Republic of Zambia
Ministry of Agriculture
Department of Agriculture

Expansion of Community-Based Smallholder Irrigation Development Project (E-COBSI)

Final Report

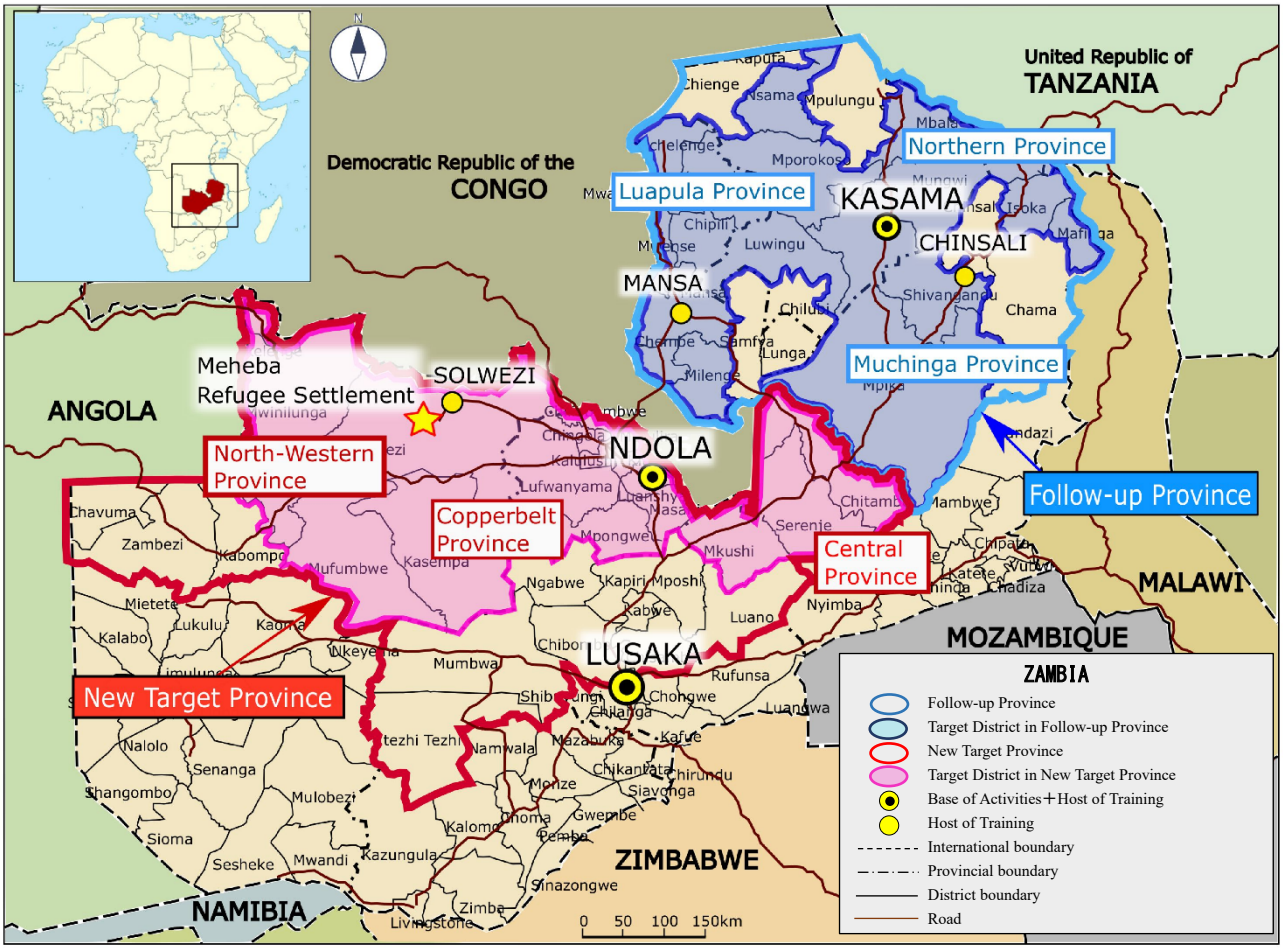
February 2024

Japan International Cooperation Agency (JICA)

Sanyu Consultants Inc. (SCI)

ED
JR
24-030

LOCATION MAP



Province		Area (km²)	Population (Persons)	Population Density (persons/km²)	Target District		
Follow-up Province	Northern Province	57,371	1,247,983	21.8	Kasama	Mungwi	9
					Mporokoso	Mbala	
					Luwingu	Nsama	
					Senga Hill	Lunte	
					Lupososhi		
	Luapula Province	36,301	1,021,220	28.1	Mansa	Mwense	8
					Kawambwa	Nchelenge	
					Milenge	MwansaBombwe	
					Chipili	Chembe	
	Muchinga Province	63,902	769,299	12.0	Nakonde	Isoka	7
					Mafinga	Shiwang'andu	
					Mpika	Kanchibiya	
					Luvushimanda		
						Total	**24 districts**
New-Target Province	Copperbelt Province	31,328	2,757,539	88.0	Chililabombwe	Chingola	10
					Mufulira	Kitwe	
					Kalulushi	Ndola	
					Luanshya	Lufwanyama	
					Masaiti	Mpongwe	
	North-western Province	99,531	1,041,089	10.5	Solwezi	Kasempa	8
					Mufumbwe	Ikelenge	
					Mwinilunga	Manyinga	
					Kalumbia	Mushindamo	
	Central Province	28,097	788,142	28.1	Chitambo	Serenje	3
					Mkushi		
						Total	**21 districts**
						Grand Total	**45 districts**

Source：ZAMBIA 2022 CENSUS OF POPULATION AND HOUSING PRELIMINARY REPORT

Photos（1/6）

Training / Meeting ①

The 1st JCC meeting (January 2019)

Japanese experts explained the project outline, purpose, goals, and PDM. Besides, CPU members made a presentation on the annual action plan in the first year. (Lusaka)

Inception workshop (January 2019)

In the inception workshop for the FU Provinces, Mr. Aikawa, a Senior Advisor of JICA, explained SHEP approach by showing actual cases. In the discussion, participants asked many questions that revealed their keen interest in the approach. (Northern Province)

Training of Trainers (TOT) (March 2019)

Japanese experts lectured the provincial CPU members on E-COBSI activities at TOTs in the FU and NT Provinces, respectively. Those provincial CPU members became lecturers in the next KOT and MTT. (Northern Province)

Kick-off Training (KOT) (May 2019)

KOT in the NT Provinces mainly conducted training related to irrigation development. The photo shows a practical exercise on simple weir construction. (Copperbelt Province)

MST in the FU Provinces (January 2020)

Market research training (MST) was conducted for FU Provinces from 2020. Participants conducted market survey using the interview methods and survey sheets they learned in the training. (Muchinga Province)

MTT Preparatory CPU meeting (September 2021)

In 2021, the MTT preparatory meetings were held online using the monitors and PCs provided by the Project due to movement restrictions caused by COVID-19. (Copperbelt Province)

Photos（2/6）

Training / Meeting ②

Mid-term Training (MTT) (October 2021)
Provincial and district officers and CEOs participated and discussed their achievements and action plans. Field visits and trainings for cultivation techniques and nutrition improvements were also implemented. (Copperbelt Province)

Permanent weir training(NT Provinces)（October 2021）
Lectures on permanent weir and field surveys of potential construction sites were conducted in the NT provinces. Based on the survey results, one permanent weir construction site was selected in each province.（Copperbelt Province)

Annual Evaluation Workshop (AEW) (December 2021)
During discussion in AEW, Japanese experts also commented and the participants shared their issues and counter measures with the others. (Copperbelt Province)

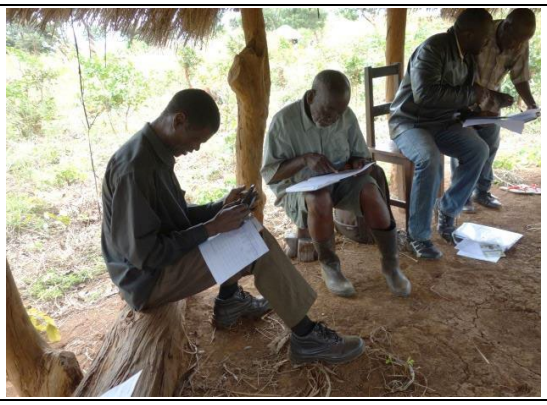
TOT of *Tebakari Eiyouhou* (August 2022)
In 2022, the first year when *Tebakari Eiyouhou* was introduced, TOT of the method for the SFNOs were implemented. (Copperbelt Province)

The 6th JCC meeting (Terminal Evaluation) (September 2023)
The terminal evaluation was implemented in 2023, the final year of the Project. After the site visit, a joint evaluation team from both Japan and Zambia reported the evaluation results and recommendations. (Lusaka)

Final seminar (January 2024)
A final seminar was held to present the project results and the beneficiary farmers' experiences. C/P staff, donor agencies and mass media in Zambia were invited to the seminar. The seminar was broadcast on ZNBC news and reported in the newspaper by NAIS. (Lusaka)

Photos（3/6）

Survey / Monitoring and Follow-up ①



Base-line survey (Socio-economic survey) (Sep-Dec 2019)
District officers and CEOs conducted the questionnaire survey to the farmers in the district model sites using the survey sheets prepared by the provincial CPU members. (Muchinga Province)

Base-line survey (Nutrition Improvement) (April 2019)
Provincial and district food and nutrition officers and CEOs conducted the nutrition survey at the district model sites. Japanese experts also accompanied them to confirm the important points and the questionnaire. (Luapula Province)

Monitoring survey in the district model sites (May 2021)
Japanese experts, the provincial and district C/P officers, and CEOs conducted monitoring in the district model sites. They confirmed the current status and points for improvement of water utilization facilities, farmers' organizations, cultivation techniques, etc. (Copperbelt Province)

Monitoring survey (Nutrition Improvement) (May 2022)
The project team visited mothers and children from the model sites and interviewed. The farmers and their children were interviewed about their dietary condition and their knowledge of nutrition. (Northern Province)

Field visit by the Joint Terminal Evaluation Mission (September 2023)
The joint Japan-Zambia evaluation mission, the JICA Zambia office, and the project team participated in the field visit for the terminal evaluation. (Copperbelt Province)

Permanent weir construction (Apr 2022 – Dec 2023)
Permanent weir construction was implemented at one site in each of the NT Provinces beginning in 2022. Construction was carried out by farmer group. Japanese experts visited the sites regularly to check progress and provide guidance. (Central Province)

Photos（4/6）

Survey / Monitoring and Follow-up ②

Simple weir (Mwansabombwe) (September 2022)
A simple weir at the model site in Mwansabombwe District. At this site, bamboo, which is easily procured locally, was used as the material for the weir.（Luapula Province)

Gravity Irrigation (Chipili) (September 2022)
Gravity irrigation at the model site farmer in Chipili District. Water is taken from a permanent weir and transported to the end field by an earthen canal. (Luapula Province)

Gravity Irrigation (Luwingu) (September 2022)
Gravity irrigation at the model site in Luwingu. Irrigation water flows from the front side of the photo toward the back. (Northern Province)

Bokashi manure (Kawambwa) (March 2023)
The price of chemical fertilizers and pesticides has increased due to the COVID-19, which has increased the necessity of organic cultivation that can be made with local materials. (Luapula Province)

Fishpond (Mbala) (November 2023)
Harvesting in a fishpond at the model site in Mbala. This was introduced as a pilot project as part of the multi-purpose use of irrigation water and nutritional improvement. The district fisheries officers implemented training and demonstrated how to make smoked fish as a fish processing method. (Northern Province)

Permanent weir (Kasempa) (December 2023)
Permanent weir constructed at the model site in Kasempa. Construction began in the dry season of 2022 and was completed in November 2023. (Northwest Province)

Photos（5/6）

Provision of Equipment, Demonstration Plots, Public Relations, and Donor Collaboration ①

Handover Ceremony of Equipment (May 2021)
Laptop computers, copiers, and online meeting equipment were provided to the Ministry of Agriculture to facilitate online meetings and remote training due to COVID-19. (Lusaka)

Demo Plots (Serenje district) (2021)
In 2021, the Project established demonstration plots in all the district model sites to promote a series of COBSI technologies (irrigation, maintenance, SHEP, nutrient improvement, cultivation techniques, etc.). (Central Province)

Demonstration Plot (Kasama) (November 2022)
FFD at a demonstration plot in Kasama. Introduction of watermelon cultivation methods and COBSI, and actual harvesting were conducted on the same day. Surrounding farmers and district office officers participated. (Northern Province)

Demonstration Plot (Mbala) (September 2022)
Okra cultivation in a demonstration plot in Mbala district. In this site, where horticultural cultivation is very popular, crop rotation is actively practiced to avoid continuous crop failure. (Northern Province)

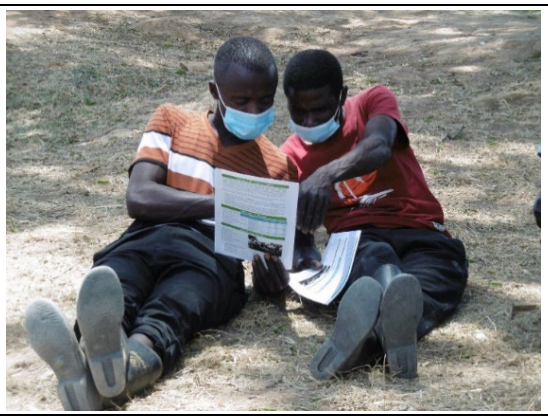
Demonstration Plots (Kalulushi) (September 2023)
Carrots in a demonstration plot in Kalulushi. Other vegetables such as cabbage and potatoes are also grown. (Copperbelt Province)

Demonstration Plot (Chipili) (September 2023)
Wheat in a demonstration plot in Chipili. In terms of food security, wheat is recommended by the MoA, and the project was asked to collaborate with them. (Luapula Province)

Photos（6/6）

Provision of Equipment, Demonstration Plots, Public Relations, and Donor Collaboration ②

Public Relations by NAIS (March 2022)
From 2020, NAIS has been invited to each training in all target provinces to enhance public relations activities. The training programs were disseminated by NAIS through various media such as newspapers, TV, and radio.（Northwest Province)



Creation of local language teaching materials
In order to disseminate the COBSI approach to more farmers, project materials were translated into a local language. The photo shows a farmer reading a brochure introducing the project. (Central Province)

Agri-Show, Copperbelt Province (June 2022)
Farmers from Kalulushi district model site who participated in the agri-show in Copperbelt Province were interviewed by a local radio station. The story of their participation in COBSI activities and their achievements were broadcast in the province. (Copperbelt Province)

Agri-Show (Northern Province) (June 2022)
The project's activities were presented at the agri-show in Northern Province. Farmers from model sites were invited to the agri-show, which also created business matching opportunities with market stakeholders at the show. (Northern Province)

National Agri-Show (August 2023)
After the agri-shows in each province, the project was exhibited at the National Agri-Show in Lusaka. The photo shows a provincial CPU member explaining the project's activities to visitors. (Lusaka)

Collaboration with other donors (GIZ) (fishpond activities) (February 2023)
The project agreed with GIZ to collaborate on fishpond activities, and jointly conducted fish farming training at the model site of the Project. (Luapula Province)

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ABBREVIATIONS AND ACRONYMS

AEW	Annual Evaluation Workshop
BEO	Block Extension Officer
CAPI	Computer Assisted Personal Interviewing
CEO	Camp Extension Officer
COBSI	Community Based Smallholder Irrigation
COBSI Study	Study for the Capacity Building and Development for Community-based Smallholder Irrigation Scheme in Northern and Luapula Provinces (JICA)
C/P or CP	Counterpart
CPU	COBSI Promotion Unit (Member)
CSI	Cooping Strategy Index
DACO	District Agricultural Coordinator
DCO	District Crop Officer
DFNO	District Food and Nutrition Officer
DMDO	District Market Development Officer
DOA	Department of Agriculture (under MoA)
DSA	Daily Subsistence Allowance
FAO	Food and Agriculture Organization
FBDG	Food-Based Dietary Guidelines
FFD	Farmer Field Day
F4F	Fish for Food
FISP	Farmer Input Support Program (ex FISP)
FRA	Food Reserve Agency
FU Province	Follow-up Province
GIZ	Deutschen Gesellschaft für Internationale Zusammenarbeit
GOJ	Government of Japan
COMACO	Community Market for Conservation
GRZ	Government of Republic of Zambia
Ic/R	Inception Report
IFAD	International Fund for Agricultural Development
IPM	Integrated Pest Management
JCC	Joint Coordinating Committee
JICA	Japan International Cooperation Agency
KOT	Kick-off Training
MoA	Ministry of Agriculture (former MAL)
M/M	Minutes of Meeting
MST	Market Survey Training
MTT	Mid-Term Training
NAIS	National Agricultural Information Services (under MoA)
NARDC	National Aquaculture Research and Development Centre
NGO	Non-Governmental Organization
NT Province	New Target Province
OJT	On-the-Job Training
O&M	Operation and Maintenance
PACO	Provincial Agricultural Coordinator
PAO	Provincial Agricultural Officer
PAP	Provincial Agriculture Planner
PCM	Project Cycle Management
PDM	Project Design Matrix
PIE	Provincial Irrigation Engineer
PR1	Progress Report No.1 (this report)
PS	Permanent Secretary
R/D	Record of Discussion
RCT	Randomized Controlled Trial
SAO	Senior Agricultural Officer
SCA	Success in Community Action
SCCI	Seed Control and Certification Institute

SCHO	Senior Crop Husbandry Officer
SFNO	Senior Food and Nutrition Officer
SHEP	Smallholder Horticulture Empowerment & Promotion (SHEP)
SIE	Senior Irrigation Engineer
SLHO	Senior Land Husbandry Officer
SMDO	Senior Market Development Officer
SMS	Subject Matter Specialist
SUN	Scale-up Nutrition Program
S3P	Smallholder Productivity Promotion Programme (IFAD)
T-COBSI	Technical Cooperation Project on Community-based Smallholder Irrigation (JICA)
TOT	Training of Trainers
TSB	Technical Services Branch (the principal counterpart organization at the DOA)
WARMA	Water Resources Management Authority
WB	World Bank
ZCOA	Zambia College of Agriculture
ZNRDC	Zambia Natural Resources development College
ZMGRO	Zambia Growth Opportunities Program
ZMK	Zambian Kwacha

UNIT CONVERSATION

1 lima = Quarter hectare (50m ×50m)

ZAMBIA FISCAL YEAR

January 1 to December 31

CURRENCY CONVERSION RATE (JICA rate at the time of January 2024)

EUR 1.00 = 157.599000 yen

US$ 1.00 = 142.364000 yen

ZMK 1.00 = 5.588340 yen

CHAPTER 1 PROJECT FRAMEWORK

This report is prepared in accordance with the Record of Discussion (R/D) on the "Technical Cooperation Project on Expansion of Community-Based Smallholder Irrigation Development Project in the Republic of Zambia" (hereinafter referred to as the Project or E-COBSI) signed between the Ministry of Agriculture of the Republic of Zambia (hereinafter referred to as MOA) and the Japan International Cooperation Agency (hereinafter referred to as JICA) on 11 October 2017. This report includes the rationale, implementation principles, methodology, overall work flow, implementation arrangements and achievements towards the project purpose for the entire project period.

1.1 BACKGROUND OF THE PROJECT

In the Republic of Zambia (hereinafter referred to as Zambia), approximately 60% of the total population is living in rural setting, and about 90% of them are engaged in agriculture[1]. Although the agriculture sector is important one to boost economic development, the agriculture depending on rain-fed is not stably productive due to the unstable rainfall pattern. Hence, irrigation development has been recognized as a significant approach. Still, out of 2,750,000 ha of potential irrigation area in Zambia, only 156,000 ha of the farmland has been developed[2]. For increasing the agricultural production, expansion of irrigated farmlands and dissemination of irrigation techniques are required, specifically, for the community-based irrigation, which covers approximately 70% of irrigation area.

Based on the achievement from the previous “Irrigation System Development Planning Study for Small-Scale Farmers (2009-2011)” (hereinafter referred to as “COBSI Study”) and “Irrigation Development Project for Small-Scale Farmers (2013-2017)” (hereinafter referred to as “T-COBSI”), the Follow-up Provinces (Northern Province, Luapula Province, and Muchinga Province) had already shared the technology and experience related to the construction of small-scale irrigation facilities (simple weirs, permanent weirs). Therefore, based on the understanding and recognition that COBSI is well-established in the Follow-up Provinces was provided comprehensive activities such as market-oriented agriculture, farm management, water management, facility maintenance, farmer organizations, nutrition improvement, gender, etc.

On the other hand, New Target Provinces (Copperbelt, Northwestern, and Central) focused on small-scale irrigation development by introducing simple weir construction into irrigation farming. In addition, marketing and nutritional improvement were used as motivation for farmer group activities. Furthermore, the Project has worked on packaging training and dissemination mechanisms that embody these COBSI approaches.

1.2 OBJECTIVES AND ACTIVITIES OF THE PROJECT

1) Overall Goal

Indicators[3] of Action Plan (2024-2026) for smallholder Irrigation development are achieved.

1 2015 Living Conditions Monitoring Survery Report, Central Statistical Office
2 Irrigation Policy and Strategy, Ministry of Agriculture and Co-operatives, 2004 (This is the latest version and no official revised one has been published since 2004)
3 The indicators of outputs of the Action Plan such as 1) number of trained staff (District TSB and camp extension officers), 2) number of sites and area of simple weirs, and 3) number of sites and area of permanent weirs are set for the indicators of Overall Goal of this project.

2) Project Propose

Community-based smallholder irrigation farming is promoted through the provision of smallholder irrigation infrastructure and management skills for smallholder farmers in the target area.

3) Expected Outputs

Output 1: Capacity of COBSI Promotion Unit officers is enhanced for planning and management of smallholder irrigation development schemes.

Output 2: Current situation and challenges of agricultural production in the target areas are clarified through surveys.

Output 3: Capacity of provincial, district and camp officers in promoting irrigation and agronomy technologies and marketing skills of farmers is enhanced for smallholder irrigation development.

Output 4: In the model site, smallholder farmers' knowledge and skills are improved for operation and maintenance (O&M) of irrigation facility, farm management and marketing.

Table 1.1 Project Outputs and Activities

Output/Activities	Description
Output 1	**Capacity of COBSI Promotion Unit officers is enhanced for planning and management of smallholder irrigation development schemes.**
Activity 1-1	Select COBSI Promotion Unit members and assign them as trainees from MoA to enhance planning and management capacity for smallholder irrigation development schemes.
Activity 1-2	Conduct trainings for the COBSI Promotion Unit members on basic principles of the irrigation development plan and design.
Activity 1-3	Conduct trainings for the COBSI Promotion Unit members on irrigation inventory survey and analyze irrigation potentials of the target areas.
Activity 1-4	Conduct OJT (On the Job Training) for the COBSI Promotion Unit members on site survey, design and construction supervision of permanent weirs to be constructed in the new target provinces.
Activity 1-5	Conduct OJT for the COBSI Promotion Unit members on O&M activities of the permanent weirs in the target sites in the new target and follow up provinces.
Activity 1-6	Prepare the annual budget and work plans for smallholder irrigation development.
Activity 1-7	Prepare a 3-year action plan (2024-2026) for smallholder irrigation development.
Output 2	**Current situation and challenges of agricultural production in the target areas are clarified through surveys.**
Activity 2-1	Collect basic data related to irrigation and agriculture in the new target provinces.
Activity 2-2	Select target sites from new target provinces based on the results of the data analysis.
Activity 2-3	Clarify the current socio economic status of the target sites (Activity 2.2) through interviews, workshops, etc.
Activity 2-4	Clarify the current status of irrigation/agriculture status of the target sites (Activity 2.2) through site inspection, interviews, etc.
Activity 2-5	In the follow-up provinces, clarify the current status of smallholder irrigation schemes (permanent and simple weir schemes) such as irrigation area, canal length, status of irrigation farming, the number of beneficiaries, issues that farmers are faced with, etc., though site inspection, questionnaires and interviews.
Output 3	**Capacity of provincial, district and camp officers in promoting irrigation and agronomy technologies and marketing skills of farmers is enhanced for smallholder irrigation development.**
Activity 3-1	Formulate training plans (kick-off, follow-up and annual evaluation workshop).
Activity 3-2	Conduct trainings with emphasis on simple weirs in new target provinces.
Activity 3-3	Formulate a plan to develop model sites for training of provincial, district and camp officers in the target sites in the follow-up provinces.
Activity 3-4	Conduct follow-up trainings in the model sites with emphasis on farm management, marketing, water management, and monitoring (mainly in the follow-up provinces).

Output/Activities	Description
Output 4	**In the model site, smallholder farmers' knowledge and skills are improved for operation and maintenance (O&M) of irrigation facility, farm management and marketing.**
Activity 4-1	Instruct famers on (O&M) of irrigation facility and farm management in the new target provinces.
Activity 4-2	Instruct farmers on farm management with emphasis on marketing (including SHEP study tours for lead farmers), water management, and cultivation technologies through model sites development in target sites in the follow-up provinces.

Source: Edited by JICA E-COBSI from RD

1.3 PROJECT TARGET AREA

The target area of the Project is composed of six provinces, and they are classified into two groups. First one consists of three provinces, namely, Northern, Luapula and Muchinga province, where COBSI Study and T-COBSI had been implemented (hereinafter referred to as “Follow-up Provinces”). Second group consists of newly targeted three provinces, namely, Copperbelt, North-Western and Central Provinces (hereinafter referred to as “New Target Provinces”). The total number of target districts is 45, 24 and 21districts from each Follow-up and New Target Provinces, respectively. In addition, in Follow-up Provinces, from the second year (2020) of the first phase, target districts were categorized into "direct support districts (15 districts)" and "indirect support districts (9 districts)", and the subsequent proceeded with project activities.

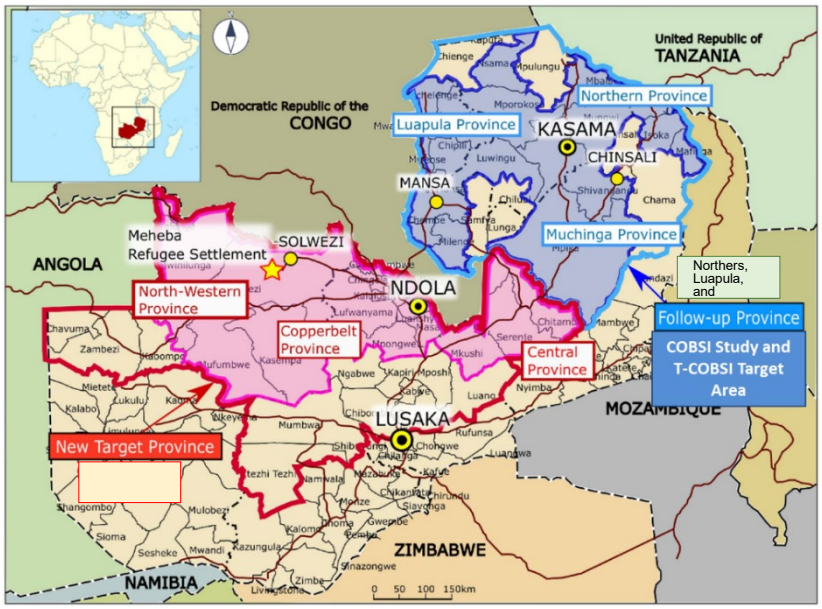


Figure 1.1 Target Area

Source：JICA E-COBSI

Table 1.2 Target Province and District

Target Area	Province	Number of target district	Remarks	
Follow-up Provinces	Northen	9	Direct supported district：6	Indirect supported district：3 (Nsama, Mporokoso, Senga hill)
	Luapula	8	Direct supported district：5	Indirect supported district：3 (Milenge, Nchelenge, Chembe)
	Muchinga	7	Direct supported district：4	Indirect supported district：3 (Mafinga, Shiwangandu, Lavushimanda)
	Total	24	15	9

Target Area	Province	Number of target district	Remarks	
New Target Provinces	Copperbelt	10		
	North-Western	8		
	Central	3		
	Total	21		
G. Total		45		

Source: JICA E-COBSI

1.4 PROJECT IMPLEMENTATION ARRANGEMENT

1.4.1 Joint Coordination Committee (JCC)

In the project, a Joint Coordination Committee (hereinafter referred to as JCC) was established to manage the project in order to determine the overall policy of the project and ensure smooth implementation of project activities. JCC members are from Headquarters of Ministry of Agriculture (hereinafter referred to as Ministry of Agriculture Headquarters or MOA HQ), Project Director, Project Manager, Project Coordinator, COBSI Promotion Unit of HQ and provincial level (hereinafter referred to as CPU), Zambian government officials, and the officers of JICA Zambia Office. Furthermore, the committee consisted of stakeholders from the Embassy of Japan in Zambia, and other related parties from the Japanese side.

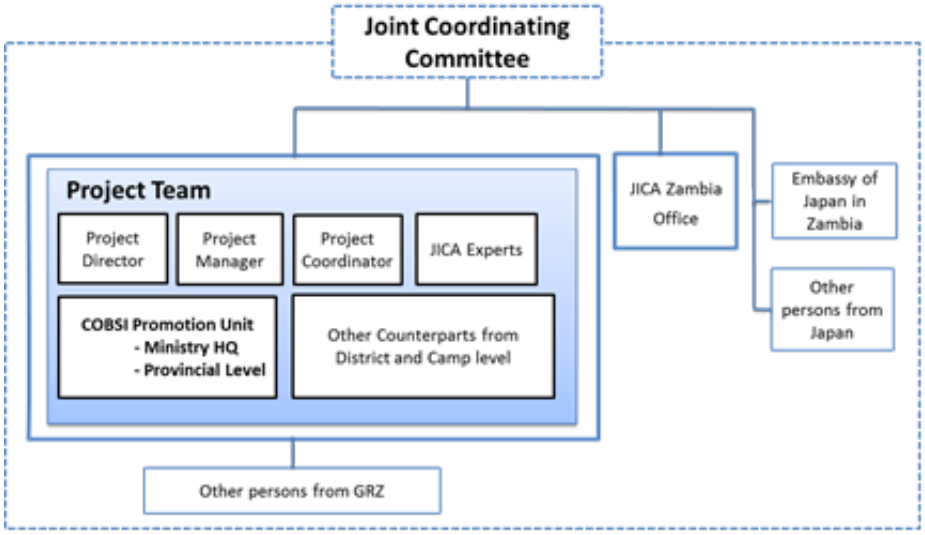


Figure 1.2 Structure of Joint Coordination Committee (JCC)

Source：JICA E-COBSI

1.4.2 COBSI Promotion Unit (CPU)

In this project, a CPU consisting of key counterparts (hereinafter referred to as C/P) was formed at MOA HQ and at the provincial level, respectively, as the Zambian implementation and management body for the project activities. The CPU will be responsible for a series of training activities and on-site monitoring and follow-up conducted by E-COBSI together with JICA project team, as well as liaising and sharing information with MOA HQ. The table below shows the CPU members as of January 2024.

Table 1.3 COBSI Promotion Unit（CPU）Member (As of January 2024)

MOA HQ, Province	Name	Position
MOA HQ	Dr. Shepande Chizumba	Director of Department of Agriculture, Project Director
	Mr. Malumo Nawa	Deputy Director of Technical Services Branch, Project Manager
	Mr. Andrew Sipawa Songiso	Principal Irrigation Engineer, Project Coordinator
	Mr. Davis Sampa	Principal Irrigation Engineer
	Mr. Mulele Sibeso	Principal Food Processing, Preservation and Storage Officer (Nutrition)
	Mr. Peter Zulu	Principal Agribusiness and Marketing Development Officer
	Ms. Harriet Matipa	Senior Planer
Northern Province	Mr. Sylvester Nyendwa	Provincial Agricultural Coordinator
	Mr. Innocent B. Mulauzi	Principal Agricultural Officer
	Mr. Sifaya Mufalali	Senior Irrigation Engineer
	Ms. Vivian Mwansa	Senior Food and Nutrition Officer
	Mr. Munsanka Chikobola	Senior Marketing and Development Officer
	Mr. Aaron Sakala	Senior Crop and Horticulture Officer
Luapula Province	Mr. Chate Godwin	Provincial Agricultural Coordinator
	Mr. Osbert Hamweete	Principal Agricultural Officer
	Mr. Mayson Sails	Senior Irrigation Engineer
	Mr. Festus Phiri	Acting Senior Food and Nutrition Officer
	Mr. Fidelis Mazuba	Senior Marketing and Development Officer
	Mr. Hobab Mumbo	Senior Crop and Horticulture Officer
Muchinga Province	Dr. Victor Mulopa	Provincial Agricultural Coordinator
	Mr. Fred Chikuta	Principal Agricultural Officer
	Mr. Nelson Phiri	Senior Irrigation Engineer
	Ms. Zulu Kochiwe	Senior Food and Nutrition Officer
	Mr. Francis Sakala	Senior Marketing and Development Officer
	Ms. Diana Simbotwe	Senior Crop and Horticulture Officer
Copperbelt Province	Mr. Yapulani Chunga	Provincial Agricultural Coordinator
	Mr. Julius Malipa	Principal Agricultural Officer
	Mr. Mwenya Sampule	Senior Irrigation Engineer
	Mr. Nalukui Sakala	Senior Food and Nutrition Officer
	Mr. Alick Chirwa	Senior Marketing and Development Officer
	Mr. Michael Musonda Mumbi	Senior Crop and Horticulture Officer
North-Western Province	Mr. Muyobo Shimabale	Provincial Agricultural Coordinator
	Mr. Mubambwe Simbarashe	Principal Agricultural Officer
	Mr. Jackson Bwalya	Senior Irrigation Engineer
	Mr. Kelvin Mutelo	Senior Marketing and Development Officer
	Mr. Bright Simwinga	Senior Food and Nutrition Officer
	Mr. Nakanga Austine	Senior Crop and Horticulture Officer
Central Province	Mr. Etambuyu Anamela	Provincial Agricultural Coordinator
	Ms. Jane Chintu Monga	Principal Agricultural Officer
	Ms. Mudenda Senkwe Cheelo	Senior Irrigation Engineer
	Mr. Brenda Maliti	Senior Food and Nutrition Officer
	Mr. Munthali Patrick	Senior Land Husbandry Officer
	Mr. Msiska Kachulu	Senior Horticulture Officer

Source：JICA E-COBSI

1.5 PROJECT PHASES

E-COBSI is composed of three phases as below. The initial schedule for the first phase was from January 2019 to August 2020. Due to the worldwide pandemic of COVID-19, the end of the first phase was changed to December 2020.

Table 1.4 E-COBSI Project Phases

Phase	Original	Revised	Remarks
Ph-1	December 2018～August 2020 (21 months)	December 2018～December 2020 (25 months)	-
Ph-2	September 2020～January 2022 (17 months)	February 2021～January 2022 (12 months)	-
Ph-3	February 2022～February 2024 (25 months)	February 2022～February 2024 (25 months)	No change

Source: JICA E-COBSI

1.6 TRAININGS

One of the main activities of the Project is implementation of a series of training. In order to promote the activities packaged by E-COBSI, such as small-scale irrigation development (COBSI approach), market-oriented agriculture (SHEP approach), water management, irrigation facility maintenance, farmer organization and nutrition improvement, the Project adopted a cascade-like technology transfer mechanism.

Here the project didn't set up a new specialised extension system, but used the existing agricultural extension system of the MOA to acquire a range of knowledge and techniques necessary for irrigated agriculture, marketing etc. The technology will be disseminated in a step-wise manner, from the small number of C/Ps to more relevant government officials, and finally to farmer groups in the community. By using this dissemination system, the project achieved impact from the first year of the project.

As the first step in this dissemination process, Training of Trainers (TOT) was conducted. The first step is to transfer COBSI technology from Japanese experts of JICA project team to provincial CPU members. Next, provincial CPU members who took TOT served as instructors, giving lectures to district technical service branch technicians (hereinafter referred to as district TSB), subject matter specialists (hereinafter referred to as district SMS), and CEOs who are on the front lines of agricultural extension. Kick-off training (hereinafter referred to as KOT) and Mid-term training (hereinafter referred to as MTT) were conducted to transfer a series of knowledge and techniques necessary for irrigated agriculture, cultivation, marketing, nutrition improvement, etc. After KOT, the district TSB, district SMS, CEO and others carried out wide-area deployment of COBSI technology through on-the-job training (OJT) for local farmer groups and fellow officers.

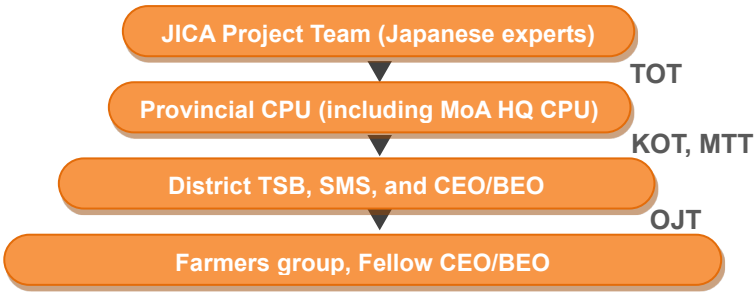


Figure 1.3 Cascade-like System for Technical Transfer

Source：JICA E-COBSI (BEO: Block Extension Officers who cover and manage some camps)

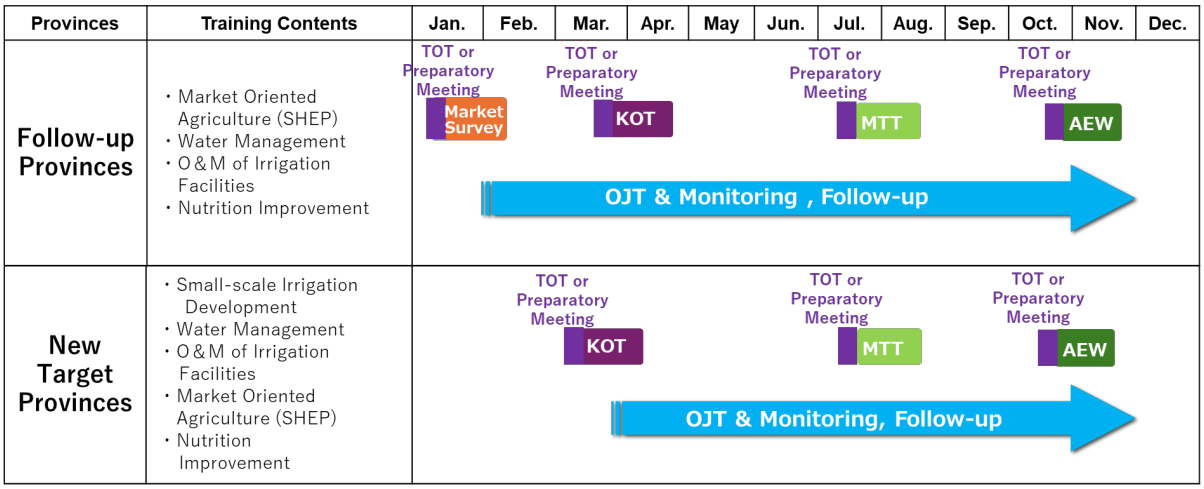


Figure 1.4 Training Schedule of E-COBSI
Source: JICA E-COBSI

1.6.1 Training of Trainers (TOT)

TOT was held in conjunction with the subsequent KOT, MTT, and Annual Evaluation Workshop (hereinafter referred to as AEW), with the purpose of developing instructors for these trainings and workshop.

JICA project team was the trainer of TOT, and the participants were TSB members from MOA HQ and CPU members from the provinces. During TOT, the training contents, points to emphasize in each training, how to transfer technology, etc. and training management methods such as determining the role of trainer for each training item, time allocation, and so on were explained. And the participants confirmed the preparation methods and logistics for training materials, stationery, etc. to be distributed.

This TOT was carried out throughout the entire project period. In 2019, the first year of the project, it was conducted face-to-face way, but from the second year (2020) onwards, it was conducted remotely in response to the coronavirus pandemic. At first, both the Japanese experts and the Zambian C/P were unfamiliar with implementing TOT remotely, but with repeated experiences, the both parties gradually adapted and were able to conduct it without any problems.

During the coronavirus pandemic, on-site activities such as monitoring and follow-up were limited due to the absence of Japanese experts in Zambia and domestic travel restrictions even within the country. Therefore, Japanese experts and Zambian C/Ps worked to further strengthen their mutual communication system and progress the project activities. This had a positive impact on the subsequent progress of the project.

1.6.2 Kick-off Training (KOT)

KOT conducted to transfer a set of technologies and skills necessary for small-scale irrigation development. The training period was from March to April, when the dry season begins every year. The trainer of KOT were provincial CPU members, and the trainees were from the district TSB, SMS (Market Development Officer (hereinafter referred to as DMDO), Crop Officer (hereinafter referred to as DCO), Nutrition Officer (hereinafter referred to as DFNO), and CEO. These participants also attended MTT and AEW following KOT, and implemented COBSI dissemination activities to farmers group

throughout the year.

KOT was conducted over 5 days (Monday to Friday) in both FU and NT provinces. The content of the training items differed between FU and NT provinces to match the objectives of the project. In other words, in FU provinces, the training held courses on the SHEP approach, horticultural crop cultivation methods under irrigation, and nutritional improvement.

In NT provinces, on the other hand, the training focused on introducing small-scale irrigation, such as how to construct simple weirs and irrigation canals. In response to suggestions from CPU members in NT provinces, KOT is also introducing content related to SHEP approach and nutritional improvement concepts. Regarding SHEP in particular, CPU members expressed the opinion that incorporating SHEP into the training will trigger the farmer group to move on to simple weir irrigation, so SHEP training was included at the beginning of the KOT training program.

In both FU and NT provinces, on the last day of the training, all trainees set their own annual activity plans and targets, and after KOT, they immediately returned to their respective areas/camps and begin COBSI activities to extend them to farmers group in community. In addition to KOT, in all of MTT and AEW trainings, achievement tests were conducted to gauge participants' understanding of the training content. (See attached appendix)

1.6.3 Mid-Term Training (MTT)

MTT was conducted every year between July and August, the middle of the dry season. The training schedule is 3 days. At the MTT, as a common item of the training for FU and NT provinces, the person in charge of each district gave a presentation on the progress of field activities after KOT, issues that occurred at the field level, and countermeasures to them, etc., and the participants shared these experiences and used as a reference for activities during the remaining dry season. MTT training items mainly include horticultural crop cultivation under irrigation, nutritional improvement, general farming management, demonstration field activities, and reporting systems.

Training on horticultural crop cultivation under irrigation includes training on appropriate cultivation techniques and methods for five crops, namely tomatoes, onions, okra, cabbage, and watermelon, which are often selected based on marketing surveys conducted as part of SHEP activities.

Regarding nutrition improvement, E-COBSI developed a material for dissemination using the hand-measured nutrition method and provided training so that even farmers who do not have measuring equipment can easily understand the amount of food they need to consume per day. In addition, in collaboration with COBSI, a pilot activity on fish farming was carried out, and training was provided on improving the nutritional status of entire families through self-consumption of fish harvesting or food purchases using sales proceeds.

Regarding general farming, training included irrigated farming, soil improvement, making bokashi fertilizer and compost, and how to keep farm records. In particular, in the training on how to keep farm management records, farmers are able to select more profitable crops by recording the production costs and sales income involved in crop cultivation and correctly understanding the net profit calculated from the record.

Regarding demonstration field activities, the officers reported on the status of district model sites set up

in each district. The activity of demonstration field was reported on the cultivation status of crops selected based on market research, as well as the trial activity of farming techniques the farmers would like to learn. Furthermore, during this demonstration field activity, the activity of Farmer Field Day (FFD) was also reported. At FFD, in addition to the members of COBSI farmer group, neighboring farmers also gathered to broadly share and exchange information on techniques and skills acquired through demonstration field activities from a ``Farmer to Farmer'' perspective.

With respect to the reporting system, E-COBSI trialed a reporting system using the Kobo tool box (data collection and aggregation app) as a way to gather information on the situation of COBSI activities from the camp level. The system piloted in Kasama District in Northern Province and Ndola District in the Copperbelt Province in 2022, followed by a trial in all districts in 2023. (See attached appendix)

1.6.4 Annual Evaluation Workshop (AEW)

At AEW, all participants presented their own progress toward the annual activity target they planned during KOT, and they discussed and evaluated the project achievements. They also presented on the difficulties faced during COBSI activities, the solutions adopted for them, and the results (good examples), and shared them as reference for the next year's activities.

Particularly, group discussion was carried out to share the important topics raised in the target season, and the results, challenges, and solutions were confirmed among the participants.

In addition, feedback from provincial CPU on one year's monitoring and the next year's activity and budget plans were presented. (See attached appendix)

1.6.5 Market Survey Training (MST)

In addition to the above-mentioned trainings and workshop, FU Provinces additionally implemented Market Survey Training (hereinafter referred to as MST) as part of SHEP activities from the second year onwards.

The implementation period of MST was set from January to February every year in accordance with the order of SHEP approach.

By implementing MST during this period, farmers will obtain information to determine target crops for coming dry season irrigation.

From the above mentioned so far, the annual training schedule of E-COBSI is as follows: January-February: MST (FU Provinces only), March-April: KOT, July-August: MTT, and November-December: AEW. During this irrigation season, through on-the-job training (OJT) activities for farmer groups, the Project promoted introduction of simple weir-irrigated agriculture, including simple weir construction, water management, irrigation facility maintenance, implementation of the SHEP approach and nutrition improvement activities. (See attached appendix)

1.7 LOGISTICS OF THE PROJECT

1.7.1 Condition of Logistic Support from Japan Side

Under the principle of Japan’s technical cooperation project, JICA mainly focuses on the technical support, which is essentially to be led by the recipient government’s initiative. Considering the current

situation and the other donors support in Zambia, the Project decided the condition of support as follows; i) the Project does not cover payment of Daily Subsistence Allowance (DSA) to the extension officers for conducting OJT regarding irrigation agriculture development in their responsible areas; and ii) the Project supports DSA and lodging allowance for participating in the training by the project or conducting additional activities such as basic information survey. iii) the price of supports follows the regulation of JICA Zambia Office or the Government of Zambian. Also, fuel support is necessary for the extension activity. Therefore, the Project covered the fuel cost within one year since the first participation in the training, as far as the extension officers conducts their routine works in addition to the Project activities.

1.7.2 Provision of Fuel for COBSI Dissemination

As mentioned above, the Project utilizes MOA's existing agricultural extension framework, first from Japanese experts of JICA project team to provincial CPU, then from provincial CPU to district TSB, SMS and CEO, and then the Project established an extension system that provides technical know-how in cascade-like stages from the district TSB, SMS, and CEO to farmer groups. Therefore, the challenge was how to implement outreach activities to farmers by the CEO, who play extension activity at the frontline.

The CEO's activities in E-COBSI are different from the usual agricultural extension service being carried out by her/him, and include identification of potential sites for small-scale irrigation development and construction of simple irrigation facilities and transfer of knowledges and skills of the SHEP approach to farmers. Securing transportation for such activities is a huge challenge for many CEOs. To support this effort, the Project provided fuel for motorcycles used by CEOs for E-COBSI dissemination, and fuel for provincial CPU and district TSB and SMS too. Furthermore, as this fuel arrangement was for OJT to put into practice what CEO learned in the training, fuel costs for each CEO was provided only for one activity season (only for one irrigation season).

Table 1.5 Fuel Provision Arrangement

Office, CEO	Amount per month	Unit	Type of fuel
Provincial CPU	250	Liter/office	Diesel
District TSB	150	Liter/office	Diesel
CEO, BEO	30	Liter/person	Petrol

Source：JICA E-COBSI

1.7.3 Necessity of Budget Allocation by the Government of Zambia

Although the Project decided to support a part of necessary expenditures, the most important task of the Project is the capacity development of the governmental officers (e.g., CPU, TSB and CEO). In order to accomplish increasing the agricultural production, the budget preparation, especially, logistics for provincial CPU, District TSB and SAM, and CEO and the budget of weirs establishment, by the Government of Zambia is necessary.

In addition, in order for the Zambian government to continue disseminating COBSI even after the end of E-COBSI, the Project supported CPU of MOA HQ in developing the 3-year action plan (2024-2026) which indicates the activity budget for the next three years. In addition to MOA's own budget, these funds are scheduled to be allocated by ZAMGRO with support from the World Bank (hereinafter referred to as WB). However, at the time of writing this report, no clear policy regarding budget expenditure has been established, and continued follow-up is required.

1.7.4 Project Office

The location of two target areas, Follow-up Provinces and New Target Provinces, are located far away, approximately ten hours by car from the former to the latter. In order to carry out the Project activities effectively and efficiently, the Project set up the Project base office for the implementation in Kasama, capital of Northern Province, and in Ndola, capital of Copperbelt Province, respectively. Besides, the Project set the base in Lusaka as well to share the progress with HQ of the MOA and to enhance the capacity of CPU. In total, three project bases are to be established for the Project implementation.

In order to achieve the project purpose, close communication among CPUs in HQ and each province is necessary. The Project assigns the Team leader and Co-team leader a key role of the communication. The Team leader manages the Project activities and enhances the capacity of CPU of MOA HQ at the project base in Lusaka and in Ndola. The Co-team leader is mainly in charge of the SHEP approach training and monitoring, and also closely works together with the CPU in the Follow-up Provinces at the project base located in Kasama.

CHAPTER 2 PROJECT ACTIVITIES

2.1 ACTIVITIES ON OUTPUT NO.1

2.1.1 Select COBSI promotion unit members and assign them as trainees from MoA to enhance planning and management capacity for smallholder irrigation development schemes

During the first phase, CPUs were established in the Ministry of Agriculture headquarters and in each province. They played a central role in project training management and administration, as well as in monitoring and follow-up of COBSI sites within the province. Especially during the second phase, Japanese experts' travel to Zambia and movement within the country were restricted due to the effects of the COVID-19 pandemic. During this period, Japanese experts were not physically present on-site and were primarily supported remotely. However, the CPU took the lead in managing and organizing the training, enabling the planned project activities to proceed as scheduled. Through this, the CPU's capacity for planning and managing small-scale irrigation development was significantly strengthened.

2.1.2 Conduct trainings for the COBSI promotion unit members on basic principles of the irrigation development plan and design

Japanese experts conducted TOT training and training preparation CPU meetings, during which CPU members, including irrigation officers and extension officers, learned the basic principles of irrigation development planning and design.

2.1.3 Conduct trainings for the COBSI promotion unit members on irrigation inventory survey and analyze irrigation potentials of the target areas

In the Follow-up Provinces, CPU members explained how to conduct the irrigation inventory survey (existing site survey) during the 2019 MTT. CPUs took the lead in mobilizing county officials and CEOs to conduct the study. By 2023, 461 sites had responded to the survey. The results are outlined below in 4.1.3. Meanwhile, in the New Target Provinces, the findings of the analysis of the natural conditions survey to determine irrigation potential, as described in 4.1.1, were reported and the evaluation content was explained during the 2019 TOT.

2.1.4 Conduct OJT (On the Job Training) for the COBSI promotion unit members on-site survey, design and construction supervision of permanent weirs to be constructed in the New Target Provinces

Training on permanent weir construction was conducted in the New Target Provinces in October-November 2021, along with site surveys and design work. Construction of permanent weirs started in the dry season of 2022, and by December 2023, a total of three permanent weirs had been constructed, one in each of the New Target Provinces. During the construction period, on-the-job training on construction management was provided to CPU members, county officials, and the farmer groups involved. Additionally, following the recommendations of the terminal evaluation mission, training was conducted from October to December 2023 for the construction of an additional permanent weir, as well as the preparation of design drawings and documents for seven more weirs.

2.1.5 Conduct OJT for the COBSI Promotion Unit members on O&M activities of the permanent weirs in the target sites in the New target and Follow-up Provinces

Japanese experts conducted monitoring of the maintenance of 14 permanent weirs constructed in T-COBSI with CPU members in the Follow-up Provinces in May 2019. On this occasion, supplementary explanations of the training materials were provided to the provincial CPU members, district officials, CEOs in charge, and farmers. Direct on-the-job training was also provided in the field. Additionally, in September-October 2020, a Follow-up Provincial CPU member, Senior Irrigation Engineer (SIE), and in October-November 2021 and October-November 2023, a CPU member of the Ministry of Agriculture headquarters, Principal Irrigation Engineer (PIE), similarly monitored 14 existing permanent weir sites to check their condition and provide on-the-job training on maintenance and management. In addition, Japanese experts are providing on-the-job training on maintenance and management in 2023, when the construction of permanent weirs is completed in the New Target Provinces.

2.1.6 Prepare the annual budget and work plans for smallholder irrigation development

All provincial CPUs prepare their activity budget and work plan for the following year in the AEW. The activity budgets and work plans are also reported and shared at the national CPU and JCC meetings.

2.1.7 Prepare a 3-year Action Plan (2024-2026) for Smallholder Irrigation Development

A three-year action plan for post-E-COBSI activities was prepared by the C/P officer of the Ministry of Agriculture HQs in 2023 with the support of Japanese experts. The action plan was completed in October 2023 and subsequently approved by the Permanent Secretary (PS) of the Ministry of Agriculture on 6 December 2023.

2.2 ACTIVITIES ON OUTPUT NO.2

2.2.1 Collect basic data related to irrigation and agriculture in the New Target Provinces

To determine the irrigation potential of the target districts in the New Target Provinces during the first phase, basic information on irrigation and agriculture within these areas was collected. This included surveying the number of perennial rivers, assessing the status of existing irrigation systems, and evaluating the productivity and marketability of agricultural products in each location.

2.2.2 Select target sites from New Target Provinces based on the results of the data analysis

In the first phase, the results of the Natural and Social Conditions Survey conducted in the New Target Provinces were organized and analyzed. The irrigation potential was assessed and categorized into four ranks (Rank A to Rank D). Based on the evaluation results, camps with a rank of B or higher were selected as potential project targets. The target sites (camps) were then chosen in consultation with the State CPU.

2.2.3 Clarify the current socio-economic status of the target sites (Activity 2.2) through interviews, workshops, etc.

The household survey revealed the socio-economic situation in the target sites. The household survey was conducted in model sites in all 45 target districts (21 New Target Provinces and 24 Follow-up Provinces) using a questionnaire with about 10 households in each site. The survey covered a wide range of items, including household situation, farm and off-farm income, access to infrastructure, ownership of household goods, access to water, gender roles, irrigated and rainfed farmland area, irrigation water

management, land use status, adoption of appropriate agricultural technologies, marketing, farming, and marketing challenges. As a result, 435 households from 45 model sites responded. In addition to this household survey, a nutrition survey was conducted in 15 districts in the Follow-up Provinces and all 21 districts in the New Target Provinces, revealing the current situation and challenges related to nutrition in the target areas.

2.2.4 Clarify the current status of irrigation/agriculture status of the target sites (Activity 2.2) through site inspection, interviews, etc.

The irrigation and agriculture situation in the New Target Provinces was revealed through the household survey and group interviews conducted in all model sites. The group interviews in the model sites covered the same survey items (irrigated area, canal length, number of beneficiary households and farmers, water management and maintenance, farming situation and challenges, etc.) as those mentioned in the COBSI existing site surveys above. Additionally, throughout the project period, Japanese experts and provincial CPU members visited the district model sites and other COBSI sites to conduct interviews on irrigation, agriculture, and nutritional status, as well as to monitor and follow up on the progress of activities.

2.2.5 In the Follow-up Provinces, clarify the current status of smallholder irrigation schemes (permanent and simple weir schemes) such as irrigation area, canal length, status of irrigation farming, the number of beneficiaries, issues that farmers are faced with, etc., though site inspection, questionnaires and interviews

The current status of small-scale irrigation schemes in the Follow-up Provinces is revealed by the COBSI existing site survey. Interviews were conducted at the COBSI sites identified at the end of the former project, T-COBSI. The interviews covered topics such as irrigated areas, canal length, number of beneficiary households and farmers, water management and maintenance, farming situation, and challenges, among others. The survey methods and contents were explained in the MTT, and the Provincial CPU took the lead in conducting the survey and mobilizing district officials and CEOs. Responses were received from 461 of the 774 sites identified so far.

2.3 ACTIVITIES ON OUTPUT NO.3

2.3.1 Formulate training plans (Kick-off, Mid-term and Annual Evaluation Workshop)

The training plan was based on the plan prepared for the former project, T-COBSI, and was developed in the first year of the project after consultations with CPU members at the Ministry of Agriculture's headquarters and with the provincial CPUs in each province. The results of implementing this training plan were reported at each province's AEW and discussed at the national CPU and JCC meetings held after each training cycle to improve the plan for the next activity cycle.

2.3.2 Conduct trainings with emphasis on simple weirs in New Target Provinces

In the New Target Provinces, training focused on the construction of simple weirs, which serve as the entry point for irrigation development, was conducted in KOT. Training on water management and maintenance, as well as training on the SHEP approach, were also provided to ensure proper operation and maintenance of irrigation facilities by farmers who had constructed simple weirs. Additionally, crop selection based on market needs was covered in the training.

2.3.3 Formulate a plan to develop model sites for training of provincial, district and camp officers in the target sites in the Follow-up Provinces

One model site was established in each district in Follow-up and New Target Provinces. Through various trainings, Provincial CPUs, district officials, and CEO/BEOs learned how to utilize the model sites, and each district developed an activity plan for the model site. Based on this activity plan, each district office and the CEO/BEO in charge implemented the activities and reviewed them at AEW.

2.3.4 Conduct follow-up training in the model sites with emphasis on farm management, marketing, water management, and monitoring (mainly in the Follow-up Provinces)

Lectures and practical training on irrigation development, cultivation techniques, marketing (using the SHEP approach), water management, gender dynamics, nutrition improvement, and strengthening farmers' organizations were conducted during the TOT for Provincial CPU members. Later, similar training sessions were held during the KOT and MTT for district officials and BEOs/CEOs. Provincial CPU members, district officials, and BEOs/CEOs reviewed each activity and further deepened their knowledge through feedback from Japanese experts and CPU members from the Ministry of Agriculture headquarters, in the AEW.

In each training session, district officials and BEOs/CEOs, who had acquired skills and methods related to project activities, provided on-the-job training to farmers in the target sites on marketing (using the SHEP approach), water management, maintenance management, strengthening farmers' organizations, gender, and nutrition improvement after completing their training. In addition, Provincial CPU members and Japanese experts regularly monitored and followed up on the progress of farmer capacity building by these BEOs/CEOs. Specifically, the survey focused on the district model sites, reviewing the implementation of E-COBSI training for farmer groups, irrigation facilities and water management, field conditions, and the status of farmer group organisation and marketing.

2.4 ACTIVITIES ON OUTPUT NO.4

2.4.1 Instruct farmers on O&M of irrigation facility and farm management in the New Target Provinces

The project implemented a cascade approach, with TOT training conducted by Japanese experts and CPU members from the Ministry of Agriculture headquarters for provincial CPU members. This was followed by KOT and MTT sessions for district officials and BEOs/CEOs, with the provincial CPU members who had attended the TOT serving as instructors. Following these trainings, district officials and BEOs/CEOs who had attended KOT and MTT provided on-the-job technical transfer of the training to farmers in their areas of jurisdiction. Training on maintenance of irrigation facilities and farming operations for farmers in the New Target Provinces has continued since the KOT conducted in April 2019, when the project started.

2.4.2 Instruct farmers on farm management with emphasis on marketing (including SHEP study tours for lead farmers), water management, and cultivation technologies through model sites development in target sites in the Follow-up Provinces.

In the Follow-up Provinces, training was conducted in a cascade approach as in the New Target Provinces. Content on SHEP approaches, water management/maintenance, cultivation techniques,

farmer management, gender, improved nutrition, and farmer organizational strengthening in the Follow-up Provinces was communicated to district officers and BEOs/CEOs through the implementation of KOT and MTT. This was attended by district officers and BEOs/CEOs, who provided training to farmers within their command area, including at district model sites. In addition, from 2021 onwards, demonstration plots were established at all district model sites to enhance the dissemination of SHEP and cultivation techniques. To this end, district officers and BEOs/CEOs organized FFD using the district model sites in many places, which facilitated the dissemination of the technologies to farmers in the vicinity. Moreover, the National Agriculture Information Service (NAIS), the public information department of the Ministry of Agriculture, participated in the FFD, and E-COBSI activities were introduced in newspapers, TV, and radio agricultural news programs. Furthermore, farmer groups supported by other donors have visited the district model sites developed by the project for study tours, facilitating the spread of knowledge and technologies introduced by E-COBSI.

2.5 PERMANENT WEIR CONSTRUCTION

COBSI's entry point for introducing small-scale irrigation is through the construction of simple water harvesting structures called ``Simple Weirs'' by farmer groups. This enables farmers (groups) who previously had no irrigation facilities and relied solely on rain-fed agriculture to start dry season irrigated agriculture. Simple weirs can be constructed using only locally available materials that can be collected in the community area, and do not require large investments. In this way, a group of farmers who start irrigated farming using simple weirs become accustomed to irrigated farming by experiencing one or two irrigation seasons.

On the other hand, simple weirs have a certain extent of water leakage due to their structure. Therefore, in order to more stably intake the irrigation water from the weir and move toward the vertical or horizontal expansion of irrigated agriculture, COBSI has an upgraded system from a simple to a permanent weir and has been building permanent weirs in various locations.

The cost of constructing this permanent weir is approximately USD 18,000, depending on the size of the weir. The cost is estimated as the average cost of the three weirs constructed by E-COBSI, including construction tools, cement, stone, sand transport, etc. In addition, the labour required to collect construction materials such as stones and sand, and to construct the permanent weir, is provided by targeted groups of farmers. The farmer group already has experience in irrigation using simple weirs and possesses the technology and knowledge to operate a sustainable irrigation system, including water management and maintenance. Therefore, the investment risk associated with constructing the permanent weir can be minimized.

This section reports on the training, current construction status and economic analysis of the permanent weir constructed using the COBSI upgrade system.

2.5.1 Training for permanent weir construction

In 2021 and 2023, training on permanent weir development was conducted for senior irrigation officers in the New Target Provinces. The purpose of the 2021 training was to select and construct one permanent weir in each province to be constructed under E-COBSI, and the purpose of the 2023 training was to select and design 2-3 sites in each province to be constructed by other donor funds such as ZAMGRO.

1) Training in 2021

From 19 to 22 October, SIEs from Northern and Luapura Provinces participated as master trainers in Masaiti Farm Institute, where lectures were given on irrigation development planning, field survey methods, design, construction plans, construction cost estimation, surveying and irrigation water demand calculation by CROPWAT. The participants then collected information on suitable sites for permanent weirs in each province and selected three candidate sites in each province. From 1 November, field surveys of natural conditions, social conditions, etc. were conducted, including surveys of candidate sites in each province. From 15 to 19 November, based on the survey results, they conducted design, construction planning, construction cost estimation, and compared various conditions to determine a permanent weir site in each province, and prepared a design report. After that, the orientation on the construction of the permanent weir in the target area was conducted. The participants of the training are as follows.

Table 2.1 Participant List of the Training for Permanent Weir Construction(2021)

Province	Name	Position
Copperbelt Province	Mwenya Sampule	SIE: Senior Irrigation Engineer
	Masauso Ndhlovu	SFPMO: Senior Farm Power and Mechanization officer
	Nswana Malwa	AS: Agriculture Specialist
	Peter Mbao	TO, Mfulira: Technical officer
	Wilfred L. Hanjabu	AS, Chingola
	Valentine Michele	SLHO: Senior Land-husbandry officer
North-Western Province	Jackson M Bwalya	SIE: Senior Irrigation Engineer
	Teddy Malipilo	AS: Agriculture Specialist
	Alfred Anyandwile	AS, Solwezi: Agriculture Specialist
	Mwansa Musankabala S.	TO, Mufumbwe: Technical officer
	Sampa Soneka	AS, Kabombo
Central Province	Cheelo H M Senkwe	SIE: Senior Irrigation Engineer
	Patric Munthali	SLHO: Senior Land-husbandry officer
	Jephurn M. Shemu	SFPMO: Senior Farm Power and Mechanization officer
	Obster Lungu	TO, Serenje: Technical officer
	Lawrencw Mbewe	STO, Mkushi: Senior Technical officer
Nortern	Sifaya Mufalali	SIE, Master Trainer: Senior Irrigation Engineer
Luapula	Mayson Saila	SIE, Master Trainer: Senior Irrigation Engineer

Source: JICA E-COBSI

(1) Lectures on design of permanent weir

The training was carried out as follows.

On the first day, after orientation on the contents of the training, the participants learned about the implementation procedure, construction of a permanent weir, selection of candidate sites, field survey items and survey methods, irrigation plans, actual design methods, determination of the design flood level, layout of weirs, drawing methods, etc., and the basics of design.

On the second day, participants learned about quantity calculation, construction planning, construction cost estimation, construction methods, maintenance of facilities, creation of location maps using GPS and Google Earth, and practiced examining irrigation water requirements using CROPWAT.

On the third day, the participants practiced on-site surveying and learned about investigating the natural conditions around the proposed site of the permanent weir. They also studied the conditions for

determining the weir's position, its environmental impact, and its effects on both upstream and downstream areas. Additionally, they practiced surveying along the weir axis.

On the fourth day, based on the survey results, the participants practised making a river cross-section, determining the design flood level, determining various heights and dimensions, and making longitudinal cross-sections and plans of weirs.

(2) On-site survey on candidate sites

Starting the week after the lecture, three candidate sites were selected in each province, and a field survey was conducted in each candidate area. During the field survey, weir sites were selected and surveyed, taking into account topographical conditions. In many cases, the current simple weir sites were not suitable for permanent weir construction, and in some districts, the weir site was selected several hundred meters upstream of the current simple weir site with consideration given to another simple weir upstream. In addition to the river flow and natural conditions around the proposed site, the field survey included the number of beneficiaries, irrigable area, crops grown, upstream and downstream water use, the presence of water conflicts and other agricultural and social conditions, the location of stone and sand extraction as the main construction material, and access to the site.

(3) Design, construction plan, and construction cost estimation based on the site survey results

Each candidate site was designed on the basis of the field survey conducted at three sites in each province. The training took five days. On day 1, the cross-section of the river was prepared based on the actual survey results and the design flood levels were determined. On day 2, the longitudinal section of the weir, plans and various cross-sections were prepared. On the third day, quantity surveying and manpower planning were carried out. On the fourth day, the work schedule was prepared, the construction cost was calculated, and the comparative table was prepared, including agriculture, maintenance, social environment and socioeconomic. The priority of the candidate sites for the construction of the permanent weir was determined according to the comparison table. On the fifth day, the participants learnt how to study the amount of irrigation water required and how to prepare a design report.

(4) Candidate District Selection Results

The results of the site selection process are shown in the following tables. At the first priority site, an orientation meeting was held with the farmers' group. During the orientation, members of the monitoring committee were elected and details of the construction of the permanent weir were discussed, such as the farmers providing labour, collecting stones and sand, how many days a week and how many hours a day they would work. The construction method was explained with the help of manuals and it was agreed that the construction period would be about six months. After the orientation, the preparatory work began.

Table 2.2 List of candidate sites for permanent weir construction in Copperbelt Province (2021)

District	Chingola	Kalulushi	Mufulira（建設実施郡）
Site	Minshingwa	Mupitanshi	Twalubuka
Outline	20 Households, 10Ha Potential area & 5Ha currently under irrigation	10 Households, 15Ha potential & 1Ha currently under irrigation	20 Households, 10Ha potential area & 5Ha currently under irrigation
Technical View	L=70m, H=3.85m, Right-Sided weir, Width of spillway = 9.8m, Stone masonary volume=262.92m³	L=50m, H=4.5m, Right-sided weir, Width of spillway=10.7m, Stone masonry volume=295m³	L=70m, H=3.5m, Both sides combined weir, width of spillway=17.6m, Stone masonry volume=450.4m³
Farming O & M	Tomato (1Ha), Impwa (1Lima),Cabbage (1Ha), Rape & Chili (1.5Ha), G/Maize (3Ha). Weir & furrow maintenance poorly maintained	Green Maize(2.5Lima), Rape (0.5Lima), Onion (1Lima) & Okra (0.25Lima). Weir & furrow maintenance conducted.	Tomato (1Ha), Cabbage (3Ha), Rape 2Ha, Maize (4Ha), Onion (0.5Ha). Weir & furrow regularly & well maintained
Social & Environmental View	No significant environmental impact. No need to cut trees and good participation of men, women & youths	The site is in a forest reserve. Fair farmer participation	Need to cut few trees around the site. Good participation of men, women & youths
Socio-economic view	Cost: K520,190.00, 20 Households & 10Ha Potential area	Cost: K543,504.20, 10 Households & 15Ha potential area	Cost: K733,720.00, 20HH & 10Ha potential area
Overall	The current irrigated area is large enough for upgrade and there is potential to upgrade. The group is formalized & farmers are actively engaged in crop cultivation	The area has high potential but the current area is very low. The site is in forest reverse resulting in low turnout of farmers & group is not formalized	Good potential for upgrade & group is formalized & farmers are actively in crop cultivation
Priority	2	3	1

Source: JICA E-COBSI

Table 2.3 List of candidate sites for permanent weir construction in Northwestern Province (2021)

Site	Kasamba	Kanyikomboshi	Kabele/shibende（建設実施郡）
Outline	13 Households irrigate 0.56 ha	12 Households irrigate 1.1 ha	35 Households irrigate 1.75 ha
Technical View	Permanent weir is adoptable L = 49.8m, H = 0.7m, both side combined type weir. Width of spillway 32m, Stone masonry 684.8m^3 , embankment m^3, River flow 229.2lts/s	Permanent weir is adoptable L = 23.5m, H = 1.34m, both side combined type weir. Width of spillway 12.9m, Stone masonry 243.18m^3 , embankment 30.2m^3, River flow 338lts/s	Permanent weir is adoptable L = 55m, H = 0.9m, both side combined type weir. Width of spillway 14.5m, Stone masonry 348.62m^3 , embankment xx m^3, River flow 97lts/s
Farming operation and maintenance	Vegetable: 0.25lima Chinese Cabbage, 0.25lima Tomato, 0.25lima Cabbage, 0.25lima onion, 1lima Maize, 0.25lima G/nuts	Vegetable: 1.2lima Onion, 0.25lima Cabbage, 1.2lima Egg plants, 1lima tomato, 0.25lima Ginger, 0.25lima Green Maize and 0.25 Green beans	Vegetable: 0.25lima Rape, 2lima Maize, 0.25lima Cabbage, 2lima Egg plants, 0.25lima Okra
Social and environmental view	No significant environmental impacts. No need to cut trees around the site. Young people are actively working for irrigation group	No significant environmental impacts. No need to cut trees around the site.	No significant environmental impacts. No need to cut trees around the site.
Social economic view	Cost 1,418,381ZMK, 22 HH, Potential area 8 Ha	Cost 243,551ZMK, 12 HH, Potential area 3 Ha	Cost 436,882ZMK, 35 HH, Potential area 8 Ha
Overall	Most costly and less beneficiaries	Most economical but current irrigated area is small	Current irrigated area is enough large. Young people are working actively and sustainability and expansion of area is expected
Priority	3	2	1

Source: JICA E-COBSI

Table 2.4 List of candidate sites for permanent weir construction in Central Province (2021)

Site	Mbaswa-Serenje District	Mulembo-Serenje	Kafwa- Mkushi（建設実施郡）
Outline	36 households,Irrig 2Ha	16 house holds, Irrig 5Ha	56 Households, Irrig 18 Ha
Technical View	L 56.85m, H=3.15m, Length of Spill way=14m, Stonemasonery:340.38m³. Permanent weir is adoptable, River flow 135lit/s	L=49.34m, H=1.06m, Length of Spill way=7.43, Stonemasonry:151.09m³. Permanent weir is adoptable	L=43.9m, H=1.03m, Length of spill way=6m, Stonemasonry=318.27m³ Permanent weir is adoptable, River flow 120lit/s
Farming O&M	Veg grown: Tomato=1Ha, Okra=0.2Ha, Onion=0.1, Impwa=0.05Ha, Cabbage=0.035, Rape=0.375Ha. Maintenance of weir is done 4times in ayear & Maintenance of the canal is done 3times in a year	Veg grown: Maize=1.35Ha, Impwa=1.3Ha, Rape = 1.1Ha, Onion= 0.3Ha, Tomato=0.4Ha	Veg Grown: Tomato 6.5Ha, Green maize=4Ha, Impwa =1Ha, Rape=2Ha, Cabbage=3Ha, Onion 1.5Ha. Maintenance of the weir is done once per year and maintenance of the canal is done 4times per year
Social and Environmental View	No significant environmental challenges. Farmers are working together and are committed	No significant environmental challenges. Farmers are working together and are committed	Proposed site is in the forest reserve but farmer fields are outside the forest area. Farmers are committed.
Social Economic View	Cost Est K320,542.03, Potential Irrig. Area 15Ha. Currently, the Furrow is also supplying water to two fish ponds	Cost Est. K172,763.70 Potential Irrigated area 8Ha	Cost Est. K399,527.4, Potential Irrig. Area 26Ha, Currently the Furrow is also supplying water to 12 fish ponds
Overall	Potential to increase the irrigated area is high but farmers are underutilizing the furrow	Most cost-effective site but farmers are underutilizing the furrow (current irrigated area is small)	Farmers are committed but the current challenge is in sharing the water between the two groups. The proposed permanent weir will boost the water supply to the two irrigation schemes which will help resolve the challenge. The site has the highest cost but its the most productive site
Priority	2	3	1

Source: JICA E-COBSI

2) Training in 2023

(1) Summary

Training on permanent weir development was provided to 16 senior irrigation officials in the New Target Provinces. This training is similar to the one conducted in 2021 but aims to prepare for the construction of a permanent weir using ZAMGRO and other donor funds and to familiarise irrigation staff with the development of a permanent weir. Nine of the 16 officers did not receive the previous training due to transfer or other reasons, but more staff were trained as a result.

From 17 to 20 October, lectures and drawings on irrigation development plans, field survey methods, design, construction plans and construction cost estimation were prepared at the Masaiti Farm Institute, Copperbelt State, as well as practical training on calculating the amount of water used for irrigation using CROPWAT. At that time, irrigation engineers (SIEs) from the New Target Provinces who had received the previous training led the lecture as trainers, and the Japanese expert only gave advice and supplementary explanations.

Participants then gathered information on suitable sites for permanent weirs in each province, selected seven candidate districts in three provinces, and conducted field surveys of natural and social conditions.

The surveys for the candidate districts were conducted from 31 October to 3 November in Central Province, from 6 to 9 November in Copperbelt Province and from 13 to 16 November in North western Province. Based on the survey results, design drawings, work plans and cost estimates were prepared at Masaiti Farm Institute from 27 November to 1 December.

Due to time constraints, the design reports for three of the seven districts were completed by the end of 2023 for implementation in 2024, and the design reports for the remaining four districts were completed by the end of January 2024 for implementation in the next financial year or later.

Table 2.5 Participant List of the Training for Permanent Weir Construction (2023)

州	Name	Position
Copperbelt Province	Mwenya Sampule	SIE: Senior Irrigation Engineer
	Reuben Wanki	TO: Technical officer
	Lackson Chombela	IO: Irrigation officer
	Francis Kashweka	TO: Technical officer
	Wilfred L. Hanjabu	AS: Agriculture Specialist
	Eugene Sinyangwe	TO: Technical officer
North-Western Province	Jackson M Bwalya	SIE: Senior Irrigation Engineer
	James Nsowela	TO: Technical officer
	Alfred Anyandwile	AS: Agriculture Specialist
	Mwansa Musankabala S.	IE: irrigation Engineer
	Chinyanta Kennedy	AS: Agriculture Specialist
Central Province	Cheelo H M Senkwe	SIE: Senior Irrigation Engineer
	Patrick Munthali	SLHO: Senior Land-husbandry officer
	Jephurn M. Shemu	SFPM: Senior Farm Power and Mechanization officer
	Adamson Tembo	IE: irrigation Engineer
	Chindima Kalaba	TO: Technical officer

Source: JICA E-COBSI

(2) Candidate Site Selection Results

The candidate districts were as follows An orientation will be given to the farmer groups in the future, and the same explanations and agreements will be made with the farmer groups as before, and preparatory work will be started.

Table 2.6 List of candidate sites for permanent weir construction (2023)

Copperbelt Province			
District	1-Chililabombwe	2-Masaiti	-
Site	Fitobaula	Mwambachimo	-
Outline	10 Households, 3.0 ha Potential area & 1.525 ha currently under irrigation	36 Households, 7.5 ha Potential area & 3.5 ha currently under irrigation	-
North-Western Province			
District	3-Ikelenge	4-Kasempa	5-Mwinilunga
Site	Mwakama	Kampombo	Kaunda Farms
Outline	16 Households, 5.0 ha Potential area & 0.5 ha currently under irrigation	36 Households, 10 ha Potential area & 1.0 ha currently under irrigation	36 Households, 6.25 ha Potential area & 2.5 ha currently under irrigation
Central Province			
District	6-Serenje	7-Chitambo	-
Site	Kabwe Kupela	Misakalala	-
Outline	15 Households, 12 ha Potential area & 1.25 ha currently under irrigation	10 Households, 10 ha Potential area & 9 ha currently under irrigation	-

Source: JICA E-COBSI

2.5.2 Permanent weir construction

1) Overview of the construction site

In the New Target Provinces, the permanent weirs have been constructed in three locations, namely, Mufulira District in Copperbelt Province, Kasempa District in North-Western Province, and Mkushi District in Central Province. The first permanent weir training session provided technology transfer from site selection to detailed design, and actual construction began in the dry season of 2022 based on the design drawings created. An overview of the permanent weir sites is shown in Table 2.7.

The target site in Mkushi District is supposed to integrate the tow farmers groups of existing simple weir sites, namely Kafwe West and Kafwe East, so the number of farmer households and irrigated area in the irrigation group can be relatively large. In addition, in all three locations, simple weirs of the site were constructed under the Project in 2019, and irrigated agriculture is practiced by withdrawing water from the simple weirs, and the sites were selected because their subsequent maintenance and management has been carried out appropriately.

Table 2.7 Profile of Permanent Weir Site

Province		Copperbelt	North-Western	Central
District		Mufulira	Kasempa	Mkushi
Camp		Mupena	Kabele	Chalata
Name of Site		Munisa	Shibende	Kafwa
Location from District Center		1.5 hrs	0.5hrs	1 hrs
Number of HHs		25 HHs	38 HHs	150 HHs
Number of Member		49 (M:19, F:30)	43 (M:23, F:20)	195 (M:150, F:45)
Year Simple Weir Constructed		2019	2019	2019
Irrigated Area	Under simple weir	3 ha	4 ha	37 ha
	Plan	12 ha	8 ha	50 ha
Major Crop		Cabbage, Reip, Tomatoes, Onion, Eggplant	Eggplant, Cabbage, Reip, Tomatoes, Maiz	Tomatoes, Maiz, Watermelon, Reip, Cabage
Major Market		Mufulira, Kitwe, Kasumbalesa	Kasempa, Solwezi	Middleman from Kitwe and Lusaka

Source: JICA E-COBSI

2) Role demarcation

In order to carry out the permanent weir construction efficiently, the work was progressed by dividing the roles as follows. a: The project team provided economic support such as procuring construction materials such as cement and transporting stones and sand collected by farmers, as well as technical support for the permanent weir construction, and was in charge of overall construction supervision. b: TSB officers and CEO provided construction guidance and construction management to farmer groups and played a role in bringing farmers together. c: Farmer groups played a central role in the construction by providing labour and carrying out construction work such as collecting and accumulating stones and sand, excavating on site, and masonry works.

3) Construction process and actual construction status

The main steps of permanent weir construction consist of a) Pre-orientation (Sensitization meeting), b) Distribution of tools, c) Preparatory work, d) Temporary work, e) Excavation work, f) Stone masonry

work, g) Rip-rap work, and h) Finishing work. The process and actual construction status of these major works are shown below.

a) Pre-orientation (Sensitization meeting)

Pre-orientation was held at each of the three sites in November 2021, and the group organization and work procedures related to permanent weir construction were explained. The meeting included the selection of committee members, the construction period and frequency of participation (number of working days a week), collection of stones and sand by farmers themselves, methods of masonry work, etc. Construction methods were explained using an explanation manual.

b) Distribution of tools

The following necessary tools were procured by the project team and distributed to each site for permanent weir construction. The main tools distributed were: 1) wheelbarrow, 2) Plastering trowel, 3) Shovel, 4) Bucket, 5) Level, 6) Tape, 7) Hammer, 8) Pickaxe, 9) Gumboots, 10) Gloves, 11) goggles, etc.

c) Preparatory work (e.g. collection of stones and sand)

The collection of stones and sand began in the rainy season in December 2021 by the group of farmers, and after, the project team procured a truck to transport them from the collection place to the weir construction site. The group of farmers searched for places to collect stones and sand as close to the construction site as possible, and large stones were crushed with hammers and piled up for dry masonry. In addition, a group of farmers cut grass as preparatory work at the permanent weir construction site, and in the presence of Japanese experts, government officials (TSB and CEO) and the farmer group drove piles at some major points on the weir structure.

Stone Collection by Farmers Group (Mufulira District, Copperbelt Province)

When collecting stones, it was necessary to break them into pieces that could be carried by farmers. however, the hardness of the collected stones made it difficult to crush them to make them easier to use in construction, so this work took a lot of time and effort. Although the schedule was originally to complete the stone and sand collection work by April 2022, it took until July and August of the same year for all three sites. In addition, regarding the transportation of stones and sand, the access road for material transportation remained muddy due to the long rains during the rainy season, and it was necessary to wait until transportation trucks could pass. Furthermore, due to the rise in fuel prices, it became difficult to negotiate the transportation costs and it took time to adjust. In addition, farmers who had expected to receive wages and meals for participating in the works found that they did not receive these in return, and there was a decrease in the number of farmers participating in the works and a decrease in the frequency of participation throughout the construction period.

d) Temporary works (temporary cofferdam, diversion channel, etc.)

During the construction of the permanent weir itself, it was necessary to do dry work in and around the site,

so a temporary cofferdam was installed using sandbags upstream side of the permanent weir, and river water was temporarily diverted to the waterway. The work to install the temporal cofferdam and diversion channel was carried out efficiently by making full use of the experienced master trainers from FU Provinces who were involved in the construction of permanent weirs in the previous project T-COBSI. Additionally, the access road to the construction site was constructed in advance by the farmer group.


Temporal Cofferdam for dewatering (Mufulira District, Copperbelt Province)

e) Excavation Work

TSB gave instructions to the farmer group regarding the excavation area and depth according to the design drawings, and the farmer group carried out the excavation work. The groundwater level was quite high at the Mkushi District site, and a large amount of groundwater leaked for long period especially from the excavation work of ground to the masonry work at the apron part. For this reason, drainage work was carried out using a pump, but the long time spent on drainage water treatment was also a factor in the delay in the construction process.

Excavation Work at the Apron Area (Mkushi District, Central province)

f) Masonry Work

The stone masonry work was carried out by the farmers under the supervision of a master trainer from the FU Provinces and target district TSB in collaboration with the aim of catching up for the delays in construction progress. Mortar was made on-site by mixing cement, sand, and water, and the mortar was transported using a wheelbarrow. The permanent weir was then constructed by piling up stones and filling the gaps with mortar. Although men were primarily responsible for making mortar, transporting large stones, and masonry work, women also actively participated in construction work at all sites, such as transporting relatively small stones and transporting sand and mortar.

COBSI's canal construction is usually carried out using dry masonry for a section of 20m from the starting point of the canal, but at the site in Kasempa District, there is a lot of sandy soil along the right bank of the canal. in order to prevent the canal from water leakage, 50m or more from the right bank canal was lined by the farmer's group.


Stone Masonry Works (Left: Weir Body), (Right: Canal) (Kasempa district, North-Western Province)

g) Rubble foundation work

In order to prevent the permanent weir apron from scoring, relatively large stones (rubble stones) were placed downstream of the permanent weir apron.

h) Finishing

As the finishing work, the parts where there were still gaps in between were plugged by supplemental mortal. furthermore, embankments were installed at the river inlet upstream of the permanent weir. The following photo shows an overall photo taken by drone of the Kasempa district site after completion of all works. The upper part of the photo is the upstream part of the river, the centre part is the original river course, and the irrigation canals were placed on both sides of the left and right banks.

Completion of Permanent Weir Construction
(Kasempa District, North-Western Province)

2.5.3 Economic Analysis for Permanent Weirs

In T-COBSI, which was implemented between 2013 and 2017, permanent weirs were constructed at 14 sites in the Follow-up Provinces. In the current economic analysis, these permanent weir sites were selected for analysis and the costs and benefits of constructing permanent weirs were compared and analysed.

In selecting the sites for the economic analysis, it was decided to carry out the economic analysis for each of the sites with different irrigation sizes after commissioning, as the irrigated area as a benefit has a significant impact on the results of the economic analysis. For this purpose, based on the irrigated area data for 2023,

Kasama District, Northern Province (9.0 ha) was selected as a small site, Lupososhi District (16.0 ha) as a medium site and Nchelenge District, Luapula Province (36.0 ha) as a large site, and an economic analysis was carried out for these three permanent weirs. The economic analysis was carried out using the Economic Internal Rate of Return (EIRR), which is commonly used in the economic analysis of projects, and the Net Present Value (NPV) and Benefit/Cost Ratio (B/C Ratio) were also calculated.

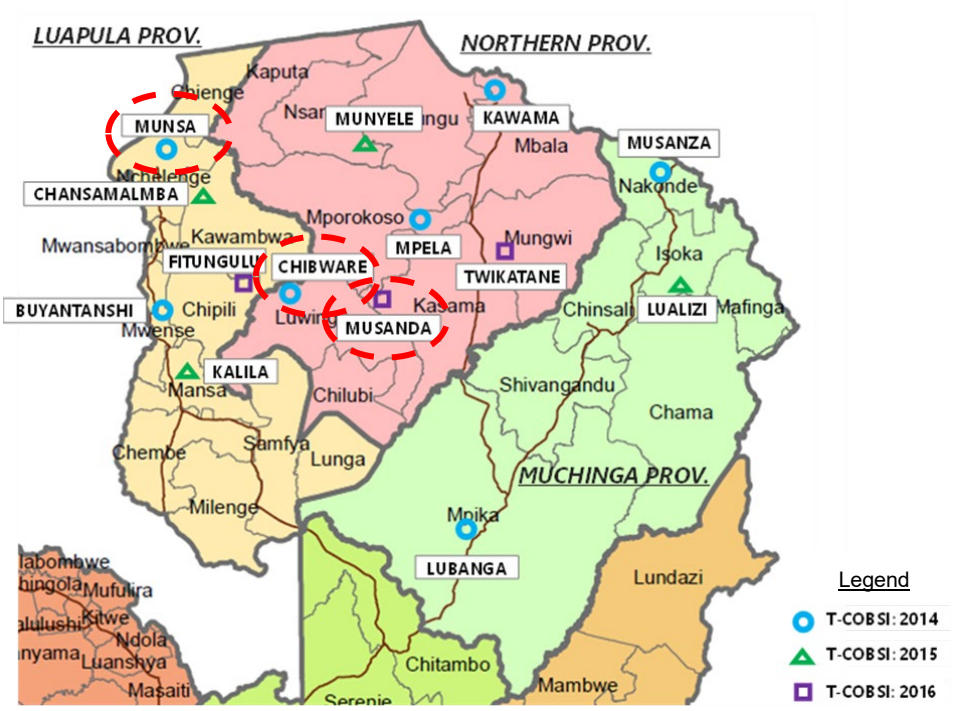


Figure 2.1 Location map of the permanent weir constructed by T-COBSI (red ellipse means the site for this analysis)

Source: JICA E-COBSI

1) Conditions for economic analysis

The following table shows a summary of the three permanent weir sites for the economic analysis.

Table 2.8 Summary of the permanent weir sites in the economic analysis

Province	District	Site Name	Year of construction	Irregated Area	
				One year before the construction	2023
Northern	Kasama	Musanda	2016	4.0	9.0
Northern	Lupososhi	Chibwale	2014	7.0	16.0
Luapula	Nchelenge	Munsa	2014	11.0	36.0

Source: JICA E-COBSI

Each economic analysis of the three permanent weirs was implemented as a single project. In T-COBSI, the upgrade from simple weirs to permanent weirs (new irrigation facilities) was implemented. The investment in irrigation facilities will increase the actual irrigated area, and the benefits will be an increase in agricultural production. To qualify the benefits, one year before the construction of the permanent weir was defined as the "Without Case" and the period after the construction as the "With Case". Other conditions necessary for this economic analysis were set as follows.

Table 2.9 Conditions in Economic Analysis

Items	Condition	Note
Project life	30 years	30 years, which is common in the irrigation sector, was adopted.
Discount rate	12%	An opportunity cost in Zambia (12%) was adopted.
Standard Conversion Factor (SCF)	0.983	Calculated based on import and export data for 2017-2021.
Standard year	2023	The calculation of costs and benefits was based on the year 2023.

Source: JICA E-COBSI

2) Economic project costs

Since the construction of the permanent weirs is primarily undertaken by the farmers themselves, there are no incurred costs for hiring unskilled labor. Additionally, skilled laborers will be supervised by engineers from the provincial and district offices, thus incurring no employment costs for them either. Therefore, the only actual costs associated with the construction of the permanent weir are those related to cement, transporting sand and stone, and necessary construction equipment. However, in this economic analysis, we have considered the cost of hiring both skilled and unskilled labor as economic costs of the project, as we deem anything that diminishes national wealth to be an economic cost. The unit cost of skilled workers was set at 500 ZMW/person/day, consistent with the daily allowance and lodging cost for government employees in the project. The unit cost of unskilled workers was determined to be 141 ZMW/person/day based on interviews conducted within the project.

Based on the above, Table 2.10 shows the economic project costs in Musanda, Chibwale and Munsa. As all the materials required for construction will be provided domestically, the economic project costs are only expressed in local currency (LC) and are ZMW 260,787 for Musanda, ZMW 318,366 for Chibwale and ZMW 296,416 for Munsa.

The periodic operation and maintenance (O&M) of the permanent weirs and earthen canals (desilting, weeding, concrete repair, etc.) is basically carried out by the farmers themselves. As the O&M costs are paid from the farmer group's association fees and water user fees, these costs have been recorded as annual O&M costs, as shown in Table 2.11.

Table 2.10 Economic project costs for the construction of three permanent weirs

Unit: ZMW

Item	Musanda			Chibwale			Munsa		
	Economic Price			Economic Price			Economic Price		
	FC	LC	Total	FC	LC	Total	FC	LC	Total
Material Cost	-	74,488	74,488	-	176,122	176,122	-	166,933	166,933
Skilled labor	-	27,693	27,693	-	23,954	23,954	-	34,184	34,184
Unskilled labor	-	158,607	158,607	-	118,290	118,290	-	95,299	95,299
TAX	-	-	-	-	-	-	-	-	-
Total	**-**	**260,787**	**260,787**	**-**	**318,366**	**318,366**	**-**	**296,416**	**296,416**

Source: JICA E-COBSI

Table 2.11 Annual maintenance costs for three permanent weirs

Site name	Member Households in 2023	Member fee	Water User's fee	Total O&M cost
		ZMW/HH・Year	ZMW/HH・Year	ZMW/Year
	a	b	c	a×(b+c)
Musanda	38	50	-	1,900
Chibwale	43	100	20	5,160
Munsa	32	50	-	1,600

Source: JICA E-COBSI

3) Economic project benefits

Table 2.12 shows the economic benefits of the project one year after the construction of the permanent weir is completed. The project benefits in the table assume only the benefits from the increase in irrigated area and the change in crops grown (no increase in unit crop price or yield is expected). The project benefit in Munsa is the highest at ZMW 734,243, while the economic benefit in Musanda is the lowest at ZMW 76,118. By crop, onion in Musanda and cabbage in Munsa had negative benefits in the economic analysis because the area planted after construction of the permanent weir was smaller than before construction, but the benefits were positive for the site as a whole.

Table 2.12 Economic project benefits from the construction of three permanent weirs

Unit: ZMW

Crop Name	Musanda			Chibwale			Munsa		
	With	Without	Benefit	With	Without	Benefit	With	Without	Benefit
Tomato	187,152	99,711	87,442	117,582	46,244	71,337	556,923	195,839	361,084
Onion	20,316	96,892	-76,576	126,502	74,440	52,062	120,338	95,177	25,161
Beans	-	-	-	33,254	6,396	26,857	-	-	-
Maize (Irrigated)	37,054	-	37,054	7,466	22,191	-14,724	356,744	17,365	339,379
Cabbage	-	-	-	12,098	9,578	2,520	44,608	70,560	-25,953
Ground nuts	17,895	-	17,895	30,254	4,126	26,127	-	-	-
Rape	7,182	-	7,182	-	1,042	-1,042	8,064	-	8,064
Chinese Cabbage	3,400	-	3,400	-	-	-	31,486	4,978	26,508
Irish Potato	-	-	-	9,388	16,791	-7,403	-	-	-
Eggplant	-279	-	-279	-	-	-	-	-	-
Total	**272,721**	**196,603**	**76,118**	**336,543**	**180,809**	**155,734**	**1,118,162**	**383,918**	**734,243**

Source: JICA E-COBSI

4) Economic analysis of permanent weir construction

Table 2.13 shows the calculated Economic Internal Rate of Return (EIRR), Net Present Value (NPV) and Benefit/Cost Ratio (B/C), with Munsa having the highest EIRR of 67.24% and Musanda having the lowest of 17.85%. If the opportunity cost in Zambia is 12%, then the construction of permanent weirs is economically justified as the EIRR is above 12% at all three sites. The NPV of Munsa is ZMW 3,519,141.9, which is very high compared to the other two sites due to the large size of the original irrigated area and the fact that the area has more than tripled since the construction of the permanent weir. Therefore, both the EIRR and the B/C ratio are the highest. On the other hand, Musanda's irrigated area was small before the construction of the permanent weir, and the increase in irrigated area after the construction of the permanent weir is also the smallest. This is the reason why the EIRR, NPV and B/C ratio are the smallest for all indicators. However, as mentioned above, the EIRR is not less than 12% and therefore, if the permanent weir is properly maintained and used, the investment for the construction

of the permanent weir is economically justified to some extent even for relatively small sites.

This economic analysis showed that Munsa, Nchelenge district, Luapula Province, had the largest percentage increase in irrigated area compared to the other two sites, and the highest economic internal rate of return. One possible reason for this may be the socio-economic situation: demand for agricultural products tends to be higher in Munsa than in other areas, as Munsa is close to the Democratic Republic of the Congo border and traders from the Congo also come to buy agricultural products. As a result, agricultural incomes in Munsa are high and new entrants from other locations have increased, requiring further expansion of irrigated farmland for new entrants. As a result, the expansion of irrigated farmland in Munsa is likely to have been greater than in other regions, and irrigation potential has been maximised.

Table 2.13 Results of economic analysis at three permanent weir sites

Province	District	Site	EIRR 30 years	NPV (r=0.12) (ZMW)	B/C (r=0.12)	Actual Irrigated Area (Increase since construction
Northern	Kasama	Musanda	17.85%	163,617.6	1.59	2016：4.0 ha 2023：9.0 ha (2.25 times)
Northern	Lupososhi	Chibwale	22.88%	452,248.6	2.26	2014：7.0 ha 2023：16.0 ha (2.29 times)
Luapula	Nchelenge	Munsa	67.24%	3,519,141.9	12.38	2014：11.0 ha 2023：36.0 ha (3.27 times)

Source: JICA E-COBSI

2.6 COMPLETION SEMINAR

A completion seminar was held on 12 January 2024 to publicize the results of the project activities and the action plan to be implemented by the Ministry of Agriculture at the end of the project. The seminar was attended by CPU members from the Ministry of Agriculture headquarters and each target province, beneficiary farmers and officials from the JICA Zambia office. In addition, other donor agencies (GIZ, World Bank, AfDB), agricultural schools (NRDA) and the Japanese Returned Trainees Group (ZAJIFA) were also invited to promote the development of the COBSI approach in Zambia after the project was completed. The total number of participants was 128.

The seminar began with opening remarks with appreciation of the support of JICA for Agriculture sector by the Acting Permanent Secretary of the Ministry of Agriculture, followed by C/P officers explaining the rationale and objectives of the project and showing a video of the project's activities. This was followed by presentations by C/P officers on each of the outcomes (small-scale irrigation, SHEP and improved nutrition). This was followed by a presentation by a district official, an extension worker and two farmers as voices of project beneficiaries. Finally, the C/P officers explained the three-year action plan that the Ministry of Agriculture plans to implement after the project is completed.

The completion seminar was covered by ZNBC (Zambia National Broadcasting Cooperation) and broadcast in a news programme at 7:00 pm on the same evening, as well as by NAIS, the public information department of the Ministry of Agriculture, and later in the newspaper.

CHAPTER 3 COBSI RESEARCH

3.1 RATIONAL AND OBJECTIVES OF THE COBSI RESEARCH

To obtain evidence for the dissemination and deployment of the COBSI Approach within sub-Saharan African countries and Zambia, JICA Ogata Sadako Research Institute for Peace and Development (hereafter referred to as JICA Research Institute) decided to conduct a scientific analysis of the effectiveness of the COBSI Approach. This project provided support for research, operation, and management at the field level for this COBSI Approach research.

3.2 METHOD OF COBSI RESEARCH

The following describes the methodology used to conduct the COBSI research: 1) Target districts for COBSI Research, 2) Duration of survey activities and number of surveys, 3) Target survey sites and the numbers of farmers households, and 4) Survey Groups and Grouping Methodology.

1) Target districts for COBSI Research

To better clarify the effectiveness of the COBSI approach, the target districts for the research were selected from districts without intervention by the E-COBSI Project. The C/Ps were consulted to identify areas outside the target districts of the project where the COBSI approach could be practiced under natural conditions. As a result, three districts, Kapiri Mposhi, Chibombo, and Chisamba, were selected from the Central Province, the project target province.

2) Duration of survey activities and number of surveys

The COBSI practice period for the survey was two dry seasons, 2023 and 2024, and three surveys were conducted: a baseline survey, a midterm survey, and an endline survey. Survey contents were set by JICA Research Institute, and each survey was conducted through a subcontracting process. The baseline survey was conducted in August-September 2022 to determine the status before the COBSI intervention. Next, a midterm survey was conducted in October-December 2023 to ascertain conditions during the first year of activity. The endline survey is scheduled to be conducted in October-December 2024.

3) Target survey sites and the numbers of farmers households

A total of 93 sites were surveyed, 71 sites in Kapiri Mposhi District, 12 sites in Chibombo District, and 10 sites in Chisamba District, from "3.3.1 Selection of target sites," described below. The total number of farmers households was 1,773. Note that the midterm survey was conducted in 93 sites, but 1,696 households were surveyed because some farmers moved, left the irrigation group, or refused to be interviewed due to lack of incentives.

4) Survey Groups and Grouping Methodology

The survey groups were divided into three groups: Group A and Group B with COBSI activity intervention, and Group C with non-intervention. The activities of each group are shown in Table 3.1. Since the total number of sites was 93, each group was equally divided into 31 sites. The grouping of each site was done using the Randomized Controlled Trial (RCT) method, and random assignment was done at the JICA Research Institute. The number of sites surveyed in each district and the breakdown of each group are shown in Table 3.2.

Table 3.1 Intervention Group Classification

Classification	Activities
Group A	Simple weir construction、Canal construction、farmer organization formation, water management and maintenance activities.
Group B	In addition to the activities of Group A, implementing SHEP and Nutrition Improvement
Group C	Control Group、No approach will be made to the farmers for two years

Source：JICA E-COBSI

Table 3.2 Number of sites surveyed and detail of each group

Item	Kapiri Mposhi District	Chibombo District	Chisamba District	Total
Group A	21	5	5	31
Group B	27	2	2	31
Group C	23	5	3	31
Total	71	12	10	93

Source：JICA E-COBSI

5) Survey schedule

The schedule of research activities outlined above is shown in Figure 3.1. It also includes the training and monitoring described in the next section, "3.3 The progress of COBSI Research activities".

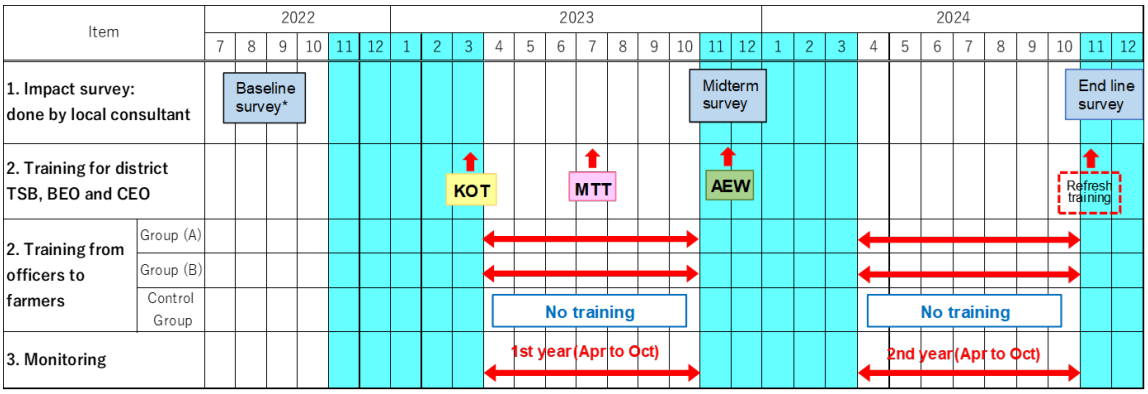


Figure 3.1 The schedule for Impact survey of COBSI research

Source：JICA E-COBSI

3.3 PROGRESS OF COBSI RESEARCH

3.3.1 Selection of target sites

Briefing sessions on COBSI research activities were held for district TSBs and CEOs in the three target districts starting in November 2021, and furthermore, a visit to a COBSI site in Mkushi District, located in the same province, was conducted to provide an opportunity to promote better understanding of COBSI. Subsequently, in order to select sites for the research, a profile of potential sites including natural conditions (duration of water availability, depth, width, gradient, etc. of small streams) and a list of households of farmer groups were submitted to select 98 sites to be COBSI sites.

Initially, 98 sites and 2,288 farm households were targeted for the survey. However, when the baseline survey was conducted, it was confirmed that there were two overlapping sites and one site that was very far from the district office, so 95 sites were surveyed, excluding these three sites. As a result, the number

of farm households was found to be 2,074. Subsequently, the TSB of Chisamba District indicated that the Water Resources Management Authority (WARMA) might be opposed to the construction of a simple weir because two sites in Chisamba District are located upstream of the dam. Therefore, these two sites were removed, and 93 sites and 1,773 households were surveyed.

3.3.2 Selection of Subcontractor

The surveys (baseline, midterm, and endline surveys) related to the impact evaluation of the COBSI research were to be conducted through subcontractor, and three companies with experience in social and economic surveys using tablet terminals were selected through the Internet and the JICA Zambia office. A short list was prepared, and Tender Documents were distributed on 1 April 2022.

All three companies submitted technical proposals and quotations, and the evaluation method was based on a ratio of 80% technical proposal content and 20% price. The contract was signed on April 25, 2022 with Integrated Business Solutions Ltd (located in Lusaka), which ranked first in the evaluation ranking.

The original contract called for three surveys to be conducted by December 2023: a baseline survey, a midterm survey, and an endline survey. However, JICA research institute instructed that the endline survey be conducted in 2024. Therefore, the contract was amended and two surveys, a baseline survey and a midterm survey, were to be conducted in the subcontractor of this project.

3.3.3 Implementation of the training

To ensure that farmers in each target site could properly conduct COBSI activities, a series of COBSI trainings (KOT, MTT, and AEW) were conducted in 2023 for the three target districts of the COBSI research as well as the target district of the E-COBSI project. CPU members from the Central Province did as instructors for the trainings.

1) KOT for COBSIresearch

KOT was conducted in Kapiri Mposhi District for 5 days from 20 to 24 March with a total of 77 participants consisting of CPUs from Central Province, SAOs from the 3 target districts, TSBs and CEOs from the 93 target sites (Provincial CPU team: 6; Kapiri Mposhi District: 36; Chibombo District: 19 participants; Chisamba District: 16 participants). The content was generally similar to that of the E-COBSI KOT.

2) MTT for COBSIresearch

MTT was conducted in Kapiri Mposhi District over four days from 22 to 25 August with a total of 71 participants, basically the same as for the KOT (Provincial CPU Team: 8; Kapiri Mposhi District: 35; Chibombo District: 13; Chisamba District: 15). The content was generally the same as the MTT conducted in E-COBSI: cultivation (classroom lecture) on the first day, cultivation and nutrition improvement (classroom lecture) on the second day, COBSI site visit on the third day, and confirmation of progress of activities, future plans and status of report submission on the fourth day.

3) AEW for COBSIresearch

The AEW was conducted in Kapiri Mposhi District over two days from 23 to 24 November with a total of 61 participants (Provincial CPU Team: 9; Kapiri Mposhi District: 31; Chibombo District: 8; Chisamba

District: 13). The meeting focused on reporting on the year's activities in each district, and participants shared challenges, lessons learned, countermeasures and best practices.

3.3.4 Monitoring and Follow-up

1) General status of activities at the target site

After the implementation of the KOT, COBSI activities were conducted in Group A and B sites from April 2023, and the monitoring and follow-up was targeted to Groups A and B, where the project intervention would take place. The CEOs of Group A and B sites explained COBSI and SHEP to farmers according to their group category. Japanese experts monitored and followed up at the sites mainly in May and June to assess the natural conditions at each site, the progress of the simple weirs and canals, and any problems. A summary of the site condition monitoring results is provided below.

Kapiri Mposhi Distict is the most northerly of the three districts and has the highest annual rainfall and has a high number of COBSI sites due to the abundance of rivers and flows. According to the provincial TSB officer, rainfall during the 2022/23 rainy season was generally as usual in Kapiri Mposhi District, but less in Chibombo and Chisamba Districts.

In Group A and Group B, there were several sites with low river flows in 2023. There were other sites where it was difficult to continue COBSI activities because of the wide and deep rivers, the hazardous nature of the construction of simple weirs due to the presence of crocodiles in the rivers, and the lack of agreement on the construction of simple weirs among the farmers' groups.

In excavating the canals, a route was selected from the simple weir point to the irrigated fields in a straight line through the higher elevations in the direction of the irrigated fields, which resulted in several sites where the excavation was more than 1 m deep.

In Chibombo and Chisamba districts, there were several farmers who were already using small pumps for irrigated agriculture and were concerned about whether they would be able to dig canals and conduct COBSI activities using their own labor. On the other hand, farmers who are struggling to raise fuel costs by using pumps were highly interested in the project because it would reduce their costs.

In several cases in Chibombo and Chisamba districts, trained CEOs were transferred to camps not covered by COBSI activities. In some cases, activities were significantly delayed due to newly assigned CEOs who had not received training, although the district TSBs supported them in carrying out the activities.

2) Construction status of simple wire

The status of simple weir construction as of December 2023 is shown in Table 3.3, with 40 sites constructed in Kapiri Mposhi District and 5 sites each in Chibombo and Chisamba Districts. The status of the construction of simple weirs and canals at each site is shown in the Appendix.

Table 3.3 Simplified weir construction status（As of December 2023）

Item	Kapiri Mposhi District		Chibombo District		Chisamba District		Total	
	No. of site	Number of simple weir constructed	No. of site	Number of simple weir constructed	No. of site	Number of simple weir constructed	No. of site	Number of simple weir constructed
Group A	21	40/48	5	5/7	5	5/7	31	50/62
Group B	27	(83%)	2	(71%)	2	(71%)	31	(81%)
Group C	23		5		3		31	
Total	71		12		10		93	

Source：JICA E-COBSI

3) Food consumption interview

A food consumption interview was conducted by the CEO for all sites. The food consumption interview included: a) how many meals were eaten yesterday; b) when was the last time meat, fish, or other animal protein (such as caterpillar) was consumed (if yes, what was consumed specifically); c) when was the last time rice was eaten; and d) whether children had diarrhea or fever in the past week. The survey period was from May to October 2023 and was divided into the following three categories according to the number of households at each site.

① Sites with 10 or fewer households: All households will be surveyed monthly.

② Sites with 11-20 households: All households will be surveyed in two groups over a two-month period.

③ Sites with 21 or more households: 10 households will be surveyed each month in two groups of 20 households.

Surveys ② and ③ were conducted in May and June, July and August, and September and October, with each household surveyed three times. The food consumption interview was conducted by the CEO through paper interviews and then data entry was conducted by the CEO or each district office using Kobo tool box (data collection and tabulation application).

Some sites did not submit interview results, and follow-up was conducted after the interview period to encourage each district to do so. Table 3.4 shows the status of submissions through the end of December. Overall, 90% of the data was submitted.

Table 3.4 Status of submission of food consumption interview（As of December 2023）

District	May	June	July	August	September	October
Kapiri Mposhi	86%	85%	92%	93%	87%	92%
Chibombo	75%	75%	75%	75%	83%	83%
Chisamba	100%	70%	100%	100%	100%	90%
Total	86%	82%	90%	91%	88%	90%

Source：JICA E-COBSI

4) Discharge Measurement (DM)in the irrigation canal

Discharge Measurement (DM) were conducted in the channel for Group A and B by district TSBs. Discharge Measurement were made after the construction of a simple weir and after the flow in the canal stabilized. Discharge Measurement were taken at 12 sites in Kapiri Mposhi District and 2 sites in

Chisamba District.

5) Photos of crop cultivation conditions in irrigated plots

Photographs of irrigated field were taken by district TSB in sites of Group A and B. Photographs were taken after the start of irrigated agriculture, and photos of crop cultivation were submitted for 15 sites in Kapiri Mposhi District and 3 sites in Chisamba District. The irrigated field taken in October 2023 are shown on the right.

Irrigated field growing maize and okra, Mubalashi river site, Kapiri Mposhi District, October 2023.

6) Questionnaire for COBSI group leaders

A survey of COBSI group leaders was conducted by the CEOs for all sites. The contents of the questionnaire are the establishment of the group, its objectives, and the group's activities, etc. The questionnaire was distributed to all site CEOs during the MTT held in August.

Completed questionnaires were collected by the end of December for 57 sites (80%) in Kapiri Mposhi District, 4 sites (33%) in Chibombo District, and 8 sites (80%) in Chisamba District.

3.4 PLAN FOR COBSI RESEARCH ACTIVITIES

For COBSI research activities in 2024, the target sites for the research will continue the activities to follow the same groupings (Groups A, B, and C) as in 2023, and then the endline survey is to be conducted in November-December 2024. In addition, each district will continue monitoring activities through the budget in the district office.

CHAPTER 4 RESULTS OF SURVEYS AND ACHIEVEMENTS OF PDM INDICATORS

4.1 SURVEY AND THE RESULT

The project conducted four baseline surveys and two endline surveys to ascertain the pre-project intervention status and the effects of the project intervention within the project target areas. The contents and results of these surveys are described below.

4.1.1 Natural Condition Survey

In order to introduce COBSI in the New Target Provinces, a survey was conducted on the existence and extent of irrigation potential in the provinces. At the start of the project, the target districts for activities had already been selected, and this survey was conducted at camp levels in the target districts and used as basic information for the selection of potential camps.

1）General Information of New Target Provinces

An overview of the New Target Provinces is presented in Table 4.1. The project covered the entire Copperbelt Province, the North Western Province except Chavuma, Zambezi and Kabompo Districts, and the Central Province, the three north-eastern districts (two districts from Phase 3 (dry season 2023)).

Table 4.1 General Information of New Target Provinces

Items	Results
1. Agro-ecological zone	Zone Ⅲ(same as the Follow-up provinces)
2. Annual precipitation	1,173mm in North Western Province and 1,230mm in Copperbelt Province almost at the same level with the Follow-up Provinces (1,197mm in Northern Province and 1,321mm in Luapula Province)
3. Elevation	1,026-1,362m in North Western Province, and 1,242m-1,270m in Copperbelt Province (slightly lower than the project area)
4. Geography	Gentle slope areas like Kasma and Mungwi Districts.
5. Rivers	A lot number of small streams exist flowing into Kafue, Lunga and Kabompo river, which eventually flow into Zambezi river.
6. Land use (type)	Size of wetland (*Dambo* areas) is smaller than in the Follow-up Provinces; ratio of agricultural land in CB is bigger (2.2%) than the Follow-up Provinces but that of North Western Province is lower (0.3%)
7. Population	Population of Copperbelt Province is the second largest in the country, while that of North Western Province is quite low.
8. Income per capita	US$442 in North Western Province lower than the Follow-up Provinces, and US$568 in Copperbelt Province higher than that; however, percentile 75 (US$421 in North Western Province and US$ 460 in Copperbelt Province) implies large portion of poorer farmers than the project area (US$548 in Northern Province and US$514 in Luapula Province)
9. Size of farmland per capita	3.5 ha in Copperbelt Province, and 2.8 ha in North Western Province as compared to 4.3 ha in Northern Province and 3.2 ha in Luapula Province.

Source: JICA E-COBSI

(1) Irrigation

The Dambo areas are not as large as those in the Follow-up Provinces, but the water table is generally high, so farmers use bucket irrigation, treadle pump irrigation or motor pump irrigation. Even if a furrow has been dug towards the farmland, the water is applied to the crops by bucket - there is room for improvement. Irrigated farming in this area is mostly done individually, so if simple weir irrigation schemes are to be introduced, the focus needs to be on institutionalising the group.

However, the western part of the North Western Province, particularly the Chavuma and Zambezi Districts, is generally not very suitable for irrigation development due to its sandy soils. Potential

districts are therefore Mwinilunga, Solwezi (Kalumbia, Mushindamo), Kabompo (part of which is still sandy), Mufumbwe and Kasempa.

Treadle pump was promoted through a donor project, but the labor is a problem (Solwezi)

A man pours water from the shallow well to irrigate his small plot of approx. 1 lima (Kitwe)

(2) Farming

The New Target Provinces are dotted with large mines and many egg farmers supply these mines, and many farmers use poultry manure as fertiliser. Some farmers also use grass weed and wood mulch. The types of crops grown are generally the same as in the Follow-up Provinces, including tomatoes, oilseed rape, cabbage, maize, potatoes and onions.

Engine pump is used to irrigate; farmers are concerned about the cost of fuel (Solwezi)

Mulch is organized for cabbage field which is irrigated by engine pump left (Solwezi)

(3) Marketing

Most irrigated farmers sell their produce to the market. Sometimes marketers come to their farmland and harvest the produce themselves. Since there are big cities like Ndola, Solwezi and Kitwe in the area, it is quite easy to sell their produce. More specifically, even smallholder farmers have access to larger markets or middlemen who have access to larger markets much easier than those in the FU project area who sell in the small market near the village. According to TSB officers in North Western and Copperbelt Provinces, these areas have high marketing potential because of the large working population and better road network. In reality, demand is much higher than supply within the region, so many agricultural commodities are imported from other regions of the country.

Bicycle is commonly used to carry harvest to the nearby market (Kitwe)

A group of marketers visit the farm and harvest what they need; payment is done on-site

2） Irrigation potential survey

Summary: In each camp in each of the new target districts, the number of perennial rivers, existing irrigation systems, productivity and marketability of agricultural produce, availability (number of motorcycles owned) for extension and potential for irrigation development will be surveyed to provide data on the irrigation potential of the target districts as a whole and the camps.

Objective: The survey is designed to determine irrigation potential in the project target counties in the New Target Provinces. It will also be used as a basis for determining the extension agents to be invited for training so that extension agents from camps with high irrigation potential can participate in the training.

Survey Method:

- Period: January to February 2019
- Target: Districts covered in New Target Provinces, 21 districts in all (Copperbelt: 10 districts, North western: 8 districts, Central: 3 districts)
- Method: An irrigation potential survey form was distributed to each district, and district TSBs and BEOs/CEOs completed the form for each camp, which was collected during the inception workshop in February 2019. The data were organised and analysed for each camp. The irrigation potential of the camps was scored based on four criteria, which were then summed and divided into four ranks, and the results of the assessment were organised by county.

Results and discussion:

A table of the results, summarised by district, is shown in Table 4.2. The results for each province are also presented below.

(1) Copperbelt Province

A total of 171 camps were located in the 10 target districts and responses were received from 114 camps. The number of motorcycles available in these camps was 42. There are more than 300 perennial rivers that do not run dry throughout the year, and a similar number of small irrigation sites could be developed. In addition, the irrigable area is estimated at 15,700 Lima (3,925 ha), with sufficient potential for

irrigated agriculture. Bucket irrigation is the most common irrigation method in the current situation, accounting for 71% of all irrigated sites, followed by irrigation using small pumps, which is used in 22% of all irrigated sites. Irrigated agriculture using simple weirs is expected throughout the project. There are also markets in almost all camps, numbering 191. The Copperbelt Region, with its large cities such as Kitwe, Ndola and Chingola, has great potential as a market for the sale of produce in the introduction of small-scale irrigation development.

(2) North Western Province

There are a total of 185 camps in the eight target districts and responses were received from 135 camps; the number of motorcycles available in 135 camps is 42. There are over 500 perennial streams and a similar number of development sites are expected. As on the Copperbelt, bucket irrigation is widespread, accounting for 85% of all irrigated sites; in Mufumbwe District it is not recorded as an existing irrigated site, but the average area available for irrigation is estimated to be about 200 lima (50 ha) per camp. The number of markets is 117, which is small compared to the number of camps. As Solwezi is the largest town in the North Western Province and also borders the Copperbelt and the Congo, it has a high market potential, which is important for the implementation of small-scale irrigation and market-oriented agriculture (SHEP), as in the Copperbelt Province.

(3) Central Province

There are a total of 59 camps in the three target districts and responses were received from 35 camps; the number of motorcycles available in the 35 camps was 13. There are more than 160 perennial rivers with an estimated irrigable area of 5,700 lima (1,425 ha) and high irrigation potential. Bucket irrigation is the most common irrigation method, accounting for 56% of all irrigated areas; small pumps are also widely used in Mkushi District. Markets are plentiful in the district and the presence of large cities such as Kabwe and Kapiri Mposhi in the province means that, like the other two provinces, the potential as a market for small-scale irrigation development is high.

Table 4.2 List of irrigation potential survey results by district

Copperbelt Province

District	Number of Camp answered	Number of mortorbike	Number of perenial stream	Simple weir		Natural diversion		Bucket irrigation		Engine pump		Treadal pump		Irrigation total		Market	Potential irrigated area (lima)
				Sites	Area (lima)	Sites	Area (lima)	Sites	Area (lima)	Sites	Area (lima)	Sites	Area (lima)	Sites	Area (lima)		
Kalulushi	12	–	47	1	20	2	80	196	3,003	20	308	0	0	219	3,411	36	6,300
Kitwe	12	3	30	0	0	0	0	0	0	0	0	0	0	0	0	32	1,060
Luanshya	5	3	16	0	0	28	140	360	164	60	88	30	21	478	413	20	270
Lufwamanya	13	–	28	0	0	1	8	29	475	0	0	0	0	30	483	26	927
Masaiti	23	0	58	0	0	1	20	854	36	303	14	56	16	1,214	86	36	3,879
Mpongwe	5	0	12	1	12	1	200	12	159	67	405	0	0	81	776	5	280
Mufulira	13	7	34	0	0	5	103	21	180.25	11	93	2	21.5	39	397.75	5	200
Ndola	7	3	23	2	36	0	0	68	2	2	3	0	0	72	41	1	744
Chililabombwe	9	9	16	3	11	8	43	19	153	3	24	6	26	39	257	10	916
Chingola	15	0	51	3	4	0	0	40	1,422	25	526	16	109	84	2,061	20	1,143
Total	114	25	315	10	83	46	594	1,599	5,594.3	491	1,461	110	193.5	2,256	7,925.8	191	15,719

North Western Province

District	Number of Camp answered	Number of mortorbike	Number of perenial stream	Simple weir		Natural diversion		Bucket irrigation		Engine pump		Treadal pump		Irrigation total		Market	Potential irrigated area (lima)
				Sites	Area (lima)	Sites	Area (lima)	Sites	Area (lima)	Sites	Area (lima)	Sites	Area (lima)	Sites	Area (lima)		
Ikelenge	15	2	82	4	15	7	22	167	461.0	7	42	2	2	187	542.0	7	21,694
Mwinilunga	27	6	102	6	85	17	164	89	609.0	9	41	4	17	125	916.0	26	2,784
Kalumbila	14	11	68	3	15	12	267	914	478.6	37	118.5	18	18.75	984	897.8	16	7,309
Solwezi	19	5	158	14	52.5	11	101	321	1,062.0	106	310.5	29	46	481	1,572.0	24	5,222
Kasempa	16	5	55	3	5	6	62	316	262.5	27	81	4	20	356	430.5	23	644
Mushindamo	6	4	41	0	0	0	0	21	2,077.0	7	53	0	0	28	2,130.0	6	3,560
Manyinga	16	3	25	12	4	21	19.5	338	151.5	19	75.25	4	7	394	257.3	8	873
Mufumbwe	22	6	31	0	0	0	0	0	0.0	0	0	0	0	0	0.0	7	104,230
Total	135	42	562	42	176.5	74	635.5	2,166	5,101.6	212	721.3	61	110.8	2,555	6,745.6	117	146,316

Central Province

District	Number of Camp answered	Number of mortorbike	Number of perenial stream	Simple weir		Natural diversion		Bucket irrigation		Engine pump		Treadal pump		Irrigation total		Market	Potential irrigated area (lima)
				Sites	Area (lima)	Sites	Area (lima)	Sites	Area (lima)	Sites	Area (lima)	Sites	Area (lima)	Sites	Area (lima)		
Chitambo	8	4	44	3	5.5	1	3	30	219	2	6	8	79	44	312.5	13	2,168.0
Mukushi	16	6	47	2	3	22	227.5	45	484.95	43	370.3	9	19	121	1,104.7	17	2,254.8
Serenje	11	3	69	10	56	11	57	99	322	7	51	9	33	136	519	12	1,242.0
Total	35	13	160	15	64.5	34	287.5	174	1,026.0	52	427.3	26	131	301	1,936.2	42	5,664.8

Source: JICA E-COBSI

(4) Assessment of irrigation potential

The irrigation potential of each camp was assessed on the basis of four evaluation criteria using weights: 1) general information (availability of motorcycles), 2) water source (number of perennial rivers), 3) irrigation status such as bucket irrigation (number of sites, irrigated area) and 4) market (number of markets). Note that irrigable area was excluded from the scoring as it may have been overestimated. Table 4.3 shows the evaluation criteria and scores for irrigation potential.

Table 4.3 Irrigation potential evaluation criteria and scoring

Large Category	Sub Category	Point Allocation	Remarks
1. General information	Availability of motor bike of CEO	Yes: 5 point, No: 0 point	Availability of motor bike is important issue.
2. Water Source of the camp	Number of perennial streams in the camp	0-1: 0 point, 2-3: 3 point, 4 =<n: 5 point	Perennial stream is fundamental. There should be at least two streams in the camp.
3) Irrigation situation in the Camp	Total nos. of the sites	0-5: 0 point, 6-9: 1 point, 10 =<n: 2 point	Standard: three streams and two sites for each stream.
	Total area irrigated (lima)	0-49: 0 point, 50-99: 1 point, 100 =<n: 2 point	2ha (8 lima) x 6 sites = 48 lima → more than 50 lima
4) Market	No. of major markets	Yes: 2 point, No: 0 point	At least one market
Total		Max.: 16 points, Min.: 0 point	

*Ranking: Rank A: 12-16 (very good)、Rank B: 7-11 (good)、Rank C: 4-6 (fair)、Rank D: 0-3 (poor)
Source: JICA E-COBSI

Once the scores for the irrigation potential in each camp were given, they were summed and classified into four ranks (Rank A: 12-16 points (very high), Rank B: 7-11 points (high), Rank C: 4-6 points (normal) and Rank D: 0-3 points (low)). The results of this assessment were organised by district and a list of the results for irrigation potential is presented in the table below. Overall, only about 10% of the camps are rated as Rank A, while Rank B accounts for about 30%, followed by Rank C and Rank D. The North Western Province has a relatively high number of motorbikes and perennial rivers, which is likely to have led to a higher number of Rank A camps than in other provinces.

As it is desirable that the extension agents invited for training should be from camps with high irrigation potential, in principle, camps with Rank B or above were considered as candidates, and the decision was made in consultation with the Provincial CPU members based on the evaluation results.

Table 4.4 List of irrigation potential results (number of camps)

Province	District	Number of Camp	Rank A	Rank B	Rank C	Rank D	No Answer
Copperbelt	Kalulushi	13	0	12	0	0	1
	Kitwe	12	1	5	2	4	0
	Luanshya	11	4	1	0	0	6
	Lufwamanya	33	0	1	9	3	20
	Masaiti	29	0	14	8	1	6
	Mpongwe	27	0	4	1	0	22
	Mufulira	13	1	6	2	4	0
	Ndola	9	0	5	1	1	2
	Chililabombwe	9	1	8	0	0	0
	Chingola	15	1	10	3	1	0
Sub Total		**171**	**8**	**66**	**26**	**14**	**57**
North Western	Ikelenge	17	2	8	4	1	2
	Mwinilunga	39	3	8	12	4	12
	Kalumbila	30	5	7	2	0	16
	Solwezi	20	3	11	4	1	1
	Kasempa	24	1	8	6	1	8
	Mushindamo	12	3	3	0	0	6
	Manyinga	21	0	1	5	10	5
	Mufumbwe	22	0	5	5	12	0
Sub Total		**185**	**17**	**51**	**38**	**29**	**50**
Central	Serenje	31	1	6	3	1	20
	Mkushi	18	2	7	4	3	2
	Chitambo	10	3	3	0	2	2
Sub Total		**59**	**9**	**15**	**7**	**4**	**24**
Total		**415**	**34**	**132**	**71**	**47**	**131**

Source: JICA E-COBSI

4.1.2 Baseline Household Survey

A survey was conducted in all district model sites (45 sites) in the six target provinces to assess the situation prior to project intervention. A summary of the survey is presented below.

Target: Farmer groups in all district model sites (45 counties) and 10 farm households in each district model site (450 households in total)

Target Year: 2018

Survey Period：September to December 2019

Survey Contents: Irrigation site status, farmer group status, water management and maintenance status, natural site conditions, household situation, household income (farm and off-farm), access to infrastructure, access to water, gender, irrigated and rainfed farmland area,

irrigation water management, land use status, adoption of appropriate agricultural technologies and marketing, farming and marketing challenges

Survey Method: Japanese experts and members of the provincial CPU accompanied the survey team and, under their guidance, district agricultural office staff and the CEO conducted the interviews using questionnaires. The data collected was then entered into a PC by the project staff and organised and analysed by the project team.

The annual agricultural income per farm household in the Follow-up Provinces was ZMW 4,649. The project aims to increase farm incomes through the promotion of irrigated agriculture and SHEP approaches, which will mainly contribute to higher incomes from crops, vegetables and other products. The amount of income from crops and vegetables per household was around ZMW 4,800 in the endline survey conducted at the end of T-COBSI (2016), so the current amount of ZMW 4,649 was considered reasonable before the project intervention.

The annual income per farmer in the New Target Provinces was ZMW 4,559, similar to that in the Follow-up Provinces. The location of major consumption centres such as Ndola, Kitwe, Solwezi and Kabwe in the New Target Provinces, as well as a large non-agricultural labour force such as miners and a very high demand for food products, make them a good marketing opportunity with high market potential. In addition, there is a large market on the neighbouring side of the DRC, the Kasumbalesa market, which also receives agricultural products from the target provinces, so export sales to this country are also likely to be beneficial for increasing agricultural incomes.

In order to understand the status of irrigated agriculture among smallholder farmers in the district model sites, 33 farming technologies considered necessary for good farming were enumerated and their adoption verified. The 33 technologies were narrowed down to only those that could be adopted by individual farmers, such as water management techniques, farm management and cultivation techniques, and were implemented in groups. As the average uptake of the 33 appropriate technologies was 64% in Follow-up Provinces, 49% in New Target Provinces and 57% overall, figures below the PDM indicator achievement target of at least 80%, the target of at least 80% was considered appropriate. The values were higher in the Follow-up Provinces than in the New Target Provinces because they had worked on technology adoption through the COBSI studies and T-COBSI, which were previous projects.

In terms of marketing of agricultural products, the survey revealed that farmers are reluctant to participate in group marketing activities in the target areas, with 91% of farmers participating in individual marketing activities and 16% in group marketing activities (some farmers participate in both individual and group marketing activities). On the other hand, in Millengi District, Luapula Province; Nakonde District, Muchinga Province; Mungwi District, Northern Province; and Ikekenge District, North Western Province, over 70% of farmers participate in group marketing activities, so group activities are not necessarily an unacceptable part of Zambian culture.

Furthermore, the average distance to markets, which was cited as a major marketing challenge in Zambia, was 38.4 km in Follow-up Provinces, 20.8 km in New Target Provinces and 29.6 km overall. This average distance was the distance to each farmer's first priority market, with some farmers citing local markets with shorter travel distances. There was wide variation between counties, with the most distant market cited in Mbala, Northern Province, at 290 km (where the group rented a vehicle to transport their

sales), and the closest market in Chitambo District, Central Province, at 3.2 km (where individual farmers transported their sales by bicycle or on foot). It was observed that the marketing strategies for agricultural products differed according to the location of each county, and the selection of suitable crops accordingly (e.g. less damaged and long-lasting crops were selected for sites where the market was further away).

4.1.3 Existing Site Survey

Summary: A survey of the current status (including irrigated area, canal length, number of beneficiary households and farmers, water management and maintenance, agricultural status, etc.) was conducted by C/P officers for simple and permanent weir sites constructed in the former JICA's project, COBSI study (2009-2011) and T-COBSI (2013-2017). At the conclusion of E-COBSI, responses were received from 461 out of the 773 sites identified at the end of T-COBSI.

Objective: The objective of the survey is to determine the current status of the simple and permanent weirs identified at the end of T-COBSI and to identify any changes since the end of T-COBSI.

Method**:**

- Period: September 2019 to December 2023
- Target: Sites constructed in the COBSI Study and T-COBSI in the Follow-up Provinces and their beneficiary farmer groups
- Method: Mid-term training (MTT) participants and Technical Service Branch (TSB) staff in the target districts of the Follow-up Provinces were given an overview of the survey, information about the sites to be surveyed at the end of the T-COBSI, and a survey form. TSB staff then carried out the site surveys.

Four hundred and sixty-one weirs (461 responses) were constructed after 2010, showing that most of the existing weirs were newly constructed during the implementation of the COBSI study and T-COBSI. Thirty irrigation sites (out of 454 valid responses) were registered, showing inactive progress. Although farmer groups were operating and maintaining the weir, registration is still incomplete.

The average number of farmers using irrigation sites is 38.86 in Northern Province, 53.74 in Muchinga Province, 22.64 in Luapula Province, and 37.26 for all sites analysed. The percentage of male participants is 56.13% while the percentage of female participants is 43.87%. The percentage of males is, therefore, slightly higher than that of females.

Table 4.5 Construction year, registration for water users group, composition of farmers at each site

	Northern	Luapula	Muchinga	Total
Construction year of weirs				
Weirs constructed before 2010	29	22	26	77
Weirs constructed after 2010	144	141	86	371
Total	173	163	112	448
Registration as Irrigation water Users Group				
Registered	7	7	16	30
Not registered	166	156	102	424
Total	173	163	118	454
Group member's information				
Average number of farmers	26.48	15.52	28.55	23.19*
Male（%）	61.21	54.75	51.58	56.13*

Female（%）	38.79	45.25	48.42	43.87*

*Average of all the valid responses
Source: JICA E-COBSI

Eighty-three irrigation schemes (440 valid responses) collected membership fees and 16 irrigation schemes (362 valid responses) collected water user fees. Of the seventy-seven responses that indicated the purpose or use of membership fees, the most common use was for the maintenance of weirs and canals (33%). This was followed by almost equal percentages for the purchase of fertiliser, pesticides, seeds etc. (about 23%), food during work (22%) and running costs (about 22%). Out of thirteen responses to the question of the purpose / use of the water user fee, twelve irrigation sites used it for maintenance and one irrigation site used it for operational costs. This result shows that maintenance is the main purpose of both membership fees and water user fees. Another finding is that membership fees were used not only for water facilities, but also for cultivation and group management.

In terms of farmer group management issues, 214 sites (461 responses) faced difficulties in working with farmer group members, followed by difficulties in collecting membership fees or water user fees (150 irrigation sites) and land distribution difficulties (98 irrigation sites). Zambian farmers live in scattered areas and have less experience of working with other farmers, which may be one reason for these problems.

As for the type of weir, 219 irrigation sites (397 valid responses) used the single line type of simple weir, followed by the inclined type (81 irrigation sites) and then the double line type (44 irrigation sites). Thirty-three permanent weirs are still in good working order. The average canal length is 6.69 km. The average number of functioning fishponds is 3.99. Two hundred and twelve irrigation sites (438 valid responses) irrigate their land on a rotational basis. One hundred and thirty-three irrigation sites irrigated their land by rotation only when the available volume of water became less. Four hundred and fourteen (about 90%) of the irrigation sites carried out maintenance work on weirs and canals. This shows that most of the beneficiary farmers carried out maintenance activities. Looking specifically at the maintenance activity, 352 irrigation sites cleaned their weirs and canals every month, 279 checked the water flow, 278 checked the canal, 255 repaired the weir and 251 repaired the canal.

Table 4.6 Collection of member fee, water user's fee, weir type, furrow length, number of fish pond, water distribution method

	Northern	Luapula	Muching	Total
Member fee				
Collecting	22	32	29	83
Not collecting	152	123	82	357
Total	174	155	111	440
Water user's fee				
Collecting	6	5	5	16
Not collecting	145	119	82	346
Total	151	124	87	362
Weir type				
Simple weir（Inclined）	45	21	15	81
Simple weir（Single line）	97	63	59	219
Simple weir（Double line）	15	21	8	44
Simple weir（Trigonal）	0	5	1	6
Permanent weir	12	4	17	33
Total	169	114	100	383
Main Furrow and Active Fish Pond				
Main Furrow（km）	6.04	6.66	7.71	6.69
Active Fish Pond	3.77	5.31	3.03	3.99

Water distribution method				
Rotational water distribution	95	65	52	212
Simultaneous water distribution	77	86	63	226
Total	172	151	115	438

Source: JICA E-COBSI

Three hundred and thirteen irrigation sites (70% of 450 valid responses) reported that soil fertility was "good" when their site was constructed. By 2019, the percentage had dropped to around 60% (270 sites out of 428 valid responses). Continued use of the land could be a possible cause of this problem. Only about 40% of the beneficiary farmers used compost, which can maintain and restore soil fertility. On the other hand, chemical fertilisers were widely used, with around 90% of respondents saying they used them.

The average distance from the irrigation sites to their target market was 40 km for the first target market, 45 km for the second, and 70 km for the third. Although the distance to the first target market is usually close, the average distance was still 40 km. Although most sites cose the target market according to the distance from the irrigation sites, some sites chose markets in Lusaka, which was 1,000 km away from the sites, or Kasumbalesa market in Copperbelt Province, which was 700 km away from the sites.

Table 4.7 Soil fertility, use of compost and chemical fertiliser, distance from irrigation site

	Northern	Luapula	Muchinga	Total
Soil fertility at the beginning year of the scheme				
Good	125（72.25%）	113（70.63%）	75（64.1%）	313（69.56%）
Fair	48（27.75%）	45（28.13%）	41（35.04%）	134（29.78%）
Bad	0（0.00%）	2（1.25%）	1（0.85%）	3（0.67%）
Total	173（100%）	160（100%）	117（100%）	450（100%）
Soil fertility at present				
Good	109（67.28%）	95（61.29%）	66（59.46%）	270（63.08%）
Fair	52（32.10%）	58（37.42%）	43（38.74%）	153（35.75%）
Bad	1（0.62%）	2（1.29%）	2（1.80%）	5（1.17%）
Total	162（100%）	155（100%）	111（100%）	428（100%）
Use of compost at present				
Popular	57（33.93%）	79（53.02%）	43（38.39%）	179（41.72%）
Not popular	111（66.07%）	70（46.98%）	69（61.61%）	250（58.28%）
Total	168（100%）	149（100%）	112（100%）	429（100%）
Use of chemical fertiliser at present				
Popular	162（97.59%）	119（90.84%）	103（91.15%）	384（93.66%）
Not popular	4（2.41%）	12（9.16%）	10（8.85%）	26（6.34%）
Total	168（100%）	131（100%）	113（100%）	410（100%）
Distance from irrigation site				
To 1st priority market	53.66	16.88	15.19	40.99
To 2nd priority market	40.23	21.99	71.66	45.13
To 3rd priority market	52.82	30.79	97.74	67.80

Source: JICA E-COBSI

Three hundred and ninety-three irrigation sites identified "agricultural inputs" as the most challenging aspect of agricultural production and marketing practices. Chemical fertilizer was widely utilized across the sites and readily available, but many farmers found its cost burdensome. To address this challenge, the project introduced alternatives such as compost, BOKASHI, organic pesticides, etc. Additionally, three hundred and twenty-four sites reported facing long distances to markets, while 290 sites cited high transport costs as their primary challenge. Zambia, being a vast country, has many irrigation sites situated in remote areas, making the transportation of agricultural products a significant marketing challenge in such areas.

Interviews with district officers revealed that 77 of the 773 irrigation sites identified at the end of T-COBSI had stopped COBSI activities. The most common reason was related to natural conditions (37 sites). For example, water abstraction was no longer sufficient due to low river levels, the choice of abstraction points was inappropriate (e.g. the depth of the river made it difficult to repair the weirs), etc. The second most common reason was social and group organisation (21 sites). These included the relocation of farmer groups and the buying and selling of farmland by landowners. The third was extension and intervention related reasons (19 sites). For example, problems with extension staff (e.g. CEOs not properly assigned, lack of capacity, etc.) and other interventions reduced farmers' time, effort and interest in COBSI activities.

The average number of households in each site increased from 14.75 in 2016 to 22.08 in 2018. The average number of farmers in each site also increased from 27.61 in 2016 to 34.13 in 2018. This suggests that the introduction of COBSI has led to the revitalisation and expansion of the community. The average canal length of each site increased from 1.56 km in 2016 to 2.73 km in 2018. In addition, the average irrigated area increased from 5.18 lima in 2016 to 7.37 lima in 2018. These results confirm that CEOs and farmers continued to voluntarily develop the canals and irrigated areas of the COBSI sites after the end of T-COBSI.

Table 4.8 Average number of households and farmers, length of main furrow, irrigation area

	Year 2016	Year 2018
Average number of household	14.75	22.08
Average number of farmers	27.61	34.13
Average length of main furrow（km）	1.56	2.73
Average irrigation area（lima）	5.18	7.37

Source: JICA E-COBSI

4.1.4 Nutrition Survey

1) Survey using questionnaire

A baseline survey was conducted with the following objectives: 1) to understand issues related to nutrition in the target sites for implementation of nutrition improvement activities at E-COBSI and reflect countermeasures in nutrition improvement awareness activities, 2) the effect of COBSI approach on nutrition improvement is determined as a baseline. Furthermore, an endline survey was conducted to compare with baseline and measure the effectiveness of the COBSI approach in improving nutrition. Schedule of the nutrition survey is shown in the table below.

Table 4.9 Schedule of the nutrition survey

	Baseline survey	Endline survey
Northern P	April 4, 2019, to April 12, 2019	June 20, 2023, to October 26, 2023
Luapula P	April 15, 2019, to April 19, 2019	July 10, 2023, to July 14, 2023
Muchinga P	April 23, 2019, to April 26, 2019	June 23, 2023, to August 23, 2023
Copperbelt P	January 11, 2021, to January 26, 2021	June 19, 2023, to June 27, 2023
Northwestern P	January 6, 2021, to January 14, 2021	July 21, 2023, to August 27, 2023
Central P	January 12, 2021, to January 15, 2021	July 17, 2023, to July 20, 2023

Source: JICA E-COBSI

The following table shows the number of target districts and households surveyed on the Nutrition survey.

Table 4.10 The number of target districts and households on the nutrition survey

	Baseline survey		Endline survey	
	Target districts	Total households	Target districts	Total households
Northern P	5	25	5	40
Luapula P	5	25	5	42
Muchinga P	5	25	5	37
Copperbelt P	10	53	6	30
Northwestern P	8	41	8	70
Central P	3	15	3	22
Total	36	184	32	241

Source: JICA E-COBSI

In the endline survey, the Project attempted to target the same households (particularly children) as in the baseline survey, but in many cases the target households were not present on the survey day due to reasons such as moving, going out, or children commuting to school. It was difficult to track. Therefore, the Project decided to target the same households as the baseline survey as much as possible, and also included other households with children under 5 years.

Details of the baseline survey and endline survey results for each target province are summarized in APPENDIX 6. The following positive results were confirmed: 1) stunting rates among children under 5 years decreased in all target provinces except the Central Province, and 2) agricultural land area owned by women increased, mainly in the FU Province, 3) balance of labour force between men and women improved in all the target districts, and 4) expenditures on food increased. On the other hand, there were results that had negative effects, such as the Cooping Strategy Index (CSI) measuring food security, and children's weight.

The following figure shows times of each food group consumed per week. Overall, the charts at the endline became larger compared to the baseline, indicating that dietary diversity had improved.

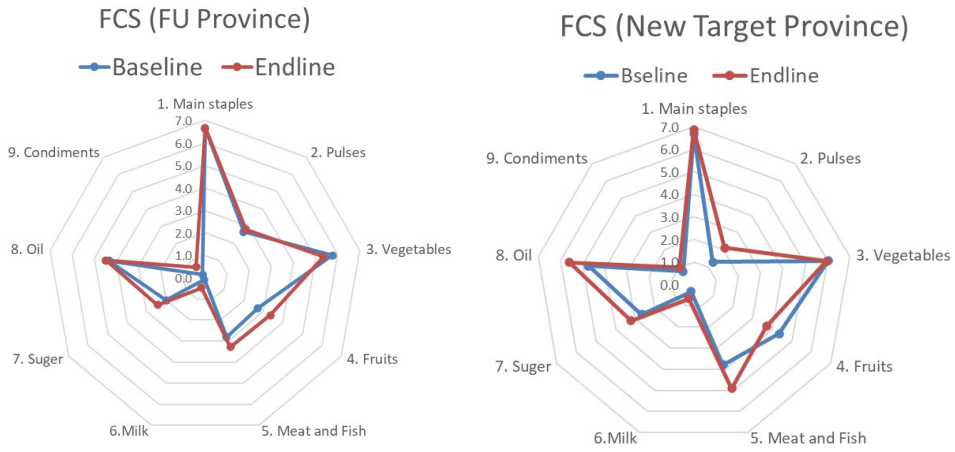


Figure 4.1 Times of each food group consumed per week

Source: JICA E-COBSI

In the endline survey, the number of children who were able to be followed up from baseline is as follows, along with the number of children whose height and weight are improving. Stunting is said to be irreversible, and if a child is considered to be stunted before 2 years, the effects of stunting are thought to continue into the future, even if their subsequent growth exceeds -2 standard deviations. Therefore, although this report states that “height for age" has improved, it is important to note that this does not

necessarily mean that the situation of stunted growth has improved. According to this study, more than half of the children's “height for age" improved at the endline survey compared to the baseline survey.

Table 4.11 Follow-up of surveyed children at the baseline survey in the endline survey

Province	Number of children able to follow up at endline	Height for age Number of children improved	Weight for age Number of children improved	Westing Number of children improved
Copperbelt P	10	2 (3)	2 (3)	0(0)
Central P	8	0 (0)	1 (1)	1(1)
Northern P	9	5 (5)	0 (1)	0(0)
Luapula P	5	2 (2)	0 (0)	1(1)
Muchinga P	14	4 (8)	0 (1)	0(0)
Northwestern P	29	1 (7)	2 (3)	2(2)
Total	75	14 (25)	5 (9)	4(4)

( ) shows number of children below -2 standard at the baseline survey
Source: JICA E-COBSI

2) Qualitative Survey

Among the households in which follow-up surveys were conducted as shown in Table 4.11, further qualitative interviews were conducted with households whose children had improved in “height for age". In addition, a qualitative survey was conducted on 131 households, including 108 other households. Below are case studies in FU Province and New Target Province.

Case study 1

・Mother of a member of an irrigation group in Mporokoso District (right figure). She has been participating in E-COBSI's activities since 2019 and participated in E-COBSI's nutrition improvement activities. From the CEO, she learned about balanced diet, food groups, the first 1000 days, fish farming, marketing, cultivation techniques, Tebakari-Eiyouhou, etc.

・She knows about and uses Tebakari-Eiyouhou. She can know how much food to eat at the household level, and individuals can also know how much they should eat. She can also reduce food waste.

Mothers and children interviewed in Mporokoso District

・Before participating in E-COBSI (before 2018), she ate twice a day, but now she eats three times a day. As shown below, the content of the meals has also been improved.

Table 4.12 Dietary changes before and after participation in E-COBSI (Mporokoso District case study)

Both handful

2018 (Before E-COBSI)

Time: 8:00		Time: 18:00		Time:	
Food	**Amount**	**Food**	**Amount**	**Food**	**Amount**
Cassava	1 both handful	Nshima	2 both handful		
Sweet potato	1 both handful	Vegetable	1 both handful		

2022 (After E-COBSI)

Time: 8:00		Time: 12:00		Time: 18:00	
Food	**Amount**	**Food**	**Amount**	**Food**	**Amount**
Fruits	1/2 both handful	Fruits	A little	Nshima	1 both handful
Samp	1 both handful	Nshima	3 both handful	Mushrooms	2 both handful
Maize Samp	1/2 both handful	Beans	1 both handful	Egg	1/2 both handful
Bread	A little	Vegetable	2 both handful	Vegetable	1 both handful

Source: JICA E-COBSI

・Comparing before and after E-COBSI implementation, consumption of fish and meat increased. Main reasons are construction of weirs, participation in SHEP activities, and rising price of vegetables sold. Meat consumption increased from once a week to three times a week, and fish consumption increased from once a week to three times a week.

・Her diet has changed. This is because women in a community used to depend on men, but now women are participating in all production activities, growing crops on farms, and earning income. There has also been a change in the way children eat, allowing them to provide well-balanced meals. Before E-COBSI, they were being fed two meals a day, but now they are being fed four times a day.

・Due to construction of a weir and participation in training, amount of vegetables consumed increased from once a week to seven times a week, and many types of leafy vegetables were grown.

・Income also increased. She participates in a savings group within her community. Main reasons for increased income are construction of weirs, participation in SHEP activities, rise in price of vegetables sold, and acquisition of knowledge through participation in training. The income is used to purchase materials for houses, tuition fees, goats and seeds, and food (oil, eggs, chickens, fish, rice, etc.).

・Especially because she had many opportunities to participate in training through E-COBSI, she feels that her life has changed. Diet, purchase of closes, construction of house and children's education has changed positively.

Case study 2

・Mother of an irrigation group member in Serenje District, Central Province. She has been participating in E-COBSI's activities since 2020, and also participated in E-COBSI's nutrition improvement activities. From her CEO, she learned about improved nutrition, balanced diet, food groups, malnutrition, fish farming, livestock, and Tebakari-Eiyouhou.

・Before she joined E-COBSI, she put enough food for her entire family on one plate without measuring amount of food family eat, but after learning about Tebakari-Eiyouhou, she started measuring amount of food to be eaten individually by hand and putting it on a separate plate.

・Before participating in E-COBSI (before 2018), she ate twice a day, but now she eats four times a day. As shown below, the content of the meals has also been improved.

Table 4.13 Dietary changes before and after participation in E-COBSI (Serenje District case study)

2018 (Before E-COBSI) * Amount of food was not recorded because it was prepared without measuring food for everyone.

Time:		Time:		Time:	
Food	**Amount**	**Food**	**Amount**	**Food**	**Amount**
Sweet potato				Nshima	
				Fish	
				Bean leaves	

2023 (After E-COBSI)

Time:		Time:		Time:	
Food	**Amount**	**Food**	**Amount**	**Food**	**Amount**
Porridge	1 both handful	Nshima	1 both handful	Nshima	1 both handful
		Fish	1/2 both handful	Fish	1/2 both handful
		Pumpkin leaves	1/2 both handful	Pumpkin leaves	1/2 both handful
				Beans	1/2 both handful

Source: JICA E-COBSI

・Comparing before and after E-COBSI implementation, consumption of fish and meat increased. Main reasons are construction of weirs and participation in SHEP activities, increase in the number of livestock (chicken), which leads to an increase in domestic consumption of livestock. Besides, since there are farmers who own fish ponds, she can buy fish at low prices. Meat consumption increased from

once a week to four times a week, and fish consumption increased from three times a month to once a week.

・Her diet has changed. Before participating in E-COBSI, she ate two meals a day, but now she has increased her meals to four times a day. She has become more conscious of the amount of food she eats and a well-balanced diet after learning Tebakari-Eiyouhou. Additionally, she uses income from selling vegetables to purchase fish and meat, which has resulted in a more balanced diet.

・Due to construction of weir and participation in training, amount of vegetables consumed has increased from two times a week to seven times a week, and many types of vegetables are grown now.

・Income also increased. Main reasons for increase in income are construction of weirs, participation in SHEP activities, a rise in the price of vegetables sold, and livestock sales due to an increase in the number of livestock. The income is used to buy clothes, shoes, livestock, and food (oil, fish, etc.).

Qualitative survey found that 1) many mothers learned about balanced diet and nutrition, which led to improvements in family meal frequency and nutritional balance, 2) improved nutritional knowledge among mothers led to improved dietary balance and nutrition for children under 5 years, 3) construction of a weir by COBSI has made water available throughout the year, which has increased vegetable production and consumption, and people are now consuming a wider variety of vegetables than before, 4) after implementing COBSI and SHEP, income increased, families were able to purchase meat and fish, and protein intake became more frequent

3) Interviews regarding gender and nutrition improvement in Farmer's Household Survey

When conducting the "4.1.5 Endline Survey," the Project also conducted interviews related to gender and nutrition improvement, and the results are shown in Table 4.9. sample size is the same as "4.1.5 Endline Survey" and only valid responses are counted.

Approximately 90% of households in FU Province and over 90% in New Target Provinces responded that there had been a positive change in gender-related issues after participating in E-COBSI, indicating generally good results. In particular, over 80% of men said that their involvement in activities related to diet and nutrition had changed positively after participating in E-COBSI. In the target areas, men are often the heads of households and often have control over food expenditures, so it is important to change men's awareness of nutritional improvement. E-COBSI's nutrition improvement training module also emphasizes this. This survey confirmed results of E-COBSI's activities from a gender perspective.

Regarding nutrition improvement, it was found that approximately one-fourth of the respondents did not participate in nutrition improvement training (organized by district officers or CEOs). The reason given was that most of the participants were absent on the training day due to being out or sick. However, in Chitambo District, Central Province, there are complaints that the training itself was not held in 2022, and there are also cases where CEOs have not communicated what they learned in the E-COBSI training, so improvements are needed.

The survey found that majority of households that participated in nutrition improvement training noticed changes in their own or their family's nutritional status, indicating that the training encouraged behavior changes. More than 80% of households said they had increased their intake of vegetables, meat, and fish, and the number of times they consumed each item increased after participating in E-COBSI.

Table 4.14 Results of interviews regarding gender and nutrition improvement in Farmer's Household Survey

Question related to gender		FU	New Target
Has the role of women in agriculture and housework changed after participating in E-COBSI?			
	Yes, positively changed	91%	83%
	Yes, negatively changed	2%	0%
	No, nothing changed	7%	16%
Has women's access on agriculture changed?			
	Yes, positively changed	91%	81%
	Yes, negatively changed	0%	0%
	No, nothing changed	9%	18%
Has women's control on agriculture changed?			
	Yes, positively changed	92%	76%
	Yes, negatively changed	0%	3%
	No, nothing changed	8%	21%
Has men's involvement in food and nutrition activities changed?			
	Yes, positively changed	92%	84%
	Yes, negatively changed	0%	0%
	No, nothing changed	7%	16%
Questions related to nutrition improvement activities in 2022			
Did you receive the nutrition improvement training of E-COBSI such as "Tebakari-Eiyohou (Hand scale method)"?			
	Yes, I participated in the E-COBSI nutrition training.	77%	75%
	No, I didn't.	23%	25%
If your answer is "Yes" to above question, do you feel any change of nutrition condition on yourself and your family members as well?			
	Yes, it has changed.	97%	100%
	No, no change.	3%	0%
If Yes, please specify what has changed.			
	Started paying more attention to my family members' meals	64%	62%
	Started eating more conscious of food quantity and dietary balance	64%	68%
	Started purchasing more nutritious foods than that of previous	46%	60%
	Others	4%	1%
Has your consumption of vegetable, meat and fish increased compared to when you joined E-COBSI?			
	Yes, it has increased.	89%	86%
	No, no change.	11%	14%
If your answer is "Yes" to above question, how much has your weekly consumption of vegetables, meat, and fish changed at when you joined E-COBSI and in the year 2022.			
When you joined E-COBSI	Vegetable consumption (times/week)	4.9	5.3
	Meat consumption (times/week)	0.9	1.4
	Fish consumption (times/week)	2.2	2.2
2022	Vegetable consumption (times/week)	6.8	6.9
	Meat consumption (times/week)	1.6	2.1
	Fish consumption (times/week)	3.2	3.3

Source: JICA E-COBSI

4.1.5 Endline Survey

An endline survey was conducted in the final year of the project to compare results with the baseline survey and to determine the impact of the project interventions. In order to make comparisons with the baseline survey results, the survey items were largely the same as in the baseline survey. An overview of the endline survey is provided below.

Target: Farmer groups in all district model sites (45 counties) and 10 farm households in each district model site (450 households in total)
Target Year: 2022
Survey Period: May to July 2023
Survey Contents: Irrigation site status, farmer group status, water management and maintenance status, natural site conditions, household situation, household income (farm and off-farm), access to infrastructure, access to water, gender, irrigated and rainfed farmland area, irrigation water management, land use status, adoption of appropriate agricultural technologies and marketing, farming and marketing challenges, changes after E-COBSI intervention.
Survey Method: Provincial CPU members took the lead in mobilising district agricultural office staff and BEOs/CEOs to conduct interviews using questionnaires. The data collected was then entered by the provincial CPU and the project team organised and analysed the data.

1) Results of the survey

In terms of model sites, 14 of the 45 sites were new, while 31 were sites that had been previously irrigated and were renovated or improved. In Follow-up Provinces, 3 out of 24 sites were new, and in New Target Provinces, 11 out of 21 sites were new. In the Follow-up Provinces where the earlier projects were implemented, many irrigation sites had already been developed and in many cases the project intervened to improve them. There were also some sites in the New Target Provinces where bucket irrigation had been implemented by altering the course of the river, and the project was often introduced at such sites. In terms of weir type, 32 sites had simple weirs and 13 sites had permanent weirs. The simple weirs included 8 sites of the inclined type, 17 sites of the single line type, 5 sites of the double line type and 2 sites of the trigonal type. Note that all 13 permanent weir sites were in the FU and had been constructed in previous projects.

The average annual agricultural income per household at endline (2022) was ZMW 10,527 in Follow-up Provinces and ZMW 10,477 in New Target Provinces. By province, Northern Province had ZMW 11,915, Luapula Province ZMW 9,963, Muchinga Province ZMW 8,817, Copperbelt Province ZMW 9,340, North western Province ZMW 13,437 and Central Province ZMW 6,027. All provinces exceeded their baseline values by more than 60%, with the North-West province showing the largest increase of 218.6%, the Follow-up Province showing an average increase of 126.4%, and the New Target Provinces showing an average increase of 129.8%. In addition, interviews with farmers confirmed changes in their lives, such as improved incomes that enabled them to repair their houses, buy a motorbike and send their children to school.

Looking at the number of members per household, the average number of members was 6.0 in Follow-

up Provinces and 6.6 in New Target Provinces, with most households having an equal number of men and women. Regarding the income-generating activities in which each household engaged, crop and horticultural production were carried out by all farmers. This was followed by animal husbandry at about 50%, petty trade at approximately 30%, the sale of forest products and seasonal work at about 1.5%. Almost all target farm households were involved in horticulture, cereals, and animal husbandry as sources of income.

2) Comparison with the baseline survey data

Comparisons were made on the same survey items as in the baseline survey results. However, 12 sites (5 in FU and 7 in NT) have changed since the baseline survey, so not all changes can be attributed to the project interventions. However, given that 33 sites are the same as in the baseline, an overall trend can be confirmed.

Table 4.15 Changes in the number of farmers and irrigated area and canal length across all sites

Province	FU Province		NT Province		Total	
Year	2018	2022	2018	2022	2018	2022
No. of Households:	739	813	438	581	1,177	1,394
Total number of members:	1,222	1,410	702	808	1,924	2,218
(Male)	658	711	328	415	986	1,126
(Female)	564	699	374	393	938	1,092
Irrigated Area (Lima)	918.8	1,226.3	95.5	295.0	1,014.3	1,521.3
Length of Main Canal (km)	49.2	77.3	12.9	32.4	62.1	109.6

Source: JICA E-COBSI

Comparing totals across all model sites, the number of households had increased by 217, from 1,177 to 1,394, in 2022 at endline compared to 2018 at baseline. In terms of the number of participating farmers, the number had increased by 294 from 1,924 to 2,218. In terms of irrigated area, there was an increase of 507 lima, from 1,014.3 lima to 1,521.3 lima, and the length of canals increased from 62.1 km to 109.6 km. Compared to the baseline survey, the model sites showed an increase in both the number of participating households and the irrigated area at the time of the endline survey.

Figure 4.2 shows the status of farmer group bylaws at baseline and endline. In 2018, 22% of farmer groups had written bylaws, 47% had verbal bylaws and 31% said they had no bylaws. In contrast, by 2022, 80% of farmer groups had written bylaws, 9% had verbal bylaws and 11% said they had no bylaws. The project has recommended that farmer groups have written bylaws as they are necessary for the operation of irrigation schemes. The status of the farmer groups' bylaws improved significantly at endline compared to baseline.

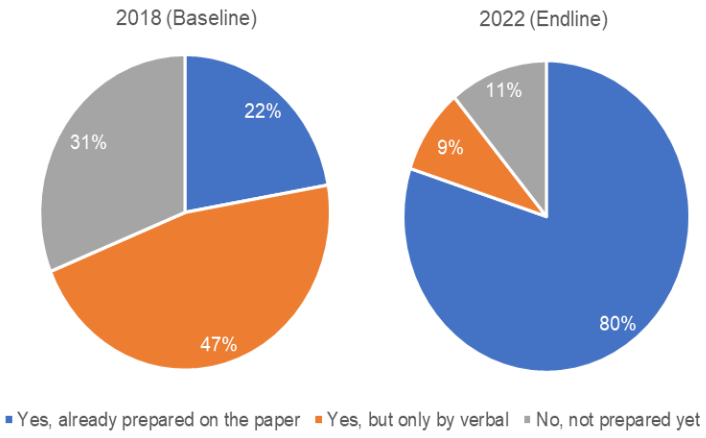


Figure 4.2 Comparison of status of farmer group bylaws（n=45）

Source: JICA E-COBSI

Figure 4.3 illustrates the collection of membership fees by farmer groups. In 2018, only 36% of groups were collecting membership fees, but by 2022, 78% of groups were doing so, more than doubling the number of farmer groups collecting membership fees. The project recommended that farmer groups recover membership fees due to the costs involved in jointly operating and maintaining permanent weirs. It was found that the collection of membership fees by farmer groups improved significantly.

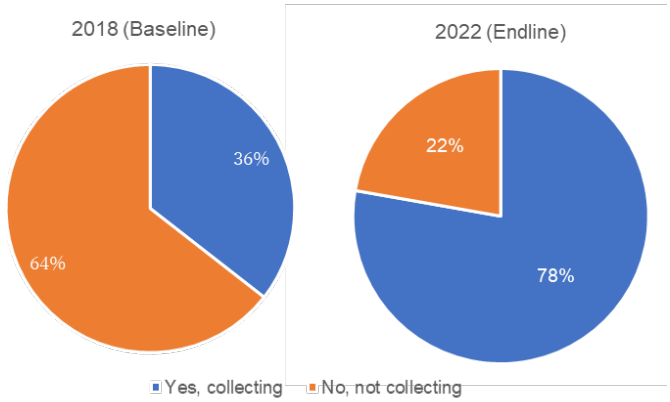


Figure 4.3 Comparison of collection of membership fees by farmer groups (n=45)
Source: JICA E-COBSI

Figure 4.4 shows the state of water distribution in the model area. In 2018, 52% of the farmer groups were using rotational irrigation, which increased to 89% in 2022. The weirs created by COBSI are not dams or reservoirs; thus, at the end of the dry season, river flows are low, making it difficult to distribute water to all irrigated plots simultaneously. In such cases, the project has recommended rotational irrigation to manage more irrigated land effectively. Many sites have adopted the project's recommendations for water distribution.

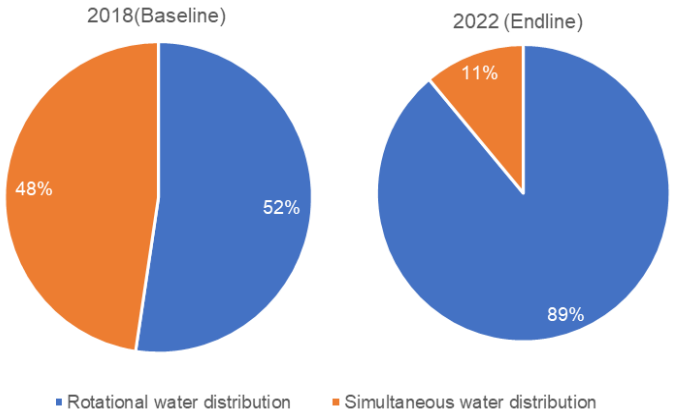


Figure 4.4 Comparison of site-specific water distribution methods
Source: JICA E-COBSI

Figure 4.5 illustrates the condition of irrigated farmland soils by site. In 2018, 38% of sites reported good soil quality, 53% indicated normal conditions, and 9% described it as poor. However, by 2022, the percentages shifted slightly, with 35% reporting good soil, 58% normal, and 7% poor. Continuous cultivation without proper maintenance and management can lead to soil degradation. Despite this risk, no significant cases of soil

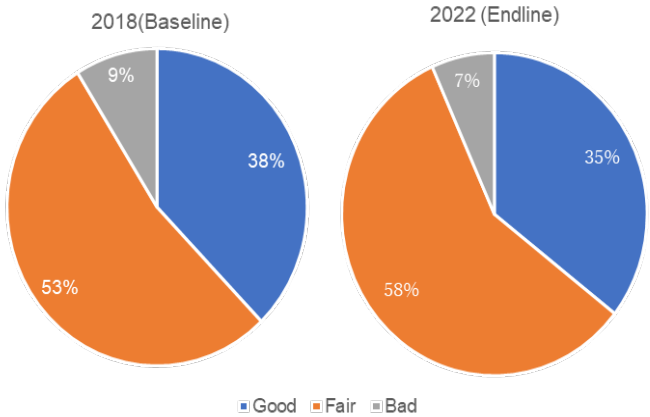


Figure 4.5 Comparison of soil conditions in irrigated agricultural land (n=45)
Source: JICA E-COBSI

degradation were identified throughout the project implementation period. The project introduced farming techniques such as compost and Bokashi manure utilization and crop rotation, which were deemed effective in maintaining soil fertility on irrigated land.

Figure 4.6 illustrates the use of compost by site. In 2018, only 29% of sites utilized compost, but by 2022, this figure had nearly doubled to 56%. The baseline survey indicates that farmers tend to favor compost less due to the time required for preparation. However, the project recommended the preparation and use of compost as it effectively maintains soil fertility on irrigated farmland. Furthermore, with the increase in the price of chemical fertilizers since the onset of the COVID-19 pandemic in 2020, the production and application of compost, which farmers can produce themselves, appear to be on the rise.

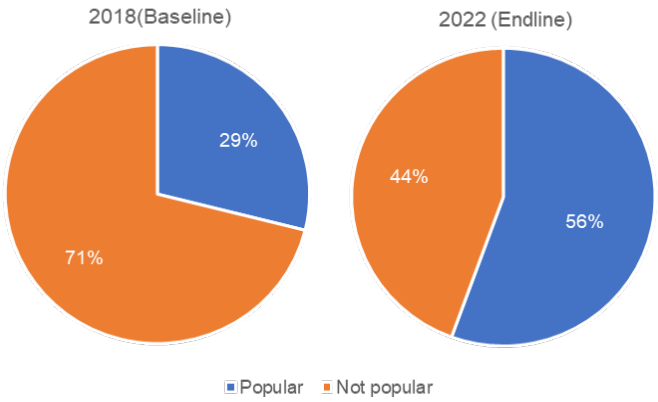


Figure 4.6 Comparison of compost use（n=45）

Source: JICA E-COBSI

Figure 4.7 illustrates the utilization of livestock manure compost. Similar to compost, its usage experienced a significant increase in 2022 compared to 2018. This growth can be attributed in part to households initiating livestock rearing following recommendations from nutrition improvement activities. Interviews conducted during the nutrition survey revealed that some households had begun livestock keeping as part of the nutrition improvement program. Another contributing factor could be the heightened demand for alternative fertilizers due to the inflated prices of chemical fertilizers resulting from the COVID-19 pandemic. The project advocated for the production and utilization of livestock manure and compost, potentially leading to a noteworthy

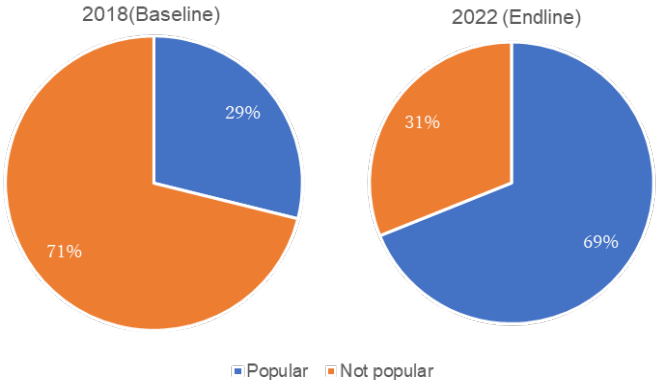


Figure 4.7 Comparison of livestock manure use（n=45）

Source: JICA E-COBSI

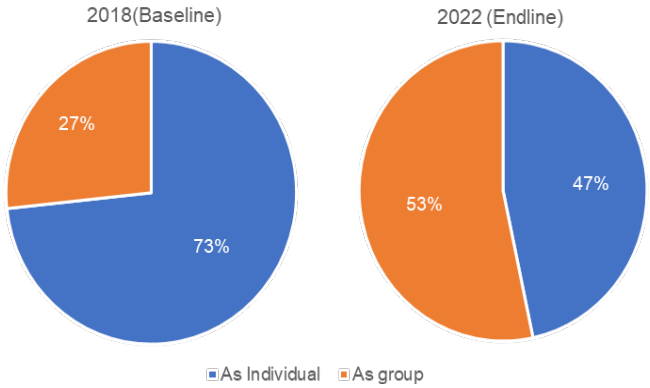


Figure 4.8 Comparison of agricultural marketing methods（n=45）

Source: JICA E-COBSI

surge in their production and usage.

Figure 4.8 shows a comparison of methods for selling agricultural products. The results from group interviews indicate that in 2018, only 27% of the groups engaged in group selling, while by 2022, this figure rose to 53%. Group selling was advocated by the project due to its benefits, such as facilitating larger transactions with market actors by securing the volume of produce and reducing transport costs, particularly when selling to distant locations. However, it was observed that group sales were not always effective, especially in urban sites where individual sales were not significantly costly to transport, and sometimes middlemen directly purchased produce from the fields. Nevertheless, COBSI sites typically were situated farther from urban areas, potentially explaining the higher prevalence of group sales.

Figure 4.9 shows a comparison of the number of market actors contacted at the time of sale. In 2018, 67% of farmer groups reported contacting four or more market actors, while by 2022 this had increased to 73%. The project recommended conducting market research (SHEP), which showed that farmer groups were contacting and selling to more market actors than before the project intervention. The project intervention was perceived to have improved farmers' business attitudes and consequently contributed to higher farm incomes.

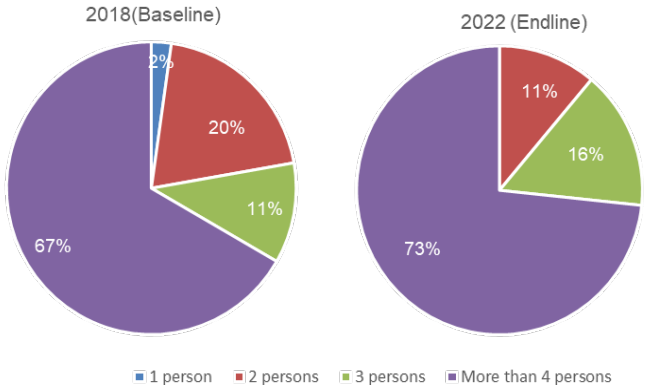


Figure 4.9 Comparison of the number of market stakeholders contacted at the time of selling（n=45）

Source: JICA E-COBSI

Table 4.16 illustrates individual farmers' access to infrastructure. Comparing 2018 and 2022, there have been slight changes in access to all infrastructure, but none significant. Model sites in 12 out of the 45 districts had been changed by the endline survey, yet it was evident that the situation of the target farmers had not undergone significant changes.

Table 4.16 Comparison of individual farmers' access to infrastructure

HH Conditions	Follow-up Provinces		New Target Provinces		Total	
Year	2018	2022	2018	2022	2018	2022
Availability of electricity (National grid)	7.7%	16.7%	16.1%	20.4%	11.9%	18.6%
Availability of piped water	6.1%	10.5%	11.9%	13.2%	9.0%	11.8%
Accessibility of Mobile Phone Network from your house	91.4%	92.6%	90.8%	87.9%	91.1%	90.2%
Accessibility of Radio Network from your house	87.3%	88.5%	82.6%	84.5%	84.9%	86.5%
Accessibility of TV Network from your house	47.9%	57.0%	58.1%	66.4%	53.0%	61.7%

Source: JICA E-COBSI

Table 4.17 illustrates the level of adoption of the cultivation technologies surveyed among target farmers in the model sites at baseline (2018) and endline (2022). Initially, 33 technologies were identified, increasing to 35 by endline. The findings indicated that adoption rates for all technologies were higher

at endline compared to baseline, although variations were observed among the technologies.

Comparing Follow-up and New Target Provinces, the overall trend was considered to be the same, but generally higher in the Follow-up Provinces. This may be due to the fact that the Follow-up Provinces were the target areas of the former JICA's project COBSI Study and T-COBSI projects, and that these projects had disseminated cultivation techniques to C/P officers and farmers in the target areas. On the other hand, in the New Target Provinces, irrigation technology, market-oriented farming technology, etc., which were very low at baseline, increased to about 80% at endline, which was considered to be an effect of the project interventions.

At endline, more than 80% of farmers reported that they had adopted irrigation technology, market-oriented crop selection, crop calendar preparation, nursery stock preparation and field manure management, indicating that the project had improved the irrigated farming technology of farmers in the district model sites. On the other hand, although there was an improvement from baseline, less than 50% of farmers had adopted composting and Bokashi manure from weeds, mulching rows in the field, applying organic pesticides, adapting IPM and pre-sale weighing. Compost, Bokashi manure and organic pesticides were not widely used in individual plots, although they were used in group plots and demonstration plots because of the time and effort required to prepare them. Regarding mulching the ridges of the cultivated plots, many farmers cultivate COBSI without ridges in the first place, because COBSI cultivation is limited to the dry season and the risk of wet damage is low, and because the plots are large, not many farmers feel the need for mulching, and the adaptation rate was only 43.6%.

Regarding IPM, many farmers answered 'no' because they did not fully understand the meaning of the term IPM, although they had actually implemented it. Regarding pre-sale weighing, many respondents said this was because crops are sold in bags or boxes in the first place, so they are measured by the number of bags or boxes.

Table 4.17 Comparison of cultivation technology adaptation in individual farm households

Cultivation Technics		Follow-up Provinces		New Target Provinces		Total	
Year		2018	2022	2018	2022	2018	2022
Irrigation Method	Applying Water Management	68.1%	88.9%	38.3%	77.1%	53.2%	83.0%
	Conducting Operation and Management of Irrigation facilities	71.1%	93.6%	42.5%	86.2%	56.8%	89.9%
	Applying Gravity Irrigation	64.1%	91.3%	27.2%	84.9%	45.7%	88.1%
Preparation	Market survey for crop selection	63.0%	84.2%	34.6%	77.8%	48.8%	81.0%
	Selecting crops with consideration of cultivation experience and season	77.1%	92.3%	68.6%	89.4%	72.9%	90.9%
	Selecting crops with consideration of crop rotation	71.6%	78.7%	69.9%	83.6%	70.7%	81.2%
	Preparing crop calendar	58.3%	84.9%	34.0%	75.1%	46.2%	80.0%
	Preparing certified seed	81.3%	94.4%	63.4%	88.7%	72.3%	91.6%
	Making compost using grasses	39.1%	33.6%	17.2%	34.1%	28.2%	33.9%
	Making compost using “Bokashi”	22.4%	15.2%	6.1%	22.8%	14.2%	19.0%
	Using manure	59.5%	65.6%	51.1%	60.6%	55.3%	63.1%
	Keeping record of agriculture activities	53.8%	67.5%	32.5%	55.2%	43.1%	61.4%
	Keeping record of expenditure (input cost, tools, etc.)	54.8%	77.9%	37.4%	52.9%	46.1%	65.4%
	Measuring the farm plot size for each crop before cultivation	72.5%	76.9%	48.1%	77.5%	60.3%	77.2%
Nursery	Making nursery bed for raising seedlings	84.6%	91.1%	69.8%	85.9%	77.2%	88.5%
	Applying manure and/or compost for	58.4%	59.3%	45.5%	53.0%	52.0%	56.2%

Cultivation Technics		Follow-up Provinces		New Target Provinces		Total	
Year		2018	2022	2018	2022	2018	2022
	nursery bed						
	Sowing appropriate amount of seed and row sowing on nursery bed	75.2%	91.6%	54.1%	83.1%	64.7%	87.3%
	Applying mulching on nursery bed	79.1%	93.1%	59.4%	77.8%	69.2%	85.4%
	Watering nursery bed gently	86.2%	92.5%	72.0%	86.8%	79.1%	89.7%
Management on Farm	Making ridges for transplanting	79.8%	81.0%	57.6%	72.3%	68.7%	76.6%
	Making Contour ridge on the slope area	55.8%	49.4%	45.1%	63.5%	50.4%	56.4%
	Applying the compost or manure as a basal fertilizer	47.7%	57.5%	40.2%	61.6%	43.9%	59.6%
	Applying the grass mulching on the ridge	43.0%	40.8%	33.1%	46.4%	38.0%	43.6%
	Applying Chemical Fertilizer	83.4%	93.0%	70.4%	88.4%	76.9%	90.7%
	Applying Organic pesticide		30.9%		37.4%		34.1%
	Applying Agricultural Chemicals (e.g. Pesticide, Fungicide)	84.9%	92.1%	73.5%	87.1%	79.2%	89.6%
	Applying Agricultural Chemicals by Sprayer	79.7%	93.2%	63.9%	84.2%	71.8%	88.7%
	Applying IPM (Integrated Pest Management)	34.8%	38.7%	34.7%	31.3%	34.8%	35.0%
	Weeding done regularly	90.9%	94.1%	77.4%	92.1%	84.1%	93.1%
	Watering done regularly		79.4%		86.5%		82.9%
Post-Harvest	Measuring the amount (kg) of product before selling	50.2%	54.8%	41.7%	41.0%	46.0%	47.9%
	Recording the amount of harvesting	59.1%	74.7%	38.5%	65.8%	48.8%	70.3%
	Recording the selling detail	52.1%	75.6%	32.1%	50.2%	42.1%	62.9%
	Communicating with buyers/ marketers regularly	72.0%	87.0%	56.1%	84.3%	64.1%	85.7%
	Conducting profit analysis after each season	52.0%	78.2%	39.1%	69.3%	45.5%	73.8%

Source: JICA E-COBSI

Figure 4.10 shows the O&M status of irrigation facilities. It was observed that all O&M work has improved from the baseline survey. The project recommends regular O&M to ensure sustainable use of irrigation facilities. The results show that more sites have implemented the O&M activities recommended by the project than before the project intervention. In addition, the sites that were converted to permanent weirs did not require frequent O&M as the weirs were rarely damaged due to the robust weir structure.

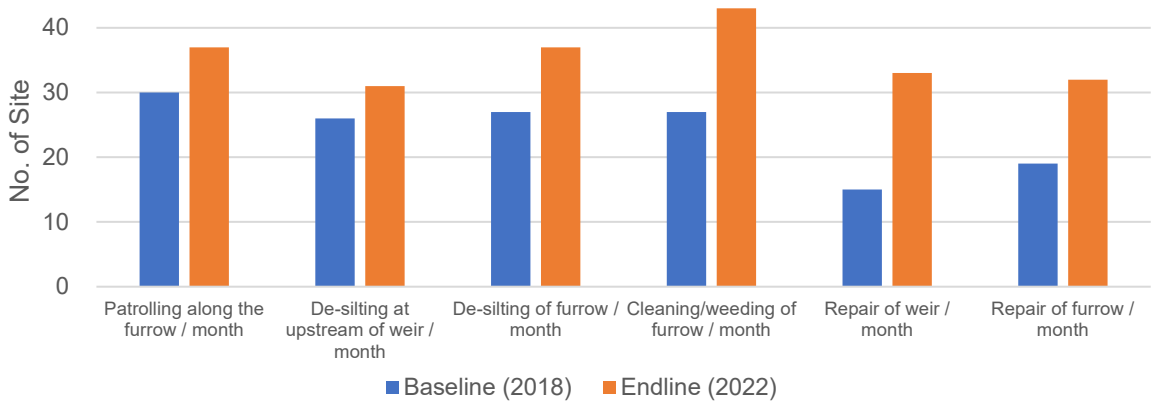


Figure 4.10 Comparison of O&M implementation（n=45）

Source: JICA E-COBSI

4.2 TERMINAL EVALUATION

4.2.1 Implementation of terminal evaluation

As the project's field activities were set to conclude in January 2024, a terminal evaluation mission was conducted from July to September 2024 to assess the project's activities to date. Questionnaires were dispatched to C/P staff in August, and the terminal evaluation mission commenced fieldwork, organizing a joint evaluation mission with the Zambian C/P counterparts from August 23, 2023, to visit a total of 12 sites in Northern Province and Copperbelt Province over a two-week period. Based on the results of the preliminary survey, the questionnaire survey of the C/Ps, and the field visits, an exit evaluation report was prepared. This report received approval at the 6th JCC meeting on September 12.

4.2.2 Recommendations form the terminal evaluation mission

The report prepared by the terminal evaluation mission made the following six recommendations for the project team to implement by the end of the project.

1. Conduct additional permanent weir training
2. Invite international organisations, other donors and media to the final seminar
3. Support the development of a Ministry of Agriculture Action Plan by the end of the project
4. Organising and analysing the results of the endline survey on Output 4
5. Consultation with WARMA (Water Resources Management Authority) on water rights
6. Conduct economic analysis on permanent weirs

4.3 ACHIEVEMENT STATUS OF PROJECT PURPOSE AND OUTPUTS INDICATORS

4.3.1 Achievement status of project purpose

As mentioned in Chapter 1, the project objective is "Community-based smallholder irrigation farming is promoted through the provision of smallholder irrigation infrastructure and management skills for smallholder farmers in the target area" As indicators of this project objective, the PDM ver. 0 at project inception included the following three items.

1. Irrigation area is expanded by xx ha in the New Target Provinces (Copperbelt, North Western and Central).
2. Income of famers is improved xx % in the model sites in the Follow-up Provinces (Luapula, Muchinga and Northern) by virtue of irrigation and marketing approach.
3. Action Plan (2025-2027) for smallholder Irrigation development is approved by MoA.

With regard to the third indicator, the year 2025 was one year after the end of the project, which meant that the Ministry of Agriculture would need to secure its own budget from 2024 onwards in order to continue the project activities. Therefore, at the first JCC meeting on 23 January 2019, the year covered by the Action Plan was changed from the original '2025-2027' to '2024-2026'. Furthermore, the numerical values of the above indicators were set based on the actual implementation of the project activities and changed as follows at the 5th JCC meeting held on 16 December 2022.

1. Irrigation area is expanded by 500 ha in the New Target Provinces (Copperbelt, North Western and

Central).

2. Income of famers is improved 70 % in the model sites in the Follow-up Provinces (Luapula, Muchinga and Northern) by virtue of irrigation and marketing approach.

For the first indicator, the increased irrigated area in New Target Provinces from 2019 to 2023 was aggregated. For the increased irrigated area in each year, the newly irrigated area reported by each target district in AEW was aggregated. This shows that at the end of 2023, 515.8 ha had been newly irrigated in the New Target Provinces, thus exceeding the project target of 500 ha and achieving the indicator (Figure 4.11).

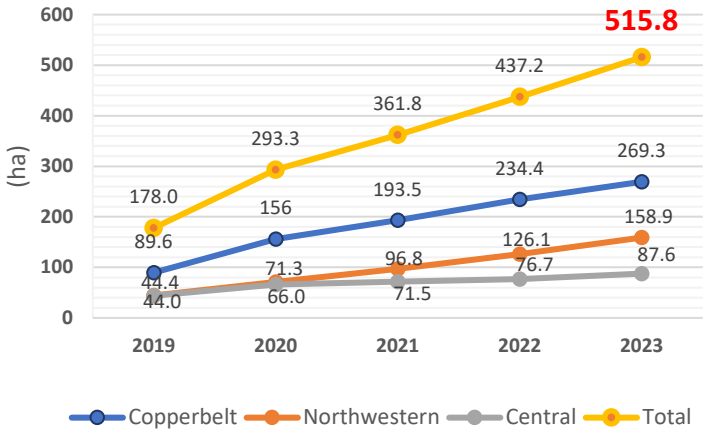


Figure 4.11 Changes in the area under irrigation development in New Target Provinces

Source: JICA E-COBSI

For the second indicator, improvement in farmers' incomes, the incomes of 10 farmers in each site were surveyed in the district model sites in all 24 districts of the Follow-up Province, and the average of these was used. The same households were surveyed every year since 2019, when the project started, about their income in the previous year. The survey was conducted by the provincial CPUs together with district officials and BEOs/CEOs. However, values for Mwense District, Luapula Province, and Kanchibiya District, Muchinga Province, where the model site was changed after 2020, were not included in this average because continuous values were not available.

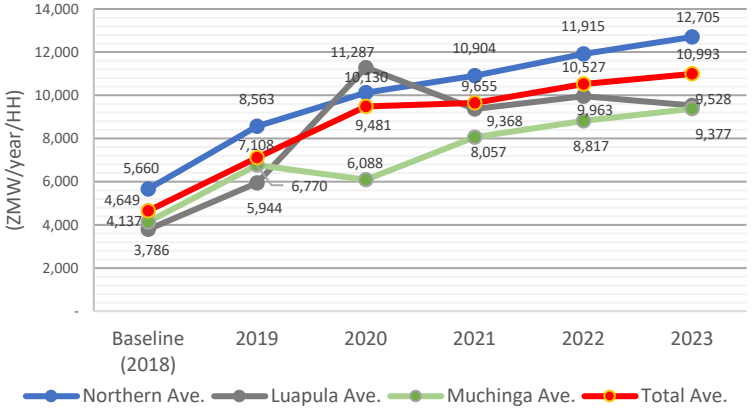


Figure 4.12 Changes in household agriculture income in Follow-up Provinces

Source: JICA E-COBSI

The results showed that the average values for each province tended to increase each year since the project started (Figure 4.12). In Muchinga Province, a downward trend was observed in 2020, which was thought to be due to the impact of the COVID-19 expansion. However, interviews with farmers and government officials in the target area indicated that they were generally not significantly affected by the COVID-19. In urban areas, C/P officials heard that hospital beds were being stretched by the spread of the COVID-19, while in rural areas, low population density and scattered farm households meant that the disease did not spread widely and did not appear to have a major impact. The average increase in the Follow-up Provinces was 52.9% in 2019, 104.0% in 2020, 107.7% in 2021, 126.4% in 2022 and 136.5% in 2023, compared to the baseline data(Table 4.18). In 2019, the first year of the project, the percentage increase in income was only around 50%, partly due to the late start of project activities in some counties, but from 2020 onwards the increase was over 100% each year, indicating an increase of over 70%, which

was the target. The project objective indicator was therefore achieved.

Table 4.18 Average annual HH income by province by year and growth rate (HH/year)

Province	Baseline (2018)	2019	2020	2021	2022	2023
Northern Ave. (ZMW)	5,660	8,563	10,130	10,904	11,915	12,705
% increase from baseline		51.3%	79.0%	92.6%	110.5%	124.5%
Luapula Ave. (ZMW)	3,786	5,944	11,287	9,368	9,963	9,528
% increase from baseline		57.0%	198.1%	147.4%	163.1%	151.6%
Muchinga Ave. (ZMW)	4,137	6,770	6,088	8,057	8,817	9,377
% increase from baseline		63.6%	47.1%	94.8%	113.1%	126.6%
Total Ave. (ZMW)	**4,649**	**7,108**	**9,481**	**9,655**	**10,527**	**10,993**
Total Ave. % increase		**52.9%**	**104.0%**	**107.7%**	**126.4%**	**136.5%**

Note: Red number means over target number.
Source: JICA E-COBSI

The third indicator, the Action Plan for Community-based Small-Scale Irrigation Development (2024-2026), was prepared in 2023 by the C/P of the Ministry of Agriculture headquarters with the assistance of Japanese experts. The action plan was subsequently approved by the Permanent Secretary (PS) of the Ministry of Agriculture on 6 December 2023. The project purpose indicators were therefore achieved.

As stated above, all project purpose indicators were achieved.

4.3.2 Achievement status of project outputs

The expected output of this project is as flows.

Output 1: Capacity of COBSI Promotion Unit officers is enhanced for planning and management of smallholder irrigation development schemes.
Output 2: Current situation and challenges of agricultural production in the target areas are clarified through surveys.
Output 3: Capacity of provincial, district and camp officers in promoting irrigation and agronomy technologies and marketing skills of farmers is enhanced for smallholder irrigation development.
Output 4: In the model site , smallholder farmers' knowledge and skills are improved for operation and maintenance (O&M) of irrigation facility, farm management and marketing.

The indicators for the above outputs were as follows.

Indicator for Output 1:
Action Plan (2024-2026) for smallholder irrigation development is prepared by COBSI Promotion Unit of MOA.

Indicator for Output 2:
Survey results are compiled into reports and reflected into the training plans for provincial, district and camp officers and dissemination plans in the target provinces.

Indicator for Output 3:
3-1 : In the New Target Provinces, all of target district offices equip officers with acquiring sufficient knowledge and skills as a trainer to promote farmers' irrigation and cultivation technologies and marketing skills by the beginning of 2023.

3-2 : In the New Target Provinces, all of participated camp officers for E-COBSI training pass the achievement test with more than 60% correct by the beginning of 2023.
3-3 : In the Follow-up Provinces, all of target district offices equip officers with acquiring sufficient knowledge and skills as a trainer to promote farmers' irrigation and cultivation technologies and marketing skills by the beginning of 2023.
3-4 : In the Follow-up Provinces, all of participated camp officers for E-COBSI training pass the achievement test with more than 60% correct by the beginning of 2023.

Indicator for Output 4:
4-1 : O&M activities by farmers are practiced in accordance with the Maintenance Check List at more than 80% of the smallholder irrigation sites.
4-2 : More than 80 % of farmers in the model sites practice on-farm irrigation following the timing and intervals recommended by the Project.
4-3 : More than 80 % of farmers in the model sites practice the pest control techniques recommended by the Project.
4-4 : More than 80 % of farmers in the model sites increase the sales of their produce.

Regarding the Output 1 indicator, an action plan (2024-2026) was developed by the C/P of the Ministry of Agriculture headquarters in 2023 with the support of Japanese experts.

With regard to the Output 2 indicator, as described in Chapter 4, 4.1, various surveys were conducted during the project period and the results were included in the monthly reports and progress reports. Based on these results, the training and dissemination plans were revised. The indicator was achieved.

For Output 3 indicators 3-1 and 3-3, by the end of 2023, a total of 899 disrict officials will have participated in trainings on this project (204 in 2019, 135 in 2020, 204 in 2021, 161 in 2022 and 195 in 2023). In addition, district model sites have been established in all districts since 2019, where a series of trainings on E-COBSI have been conducted. Therefore, it can be concluded that this indicator has been achieved.

Indicators 3-2 and 3-4 were determined by aggregating the results of the achievement tests administered at the AEW in each year. The results showed that all provinces in both the new target and Follow-up Provinces answered more than 60% of the questions correctly (Table 4.13). The achievement tests were prepared by Japanese experts and finalised by the respective provincial CPUs. In all years, the percentage of correct answers was above 60% in all countries, although the questions became more difficult and in some years less than 50% of the advisers got more than 80% of the answers correct. This indicator has therefore been met.

For the Output 4 indicator, the level of achievement was determined from the results of an endline survey conducted in April-June 2023. For indicator 4-1, the results of group interviews with all 45 model sites indicated that O&M was carried out at all district model sites using the maintenance checklist. This indicator was therefore achieved.

For indicator 4-2, the results of the endline group interviews showed that 37 out of 45 sites were using the project's recommended rotational irrigation. Thus, approximately 82.2% of the sites were irrigating according to the project's recommended timing and intervals. This means that more than 80% of the farmers in the model sites were irrigating according to the timing and intervals recommended by the

project, which means that the indicator was achieved.

For indicator 4-3, the results of the endline group interviews showed that 43 of the 45 sites were practicing the pest management techniques recommended by the project. The total number of farmers in all 45 sites was 2,218, with 2,055 farmers in the 43 sites were practicing the pest management techniques recommended by the project. This means that approximately 92.6% of the district model sites were using the project's recommended pest management techniques, exceeding the target of 80%. The indicator was therefore considered achieved.

Table 4.19 Rate of correct answers on the BEO/CEO achievement test

Province	Correct answer rate	2019	2020	2021	2022	2023
Copperbelt	**80%**	44%	48%	80%	58%	66%
	70%	89%	92%	88%	96%	95%
	60%	100%	100%	100%	100%	100%
Central	**80%**	56%	67%	76%	86%	73%
	70%	100%	100%	92%	100%	94%
	60%	100%	100%	100%	100%	100%
Northwestern	**80%**	68%	48%	74%	71%	32%
	70%	100%	87%	93%	100%	75%
	60%	100%	100%	100%	100%	100%
Northern	**80%**	62%	64%	70%	75%	55%
	70%	92%	79%	89%	94%	87%
	60%	100%	100%	100%	100%	100%
Luapula	**80%**	79%	70%	67%	92%	57%
	70%	96%	100%	89%	100%	93%
	60%	100%	100%	100%	100%	100%
Muchinga	**80%**	57%	75%	60%	63%	42%
	70%	76%	88%	100%	81%	75%
	60%	100%	100%	100%	100%	100%

Source：JICA E-COBSI

Regarding the Indicator 4-4, that the results of the endline group interviews identified 17 sites where all farmers in the site reported increased sales of their produce, 8 sites where 90% or more of farmers reported increased sales of their produce, and 80% or more of farmers reported increased sales of their produce. In 13 sites, more than 80% of farmers reported increased sales of their produce. The total number of farmers who increased their sales of agricultural products across all sites was 1,808, and the total number of farmers was 2,218, indicating that approximately 81.5% of farmers had increased their sales. As this is higher than the indicator of 80%, the indicator was considered achieved.

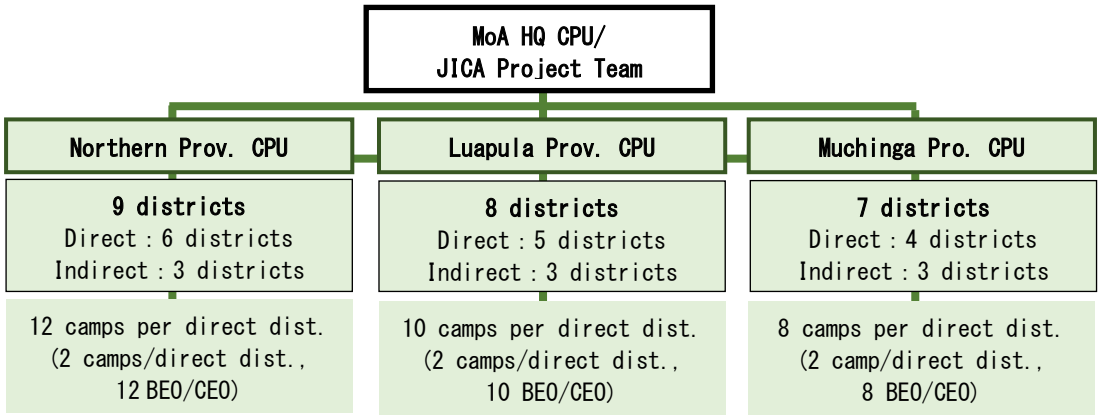
In summary, all indicators were achieved in terms of expected outputs and project purpose.

CHAPTER 5 CHALLENGES AND LESSON LEARNED FROM THE PROJECT IMPLEMENTATION

5.1 EXTENTION SYSTEM

In the very beginning of the project implementation, CPUs were formed at MoA HQ and in all six target provinces, and the project activities were carried out in collaboration with the JICA project team. Based on this formation, the technical transfer related to small-scale irrigation development, market-oriented agriculture (SHEP approach), and other components to TSB, SMS, and CEO at district level was carried out. After, the district officers including CEO conducted OJT activity to share the knowledge and skills with COBSI farmers group at the field level. The officers targeted for technical transfer were as above. From among these, 2 to 3 CEOs per district per year (per irrigation season) participated in all project activities during that year. As mentioned above, these CEOs were provided with fuel for COBSI dissemination activity during only the one dry season (one irrigation season) in which they participated in the project.

From the second year (2020) of the first phase of the project, in the follow-up province, all 24 target districts were divided into 15 direct support districts and 9 indirect support districts in order to efficiently proceed the project activity. The former involved Japanese experts in monitoring and follow-up, and invited the district officers with CEOs to E-COBSI training, while in the latter, the involvement of Japanese experts was limited and the project extension, monitoring and follow-up activities were mainly conducted by C/Ps of Zambia side such as province CPU team, district TSB, SMS, and CEO.



※Category-like arrangement of districts were introduced from 2020 season.

Figure 5.1 Implementation Arrangement of Technical Transfer (FU Provinces)

Source: JICA E-COBSI

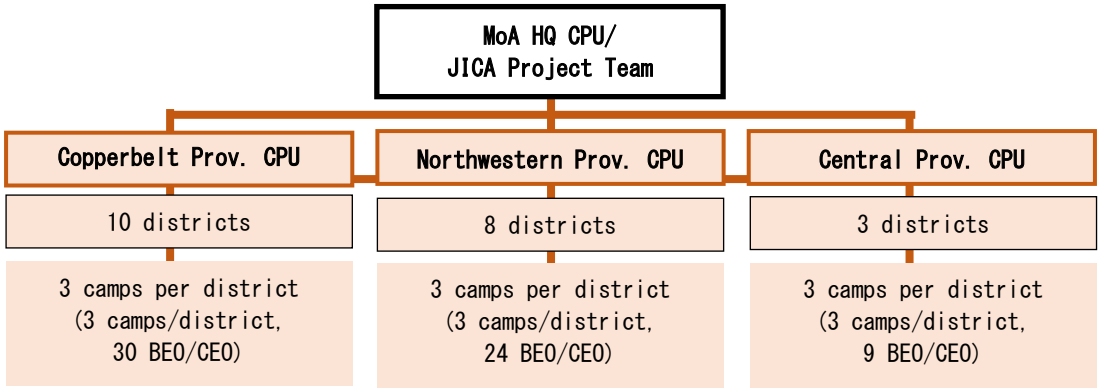


Figure 5.2 Implementation Arrangement of Technical Transfer (NT Provinces)

Source: JICA E-COBSI

5.2 PROJECT IMPLEMENTATION ARRANGEMENT

In order to make better progress with the project and achieve its objectives and results, the project team identified and reflected the following 12 improvements, ingenuity, and reinforcement points based on the issues and lessons learned raised from the field level. The points were carried out based on these contents after approval of JCC meeting.

5.2.1 National CPU meeting

Due to project activities in the first year of the project, information sharing between provincial CPUs was not considered sufficient in the original plan. Although the project targeted all six provinces, the CPUs in each province implemented the activities in that province, so the only opportunity for information sharing across provinces was at the JCC meetings. Therefore, a national CPU meeting was proposed as a place to share experiences in each target province and discuss activities for the following year. The first national CPU meeting was held in December 2019. As this meeting was not included in the original plan, it was decided in principle to hold it the day before the JCC meeting in order to reduce transport and daily allowance costs. The meeting was attended by project managers, project coordinators, CPU members from MoA HQ and CPU members from each state.

At this meeting, CPUs from each province reported on the results of the year's E-COBSI activities, as identified by AEW and Monitoring, and shared experiences and challenges. Japanese experts also presented their activity plans for the following year and discussed how to make the project more effective and efficient. In addition, whenever there were topics to be shared, such as nutrition survey results or presentations for the SHEP International Workshop, these were included in the agenda. The national CPU meeting was held over one day, which allowed sufficient time for discussion and contributed to the exchange of information and motivation for project implementation between the central and provincial CPUs of the Ministry of Agriculture.

5.2.2 Implementing the Market Survey Training (MST)

Based on the outcomes of discussions during the initial national CPU meeting and the subsequent second JCC meeting, which evaluated the first year of project implementation, it was determined that MST (Market Survey Training) would precede all trainings in the subsequent states. This decision aimed to enable the implementation of crop selection aligned with market demands ahead of the dry season, coinciding with the commencement of irrigated agriculture.

Initially, MST was incorporated into KOT in the early dry season in the Follow-up Provinces. However, in the Follow-up Provinces, where many sites had already installed and operated irrigation facilities, there was concern that if district officers and BEOs/CEOs learned how to conduct market surveys at the KOT, and then trained farmers to select crops, they would not be able to start planting in time for the start of the dry season. It was therefore decided that MST would only be implemented during the rainy season, from January to February. On the other hand, C/Ps reported that the implementation of MST had raised their expectations of irrigated agriculture and that farmers were actively constructing and maintaining small irrigation schemes.

5.2.3 Direct and Indirect Support District

This project is a technical cooperation project and it is important to implement it while drawing out the

initiative of the C/Ps. In addition, as the target area of the project was almost double that of the former JICA's projects, COBSI Development Study and T-COBSI, a method was required to reduce the degree of involvement of Japanese experts while increasing the autonomy of the C/Ps and implementing the project. Therefore, from the second year of the project (2020), it was decided to divide the target districts into direct support and indirect support districts in the Follow-up Provinces where prior projects had been implemented and many C/P officers had a good understanding of COBSI approach.

All 24 districts in the Follow-up provinces were divided into 15 directly supported districts and 9 indirectly supported districts, and in the former, Japanese experts were involved in monitoring and follow-up as before, and district officials and BEOs/CEOs were also invited to a series of trainings conducted by the project. The latter, on the other hand, did not involve Japanese experts in monitoring and follow-up, and activities were mainly carried out by the Provincial CPU and district officers. In addition, the number of participants in the project trainings was limited to about half of the directly supported district.

A comparison of activity outcomes between directly and indirectly supported districts in AEW showed that many indirectly supported districts had lower project activity than directly supported districts. On the other hand, in Luapula Province, some indirect-support districts were also active, and it was considered that this was largely dependent on the location of the indirect-support districts, the district office and the CEO. Confirming the activities of the Provincial CPUs, monitoring and follow-up were conducted in both indirectly and directly supported districts, which was considered to have a certain effect in bringing out the initiative of the C/Ps.

5.2.4 Training Preparatory CPU Meeting

Regarding the project's training operations, FY2019 was the first year of the project, and the Project team was highly involved in preparation, procurement, and operation of a series of training programs (TOT, KOT, MTT, and AEW) conducted throughout the year. This modality made the Project possible to implement high-quality training.

However, in post-E-COBSI, it is necessary for C/Ps to plan, prepare, and implement training, and to continue activities related to COBSI approach. Therefore, it is important to reduce level of Japanese experts' involvement as early as possible, bring out independence of C/P, and switch to C/P-led activities. Therefore, from the second year, an attempt was made to limit the level of Japanese experts' involvement and shift a main training organizer to the provincial CPU members.

Based on the above background, the 2nd JCC meeting agreed that the series of E-COBSI training from FY2020 is implemented mainly by provincial CPUs, instead of being prepared and operated mainly by the JICA project team. Since KOT was scheduled to be implemented in the new target province from late February to early March 2020, a KOT preparatory CPU meeting was held from February 12 to 14, 2020, prior to the KOT training.

The main contents of the workshop were: 1) review of E-COBSI activities in 2019, 2) confirmation of E-COBSI activity plan in 2020, 3) explanation of KOT training modules, 4) implementation of KOT including logistics, 5) list of materials required for KOT and making a budget, 6) procurement of materials based on the budget, and 7) review of KOT training materials. The participants gained a new understanding not only of the training content, but also of the role of the CPU and the importance of

training preparation.

The 2019 KOT, in which CPU took the lead in everything from preparation to implementation, was the first attempt on the COBSI package. Although there were some deficiencies in handouts and materials and equipment necessary for the training, these did not have a major impact on the training as a whole, considering the short preparation period of the KOT held one week after the preparatory meeting. Therefore, the preparations were said to be sufficient. Provincial CPU members served as instructors for each module. Since they participated in the TOT in 2018, some members have reached a level of Masters of trainers in some of the training modules.

A first KOT preparatory CPU meeting in the FU province was held on March 13th and 14th, 2020 at Kasama Farm Institute (KFI) in Kasama District, Northern Province. After the KOT preparatory CPU Meeting, the FU provinces scheduled to hold the KOT in late March, but due to the pandemic of the COVID-19, it was canceled and could not be held.

After that, in July 2020, the Project decided to combine the contents of KOT and MTT into one training. The Project team once again held an online preparatory meeting with CPU members from each province in advance to explain and discuss implementation of KOT/MTT.

After the 2019 KOT in the New target province and the 2019 KOT/MTT in the FU province, the C/P became entire implementing body and managed the training. A preparatory CPU meeting was held online or in person at least one week before each training date, and the project team and C/Ps reviewed the training content and discussed necessary preparations together. Additionally, amid the COVID-19 pandemic, training was planned while adhering to instructions from the Ministry of Health, and necessary measures were confirmed. In addition, TOT is conducted as necessary, such as when new modules such as "*Tebakari Eiyouhou*" are added, and training content is shared with trainers.

Even after the implementation body was transferred, the project team also participated in each training session as much as possible and monitored the training management by the C/Ps. The level of achievement in training management varied by province, but in terms of management, the CPU members were able to carry out most of the steps such as distribution of programs, implementation of pre-training knowledge/experiences inventory, preparation of participant lists, distribution of training materials, implementation of achievement tests and training evaluations. The project team also pointed out any deficiencies in the group works and content of the training, and shared points for improvement.

From the 2023 KOT, looking ahead to the post-E-COBSI phase, a trainers' team was composed of district level C/Ps. This makes it possible to develop human resources, which are essential for the sustainable extension of COBSI approach, and to minimize the costs required for extension activities, which are a bottleneck in the spread of COBSI.

Regarding the cost, original E-COBSI training required district officers and CEOs to come to a capital of each province, which required participants' transportation and accommodation expenses. These expenses can be reduced if DACO's office provided training within district. The project team observed that explanation given to the participants by the district officers who served as lecturers was generally good, and it was confirmed that they had a sufficient understanding of COBSI. The team found that technology transfer from the provincial CPUs to the district officers was carried over sufficiently.

5.2.5 Demonstration plot for District Model Site

Demonstration plots were established in all district model sites from the third year of the project (2021) to facilitate the dissemination of project activities, irrigated agriculture and cultivation techniques among farmers and extension workers. Farmer groups in each district model site made market-oriented crop selections and prepared demonstration plot plans with the support of district officials and the BEO/CEO. The plans also included a cropping calendar and required agricultural inputs, which were reviewed by Japanese experts and then procured by the district office under their supervision.

In many sites, tomatoes, cabbage, onions and leafy vegetables were selected as demonstration crops. The reasons given were (i) the decision was based on market research learned from the SHEP approach, (ii) the choice was made with the aim of passing on cultivation methods to other farmers, and (iii) the choice was made to try out fertilisers and pest repellents other than the types traditionally used. For (i), it could be seen that the SHEP concept is widespread. For (ii) and (iii), the findings and experiences from the demonstration field activities were to be shared within the group and with surrounding farmers.

FFDs were organised as part of the demonstration site activities. The FFDs held in each district model site were attended by PACO and other provincial CPU members, district officers, BEOs/CEOs from other camps, agro-dealers, marketers, district commissioners, etc. The FFDs began with a tour of the entire irrigation site by all participants, followed by a presentation by the farmer groups on the skills and knowledge gained from the demonstration plot activities conducted this year, as well as the challenges they faced in their farming operations. This was followed by comments from state CPU members and district officials, which were shared with all participants.

The FFD attracted many farmers from the vicinity of the district model plots and was used to promote farmer-to-farmer dissemination from the model plots to neighbouring farmers, as well as to introduce the latest agricultural inputs from agro-dealers and to build relationships with market actors. In response to these activities, C/P staff heard the importance of the farmer groups themselves presenting their experiences from the demonstration plots, and the sharing and horizontal development of knowledge and information at the farmer-to-farmer level. In addition, NAIS officials from each province and district sometimes attended the FFD, and there were instances of interviews and filming by NAIS that were later broadcast on TV news and radio, and featured in newspaper articles.

5.2.6 Introduction of Organic Pesticides

The project has provided organic pesticide training since MTT in 2021. The high price of chemical pesticides has led to high agricultural production costs. Furthermore, many farmers pointed out that the price escalation of pesticides and fertilizers had been accelerated after COVID-19. Considering the circumstances, organic pesticide training was introduced to reduce farming costs and negative environmental impacts. Beneficiary farmers practiced organic pesticides by realizing the benefit: less expensive than chemical pesticides and have less impact on the human body and the environment. On the other hand, CEOs and farmers raised challenges in the practice and dissemination of it. The following is a summary of challenges and the countermeasures raised by counterparts.

Three main challenges in the practice and dissemination of organic pesticides were raised. Firstly, it is difficult to obtain the materials to make organic pesticides. The material plants are not grown; even if they are grown, the quantity is insufficient in some sites. Secondly, producing and applying organic

pesticides require more labor than chemical pesticides. Thirdly, compared to chemical pesticides, it takes time to confirm the effectiveness of pesticides, and the types of targeted diseases and pests are limited. As a countermeasure, some argue that demonstrating or visiting successful fields would be effective because farmers could see the effect of organic pesticides with their own eyes. Another countermeasure is to demonstrate their economic advantages over chemical pesticides by analyzing the benefits and costs of organic pesticides. In addition, the importance of collaboration with other stakeholders and public relations activities through the media is suggested. These countermeasures are expected to be promoted in the future, utilizing demonstration plots, field days, agriculture shows, and public relations activities through NAIS which were promoted during the project period.

5.2.7 Introduction of online reporting system

The project has piloted an online reporting system since 2021 to share CEOs' monthly reports among concerning officers in real time and improve the submission rate. The reporting system that CEO could submit by smartphones has been developed using Kobo Toolbox, one of Computer Assisted Personal Interviewing (CAPI), since 2022. Initially, the system was piloted with CEOs in Kasama district and Ndola district in 2022. After that, the pilot area was expanded to all the project target districts. Results and lessons learned from the practice are shown in the following.

As a result of the pilot in 2023, approximately 44% of the districts submitted. There are three possible reasons for the low report submission rate. First, the network conditions of CEOs were not good. Moreover, the CEOs might have few chances to move to city areas where the network is good because of the limited fuel for their activity. Different arrangements according to the CEO’s network conditions are necessary because the network is required in report submission in this system. The second point is that the number of questionnaires was too many and the structure was complicated. The questionnaire needs to be simplified so that anyone can submit it easily regardless of the age and ability of CEOs. The third point is that sharing of submission status and calls for submissions were insufficient. Sharing the submission status of each CEO among relevant officers would contribute to raising awareness of submission. Thus, improvements such as checking the submission status at each training session are required. Since monitoring each site's progress contributes to monitoring irrigation plans, such as the Three-Years Action Plan, it is expected that the online reporting system will be integrated into the Ministry of Agriculture's regular work in the future through the improvement of the above issues.

5.2.8 Introduction of Hand Scale Method (*Tebakari Eiyouhou*)

Results of the baseline survey (Nutrition survey) revealed low dietary diversity in the target area, and in particular low intake of vegetables and protein-source foods. Therefore, in order to promote understanding of importance of a well-balanced diet, CEOs needed to instruct farmers on “varieties” and “amounts” of food that each person should consume per day in nutrition awareness activities.

In the first year of E-COBSI, the Project team monitored nutrition awareness activities by provincial and district Food and Nutrition officers and CEOs. We found that they were giving instructions to farmers such as “you should consume XX g of protein per day” in some cases and did not provide practical information on varieties and amounts of foods. In addition, although Zambia has developed Food-Based Dietary Guidelines (FBDG: published by MoA, FAO, and EU in 2021) as a method of dietary and nutritional guidance of people, but simple dissemination materials had not been developed.

In response to this current situation, E-COBSI introduced Tebakari-Eiyouhou (hand scale to serve food per day" developed by Health Planning Aichi Co., Ltd., which is widely used in the field of nutritional education in Japan. The Project started its introduction from mid-term training (MTT) in 2022. Good point of Tebakari-Eiyouhou is that it allows people to easily understand "varieties" and "amounts" of foods that each should consume each day.

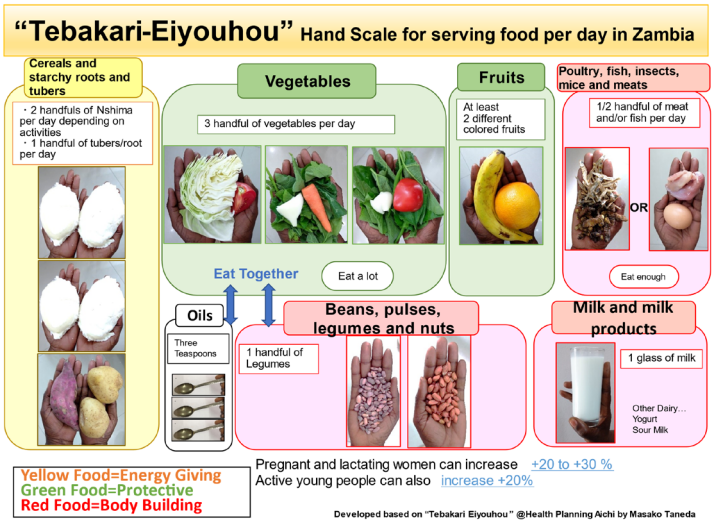


Figure 5.3 "Tebakari Eiyouhou" developed for Consumer Guideline
Source: JICA E-COBSI

First of all, the Project team visited Health Planning Aichi Co., Ltd., located in Aichi Prefecture, and received advice on steps and points to keep in mind when developing the Zambian version of Tebakari-Eiyouhou. Subsequently, the team together with a food and nutrition officer from MoA and a officer from PACO's office in the Northern Province developed a draft of the Zambian version of Tebakari-Eiyouhou in March 2022.

Since MTT held in August 2022 introduced a newly developed Tebakari-Eiyouhou, the Project team implemented TOT twice to explain to food and nutrition officers in target provinces how to instruct Tebakari-Eiyouhou. The first TOT (August 3rd, 2022) was conducted in Copperbelt Province for the food and nutrition officers from the new target provinces, and the second TOT (August 5th, 2022) was done in Northern province for the officers from the FU provinces.

At the MTT held in August 2022, the trainers for module of nutrition improvement were the provincial food and nutrition officers who had attended the TOT mentioned above. District food and nutrition officers also supported their training. MTT participants were highly interested in the module, and a lively question and answer session took place. After teaching an overview of the nutritional situation in Zambia, Tebakari-Eiyouhou by E-COBSI was introduced, and the participants showed great interest. The Project distributed teaching materials (laminated A3 size illustrations) of Tebakari-Eiyouhou in order to disseminate it to farmers at the field level.

During the MTT, the trainers used this laminated training material to conduct role plays and ask hypothetical questions and answers. The training participants were divided into CEOs and farmers and practiced how to disseminate Tebakari-Eiyouhou. In addition, based on the concept of E-COBSI (small-scale irrigation development, market-oriented agriculture (SHEP) and nutrition improvement), a lecture was given on how to practice dry-season horticultural crop cultivation by irrigation to improve nutrition of family members through self-eating and selling of crops throughout the year. The trainers said that a message of Tebakari-Eiyouhou is very simple and does not require any special tools, so it is easy for farmers to understand. Additionally, the MTT in 2022 included cooking demonstration training for the first time.

The Project team hold a verification meeting for E-COBSI nutrition materials in order to review them,

especially Tebakari-Eiyouhou, based on results of the 2022 AEW and monitoring of nutritional awareness activities by the Project team, on January 30th and 31st, 2023. The figure on the right shows Tebakari-Eiyouhou that was revised to reflect the results of this workshop, and was used to conduct nutrition awareness activities and MTT in 2023. The main improvements are as follows.

・As farmers commented that the amount of food was low considering the amount of activity (particularly amount of Nshima), intake of food groups that are energy sources such as Nshima, sweet potatoes, and potatoes was increased. The increased nutrients were adjusted with other food groups. Additionally, the standard calorie intake for adult Zambian women is 2,200 kcal, but the Project increased this figure to approximately 2,350 kcal, taking into account the amount of farmers' activity.

・Since the MOA recommends consuming two fruits of different colors per day, the recommendation was reflected to Tebakari-Eiyouhou.

・As a result of adjusting amount of nutrients, intake of animal-source protein was reduced to half a palm (half of both handful). The photos show examples of small fish and caterpillars, or meat and eggs.

・Names of each food group have been revised to match the contents of FBDG. Tebakari-Eiyouhou is basically developed in accordance with the same guidelines.

・FAQs (Frequently Asked Questions) regarding Tebakari-Eiyouhou was prepared for technology transfer from province to district.

5.2.9 Fish farming training

This project aimed to improve the nutrition of rural farmers by increasing their protein intake, which is in short supply, through fishpond activities as part of the multi-purpose use of irrigation water taken from small-scale irrigation development. The water source was a simple or permanent weir constructed at T-COBSI or E-COBSI. In cooperation with province and district fisheries departments, fish farming training was conducted at district model sites in two disticts in the Northern Province (Lupososhi and Mbala), one district in the Copperbelt (Kalulushi), and two districts in Luapula (Kawambwa and Muwansabonbwe).

In the Northern Province and Copperbelt Province, fish farming training was conducted in the field, mainly by district fisheries department officers, with farmers interested in fish farming among the E-COBSI group members. The fish farming training included site selection and construction of fishponds, fertilizer application to fishponds, preparation of compound feed using locally available crops, management of fishponds, and harvesting and post-harvesting methods. The project covered the costs of constructing and managing the fishponds, which were jointly managed by the fish farming group members. On the other hand, in Luapula Province, GIZ had already conducted fish farming training in the Fish for Food (F4F) Security project, so the project collaborated with GIZ and conducted fish farming training in E-COBSI target sites in collaboration with a local NGO employed by GIZ as a subcontractor. A summary of the efforts in each province is shown in Table 5.1 below.

Table 5.1　Fish farming activities in Northern province

Item	FTC
Target site	Lupososhi district model site （The water source was a permanent weir constructed at T-COBSI）

Item	FTC
	Mbala district model site （The water source was a simple weir constructed at E-COBSI）
Implementation period	From October, 2022 to October, 2023
Reasons for selection of target areas	The district model site must have a perennial river and river water available for fishponds. There must already be a group of scheme members and COBSI members must be interested in fish farming and already have experience in fish farming.
Fish farming training	District Fisheries Department officers provided fish farming training to farmers at the district model site a total of five times over a six-month period.
Types and Purpose of Fishponds	A group of COBSI members who are farmers interested in fish farming created and manage two community ponds. The purpose of these ponds is to grow fish for sale while producing fingering fingerings for distribution to the group members' individual fishponds.
Training cost	The project covered the cost of per diem for Fisheries Department district officers for fish farming training, materials for fishpond construction, fingerings costs, and fish feed costs.
Monitoring	Monitoring was conducted by Japanese experts, and during the absence of Japanese experts, monitoring was conducted twice a month by district fisheries officers and reported to the project team.
Result（Change in the number of households engaged in fish farming）	Lupososhi district ・The number of households in the irrigation group engaged in fish farming before E-COBSI's fish farming training increased from 3 to 15 after the fish farming training. ・There were 7 fishponds before E-COBSI's fish farming training, but this number increased to 11 after the fish farming training. Mbala district ・The number of households in the irrigation group engaged in fish farming before E-COBSI's fish farming training was 0, but increased to 20 after the fish farming training
Income Changes	Lupososhi district Before E-COBSI's fish farming training, gross income from one fishpond was K450, expenditures were K240, and net income was K210 (one harvest per year). After the fish farming training, gross income was K660, expenditures were K175, and net income were K485 (two harvests per year). Post-training expenditures did not include initial investments from E-COBSI (pipe, fingerings, and pound liners)

Source：JICA E-COBSI

Table 5.2　Fish farming activities in Copperbelt province

Item	FTC
Target site	Kalulushi district model site（The water source was a simple weir constructed at E-COBSI）
Implementation period	From October ,2022 to October, 2023
Reasons for selection of target areas	The district model site must have a perennial river and river water available for fishponds. There must already be a group of scheme members and COBSI members must be interested in fish farming and already have experience in fish farming.
Fish farming training	Four farmers and one CEO from the Kalulushi District Model Site were invited to fish farming training for four days at the National Aquaculture Research and Development Centre (NARDC) located in Kitwe District. In addition, District Fisheries Department officers conducted field training at the district model site.
Types and Purpose of Fishponds	A group of COBSI members, farmers interested in fish farming, have created and are managing one community pond. The purpose of this pond is to grow fish for sale while producing fingerings for distribution to the group members' individual fishponds.
Training cost	The project covered the cost of training at NARDC, per diem for Fisheries Department district officers for on-site fish farming training, materials for construction of fishponds, cost of fingerings, and fish feed for fish farming.
Monitoring	In addition to the monitoring conducted by the Japanese experts, the officers of the

Item	FTC
	district fisheries department conducted monitoring twice a month during the absence of the Japanese experts and reported to the project side.
Result（Change in the number of households engaged in fish farming）	・Two households were engaged in fish farming before E-COBSI's fish farming training, but this number increased to six households after the fish farming training (the number of farmers engaged in fish farming increased from four to thirteen). ・The number of fishponds increased from 2 before E-COBSI's fish farming training to 9 after the fish farming training. ・Self-consumption is 30% of the harvest.
Income Changes	Before E-COBSI's fish farming training, gross income from one fishpond was K2,800, expenditures were K2,000, and net income was K800 (one harvest per year). After the fish farming training, gross income was K25,000, expenditures were K2,000, and net income was K23,000 (two harvests per year). Post-training expenditures did not include the initial investment (pipes) from E-COBSI.
Impact to the community by Fish Farming Activities	In addition to the communal fishponds, seven households constructed individual fishponds. 3 of the 7 households have already purchased fingerings at their own expense and stocked their fishponds.

Source：JICA E-COBSI

Table 5.3　Fish farming activities in Luapula province

Item	FTC
Target area	Kawambwa district model site （The water source was a permanent weir constructed at T-COBSI） Mwansabombwe district model site （The water source was a simple weir constructed at E-COBSI）
Implementation period	From February 2023 to September 2023
Reasons for selection of target areas	Fish for Food (F4F) areas implemented by GIZ and new target areas
Fish farming training	A local NGO (Success Community Action: SCA), employed by GIZ as a re-contractor, arranged the fish farming training and conducted a 3-day training at the district model site with　district officer in the fisheries department, and the senior food and nutrition officer as instructors.
Types and Purpose of Fishponds	Farmers who are interested in fish farming among COBSI members build and manage their own individual ponds. Some fish are sold as a source of income, while others are raised for self-consumption.
Training budget	E-COBSI covered lunch and refreshment expenses for the trainers and farmers GIZ covered Daily allowance and travel expenses for trainers
Monitoring	SCA conducted and reports to the project
Result（Change in the number of households engaged in fish farming）	The number of households in the irrigation group that were engaged in fish farming before E-COBSI's fish farming training increased from 3 to 12 after the training (the number of farmers engaged in fish farming increased from 6 to 21). Before E-COBSI's fish farming training, there were 6 fishponds, but after the fish farming training, the number of fishponds increased to 9.
Income Changes	Case 1: Before E-COBSI's fish farming training, the farmers didn't conduct fish farming and there was no income from fishponds. After the fish farming training, gross income was K7,500, expenditure was K1,700, and net income was K5,800. Starting fish farming increased the availability of fish in rural areas and income. Case 2: Before E-COBSI's fish farming training, gross income from one fishpond was K600, expenditure was K300, and net income was K300. After the fish farming training, gross income was K4,200, expenditure was K960, and net income was K3,240.

Source：JICA E-COBSI

In Lupososhi District, Northern Province, water did not accumulate in the ponds at first due to leakage

problems caused by the sandy soil, but six months after the ponds were excavated, water began to accumulate in the ponds after compost was applied to the pond surface.

It was clear that the fish farming training program was beneficial to the community and to the individual farmers' income, although there were differences among the province and district. The number of fishponds owned by individual farmers increased after the fishpond training, and it is expected that the number of fishponds built by individual farmers will further increase in the future, leading to additional income for farmers. In each province, about 20-40% of the harvest is used for self-consumption, which is expected to lead to improved household nutrition (increased protein intake).

5.2.10 Collaboration with other donors (GIZ and FAO)

1) Fish farming training in collaboration with GIZ

In the Luapula province, GIZ is implementing fish farming training in Fish for Food (F4F) activities. From the perspective of improving nutrition, this project aimed to improve protein intake, which is lacking among rural farmers, through fishpond activities using surplus irrigation water. To this end, the project conducted fish farming training at the project's district model site in collaboration with GIZ's F4F, a local NGO sub-contracted by GIZ, Success in Community Action (SCA), and the district office of the Fisheries Department. The fish farming training was conducted with GIZ staff members providing for the fish farming part and the Provincial Food and Nutrition Officer providing for the gender part. The first fish farming training was conducted at the distrit model site in Kawambwa District, which is the target area of GIZ/F4F. The water source of the district model site is a permanent weir constructed by T-COBSI. The fish farming training was held for three days and was a comprehensive training on fish farming that included both classroom lectures and practical training. Twenty-four farmers from irrigation group of farmers in the district model site participated in the training, seven of whom already had fishponds. In terms of nutritional improvement, the farmers were instructed by SCA on Partial Harvesting (harvesting several times when the fish are small before the main harvest). Partial harvesting is useful for harvesting larger fish that can be sold at a higher price during the main harvest, and harvesting small fish on a daily basis contributes to improved nutrition by allowing the farmers to eat fish bones, which provides them with calcium and iron, which are often lacking.

The second fish farming training was conducted at the district model site in Mwansabombwe District, a new target area for GIZ-F4F. The water source at the district model site is a simple weir constructed by T-COBSI. The training was attended by 42 farmers who were members of the irrigation group in the district model site and farmers who were interested in fish farming and wished to join the irrigation group.

GIZ broadcasts a radio program on fishpond management for farmers three times a week in Luapula Province on Fish for Food project. The SIE of Luapula Province participated in the radio recording, as GIZ requested the SIE to introduce the small-scale irrigation that E-COBSI is implementing. The SIE also visited a small-scale irrigation site in Mansa District with a radio producer from GIZ and explained about simple weirs, canal construction, and water management. In addition, male and female farmers were interviewed and shared their experiences of participating in small-scale irrigation and E-COBSI activities.

2) Preparing a Consumer Guideline in collaboration with FAO

With support from FAO, MOA is working with multiple ministries and donors to make a Consumer Guideline as a guideline for improving nutrition and diet for the general public, including farmers. Preparations are underway to include the "Tebakari-Eiyouhou" recommended by E-COBSI. A workshop for preparation of Consumer Guideline was held in April 2023, and when the officer from MoA explained "Tebakari-Eiyouhou", various opinions and questions were raised by the participants.

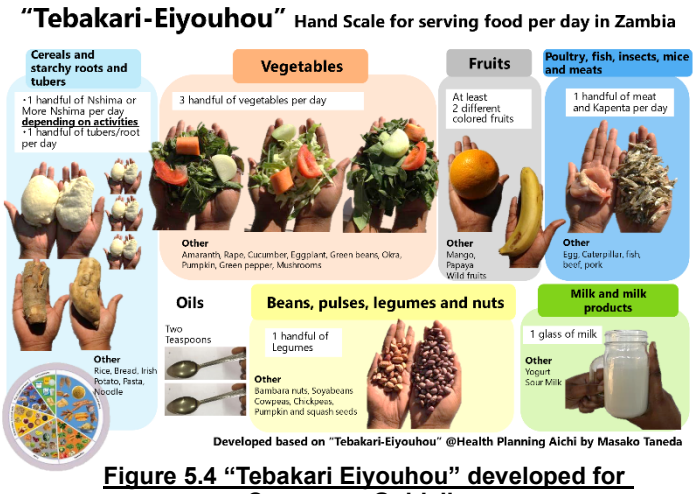


Figure 5.4 "Tebakari Eiyouhou" developed for Consumer Guideline

Source: JICA E-COBSI

Furthermore, "Tebakari-Eiyouhou" was explained again at the June meeting of the same year, and questions and comments raised at the previous April meeting were answered.

Tebakari-Eiyouhou was revised in strict accordance with FBDG (Figure 5.4) on July 26 and 27, 2023. FBDG was developed using FAO's Diet modeling, and the participants at the workshop in April proposed to the project team that Tebakari-Eiyouhou should be based on the same model. Mr. Ramani Wijesinha-Bettoni of FAO Rome explained that when developing Tebakari-Eiyouhou, cooked food in the same model should be converted to nutritional content of uncooked food, and inedible parts should be considered (she participated in the discussion online). Afterwards, the participants revised Tebakari-Eiyouhou on her advice.

Although there are no major differences between Tebakari-Eiyouhou before and after the revision, the use of FAO's diet modeling as a process has made the teaching materials more based on scientific evidence. As of January 2024, the Project team has been informed that the Consumer Guideline is being finalized by MoA and other related organizations, and is scheduled to be published in March 2024.

5.2.11 Making Introduction Video for COBSI Approach

To publicize the project activities, a local video production company was contracted to create two promotional videos for E-COBSI, one lasting 40 minutes and a shorter 20-minute version. The video content primarily comprised footage previously captured by the project. However, there was a shortage of material for interviews and footage showcasing irrigation facilities like weirs and canals. To address this, the project conducted visits to and filmed at two district model sites in the Copperbelt and North western provinces with a video contractor in early December 2023. At these sites, interviews were conducted with CP officers and COBSI group farmers, alongside capturing comprehensive views of completed simple and permanent weirs using a drone. Additionally, interviews with CP officers, the Permanent Secretary (PS), and Japanese experts were filmed at the Ministry of Agriculture in Lusaka.

5.2.12 Ideas and Efforts made during Permanent Weir Construction

In the construction of permanent weirs, progress at each site was delayed compared to the original

schedule. For this reason, efforts were made to catch up on the construction schedule through improvements in human resource allocation, backup from a technology transfer perspective, and improvements from an organizational perspective.

The main reasons why the construction work was delayed than planned were that 1) groundwater leaked in an amount greater than expected (Mkushi district site), 2) the number and frequency of construction participants from farmer groups was lower than planned (Mkushi district site, Mufulira district site), 3) the collection site for construction materials such as stones and sand was further away than originally planned (Mufulira District Site, Kasempa District Site), 4) the road leading to the construction site was muddy due to long rain, which made the timing of material transportation delay (Mkushi district site, Mufulira district site), and an increase in the length of canal-lining because of sandy soil along the canal (Kasempa district site).

In response to these general circumstances, the project made maximum use of the COBSI human resources trained through the COBSI projects (COBSI Development Study and T-COBSI) implemented to date. Specifically, TSBs, who has extensive experience in permanent weir construction within the FU provinces, were dispatched to each site as a master trainer, and through collaboration and technology transfer with TSB of the targeted districts, the level of experience on permanent weir construction were improved which was one of effort to catch up the original schedule.

Furthermore, since many of the new target province's engineers who were targeted for technical transfer of permanent weir construction had no experience of seeing actual permanent weirs, the project conducted field trip training to existing permanent weirs in the FU provinces. During the field training, the officers participated in learned construction methods from a technical perspective, and they also learned about the conditions at the time of construction (difficulties and countermeasures, etc.) through interactions with the farmer groups of visited sites.

Of the factors contributing to the delay in the construction process, in particular improving the number of participants in the construction work, from an organizational perspective, district TSB and CEO approached target farmer groups and traditional authorities such as chiefs, village chiefs, councils, etc. The aim of this action was to foster awareness of the project which involves the entire community. In addition, the number of participants in the construction work recovered as a result of efforts to encourage indirect water users of constructed permanent weir other than the target farmer group, such as PTA of schools nearby which use the irrigation water running from the permanent weir constructed.

Furthermore, since this construction work was a first experience not only for the district TSB and CEO, who are responsible for construction management, but also for most of target farmers (groups), they realized the difficulty of the work after the construction was actually commenced. in addition, there was case in which some farmers withdrew from construction work because they did not receive the rewards they had expected (wages, meals, etc.).

In addition, there was case in which some farmers withdrew from construction work because they did not receive the rewards they had expected (wages, meals, etc.). Regarding this point, a preliminary orientation (sensitization meeting) was held prior to the start of construction, and explanations were provided by the provincial CPU and district TSB, however, it is presumed that it was not fully understood by the farmer groups. In the future, the project has to provide sufficient explanations and

confirmations in advance consultations with farmer groups, and also should involve and share the project content and construction plans with local stakeholders and traditional authority from the beginning to gain their understanding.

CHAPTER 6 RECOMMENDATION FOR FURTHER EXPANSION OF COBSI APPROACH

6.1 RECOMMENDATIONS FOR SUSTAINABLE IMPLEMENTATION OF E-COBSI ACTIVITIES

6.1.1 Continuation of COBSI Promotion Unit (CPU)

At the beginning of the project, the CPU team was set up to each of MoA HQ and provincial levels to well promote the project activity. The members of CPU in each level were composed of TSB, Policy and Planning Department, Crop Production Section, Advisory Branch, Agribusiness and Marketing, etc. as at MoA HQ level and Provincial Agriculture Coordinator (PACO), Provincial Agriculture Office (PAO), Provincial Agriculture Planner (PAP), Senir Irrigation Officer (SIE), Senior Marketing Development Officer (SMDO), Senior Crop Officer (SCO), Senior Land-husbandry Officer (SLHO), Senior Food And Nutrition Officer (SFNO) and others as at provincial level.

The CPU system had a very effective effect on the progress of the project. Since this project was an irrigation project, it is probable that TSB was the center, and the system to collaborate while involving government officials in several field was functioning. On the other hand, the provincial level CPU team was expected to play roles, namely, technical transfer of COBSI approach to the officers of district level like TSB, SMS, CEO and BEO, and reporting and information sharing tin terms of project progress to MoA HQ. With respect to these roles of provincial level CPU, however, it can be said that the communications among each level of MoA HQ, provincial CPU, and district officers need to be further improved.

6.1.2 Implementation of 3-Year Action Plan

The project supported MoA HQ to formulate the "3-year action plan (2024-2026)" as an activity plan for post E-COBSI period. The plan indicates the targets in the next three years, namely, the number of COBSI trainees: 672 (district officer: 192, CEO: 480), simple weir irrigation development area: 680 ha, permanent weir irrigation development area: 90 ha, farmer beneficiaries household: 21,660, farmer beneficiaries: 108,300 beneficiaries, budget: 58,917,640 ZMW/ 3 years. The plan has been approved by the permanent secretary of MoA. After that, the JICA project team requested to acquire a budget to surely execute the activities planned through interviews with the director of the agriculture and the CPU of MoA. MoA intends to apply its own budget and ZAMGRO budget.

In COBSI, the construction and maintenance of simple irrigation facilities are all conducted by the farmers under instruction from CEO and district TSB, so there is not necessary of a large amount of government expenditures in this regard. However, since the cost of training for government officers, OJT training for farm groups, and subsequent monitoring costs (mainly fuel costs for vehicles and motorcycles) are required. Ensuring the budget funds mentioned above and their execution must be done.

In addition, since ZAMGRO centers irrigation infrastructure development on, it is necessary to secure a budget that can be applied to SHEP and nutrition improvement activities as implemented in this project separately. In this regard, it is desirable to consider responding with the budget of other departments within the Ministry of Agriculture and the budget of the provincial level, district level as well.

6.1.3 Introduction of E-COBSI approach to Agricultural School’s curriculum

In the forefront of agricultural extension service of MoA in Zambian, CEO and BEO play a central role, and most of them graduate agricultural schools (ZNRDC: Zambia Natural Resources Development College (Lusaka), ZCOA: Zambia college of school (Mpika in Muchinga province and Monze in Southern province).

Therefore, it can be proposed that a series of COBSI training (small irrigation development, water management and maintenance, SHEP, nutrition improvement, etc.) will be incorporated into the curriculum of such schools. As a result, CEO and BEO have already become known to some extent the concept/ flamework of COBSI when they start their career as extension officer of MoA. By this, MoA can save the budget for COBSI training implementation, and COBSI extension can be speeded up in future.

6.1.4 Collaboration with other Development Partners

In this project, as part of nutritional improvement, pilot fish farming activities were carried out as a multi-purpose use of irrigation water. Particularly in Luapula Province, we collaborated with GIZ and were able to obtain mutual benefits through COBSI irrigation, which uses the same water source, and fish farming activities promoted by GIZ. In addition, as a result of collaboration with the Nutrition Department of MoA and FAO, etc. the "Hand-Measured Nutrition Method" advocated by E-COBSI is being considered to incorporate with the Consumer Guideline, which is currently being compiled by Nutrition Department of MoA. It is hoped that cooperation with other donors, like GIZ, will continue in the future so that E-COBSI's nutrition improvement concept can further penetrate farmer groups.

Additionally, in this project, permanent weir construction was carried out at three locations through two permanent weir training sessions, and design documents for the following seven candidate sites were created. As mentioned above, permanent weirs are an upgrade from simple weirs that enable stable intake of irrigation water and expansion of irrigated agriculture. In the previous project, T-COBSI, seven permanent weirs were constructed using IFAD's budget based on the design drawings left at the end of the project. Therefore, it is necessary to approach other donors for the construction of permanent weirs, such as seeking funding from other donors for the construction of the seven candidate sites for which design documents have been prepared.

6.1.5 Water right (Water permit)

WARMA (Water Resources Management Authority) requests river water abstractors (water users) who withdraw more than 10 m3 of water per day to apply for and obtain water rights. Currently, only large-scale water users and some small and medium-sized water users are complying with this policy, but such policies have not been communicated to the endline water users. In addition, at the field level, it has been confirmed that individual farmers are taking water through pumps without having permission to abstract the river water. For this reason, it is necessary to continue carrying out awareness-raising activities regarding water rights. In doing so, it is considered importance to provide and share the information in terms of water right with traditional authorities who own wider areas in Zambia.

In addition, by acquiring water rights, even if water resources are developed in the upstream area, the amount of water intake through simple or permanent weirs will be guaranteed. In an interview with WARMA, it was stated that ``small-scale irrigation farmers will continue to be the target of protection and support," so MoA needs to encourage COBSI farmer groups to actively apply and obtain water permit. This will enable stable

COBSI development and dissemination into the future.

On the other hand, the fees for applying for and acquiring water rights (needs renewal every five years) and the fees for water use (annually) are set according to the amount of water withdrawn (Table 6.1), so that depending on the farming size, application fees and water usage fees can become expensive and burdensome. Therefore, it is desirable for MoA to hold discussions with WARMA regarding setting the amount according to the economic growth stage of the water users group.

Table 6.1 Application Fee to Water Right and Water Use Fee

Water volume abstracted	Application Fee	Water Use Fee (Annually)
Less than100m^3/day	K500	K5/day x Irrigation days e.g.) 180 days of irrigation: K5/day x 180 days = K900
More that 100m^3/day	K5,000	Up to 100m^3/day: K5/day x Irrigation days More that 100m^3/day: K0.0048 x exceeding 100m^3/day x Irrigation days e.g.) 340m3/day, 180days of Irrigation Up to 100 m^3/day: K5/day x 180 days = K900 Above 100 m^3/day: K0.0048 x (340 -100) x 180 days = K207 Total: K900+K207=K1,107

Source: JICA E-COBSI (based on information from WARMA)

6.2 RECOMMENDATIONS FOR FURTHER EXPANSION OF COBSI ACROSS AFRICA

Through the three COBSI projects so far implemented in Zambia (COBSI Development Study, T-COBSI, and E-COBSI), a certain number of government C/Ps and farmers have acquired COBSI technology, knowledge, and skills, and the number of persons concerned who can transfer COBSI technology to others is steadily increasing. In addition, the recent E-COBSI confirmed the high affinity between COBSI and SHEP and nutritional improvement. Since COBSI has created such human resources and has experience working with SHEP and nutrition improvement, it is proposed that Zambia can be positioned as a hub country for the future wide-area expansion of COBSI in Africa.

In that case, sufficient explanation and consultation with Zambian COBSI C/Ps and support, especially in terms of logistics, would be necessary. Regarding the former, it is necessary to specifically decide on the content and method of implementation. As an example, regarding the timing of training implementation, there are timing when it is difficult for government officials to respond. For example, from June to August, they need to respond to the Nationwide Agriculture Show, and from October onwards, C/Ps will be responding to the Farmer Input Support Program (FISP).

As for the location of the COBSI training, as part of the training will include hands-on training on how to build a simple weir, it will need to be in an area and location where relatively stable river flow can be expected, and in addition, cooperation from local COBSI farmer groups will also be required. Although it is assumed that the training program will be implemented based on the KOT training content conducted by E-COBSI, it may also be necessary to revise it in line with the situation in other countries. With respect to the latter, support will be needed, such as travel expenses and daily allowances for Zambian personnel to carry out training, as well as vehicle fuel needed for on-site inspections for advance preparation.

In addition, for the future wide-area expansion of COBSI in Sub-Saharan Africa, the target area will be divided into the regions (eastern/southern Africa, central Africa, and western Africa) and firstly

implement a project to develop hub countries in each region, and then a possible method is to expand to neighboring countries within the area. In particular, it was confirmed in the preceding project "Information Collection and Confirmation Survey on Wide-Africa Expansion of Community-Based Small-Scale Irrigation" (2023, JICA) that there are many countries with high COBSI potential in West Africa. It is expected to expand COBSI approach in this area. After that, when expanding from a hub country, it will be possible to simultaneously expand to multiple countries through regional integration, taking into account the efficiency of wide-area expansion.

In developing hub countries in the West African region, it would be relatively easy to start with English-speaking countries (for example, Sierra Leone). Additionally, since there are many French-speaking countries in West Africa, it is important to expand to these countries (for example, Benin and Togo). In terms of language, in Mozambique, which is a Portuguese-speaking country, local activities for the COBSI pilot project will begin in 2024 under the Small-Scale Irrigation Advisory Service (from 2023, JICA), so that wide-area expansion to Angola is also considered possible.

In implementing the COBSI approach, human resource development of C/Ps is most important, so as a first step, pilot projects will be implemented in areas with high potential, and COBSI model sites will be constructed and COBSI trainers trained. Then, in the second step, t the experiences, knowledges and human resources gained from the pilot activity will be utilized to expand COBSI sites within the country. This two-step process like can be effective and recommended.

Furthermore, as it is done under the SHEP approach, it is also considered effective to increase the number of persons who understand COBSI in multiple countries through subject-specific training and use this approach as a foothold for COBSI introduction. In addition to the classroom lectures in this project on how to construct simple weir, maintenance, water management, and organizational strengthening, and so on,

E-COBSI also covered the assembly of the simple weir and the important points in selecting canal alignment which were practically held at the outdoor grounds of the training venue. Line-level usage practice is also possible in Japan. On the other hand, although it is extremely important to visit actual COBSI sites to learn what COBSI is, practical exercises on constructing simple weirs on rivers, and exchange opinions with Zambian C/P staff and farmers, it is difficult to implement these activities in Japan.

Therefore, it is effective to carry out supplementary overseas training in Zambia after training in Japan so that trainees can acquire more practical skills and knowledge. Furthermore, in the topic-based training, each trainee will create an action plan on their own and develop COBSI sites in their own country and practice irrigated agriculture. This is also opportunities for monitoring and sharing results for them and will provide a basis information for identifying which countries and regions have a more potential to introduce COBSI extension in the future.

Since COBSI is high affinity with SHEP and nutrition improvement activities, each activity has a great synergistic effect. In other words, COBSI can be said to be an irrigation extension program, which requires rivers from which irrigation water can be taken. Therefore, by selecting suitable areas for small-scale irrigation (from the national/regional macro level to the community/village level) and introducing COBSI even in countries where SHEP and nutrition improvement projects are currently being

implemented, it is expected to acquire further effectiveness through collaborating each approach.