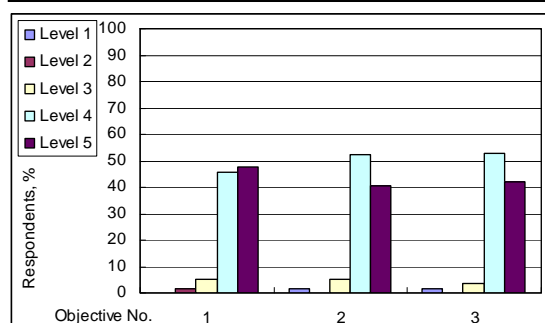


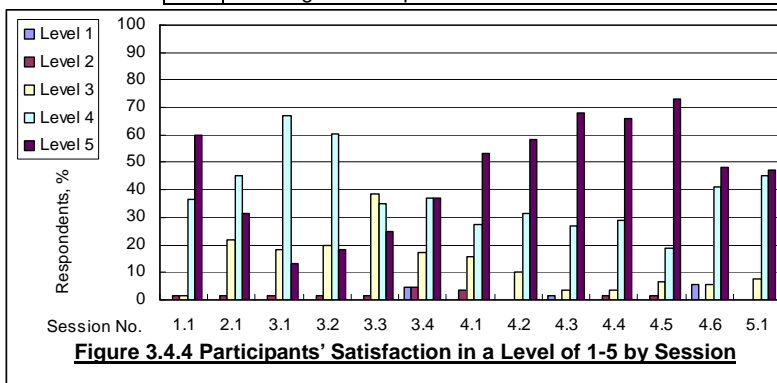
Figure 3.4.3 Achievement in 1-5 by Objectives

3.4.5 Participants' Satisfaction by Session

At the end of each session, the participants were asked of what extend he/she was satisfied: level 1 being the least satisfied while level 5 being the most satisfied. Table 3.4.9 shows the sessions undertaken during the net 3-day training, and Figure 3.4.4 summarizes the level of satisfaction by the participants in conjunction with the sessions. The highest satisfaction can be seen in such sessions as '1.1 Programme Orientation', '4.1 & 4.2 Problems arisen and Actions taken (group preparation and presentation)' and '4.3 & 4.4 Proud achievement and events (both group preparation and presentation)', and '4.5 JICA and CP's contribution. During these sessions, they could exchange their experiences among the participants and shared precious lessons, resulting in higher level of satisfaction.

Table 3.4.9 Sessions Undertaken by Training

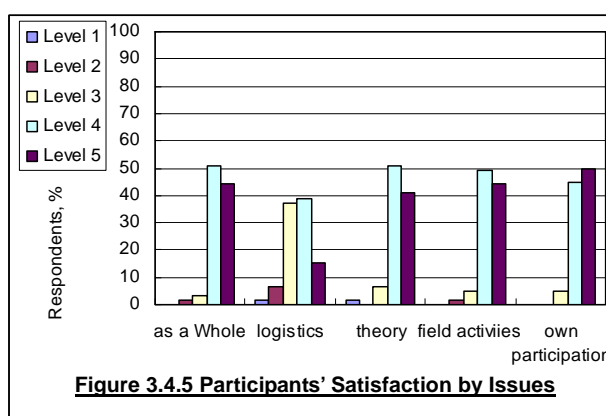
1.1	Program orientation
2.1	Site Visit
3.1	Output Preparation by District (Temporary/Permanent)
3.2	Output Presentation by District (Temporary)
3.3	District Crossover Comparison (Temporary)
3.4	Output Presentation by Permanent Scheme
4.1	Problems arisen & Actions taken (Group Preparation)
4.2	Problems arisen & Actions taken (Group Presentation)
4.3	Proud Achievements and Events (Group Preparation)
4.4	Proud Achievements and Events (Group Presentation)
4.5	JICA & CP's Contribution
4.6	COBSI Programme Evaluation
5.1	Training Workshop Evaluation



On the other hand, sessions 3.1 – 3.4 have marked a relatively lower satisfaction though more than two third participants gave level-4 or level-5 satisfaction. The sessions undertook output preparation and its presentation. Some districts have marked very low achievement despite the fact that almost equal fuel has been distributed among the districts. Participants in those districts could not raise the justifiable reason why they had performed less than the others. This situation may have led the participants to mark lower satisfaction as compared with other sessions.

3.4.6 Participants' Satisfaction by as a Whole, Logistics, Theory, Practice, and Own Participation

In addition, satisfaction by as a whole, logistics, theory, practice and own participation were also asked in a level of 1-5. Figure 3.4.5 shows the satisfactions for the participants by those issues. Issue which marked highest level-5 satisfaction was 'own participation' and then followed by 'as a whole'. Almost half the participants gave level-5 satisfaction to the 'own participation'. Such issues as 'theory' and 'field activities (site visit)' also marked high level of satisfactions as the summated percentage of level-4 and level-5 satisfactions can arrive at around 90%. As per 'logistics', however there were participants who gave satisfaction level-2 and even level-1, both of which together account for almost 10 percent. They felt some difficulties in lodging where they accommodated in Kasama Agriculture Institute. Some of the difficulties are associated with water problem, causing trouble on them.



3.5 Achievement in 2010 Dry Season (Simple Diversion Scheme)

Numerical targets for simple scheme development were set at the end of the kick-off workshop by the participants. With reference to the targets, BEOs and CEOs supported by district TSB officers have carried out the pilot project in 2010. Table 3.5.1 summarizes the achievements in comparison with the targets. In sum, TOT was carried out 88 times against the target 113 times, 78% achievement, to which total 180 fellow officers were invited. Total 193 simple existing sites have been improved which consisted of 90% of the target 215 sites. With regard to new construction, they have established 181 simple diversion sites, meeting 76% of the target 238 sites.

Table 3.5.1 Summary of the Achievements in 2010 Pilot Project in Comparison with Targets

District	TOT (Training of Trainers)						Improvement			New Construction			
	Time			No. of Officers Participated			No. of Site			No. of Site			
	Target	Achievement	Progress	Target	Achievement	Progress	Target	Achievement	Progress	Target	Achievement	Progress	
Northern Province	Kasama	13	13	100%	15	17	113%	25	15	60%	19	11	58%
	Mbala	9	4	44%	9	33	367%	15	26	173%	18	14	78%
	Mpika	6	8	133%	12	13	108%	17	12	71%	20	15	75%
	Mporokoso	8	9	113%	9	10	111%	29	31	107%	16	17	106%
	Mungwi	10	7	70%	11	19	173%	36	26	72%	31	18	58%
	Luwingu	9	6	67%	9	6	67%	11	13	118%	17	14	82%
	Nakonde	8	2	25%	8	18	225%	15	17	113%	21	16	76%
	Isoka	5	4	80%	11	11	100%	12	9	75%	17	7	41%
Total	68	53	78%	84	127	151%	160	149	93%	159	112	70%	
Luapula Province	Mansa	11	10	91%	11	11	100%	15	4	27%	20	11	55%
	Kawambwa	10	10	100%	10	11	110%	16	15	94%	17	24	141%
	Milenge	8	5	63%	9	9	100%	0	3	N/A	15	8	53%
	Nchelenge	3	3	100%	6	9	150%	0	1	N/A	10	7	70%
	Mwense	13	7	54%	13	13	100%	24	21	88%	17	19	112%
	Total	45	35	78%	49	53	108%	55	44	80%	79	69	87%
Total of the 2 Provinces	113	88	78%	133	180	135%	215	193	90%	238	181	76%	

Source: Follow up training 2010, JICA Study Team

3.5.1 Achievement on TOT

Table 3.5.2 again summarizes the achievement for TOT in terms of time and number of participants. It shows the number of participants per TOT as well. At a glance, it is known the participants per TOT ranges from only one personnel to 9 personnel with an average of 2 participants only. This is because there is a difficulty of inviting many fellow BEOs/CEOs to a TOT. BEOs/CEOs are supposed to attend every quarterly meeting to be held at district level. However, this meeting is hardly held in nowadays due to financial matters.

Therefore except for some of the TOTs carried out at Mbala and Nakonde districts, most of the TOTs mentioned above were carried out at their sites inviting neighbor CEOs only. Mbala and Nakonde districts took an advantage of a gathering which invited number of officers by chance. Otherwise, trained BEOs/CEOs invited fellow CEOs who are in most cases their neighbors during the construction of weir, pegging of canal, digging of canal, etc. By so doing, sort of on-site TOT has been carried out and a total of 180 fellows were trained.

Table 3.5.2 TOT and Participants done in Field in 2010

District	No. of TOT done	No. of CEO/BEO Participated	Participants per TOT
Kasama	13	17	1.3
Mbala	4	33	8.3
Mpika	8	13	1.6
Mporokoso	9	10	1.1
Mungwi	7	19	2.7
Luwingu	6	6	1.0
Nakonde	2	18	9.0
Isoka	4	11	2.8
Sub-total	53	127	2.4
Mansa	10	11	1.1
Kawambwa	10	11	1.1
Milenge	5	9	1.8
Nchelenge	3	9	3.0
Mwense	7	13	1.9
Sub-total	35	53	1.5
Grand Total	88	180	2.0

Source: Follow up training 2010, JICA Study Team

3.5.2 Achievement on Improved Sites

Most of the existing simple schemes constructed by farmer themselves do not have diversion structure. Smallholder irrigation development in 2010 dry season therefore undertook the improvement of these existing simple schemes as one of the major activities. Table 3.5.3 summarizes the achievement for improved sites, from which following are found:

- 1) A total of 193 existing sites have been improved in 2010 dry season, against the target of 215 sites. This shows achievement ratio of 90%. By district, Mporokoso district has improved as many as 31 sites, followed by Mbala district (26 sites) and Mungwi district (26 sites), Mwense district (21 sites), and so on so forth. The district which carried out the least improvement is Nchelenge (only 1 sites) and then Milenge (3 sites) and Mansa (4 sites), which fall all in Luapula province. There are in fact some sites which were newly constructed in 2009 under the same JICA smallholder irrigation programme. Of the total 193 sites, those sites which started in 2009 arrived at 26 sites, so that 167 sites were newly undertaken in 2010 under the category of improvement.
- 2) In terms of farmers concerned, there are total 3,490 members who participated in the construction, composed of 2,236 male members and 1,254 female members². A typical site has 18 participants (12 male members and 6 female members) as average. Of them, 2,038 beneficiary farmers carried out irrigation in 2010 season, equivalent to 58% of the total membership. On the other hand, average number of land owners per site is only 4, which means one out of about 5 participant members has the land ownership. Those members share the land by mutual agreement.
- 3) Original canal length in total was 258 km summated for the 193 sites, providing an average canal length of 1.33 km per site. Under these canals, a total area of 205 ha had been irrigated before the improvement. The improvement altogether has done an additional canal digging of 85 km with an average of 0.44 km per site. With the canal additionally dug, a total of 294 ha have been newly opened. However, not all of the 294 ha was irrigated and planted in the 2010 dry season. Out of the 294 ha newly opened, area actually irrigated and planted was 192 ha in total. Thus the average irrigated/planted area newly added in the 2010 dry season arrives at 0.99 ha per site. Summing up the original irrigated area of 205 ha, the improved sites altogether irrigate 397 ha, giving an average irrigated area of 2.06 ha per site.
- 4) As per irrigated are per participant member, original average area was 0.059 ha (0.24 lima). The improvement opened an area of 0.084 ha (0.34 lima) per member, out of which 0.055 ha (0.22 lime) per member was irrigated and planted in 2010 dry season. There is however a possibility that not all the participant members were able to irrigate. In 2010, those members who had actually irrigated were also confirmed, and it was learned that only 58% of all the members had arrived at the stage of irrigation. With those members who carried out irrigation, one probable irrigator may have irrigated 0.101 ha originally and may have had an additional irrigated area of 0.094 ha, totaling 0.195 ha as shown at the bottom of Table 3.5.3.
- 5) In 2010, the pilot project has promoted compost manure as well including Bokashi, a quick making manure. For the total improved 193 sites, total 93 compost heaps were made and these were demonstrated to total 530 farmers. Also, fish pond was newly constructed in some sites upon the improvement of the diversion weir. Total 36 fish ponds were newly constructed in 2010 while there were originally as many as 180 fish ponds, which means as an overall average one fish pond per site was existent.

² In fact, all the participant members may not be necessarily beneficiary farmers. This is because that though construction can attract many villagers, including then non-beneficiary farmers, also instructed by village headman, some may have dropped off from the membership in later dates due to, for example, not enough plot, not enough water, etc.

3.5.3 Achievement on New Development Sites

Table 3.5.4 summarizes the achievement on new development sites. The target in terms of site was 238 while BEOs/CEOs with district TSBs together developed a total of 181 sites in the 2010 dry season. Kawambwa district has developed as many as 24 sites, followed by Mwense district (19 sites), Mungwi district (18 sites), Mporokoso (17 sites), Nakonde (16 sites), Mpika (15 sites), etc. Following are the findings:

- 1) Though it had not reached the target, it can be still said that all the concerned officers had worked well given just 5-day kick-off training plus fuel for motorbike. Out of the 181 newly developed sites, those which had started irrigation/planting in the 2010 dry season were 146 sites while the rest, 35 sites, have not yet started irrigation. They are still engaged in canal digging, canal extension, land opening, land demarcation, etc. or otherwise it was already too late to plant dry season crops in 2010 dry season although the scheme was completed. The ratio of the sites which have not yet started irrigation consists of 19% of the total sites. This is a quite improvement as compared to 2009 year's operation. In 2009, 31 sites out of 94 sites, 33% of the sites, could not start irrigation in the same year.
- 2) Under the development of 181 new sites, concerned officers altogether have organized as many as 3,381 farmers (2,247 male members and 1,134 female members). Out of whom, in the 2010 dry season, 1,296 farmers have been benefited by irrigated agriculture consisting of 38% of the total members. A typical new site was established with 19 farmers composed of 12 male and 6 female members (due to roundup of the numbers, the total does not meet the male and female numbers). As for landowners, there are 841 owners in total for the 181 sites, arriving at an average of only 5 landowners per site.
- 3) Canal excavated in 2010 dry season reached a total stretch of 163 km. A typical site is therefore given an average length of 0.90 km. The area opened has arrived at 262 ha in total, and the average area opened per site is estimated at 1.45 ha. This means that an average area of 0.078 ha (0.312 lima) was opened per participant member. All the opened areas have not been put under irrigation in this 2010 dry season, but the areas can be referred to as the expected one to be irrigated in the following years.
- 4) Out of the 262 ha newly opened, area actually irrigated and planted in 2010 dry season reached 131 ha. It means about half of the opened area could start irrigated agriculture in 2010 dry season, while it was too late for the other half area to plant crops this season. This half of the area is to start irrigated agriculture in the following years. Average irrigated area per site arrives at 0.725 ha (2.9 lima) when divided by all the 181 sites and 0.899 ha (3.60 lima) when divided by those sites which actually started irrigation in 2010, 146 sites. As per irrigated area per farmer beneficiary, though it is only 0.039 ha (0.16 lima) when divided by all the participating members it can be as much as 0.101 ha (0.41 lima) when divided by only those farmers who had started irrigation.
- 5) As per compost promotion, total 193 heaps were made which were mostly Bokashi compost. The compost promotion was demonstrated to total 734 farmer beneficiaries. Also, fish pond was promoted in line with the new development of simple schemes. In total, 127 fish ponds were newly constructed in 2010 season for those 181 sites newly constructed.

Table 3.5.3 Summary of Improvement for Existing Sites in 2010 Dry Season (Simple Scheme)

District	No. of Sites	No. of Started 2009	No. of member farmers			No. of farmers who irrigated	No. of Land Owners	Original		Additional by Improvement in 2010		Original + Newly Irrigated, ha	Original + Opened, ha	Compost Making		No. of Fish Pond	
			Total	Male	Female			Original Canal Length, Km	Originally Irrigated Area, ha	Canal Length newly dug, Km	Opened Area in 2010, ha			Area newly irrigated in 2010, ha	No. of farmers	No. of heaps	Original
Kasama	15	2	330	242	88	142	20	20.90	10.70	7.40	21.70	6.45	32.40	60	14	11	3
Average			22	16	6	9	1	1.39	0.71	0.49	1.45	0.43	2.16	4.0	0.9	0.7	0.2
Mbala	26	0	330	218	112	330	87	21.75	20.45	12.50	24.64	19.00	45.09	12	4	7	3
Average			13	8	4	13	3	0.84	0.79	0.48	0.95	0.73	1.73	0.5	0.2	0.3	0.1
Mpika	12	8	280	182	98	190	146	28.60	66.25	6.90	31.75	11.75	98.00	18	0	11	0
Average			23	15	8	16	12	2.38	5.52	0.58	2.65	0.98	8.17	1.5	0.0	0.9	0.0
Mporokoso	31	0	584	362	222	421	31	53.20	32.25	26.50	70.75	52.20	103.00	3	1	46	7
Average			19	12	7	14	1	1.72	1.04	0.85	2.28	1.68	3.32	0.1	0.0	1.5	0.2
Mungwi	26	0	454	306	148	268	136	44.00	21.94	8.90	20.65	17.90	42.59	0	0	12	3
Average			17	12	6	10	5	1.69	0.84	0.34	0.79	0.69	1.64	0.0	0.0	0.5	0.1
Luwingu	13	13	338	220	118	135	13	11.88	2.25	9.30	23.75	18.25	26.00	25	2	0	0
Average			26	17	9	10	1	0.91	0.17	0.72	1.83	1.40	2.00	1.9	0.2	0.0	0.0
Nakonde	17	0	127	95	32	94	27	3.98	7.80	1.75	16.72	13.74	24.52	32	2	8	3
Average			7	6	2	6	2	0.23	0.46	0.10	0.98	0.81	1.44	1.9	0.1	0.5	0.2
Isoka	9	0	195	94	101	136	77	13.84	8.80	0.70	15.75	11.75	24.55	113	60	17	1
Average			22	10	11	15	9	1.54	0.98	0.08	1.75	1.31	2.73	13	6.7	1.9	0.1
Mansa	4	3	71	44	27	37	17	1.68	2.75	1.40	2.19	2.18	4.94	3	3	1	1
Average			18	11	7	9	4	0.42	0.69	0.35	0.55	0.55	1.24	1	0.8	0.3	0.3
Kawambwa	15	0	251	156	95	109	64	10.78	13.05	3.99	13.75	11.00	26.80	11	6	13	8
Average			17	10	6	7	4	0.72	0.87	0.27	0.92	0.73	1.79	0.7	0.4	0.9	0.5
Milenge	3	0	27	20	7	8	5	1.60	0.90	0.55	5.50	3.70	6.40	0	0	1	0
Average			9	7	2	3	2	0.53	0.30	0.18	1.83	1.23	2.13	0.0	0.0	0.3	0.0
Nchelenge	1	0	15	12	3	8	8	4.50	1.00	0.00	0.50	0.50	1.50	0	0	0	0
Average			15	12	3	8	8	4.50	1.00	0.00	0.50	0.50	1.50	0.0	0.0	0.0	0.0
Mwense	21	0	488	285	203	160	85	40.85	17.28	5.20	46.28	23.55	63.55	253	6	53	7
Average			23	14	10	8	4	1.95	0.82	0.25	2.20	1.12	3.03	12.0	0.3	2.5	0.3
Grand Total	193	26	3,490	2,236	1,254	2,038	716	257.56	205.42	85.09	293.92	191.97	499.34	530	98	180	36
Per Site			18	12	6	11	4	1.3345	1.0643	0.4409	1.5229	0.9946	2.5872	2.7	0.5	0.9	0.2
Per Member								0.0738	0.0589	0.0244	0.0842	0.0550	0.1431	0.2	0.0	0.1	0.0
Per Irrigator								0.1264	0.1008	0.0418	0.1442	0.0942	0.2450	0.3	0.0	0.1	0.0
Last Year Started		26	644	420	224	317	139										
New Members			2,846	1,816	1,030	1,721	577										

Table 3.5.4 Summary of New Development in 2010 Dry Season (Simple Scheme)

District	No. of Sites	Own Start	Not Irrigated Yet	No. of member farmers			No. of farmers who irrigated	No. of Land Owners	Done in This 2010 Dry Season			Plan for Next 2011 Dry Season			Compost Making		No. of Fish Pond Constructed				
				Total	Male	Female			Canal Length dug in 2010, km	Opened Area In 2010, ha	Irrigated Area In 2010, ha	Canal Length to be dug, km	Additional Area to be irrigated, ha	Total Area to be irrigated, ha	No. of farmers	No. of heaps					
Kasama	11	3	2	188	119	69	102	39	21.80	14.20	6.20	12.30	8.00	14.20	82	14	3				
Average				17	11	6	9	4	1.98	1.29	0.56	1.12	0.73	1.29	7.5	1.3	0.3				
Mbala	14	0	0	265	192	73	195	84	20.60	44.70	11.35	11.95	6.95	18.30	0	0	6				
Average				19	14	5	14	6	1.47	3.19	0.81	0.85	0.50	1.31	0.0	0.0	0.4				
Mpika	15	2	6	328	215	113	89	124	27.00	43.50	18.00	41.60	34.50	52.50	6	1	7				
Average				22	14	8	6	8	1.80	2.90	1.20	2.77	2.30	3.50	0.4	0.1	0.5				
Mporokoso	17	2	2	421	270	151	106	17	21.96	45.88	16.38	25.50	36.00	52.38	0	0	22				
Average				25	16	9	6	1	1.29	2.70	0.96	1.50	2.12	3.08	0.0	0.0	1.3				
Mungwi	18	2	3	397	294	103	210	135	23.15	10.30	10.05	26.90	12.20	22.25	23	23	0				
Average				22	16	6	12	8	1.29	0.57	0.56	1.49	0.68	1.24	1.3	1.3	0.0				
Luwingu	14	0	6	354	235	119	83	17	11.27	11.08	7.28	18.65	32.50	39.78	0	0	0				
Average				25	17	9	6	1	0.80	0.79	0.52	1.33	2.32	2.84	0.0	0.0	0.0				
Nakonde	16	0	1	196	153	43	84	30	7.69	13.83	10.50	12.35	9.30	19.80	260	23	4				
Average				12	10	3	5	2	0.48	0.86	0.66	0.77	0.58	1.24	16.3	1.4	0.3				
Isoka	7	0	2	140	89	51	58	21	1.13	17.70	7.65	6.54	16.75	24.40	190	117	4				
Average				20	13	7	8	3	0.16	2.53	1.09	0.93	2.39	3.49	27.1	16.7	0.6				
Mansa	11	3	7	140	88	52	45	17	2.68	4.38	3.19	9.15	36.50	39.69	4	2	14				
Average				13	8	5	4	2	0.24	0.40	0.29	0.83	3.32	3.61	0.4	0.2	1.3				
Kawambwa	24	4	4	417	255	162	118	163	6.71	13.35	12.60	33.40	57.00	69.60	6	1	3				
Average				17	11	7	5	7	0.28	0.56	0.53	1.39	2.38	2.90	0.3	0.0	0.1				
Milenge	8	0	1	115	79	36	49	70	1.75	8.25	5.35	16.50	7.70	13.05	78	0	16				
Average				14	10	5	6	9	0.22	1.03	0.67	2.06	0.96	1.63	9.8	0.0	2.0				
Nchelenge	7	0	0	74	47	27	27	23	3.95	8.50	5.00	18.90	20.25	25.25	0	0	8				
Average				11	7	4	4	3	0.56	1.21	0.71	2.70	2.89	3.61	0.0	0.0	1.1				
Mwense	19	0	1	346	211	135	130	101	13.25	26.25	17.75	21.05	11.50	29.25	85	12	40				
Average				18	11	7	7	5	0.70	1.38	0.93	1.11	0.61	1.54	4.5	0.6	2.1				
Grand Total	181	16	35	3,381	2,247	1,134	1,296	841	162.93	261.91	131.28	254.79	289.15	420.43	734	193	127				
Per Site				19	12	6	7	5	0.9002	1.4470	0.7253	1.4077	1.5975	2.3228	4.1	1.1	0.7				
Per Member									0.0482	0.0775	0.0388	0.0754	0.0855	0.1244	0.2	0.1	0.0				
Per Irrigator									0.1257	0.2021	0.1013	0.1966	0.2231	0.3244	0.6	0.1	0.1				
		19%	35	Ratio of Irrigators ag/ members				38%	not irrigated yet at all in 2010 dry season out of the total 181 sites												
		81%	146	actually irrigated in 2010 dry season out of the total 181 sites					0.8992												

3.6 Achievement in Permanent Scheme in 2010 Dry Season

The pilot project in 2010 undertook the construction of permanent diversion schemes. There are 8 permanent schemes; 5 in Northern province and 3 in Luapula province. The type is either concrete wall type or wet-masonry type, and one earth dam. The site identification was preliminary done during the kick-off training held from May 3 – 7, 2010, and till the beginning of June, all the sites had been confirmed on the ground. Table 3.6.1 summarizes the site profile, e.g. site name, membership with the number of land owners, irrigated area so far, designed irrigable area and the potential irrigable area, design type of the diversion weir, and also the activities undertaken during the 2009 pilot project implementation.

There are 257 members in total, composed of 137 male members and 120 female members. The existing irrigated area in 2010 ranges from as small as 1.25 ha to as large as 7.9 ha with a total of 27.90 ha. As designed irrigable area per site, it is expected to expand the area up to 5 ha in case of minimum and to as far as 10.05 ha, totaling 48.51 ha. Potential irrigable area with the permanent diversion weir was identified from 5 ha to 20 ha with a total of 63.5 ha. Implementation process is briefly presented hereunder:

3.6.1 Chaiteka Site, Luwingu District, Northern Province

Chaiteka is the village name of the project site in Luwingu district. In 1979, the village started its history with 12 households after separating from Sunday village due to lack of farm land for making sure to get staple foods. The number of households of Chaiteka village has been increasing year by year. There are 72 households as of now. The villagers are proud of cooperative-ship of each other, vast farm land available with fertile soil, and so on.

Since the village was established, the farmers have been practicing bucket-irrigation farming fetching water from Malandu stream which is the stream they put up a permanent weir under the pilot project in 2010. In 2009, under this Study the farmers introduced a simple diversion structure for withdrawing stream water to the farm lands. This was the first experience for them to practice gravity furrow irrigation.

The membership of Malandu irrigation group formed in 2010 to drive forward the project is 25 in total at present: 13 males, 12 female. In addition to them, the rest of the villagers are expected to join very soon. They gathered to the construction site at least 3 days in a week from 6:00 to 12:00 during the period for “Up-front”. The members collected sand, masonry stones as a preparation work for making concrete.

The construction works were supervised by the



Collecting materials called “Up-front” is in progress at Chaiteka site in Luwingu district (as at mid July in 2010).



The masonry type weir constructed by Chaiteka community people under the supervision of Luwingu TSB staff. The members now enjoy irrigation farming with the water diverted by the new permanent structure. (As of the end of September in 2010).

CEO in charge of the project area and district TSB staff same as the other project sites. They came to the site almost the days when the farmers work on. Apart from the works like collecting sand and crushing masonry stone assigned to males, female members did clearing works for access road leading to the construction site. A female participant spoke for her colleagues, “although we are very much familiar with this kind of works, they are hard job for us. But we are making efforts and shall get achievement.”

The construction works for permanent structure were completed at the middle of September in 2010. It took about 2.5 months to finish the construction work up. During the construction period, 28 members a day on average had participated in the project. After completion of the civil works, the farmers have started irrigation farming with 3 hectares of farming land to grow green-maize, tomatoes and some other vegetables by using water diverted by the permanent weir.

3.6.2 Malashi Site, Mpika District, Northern Province

Malashi project site stretches along the trunk road leading to Nakonde. It is located at 5 km away from the district center of Mpika. The history of irrigation farming of this area started with furrow construction by 20 farmers participated in 2002. By that time, the farmers relied thoroughly on rain-fed farming. They spent about 190 days in 8 months to complete digging up the furrow, length of which reaches 2.5 km. The furrow was surveyed by some villagers who knew how to align the canal.

The scheme members once constructed a diversion weir to abstract stream water of Malashi, which is a tributary of Chambeshi river, by using sand bags. All the members shared the cost for purchasing 250 empty sand bags when they constructed it. The sand bag weir, however, has been partially worn out and flashed away. Water leakage, therefore, has been created by water pressure beneath of the weir. The sand bags had to be constantly replaced from time to time.

BULIMI TABUPWA – it means “farming never ends” - is the name of the smallholder irrigation scheme in Malashi, which was established with 50 scheme members at the same year when the furrow construction mentioned above was done. Since then, they have been enjoying irrigation farming growing maize and vegetables such as tomatoes, cabbage, onion, and so forth. The membership of the group counts 53 consisting of 27 males and 26 females. They come from 3 villages around the project site; namely, Chisowa-A, Chisowa-B and Chiponya.

In late May 2009, together with a staff of TSB and a CEO covering Mpika Main Camp, the scheme members tried to introduce a simple diversion weir replacing the existing one by using local materials according to the concept of smallholder irrigation development under this Study. The participants of the simple diversion weir construction expressed their impressions, that is, “the works is very easy, no difficult”, “never seen this kind of weir so far”, etc. The scheme members enjoyed 7.7 hectare of irrigation farming with the simple diversion structure constructed in 2009.

The farmers, however, have still problem on the water for irrigation. Since the onset of the scheme, the number of households in 4 villages indicated above has constantly been increasing and as at 2010 there are more than 600 households in total. Furthermore, some outsiders use the water at upstream area of the



The scheme members are collecting stones for making concrete as preparation work to next stage. (Malashi site, as of the end of June, 2010)

scheme in order to make bricks. After seeing the effects of simple diversion structure constructed in 2009, the scheme members, therefore, are longing to have more water to make irrigation farming stable throughout a year.

Local markets such as restaurants, guest houses, and open markets buy the farming products of Malashi project site. The site could be placed as a small-sized intensive farming in the suburbs of big town in the district. The farmers usually ferry the products by using bicycle or putting the products on the head. Farmers who can afford to hire a vehicle transport their crops to as far as Mansa district. As for onion, middlemen come to the project site from Lusaka and Kitwe (Copperbelt), and even from DRC as well.

The scheme members together with responsible TSB staff for Mpika district started weir construction works with “Up-front” collecting construction materials at the mid June 2010. In order to save the construction cost, they use an ox-cart for transportation of masonry stone instead of hiring tracks from private transporters. The community members achieved their goal by the middle of October in 2010.



The construction reached the final stage to place concrete to last layer. After that, the construction was successfully finished and then the weir has started supplying enough water to irrigated plots being cultivated by 53 farmers.

The construction processes took them almost 3.5 months. While it was under construction, irrigated farming has been practiced by using water passed through a de-watering canal. The canal had let enough amount of water pass to irrigate the farm land as the farmers always do. By applying an appropriate method, the weir construction doesn't disturb the farmers to irrigate. The weir newly constructed is able to cover 8 hectares of irrigated land approximately along the furrow extending as far as 5 kilometers.

3.6.3 Kasonde Site, Mporokoso District, Northern Province

It takes about an hour to reach Kasonde site from the district center of Mporokoso by vehicle. It is located at a distance of about 40 kilometres away from the center. Farm lands to be benefited by the permanent diversion weir is divided into two areas straddling over Kasakalabwe stream where the project is established. The right bank of the stream covers Kasonde village named as the project site and Chilangwa village is located at the left bank of the stream.

As for Kasonde village, existing simple diversion facility constructed in 2002 as a personal property was improved under the pilot project in 2009 dry season under this Study. The community members participated in the improvement works and then they irrigated vegetable garden of an area of 1 lima. Dominant crops in the area under irrigation are rape, cabbage, tomato, etc. On the other hand, cassava, maize, soya beans, and sweet potatoes are grown under rain-fed farming.



The masonry type of weir has been almost piled up on the Kasakalabwe stream, Mporokoso district (as of mid July)

It was in 1942 when the villagers of Chilangwa settled themselves in this place with 65 households. After that, some of the villagers shifted and established another village in 1952, which is the Kasonde. As a result, 45 households live in Chilangwa village at present. Membership for the project from the village is 25 farmers with 10 males and 15 females out of the 45 households.

The farmers of Chilangwa so far have practiced bucket-irrigation farming fetching water from Kasakalabwe stream and it has covered farm plots of 4 lima (1 ha). Actually, there is a furrow constructed by a Roman Catholic church near the village. However, the villagers haven't used it because it belongs to a local school for gardening and fish cultivation. The community people, therefore, had been very much eager to have their own facilities for irrigation farming. Major crops grown by bucket irrigation are onion, tomato, eggplant, etc. in and around the project site.

The farmers of the project site face marketing difficulties because of the distance to the market place. As mentioned above, the site is far away from the district center where there is the biggest market for the farmers of the site. It takes nearly 4 hours by riding bicycle. They start off the village at 6:00 and then come back to home at 19:00 to sell their farm products. Also, a refugee camp was established in 1999. It is located at only 2.5 kilometers away from their place, and there are about 8,000 refugees as of 2010. This is another market for the farmers of both Kasonde and Chilangwa villages, though it is not as big as the one in the Mporokoso centre.

As of mid July 2010, the construction work of a new weir progressed satisfactorily. The main body of masonry type weir had come to the designed level by then. The construction was over by the end of September 2010. In response to the completion of weir construction, the farmers started off canal digging work. The length of the furrow is supposed to be about 2.5 kilometers for the right bank and 1.5 kilometers for the left bank respectively for covering more than 6 hectares of farm land in total. As of end of November 2010, the area of 1.25 ha is now irrigated by using the water diverted with the new structure. The irrigable land belongs to the communities. According to the participants for the project, the farm plots are to be shared by them.



The permanent weir newly constructed has started delivering the irrigation water to the farm land. (As of the end of September 2010)

3.6.4 Chilala Ste, Mporokoso District, Northern Province

Chilala is one of the popular villages in Mporokoso district located 12 km from the district centre. The village was established way back during the pre-independence period, 1960s. At that time, this place was a favourable hiding and sleeping place for lions because of its thick forests, hence the origin of the name Chilala coming from 'Chilala Nkalamo' (where lions used to sleep).

The number of households stands at 35 and the total number of member farmers from this village is 36, 14 males and 22 females. The



The permanent weir construction was carried out in collaboration with the community people and some skilled labors (As of the end of October 2010).

member farmers were highly interested in putting up a permanent structure there as they kept on mending the temporal diversion point time and again. This site is endowed with abundant water from the Ng'andu stream from where the permanent weir had been constructed. Construction of the 13m long and 1.6m high wet masonry weir commenced on October 4th and completed on November 12th 2010. This site had been upgraded from temporal weir which was constructed 20m downstream from the permanent one. It was successfully supervised by the TSB staff from Mporokoso district.

The major activities that farmers are engaged in include: fish farming and production of horticultural crops like green maize, tomato, onion and cabbage to mention but a few. Their main outlets for their produce include: Mporokoso, Kawambwa and the Copperbelt. For external market outlets farmers come as group and hire a truck to ferry their produce which fetches more than money when sold. Tomatoes and onions are the major crops sold outside the district. The average amount of money realized per farmer per growing period is ZMK 1,200,000 from the production of vegetables and ZMK 800,000 realized from fish sales harvested from the 15 fish ponds.



A masonry type of weir constructed under 2010 pilot project has started supplying the irrigated land with water (As of mid-November 2010).

With completion of weir establishment, the members have started irrigating the farm land of 3.3 ha increasing 0.8 ha as compared to area irrigated in dry season 2009. There is possibility to expand irrigated area and fish ponds as well due to the perennial water of the stream mentioned above which keeps to flow water in plenty even in most dry spell.

3.6.5 Nseluka Site, Mungwi district, Northern Province

Nseluka is a smallholder irrigation scheme newly established in 2009 with introduction of a simple diversion weir under this Study. At the end of June 2009, the farmers put the weir along with furrow construction and then some of them started irrigation farming with small areas of farming plots. Since that time, the scheme members had engaged them in the extension work of the furrow. The furrow was extended to as far as 4 km point in May 2010. The lands stretching along the furrow belong to the community, and before the irrigation started they had not used the land for farming. With the completion of the furrow construction, the members have demarcated the farm plots by more than 1 lima per head for coming irrigation season in 2010. The land demarcated arrived at a total of about 8 ha altogether.



The construction stage is to place concrete for foundation of the weir (Nseluka site, as of mid July).

Kalungu Vegetable and Saving group is the name of the farmers' group aiming mainly at gardening, marketing and saving. In fact, this group was established in 2007 under ASP (Agriculture Support Programme). The group consists of 33 memberships with 20 males as 13 females coming from 4

villages nearby. They have visions to improve the life standard, to send children to school, and so forth through farming activities with the irrigation they are now practicing.

Before the furrow was constructed, the farmers had applied bucket-irrigation farming to grow several vegetables such as winter maize, tomato, and onion. Bucket irrigation used to force the farmers to spend a lot of time and a lot of labours to irrigate all their plots. Farmers who experienced irrigation farming in 2009 feel an effect of the furrow gravity irrigation system because they were able to save the time and labours to take care of their crops through proper water management of irrigation. They actually used saved time to do other things at home and on farms as well.



The weir equips a sand sluice gate (Center) from environmental aspect, which is expected to work to flush the sand accumulated in the water pond and to let a small fish go upstream. (As of late in September 2010)

The scheme members were on the site everyday throughout the week except Sunday during the construction of the permanent structure. The construction work to put a concrete diversion structure progressed smoothly and then it was over at the middle of October 2010 including canal lining of 30 meters from outlet of the weir. In response to equipping with the irrigation facilities, the area to irrigate has been expanded by supervision of the CEO taking care of this site. Through the efforts, the members have started enjoying irrigation agriculture at the field of about 7 ha by using water coming from the newly constructed weir.

3.6.6 Chibolya Site, Kawambwa District, Luapula Province

Farmers living in Chibolya village originally came from nearby area of the district center to start rain-fed farming in 1972. The number of households of the village at that time was only 3. The total number of households counts at 35 as of June 2010. In 1992, the farmers commenced furrow irrigation farming through construction of a simple diversion weir made of locally available materials on their own experiences and knowledge. Then, in dry season 2009, farmers introduced a trigonal-type simple diversion structure as one of the sites for the pilot project under this Study. The irrigation scheme irrigated an area of 2.5 ha of farm plots with 15 fishponds.



The participants are constructing the de-watering furrow which will be about 100 meter in length. They planned to complete this work within 10 days (Chibolya site, as of beginning of July, 2010).

Dominant crops grown in the project site with irrigation are tomato, cabbage, onion, rape, etc. The farmers, however, were still suffering from shortage of water for the irrigation and also fish cultivation. While the Chibolya farmers are proud of their cooperative-ship of each other, a high sense of solidarity, and very much hard working, they point out some issues and problems; the shortage of water for irrigation and fish cultivation, lack of inputs and equipment for farming, poor clinic facility, and low level of education. To cope with these issues, especially for farming matters, they formed a cooperative named as Kampemba cooperative.

About twenty farmers participated in establishing a masonry-type permanent scheme in 2010 dry season under this Study. The work had been well progressing since the beginning of July 2010. The membership consists of 15 males and 5 females gathering from two villages. During the construction of the permanent weir, they were on the site every day throughout week except Saturday and Sunday. The working hour for them was set from 7:30 up to 15:00. As of 2nd week of July 2010, the project reached a stage at which they were to dig de-watering canal of 100 meter in length to dry the weir construction area up. After completion of the said work, the participants were divided into two groups to share the works for collection of materials such as sand, crushed stones, and masonry stones.



The masonry main body has completed. The persons concerned such as the community members, TSB staff, and skilled labors are finally checking the details of facility. (As of early in November, 2010)

Then, by mid October 2011, the weir construction was completed and they started furrow improvement as well. It took the farmers 3.5 months with 18 attendants on average a day. The area that the irrigation water was delivered by the masonry permanent weir is estimated at 3.2 ha approximately as of November 2010. In line with the weir construction, the farmers have extended the canal length to 7 km to share the water with Spinoti villagers as they had planned.

3.6.7 Kakose Site, Mansa District, Luapula Province

The site is in a mountainous area located at 60 km away from Mansa centre. The place was opened by just 5 farmers to cultivate maize, cassava, etc. in 1999 and then a part of existing furrow was dug at that time. After a couple of years, the farmers knew a programme supported by the government through listening to the radio broadcast produced by NAIS, which was “LIMA Programme”. The radio told the farmers about effectiveness of diversion weir to utilize river/stream water for irrigation farming.

The farmers learnt how the diversion weir could be helpful for irrigation farming and then they started constructing a temporal weir and a furrow as well. This construction took place in 2001. The length of temporal weir was 46 m at that time, which was made out of locally available materials whatever they could get around the site. Some chassis used for truck vehicle were applied to support the weir body too. Much to the visitor’s astonishment, by that time, they managed those activities on their own; they had no external supports from anywhere.

In 2006, the farmers started constructing a permanent diversion weir by themselves while receiving technical supports from TSB Mansa. The officers gave the farmers advices on how to effectively capture the water, align the furrow, construct concrete weir, and so forth. Out of 46 m, 6 m of original temporal part of the weir was replaced to permanent one by spending 50 bags of cement which was contributed by all the 20 committed members.

Since that time, they had been expanding concrete parts of the weir step by step. By July in 2009, the length of permanent portion was extended by 23 m in total. The reinforcement works of the irrigation facility in 2009 took the 20 members about two weeks. All the reinforcing works were done by man-using small tools such as shovel, hummer, trowel, and so on. There was no heavy equipment on the site during whole construction period because of the location of the site. They had no option other than they did it on their own.

The construction works to grade up remaining temporal parts started in the middle of August 2010

after finishing a communal work to put a village road in good condition which took the members about 3 weeks from July to August. By constant participation in the works of about 40 members a day, the weir was completed within 4 weeks. The construction works were over by mid September. With this, all the parts of the weir have been graded to permanent structure from previous temporal one. The permanent weir has supplied the water to an area of 2 ha of irrigated plots cultivating banana, tomato, and so forth.



Since 2006, year by year, the farmers of the site have continuously reinforced the temporal weir by using foreign materials like cement and iron bars which have been contributed by members themselves. (As of July 2009).



In year 2010, by improving the remaining temporal parts, all the parts of the weir has at last been graded up from temporal to permanent. (As of late in September, 2010)

3.6.8 Mililwa Lower Site, Mansa District, Luapula Province

Mililwa Lower project site is located at about 10 km away to the east of Mansa town centre. It takes about 20 minutes by vehicle. In the area, Mililwa stream, which is one of the major water sources for irrigation farming and domestic use as well, is gently running through with a certain amount of flow throughout a year. A simple diversion weir was newly constructed under the pilot project implementation in 2009 dry season.

Topographic condition around the weir construction site forms a part of shallow *dambo*, wide-spreading with about 200 m from the right bank to the left one with very gentle slope. The whole surface around there is covered with plenty of grasses. In and around the project site, farmers grow several kinds of vegetable such as cabbage, tomato, onion and winter maize and then those productions are supplied to Mansa center, Samfya market, Mwense Kashikishi town market and as far as to Nchelenge market. The project site can be considered as an area of small-sized intensive farming in the suburbs of townships for the neighbor districts.



The participants are digging core-trench of the small earth dam. (As of mid-July 2010).

“Mililwa Lower Farmers Group” is the name of the participant group for the project. The membership counts at 25 farmers, composed of 13 males and 10 females. They come from 3 villages: Timoth (3 members, 2 males, 1 females), Chibolya (3, 2, 1), Chakulya (3, 0, 3), and Kashikishi (4, 2, 2). They have formed a farming group in 2008 to acquire the certificate of buying subsidized fertilizer, chemical, and to rear livestock such as poultry, goat and cattle.

As mentioned above, the construction site is located in *dambo* area and then the capacity of soil is not suitable to put a heavy weight structure like concrete type and masonry type one as the other sites introduce. Due to the reason, a small-scale earth dam type was selected for this project site. The group members started the construction works with excavation work of core-trench of the small earth dam since the end of May 2010. They worked on the site every 3 days in a week. As of mid July 2010, almost 100m³ of soil were excavated, which was equivalent to 7m³ of excavation per day.



The main body of small-scale earth has been piled up to the level planned. (As of the beginning of November 2010).

During the course of the dam construction, some sheet piles were also driven into the ground to shut off the water leakage passing through the core trench of the dam. After completion of putting masonry stones to equip a natural-type spillway on its right bank side, the community members completed all the dam construction works by the beginning of November 2010. It took them about 4 months. The dam irrigates 1.25 ha of farm land as of November 2010, and is designed to expand the irrigated area to 5.0 ha with a road crossing on the furrow alignment.

Table 3.6.1 Profile of the Permanent Diversion Schemes for the 2010 Pilot Project Implementation

Province District	Site Name Club Name	Membership: Total, Male, Female, (L. owner) Village concerned	With Permanent weir:		Type of structure Dimension	Construction Cost, Materials, ZMK Tools, ZMK Transportation, ZMK Skilled Labor, ZMK Total, ZMK	Activity in 2009 under COBSI Area Irrigated with simple
			Irrigated area in 2010 Designed Irrigated area Potential area	Potential area			
Northern Luwingu	Chaiteka site Milandu Irrigation Group	25, 13, 12, (25) Chaiteka	2010: 3.00 ha	5.00 ha	Masonry Height: 2.0 m Length: 12.0 m	16,160,000 5,450,000 7,100,000 3,700,000 32,410,000	New site A simple weir construction 4 km furrow digging 2009: 0.25 ha
			Potential: 6.25ha	Potential: 6.25ha			
Mpika	Malashi site Ubulini Tabupwa Farming Group	53, 27, 26, (16) Chisowa-A: 11, 6, 5 Chisowa-B: 40, 20, 20 Chiponva: 2, 1, 1	2010: 7.90 ha	10.50ha	Concrete Height: 2.3 m Length: 15.0 m	20,320,000 1,630,000 1,750,000 15,400,000 39,100,000	Improved site A simple weir improvement 2009: 7.90 ha
			Potential: 20.0ha	Potential: 20.0ha			
Mporokoso (1)	Kasonde site Right bank: Kavokolo Farmers Group Left bank: Not been formed yet	45, 18, 27, (1) Land belongs to community Right bank: Kasonde: 20, 8, 12 Left bank: Chilangwa: 25, 10, 15 36, 14, 22, (1)	2010: 1.25 ha	5.00 ha	Masonry Height: 1.4 m Length: 8.0 m	25,720,000 2,580,000 550,000 6,100,000 34,950,000	Improved site A simple weir improvement 2009: 1.25 ha
			Potential: 6.00ha	Potential: 6.00ha			
Mporokoso (2)	Chilala site	36, 14, 22, (1)	2010: 3.30 ha	5.00 ha	Masonry Height: 1.6 m Length: 13.0 m	31,211,000 0 2,714,000 6,500,000 40,425,000	Improved site A simple weir improvement 2009: 2.50 ha
Mungwi	Nseluka site Kalungu vegetable and saving group	33, 20, 13, (1) Land belongs to community Kasonde: 2, 2, 0 Wapata: 1, 0, 1 Chapewa: 5, 3, 2 Washangai: 2, 1, 1	2010: 6.00 ha	8.00 ha	Concrete Height: 1.8 m Length: 12.5 m	36,135,000 5,830,000 1,570,000 9,800,000 53,335,000	New site A simple weir construction 4 km furrow digging 2009: 1.00 ha
			Potential: 8.25ha	Potential: 8.25ha			
Luapula Kawambwa	Chibolya site Luena Irrigation Club	20, 15, 5, (1) Chibolya: 10, 8, 2 Spinoti: 10, 7, 3	2010: 3.20 ha	5.00 ha	Masonry Height: 1.8 m Length: 24.0 m	36,671,000 3,090,000 5,440,000 12,540,000 57,741,000	Improved site A simple weir improvement 2009: 1.50 ha
			Potential: 5.00ha	Potential: 5.00ha			
Mansa (1)	Kakose Tubombele Pano	20, 15, 5, (1) Kakose	2010: 2.00 ha	5.00 ha	Concrete Height: 1.8 m Length: 17.0 m (for the	30,705,000 4,320,000 1,600,000 1,680,000 38,305,000	Improved site A simple weir up-grading 2009: 0.50 ha
Mansa (2)	Miliwa Lower site Miliwa Lower Group	25, 15, 10, (23) Timoth: 3, 2, 1 Chibolya: 3, 2, 1 Chakulya: 3, 3, 0 Kashikishi: 4, 2, 2 Mutiti: 12, 6, 6	2010: 1.25 ha	5.00 ha	Small-scale earth dam Height: 2.4 m Length: 32.0 m	12,505,000 2,700,000 455,000 15,000,000 30,660,000	Improved site A simple weir improvement 2009: 0.75 ha
			Potential: 6.00ha	Potential: 6.00ha			
Total	8 sites	257, 137, 120, (69)	2010: 27.90 ha	48.50 ha	Masonry: 4 Concrete: 3 Earth dam: 1	209,427,000 25,600,000 21,179,000 70,720,000 326,926,000	New Site: 2 Improved Site: 6 2009: 15.65 ha

Source: JICA Study Team, based on the pilot project implementation 2010 for permanent scheme.

CHAPTER 4 AGRICULTURAL TRIALS

Developing water resource does not necessarily guarantee the immediate improvement of farmers' livelihood. As a next step, agricultural practice is the way to tap the output from the smallholder irrigation development. In the pilot project, several types of farming systems have been carried out. The main aim of the agricultural trial was to test the adoptability of relatively new crop or new farming method under irrigated agriculture.

As discussed earlier, however, the smallholder irrigation development itself, a basis of irrigation agriculture, faced a variety of challenges in the course of pilot project and then took some time to see the actual water flow running in the furrow both in the years 2009 and 2010. In addition, staff mobilization was also a challenge in conducting the trials. Especially from June to August, MACO staff especially district TSB officers and CEOs were to manage agriculture show in their camp, district and province. By waiting construction works as well as with limited staff mobilization, agricultural trial had delayed.

4.1 Contents of the Agricultural Trials

There were three main trials: 1) inter cropping several different crops, 2) introduction of wheat as a new crop, and 3) introduction of New Rice for Africa (NERICA) under irrigation. Table 4.1.1 shows the basic profile of the agricultural trials. The trial was managed by the CEO of each camp supported by provincial TSB officers at Kasama, Northern province.

Table 4.1.1 Basic Profile of Agricultural Trial

Trial	District	Camp	Participant	Area of the Plot	Provision
2009					
Maize/ Climbing Beans	Mungwi	Nseluka	4	Not Specified	Bean seeds
Maize/ Climbing Beans	Mungwi	Chabukila	4	Ditto	Bean seeds
Wheat as new crop	Kasama	Lukulu	4	Ditto	Bean seeds
2010					
Maize/ Climbing Beans	Mungwi	Chabukila	8	1/4 by 8=2 lima	Bean seeds
Maize/ Standing Beans	Kasama	Mulobolo	4	1/4 by 4=1 lima	Bean seeds
Maize/ Cow Pea	Kasama	Chipompo	4	Ditto	Pea seeds
Maize/ Soybean	Kasama	Chipompo	4	Ditto	Bean seeds
Maize/ Sweet Potatoes	Kasama	Mwika	4	Ditto	Seed Sweet potato
Cabbage/ Tomato	Kasama	Mwamba	4	Ditto	Cabbage and tomato seeds
Cabbage/ Onion	Kasama	Kasonde Chisuna	4	Ditto	Cabbage and onion seeds
Carrot / Onion	Kasama	Kasonde Chisuna	4	Ditto	Carrot and onion seeds
NERICA	Kasama	Chipompo	7	Ditto	NERICA seeds
Total		8	36	9 lima	

Source: JICA Study Team

4.2 Intercropping of Different Set of Crops

As described in Chapter 5.4.2 Recommended Cropping Systems of the Main Report, intercropping is one of recommendable farming systems in the Study Area where soil is highly depleted and thus farmers are challenged by lower productivity per land. Although not much farmers are engaged in this farming system, intercropping itself is not a completely new technology in the area. For instance, some combinations of crops have been already observed: maize-cabbage, cassava-tomato, and maize-beans for instance. Those existing cases of practicing intercropping are the positive sign for higher adoption rate of this technology.

Intercropping would be best fitted to the farmers in the area because their average size of irrigated land is quite limited: roughly 20-35m square per household. Thus, increasing the productivity per land becomes to be a life-changing strategy for smallholder farmers. Also, by integrating legume crops in the system, problems associated with low fertility can be addressed. In the pilot project, to build up as

many best practices as possible, eight different combinations of intercropping were proposed:

- ✓ Green Maize and Climbing Bean (relay cropping)
- ✓ Green Maize and Standing Bean
- ✓ Green Maize and Cow Pea
- ✓ Green Maize and Soybean
- ✓ Green Maize and Sweet Potato
- ✓ Cabbage and Tomato
- ✓ Cabbage and Onion
- ✓ Carrot and Onion

4.2.1 Green Maize and Climbing Bean

Intercropping of green maize and climbing beans were tried under irrigation. Firstly, a variety of climbing beans was identified and purchased through Misanfu Agriculture Research Center. They were then distributed to some farmers who were willing to participate in the trial. In Nseluka village, beans were planted at the end of August 2009, a week after the germination of maize. As a basal fertilization, some farmers applied 10kg/0.25 lima of D-compound fertilizer and others applied 5kg/0.25 lima.

At the end of growing season, then, it was found that the growth of maize was not uniform and some of them were stagnant, while the growth of beans was quite promising; it was too early to plant beans. As the growth of beans prevailed over the maize, some maize plants were covered or fasten up by the beans. Another reason of stagnant maize plants was the amount of fertilizers applied. In the plot where half of recommended amount of D-compound was applied, the growth of maize was obviously suppressed; they were just above the knee height as compared to shoulder height in other plot where recommended amount was applied.

There was a good aspect of the trial; bean leaves were used as a “vegetable.” Farmers in this area commonly consume a various types of crop leaves such as potato leave, sweet-potato leaves, and bean leaves. What was good with this trial was that farmers can pick the bean leaves while standing; you do not have to bend yourself down to pick. It was also found that picking the bean leaves incidentally controls the growth of exuberant bean as compared to the growth of maize.



Mixed cropping of green maize and climbing beans (circled)

Both crops were harvested at the end of December, about four months after the planting. As rainy season starts in and around November, the harvest time was in the middle of rainy season and thus some negative effects from the moisture might be foreseeable. On the other hand, farmers can also expect higher price of maize and beans at that time because the produce is scarce in the market during that time. If one would like to minimize the risk of production, it is recommended to start as early as the rainy season ends.

Lessons:

- 1) Beans should be planted with an enough amount of time after maize is planted. As a week after the germination is too early and cause physical interference to maize. A month after or even relay-planting is recommended, in which beans are planted shortly before the harvest of maize so that beans can climb the remaining of maize stand without any competition.

- 2) Especially for those who do not like to do careful tuning in planting schedule of beans, dwarf beans can be a good alternative to mix with maize as it has mulching effect. Note that productivity of dwarf type per a unit of land is lower than climbing type and relatively prone to the pest.
- 3) Start planting as early as the rainy season ends to get harvest before the rainy season. If it is early enough, relay-planting of green maize and beans is also applicable within the period of the dry season. To do so, irrigation has to be ready soon after the rainy season.
- 4) For those who are willing to take some risk to maximize his/her profit, late planting is also an option. At the beginning of the rainy season, agricultural produces are generally scarce and thus farmers can take an advantage of selling at higher price. However, the one has to be aware that the labor is also scarce in that season for the preparation of rainy season agriculture and the risk of disease increases.

4.2.2 Green Maize and Standing Bean

Overall situation of green maize and standing bean trial was not promising due mainly to the delay of conduct. Also, among those who were doing intercropping trials as planned, there were some challenges reported. In Mulobolo camp, for example, maize seeds have been eaten by rat, resulting in lower germination rate in the plot. Instead of the damage on maize, however, the growth of beans went quite well and the second sowing of maize also worked.

One thing confirmed from this plot was that double lining of beans seemed to work well. It was designed to plant beans and maize in double lines each so that beans, shrub-shaped plant, can receive enough sunshine. And now, from the observation of the field, it was confirmed that the bean grows quite fine next to maize.

On contrary, another farmer in the same camp experienced completely opposite result; maize went well, while beans did not grow well. As shown in the photo, a woman is about to harvest maize grown very good in her irrigated field. Before the harvest of maize, in addition, she was able to enjoy continuous harvest of beans and bean leaves (she has some bean seeds in her hand). Not just an economic value added through irrigated agriculture, diversification of harvest timing seems to be a positive effect of intercropping of maize and beans.



*Intercropping of maize and bean (double lines each)
Bean grows quite well, while maize was attacked by rat.*



A woman is harvesting bean seeds, while waiting for the forthcoming harvest of green maize.

4.2.3 Cabbage and Tomato

It is generally said the combination of tomato and cabbage can reduce the incidence of damages caused by insects. Therefore, this combination of intercropping has been tried under irrigation in 2010. In Mwamba Camp of Kasama district, four farmers have carried out this trial, of which two farmers were interviewed: Mr. Augustine Mukuka and Mr. Abel Mwewa. As they say, cabbage-tomato

intercropping was found “helps reduce the cost of production and labor.”

For example, Mr. Augustine was able to reduce the cost of chemicals by 38% from 195,000ZMK (135,000ZMK for tomato and 60,000ZMK for cabbage)/ 0.25lima to 120,000ZMK/ 0.25lima. Because the emergence of insect/disease had reduced, he was able to reduce the frequency of chemical application from “every week” for conventional single cropping of cabbage and tomato to “every two weeks” for the intercropping.

In the conventional single cropping of both crops, he often experiences severer emergence of aphid on cabbage and cutworm and/or black spot on tomato. However, under the arrangement of cabbage-tomato intercropping, aphid on cabbage was obviously reduced and so was cutworm on tomato.

One of the aspects should be concerned was the relatively unfavorable price of cabbage. Mr. Augustine sold his cabbage at the Kasama Chambeshi market about 22km away from his village at around 15,000 to 22,000 ZMK/50kg bag, which was not so attractive to him. The both crops were planted on October 18, 2010 and cabbage had been harvested from mid December 2010 to late January 2011. During this time, the price of cabbage hits the bottom as a lot of others also cultivate the same crop in and around the area, while the price of tomato is still good this time. Reportedly, cabbage from Mbala district was a lot in the market this time.

What was learned here was that the price trends of tomato and cabbage are totally different. As stated in Table 4.1.1, tomato has two peaks of price trend: June-July and January-February, while Cabbage maintains a longer period of one peak: June-October. That is, most profitable harvesting seasons of each crop has different behaviors.

Table 4.2.1 Price Trends of Tomato and Cabbage

Crop	Dry Season						Rainy Season					
	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Tomato	M	H	H	M	L	L	M	M	H	H	L	M
Cabbage	M	H	H	H	H	H	M	L	L	L	L	M

Source: Interview at Mwamba Camp, March 2011

Note: L) low price, M) medium price, and H) high price

Yet, looking at the table more carefully, there found is a two months of period, in which both crops hit the top: June to July. Therefore, it is strongly recommended for farmers to carry out intercropping of tomato and cabbage as soon as rainy season ends so that they can fetch a best price for both crops in July or at least better price in August.

In addition, it was confirmed by Mr. Abel liked that the intercropping of cabbage and tomato would enhance the quantity of the produces harvested in a unit of land. In his case, he did not reduce the frequency of chemical application and he enjoyed large quantity of cabbage production. In a common practice, cabbage is accommodated around 26 heads in a 50kg bag. Besides, 16 heads of cabbage fulfilled a same size of bag in the case of intercropping. Much more money can be expected from the same piece of land.

4.2.4 Maize and Cowpea

Intercropping of maize and cowpea was also introduced in the agricultural trial. Cowpea, an African-origin legume crop, is well known as to enhancer soil fertility. Thus, especially for farmers in the Study area where soil condition is quite depleted, it is quite a recommendable crop to be planted.

This intercropping was tried out in Chipompo village where four farmers participated. According to Mr. Evaristo Kasengele, one of the four farmers, benefit of maize-cowpea intercropping was quite pronounced; as cowpea covers the surface of soil, 1) it suppresses the growth of weed, and 2)

minimizes the evaporation of irrigated water. In fact, he organized weeding only one time during the entire growing period as compared to three times in the conventional single cropping of maize.

On the other hand, there was a little drawback to the growth of maize. Although cowpea was sown one month after sowing maize seeds, it still overwhelmed the growth of maize; growth of cowpea is considerably strong. As a lesson, cowpea should be sown roughly two months after sowing maize.

4.2.5 Maize and Soybean

Combination of maize and soybean was also organized in Chipompo village with another four farmers. Ms. Agness Mumba, one of the participants, gave a credit to this practice with five major reasons: 1) frequency of watering can be minimized; 2) less numbers of weeding is required; 3) two crops can be harvested; 4) land fertility might be improved; and 5) it is applicable even in rainy season.

On the other hand, some drawbacks have been also observed. The most considerable one was too strong vegetative growth of both crops. As they grow too strong, harvest was not so impressive. She assumed that the land fertility became too good by the soybean by which crops grow too tall. It is, however, more likely that the inter-row spacing was not enough: 30cm in between the rows of soybeans.

4.3 Wheat as a New Crop

Under irrigation, farmers' alternative to the type of crop can dramatically increase. For example, farmers can introduce new types of crops and they can plant crops in a different timing so that they can enhance the market opportunity. A series of discussions had been carried out between the Study team and provincial and district TSB officers on the types of potential crops to be newly introduced in the Study area.

The suggestion began with Irish potato that is now mostly imported from Tanzania, garlic that is seen as high value in the market and NERICA. Further suggested was wheat; it has accumulated a good reputation in some areas including Mpika. In fact, wheat was once promoted by CIDA during the late 80s in Mbala, Mpika and Nakonde in Northern province. And, in Mpika, there were some wheat farmers who performed well and are still cultivating it. Wheat flour is usually given higher price than the same amount of maize and thus the potential was seen high. For example, as of the end of November 2009, the price of bread flour was ZMK 105,000/25kg, while it was ZMK 59,000/25kg for milled maize in Kasama.

In addition to vegetables like tomato, onion, and cabbage, it could be another good model of irrigated agriculture if grain crop can be introduced in the smallholder irrigation because grain is generally stable and can be kept for a longer period of time. As the progress in the construction of irrigation schemes for the year 2009 dry season was a bit slow, the location for this trial was selected from the existing irrigation scheme: Lukulu North irrigation scheme in Kasama district, where there were a number of farmers who were willing to produce wheat under irrigation.



Wheat growing nicely six weeks after planting

As of July 20, 2009, six bags of "Lorie 1" variety in 25kg bag were purchased and conveyed to the site. A total of 150kg of wheat seeds is

applicable to around 2 ha or 8 limas. Then, the seeds were distributed to eight farmers and planted in a total area of 1.75 ha or 0.22ha/farmer. According to Mr. Lupili John, one of the farmers who participated in this trial, he planted 6 kg in 0.25 lima on August 15, 2009. Following the instruction from the district TSB officer, he planted in a row with a distance of 20-25cm in between the each row. In his farm, a group of four rows were surrounded by the ridge so that he can irrigate them under “sunken-bed” irrigation. Through this method, he applied irrigation water three times a week, in which it took about two hours per time to irrigate whole plot. His cropping calendar is shown below:

Table 4.3.1 Major Activities of a Farmer for the Wheat Production Trial

Date	Activity	Remarks
Aug. 15	Planting	6kg of Lorie 1 variety in 0.25 lima in row
Aug. 31	Applying basal fertilizer	2 gallon (10kg) of D-compound (ZMK 56,000 in total) Applied in between the rows
Sep. 7	1st Weeding	Hand weeding at the stage of 30cm in height of the wheat
Sep. 21	Applying top-dressing fertilizer	2 gallon (10kg) of Urea (ZMK 56,000 in total) Applied in between the rows
Sep. 28	2nd Weeding	Hand weeding at the stage of flowering
Nov. 13	Harvesting	By a labor (ZMK 5,000 in total) Only 1/4 of the plot was harvested due to a lack of labor 5 bags of dried panicles in 50kg bag (about 10kg) (not threshed yet)

Source: Interview to Mr. Lupili John (November 23, 2009) / Irrigation: three times a week for 2 hours per time

During the production period, he faced some problems. First, there was an occurrence of termites and maggot-type insects. It occurred in the plot of wheat and groundnuts but not in the plot of onion, implying avoidance effect of onion against the insects. He claimed the water shortage as a primary cause of this problem. In fact, irrigation stopped for about two weeks early October due to the construction work. Another problem was a lack of labor during the harvest season. Starting from November, farmers, all at once, start land preparation for the next rainy season and consequently labor becomes scarce. Due to the lack of labor force and the appreciated cost for labor, he gave up harvesting some part of his plot.



Wheat already germinated before harvesting

In addition to his case, there was an observation of differentiated productivity by the timing of planting. One farmer planted a half of his plot in July and the other in August, about two weeks later. After a while, he was able to harvest the first plot but he gave up the second plot as the latter was affected by the rain and some grains started germinating (see the picture). Interviewed farmers were willing to continue this trial for the next year. They said they will not sell their produce but keep it all as the seed for the next year.

Still, the market is the key factor to examine whether wheat can be promoted. Originally, TSB officers and farmers who participated claimed that they can sell their produce to National Milling Corporation in Kasama town. However, through a discussion with the corporation and the Study team, it was revealed that their procurement procedure is highly centralized; all the transactions are managed by their central office in Lusaka. Therefore, marketability still remains a major issue to be solved before the planting season next year.

Lessons:

- 1) Planting in late July or even August is too late for wheat production as it will be affected by the rain before the harvest. It is therefore recommended to start as early as the dry season begins. Also

farmers will face the lack of labor force in the late dry season.

- 2) Family labor cannot manage harvesting 0.25 limas of wheat. It is necessary to make sure the size of plot not to be too big, considering other crops in his/her entire field, unless one can assume enough labor force.
- 3) (Although marketing was not tried), marketability of wheat is questioned, as one of the major buyer did not show much interest in buying small quantity of wheat from individual smallholder farmers.

4.4 Introduction of NERICA under Irrigation

New Rice for Africa (NERICA) is a set of new rice varieties newly developed through an inter-specific hybridization between African and Asian rice species. NERICA, as a group of varieties, is seen having relative advantages derived from both species: higher yield potential, tolerance to dry condition, shorter maturing period, etc. It is now seen as one of the promising tools for agricultural development throughout Africa and being promoted in many African countries.

In Zambia, it is still a new type of crop and it can be seen only in the field under trials by research center or the donors' project. Furthermore, although NERICA is commonly categorized in upland rice¹, it is mainly being grown during rainy season for the seed multiplication, for example, by Misanfu Agriculture Research Center in Northern province. Therefore, growing NERICA under irrigated condition would be a good trial to see if there is a good chance of introducing NERICA for smallholder irrigation development.

Introduction of NERICA variety was once attempted as a part of year 2009 pilot project activity. In that year, however, the collaborating farmer gave up NERICA cultivation as he encountered some personal problem associated with his farming. As a result, no vital lessons had been learned in 2009. Therefore, introduction of NERICA was once again tried with more number of farmers in 2010.

Today, NERICA is getting more popularity in Zambia. The government started a new NERICA promotion program in 2009 in which NERICA seeds are being multiplied and distributed in some provinces nation wide. In fact, a NERICA variety was being sold even at an agricultural shop in Kasama town, which was also broadcasted on a radio program. Therefore, it is a desirable timing to build up a best practice of NERICA production under smallholder irrigation schemes so that more farmers can enjoy the benefit of this new variety in conjunction with the irrigation development.

In the pilot project, there were a total of 4 farmers participating in NERICA cultivation trial. First, Chipompo irrigation scheme was identified as a potential site by provincial TSB officers. Taking into the failure of last year into consideration, TSB officers firstly looked for such farmers who were serious about their farming and identified Chipompo irrigation scheme. Although Chipompo irrigation scheme was still being constructed under the Study at that time, they already demonstrated their enthusiasm in irrigated agriculture; one of



NERICA variety growing well under irrigation

¹ Note: there are several traits of lowland NERICA. However, they are not available in Zambia yet. Therefore, NERICA in this report is treated as a set of upland varieties.

the biggest weirs has been constructed and elaborate canal was being dug notwithstanding the rocky condition of the area; they proved their seriousness. Therefore, farmers who already started irrigated agriculture in the area have been chosen to be the candidates. Same as intercropping trials, 25m by 25m plot, a quarter lima was set as standard size of the plot for the trial. To do it, NERICA seeds were provided.

By the end of November 2010, it was confirmed that the growth of NERICA was quite progressive and healthy under good weed management by the farmers (see picture). Although the harvest was yet to be done, NERICA seemed to be one of the staple crops to be introduced in the smallholder irrigation schemes in the Study area.

In 2011, result of the trial was surveyed based on interviews made to the farmers. Although the growing period of NERICA was reported greater than what anyone thought at the beginning, the reproduction stage was devastated by the attack of birds. As commonly reported in other countries where NERICA is already introduced, birds' attack is severe during the reproduction stage. As a result, the harvest of NERICA rice was quite depressed and the farmers were disappointed. A farmer described that the cultivation timing was probably not appropriate; as the rainy season starts, more numbers of birds migrate back to this area and the conceivable damage may increase, he said.

Lessons:

- 1) Although it does not guarantee the success, it is better to start cultivating NERICA as early as possible to minimize the damage of birds which are migrating back from the beginning of the rainy season.

4.5 Comparative Trial of BOKASHI Compost

BOKASHI compost is being promoted since the beginning of the Study and is, by now, getting popularity. Although there is no statistical data, there have been some opportunities that farmers ask about BOKASHI compost to extension officers, to TSB officers, and to the Study Team. This is probably because farmers are suffering from a combination of depleted soil fertility and high cost of chemical fertilizer. To be an alternative measure to improve soil condition, application of compost manure is highly recommendable.

Further, BOKASHI is superior to the conventional compost making methods with its quickness required for the decomposition process of organic matters. By today, BOKASHI making trainings have been carried out by TSB officers and CEOs in many districts. Now, for this new technology to be given a concrete credit, it is a right timing to do the trial to see the performance of BOKASHI compost in the real field.

The field trial of BOKASHI compost application was thus designed to see the comparative advantage of this technology for demonstration purpose. Now that the advantage of BOKASHI compost over the conventional methods was understood in terms of required time for preparation, it was time to see the effectiveness of the compost to the growth of crops. Therefore, three different types of applications were prepared in each plot: with BOKASHI compost, with BOKASHI compost and chemical fertilizer, and without any



BOKASHI compost making training at the site

fertilizer application. Expected outcome of this trial was to see the clear difference in the crop growth of each plot.

The participants of this trial were selected from Chipompo irrigation scheme with the same reason for the NERICA trial; those farmers attained reputation with their commitment in farming. As a first step, BOKASHI making training was provided for those who were interested in this technology. After the compost became ready, the plots were to be specifically prepared as a comparative trial.

The best part of doing BOKASHI compost training by the group was that as many farmers were able to learn the technology. On the other hand, as the heap of sample BOKASHI was prepared by the group, final product of BOKASHI compost was equally distributed by the group member, notwithstanding the limited amount of compost. As a result, it became impossible to see the comparative effect of BOKASHI compost as originally planned.

CHAPTER 5 EVALUATION OF THE PILOT PROJECT

This sub-chapter carries out evaluation of the pilot project implemented in 2009 and 2010. At first, outputs from the two years pilot project implementation is presented in terms of number of TOT, number of officers trained, improved sites and newly developed sites, number of beneficiary farmers. Followed are economic impact, e.g. topped up income from irrigated agriculture against the original income, impact to what extent their poverty level is improved, how their life has been changed/improved, and others.

5.1 Output Achievements under Pilot Project Implementation

5.1.1 Output Achievements for Simple Diversion Scheme

Since the completion of the kick-off training carried out early in the 2009 and 2010 dry seasons, the trained officers have promoted smallholder irrigation in their areas. Most of the trained CEOs proceeded by his/her own while some of them sometimes just waited for district TSB to come for backstopping. The Study Team, together with the counterparts in Northern and Luapula provinces, has followed up the progress. Table 5.1.1 shows the summary of the achievements for simple irrigation schemes for the 2 years operation while Table 5.1.2 summarizes the economic impact based on unit net cash income from harvest. From the tables;

- 1) During the 2 years pilot project implementation, total 95 officers, BEOs/CEOs and TSB officers, have been directly trained during kick-off training course, 3-day course in 2009 and 5-day course in 2010. They upon completion of the kick-off training have also trained their colleagues mostly at the sites under so-called TOT. Total 133 TOTs have been carried out by the kick-off participant officers wherein total 309 officers were trained through peer-to-peer.
- 2) With regard to Improvement of existing temporary schemes, total 293 sites have been undertaken composed of 100 sites in 2009 and 193 sites in 2010. Of those sites improved in 2010, 26 sites were newly developed in 2009 whereby total 267 individual sites have been undertaken for the 2 years operation. In these total 293 (or 267 sites) improved sites, total 7,550 (or 6,906 individual) farmers have participated while those who had started irrigation in the respective years were 4,393 farmers.
- 3) Under the Improvement category, 112 km of canal has been newly constructed composed of 27 km in 2009 and 85 km in 2010 while there was total 451 km canal already existent, making the total 563 km for the 293 sites. Those canals together have newly irrigated the total area of 290 ha in addition to the original irrigated area of 354 ha, now making the total 644 ha. 530 farmers were trained on compost manure making and also 36 fish ponds were newly constructed in 2010 (data in 2009 is not available).
- 4) With regard to New Development of simple irrigation scheme, total 275 sites have been established composed of 94 sites in 2009 and 181 sites. Of them, 63 sites and 146 sites had started irrigation in the same year, totaling 209 sites. During the construction of these schemes, total 6,499 farmers have participated while about one-third of the participants, 2,481 farmers, could start irrigation in the same year. 71 km length of canal was dug in 2009 and another 73km canal was done in the following year 2010 for those sites which had been newly constructed in 2009. In 2010, total 163 km of canal was dug in the 181 sites constructed newly in 2010. The total stretch of the canals under new development arrives at 234 km or 307 km including the ones done in 2010 for the sites developed in 2009.
- 5) Under Newly developed 275 sites, farmers have opened total 366 ha of land, of which 183 ha were irrigated in the respective year. In addition, another 70ha was put under irrigation in 2010 mostly by farmers for those sites newly established in 2009. Adding this 70ha, there is a total area of 253

ha now irrigated as at 2010 dry season for the newly developed sites over 2 years. Apart from the irrigation, total 734 farmers were trained on compost making and 147 fish ponds were also established.

- 6) In sum, total 568 sites (or 542 individual sites) have been undertaken during the 2 years pilot project operation composed of improvement and new development. Of them 527 sites are put under irrigation as of November 2010. Total 14,049 farmers (or 13,405 individual farmers) have participated in the programme, creating as many as 6,874 irrigators who have actually benefited from irrigated agriculture. Total length of canal newly dug under this programme has reached 346 km and another 73 km was dug by farmer themselves in 2010 for the sites newly developed in 2009. Total canal length newly dug over the 2 years operation arrives at 419 km. Adding the originally existent canal length of 451 km, there is as long as 870 km length of canal for all the 542 individual sites. Total area irrigated comes to 473 ha, and adding another 70 ha which was put under irrigation by farmers in 2010 for those sites newly developed in 2009, total area irrigated arrives at 544 ha¹. There was originally irrigated area for those sites improved. This was 354 ha. With this originally irrigated area of 354 ha, the total irrigated area under 542 individual sites come to as much as 898 ha.
- 7) For the economic impact from the irrigated area, we refer to the result of harvest survey carried out in 2010. Under the survey, total 806 sample plots (471 sample households) were surveyed to explore the gross profit, invested cost and the net profit. The average net profit per hectare arrived at ZMK 7.128 million (equivalent to US\$ 1,483 with exchange rate of 4,808 as at March 2011). With this unit net profit, the newly irrigated area under the pilot project generated a total sum of ZMK 1.069 billion in 2009 and another ZMK 2.805 billion in 2010 respectively. As at 2010 and also onward, total ZMK 3.874 billion is generated as net profit out of the 527 sites which already started irrigation. When considering the originally irrigated areas for those improved sites, the net profit comes to ZMK 2.130 billion, ZMK 4.269 billion and ZMK 6.399 billion. In US\$ term, it is US\$ 222,394, US\$ 583,417 and US\$ 805,811 respectively in case of considering only areas irrigated under the pilot project. When considering the originally irrigated areas, it comes to US\$ 442,965, US\$ 887,950 and US\$ 1,330,915.
- 8) In terms of net profit per farmer household, it is ZMK 302,054 according to the area newly irrigated in 2009, and ZMK 841,352 in 2010. Though net profit in 2010 is far bigger than that of 2009, this is because the area irrigated per member in 2010 is also bigger than that of 2009. In fact, taking into account lessons from 2009 pilot project implementation, the CEOs have tried not to involve ambitious number of potential beneficiary farmers in 2010.
- 9) Fish pond also generates cash income. According to field interviews, net profit from a typical fish pond, 10m x 15m, can generate about ZMK 850,000 – 1,200,000. Therefore, ZMK 1 million is set as net profit per fish pond. With this unit net profit, the fish ponds constructed under the pilot project altogether have generated ZMK 20 million and ZMK 163 million, totaling ZMK 183 million.

Table 5.1.1 Achievement of Simple Diversion Weir Irrigation Schemes in 2009 and 2010

Particulars	Year 2009	Year 2010	Total	Remarks
Officers Trained under Kick-off Training	35	60	95	
TOT on the Ground	45	88	133	
Officers Trained under TOT	129	180	309	
Under Improvement				
No. of Sites Improved	100	193 (-26)	293 (267)	(-) newly developed in 2009, hence excluded in the total
No. of Members Participated	4,060	3,490 (-644)	7,550 (6,906)	
No. of Irrigators	2,355	2,038	4,393	
Canal Newly Dug, km	27	85	112	

¹ Due to roundup of the numbers after decimal, the sum does not meet the aggregated amount of the two numbers.

Particulars	Year 2009	Year 2010	Total	Remarks
Canal Originally Dug, km	194	258	451	
Canal in Total, km	221	343	563	
Area Newly Irrigated, ha	98	192	290	
Area Originally Irrigated, ha	149	205	354	
Area Irrigated in Total, ha	247	397	644	
Farmers trained on Compost	-	530	530	
No. of Fish Pond Newly Constructed	NA*	36	36	*not confirmed in 2009 PP
Under New Development				
No. of Sites Newly Developed	94	181	275	
No. of Sites started Irrigation	63 (67%)	146 (81%)	209 (76%)	
No. of Members Participated	3,118	3,381	6,499	
No. of Irrigators	1,185	1,296	2,481	
Canal Dug, km	71 (+73.1)	163	234 (307)	(+) dug in 2010
Area Opened, ha	104	262	366	
Area Irrigated, ha	52 (+70)	131	183 (253)	() irrigated as at 2010
Farmers trained on Compost	-	734	734	
No. of Fish Pond Newly Constructed	20	127	147	
Total for both Improvement and New Development				
No. of Sites Undertaken	194	374 (-26)	568 (542)	For both categories
No. of Sites started Irrigation	163 (+25)	339	502 (527)	(+) done in 2010
No. of Members Participated	7,178	6,871 (-644)	14,049 (13,405)	(-) newly dev. in 2009
No. of Irrigators	3,540	3,334	6,874	
Canal Dug, km	98 (+73.1)	248	346 (419)	(+) dug in 2010
Area Irrigated, ha	150 (+70)	323	473 (544)	() irrigated as at 2010 or
Farmers trained on Compost	-	1,264	1,264	898 ha including original
No. of Fish Pond Newly Constructed	20	163	183	354 ha

Source: JICA Study Team based on Pilot Project Implementation of 2009 and 2010

Table 5.1.2 Fiscal Achievement of Simple Diversion Weir Irrigation Schemes in 2009 and 2010

Particulars	Year 2009	Year 2010	Total	Remarks
No. of Sites Undertaken	194	374	568 (542)	For both categories
No. of Sites started Irrigation	163 (+25)	339	502 (527)	(+) done in 2010
No. of Members Participated	7,178	6,871 (-644)	14,049 (13,405)	(-) newly dev. in 2009
No. of Irrigators	3,540	3,334	6,874	
Area Irrigated in the same Year, ha	150.01	323.25	473.258	Only areas newly irrigated
Area Irrigated in the Following Year, ha	-	70.28	70.28	ditto
Total Area Irrigated by Year, ha	150.01	393.528	543.538	ditto
Area Originally Irrigated, ha	148.8	205.4	354.2	Already existed area.
Area Irrigated including Original Area, ha	298.8	598.9	897.7	
Net Income for Newly Irrigated Area, M ZMK	1,069	2,805	3,874	@ZMK 7.128 million/ha
Net Income for Area incl. Originals, M ZMK	2,130	4,269	6,399	ditto
Net Income for Newly Irrigated Area, US\$	222,394	583,417	805,811	1 US\$ = ZMK 4,808 as at
Net Income for Area including Originals, US\$	442,965	887,950	1,330,915	March 2011
Net Income/ Irrigator on New Area, ZMK/HH	302,054	841,352	563,622	
Net Income/ Irrigator on Total Area, ZMK/HH	601,631	1,280,524	930,905	
Fish Pond Constructed, No.	20	163	183	
Net Income from the Fish Pond, ZMK million	20	163	183	ZMK 1 million per pond

Source: Based on Pilot Project Implementation of 2009 and 2010, and harvest survey in 2010 & 2011 by the JICA Team

5.1.2 Output Achievements for Permanent Diversion Schemes

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

However those permanent schemes could irrigate at least the area already put under irrigation in the previous years with a simple diversion structure. This is because all the permanent schemes were designed as upgrading scheme from simple scheme, and they are designed to enlarge the irrigated area

from the following year onwards. Table 5.1.3 summarizes the achievements of the permanent scheme construction including designed irrigated area as well as designed economic profit. From the table:

- 1) Total 23 TSB officers were trained to construct permanent schemes, composed of 18 district TSB officers and 5 provincial TSB officers. They started mobilizing concerned farmers with CEOs in charge of the area, and the construction has been progressed under direct force account. By the end of the dry season 2010, all the 8 permanent sites have been completed.
- 2) All these 8 sites had irrigated some farm lands even during construction since these were all upgraded from simple scheme. The total area irrigated in 2010 arrives at 27.9 ha and this is to be increased to 48.5 ha according to the design within a couple of years. There are 257 members engaged, 137 male members and 120 female members. Given these memberships, a typical member irrigates 0.109 ha and it is to increase up to 0.189 ha by design.
- 3) By applying a net profit of ZMK 7.128 million per hectare, total 27.9 ha of irrigated area generated a net income of ZMK 199 million (US\$ 41,363), and this is to increase to ZMK 346 million (US\$ 71,903) in a couple of years referring to the design. Likewise, the net average profit per irrigator arrived at ZMK 773,818 (US\$ 161) in 2010 and this is to be ZMK 1.345 million (US\$ 280) in years.

Table 5.1.3 Achievement of Permanent Diversion Weir Irrigation Schemes in 2010

Particulars	Year 2010	Design	Remarks
No. of Trained TSB officers	23		18 district officers and 5 provincial officers
No. of Sites Undertaken	8	-	Permanent scheme in 6 districts
No. of Sites started Irrigation	8	-	Upgraded from simple scheme
No. of Members Participated	257 (137M, 120F)	-	same as the potential irrigators
Total Construction Cost, ZMK	326,926,000	-	Direct construction cost only
Area Irrigated, ha	27.9	48.5	Potential 63.5 ha
Area Irrigated per Member, ha	0.109	0.189	
Net Income for Irrigated Area, M ZMK	199	346	@ZMK 7.128 million/ha
Net Income for Irrigated Area, US\$	41,363	71,903	1 US\$ = ZMK 4,808 as at March 2011
Net Income/ Irrigator, ZMK/HH	773,818	1,345,167	
Net Income/ Irrigator, US\$/HH	161	280	

Source: JICA Study Team based on Pilot Project Implementation of 2010, and harvest survey in 2010 by the Team

5.2 Economic Impact on Cash Income

To prospect the economic impact of smallholder irrigation schemes, profitability of irrigated agriculture was estimated. First, harvest survey has been carried out in a total of 27 irrigation schemes in seven districts. The detail profile of each site is shown in Table 5.2.1, of which 25 schemes had been implemented under the pilot project of the Study in a form of either improvement of existing scheme or new development. Through the survey, a total of 478 farmers had been interviewed², averaging 18 farmers per site. In the interview, cost and benefit of 19 kinds of crops were surveyed in a total of 855 plots. Those districts and irrigation schemes were selected taking the geographical diversity into consideration.

Table 5.2.1 Profile of Harvest Survey Sites

No.	Name of the Scheme	District	Year of Establishment	No. of Members	Irrigated Area (ha)	No. of Farmers Interviewed	No. of plot addressed	Scheme
1	Nseluka	Mungwi	2009	32	10	13	25	New
2	Kalupa	Mungwi	1948	30	4	13	23	Improve
3	Mpangankulu	Mbala	2009	30	3	21	41	New
4	Chibalashi	Mansa	1999	25	2	10	18	Improve

² Number of samples required for a statistical survey depends on the deviation of the parent population and its representativeness of the samples. However, if the parent population shows normal distribution, statistically significance number of samples is given by; number of samples = (level of significance \times P)/(1-P)/designed error where P is given 0.5. Given 5% of level of significance, required sample number is calculated at 384. Therefore, the number of the samples in this harvest survey is assumed to be enough to provide statically significant meaning.

No.	Name of the Scheme	District	Year of Establishment	No. of Members	Irrigated Area (ha)	No. of Farmers Interviewed	No. of plot addressed	Scheme
5	Mwililwa Upper	Mansa	1998	25	4	11	18	Improve
6	Mwililwa Lower	Mansa	2009	25	1.5	11	21	Improve
7	Chisheta	Kawambwa	2000	36	3	21	36	Improve
8	Malashi	Mpika	2002	53	7	25	61	Improve
9	Malisawa B	Mpika	2009	25	0.75	18	21	New
10	Lunda	Kasama	1968	5	1	13	19	Improve
11	Ngulula	Mungwi	1950	80	10	20	33	GRZ
12	Mwembezi	Mbala	1972	65	33	14	24	Improve
13	Chinenke	Mbala	1972	350	175	27	64	GRZ
14	Chipompo	Kasama	2009	60	4	23	35	New
15	Chabukila	Mungwi	2009	100	20	32	41	New
16	Itongo	Mpika	2009	54	10	29	53	New
	Mihamba	Mpika	2009		2			Improve
17	Kambafwile	Mbala	2009	28	3	29	61	Improve
18	Mpangankulu	Mbala	2009	48	13	20	39	New
19	Nseluka	Mungwi	2009	35	10	29	59	New
20	Chabukila	Mungwi	2009	75	5	28	50	New
21	Mayanga	Mbala	2009	30	2	4	8	New
22	Chilala	Mporokoso	1965	35	4	13	22	Improve
23	Sokoni	Mporokoso	2009	25	3	7	23	New
24	Kabale	Mpika	2009	40	3.5	5	9	New
25	Chikwanda	Mpika	1965	35	5	12	19	Improve
26	Chipamano	Mungwi	2009	27	11	10	20	New
27	Kalupa	Mungwi	1948	30	4	20	12	Improve
Total				1,403	N/A	478	855	
Average				52	12.6	18	32	

Source: Harvest Survey by the Study Team 2010-2011

Note: Irrigated area indicates the total area under irrigation in the whole scheme, which was indicated by the group leader.

The sites indicated by "GRZ" is not the site developed through the COBSI Study but originated by GRZ.

The total irrigated area is not calculated because some sites were surveyed twice in different years.

In the number 16, interview was made to the farmers from the two sites altogether.

Survey was carried out in 2010 for the site No.1-15, while it was done in 2011 for the site No.16-27.

The harvest survey was carried out with a manner of questionnaire survey, covering: 1) size of cultivated area (estimation and actual measurement), 2) cost of inputs, 3) portion of harvest sold, 4) portion of harvest consumed, 5) items for which income was spent, 6) change in the use of chemical fertilizer before and after starting irrigated agriculture, 7) change in the area of *Chitemene* shifting cultivation before and after starting irrigation, and 8) change in the rain-fed maize production before and after starting the irrigation.

5.2.1 Cost and Benefit of Major Crops under Irrigation

Table 5.2.2 shows the cost and benefit of major crops in ZMK per lima under irrigation drawn from the harvest survey for a total of 806 samples³. Benefit here is estimated from the total production of the crops inclusive of those which are actually sold and those consumed in the household. Note that the selling price is based on each farm household interviewed at the prevalent farm gate price in those areas.

Table 5.2.2 Cost and Benefit of Major Crops under Irrigation, ZMK per lima

No.	Crop	No. of Samples	Cost	Gross Income	Net Income	Cost/Income
1	Onion	90	1,177,000	4,821,000	3,644,000	24%
2	Cabbage	76	1,897,000	4,561,000	2,664,000	42%
3	Irish Potato	27	654,000	2,749,000	2,095,000	24%
4	Chinese Cabbage	29	861,000	2,662,000	1,801,000	32%
5	Tomato	156	1,090,000	2,854,000	1,764,000	38%
6	Beans	20	201,000	1,800,000	1,599,000	11%
7	Rape	106	785,000	2,343,000	1,558,000	34%
8	Groundnuts	89	150,000	1,616,000	1,466,000	9%

³ Although a total number of sample plots was 855, only 806 samples were used as some crops were omitted from the list due to the limited number of samples per crop.

No.	Crop	No. of Samples	Cost	Gross Income	Net Income	Cost/ Income
9	Green maize	194	464,000	1,637,000	1,173,000	28%
10	Okra	19	598,000	1,568,000	970,000	38%
	(Total)/ Average	(806)	738,000	2,520,000	1,782,000	29%

Source: Harvest Survey by the Study Team (2010 & 2011)

Area is based on the amended data which was derived from the actual measurement at the fields.

Cost does not include any family labor.

Income is inclusive of the value of produce which have been consumed by the producers.

The results are based on the cultivated areas which are either actually measured or amended. In fact, it was revealed that the actual cultivated areas were in many cases smaller than what were claimed by farmers based on their perception (for more details, refer to chapter 6.5.6 of the Main Report). It implies that the farmers own perception entails a risk of underestimation of crop production per a unit of land. Therefore, for the plot actually measured, actual size of cultivated area was applied and, for those not measured, the average ratio, 92.6%, was applied to what the farmers claimed.

As shown in the table, average cost and income per lima (1/4 ha) were ZMK 738,000 and ZMK 2,520,000 respectively and thus net income resulted in ZMK 1,782,000 per a lima of plot as an average of 10 types of crops which have more than 15 samples. Comparing to theoretical profitability estimated by the TSB officers in several districts (approximately ZMK 5 million per lima), this practical profit was found quite limited. In fact, there were some cases that the cost surpassed gross income, resulting in net loss, for example, in case of pest and disease prevalent.

Note that estimated net income has a wide range among the samples, ranging from minus ZMK 6,178,300 (a particular case of tomato plot in Mbala district) to ZMK 17,081,200 (another specific sample of tomato in Kasama district). Needless to say, market oriented agriculture is always associated with risks and lucks. Fertility of the soil, availability of funding, level of on-farm management, and access to the market—all those factors influence the results of the profitability. The averaged profit in the table, however, comprehends those successes and failures of each case on the ground and therefore it should be more reliable and realistic to measuring the economic impact of irrigated agriculture than the theoretical estimation.

5.2.2 Profitability per Household and Comparison to Original Income

Now that roughly ZMK 1.782 million can be expected from one lima of irrigated area, it is questioned how much of Kwacha can be expected per one farmer household. The result of harvest survey also provides practical size of cultivated area per household under irrigation. As shown in Table 5.2.3, it was found that interviewed farmers cultivate an average of 0.873 lima (equivalent to 47m x 47m) per household. Based on this result, an average profit per household can be estimated at ZMK 1,554,994 (US\$ 323) per household. Table 5.2.3 also provides an example of the most profitable crop, onion, and least profitable crop, okra.

Table 5.2.3 Average Profit of Irrigated Agriculture Per Household

Item	Area Irrigated lima	Cost ZMK per HH	Gross Income ZMK per HH	Net Income ZMK per HH
Average	0.873 (47m x 47m)	643,987 (US\$ 134)	2,198,981 (US\$ 457)	1,554,994 (US\$ 323)
Onion (most profitable)	0.873	1,027,521	4,208,733	3,181,212 (US\$ 662)
Okra (least profitable)	0.873	522,054	1,368,864	846,810 (US\$ 176)
Max Area	8.33	18,205,000	27,900,000	21,750,000
Min Area	0.02	0	12,500	-2,480,000

Source: Harvest Survey by JICA Study Team 2010 & 2011

One may claim how significant this additional income is for a smallholder household. However, this

additional income may not be brought to all the smallholder farmers from the 1st year since most of the farmers start with minimal areas and then increase the irrigated land over years. According to the result of the pilot project implementation, in fact, total area irrigated was 572 ha composed of 544 ha by simple schemes and another 28 ha by permanent schemes, excluding the irrigated areas that had existed even before the intervention by the pilot project. On the other hand these irrigated areas have benefited a total number of 7,131 farmer household composed of 6,874 farmer households by simple schemes and 257 farmer households by permanent schemes.

This means that overall average area benefited by a typical farmer household arrives at 0.0802 (572/7,131) ha (equivalent to 0.321 lima)⁴. While, the average area which came from the harvest survey was 0.873 lima, 2.72 times bigger than what was estimated based on the overall irrigated area vs. overall benefited farmer households throughout the pilot project. This difference may have come from the facts that; 1) the harvest survey results included the irrigation benefit which had accrued from the originally existed irrigation area in case of Improved Site, and 2) sites selected for the harvest survey may have represented rather better ones, as recommended by CEOs in charge.

With reference to the above findings, there is a gap between the results of the harvest survey and what was established based on the achievements from the pilot project implementation. This difference can be construed as such that the result from the harvest survey can be a very probable impact that the farmers can achieve in years, e.g. 2-5 years, after they have started the irrigated agriculture. This is because farmers in most cases cannot attain the maximum irrigated area in the first year, or rather they increase the irrigated area year by year as aforementioned. Thus, the irrigated area of 0.873 lima per farmer whereby net income of ZMK 1.55 million per farmer are taken as the expected impact from the irrigated agriculture in the following discussions.

Given the net income from irrigated agriculture, ZMK 1.55 million per household, the impact is examined in comparison with the original household income. Baseline survey carried out in 2009 and 2010 identified villagers' income level. For 12 villages, it ranges from ZMK 2.9 million to as much as ZMK 16.3 million, with an average of ZMK 5.8 million with the highest income of Nchelenge and ZMK 4.7 million⁵ without it. Table 5.2.4 compares the impact of ZMK 1.55 million out of irrigated agriculture per household with the original annual income by village; from which:

- 1) The additional income of ZMK 1.55 million per household can raise the original income by 9.5% (Mulonda) to as much as 53.3% (Mumba) depending on the village.
- 2) In comparison to the average, the additional income from irrigated agriculture is commensurate to a top of 26.7% including Mulonda and 33.3% excluding Mulonda. When comparing to the median, it is now

Table 5.2.4 Impact of Irrigated Agriculture

Village	Original Income (Z million)	Profit/HH (Z million)	Increment (%)
Lunda	4.47	1.55	34.8
Molwani	5.33	1.55	29.2
Kalamba Chiti	4.06	1.55	38.3
Chipapa	5.85	1.55	26.6
Saise	3.43	1.55	45.3
Mayanga	6.82	1.55	22.8
Mumba	2.92	1.55	53.3
Makashi	4.27	1.55	36.4
Kawikisha	4.30	1.55	36.2
Chisheta	5.80	1.55	26.8
Mutiti	4.56	1.55	34.1
Mulonda	16.32	1.55	9.5
Total w/ Mulonda	5.82	1.55	26.7
Median	3.98	1.55	39.1
1st quartile	2.44	1.55	63.7
Total w/o Mulonda	4.67	1.55	33.3
Median	3.69	1.55	42.1
1st quartile	2.27	1.55	68.5

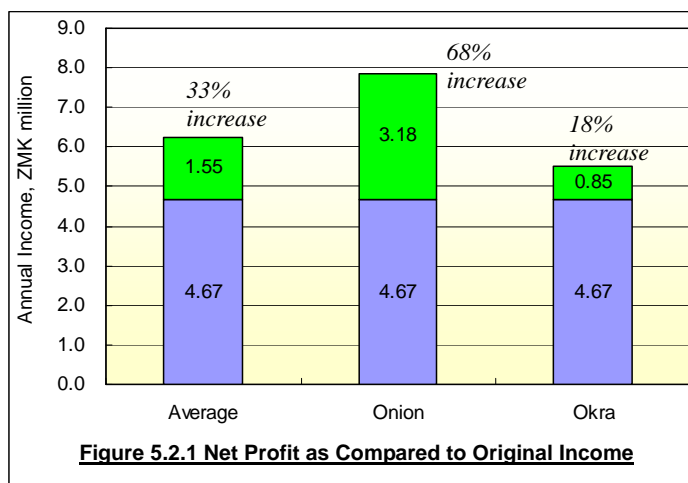
Source: JICA Study Team

⁴ With this overall average of irrigated farmland, 0.321 lima, the net income per farmer household arrives at ZMK 0.572 million (0.321 x 1.782), equivalent to US\$ 119 with an exchange rate of 4,808.

⁵ Since the annual income of Mulonda village was by far bigger than the other villages, e.g. ZMK 16.32 million while the 2nd one was ZMK 6.82 million, the average was calculated at 2 cases: one for the average for all the villages and the other for those villages excluding the Mulonda.

39.1% including Mulonda and 42.1% excluding Mulonda. This can be concluded as is very noticeable impact.

- 3) When comparing to the original income of those people ranked at 1 quartile, it can be as much as 63.7% increment including Mulonda and 68.5% excluding Mulonda. It means for those people who are ranked at lower 25th order among every 100 people, the profit from irrigated agriculture has a potential to raise their income by more than half of the original one.
- 4) Further, a comparison is made by not only the average net profit of ZMK 1.55 million but also by the most profitable crop and the least profitable crop as shown in Figure 5.2.1. From the figure, it can be said if a typical farmer cultivate onion only in the averaged farmland area, she/he can fetch ZMK 3.18 million corresponding to as high as 68% increase and if the farmer cultivate okra only, she/he can still fetch ZMK 0.85 million equivalent to 18% top-up.



5.2.3 Disposable Benefit of Major Crops

The harvest survey also addressed how much of the harvest the interviewees have actually sold. Table 5.2.5 summarizes the results, showing that as much as 88% of the harvest has been sold as an overall average. By crop, 95 % of produce was sold in case of okra which was the maximum case, followed by cabbage (94%) while 72% was sold for the minimum case that was for beans. It means dry season irrigated agriculture is practiced primarily for the purpose of cash income.

In addition, disposal cash income per household also became available from the harvest survey. As aforementioned and also shown in Table 5.2.6, farmers spent ZMK 643,987 per household (US\$ 134) for crop production while the gross cash income with the prevalent farm gate price arrived at ZMK 2,198,981 (US\$ 457) per household in the average size of 0.873 lima. Then, what was actually sold accounted at 88% of what were produced, resulting in a disposal cash income of ZMK 1,291,465 (US\$ 269) per household.

Table 5.2.5 Disposable Cash Income, ZMK per lima

No.	Crop	Cost	Gross Income	Net Income	Ratio Sold	Disposal Benefit
1	Onion	1,177,000	4,821,000	3,644,000	90%	3,162,000
2	Cabbage	1,897,000	4,561,000	2,664,000	94%	2,390,000
3	Irish Potato	654,000	2,749,000	2,095,000	84%	1,655,000
4	Chinese Cabbage	861,000	2,662,000	1,801,000	91%	1,561,000
5	Tomato	1,090,000	2,854,000	1,764,000	92%	1,536,000
6	Beans	201,000	1,800,000	1,599,000	72%	1,095,000
7	Rape	785,000	2,343,000	1,558,000	90%	1,324,000
8	Groundnuts	150,000	1,616,000	1,466,000	80%	1,143,000
9	Green maize	464,000	1,637,000	1,173,000	84%	911,000
10	Okra	598,000	1,568,000	970,000	95%	892,000
	Average	738,000	2,520,000	1,782,000	88%	1,480,000

Source: Harvest Survey by the Study Team (2010&2011)

Area is based on the amended data which is derived from the actual measurement at the fields.
Income is inclusive of the value of produce which have been consumed by the producers.

Table 5.2.6 Disposable Cash Income per Household, ZMK per 0.873 lima

Area Irrigated (lima)	Cost ZMK per HH	Gross Income ZMK per HH	Net Income ZMK per HH	Ratio of Selling	Disposal Cash Income ZMK per HH
0.873 (47mx47m)	643,987 (US\$ 134)	2,198,981 (US\$ 457)	1,554,994 (US\$ 323)	88%	1,291,465 (US\$ 269)

Source: Harvest Survey by JICA Study Team 2010 & 2011.

Note: Exchange rate is set at ZMK 4,808 per US\$ 1 as at March 2011

5.2.4 Composition of Input Cost

As Table 5.2.7 shows, it was confirmed that the production cost, excluding family labors, shares on average 29% of the gross income, ranging from 9% for groundnut to 42% for tomato and cabbage. The table also shows the composition of input costs. In the harvest survey, six items have been designated as major inputs and then it was asked how much Zambian Kwacha was spent by each item. As shown in the table, the input that shares the most was D-compound fertilizer (29%) and the second was Urea (20%); those two kinds of chemical fertilizer shares 49% of all the input cost. Transportation, pesticide and labor follow them: 16%, 12% and 12% respectively.

This share differs depending on the types of crops. For instance, nothing is spent for chemical fertilizers and pesticide for groundnuts as it can grow in less fertile soil. As a result, shares in the costs of seeds and labor became high in this crop. For another instance, D-compound (43%) and Urea (22%)

shares 65% of the total input cost of rape. This case implies that chemical fertilizer may be a decisive factor to the rape production. The bottom line in this section is that farmers who practice irrigated agriculture in the area are spending mostly for chemical fertilizer if at all.

5.3 Economic Impact to Poverty Line

The baseline survey has established poverty line based on Cost of Basic Needs Method. In fact, the poverty line refers to the consumption/expenditure level of the people surveyed, which means the poverty line does not directly relate to the level of people's income. However, there is a general tendency that the less money people earn the less expenditure the people spend, whereby high poverty ratio can show up amongst the people who earn less amount of money. This situation can be observed very often among the people what they earn can narrowly meet what they have to spend. With this assumption, examined here is the magnitude to what extent the additional income from the irrigated agriculture can mitigate poverty in relation to the poverty line established.

Poverty Line established under this Study is ZMK 8,191,150 per typical household. The share of the poor people who cannot spend on the expenditure of ZMK 8,191,150 is defined as poverty ratio, ranging from 29.4% in Mulonda village in Nchelenge district and as high as 76.3% in Mumba village in Mungwi district with the overall poverty ratio of 56.2% as shown in the Table 5.3.1. Poverty gap ratio is correspondent to the distance in percentage between the poverty line (ZMK 8,191,150) and the average expenditure level of those people who are below the poverty line. It means multiplying the poverty gap ratio into the poverty line gives us how much in monetary value we need to raise the average poor people up to the poverty line, namely, the distance to the poverty line in monetary value.

Table 5.2.7 Composition of Input Cost, ZMK per lima

No.	Crop	Cost/Income	Composition of the Cost						Fertilizer (kg/lima)	
			Seed	D compound	Urea	Pesticide	Labor	Transport	D	U
1	Onion	24%	18%	27%	16%	6%	9%	24%	80.4	57.6
2	Cabbage	42%	11%	31%	20%	9%	7%	21%	137.1	95.3
3	Irish Potato	24%	23%	32%	18%	6%	9%	12%	60.3	28.6
4	Chinese Cabbage	32%	7%	42%	27%	11%	8%	4%	80.0	59.4
5	Tomato	38%	6%	22%	16%	27%	17%	12%	58.7	50.1
6	Beans	11%	40%	21%	10%	2%	24%	4%	8.3	5.9
7	Rape	34%	8%	43%	22%	15%	6%	4%	71.4	43.0
8	Groundnuts	9%	28%	0%	0%	0%	24%	47%	0.4	0.4
9	Green maize	28%	10%	38%	31%	1%	12%	9%	44.5	42.3
10	Okra	38%	13%	30%	26%	18%	6%	7%	37.5	46.5
	Average	29%	11%	29%	20%	12%	12%	16%	51.9	41.3

Source: Harvest Survey by the Study Team (2010&2011)

Area is based on the amended data which is derived from the actual measurement at the fields.
Income is inclusive of the value of produce which have been consumed by the producers.

Table 5.3.1 Poverty Indicators per Household and Impact from Irrigated Agriculture

Particular	Valid Sample No.	Poverty Ratio, %	Poverty Gap Ratio, %	Distance to the P.L., ZMK	Income fr. Irrigation, ZMK	Remaining Distance, ZMK	Improved Ratio, %
Whole 12 Villages	370	56.2	18.4	1,507,172	1,554,994	-47,822	103
Lunda	30	72.3	22.8	1,867,582	1,554,994	312,589	83
Molwani	31	59.9	16.5	1,351,540	1,554,994	-203,454	115
Kalembe Chiti	30	58.4	23.6	1,933,111	1,554,994	378,118	80
Chipapa	30	72.6	19.5	1,597,274	1,554,994	42,281	97
Saise	31	50.2	17.3	1,417,069	1,554,994	-137,925	110
Mayanga	30	48.7	14.9	1,220,481	1,554,994	-334,512	127
Mumba	31	76.3	28.1	2,301,713	1,554,994	746,720	68
Makashi	30	52.0	16.6	1,359,731	1,554,994	-195,263	114
Kawikisha	30	48.8	16.2	1,326,966	1,554,994	-228,027	117
Chisheta	30	55.2	18.2	1,490,789	1,554,994	-64,204	104
Mutiti	31	59.9	20.9	1,711,950	1,554,994	156,957	91
Mulonda	36	29.4	7.2	589,763	1,554,994	-965,231	264

Source: JICA Study Team based on Baseline Survey and Harvest Survey

The distance in monetary value we need to raise the typical poor family ranges from as much as ZMK 2.30 million to about ZMK 590,000 with the overall average of ZMK 1.507 million. On the other hand, the expected additional income out of irrigated agriculture per household can count at about ZMK 1.55 million as aforementioned. With this additional income out of irrigated agriculture, a typical poor family of all the sampled households can now get out of the poverty, reaching to a level of ZMK 47,822 over the poverty line. In fact, of the 12 villages surveyed, those who are under the poverty line in 7 villages can reach over the poverty line (see the minus distance on the remaining distance in the table above).

There are nevertheless 5 villages wherein those who are originally below the poverty line can still not reach the line even after having the ZMK 1.55 million, the average net profit per household out of the irrigated agriculture. However, it is revealed that they are reaching up to the poverty line to a greater extent. For example, the distance to the poverty line was ZMK 2,301,713 in case of the poorest village of Mumba and this is now ZMK 746,720, improved by 68%. One can see how much the smallholder irrigation can contribute to raising the people's income and thereby reducing the poverty prevalent in rural areas.

5.4 Re-investing in Year-round Agriculture

Impact of introducing irrigated agriculture is not just an increase in the dry season's production and thus income. There are many different phases of positive, and possibly negative, impacts brought by the smallholder irrigation schemes. One of those spillover effects is a re-investment in year round agriculture. Through a series of interviews, it have been outlined that farmers are actually using their income gain as a source of next farming; they are not just consuming within the season whatever they gained from the irrigated agriculture. Following are some examinations whereby they have reinvested in the following years' agriculture.

5.4.1 Investing in Rain-fed Maize Production Based on Harvest Survey

Quantitative data from the harvest survey also supports this phenomenon. As shown in Table 5.4.1, production of rain-fed maize has increased since farmers started irrigated agriculture. Of an average of 373 farmers, their production has increased from 18 bags (50kg/bag) per household to 31 bags per household—74% of increase. In fact, 333 farmers out of 373 farmers answered that they experienced an increase in rain-fed maize production. Although the irrigated agriculture may not necessarily explain this increase, output from the irrigated agriculture could have brought about the positive impact to the rain-fed agriculture.

Table 5.4.1 Change in Rain-fed Maize Production After Starting Irrigated Agriculture

Item	Before	After	Increase	(%)	No. of Samples
Average, bags	18 (900 kg)	32 (1,600 kg)	14 (700 kg)	72%	373
Increased, bags	13	25	12	92%	333
Decreased, bags	32	19	-13	-40%	35
No Change, bags	29	29	0	0%	5

Source: Harvest Survey by the Study Team (2010) Unit: (Bags (50kg)/household)

Increased production of rain-fed maize production may be explained by several factors including increase in the use of chemical fertilizer, expansion of cultivated area and hiring more farmer labors. The harvest survey also revealed the change in the use of chemical fertilizer since starting irrigated agriculture. As shown in Table 5.4.2, 300 households out of 327 households increased the use of chemical fertilizer in rain-fed maize production after they have started irrigation. On average of all the farmers who increased or decreased, farmers increased from 76 kg/household to 176 kg/household; 100 kg/ household was newly added since having started irrigated agriculture (132% of increase).

Table 5.4.2 Change in Fertilizer Use After Starting Irrigated Agriculture

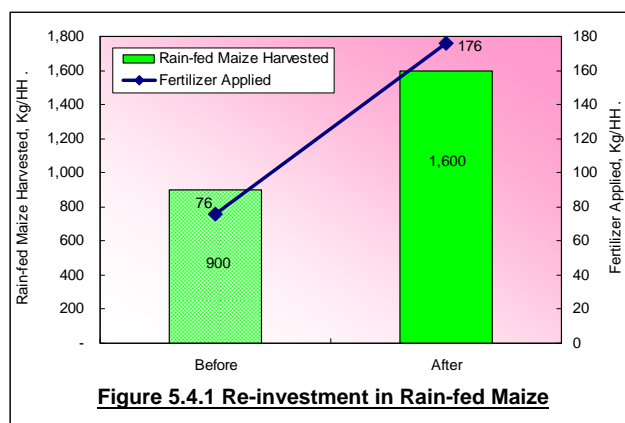
Item	Before	After	Increase	(%)	No. of Samples
Average, kg/HH	76	176	100	(132%)	327
Increased, kg/HH	49	124	75	(153%)	300
Decreased, kg/HH	71	35	-36	(-51%)	19
No Change, kg/HH	251	251	0	(0%)	8

Source: Harvest Survey by the Study Team (2010-2011) Unit: (kg/household)

It is noted that the change in the use of chemical fertilizers may be caused not only as an impact of irrigated agriculture per se but also by other factors including the government's intervention of FISP. However, at least it can be said that for this increase of chemical fertilizer, the income from the irrigated agriculture must have contributed to some extent. Figure 5.4.1 shows the comparison of 'before' and 'after' in terms of maize harvest in kg and the fertilizer application.

On the other hand, among all the responded farmers, 19 farmers reduced the use of chemical fertilizer and 8 farmers did not change at all. To be sure, the original amounts of fertilizer for those categories who reduced or did not change were comparatively higher than that of those farmers who increased: 71kg and 251kg/household respectively as compared to 49 kg/household who increased.

It was not probably really necessary for those farmers to increase because they originally apply enough, or sometimes more than enough, amount of fertilizer. In addition, there were several cases reported that some farmers reduced the use of chemical fertilizer in the rainy season because they kept those subsidized fertilizers to the dry season irrigated agriculture.

**Figure 5.4.1 Re-investment in Rain-fed Maize**

5.4.2 Change in Income-Expenditure identified from In-depth Interview

The Team conducted first series of field interviews from late October to mid November 2010 to collect information on change in income-expenditure. Some representative examples are elaborated below:

1) A Farmer who started with Groundnuts

First case is a farmer who is widowed and regarded as vulnerable in the village. Since her family could not afford fertilizer for maize and vegetables, they started to cultivate groundnuts which require almost

nil fertilizer. As many farmers face the problem of lack of capital for fertilizer, whereby some farmers even have to give up growing rain-fed maize as mentioned earlier, starting with groundnuts may be the best clue to start off for those who face the problem of the acquisition of fertilizer.

She is an irrigation club member of Chabukila, Mungwi district. She practices farming with support from 4 children after her husband passed away. Her family started furrow irrigation by planting groundnuts in a plot of 22m x 30m and pumpkin leaves along the edge of the groundnuts in 2009 season. They could not afford fertilizer for vegetable cultivation, thus she started with groundnuts.

Figure 5.4.2 shows the income before-after the irrigation. With regard to before-irrigation, her family used to fetch cash income from sweet potato in April under rain-fed agriculture, and irrigated pumpkin leaves in October which used to grow by bucket irrigation. In addition, she used to make broom and sell them (ZMK 20,000 in total). With the irrigation, she could get as much as ZMK 270,000 from groundnuts in January 2011. The income last year was only ZMK 144,000, meaning the year's harvest was almost doubled. In addition to the groundnuts, her family also fetched ZMK 15,000 from pumpkin leaves and another ZMK 6,000 from Okra which was newly started in 2010. As for the rain-fed crops, they earned ZMK 32,000 from sweet potato in May 2010.

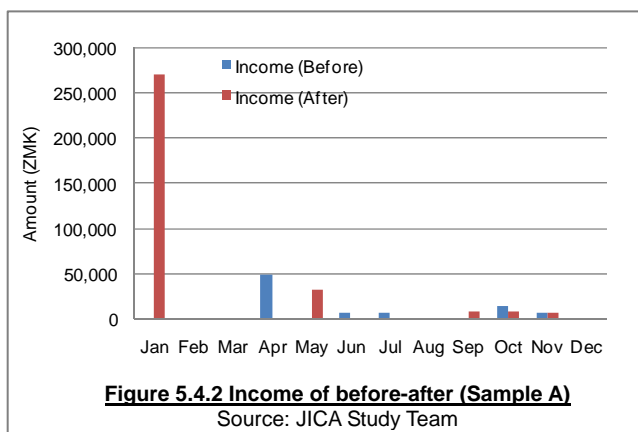
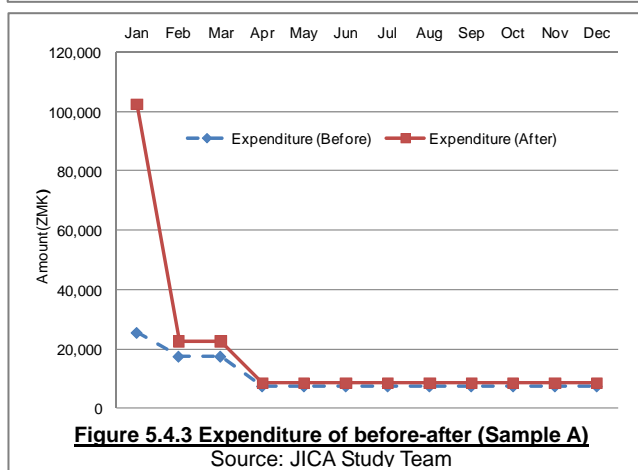


Figure 5.4.3 shows her family's expenditure trend of the year for the before and after the irrigation. She could afford new shoes for her school going children for the first time in these years. This dream came true with the profit from the irrigated agriculture. They were very happy and said "I could not wait for morning. I want to show these new shoes to my friends!" Furthermore, she bought reed mat for sleeping and 4 "nice" plates in January after having got income from the groundnuts in addition to the regular expenses such as food, domestic. She even came up with an idea of re-selling cassava chips this year. She bought 6 gallons of cassava with the income from groundnuts. These new trials came true with the irrigation.



2) A Farmer who started with Groundnuts, then moved to Vegetables and Green Maize

Next case is a farmer who started irrigation by growing groundnuts for the first time and then extended the field and started growing tomato and green maize by investing the profit from the groundnuts. An irrigation club member of Chabukila, Mungwi district who is also widowed shared with the Team that her family started to grow groundnuts though they wanted to grow tomato. Since they could not afford the fertilizer in the first year, she had no way but to start with groundnuts.

Her family used to face hunger throughout the year. She could not send her children to school, and she could not buy clothing for their children either before starting the irrigation. Her family used to have only one time *Nshima* almost throughout the year and used to have cassava leaves as a main relish. This was the life before she started irrigation under the pilot project.

With the irrigation, her family extended the field from 20m x 20m to 40m x 40m and they started to grow tomato and green maize in 2010. Figure 5.4.4 shows the income of her family before-after the irrigation. She used to go and work at others' fields in April, June, August and December and this is her family's all income before the irrigation. In fact, she even could not grow any rain-fed crops due to such reasons as no capital to buy fertilizer, not enough labor for land preparation, etc.

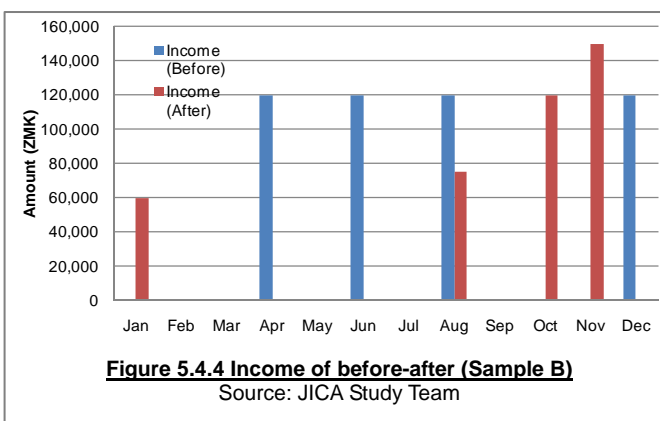
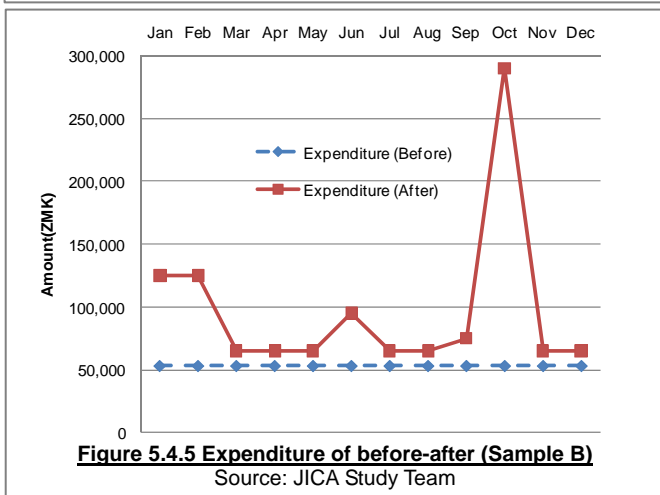


Figure 5.4.5 shows the expenditure of her family before-after the irrigation. She used to spend about ZMK 53,000 per month and about half of that was spent for maize mealie meal before the irrigation. Her family's basic expense such as food and domestic has increased than before, and the contents have been changed because her family does not have to buy maize mealie meal and even relish such as beans and vegetables after having started irrigation. The amount for soap, salt, cooking oil, lotion and Vaseline has become almost double instead. In addition, she could manage to buy what she could not buy before the irrigation such as clothing, blanket for children and Chitenge (traditional cloth) for herself.



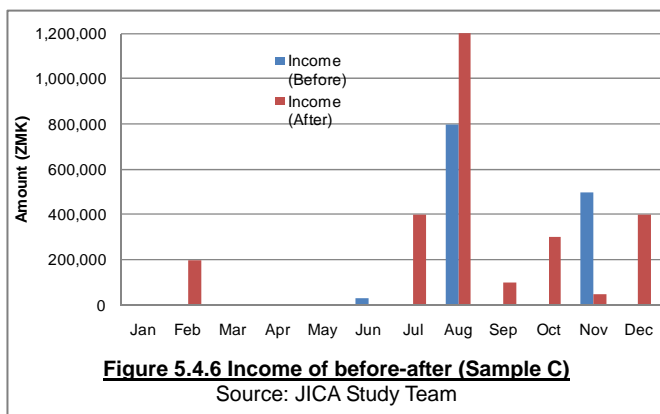
In addition, she could manage to buy what she could not buy before the irrigation such as clothing, blanket for children and Chitenge (traditional cloth) for herself.

She said, "Total disposable cash income appeared to be lower than that of before, but still I am very proud of myself because I am now independent. I used to feel like I was a slave when I was working for others. But now, we have reliable income sources and we are also planning to increase area by reinvesting the profit from irrigation. I even have a dream of getting bicycle and iron sheet now"

3) A Farmer who used to get income from non-agriculture activity

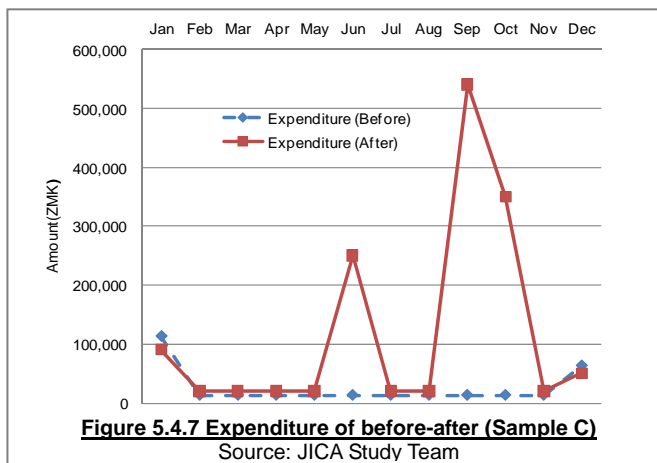
There is a farmer who used to grow rain-fed maize and sell them even before starting irrigation. He used to practice irrigation by bucket and earned only about ZMK 30,000 from tomato. As for the rain-fed crops, he used to have rain-fed maize income of ZMK 800,000. In addition, he used to get income from bricklaying about ZMK 500,000. However, he has 11 family members including himself and it was still difficult for him to maintain this large family especially in January and February. He and his family members used to go for piece works together about 4 times a month and they were given 50kg bag of cassava.

With the irrigation, his earning totaled about ZMK 1.2 million from tomato sold in February and September, onion sold in July, cabbage sold in October and green maize



sold in December as shown in Figure 5.4.6. His family does not have to go for piece work anymore because they can have 2 times *Nshima* now by selling vegetables and crops in the garden whenever they needed money. He has even stopped to work as a brick layer because he feels that he can get much money from irrigation. He said, “I purchased a plot in Nseluka last year (in June 2010), so I will work as a brick layer on my own home not for others this year”.

Figure 5.4.7 shows his family’s expenditure pattern of before-after the irrigation. His family used to afford only ZMK 50,000 for fertilizer (in December) before he had started irrigation, but now his family could afford as much as ZMK 480,000 in 2010 for further expansion of the field of maize and vegetables. Surprisingly, the level of expenditure for clothing and food (relish) has become 3 times more than that of the “before”. As for clothing, he could not afford all family members at once but after he started irrigation he could buy clothing for all of them in October 2010.

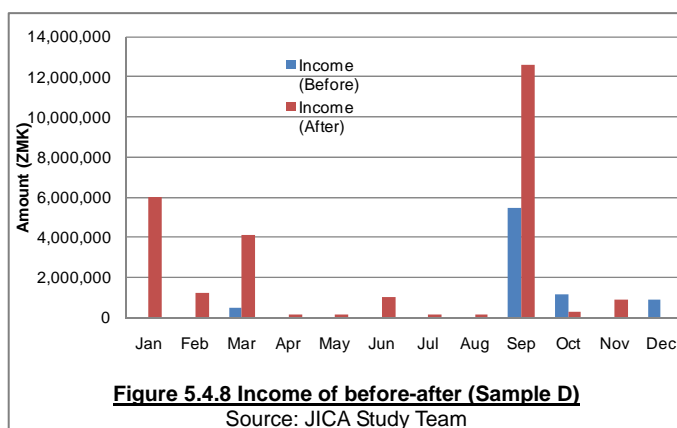


4) A Big Success Farmer

Last case is an advanced type of farmer who used to have more than ZMK 8 million from agriculture (about ZMK 4.9 million from bucket irrigation and remaining from rain-fed income) even before he started furrow irrigation under the pilot project. This case study can give us the clear image of what will happen if the profit from the garden was fully re-invested in the rainfed crops, especially for maize. Chairperson of Mpangankulu irrigation club in Mbala district started furrow irrigation in October 2009 and earned from the irrigated fields about ZMK 10 million from tomato (in January), onion and green maize (February) in 2010.

Before starting furrow irrigation, he used to practice bucket irrigation and earned about ZMK 4.9 million, and also earned ZMK 3.2 million (about 3 million was from maize) from rain-fed crops. Even though the amount of his total cash income seems large they used to get those incomes in only 4 months and they did not get any income in other months.

In 2010, he expanded the field of green maize (earned ZMK 5 million already and expects additional ZMK 2 million in April 2010), and added cabbage in 2011. He also earned from rain-fed crops a total of ZMK 14 million (about ZMK 13 million was from maize) and also earned ZMK 500,000 from chicken sales. He could get cash income almost every month except for December in 2010 as shown in Figure 5.4.8.



Rain-fed maize area was also expanded from 1 ha to 3 ha after getting profit from irrigated crops. The amount of fertilizer and seed spent for maize was ZMK 4 million (in October) and the amount spent for labor was ZMK 1 million in October to January, which are more than 10 times and 5 times of those of “before” respectively. On top of this, he built a new house with iron sheets, and bought TV, speakers, adapter, battery, inverter, DVD etc. in October 2010 after he had a big harvest from the rain-fed maize. Of course, the big harvest of rain-fed

maize was realized by investing the profit from the irrigated agriculture.

5.5 Investing in Area under Rain-fed Maize Production

There is no quantitative evidence that explains the increase in cultivated area under rain-fed maize production. Here introduced are some qualitative examples derived from a series of in-depth interview to the farmers on the ground. Among 14 farmers interviewed who are not necessary under the pilot project of this Study, all the farmers were using the outcome of irrigated agriculture for the next season's cultivation. Some buy fertilizer or other agricultural inputs for rain-fed maize production and others hire more number of labors. As a result, they all have expanded their cultivated area gradually and continuously.

For example, Mr. Henry of Chiseta village, Kawambwa district increased the cultivated area during the rainy season from 1.75 lima to 7.5 lima in 13 years since he started irrigation. He claimed that this 4.3 times of expansion of cultivated area was only available with the continued benefit from irrigated agriculture in dry season.

It was not a special case only for him. As shown in Table 5.5.1. An average cultivated area in rain-fed area has increased from 2.92 lima to 6.58 lima in 10.58 years: 3.67 times increase. It is partly, if not all, due to the benefit from irrigated agriculture. Although number of

Table 5.5.1 Change in Cultivated Area

Item		Rain-fed	Irrigated
Before	lima/HH	2.92	0.33
After	lima/HH	6.58	1.46
Increase per HH	Times	3.67	1.13
Years	years/HH	10.58	11.33
Speed of Increase	lima/year	0.41	0.10

Source: JICA Study Team

samples is quite limited and thus this result cannot represent the whole Study area, it implies some degrees of positive collateral impact of irrigated agriculture. What is important is that the benefit of irrigation is not limited to the dry season but have a ripple effect toward the rainy season.

Also confirmed was the change in cultivated area under irrigation. In the dry season, cultivated area has increased from 0.33 lima to 1.46 lima as of the average of four farmer households. The cultivated area has more than doubled in 11.33 years on average. For a period of around 11 years, they have expanded their cultivated area 0.1 lima a year, which is equivalent to 14.5% of increase every year.

As discussed, irrigated agriculture can stabilize the year-round agriculture because it is far more stable than rain-fed agriculture. Even if farmers received damage during rainy season, it can be supported by the benefit from irrigated agriculture.

5.6 Effects on *Chitemene*

In addition to economical impact, irrigated agriculture also has several indirect impacts attributing to its additional income. Change in the cultivated area under *Chitemene* slash-and-burn cultivation may be considered as one of them. Looking at the individual cases as shown in Table 5.6.1, out of 187 farmers, 38 farmers (20%) increased their *Chitemene* area while 85 farmers (45%) decreased it after they started irrigated agriculture. With respect to the overall average change, it was slightly reduced: 0.69 lima of *Chitemene* area before irrigation became to 0.60 lima of *Chitemene* area after irrigation per individual farmer (see Table 5.6.1 and Figure 5.6.1).

Table 5.6.1 Change in *Chitemene* Area After Starting Irrigated Agriculture

Item	Before, lima	After, lima	Increase, lima	(%)	No. of Samples
Average	0.69	0.60	-0.09	-13%	187 (100%)
Increased	0.10	0.18	0.08	80%	38 (20%)
Decreased	0.76	0.24	-0.52	-68%	85 (45%)
No Change	0.52	0.52	0.0	0%	64 (34%)

Source: Harvest Survey by the Study Team (2010)

According to some informal interviews made to some farmers, there were a number of farmers who

showed their interest to boost the cultivated area under *Chitemene* system. For those farmers, irrigated agriculture was a good source to hire more labors to expand their *Chitemene* area. On the other hand, some said they decreased *Chitemene* area because they liked to shift their farming style from shifting cultivation to more intensive farming system.

For them, additional income from irrigated agriculture was a good source to buy fertilizer for rain-fed maize production, a more steady farming system. What makes this difference may be availability of natural forest. For those who face a decrease of natural forest around, *Chitemene* is, first of all, not a sustainable choice (see an example in the box). They are originally looking for a chance to shift from *Chitemene* to rain-fed maize.

Those who are blessed with plenty of natural forest draw a totally opposite scenario from those who do not have enough forest. For such farmers, it could be a rational idea to further expand *Chitemene* area

using the increased income to hire more labors specifically required for slashing and opening the area. In short, increased income from irrigated agriculture could work in both ways and it behaves as a leverage to help farmers going to whichever farmers want to go.

To be sure, it is obvious that natural resources are generally getting less and less in the Study area. It would make farmers difficult to continue the *Chitemene* slash and burn cultivation in the long run. Given this scenario, the irrigated agriculture may lead the farmers to the direction where farmers tend to practice stable agriculture, discarding slash and burn cultivation over mid – long terms.

5.7 Investing out of Irrigated Agriculture

Figure 5.7.1 and Table 5.7.1 show the major items that farmers spent their cash income from the irrigated agriculture for. Based on the harvest survey carried out in 27 irrigation schemes, the most frequent one among the 13 items listed in the table was fertilizer (169 responses), which accounts for 23% of all the responses (751). The second most frequent answer was school fee, which shared 21%

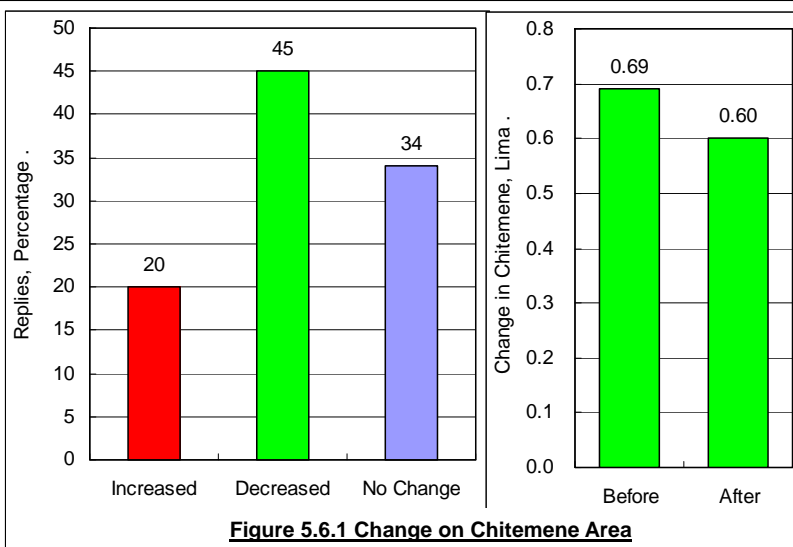


Figure 5.6.1 Change on Chitemene Area

A Farmer's Endeavor with Smallholder Irrigation:

Mr. Sydney Mulanga is one of the 7 members who started irrigated agriculture last year. He, according to the interview, harvested more than 40 buckets of tomato, and harvested about 20 sacks of eggplant. Tomato and eggplant together make his total gross margin to be ZMK 700,000.

With the money, he together with his wife bought his shoes, wife's sipper, cloths for both of them, shorts and shoes for children, and essentials for rainy season agriculture. The essentials are chemical fertilizer and hybrid maize seeds. In fact, he had been practicing *Chitemene*, slash and burn cultivation. He wanted to grow maize but unfortunately the capital he had was not enough. Therefore he had long been practicing slash and burn cultivation growing mainly millet.

Now, he bought 4 pockets of subsidized fertilizer under FSP (fertilizer support programme) and 10kg of hybrid maize seeds. He spent ZMK 200,000 and ZMK 82,000 respectively. The maize seeds are enough for half hectorage of farmland where total 200kg of fertilizer was applied. We could see well grown up maize waiting for harvest.

According to his estimation, he would harvest more than 40 bags. If he could harvest 40 bags, he is going to fetch 2 tons of maize out of the half hectorage of farmland. He shifted from *Chitemene* cultivation to conventional rain-fed farming thanks to the smallholder irrigation.



(160 responses). Domestic expenses came the third rank, sharing 15% with 112 responses, including meat, salt, cooking oil, kerosene for lighting, soap, etc. As such, general household expenses composed of “domestic expenses (15%),” “clothes (5%),” and “medical expenses (1%)” shared 21% of the total number of the answers.

Table 5.7.1 Items Income from the Irrigated Agriculture is Spent for

Item	Frequency	%
Fertilizer	169	23%
School Fee	160	21%
Domestic Expenses	112	15%
Seeds	111	15%
House construction	42	6%
Clothes	41	5%
Land Preparation	30	4%
Bicycle/ Spare Parts	26	3%
Livestock	18	2%
Cooperative	9	1%
Medical Expenses	6	1%
Chemical	5	1%
Others	22	3%
Total	751	100%

Source: Harvest Survey by the Study Team 2010-2011

Based on an multiple answer to the open ended question.

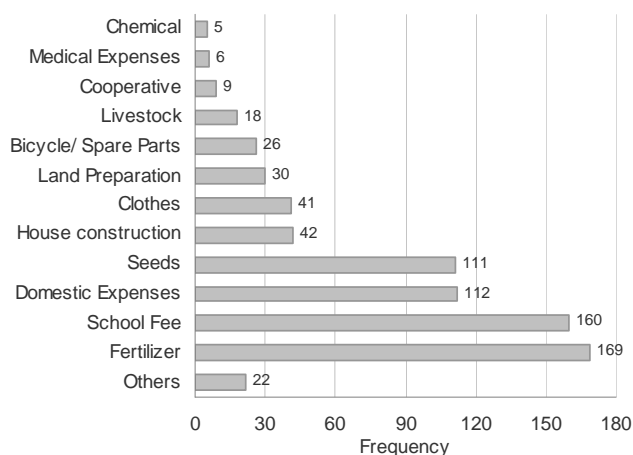


Figure 5.7.1 Items Spent For from Irrigated Agriculture

On the other hand, investment in agricultural production for the next season is also an important consumption behavior of the farmers. In addition to fertilizer, which was first ranked, cost for “seed” including vegetables, rain-fed maize, and groundnuts came the fourth rank. Income is also spent for land preparation for the rain season agriculture. As a whole, frequency related to agricultural production accounted for 43%: fertilizer (23%), seeds (15%), land preparation (4%), chemicals (1%). This set of result implies that farmers spent cash income from the irrigated agriculture mostly for education, household expense, and re-investment in agricultural production.

5.8 Cascaded Extension

The pilot project has tried a cascade-like extension mechanism in which a new technology is to be transferred through step-wise communications from center to periphery: more specifically from provincial/ district TSB officers to the field officers, and again from the field officers trained to their fellow field officers. Note that as the core technology of smallholder irrigation scheme is quite simple and easy, to be a part of this communication channel, technical background would hardly be required.

The dissemination communication in the pilot project started from the Training of Trainers (TOT) in which necessary information and guidance were conveyed from the Study Team to the core counterpart officials in provincial and district TSBs. Then, through a lecture and on-site training in the kick-off training, 20 extension officers, called BEOs and CEOs in Zambia, were trained in 2009 and another 55 extension officers in 2010.

Although the two sessions were managed by the Study Team, everything afterward was entrusted to the officers who participated in the kick-off training. Then, the trained district TSB officers and also the BEOs/CEOs have trained their fellow officers at their areas as field or on-site TOTs. From this arrangement, fortunately, there was a positive case reported that fellow officers trained by kick-off training participants had developed a lot of sites. As summarized in Table 5.8.1 below, in 2009, more than half of the sites improved and developed (56%) had been undertaken by fellow BEOs/CEOs who were trained by the cascaded system. In 2010, about one-third of the improved sites and about a quarter of the newly developed ones were undertaken by fellow BEOs/CEOs.

Table 5.8.1 Summary of the Sites Undertaken by Fellow BEOs/CEOs

Particular	No. of site	By kick-off training participant	By Fellow BEOs/CEOs	Ratio
In 2009, improvement	100	44	56	56%
In 2009, new development	94	41	53	56%
In 2010, improvement	193	126	67	35%
In 2010, new development	181	134	49	27%

Source: Pilot Project Implementation, JICA Study Team

As an example, Ms. Estella Nalupya Mwami, a CEO in Mpika district developed a new site with her clientele farmers in early June 2010. She originally joined a TOT organized by the district TSB officers who participated in the kick-off training in 2010. Although she did not have any experience in irrigation development, the TOT reminded her of the discussion with her clientele farmers; they have been longing to have irrigation scheme in their area. Then, she talked with the farmers about smallholder irrigation scheme and, as farmers showed great interest in it, walked along a stream with farmers to identify an appropriate diversion site.

At the beginning, it was not so easy for her who does not have concrete picture of what smallholder irrigation was like. Especially, she did not have much idea about what the appropriate location for gravity diversion exactly was. But, just following the tips described in the technical manual prepared under the pilot project, she found a good site with farmers where there was a foot bridge and both side of the stream banks are firm.

After that, she managed, with 20 farmers, constructing a single-line weir 20m in length. The weir has a very beautiful looking and was tightly blocking the flow. She noted, however, that there was a minor mistake during the construction process. With uncertain knowledge, she first guided farmers digging a furrow toward an upward direction. And therefore, farmers had to dig the furrow deeper. After about 5m length of digging, she realized something was wrong and stopped the work. Then, she requested a TSB officer for re-aligning the furrow with line-level; it surely was a process-oriented work. By the time JICA team visited, the furrow was re-aligned and pegged for around 200m, of which about 100m had been already dug.

The fact that even the fellow officer did a good job assured more confidence in the extension mechanism. The basic principle that easy and low-cost technology can be widely adopted has not been denied at all. It is not just because it was adaptable to farmers but it was easier for extension officers too.



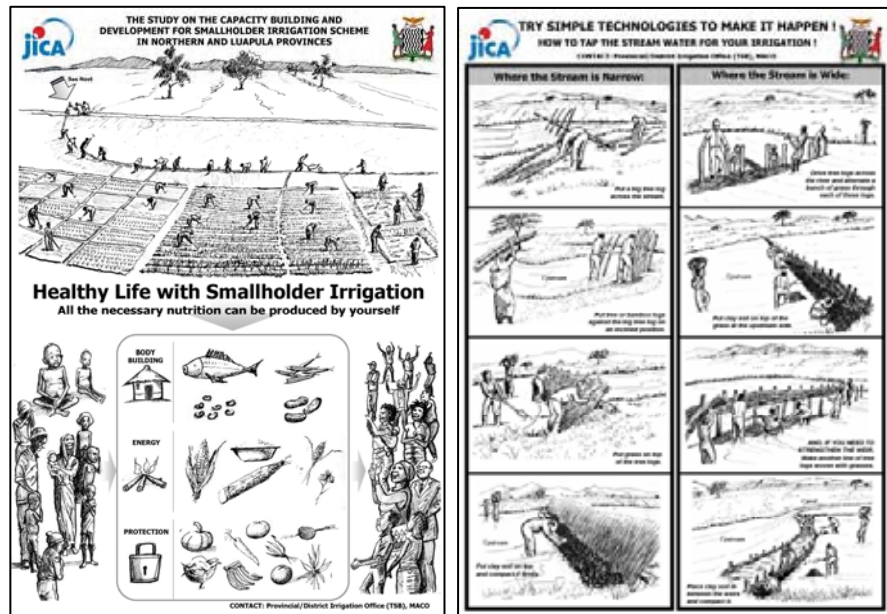
Very beautiful appearance of a single-line weir, managed by Estella Nalupya Mwami, a fellow CEO, who does not have any prior experience in irrigation development.

As long as a technology is easy and of low-cost, cascaded extension mechanism can work. Of course direct training for all the concerned officers may have resulted in higher performance and achievement. However, such direct training for all the concerned officers definitely requires more budget. Due consideration should always be sought in that best effective approach and should be applied taking into account both the cost as well as the achievement. In this sense, cascaded dissemination mechanism was proved effective in promoting simple technology e.g. simple diversion schemes.

5.9 Extension of Simple Smallholder Irrigation Schemes through Posters

Under this Study, 4 types of A-3 posters were produced in 2009, and another 2 types of A-3 posters

were produced in 2010. The posters produced in 2009 were primarily used by BEOs/CEOs directly to the potential farmers who were to embark on smallholder irrigation development. The posters showed how to construct 4 typical simple diversion weirs by step. They could be used as a pictorial story whereby farmers could easily understand the step of constructing, e.g. a simple single line diversion weir. The posters were utilized to motivate farmers specifically at the beginning stage of promoting simple diversion schemes.



Posters meant to promote people's health linked up with smallholder irrigation. The left poster tells people how smallholder irrigation contribute to improving people's health and left one shows how to construct an inclined weir on the left and simple-line weir and double-line weir by step.

On the other hand, posters produced in 2010 were not meant to use on the sites by BEOs/CEOs. They were meant to promote health linked up with irrigation. The first sheet of the A-3 posters showed how smallholder irrigation could contribute to improving the people's health linked up with smallholder irrigation development, and the 2nd sheet showed how to construct 3 types of simplest diversion weirs. According to the recommendations from CEOs and district TSB officers, the posters were posted at dispensary, school, village kiosk, market, village assembly place, etc. where most of the people gathered. Eight (8) places and 10 places were selected in Northern province and Luapula province respectively.

Table 5.9.1 summarizes the places where the posters were posted, and also briefly shows some outputs from the posters. Of the total 18 places, 5 sites have been constructed by farmer themselves and one site after having contacted the CEO in charge. Also, a site in Mansa district improved their own temporal diversion weir after they saw the posters. Some farmers in Chiwote camp have contacted CEO for requesting brochures.

The poster was produced in A-3 size, so that a photo copy machine can duplicate more copies. In fact, the production of the posters were not ordered to a printing shop but just printed by a photo copy machine directly from a PC. After that, it was laminated at a cost of ZMK 10,000 per A-3 sheet in Kasama town. Taking into the production cost, which is only about ZMK 11,000 including lamination and copying, effectiveness of smallholder irrigation development by poster should account. This could be attributed to the simplicity, easiness, and cheapness (or almost no cost) all pertinent to the simple diversion scheme. From this experience, the promotion of simple diversion scheme should accompany with poster promotion.

Table 5.9.1 Places where a Poster Promoting Nutrition Improvement was Posted

No	District	Camp Village	Posted Place	Remarks	Output
1.	Kasama	Chiwote -	Credit Union & Saving Association	Where camp meeting is held.	Some farmers requested brochures to the CEO in charge.
2.	Mungwi	Nseluka Nseluka	Nseleuka clinic	-	Non
3.	Mungwi	Nseluka Nseluka	Nseleuka market	Market was assisted by ASP targeting woman-headed households.	They contacted CEO, and started irrigation by constructing 2 simple weirs each at Chambashi 1 and also at Kalunguishi old factory site.
4.	Mungwi	Nseluka Nseluka	Nseluka storage shade	Where camp meeting is held, as well as maize collection post and fertilizer distribution centre	Non
5.	Mungwi	Nseluka Kamena	Small market	Opposite side from the Kamena middle basic school below	Non
6.	Mungwi	Nseluka Kamena	Kamena middle basic school	Where various meetings are held.	Non
7.	Mungwi	Nseluka Lumponbwe	Meeting place	Village assembly place near the village headman.	Non
8.	Kasama	Kasama -	Kasama Urban Clinic	-	Chilubanama members put up a simple diversion weir and coupled with organic farming.
1	Mansa	Muwanguni Muwanguni	Muwanguni Satellite Depot	Maize collection post	Non
2	Mansa	Malamba Malamba	Malamba Satellite Depot	Maize collection post	11 farmers had already been doing irrigation, and they improved the weir with the posters they saw.
3	Mansa	Lukola Lukola	Lukola Satellite Depot	Maize collection post	Three (3) farmers had tried a simple diversion weir and are now using it. They managed by themselves after seeing the posters.
4	Mansa	Chembe Chembe	Chembe Satellite Depot	Maize collection post	Non
5	Mansa	Tweshe Tweshe	Tweshe Satellite Depot	Maize collection post	Non
6	Mansa	Chimfula Chimfula	Chimfula Satellite Depot	Maize collection post	Non
7	Mwense	Mwense -	Mwense Central Satellite Depot	Maize collection post	Non
8	Mwense	Lukwesa Lukwesa	Lukwesa Market	-	A group of 16 farmers of Kapamba (Lukwesa area) Chalikumbi road have started irrigation w/o CEO's contact.
9	Mwense	Lubunda Lubunda	Lubunda Market	-	One farmer at Loto village has constructed a simple weir on his own w/o any assistance from CEO.
10	Mwense	Munwa Munwa	Munwa Satellite Depot	Maize collection post	Non

Source: JICA Study Team



The poster promoting nutrition improvement with the smallholder irrigation was posted in various places where lots of people get together. Left is a clinic and the right is a village kiosk.

CHAPTER 6 CAPACITY DEVELOPMENT AND BUILDING

As it is stated under the 2nd objective of the Study, that is ‘to transfer the technology and build the capacity in smallholder irrigation development for counterpart personnel and concerned communities’, several opportunities where participants could learn were arranged during the Phase I and Phase II study. These include kick-off workshop, kick-off and follow-up trainings for the pilot project implementation, and the process of the pilot project implementation, etc. This chapter summarizes the activities for the capacity development undertaken in this study period.

6.1 Capacity Development for Officers

Table 6.1.1 summarizes the opportunities arranged for the capacity development for participating government officers. Trainings/workshops No.1 to No.4 had been arranged directly by the JICA team while training No.5, so called peer-to-peer training, was mostly carried out by the extension officers at site during the construction of simple schemes. No.5 workshop was a wrap up for this Study, and it was also arranged by the JICA team separately by province. Through those occasions, a total number of 720 personnel (or 497 individuals since some participated in the previous trainings hence double counted) have learned various issues related to the provinces, smallholder irrigation development, etc. Also total person-days in those trainings arrived at 1,250. Following are the brief contents of the training/workshop:

- 1) Kick-off workshop (No.1 in the table) was the entry point to this Study for the concerned officers of the Study area. The workshop invited PACO, PAO, DACO, SAO and TSB officers at provincial level and district offices. It invited a total of 69 officers to whom the outline of the Study was introduced. Then, taking advantage of this gathering, the Study team undertook 3 major sessions amongst others; 1) SWOT analysis, 2) PCM problem analysis, and 3) identification of smallholder irrigation potential by district. Given facilitation as well as supplementary explanation by the Team, participants got familiar to those analytical tools and they in fact identified SWOTs pertinent to MACO and smallholder irrigation development, and problems and those causes for and relationships between them. They exchanged and shared their work results amongst participants, districts, and between the provinces.
- 2) TOT (No.2 training) invited selected 7 officers in 2009, to whom JICA team administered various skills, technologies, and construction methods for simple irrigation schemes. The TOT in 2010 called 10 officers and administered the same as those in 2009 and plus technologies concerning permanent scheme. The participants were expected to be the trainers for the forthcoming kick-off training (No.3). They were trained for 2 days in 2009 and 4 days in 2010 with materials such as draft manual, leaflet, picture-story like posters, etc. Since TOT in 2010 undertook not only simple scheme but also permanent scheme, the duration was set at 4 days long.
- 3) Kick-off training (No.3) was the ‘training proper’ to implement the pilot project in 2009 and 2010 dry seasons. The training invited 35 participants (28 excluding the trainers trained under the TOT) in 2009 and 60 participants in 2010 (40 excluding those who participated in previous training), and the trainers well undertook all the modules backstopped by JICA team. In particular, JICA team facilitated the participants’ understanding by showing a lot of examples carried out in other countries including neighbor Malawi and in some cases even Asian countries.
- 4) Follow-up training (No.4) was carried out in order to assess what achievements the trained extension officers had made. This training invited 49 participants in 2009 and a total of 67 participants in 2010 including newcomers such as newly posted TSB officers, and fellow BEOs/CEOs who did not participate in the kick-off training but have actively participated in the pilot project implementation. Since this was a follow-up, the training mechanism was so designed

to facilitate them to learn from other colleagues, based on so-called peer-to-peer learning. Therefore, the Team tried to solicit the participants to come up with much experiences as they had in the field. Then, taking this opportunity in 2009, a quick making compost, *Bokashi*, was also lectured and practiced (in 2010, it was lectured and practiced during the kick-off training).

- 5) Training of fellows (No.5) was a sort of peer-to-peer training, or called another TOT from trained BEOs/CEOs to their fellows who had not participated in the above trainings. Mungwi and Mporokoso districts carried out this TOT at district level in 2009 while others, the majority, carried out at site. It means when the trained BEOs/CEOs were to construct simple irrigation schemes at their extension areas, they invited their neighbor CEOs to observe. Through this site peer-to-peer training with those done at district level, a total of 129 officers in 2009 and 180 officers in 2010 have also learned relevant skills and technologies.
- 6) Wrap Up workshop (No.5 in the table) was held separately by province, one at Kasama town for Northern province and the other at Mansa town for Luapula province. The workshops invited management officers from all the districts such as PACO, DACO, SAO in addition to TSB officers and representative BEOs and CEOs. 67 officers participated for Northern province while 47 officers for Luapula province. The objectives of this wrap up workshop were to; 1) share the achievements of the pilot project activities, 2) gain and internalize collective lessons to further disseminate COBSI schemes, and 3) synchronize the COBSI programme with on-going government programmes. Participants came to know about the present status of the Study area, the achievement of the pilot project, lessons, etc., whereby they are expected to incorporate the COBSI programme into their own development activities.

Table 6.1.1 Summary of the Trainings Carried out in Years 2009 and 2010

Opportunities	Participants	Contents (specifically related to Capacity Development)
1. Kick-off Workshop March 31, 2009	69 (69) officers from Northern and Luapula provinces	1. SWOT analysis 2. PCM problem analysis 3. Identification of smallholder irrigation potential by district
2.1 Training of Trainers (TOT), April 7 & 14, 2009	7 (0) officers from Northern province	1. Identification of potential gravity diversion sites 2. Simple diversion weirs (5 types) 3. Canal alignment and construction (by split line level) 4. Ancillary facilities
2.2 Training of Trainers (TOT), April 13 – 16, 2010	10 (1) officers from Northern & Luapula provinces	5. Organizing of farmers 6. Land allocation (dividing the land into members) 7. On-farm irrigation methods 8. Compost making (conventional and <i>Bokashi</i>) 9. Permanent weir construction (only in 2010)
3.1 Kick-off training April 16-18, 2009	35 (28) officers from Northern and Luapula provinces (of them, 7 are trainers from above TOT)	1. Smallholder irrigation facilities and structures 1.1 Identification of potential gravity diversion sites 1.2 Weir type and construction method (inclined weir) 1.3 Weir type and construction method (single-line weir) 1.4 Weir type and construction method (double-line weir) 1.5 Weir type and construction method (trigonal prop weir) 1.6 Weir type and construction method (clay soil masonry) 1.7 Canal alignment and construction 1.8 Ancillary facilities 1.9 Practice of construction of a simple weir in the field 1.10 Practice of canal alignment
3.2 Kick-off training May 3 – 7, 2010	60 (40) officers from Northern and Luapula provinces (of them, 10 are trainers from above TOT)	2. Farmers organization 2.1 Organizing of farmers 2.2 Internal set up of farmer organization 3. On-farm irrigation and agriculture aspects 3.1 Organizing of farmers 3.2 Land allocation (dividing the land into members) 3.3 On-farm irrigation methods 3.4 Compost making (lecture in 2009, and +practice in 2010) 4. Permanent scheme (only in 2010) 4.1 De-watering 4.2 Excavation of the foundation 4.3 Shuttering and formwork 4.4 Concrete placing and masonry work

4.1 Follow-up training November 4 – 5, 2009	49 (14) officers from Northern and Luapula provinces	1. Contribution from the JICA team 2. Output presentation of smallholder Irrigation development 3. Lessons sharing among participants
4.2 Follow-up training November 16 – 18, 2010	67 (10) officers from Northern and Luapula provinces	3.1 Problems arisen & Actions taken 3.2 Proud Achievements and Events 4. Quick making compost: <i>Bokashi (in 2009)</i>
5.1 Training of fellows, TOT in 2009	129 (117) CEOs, not participated in above No.4	Contents are basically same as above No.3 kick-off training dealing with construction of simple diversion weirs, ancillary facilities, organizing of farmers, on-farm irrigations methods (sunken-bed and furrow irrigation).
5.2 Training of fellows, TOT in 2010	180 (173) CEOs, not participated in above No.4	
6.1 Wrap Up Workshop March 31, 2011, Kasama	67 (27), DACO, SAO, TSB, BEO/CEO in Northern	1. Status of the Study Area 2. Achievement from the Pilot Project 3. Lessons learned from the Pilot Project Implementation 4. Implementation Modality
6.2 Wrap Up Workshop April 6, 2011, Mansa	47 (18), DACO, SAO, TSB, BEO/CEO in Luapula	
Total	720 total officers (497 individual officers) 1,250 person.days	

Source: JICA Study Team

Note: Participant's numbers in brackets are those who have not participated in any of the previous trainings.

6.2 Capacity Development for Farmers

Capacity development for farmers was undertaken through: 1) participation in the construction of smallholder irrigation schemes either simple ones or permanent ones, 2) practicing of irrigated agriculture, 3) practice on quick making compost, *Bokashi*. These occasions have been arranged and taken care of by the district TSB officers, BEOs and CEOs engaged in the pilot project implementation. Table 6.2.1 summarizes the number of farmers who have benefited. Though the member of the beneficiary farmers are not exactly correlated to the ones who have developed their capacity, we may take the number as those who have developed capacity in some aspects of smallholder irrigation development. From the table, it is learnt:

- 1) In 2009, there were 4,060 farmers in improved simple sites, who have learned how to construct temporary diversion weir, how to align canal in such sites where new alignment was required e.g. to enlarge irrigation area, and to some extent how to carry out on-farm irrigation.
- 2) Under newly developed sites in 2009, the total of 3,118 farmers were organized where they learned how to construct simple diversion weirs, the way of aligning canal by gravity with a simple split level, and the basic norm of how to operate their organization. Of them, 1,674 farmers benefited from irrigation in the 2009 dry season. They have learned irrigated agriculture, e.g. by sunken-bed method or furrow irrigation method. There was *Bokashi* compost demonstration in 2 sites carried out directly by JICA team where total 43 farmers learned relevant technologies.
- 3) In 2010, there were 2,846 farmers in improved simple sites, who have learned necessary skills pertinent to simple schemes (those farmers who were counted in the newly developed sites in 2009 are excluded). Also, 530 farmers have learned how to make compost manure including *bokashi*.
- 4) In 2010, a total of 3,381 beneficiaries were organized under newly developed schemes where they learned necessary skills for diverting stream water with simple diversion structures. Of them, 1,296 beneficiaries started irrigated agriculture where they learned on-farm irrigation methods and rotational irrigation to some extent. In addition, 734 farmers learned compost making including *bokashi*.
- 5) In 2010, 8 permanent schemes were constructed to which total 257 farmers participated. They learned how to de-water the site, how to mix and place concrete, how to construct masonry structures, and what ancillaries are required e.g. sand flush way, etc.

- 6) Taking the above into account, there were 7,172 farmers in 2009 and a total of 6,245 farmers in 2010 who have learned at least some relevant skills with respect to smallholder irrigation development including on-farm agriculture development. The total number of farmers undertaken during the 2 years arrives at 13,405 composed of 8,711 males and 4,694 females.

Table 6.2.1 Summary of the Farmers in Smallholder Irrigation Development in 2009 & 2010 Seasons

Category	Farmers	Contents
In 2009		
Improved Site (Simple)	4,060 (2,553M, 1,507F)	Construction of simple weirs Canal alignment Irrigated agriculture
Newly Developed Sites (Simple)	3,118 (2,095M, 1,023F)	Construction of simple weirs Canal alignment
	1,674 (1,081M, 599F)	Construction of simple weirs Canal alignment Irrigated agriculture
	43 (25M, 18F)	Compost making (<i>Bokashi</i>), 2 sites
Sub-total	7,172 (excluding 1,674 and 43)	1,674 and 43 are parts of 3,112
In 2010		
Improved Site (Simple)	2,846 (1,816M, 1,030F)*	Construction of simple weirs Canal alignment Irrigated agriculture
	530 (340M, 190F)**	Compost making (<i>Bokashi</i>)
Newly Developed Sites (Simple)	3,381 (2,247M, 1,134F)	Construction of simple weirs Canal alignment
	1,296 (861M, 435F)**	Construction of simple weirs Canal alignment Irrigated agriculture
	734 (478M, 256F)**	Compost making (<i>Bokashi</i>)
Permanent Sites	257 (137M, 120F)	Concrete mixing and placing Masonry placing
Sub-total	6,245 (excluding 1,296, 734 and 257)	1,296 and 734 are parts of 3,381 257 are parts of the 7,171 in 2009
Grand Total	13,405 (8,711M, 4,694F)	

Note: * since some sites were newly developed in 2009 and improved in 2010, the members of those sites were excluded in this figure. ** Since gender based numbers were not counted, overall ratio between male members and female members was applied to estimate these gender based numbers.

Source: JICA Study Team

6.3 Learning by the JICA Team

Through interactions with the participating officers as well as farmers, the Team has learned a lot. Amongst them, particular ones are briefed below:

- 1) TSB officers at the province and district were already equipped with basic knowledge and experiences for simple permanent structure, e.g. wet-masonry structure and concrete structure. Of course, not all the TSB officers are conversant with the skills, but at least they could refer to their colleagues who were already knowledgeable. Some district TSBs supported by provincial TSBs have constructed those permanent structures by direct force account through which they have acquired and improved practical skills. They may need some top-up knowledge e.g. stability of a gravity structure, buttress requirement to wall-type weir, settlement of unconsolidated foundation often found in *dambo* areas, hydrology for a spillway, etc. However, by involving the officers already equipped with these practical knowledge, 2nd year pilot project implementation well proceeded, it was learnt.
- 2) Since most of the Study area falls in plateau plane, there has been a lot of difficulties in identifying suitable gravity diversion sites by BEOs/CEOs. Gravity diversion sites can easily be found on gentle rolling hill like topography but it was not always the case in the Study area where *dambo*s were prevalent. Spirit line level may not work as expected in this kind of very plane area.

The distance between the 2 poles for the spirit line level has to be extended to 10m or even more than that instead of conventional 5m in order to cope with this situation. In fact, during a practice arranged in the kick-off training, the original distance between the 2 poles was set at 5m but it did not work. Thereafter, the distance was extended to 15m apart and worked very well.



Distance between the 2 poles is now set at 15m, instead of conventional 5 m. This is because the topography is too gentle.

- 3) “*Funjikila*” is a traditional wisdom to utilize plant biomass in improving soil texture as well as soil nutrient like compost manure. This is applied mostly when reclaiming a new farmland. A virgin land covered with tall grasses, such as elephant grass, is ploughed and soils are piled up, making *Funjikila*. The grasses mixed in the ploughed soil can be decomposed gradually as organic matters in compost do in the process. About one-third of the newly developed sites in 2009 dry season and about 20% of the same in 2010 dry season have not reached irrigated agriculture during the same season due to canal construction still un-finished, too late to plant crops, etc. In this case, strongly recommend to the sites, which could not start irrigation in the first year, is the *Funjikila* before leaving the site in that season. With *Funjikila*, the soils which were to be irrigated in the following season get improved physically and also fertilized, therefore becoming ready for the irrigated agriculture to come in the next season. It is learned and it is incorporated in planning agriculture development at newly opened areas.