CHAPTER 6 SMALL-SCALE IRRIGATION DEVELOPMENT POTENTIAL SURVEY (FIVE COUNTRIES)

Information regarding the five (5) countries where field surveys were conducted is provided and detailed from sections 6.1 to 6.5, from Mozambique to Madagascar respectively. Additionally, requirements for applying the COBSI Approach as well as points of attention, current site-specific conditions/issues, and (tentative) activity plans based on the survey results of those 5 counties are described under the summary, section 6.6.

6.1 Mozambique

6.1.1 Field Survey Outline

(1) Survey Outline

Two (2) field surveys were conducted in Mozambique, the first from October 10 to November 7, 2021 in three (3) provinces—Niassa, Zambezia, and Nampula—in the North and the second from October 15 to November 5, 2022 in four (4) other provinces—Manica, Inhambane, Gaza, and Maputo—and in two (2) cities, Maputo and Matola, in the central and southern areas. Field surveys were, thus, carried out in a total of seven (7) provinces and 2 cities. They included surveys of natural conditions such as hydrology and topography, conditions of existing irrigation sites (including facilities), of farmlands and farming, and of markets alongside interviews with farmers. During the first field survey, a simple weir and an earthen canal were constructed at 2 COBSI potential sites as a pilot project.

Visited organizations for information collection in Mozambique are listed in Table 6.1.1 below.

Table 6.1.1 Visited Organizations for Information Collection (Mozambique)

Categories	Visited Organizations
Mozambican Government	✓ **National Irrigation Institute (INIR)** ✓ **Ministry of Agriculture and Rural Development (MADER)** National Directorate for Development of Family Agriculture (DNDAF) National Directorate for Farming Family Assistant (DNAAF) Technical Secretariat for Food Security and Nutrition (SETSAN) ✓ **Mozambique Institute of Agricultural Research (IIAM)** ✓ **Ministry of Public Works, Housing, and Water Resources (MOPHRH)** National Directorate of Water Resources Management (NDWRM) ✓ **Ministry of Land and Environment (MOLE)** ✓ **Provincial Directorate of Agriculture and Fisheries (DPAP)** Provincial Department of Agriculture (DPA) Provincial Department of Agricultural Extension (DPEA) Provincial Division of Food and Nutritional Security (RPSAN) ✓ **Provincial Services for Economic Activities (SPAE)** ✓ **District Services for Economic Activities (SDAE)**
Other	✓ Project for Improvement of Rice Production in Zambezia Province (ProAPA) ✓ Multisectoral Enhancement for Nutrition Upgrading (MENU) Local consultants

Source: JICA Survey Team

(2) Potential Areas for Small-Scale Irrigation

Based on the results of detailed satellite image analysis, the distribution of small-scale irrigation potential in Mozambique is shown in Figure 6.1.1 (indicated in purple). In the northern and central areas,

annual precipitation is more than 1,000 mm and the topography is mountainous and hilly except in some coastal zones. Those areas were identified as having high potential for small-scale irrigation development based on surface runoff, soil types, and surrounding populations and land use. The southern area, on the other hand, is indicated as having low potential because its annual rainfall is below 1,000 mm.

In this Figure, red boxes highlight the 3 provinces where the first field survey was conducted and the blue ones the 4 other ones and 2 cities which were subsequently surveyed.

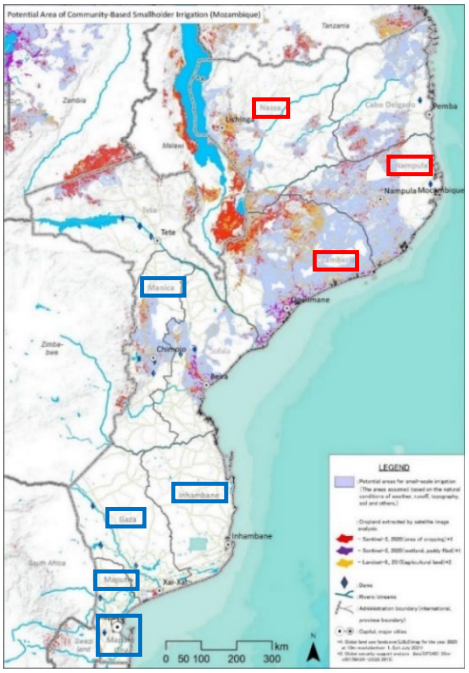


Figure 6.1.1 Small-Scale Irrigation Potential Distribution in Mozambique

Source: JICA Survey Team

6.1.2 National Development Plans and Legal Frameworks Related to the COBSI Approach

(1) Strategic Plan for the Development of the Agrarian Sector II（2021-2030）

Published by the Ministry of Agriculture and Rural Development in August 2021, the draft *"Plano Estratégico Para o Desenvolvimento do Sector Agrário – PEDSA II"* (Portuguese for "Strategic Plan for the Development of the Agrarian Sector II") aims to achieve the following:

- Shift from subsistence to commercial agriculture through modernization of agricultural production and markets;
- Inclusion of producers in the primary production–processing–retail value chain;
- Creation of more job opportunities in the agricultural sector;
- Addressing changing demand for higher quality food.

Current major challenges in Mozambique are poverty reduction, achieving food and nutrition security, strengthening agricultural competitiveness, and sustainable natural resources management. Most Mozambicans make a living from agriculture, though still conduct subsistence and traditional farming with low productivity besides low investment in modern technology that has resulted in low competitiveness. In that regard, the Government of Mozambique has started introducing modern agricultural infrastructures, including irrigation systems and farm machinery, while subsidizing inputs such as seeds, fertilizers, and pesticides. Still, the agricultural sector has yet to be sufficiently developed.

PEDSA II is essential in achieving food and nutrition security, increasing job opportunities and disaster resilience with the aim of reducing poverty, and is based on strategies related to the following eight directions:

1) Agricultural productivity and competitiveness; 2) Agricultural markets; 3) Agricultural infrastructures; 4) Food and nutrition security; 5) Natural resources; 6) Agricultural institutions; 7) Gender equality and youth participation, and 8) Climate change and natural disasters.

Activities based on the abovementioned directions will contribute to the growth of the agricultural sector

through the participation of the private sector. It is expected that PEDSA II will increase job opportunities for farmers, especially for the youth by 30%, reduce chronic malnutrition by 35% to 40%, and poverty by 40%. It is estimated that the Gross Domestic Product (GDP) per capita in the agricultural sector will rise by more than 6% thanks to income increase in the sector.

(2) National Irrigation Plan (2016)

Mozambique's *"Programa Nacional de Irrigação (PNI)"* was approved by Resolution No. 43 (2016). It aims to establish irrigation development guidelines, legal and technical standards, and respective plans and financing mechanisms—specifically to establish the means for irrigation development and a framework for such development as well as investment for river basins and agricultural growth, and to ensure sustainable expansion of irrigated agriculture and socio-economic development in Mozambique. Those goals are expected to be achieved—concretely—through a) Prioritization of areas with high irrigation potential; b) Mapping and identification of existing irrigation infrastructures; c) Identification of water availability in river basins and assessment of water demand; d) Irrigation planning based on sustainable use, and e) Identification of needs to improve the organizational capacity of the National Irrigation Institute.

(3) Legal Frameworks on Environmental and Social Considerations

Laws and regulations related to environmental and social considerations in Mozambique are described in the following table. Out of them, the ones related to Environmental and Social Impact Assessment (ESIA), resettlement, and land acquisition are specified hereinafter, with further details in Appendix 2-1.

Table 6.1.2 Summary of Environmental Impact Assessment (EIA) Procedure in Mozambique

a) Project Registration	A project proponent applies for screening to the Provincial Land and Environment Department.
b) Screening	The Ministry of Land and Environment (MOLE) inspects the proposed project site and classifies the project into categories A, B, and C based on the magnitude of expected impacts. Category A necessitates the preparation of a scoping report (Pre-viability and Definition of Scope Study: EPDA), TORs, and an EIA report; category B TORs and a Simplified Environmental Report (SER), while category C—for projects having little, no, or a positive impact on the environment—does not require any specific documents.
c) Review	The EPDA, EIA TORs, SER TORs, EIA Reports, SERs, and other documents are reviewed by the Technical Assessment Committee (TAC) within MOLE. If approved by TAC, the project can proceed to the next step.
d) Environmental License	Licenses are issued by MOLE at the national level for Category A and by MOLE provincial offices for Category B.
e) Monitoring	The project proponent shall follow the proposed environmental monitoring plan.
f) Public Participation	For Category A and Category B projects, appropriate public participation is required at the scoping and the draft EIA report preparation stages.

Source: JICA Survey Team

6.1.3 Survey Results (Current Situation/Identified Issues)

(1) Irrigation, Water Management and Maintenance

The National Irrigation Institute (*"Instituto Nacional de Irrigação – INIR"*) is mainly responsible for irrigation administration in Mozambique. The country's irrigable potential areas are estimated at about 3.1 million hectares (ha) out of which about 120,000 ha (roughly 4% of the total) have been developed so far, leaving high enough future potential for irrigation development.

Although the northern and central parts are considered to be more suitable for irrigation, there is also high demand in the south, though adequate terrain and land for irrigation development are limited. The situation in each province is as follows:

1) Manica and Niassa Provinces

These areas receive more than 1,000 mm of annual precipitation and have relatively high river flows. There are already many simple weir irrigation sites (traditional weirs and earthen canals) similar to COBSI in use in the area, especially in Manica where mountainous and hilly terrain is dominant and perennial streams are numerous. It is, therefore, possible to start COBSI activities right from permanent weir upgrade (cf. Figure 6.1.2).

Figure 6.1.2 Simple Weir Irrigation Site (Manica Province)
Source: JICA Survey Team (October 2022)

2) Nampula, Zambezia and Inhambane Provinces

There are vast low-lying coastal areas where irrigated agriculture is practiced using small- to medium-scale pumping facilities. Inhambane Province has inland hills and perennial streams but also many sites where irrigated farming can be started by constructing simple weirs upstream low marshy areas and placing earthen canals along their outside edges.

3) Gaza Province

This province has annual precipitation of about 500 mm to 800 mm and relatively flat terrain not suitable for COBSI development. In spite of that, it has several streams flowing from springs and some sites where COBSI could be applied. In the river floodplain, the drainage system is facing problems, and many farmlands are abandoned because drainage facilities constructed in the 1970s are no longer functional; canals are submerged and are unusable during the rainy season even in areas where watercourses have been built.

Figure 6.1.3 Sourcing Irrigation Water from Pump Discharge Tank (Maputo City)
Source: JICA Survey Team (October 2022)

4) Maputo Province, Maputo and Matola Cities

The field survey sites were flat like the ones visited in Gaza Province, though adaptable streams are more limited. It is, therefore, difficult to introduce gravity irrigation, which is COBSI's goal, because of such topographical conditions. As a result, peri-urban irrigated horticulture using pumping facilities on small- and medium-sized rivers is widely practiced in Maputo Province, Maputo City and Matola City.

In terms of infrastructure, INIR has constructed permanent irrigation facilities such as concrete weirs and reservoirs. Since these facilities are constructed by local contractors, construction costs are high and maintenance is technically sophisticated and economically expensive. As a result, there are irrigation sites where facilities have deteriorated due to a lack of technical support and funding. Set against that, COBSI permanent weirs boast the advantage of being built by farmers using mortar and stone which are

less costly and easier to maintain—a method considered acceptable to INIR and local farmers' groups.

(2) Extension Activities and Farmers' Groups

Mozambique is composed of ten (10) Provinces and one (1) Capital City with provincial status (Maputo) whose capital and largest suburb is Matola City. Those Provinces are subdivided into Districts under which the smallest administrative unit—called Locality—is where the Administrative Post is located. In the case of Lichinga District, there are six (6) Administrative Posts for six (6) Localities. Moreover, each Locality consists of several villages called "Povoado". Generally, extension workers go to their Povoados to conduct extension activities, and one extension worker is in charge of one or two Povoados.

As mentioned above, an agricultural extension officer is assigned to the District Services for Economic Activities (*"Service Distrital de Actividades Economicas – SDAE"*) and is responsible for farmer extension activities which are somehow hindered by the lack of adequate vehicle maintenance and fuel, office equipment such as computers and printers, and inputs (seeds, fertilizers, and pesticides) for cultivation technology dissemination, despite the fact that they are provided with motorcycles.

Creation of associations in various sectors is promoted in the country, and many individual farmers seem to belong to farming groups. Although members of such groups have communal plots and partner on a co-op basis, in practice there are few cases of cooperative farming. While there may be several reasons to this, the main one is that they join associations, as they are beneficiaries of external support from the government, NGOs, etc.

(3) Farming and Marketing

Agriculture in Mozambique is mainly covered by small-scale farmers who account for 99% of all farm households and cultivate 96% of the total farmlands which amount to 5.6 million ha. The majority of farmers practice subsistence rainfed agriculture on small plots of 1.35 ha per household on average.[1]

The most consumed staple foods in Mozambique are—in order of importance—maize, cassava, and rice. Pigeon peas, soybeans, and sesame are also intensively and increasingly produced these days in the northern and central regions in response to market demand. Furthermore, vegetables are becoming more and more important in the south, so many farmers having irrigation possibilities grow lettuce, cabbage, carrot, and maize. According to interviews with farmers, farmland area per household generally ranges from 2 ha to 10 ha (2 ha to 3 ha in most cases).

In most cases, middlemen come to the villages to buy harvested crops, but sometimes farmers go to the Namakula market located about 20 km away to sell their produce. Cultivated crops vary depending on the year and market price conditions and farmers generally understand the importance of getting market information to gain more profits and determine crops to be cultivated in relation to middlemen's prices.

Current challenges faced by farmers are diverse, for example low agricultural income, limited transportation means (they either walk or ride bicycles) and long distances/poor road conditions to marketplaces, lack of agricultural machinery and equipment such as tractors and irrigation pumps, shortage of agricultural inputs like fertilizers, insecticides, and fungicides due to their unaffordability or unavailability which is a much bigger issue, and the inexistence of farmers' organizations. Nevertheless, access to agricultural technology extension does not seem to be a major problem, as agricultural

[1] International Institute for Environment and Development, 2016

extension workers often stay in the same villages as farmers.

No farmers' organizations have been established so far, entailing that there are no farmers' groups or water users' associations. However, all interviewees expressed interest in and hope for the creation of such groups, as many could see the benefit of exchanging experiences and knowledge to help increase production and join forces among same-crop growers to have strong bargaining power. They also expect agricultural extension workers to come to their villages more frequently if such organizations are established.

(4) Environmental and Social Considerations

The JICA Survey Team discussed with MOLE officials the category that an irrigation project applying the COBSI approach is sorted into. According to them, it is difficult to specify such a category at this moment, since project classification is carried out after visiting the site where the project would be implemented. They, thus, recommended having another meeting with MOLE when any COBSI approach projects are to be implemented.

The expected impacts of COBSI approach implementation were also discussed with other governmental organizations such as the *"Direcção Nacional de Desenvolvimento da Agricultura Familiar – DNDAF"* (Portuguese for "National Directorate for Development of Family Agriculture") whose personnel cautiously ruled out environmental and/or social impacts such as water conflicts. Moreover, according to the National Directorate of Water Resources Management (NDWRM), there have been no significant such conflicts in Mozambique so far, because there is, in general, enough water in the rainy season; the southern part might, however, experience minor problems in that regard, especially in the dry season. It is, thus, difficult to say, at this moment, whether any environmental and social impacts will be caused, so detailed, site-specific surveys are to be conducted before implementing COBSI.

According to NDWRM Director, some cases of water pollution from farmland fertilizer application have been identified, but the extent is limited; water pollution due to the use of insecticides or herbicides is, however, hardly observed. Considering such situations, it is recommended to guide farmers through proper application of fertilizers and agrichemicals.

(5) Zambia COBSI Site Visit

The Zambia COBSI site visit by irrigation officials from Mozambique was held on November 24-25, 2022 with the participation of INIR and JICA's Mozambique Office. The visitors consisted of six (6) members: Two (2) from INIR including the Director General, three (3) from JICA's Mozambique Office, and one (1) from JICA's Zambia Office. At each site, they visited—in order—simple then permanent weirs, irrigation canals, and irrigated fields. Farmer representatives from irrigation groups gave brief overviews of the sites, farmers' group activities and farming conditions, then the visitors shared impressions, exchanged opinions, and had discussions with the farmers, extension officers, and the Ministry of Agriculture side (Figure 6.1.4). The participants understood that water management and maintenance activities are also important for the sustainability

Figure 6.1.4 Discussions Between Officials, Visitors, and Zambian Farmers

Source: JICA Survey Team (November 2022)

of irrigated farming, and enhancing the capacity of farmers' organizations is key to sustainable expansion of COBSI.

Moreover, the E-COBSI project being implemented in Zambia has recognized the synergistic effects of irrigated agriculture and SHEP, and the project is working on comprehensive capacity building and strengthening, not only in terms of hardware, but also software. The visitors also went to see a fishpond construction site in connection with nutrition improvement. The Zambian side seemed to have gained an understanding of its pioneering position in the COBSI approach.

6.1.4 Pilot Projects in COBSI Candidate Sites

During a first field survey, COBSI pilot projects were implemented at the Ntiwile and Calange sites in Lichinga District, Niassa Province. First, the Survey Team explained the COBSI activities to farmers' groups and identified their willingness to participate in the pilot projects, then simple weirs (double-line type) and earthen canals were constructed at each site. During the construction, concerned officials and agricultural extension officers from Lichinga District and Niassa Province also participated together with farmers' groups, learning on the job how to construct a simple weir and choose an irrigation canal alignment.

At the Ntiwile site, a canal alignment of L=700 m was selected on the left bank, besides an earthen canal constructed over 300 m, and involved the use of a spirit level (cf. Figure 6.1.5). After that, a demonstration of gravity irrigation was performed to encourage shift from bucket irrigation. As a result, the group of farmers requested to expand the irrigated area, so the Survey Team chose an additional irrigation canal alignment of L=500 m on the right bank.

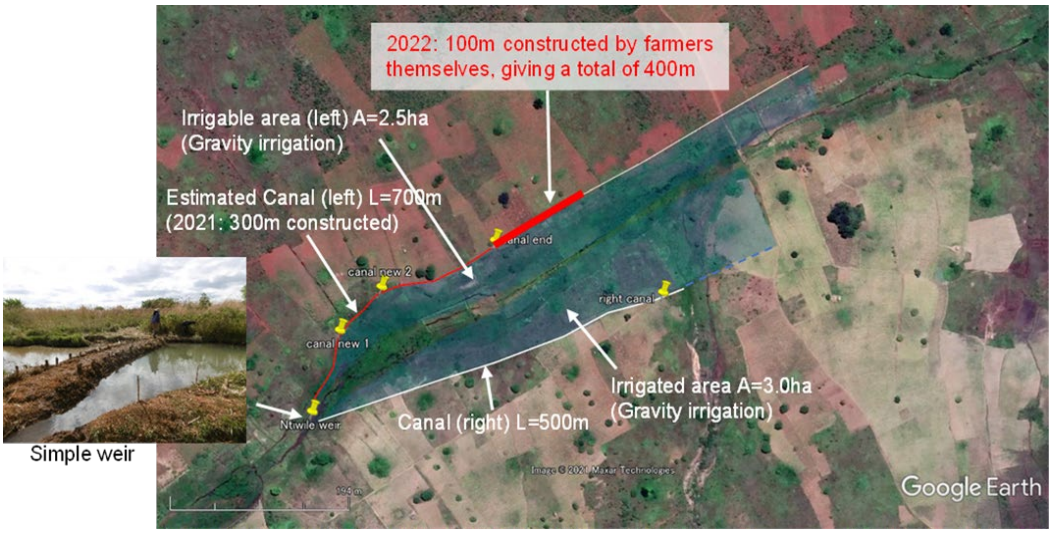


Figure 6.1.5 Photo and Location Map of a Simple Weir and Earthen Canals Constructed Through the Pilot Project (Ntiwile Site)

Source: JICA Survey Team

At the Calange site, a canal alignment of L=430 m was selected on the left bank, besides an earthen canal stretching over 130 m, also involving the use of a spirit level (cf. Figure 6.1.6).

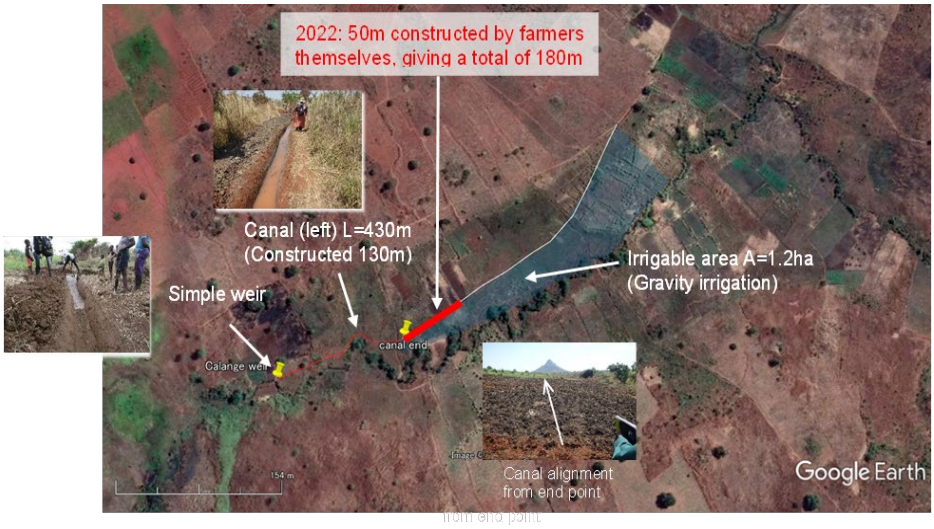


Figure 6.1.6 Photo and Location Map of a Simple Weir and Earthen Canals Constructed Through the Pilot Project (Calange Site)

Source: JICA Survey Team

Site conditions were subsequently identified during a second field survey. At both sites, canals have been extended upon the initiative of farmers themselves—by 100 m to a total of 400 m at the Ntiwile site (cf. Figure 6.1.5) and by 50 m to a total of 180 m at the Calange site (cf. Figure 6.1.6). This is one of COBSI's strongest points and is considered to be a touchstone for future small-scale irrigation development in the country.

6.1.5 Proposal for Future COBSI Approach Cooperation

(1) Target Areas

Small-scale irrigation potential for COBSI development—based mainly on topographical as well as natural conditions such as COBSI-suitable river sizes and late-dry-season river flow—was evaluated as high in Niassa and Manica Provinces, medium in Nampula, Zambezia and Inhambane Provinces, low in Gaza Province, and very low in Maputo Province (including Maputo City and Matola City).

In Niassa and Manica Provinces, river flow is usually relatively high even in the latter half of the dry season (October-November), and it is expected that cultivation and harvesting will be possible until the end of the dry season after the introduction of COBSI. Another advantage is that there are many COBSI-like simple weir irrigation sites in this area, making it easier for farmers' groups to adopt the approach in the future.

Nampula, Zambezia and Inhambane Provinces are considered to have medium COBSI potential because of their mountainous terrain averagely suitable for simple weir construction on the inland side and streams flowing even in the dry season. Although a field survey was not conducted in Sofala Province, its western mountainous area is located in neighboring Manica Province, so has similar natural conditions, placing it in the moderate category.

Gaza Province is mainly flat, and the potential for small-scale irrigation is low. However, the northern parts of the Gaza Governorate have relatively mountainous terrain, offering potential for COBSI introduction.

Maputo Province, Maputo City, and Matola City topography is flat, and land suitable for COBSI is

limited. In addition, local farmer groups have, for a long time, been sourcing water to irrigate farming from the same river under the rules of several farmers' associations. Since interviewed farmers' groups responded that they would not be accustomed to the construction of a simple weir, the Survey Team judged that conducting COBSI activities in this area would be difficult, considering the historical and social background of the project.

(2) Proposed Plans and Concept

INIR categorizes development areas into the following three levels—from largest to smallest—over 500 ha (large), 500 ha-50 ha (medium), and under 50 ha (small). Although INIR also handles the small-scale level, it has yet to implement sufficient irrigation development and services. Therefore, future cooperation direction should concern introduction of COBSI irrigation development in the small-scale category, aiming to contribute to the national goals of developing the agricultural sector, enhancing food security, and improving nutrition by increasing agricultural production as well as irrigated areas (cf. Figure 6.1.7).

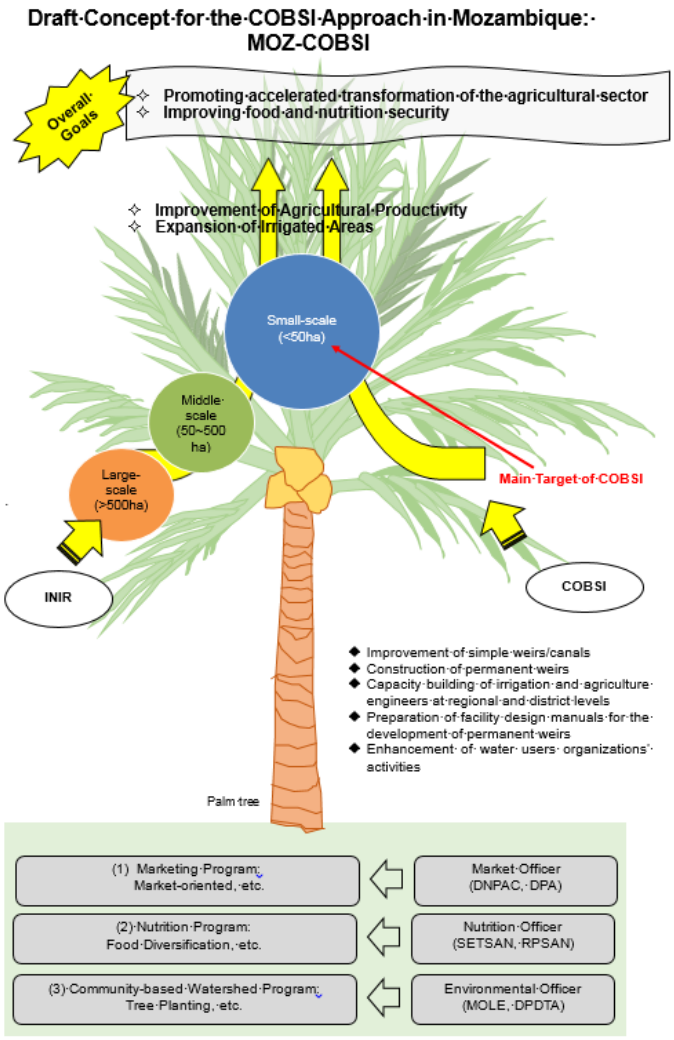


Figure 6.1.7 Concept for the COBSI Approach in Mozambique (Draft)

Source: JICA Survey Team

Furthermore, COBSI expansion in Mozambique is planned to be implemented in two stages:

1) Pilot Project Stage

As an entry to COBSI, pilot projects will be implemented in various locations, focusing on establishing model sites and training "COBSI Master Trainers" who will, in turn, share their challenges and solutions through monitoring and follow-up towards further expansion into a wider area.

Potential target areas for such activities are those where the natural conditions are suitable for COBSI, where local farmers already have some irrigation experience, and where marketing strategies can be trialed as close as possible to the capital city of Maputo. In this sense, the proposed target areas for the first stage are Manica, Inhambane and Sofala (western region) Provinces.

2) Nationwide Expansion Stage

Based on the knowledge and experience gained from the pilot project, COBSI will be expanded

nationwide through the Mozambican counterpart's Master Trainers who received training in the first stage. Niassa, Zambezia and Nampula Provinces would be target areas for this second stage, while first-stage provinces will continue their activities.

(3) Implementation Structure (Draft)

The proposed implementation and extension structure for the COBSI approach is shown in Figure 6.1.8 below. The main implementation agency will be INIR which is in charge of irrigation development. Cooperation agencies will be MADER—responsible for all aspects of agriculture, extension, smallholder support and nutrition activities—and IIAM which is responsible for crop cultivation research. At the provincial level, DPAP, which is under the umbrella of MADER, will be the main actor in this activity. Also, SPAE—the upper body of SDAE where extension agents are assigned—should also be involved. The extension system of the COBSI approach would be divided into four (4) levels: Central, Provincial, District and Local (extensionist to farmers).

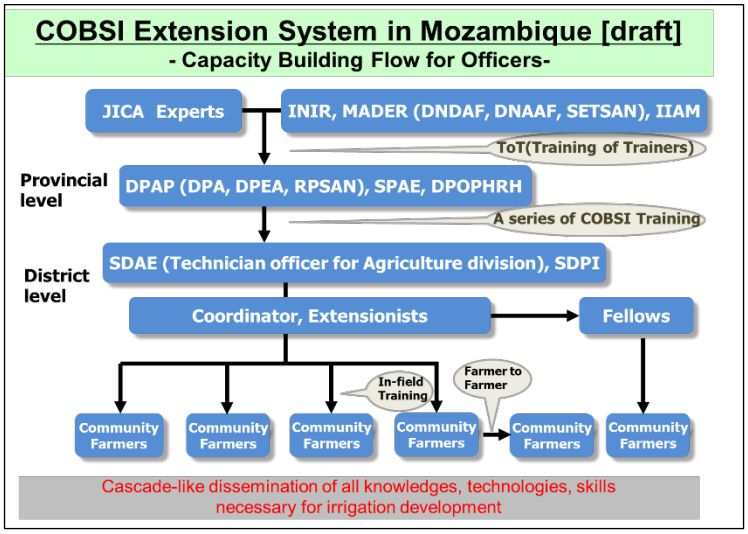


Figure 6.1.8 Implementation Structure for the COBSI Approach in Mozambique (Draft)

Source: JICA Survey Team

JICA experts and Central-level government officials such as INIR and MADER will work together to conduct Training of Trainers (TOT) for Provincial-level officials to produce training instructors. Provincial-level officials will, then, be providing direct training to SDAE technical and extension staff at District level, followed by expansion of the training to farmers' groups. This series of training will include Kick-off Training (KOT), Mid-Term Training (MTT), and an Annual Evaluation Workshop (AEW) which will be held three (3) times a year.

6.2 Sierra Leone

6.2.1 Field Survey Outline

(1) Survey outline

Field surveys for Sierra Leone were conducted from January 28 to February 19, 2022 in a total of seven (7) Districts—namely Cambia, Bombali, Kalene, Tonkolili, Kono, Bo, and Kenema. They included surveys of natural conditions such as hydrology and topography, conditions of existing irrigation sites (including facilities), of farmlands and farming, and of markets alongside interviews with farmers.

Visited organizations for information collection in Sierra Leone are listed in Table 6.2.1 below.

Table 6.2.1 Visited Organizations for Information Collection (Sierra Leone)

Categories	Visited Organization
Sierra Leonean Government	✓ **Ministry of Agriculture and Forestry (MAF)** Engineering Division, Extension Division, Planning, Evaluation, Monitoring and Statistics Division (PEMSD) ✓ **Sierra Leone Agricultural Research Institute (SLARI)** Rokupr Agricultural Research Centre (RARC), Horticultural Crops Research Centre (HCRC) ✓ **Environmental Protection Agency (EPA)** ✓ **Ministry of Water Resources (MWR)**
Other	✓ Sustainable Rice Production Project (SRPP) ✓ Sierra Tropical

Source: JICA Survey Team

(2) Potential Areas for Small-Scale Irrigation

Based on the results of detailed satellite image analysis, small-scale irrigation potential distribution in Sierra Leone (indicated in purple) is shown in Figure 6.2.1. Sierra Leone is located at the northern limit of the tropical rainforest zone, with average annual precipitation exceeding 4,000 mm in coastal areas and about 2,000 mm in the northern areas where less rainfall is available. Those areas were also identified as having high potential for small-scale irrigation development based on surface runoff, soil types, and surrounding populations and land use.

Red boxes in the Figure indicate the locations of the 7 districts where field surveys were conducted.

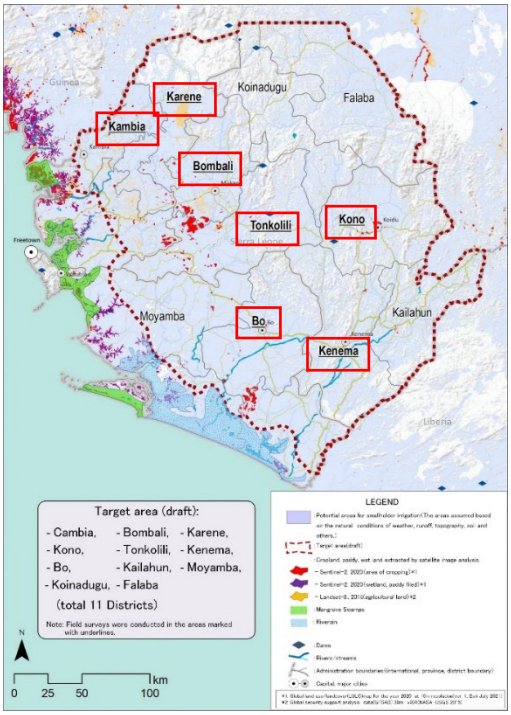


Figure 6.2.1 Small-Scale Irrigation Potential Distribution (Sierra Leone)

Source: JICA Survey Team

6.2.2 National Development Plans and Legal Frameworks Related to the COBSI Approach

(1) Sierra Leone's Medium-Term National Development Plan (2019-2023)

The Medium-Term National Development Plan (MTNDP) was developed in 2019, showing a roadmap to achieving the goal of becoming one of the middle-income countries by 2039 through "sustainable growth that leaves no one behind". The MTNDP consists of eight cluster policies, the second cluster being related to the agricultural sector, focusing on crop production increase and farming commercialization, fishery production increase and sustainable resources management, improvement of the rural economy, promotion of manufacturing and service sectors, and management of mineral resources for economic diversification and further growth.

At first glance, labor force is certainly a key factor to increasing agricultural productivity, knowing that 55% of Sierra Leone's working population is engaged in the agricultural sector.

(2) National Sustainable Agricultural Development Plan (2010-2030)

The National Sustainable Agricultural Development Plan (NSADP), which was published in 2009, focuses on small-scale farming commercialization, highway rehabilitation, wetland development for irrigation, canal establishment, storage and processing facilities rehabilitation and modernization, and research centers upgrade. Moreover, considering rice as a priority crop for commercial farming, NSADP also declares that value addition of rice based on market needs is important to increase production for achieving self-sufficiency and attaining resulting food security and poverty reduction.

(3) National Rice Development Strategy (2009-2018)

The National Rice Development Strategy (NRDS) is a strategy which was developed within the framework of CARD. Sierra Leone's annual rice consumption is the highest in the Sahara region, showing 104 kg/person—rice being an important staple food. The country has focused on the achievement of rice self-sufficiency since its independence in 1961, which has resulted in a self-sufficiency rate of 71% as of 2007. NRDS emphasizes the importance of establishing a framework for food security improvement as well as economic development through rice production increase. Specifically, it aims to increase rice production and productivity, improve post-harvest processing technology, promote marketing, enhance infrastructure, and develop the capacity of all actors in the rice sector.

(4) Legal Frameworks on Environmental and Social Considerations

In accordance with the Environment Protection Agency Act, the Environment Protection Agency (EPA) is in charge of appraisal and monitoring related to ESIA activities. In addition, the said act stipulates the type of projects that require and ESIA license as well as factors determining whether a project requires it or not. It, further, says that all projects need to commence with the preparation and submission of a project proposal as the first step. The second step is screening by EPA: If projects are judged to necessitate an ESIA, scoping is required; if —on the other hand—they do not require any, projects need to prepare an Environmental Management Plan (EMP) and submit it to EPA. In some cases, however, neither an ESIA report nor an EMP is required.

During the discussion with EPA, the JICA Survey Team noted EPA's observation that ESIA implementation is seemingly not necessary, but that preparation of an EMP would be required. However, this judgment can be affected by factors such as project location; the project, thus, needs to obtain EPA's formal evaluation. Detailed information on this section is provided in "Appendix 2-2 Sierra Leone".

6.2.3 Survey Results (Current Situation/Identified Issues)

(1) Irrigation, Water Management and Maintenance

Irrigation administration in Sierra Leone is mainly handled by the Engineering Division of the Ministry of Agriculture and Forestry (MAF). Potential irrigable areas total about 810,000 ha, about 30,000 ha (4%) of which have been developed so far, so the potential for future expansion of irrigated areas is fairly high. An irrigation master plan is being prepared for the first time with the assistance of FAO and international consultants.

In Sierra Leone, the natural environment is divided into five (5) categories: Upland, Mangrove swamp, Riverine, IVS (Inland Valley Swamp, which is relatively small), and Boliland. Since the scale of Riverine and Boliland is large, the government is proceeding with IVS development which is, in this respect, consistent with the COBSI target. There is, therefore, no irrigated area categorization into large-, medium-, or small-scale.

IVSs are numerous throughout the country, ranging from a few to several dozens of hectares per site. In IVSs that have been developed, intake weirs (earthen embankments) called “head bunds” are constructed on springs or small streams, and irrigation canals are placed on both banks to irrigate paddy fields and fields that have been developed into plots (cf. Figure 6.2.2). Drainage canals are constructed in the central lowlands but with insufficient capacity. As a result, when irrigation facilities collapse due to flooding during the rainy season, they are left untended, as farmers do not have enough capacity to maintain them. As a solution to this issue, the Sustainable Rice Production Project (SRPP) applied COBSI technology to repair drainage canals at the Mabonkani site in Bombali Province. According to interviews with local farmers, this technique is easy to use, because it allows for simple repairs by using local materials.

Figure 6.2.2 Developed IVS (Bombali District)

Source: JICA Survey Team (February 2022)

On the other hand, there are a very large number of non-developed IVSs, and the delay in their development is significant. Flood damage due to undeveloped drainage canals has occurred frequently, thereby reducing rice and vegetable harvests and causing cultivated soil erosion as well the spread and increase of pests and diseases (cf. Figure 6.2.3). In addition, IVS development is being carried out first in areas with good accessibility; rural areas with poor access conditions experience a decrease in labor force required for IVS development and construction (outflow of youth and labor to urban areas) and a resulting rise in labor and maintenance costs.

Figure 6.2.3 Non-Developed IVS (Tonkolili District)

Source: JICA Survey Team (February 2022)

In Upland environments, some groups of farmers use watering cans to irrigate near streams where COBSI is applicable. It is worth noting that the COBSI approach can be practiced not only in IVSs, but also Upland. In non-developed zones without irrigation facilities, the irrigated area is limited due to inefficient irrigation methods involving watering cans, buckets and shallow wells.

(2) Extension Activities and Farmers' Organizations

Extension activities are carried out by extension officers (BES: Block Extension Supervisor and FEW: Front-line Extension Worker) assigned to each District Office. Each District is divided into about five (5) to (8) agricultural Administrative Blocks, and each Block is further divided into about seven (7) to eight (8) Circles. BESs are assigned to Blocks and FEWs to Circles to conduct agricultural extension activities. However, the number of BESs and FEWs is not sufficient due to a lack of government budget. According to interviews with District officers, the average number of extension officers (BESs and FEWs altogether) for forty-three (43) Circles in eleven (11) Districts totals only 9.1.

In addition, District Offices experience shortages of irrigation technicians and technical skills, lack of training opportunities in new technologies relating particularly to cultivation, and lack of transportation means (vehicles and motorcycles) and survey/office equipment. Not enough extension activities are, thus, being conducted, yet the task of those extension officers is to transfer cultivation techniques to farmers by establishing demonstration plots and supporting farmers' activities.

District agricultural office directors are dispatched by the Ministry of Agriculture, and District extension officials (SMSs), who are responsible for coordinating BESs activities, are also appointed by the same ministry. This means that the Ministry of Agriculture controls the chain of command of the District's extension organization.

Regarding farmers' organizations, various agricultural activities are implemented by farmers' groups called Farmer-Based Organizations (FBOs). The establishment of FBOs is one of the tasks of extension officers and the Government also encourages such an initiative, as those organizations are the recipients of external support. In addition, the Government also recommends that five (5) neighboring FBOs get together to establish an Agricultural Business Center (ABC) whose main activities are 1) rice seed purchase and sales (with government seed certification), 2) farm equipment and machinery rental, and 3) farmer training (with government extension officer participation). As of today, ninety-two (92) ABCs have been established nationwide.

(3) Farming, Marketing and Agricultural Research Center

Sierra Leone is one of the largest rice-consuming countries in Africa, so rice cultivation is a top priority within the national policy, given that the country has not achieved domestic self-supply yet. As a result, farmers grow rice in three cropping cycles when sufficient water is available during the dry season to allow cultivation. If sufficient dry-season water supply is not available, farmers grow one or two cycles of rice, then switch to vegetables during the off-season.

In addition, vegetables such as onions, potatoes, peppers, tomatoes, cabbage, okra, and lettuce are grown in developed IVS fields at higher elevations and along canals (cf. Figure 6.2.4). Farmers are generally highly interested in growing vegetables during the dry season, some getting more profit from cultivating them over rice. As of now, however, low production combined with high demand for vegetables during the dry season have resulted in high market prices. High need for irrigation in that season can be addressed through the COBSI approach which has the potential to secure irrigation water and increase horticultural crop production.

Figure 6.2.4 Vegetable Cultivation in a Developed IVS (Karene District)

Source: JICA Survey Team (February 2022)

Lack of quality seeds for rice and vegetables and low yields due to low inputs of fertilizers are challenges. The reasons for this are shortage of funds (ready cash) in farmers' possession, lack of understanding of the proper use of seeds and fertilizers, and inexistence of nearby agricultural inputs suppliers. In the market, the priority is on quantity rather than quality as was observed in generalized rush into securing production volume.

The Rokupr Agricultural Research Center (RARC) is a research institute that focuses mainly on rice, maize and sorghum, and also handles long-stalk varieties of rice. Its staff comprises about thirty-six (36) people, including rice specialists. The Center has a storage, a cold room and bio-research facilities which are, however, not adequately maintained and seem to lack electrical equipment and agricultural machinery. The Center's building was rehabilitated in 2007 and has accommodations for trainees, though there are now concerns about its deterioration. It conducts experimental researches on vegetable cultivation by growing NERICA-L19 on a trial basis and irrigating it from a shallow well (2 to 3 meters) during the dry season, with test plots maintained in the same manner as developed IVSs. There are seven (7) of such agricultural research facilities in Sierra Leone to cover a variety of research topics.

(4) Environmental and Social Considerations

1) IVS Development and Reforestation Activities

In Sierra Leone, the development of IVSs has been carried out in accordance with national policies (cf. Figure 6.2.5). Issues such as soil flowage caused by deforestation have, however, been observed. Under such a circumstance, MAF has promoted reforestation with the "Cut One, Plant Three" slogan for balanced agricultural activities and forest protection toward basin conservation. Additionally, locals were observed patrolling community forests where field surveys were conducted to help curb illegal deforestation activities.

Figure 6.2.5 Developed IVS in Sierra Leone

Source: JICA Survey Team (February 2022)

2) Impacts Caused by Climate Change

Sierra Leone national lands can be roughly classified into two kinds: Plains of an elevation around 100 m on the western side and highlands as well as mountainous areas of an elevation of 100 m to 2,000m on the eastern side. It has been pointed out that lowland areas along the Pacific Ocean are especially susceptible to climate change impacts such as floods, coastal erosion, decrease in freshwater quality, and decline of agricultural potential.[2]

According to the results of interviews conducted during field surveys, some farmers responded that crops were affected by fields flooding flushing seeds away during the rainy season, that all crops were lost due to heavy seasonal rain in 2021, or that crop failure was caused by high-temperature damage during the dry season—confirming that situations comprehensible as effects of climate change have already occurred.

6.2.4 Proposed Plans for Future COBSI Approach Cooperation

(1) Target Areas

The Survey Team identified COBSI potential in IVS and Upland environments in all seven (7) Districts (Kambia, Bombali, Karene, Tonkolili, Kono, Bo, and Kenema) where field surveys were conducted. Conditions in Districts where field surveys were *not* conducted were, however, determined based on the results of interviews with government officials. Since the natural conditions in Kailahun, Moyamba, Koinadugu, and Falaba Districts are similar to those in the 7 aforementioned surveyed Districts, those four (4) were added to a total of eleven (11) Districts to be considered as potential areas (cf. Figure

[2] Climate Change Knowledge Portal (World Bank Group): https://climateknowledgeportal.worldbank.org/country/sierra-leone/vulnerability
and, Climate Change Risk Profile, Sierra Leone (2018, USAID): https://www.climatelinks.org/sites/default/files/asset/document/2016%20CRM%20Fact%20Sheet%20-%20Sierra%20Leone.pdf

6.2.6). Coastal areas, being constituted by large areas of Mangrove swamp and Riverine, shall be excluded from the targets.

(2) Proposed Plans and Concept

Since increasing rice production is a top priority in Sierra Leone, the Survey Team will adapt COBSI IVS technology based on collaboration with CARD. Upland, sites have been identified where COBSI can be introduced, and the Survey Team will propose COBSI expansion in that environment as well. In addition, since cultivated soil and sediment runoff from flooding are challenges, the Team will propound to add watershed conservation, market orientation through SHEP as well as nutrition improvement to the concept.

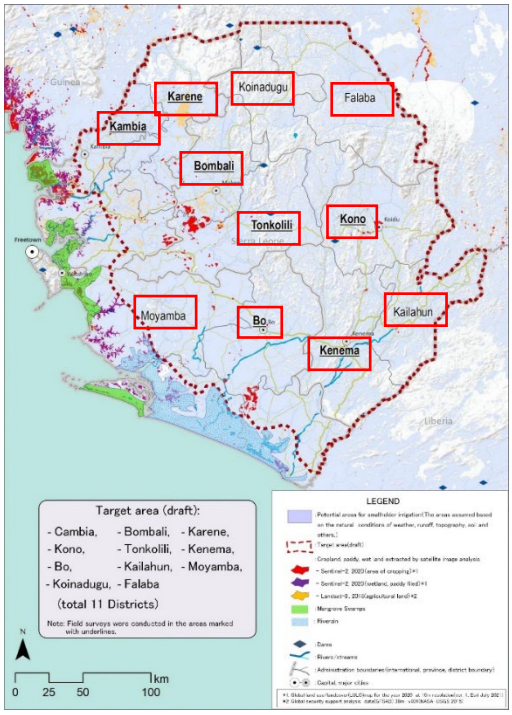


Figure 6.2.6 Sierra Leone Small-Scale Irrigation Potential Area Map

Source: JICA Survey Team

In developed IVSs, COBSI technology will be applied to rehabilitate head bunds, drainage and irrigation canals, and contribute to rice production through improved maintenance techniques. In undeveloped IVSs, however, basic irrigation facilities are to be constructed to ensure stable agricultural production, since there are many cases of flood damage due to inadequate drainage. Soil runoff control techniques (fencing and sediment ponding) will be introduced at IVS sites from the outer hillsides, and existing rice paddies will be utilized as fishponds for nutrition improvement.

Upland, a new COBSI approach project, involving construction of simple and permanent weirs alongside related canals, is expected to improve farmers' livelihoods and nutrition through irrigated horticulture and crop diversification. Water can be taken from streams upstream IVSs to irrigate uplands in the dry season and supplement IVS paddy field irrigation in the rainy season. This will promote cultivation of horticultural crops in uplands and rice production in IVSs. Sketches and plan views of integrated IVS and upland environments are shown below (cf. Figures 6.2.7 and 6.2.8).

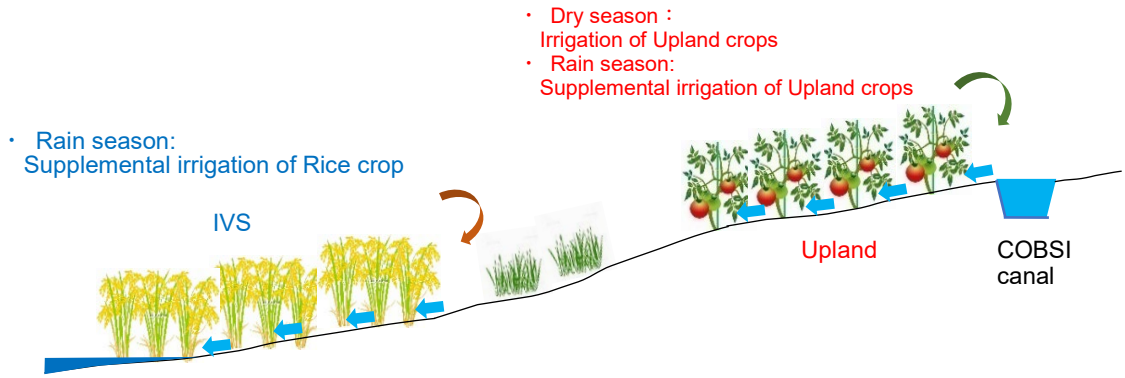


Figure 6.2.7 Sketch of Integrated Irrigation Farming (IVS and Upland)

Source: JICA Survey Team

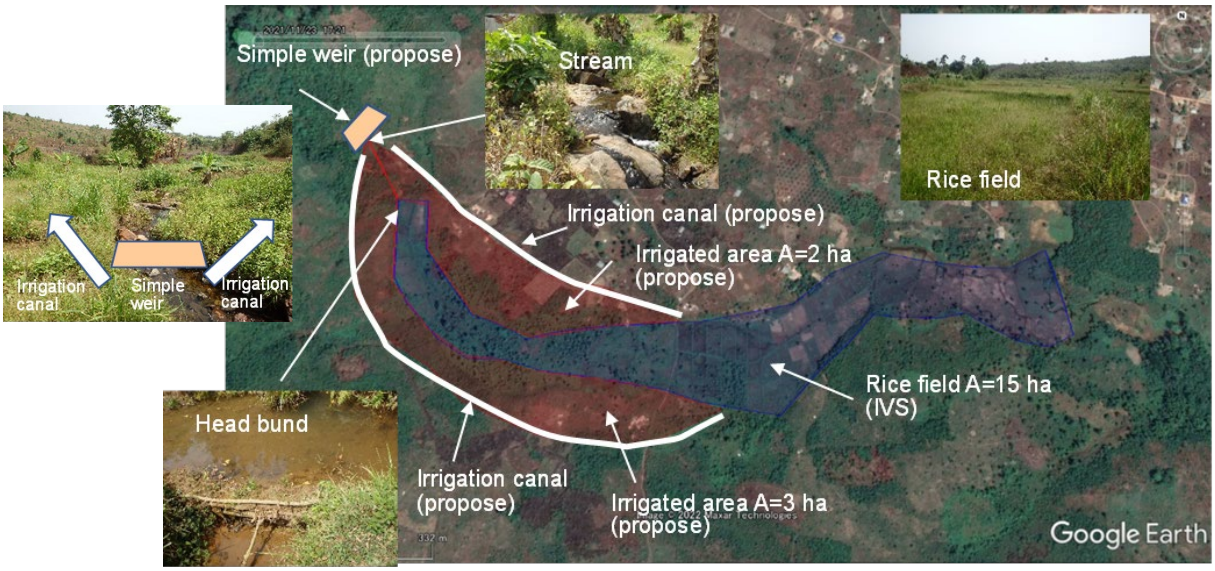


Figure 6.2.8 Pictures of Integrated Irrigation Farming (IVS and Upland)

Source: JICA Survey Team

In terms of software, the project will include capacity building of District staff to irrigation technicians and extension officers, development of water management/facilities maintenance manuals (IVS and Upland versions) and provision of related training, watershed conservation and nutrition improvement training, and SHEP implementation.

Moreover, inquiries were made to District Offices in the 11 Districts proposed as targets for new projects to identify the number of sites and areas of developed and non-developed IVSs. The number of developed IVSs is four hundred twenty-five (425) with an area of 3,663 ha and non-developed IVSs two thousand five hundred eighty-three (2,583) with an area of 19,428 ha, meaning that non-developed IVSs are five (5) times larger than developed ones. The average IVS area per site is 8.6 ha and 7.5 ha respectively. Upland, the area and number of sites were estimated at 1,000 ha for 500 sites and 12,000 ha for 1,700 sites in integrated Upland/IVS environments. Based on this information, proposed new projects are summarized in Table 6.2.2 below. It is worth noting that it is possible and crucial to collaborate with SRPP (under implementation as of 2022) concerning IVS development, since most areas are under rice cultivation.

Table 6.2.2 Proposed COBSI Approach Plans Contributing to Irrigation Development in Sierra Leone

Items	Plan 1	Plan 2	Plan 3	Plan 4
Target sites	Developed IVSs	Non-developed IVSs	Uplands	IVSs and Uplands (integrated)
Findings related to Small-scale Irrigation	・ Insufficient capacity of farmers in terms of operation & maintenance of irrigation facilities (head bunds, drainage and irrigation canals) ・ Collapsed irrigation facilities caused by flooding (structure failure and size unsuitability)	・ Vast areas of non-developed or slow-developed (developing from areas where access is easy) IVS	・ Inefficient irrigation (using watering cans, buckets, and shallow wells) and limited irrigated areas	
Concept Summary	Increase in rice production and	Increase in rice production and	Improvement of farmers' income	Increase in rice production and

Items	Plan 1	Plan 2	Plan 3	Plan 4
Target sites	Developed IVSs	Non-developed IVSs	Uplands	IVSs and Uplands (integrated)
	productivity through rehabilitation and operation & maintenance capacity building in developed IVS	productivity through consolidation of fundamental facilities in non-developed IVS	through irrigation of upland horticulture crops, as well as nutrition through food diversification	productivity in developed/ non-developed IVS, and enhancement of upland horticulture crop production
Hardware package	・ Rehabilitation of head bunds, drainage and irrigation canals through the COBSI approach (construction of simple/permanent weirs)	・ Construction of irrigation canals as well as drainage canals to prevent flood damages ・ Construction of irrigation facilities of appropriate scale and structure	・ Construction of simple weirs and irrigation canals ・ Construction of permanent weirs	・ Combination of IVS+ and COBSI Up, or IVS++ and COBSI Up
	・ Introduction of preventive techniques against soil erosion on hilly sites (fencing and ditch) ・ Promotion of aquaculture (construction of fishponds)			
Software package	・ Capacity building of irrigation engineers and extension workers at the district level ・ Formulating facilities design manuals for IVS/upland development ver. ・ Introduction of gravity irrigation ・ Provision of training on water management/ facilities operation & maintenance ・ Promotion of E-extension and dissemination by farmers themselves (FFS, FFD, demo) ・ Provision of training on horticulture crops cultivation methods ・ Introduction of Market-oriented Irrigation Farming ・ Introduction of community-based watershed conservation ・ Provision of training on nutrition improvement			
Target area	11 districts (Except for swamps in coastal areas)			
Number of potential sites	425	2,583	500	1,700
Potential sites (ha)	3,663	19,428	1,000	12,000
Potential partner projects	SRPP (CARD-related)	SRPP (CARD-related)		SRPP (CARD-related)

Source: JICA Survey Team

JICA and other international aid organizations have also provided support for IVS development by hiring farmers as laborers and paying them wages in almost all cases, or by providing them with food through the World Food Program (WFP). Therefore, many farmers have some experience in participating in temporary "cash- or food-for-work" activities. In that regard, it is crucial to determine whether voluntary participation in COBSI projects—based on the principle of not offering direct compensation—is acceptable to farmers.

(3) Implementation Structure (Draft)

The proposed implementation structure for the COBSI approach is shown in Figure 6.2.9 below. The dissemination system of this approach will be divided into Central, District and Local (farmer dissemination) levels. The main implementing agency will be MAF's Engineering Department. JICA experts and Central-level government officials from that Department will work together to produce trainers by conducting ToT related to irrigation, extension, cultivation, planning, environment, nutrition,

and staff training in District offices. Then, District government officials are next in line to provide direct training to agricultural extension officers (BESs and FEWs), followed by expansion to farmers' groups. This series of training will include KOT, MTT, and an AEW which will be held three times a year.

Many Circles are left unattended because of the limited number of agricultural extension officers in Sierra Leone. In this case, representatives of farmers' groups like FBOs and ABCs could, instead of extensionists, attend and receive COBSI training directly from District offices.

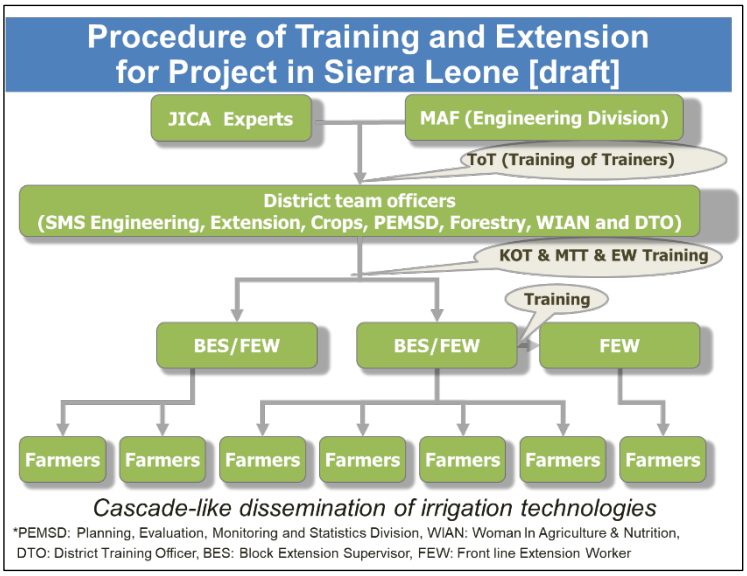


Figure 6.2.9 Implementation Structure for the COBSI Approach in Sierra Leone (Draft)

Source: JICA Survey Team

6.3 Côte d'Ivoire

6.3.1 Field Survey Outline

(1) Survey outline

Field surveys were conducted from March 19 to April 6, 2022, and the organizations listed in Table 6.3.1 below were approached to collect relevant information. The areas targeted for field surveys were determined on the basis of high small-scale irrigation potential identified from detailed satellite image analysis conducted in advance and in consideration of a travel restriction by the JICA Côte d'Ivoire office (within 7 hours' drive one-way from Abidjan). The Survey Team visited Yamoussoukro and six (6) Regions (regional seats in parentheses): Gbêkê (Bouaké), Gôh (Gagnoa), Lôh-Djiboua (Divo), Grands Ponts (Dabou), La Mé (Adzopé), and Sud-Comoé region (Aboisso). The field surveys' scope included natural conditions such as hydrology and topography, conditions of existing irrigation sites (including facilities), of farmlands and farming, and of markets alongside interviews with farmers.

Table 6.3.1 Visited Organizations for Information Collection (Côte d'Ivoire)

Category	Visited Organization
Ivoirian Government	✓ **State Ministry of Agriculture and Rural Development (MINEMINADER)** Directorate of Irrigation and Infrastructure Enhancement Directorate of Vegetable Crops and Food Security ✓ **National Agency for Support to Rural Development (ANADER)** ✓ **Ministry of the Environment and Sustainable Development（MEDD）** Directorate of the Environment ✓ **Commodities Marketing Support Board (OCPV)** ✓ **Ministry of Water and Forestry（MEF）**
Others	✓ Local Rice Promotion Project Phase 2 (PRORIL 2)

Source: JICA Survey Team

(2) Small-Scale Irrigation Potential Areas

Figure 6.3.1 shows small-scale irrigation potential distribution in Côte d'Ivoire (indicated in purple) based on detailed satellite image analysis results. Except for some areas in the northeast, annual precipitation exceeds 1,000 mm across the country, and most areas were identified as having potential based, additionally, on surface runoff, topographic gradient, soil types, surrounding populations and land use.

Red boxes in the Figure indicate the locations of Yamoussoukro and the six (6) provinces where field surveys were conducted.

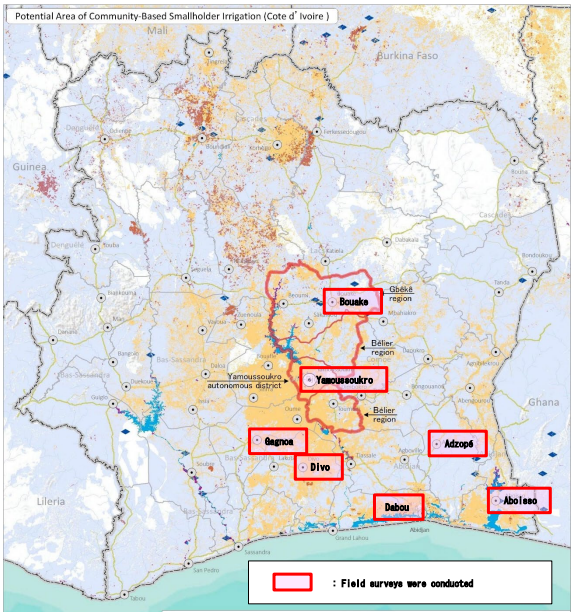


Figure 6.3.1 Small-Scale Irrigation Potential Distribution (Côte d'Ivoire)

Source: JICA Survey Team

6.3.2 National Development Plans and Legal Frameworks Related to the COBSI Approach

(1) National Development Plan (2021-2025)

The *"Plan National de Développement (PND)"* consists of five (5) pillars for economic and social innovation, including agriculture and nutrition. This Plan also includes strategies, one of which is related to agriculture and rural development and focuses on the increase of agricultural productivity, achievement of high-quality rice self-sufficiency, and rice-farming mechanization. It also sets some goals, for instance achievement of 100% rice self-sufficiency and reduction of stunting percentage in children under 5 years old to 17% by 2025.

(2) National Agricultural Investment Program II (2017-2025)

The first *"Programme National D'Investissement Agricole"* (PNIA I, 2012-2017) identified challenges in the agricultural sector in Côte d'Ivoire, namely 1) low productivity, 2) food and nutrition insecurity, 3) low income per farmer, 4) negative environmental impacts of the agricultural sector such as climate change, and 5) improvement of agricultural land management systems.

PNIA II, developed in 2017, in contrast, is a framework to promote public and private investment in the agricultural sector over the next eight (8) years, aiming for poverty reduction by half and zero hunger by 2025 through the development of sub-sectors, including agriculture, livestock, fisheries, aquaculture, and environmental management. PNIA II also proposes a vision of sustainable and competitive agriculture and puts an emphasis on even benefit sharing. It specifically focuses on value-added agricultural, livestock, and fishery products, promotion of sustainable agriculture inclusive of livestock and fishery, comprehensive growth, and rural development.

(3) National Rice Development Strategy Version 2 (2020-2030)

The *"Stratégie Nationale de Développement de la Riziculture (SNDR) 2"* (2020-2030) was prepared in March 2020 as a second version of the revised National Rice Development Strategy (2012-2020). This development strategy aims for rice self-sufficiency by 2025 whereby Côte d'Ivoire will become one of the leading rice exporters in African countries by 2030 through 1) rehabilitation of about 55,000 ha of State-owned farmlands and sixty-four (64) dams, 2) implementation of rice projects, 3) outsourcing of rice hulling and processing to the private sector, 4) production of high-yield seeds, and 5) mechanization of irrigated areas, among others.

(4) Legal Frameworks on Environmental and Social Considerations

In Côte d'Ivoire, the National Agency for the Environment (*"Agence Nationale de l' Environment – ANDE"*)—under the Ministry of the Environment, Hygiene, and Sustainable Development (*"Ministère de la Salubrité, de l'Environnement et du Développement Durable – MINSEDD"*) is in charge of ESIA procedures.

Project proponents are required to report relevant project information to the ANDE and select a consultant from a list certified by the ANDE if an ESIA survey is needed and implement it. Further, concurrent review of the ESIA and public hearing reports as well as approval of the ESIA report by an internal ministerial committee are required. In the case of agricultural development projects, ESIA implementation is mandatory if the beneficiary area is more than 999 ha—a criterion not applicable to the COBSI Approach. As a first step, however, project information shall be provided to the ANDE and the necessity of ESIA implementation and compliance with procedures stipulated by the law need to be confirmed. More detailed information on this section is provided in "Appendix 2-3 Côte d'Ivoire".

6.3.3 Survey Results (Current Situation/Identified Issues)

(1) Irrigation, Water Management and Maintenance

The Directorate of Irrigation and Infrastructure Enhancement under MINEMINADER[3] is in charge of Irrigation development in Côte d'Ivoire where only about 73,000 ha out of the 475,000 ha (about 15%) of irrigable areas has been developed so far, leaving high enough potential for future irrigation development.

The central areas (Yamoussoukro and Bouaké) where field surveys were conducted receive about 1,000 mm of precipitation annually. Given that rivers are limited throughout the year, reservoirs have been preferentially constructed, as a national policy, in the country's central and northern areas where rainfall is relatively low and many irrigation sites have already been developed. Most of these reservoirs—built with watercourses, drainage canals, intake gates, and plots—were constructed in the 1960s and 1970s. Irrigation sites with such reservoirs can produce two or three cycles of rice a year and have allowed many farmers to also grow vegetables (cf. Figure 6.3.2).

Figure 6.3.2 Irrigation Canal and Paddy Plots in Developed Irrigation Sites (Bouaké)

Source: JICA Survey Team (March 2022)

Irrigation water has been observed to be insufficient downstream developed irrigation sites, which is indicative of farmers' limited ability to manage water and maintain the facilities. As a result, farmers tend to cultivate rice in upstream areas and vegetables more downstream (cf. Figure 6.3.3).

Regarding existing facilities, no major damage was observed on concrete irrigation canals which seemed to lack maintenance, as weeds and soil deposits were not removed. In addition, drainage is done through earthen canals which frequently sustain damage from outside flood inflows, the main reasons being insufficient drainage canal cross-section sizes and untreated sediment soil in channels outside of the site. Maintenance and management activities performed by farmers themselves are inadequate, so they are relying on government support though not receiving sufficient assistance.

In Yamoussoukro, there is a reservoir site equipped with a spillway but without water intake gates and irrigation/drainage canals yet. Irrigated agriculture is also practiced during the dry season, with rice cultivated in the lower part of the site and vegetables in higher places. Small engine pumps are used along downstream banks to freely irrigate nearby fields.

Figure 6.3.3 Vegetable Cultivation in Downstream Areas of a Developed Irrigation Site (Yamoussoukro)

Source: JICA Survey Team (March 2022)

[3] *"Ministère d'État, Ministère de l'agriculture et du développement durable"*

In the southern areas (Gagnoa, Divo, Dabou, Adzopé, and Aboisso), annual precipitation exceeds 1,200 mm and there are many perennial streams, though there are also many non-developed irrigated sites. Many of those streams offer high potential to apply the COBSI approach. In addition, because of the high annual rainfall, rainfed plantation farming of crops such as oil palm (palm oil), cacao and rubber trees are widely practiced in the area. Along streams, vegetables are irrigated using watering cans and buckets which are judged inefficient, because water resources are not effectively utilized, resulting in limited irrigated areas.

Figure 6.3.4 Potential Stream for COBSI (Adzopé)

Source: JICA Survey Team (March 2022)

In Adzopé, a steel-gate type intake weir, irrigation canals, and irrigation fields were constructed and developed on a site in the 1970s, but the gate is now severely damaged and the intake weir is no longer functional. It was generally observed that fewer irrigation sites were developed in the southern areas.

(2) Extension Activities and Farmers' Organizations

In Côte d'Ivoire, the National Agency for Support of Rural Development under MINEMINADER, locally called ANADER (*"Agence Nationale d'Appui au Développement Rural"*), is responsible for rural extension activities across the whole country zoned into seven (7) Blocks and fifty-seven (57) Zones. The Survey Team first visited ANADER's zone offices to collect information before going on site to conduct field surveys. Each zone is divided into Extension Centers to which one (1) or two (2) extension officers get assigned. The Yamoussoukro zone office in the Bouaké Block has, for example, twenty-seven (27) Extension Centers, with one (1) extension officer assigned to each. There are approximately two thousand (2,000) extension officers nationwide, all of whom are equipped with motorcycles. However, the area covered by each extension officer is large, and visits to villages are consequently reduced, except during project implementation.

Regarding farmers' organizations, weaknesses in systems and activities in developed irrigation sites have been identified. For example, by-laws are not documented even when associations are set up, and maintenance activities for irrigation facilities are not performed regularly by association members.

It is worth noting that since ANADER is at the dissemination front line, it collaborates with other ministries and agencies outside of the agricultural sector, so is, for instance, sometimes called to distribute mosquito nets.

(3) Farming and Marketing

Approximately 50% of Côte d'Ivoire's rice, domestically considered as a "political commodity", is imported, as domestic production is insufficient. Possible reasons for such insufficiency is farmers in some areas continue to use the same seeds repeatedly when they lack funds, when the amount of quality seeds in distribution is not sufficient, or when there are no agricultural supply dealers in nearby villages. In spite of that, there are some case where quality rice seeds are distributed freely to farmers by ANADER and other organizations and others where farmers either use seeds obtained from ANADER and pay for them after harvest, or purchase them at agricultural supply dealers.

Vegetables such as tomatoes are also imported due to insufficient domestic production. In general, the

supply of rice and vegetables decrease during the dry season due to lack of water, which leads to an inevitable increase in sales prices compared to the rainy season. Sometimes, however, there is no change between the dry and the rainy seasons, because middlemen impose prices.

Interviewed farmers consider vegetable cultivation to be profitable, especially during the dry season when demand for vegetables is high. Regarding rice consumption, consumer preferences have, in recent years, gradually shifted to aromatic rice despite inadequacy of rice production, implying that quality is becoming a criterion of choice.

(4) Environmental and Social Considerations

1) Forest Cover Decline Caused by Plantation Expansion

In Côte d'Ivoire, there are many large-scale plantations of coffee, natural rubber, oil palm, and other crops besides cocoa beans the country is a world-dominant producer of (cf. Figure 6.3.5). Slash-and-burn farming is still conducted in plantation development, which has led to the reduction of natural forests and the degradation of the soil's water retention capacity. In this regard, the United Nations Environment Programme (UNEP) points out plantations as a major factor in the country's forest cover decline[4].

Figure 6.3.5 Palm Plantation in Southern Côte d'Ivoire
Source: JICA Survey Team (March 2022)

In southern areas such as Adzopé, Aboisso, Dabou, Divo, and Gagnoa where field surveys were conducted, the division of tasks among men and women seemed fairly clear with the former mainly doing heavy plantation work and the latter performing relatively labor-intensive vegetable cultivation.

2) Impacts Caused by Climate Change

According to an AfDB report[5], climate change has also caused temperatures to raise between 1979 and 2015 in Côte d'Ivoire, and it is predicted that agricultural production will continue to be affected by such change in areas climatically suitable for agricultural production, by an increased risk of crop exposure to water stress (a condition in which water supply and demand are tight), etc. DGRE[6] Deputy Director expressed his expectation—during a field survey enabling the JICA Survey Team to explain the COBSI Approach—that the introduction of COBSI promoting efficient water use could help farmers who are already facing challenges in their farming activities due to impacts of climate change.

[4] Post-Conflict Environmental Assessment (2015, UNEP):
https://postconflict.unep.ch/publications/Cote%20d'Ivoire/UNEP_CDI_PCEA_EN.pdf
[5] National Climate Change Profile (2018, AfDB):
file:///C:/Users/AYUMI%20SHIGA/Downloads/afdb_cote_divoire_final_2018_english.pdf
[6] *"Direction Générale des Ressources en Eau"* (French for "Directorate General of Water Resources")

3) Inappropriate Use of Agricultural Chemicals

According to the Directorate General of the Environment (*"Direction Générale de l'Environnement – DGE"*) under MINSEDD, while significant environmental impacts caused by irrigation projects are not seen in Côte d'Ivoire, inappropriate use of agricultural chemicals such as excessive application is a source of concern. Empty bottles of agricultural chemicals such as herbicides were, for instance, found disposed of near farmlands during our field survey (cf. Figure 6.3.6). The majority of interviewed farmers replied that they used such chemicals, some having been trained by extension workers on their proper use, while others had received no training at all.

Figure 6.3.6 Agricultural Chemicals Used in Farmlands in Côte d'Ivoire

Source: JICA Survey Team (March 2022)

4) Water Conflicts

According to the DGRE of the Ministry of Water and Forestry (*"Ministère des Eaux et Forêts – MEF"*), farmers are surface water users next to fishermen, animal breeders, illegal gold diggers, etc.; there are risks of water conflicts between farmers and those other users if water rules are not instituted. The DGRE pointed out, further, that cooperation between MINEMINADER and MEF is essential to prevent such conflicts and expects to include MEF in the project implementation for the technical management.

(5) Nutrition

ANADER, which MINEMINADER has entrusted extension activities to, assigns extension workers in charge of nutrition issues. An ANADER officer indicated the country's nutritional situation can be comparatively better in the rainy season when water is more accessible and crop cultivation flourishes, farmers having crops in hand for their own consumption. In the dry season, however, nutritional conditions tend to deteriorate, as cultivation itself is impacted by a lack of irrigation water. Côte d'Ivoire is also characterized by undiversified regional agriculture, leading to farmers having to pay high transportation costs if nutrients are recommended to be obtained from a particular crop. From a nutritional standpoint, it is possible to get the necessary nutrients from alternative crops, but whether farmers actually grow them with such knowledge is uncertain. Further, a nutritionally unbalanced diet composed of yams and bananas without any side dishes at mealtimes seems to have become usual among people. Under such circumstances, the ANADER is working with extension workers (*"Agents de Développement Rural -ADR"*) to provide guidance and other activities to improve nutrition.

6.3.4 Proposed Plans for Future COBSI Approach Cooperation

(1) Target areas

In Yamoussoukro and the six regions where field surveys were conducted, irrigation facilities and natural environment conditions differed from area to area, but the potential for introducing the COBSI approach was identified in all areas. In addition, interviews were conducted with ANADER and other government officials regarding situations in regions the Survey Team could not visit this time. Based on comprehensive consideration of the results of those surveys, division of candidate areas for the

introduction of the COBSI package in Côte d'Ivoire in two (2) was decided: Northern/central and southern/western areas (cf. Figure 6.3.7).

In the northern/central area, although the number of perennial streams is limited, facilities and water management and maintenance capacities are expected to be enhanced by applying COBSI techniques in already developed irrigation sites (red line in Figure 6.3.7).

The western/southern area has, on the other hand, many perennial streams and non-developed sites, so the existing COBSI approach can be adapted (blue line in Figure 6.3.7).

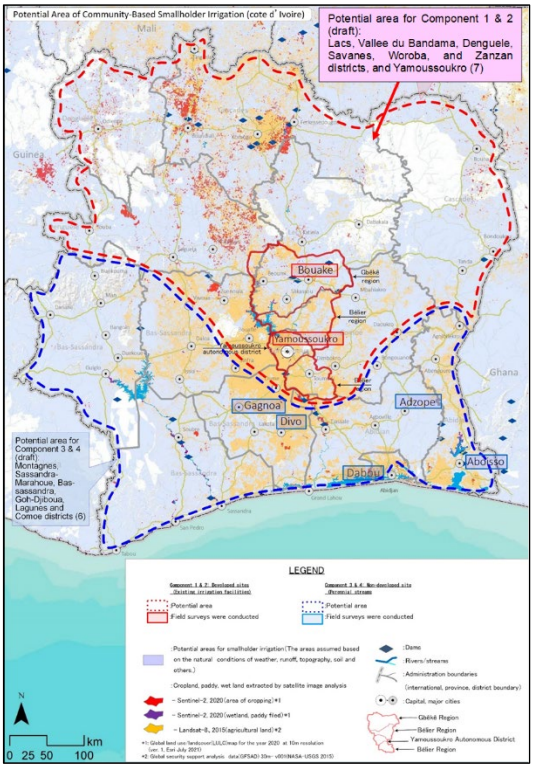


Figure 6.3.7 Côte d'Ivoire Small-Scale Irrigation Potential Map

Source: JICA Survey Team

(2) Proposed Plans and Concept

New projects introducing COBSI package technology in Côte d'Ivoire were examined by dividing the targets into four categories based on irrigation facilities and stream conditions. New project proposals with respective concepts, activities (hard and soft), and potential areas are summarized in Table 6.3.2.

The common concept for all categories is to increase rice and vegetable production through enhanced water management and maintenance capacities to which facilities maintenance will be added in sites where facilities are not developed.

Regarding activities for developed sites, Plan 1 applies COBSI technology to maintain drainage canals, whereas Plan 2 helps construct intake gates and irrigation canals using COBSI technology. Designed for *unimproved* sites, Plan 3 implements the traditional COBSI approach from scratch where simple weirs and earthen canals are constructed and used to irrigate farming before a future upgrade to permanent weirs. Plan 4 is almost the same as Plan 3, except that it, instead, rehabilitates some facilities which are still in place but not functioning. A common activity for all those plans is either construction of new fishponds, or use of existing rice paddies as fishponds for nutrition improvement.

Software activities include strengthening the capacity of irrigation engineers and extension officers, developing water management and facilities maintenance manuals, conducting water management/facilities maintenance training, and introducing market orientation through SHEP. The introduction of community-based watershed conservation (fencing, sediment ponding) is particularly important in developed sites.

Regarding potential partner projects, PRORIL 2 is supporting the expansion of financial services to rice millers and dealers for seed production quality and post-harvest handling improvement in developed sites, mainly in central areas. Supporting water management and maintenance capacity enhancement through the COBSI approach will allow for more stable irrigation water availability which is expected to increase production not only of rice, but also of vegetables.

Table 6.3.2 Proposed COBSI Approach Plans Contributing to Irrigation Development in Côte d'Ivoire

Items	Plan-1	Plan-2	Plan-3	Plan-4
Target Sites/ Area	Developed sites (1) (Existing irrigation facilities)	Developed sites (2) (Existing irrigation facilities)	Non-developed sites (1) (Perennial streams)	Non-developed sites (2) (Perennial streams)
	Northern and Central areas	Northern and Central areas	Western and southern areas	Western and southern areas
Findings related to Small-scale Irrigation	・ There are existing reservoirs, irrigation/ drainage canals, intake gates and fields. ・ Farmers' level of knowledge of water management and capabilities of operation and maintenance are not sufficient. ・ Operation and maintenance are left solely in the hands of the government. ・ Crops and facilities are frequently damaged by floods. The considered reasons for such inflow are inappropriate drainage canal sections/ capacity of irrigated areas	・ While there are existing reservoirs and spillways, no intake gates or irrigation/ drainage canals have been developed.	・ There are many perennial streams in western and southern areas where the annual rainfall volume exceeds 1,200mm. However, no irrigation system has been installed yet in most areas.	・ While there are areas with iron gate weirs, irrigation canals, and fields which were developed in the 1970s, the weirs are no longer functional due to significant damages on the gates.
			・ Since inefficient irrigation using watering cans and buckets are conducted, irrigated areas are narrow and water resources have not been used efficiently.	
Concept Summary	Increase in production of rice and vegetables through enhancement of water, operation and maintenance management	Increase in production of rice and vegetables through improvement of intake gates and canals, as well as enhancement of water, operation and maintenance management	improvement of female farmers' income through upland farming in the dry season as well as of nutrition through food diversification	Increase in production of rice and vegetables through improvement of intake facilities and enhancement of water, operation and maintenance management
Package of Components	・ Introduction of operation and maintenance technology for drainage canals based on the advanced COBSI approach	・ Improvement of intake gates, and irrigation canals through application of the COBSI approach	・ Construction of simple weirs and irrigation canals ・ Construction of permanent weirs	・ Construction of simple or permanent weirs, and rehabilitation of irrigation canals
	Enhancement of aquaculture: use of existing paddy fields as fishponds			
Package of Soft Components	・ Capacity building of irrigation technicians and extension workers ・ Development of manuals on water, operation and maintenance management ・ Provision of training on water, operation and maintenance management ・ Promotion of E-extension and dissemination by farmers themselves (FFS and FFD) ・ Promotion of training on horticulture crop production, including a topic on the appropriate use of agricultural chemicals ・ Introduction of Market-oriented, SHEP approach ・ Introduction of community-based watershed conservation (fencing and ditch) ・ Promotion of training for nutrition improvement ・ Introduction of the concept of water rights			
Potential partner project(s)	PRORIL-2			

Source: JICA Survey Team

Concerning cooperation schemes for new projects, the Survey Team proposes to dispatch short-term experts to start with a pilot project which would be limited to two (2) or three (3) regions such as the central area (Bouaké) and the southern areas (Adzopé and Dabou) and focus on establishment of model sites and development of human resources. Then, the project could be expanded nationwide through Technical Cooperation.

Moreover, by promoting Côte d'Ivoire as a hub for COBSI expansion in West Africa, it is expected to lead to wider outreach through regional integration involving, especially, neighboring French-speaking countries such as Togo and Benin.

(3) Implementation Structure (Draft)

Figure 6.3.8 below shows the proposed implementation structure for the COBSI approach. COBSI's dissemination system will be divided into Central, Zone, and Local (dissemination to farmers) levels. The main implementation agency will be the Directorate of Irrigation and Infrastructure Enhancement under MINEMINADER, with ANADER as the cooperating agency. This Directorate has about thirteen (13) Central-level irrigation technicians traveling to but not stationed in the regions; ANADER also has irrigation engineers though assigned only to the headquarters.

JICA experts, the Directorate of Irrigation and Infrastructure Enhancement, and central-level ANADER officials will collaborate to train technical experts at ANADER's Zone Offices by conducting ToT. Then, government officials from the Zone Office are next in line to provide training directly to ANADER's extension officers (ADRs), followed by expansion to farmers' groups. This training, which includes KOT, MTT, and an AEW, will be conducted three times a year.

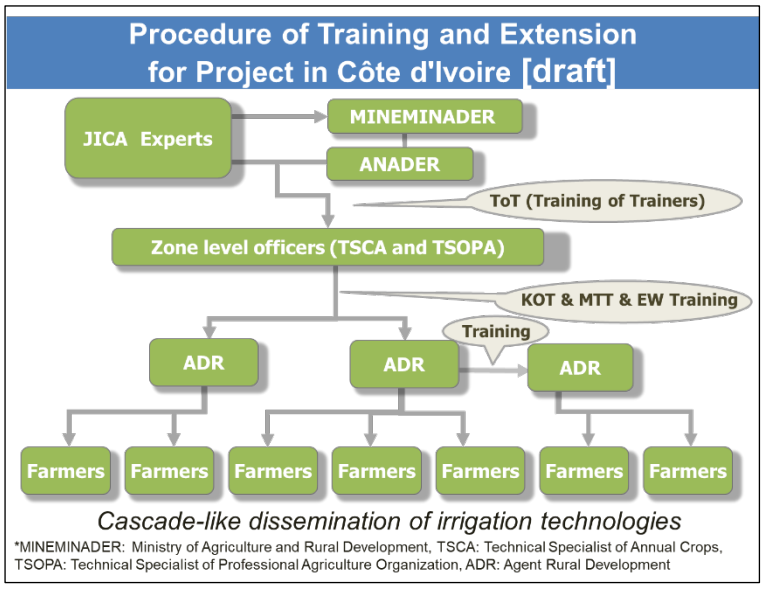


Figure 6.3.8 Implementation Structure for the COBSI Approach in Côte d'Ivoire (Draft)

Source: JICA Survey Team

6.4 Tanzania

6.4.1 Field Survey Outline

(1) Survey outline

Field surveys for Tanzania were conducted from June 7 to 26, 2022, and various organizations listed in Table 6.4.1 below—with offices in the capital city of Dodoma—were approached to collect relevant information. The areas targeted for field surveys were determined on the basis of relatively high small-scale irrigation potential identified from detailed satellite image analysis conducted in advance and in consideration of a travel restriction by the JICA Tanzania office (within 8 hours' drive each way from Dar es-Salaam and specific areas where domestic flights were available). Field surveys were conducted in a total of thirteen (13) Districts and six (6) Regions: Kilimanjaro Region (Moshi, Hai, and Rombo Districts), Tanga Region (Lushoto and Korogwe Districts), Pwani Region (Rufiji District), Mbeya Region (Mbeya, Mbarali, and Busokelo Districts), Songwe Region (Mboshi District), and Morogoro Region (Morogoro, Kilosa, and Mvomero Districts). The field surveys' scope included natural conditions such as hydrology and topography, conditions of existing irrigation sites (including facilities), of farmlands and farming, and of markets alongside interviews with farmers.

Table 6.4.1 Visited Organizations for Information Collection (Tanzania)

Categories	Visited Organizations
Tanzanian Government	✓ **National Irrigation Commission (NIRC)** ✓ **Ministry of Agriculture (MOA)** Agricultural Mechanisation and Irrigation Division (DMI), Agricultural Training, Extension services and Research Division (DTER), Crop Development Division (DCD), Environment Management Unit (EMU) ✓ **Ministry of Water** ✓ **President's office, Regional Administration and Local Government (PoRALG)**
Other	✓ Project for Strengthening DADP Planning and Implementation capacity through the Use of the SHEP Approach (TANSHEP)

Source: JICA Survey Team

(2) Potential Areas for Small-Scale Irrigation

Figure 6.4.1 shows small-scale irrigation potential distribution in Tanzania (indicated in purple) based on detailed satellite image analysis results. Eastern to southern as well as western and Mt. Kilimanjaro areas receive more than 1,000 mm of annual precipitation. The country's small-scale irrigation development potential was identified as high based on surface runoff, soil types, and surrounding populations and land use. Northern to central areas were, on the other hand, analyzed as having low potential due to vast areas with annual rainfall below 1,000 mm.

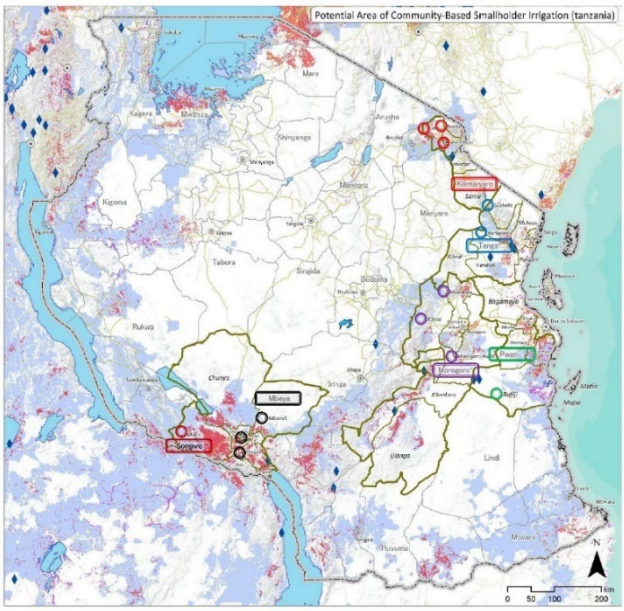


Figure 6.4.1 Small-Scale Irrigation Potential Distribution (Tanzania)

Source: JICA Survey Team

Southern and western regions near COBSI-implementing Zambia and Malawi are considered to have particularly high potential.

The locations of the 6 Regions and 13 Districts where field surveys were conducted are respectively indicated in squares and circles in the same Figure.

6.4.2 National Development Plans and Legal Frameworks Related to the COBSI Approach

(1) National Agriculture Policy (2013)

Irrigation development is regarded as an effective approach in terms of food security and poverty reduction in Tanzania, since it can lead to crop productivity increase and continuous agricultural development. Additionally, climate change—particularly rainfall decrease and change in patterns—is having more severe consequences these days to the point that irrigation development is recognized as essential in addressing impacts on crop production.

(2) Agriculture Sector Development Programme II (2017)

Agriculture Sector Development Programme II is a 10-year program consisting of two phases with a 5-year implementation period each. The first phase covers five years from 2017/2018 to 2022/2023. The Programme aims for productivity increase in the agricultural sector, commercial farming, and small-scale farmers' income increase, thereby improving livelihoods, reinforcing food and nutrition security, and increasing GDP. It especially focuses on increasing production of targeted commodities in a sustainable manner, while enhancing competitiveness and value chain development.

(3) National Irrigation Master Plan (NIMP 2018)

After the National Irrigation Master Plan of 2002 (NIMP 2002) was developed, the National Irrigation Agency, which is in charge of irrigation development and management in Tanzania, was established as an independent administrative agency under the Ministry of Water and Irrigation in 2015. The Tanzanian Government reported that irrigation development areas increased from around 200,000 ha in 2004 to around 460,000 ha in 2015 as a result of a series of irrigation projects under NIMP 2002.

Considering that more than fifteen (15) years have passed since the drafting of NIMP 2002; and situations concerning irrigation development have significantly changed, NIMP II was formulated in 2018 with the support of JICA, with the aim of "contribut[ing] to the improvement of the national economy and food security through the increase of agricultural productivity and incomes by irrigation development, which leads to poverty reduction and taking measures against climate change."[7], The Master Plan targets one (1) million ha of irrigated areas, three hundred fifty-eight (358) thousand farm household beneficiaries, yield increases for rice, tomato and onion (5 t/ha, 40 t/ha, and 10 t/ha respectively), and net farm income increase of TZS3-4 million/ha/year by 2035. The project will be implemented in two (2) phases, 2018-2025 for Phase 1 and 2026-2035 for Phase 2.

[7] The Project on the Revision of National Irrigation Master Plan in the United Republic of Tanzania: Final Report (JICA, 2018)

(4) Legal Frameworks on Environmental and Social Considerations

In Tanzania, the Environmental Management Act (2004) regulates the ESIA procedure. The project proponent shall submit a project brief to the National Environmental Management Council (NEMC) where projects get categorized through screening into either Type A for which a full-scale ESIA is mandatory, or Type B for which a preliminary-level ESIA is required.

The First Schedule of the Environmental Impact Assessment and Audit Regulations (2005) lists the twenty-two (22) sectors that require implementation of an ESIA, including the agricultural sector. Since "water resources development projects (dams, water supply, flood control, irrigation, drainage)" is included in the list, this requirement is most likely to apply to the COBSI Approach. However, there is no stipulation of the detailed scale for which an ESIA is mandatory. It is, therefore, essential to reconfirm that aspect with the NEMC when implementing the project for adequate environmental and social considerations. Detailed information on that section is provided in "Appendix 2-4 Tanzania".

6.4.3 Survey Results (Current Situation/Identified Issues)

(1) Irrigation, Water Management and Maintenance

The Director of NIRC's Planning Department explained that potential irrigable area in Tanzania is twenty-nine (29) million hectares, about only 3% (about 870,000 ha) of which has been developed for irrigation. According to The project on the Revision of the National Irrigation Master Plan in the United Republic of Tanzania, "irrigation developed area was about 460,000 ha in 2015", which suggests that irrigation development has been progressing at a rapid pace since 2016. Although Tanzania has many traditional irrigation schemes and permanent irrigation facilities sites where irrigation canals are already utilized, very large numbers of undeveloped irrigable areas were identified through the field surveys.

Figure 6.4.2 Intake Weir Made of Stones at Traditional Irrigation Schemes (Mbeya Region)

Source: JICA Survey Team (June 2022)

In Tanzania, there are about nine-hundred (900) sites with traditional irrigation schemes that have, for a long time, been developed and farmed next to reinforced concrete structures built by contractors. Materials used in simple weirs for taking irrigation water from rivers include wood, grass or soil (fewer cases), and stones or sacks (weirs installable by farmers) (cf. Figures 6.4.2 and 6.4.3). Many of the sites have long experience in irrigated agriculture, so it may be relatively easy for farmers to understand COBSI and accept its introduction. Therefore, for sites where irrigated agriculture has been practiced for a while, it is possible to skip the stage of simple weir construction and start off with upgrading to permanent weirs.

Figure 6.4.3 Intake Weir Made of Sacks at Traditional Irrigation Schemes (Morogoro Region)

Source: JICA Survey Team (June 2022)

As observed in many of the surveyed irrigation sites, irrigation water was not distributed appropriately amongst group members, upstream areas always getting irrigation priority, and maintenance and management activities of irrigation facilities did not seem to be carried out regularly, if not at all. Packaging related technical transfer solutions, COBSI can contribute to addressing such problems faced by existing sites not only by constructing simple weirs and other facilities, but also introducing software. It is also important to note that when introducing COBSI in the future, it is a common practice to implement it downstream existing simple weirs so as not to interfere with farming activities at the existing site.

On the other hand, in areas where traditional irrigation schemes are active, it is essential to coordinate with them—through prior discussion and agreement with all parties involved—when planning to introduce COBSI in the future, particularly in relation with water intake from the same stream, which may be a sensitive issue unless the intake location is downstream of the existing site.

As previously mentioned, there are many such traditional irrigation schemes in Tanzania, and NIRC believes that those schemes need to be formally registered—a process which has been started and is ongoing, since many irrigation schemes are still unregistered. Table 6.4.2 below describes the registration approach to those traditional schemes.

Table 6.4.2 NIRC's Registration Approach to Traditional Irrigation Schemes

Condition of Eligibility	Organized by at least 10 farmer members (the irrigated area is not a requirement)
Registration	✓ NIRC provides support to farmers' groups, upon their request, in scheduling construction of facilities and setting up water users' associations, among other matters. ✓ When upgrading irrigation facilities, the feasibility of the upgrade shall be surveyed and identified in relation to water resources reliability, household benefit, social and environmental aspects survey, agricultural factors, geographic conditions, marketing, and so on. If feasibility is identified, the project will proceed to rehabilitation. ✓ The irrigation facilities rehabilitation includes permanent weir, canal lining and gate installation. NIRC will conduct surveying and mobilize excavation equipment during construction (they have their own heavy equipment). ✓ All irrigation schemes need to apply for a water use permit from the Ministry of Water in which case farmers' groups contact NIRC who will provide them with both soft and hard support such as calculating the amount of irrigation water requirements. The farmers' groups then apply to the Ministry of Water for related permits. ✓ In the past, irrigation development in Tanzania was conducted in a top-down manner, and there were many failed cases. Currently, irrigation development has been switched to a

	bottom-up approach, and many successful sites have been found. At irrigation sites, they consider water management and maintenance of facilities to be important.

Source: JICA survey team.

(2) Extension Activities and Farmers' Organizations

Governmental organizations responsible for agricultural extension in Tanzania are MOA-DTER and PoRALG, the former being in charge of preparing extension plans, while the latter takes care of implementing them.

1) MOA-DTER

MOA-DTER is in charge of conducting ToT, supervising organization of farmers' groups, FFS (Farmers Field School) training, inputs support, etc. There are fourteen (14) agricultural colleges which extension officers initially graduate from (level 4-5 certificate) before college (level 6 diploma), then university (level 8 degree).

"Political crops" being promoted by MOA-DTER include cashew nuts, tea, coffee, sugarcane, cotton, sunflower, and palm oil, with target crops changing every few years—avocado being currently promoted. Tomatoes are the dominant horticultural crop produced under COBSI in Morogoro and Ulanga Districts. All those crops complement each other, as each region of the country produces its own specific crops.

DTER has a total of about twenty-five (25) officers including the Director and Administration staff, five (5) officers in the Training & Support section, and eleven (11) officers in the Extension & Research section. MOA has no agricultural extension officer who directly intervenes in the field; they usually request PoRALG to arrange and collaboratively conduct all dissemination program activities with them. Budget for such dissemination activities is usually provided by MOA, though PoRALG may also allocate from their own.

2) PoRALG

PoRALG's main tasks include 1) training farmers in terms of agro-production and demo plots as well as providing farming inputs, 2) involving the private sector in the provision of farming inputs, and 3) providing agro-inputs purchased with government subsidy.

Extension activities are carried out by about seven (7) thousand extension officers throughout the whole country. Those extension officers have a District-level degree, a Ward-level diploma, and a Village-level certificate, all of which are eligible for salary payments when integrating PoRALG. Village-level extension officers are the ones who usually live in the village and are familiar with the farmers' situations. Those field-level officers are responsible for providing extension services (giving information on new diseases and seeds, drafting a list for the government's subsidy program, etc.), collaborating with other agriculture stakeholders and NGOs (e.g. supporting future actors dealing with agriculture and nutrition, identifying agro-dealers, and connecting with farmers), etc.

Challenges in extension activities include insufficient water management and maintenance in existing irrigation schemes, lack of access to up-to-date information on cultivation techniques and farming practices (limited governmental refresh training opportunities), lack of means of transportation for extension activities (cases of borrowings from colleagues reported), lack of means of communicating information, and so on.

Collaboration between PoRALG and Sector-Specific Ministries (SSM), such as the ministry in charge of agriculture, involves both soft and hard planning on policies, criteria, standards, and technical

innovations, with the SSM handling preparation and PoRALG taking care of their implementation. Extension officers participating in those activities prepare technical reports which are, then, submitted to both the SSM and PoRALG.

3) Farmers' Organizations

As mentioned above, there are many traditional irrigation schemes in operation in Tanzania, and it is considered that there are no major obstacles in securing farmers' understanding of COBSI and acceptance of its introduction. However, most of those irrigation schemes have no water users groups (Irrigators' Organizations, Water Users Associations, etc.), which may have led to water being unequally, untimely, and inadequately allocated, facilities improperly maintained, damaged parts left unrepaired or unreplaced, and to failure to secure the required amount of irrigation water.

COBSI provides not only skills for irrigation facilities construction, but also capacity in water management, maintenance and farmers' group organization as package components, which could pertinently be utilized in Tanzania to address and solve the abovementioned among other agriculture-related issues.

(3) Farming and Marketing

In general, existing irrigation schemes produce tomatoes, onions, cabbage, eggplant, carrots, and other horticultural crops as well as irrigated maize, beans and watermelons (cf. Figure 6.4.4). Some areas also grow rice in the rainy season with two rice plantings per year (made possible in most cases by irrigation canals supplementing rainfall) depending on the location.

Figure 6.4.4 Farming at Irrigation Schemes (Tanga Region)

Source: JICA Survey Team (June 2022)

Challenges in farming included mainly insufficient irrigation water intake, which can be increased with construction of permanent irrigation facilities, and the lack of specific rules for proper water management and distribution. Moreover, high agricultural input costs, long distances and lack of transportation to markets add up to the limited availability of quality rice seed, causing farmers to reuse the same seeds over and over again, which inevitably results in reduced yields, among other problems.

In general, market prices tend to be high in the dry season when (irrigated) production is low yet demand is high, and the opposite during the rainy season when production is high and demand is low. However, where rice is grown in addition to horticultural crops during the rainy season, the latter becomes expensive due to reduced production as a direct consequence of reduced cultivated areas and wet weather damage. Oppositely, prices become lower in the dry season when horticultural crop production increases, a situation that was also observed with rice.

(4) Environmental and Social Considerations

1) Forest Cover Decline and Soil Erosion Caused by Cultivation

In the Lushoto hilly areas—Kilimanjaro Region—cultivation has been conducted up to the upstream of the basin where crops such as maize are cultivated (cf. Figure 6.4.5). However, issues in the basin management caused by the decrease in the number of water retention trees, such as soil erosion by rain, have been observed.

Figure 6.4.5 Cultivated Hilly Areas in Tanzania

Source: JICA Survey Team (June 2022)

2) Impacts Caused by Climate Change

Regarding the impacts of climate change in Tanzania, there have been reports about the melting of the glacier on top of Mt. Kilimanjaro—Africa's highest mountain (5,895 m elevation)—as a consequence of rising temperatures after 1912[8]. Moreover, several areas such as Dar es-Salaam, Kilosa, Mpwapwa, and Kilombero have suffered from significant floods and droughts, affecting lives since 2008. Impacts of climate change on the rain pattern and, consequently, on agricultural activities were recognized by farmers as confirmed during field survey interviews; officers at the Environment Management Unit (EMU) under the Ministry of Agriculture also pointed out the same.

3) Excessive Use of Agricultural Chemicals

According to EMU, Tanzanian agriculture is also experiencing issues caused by excessive use of chemicals and an ensuing increase in soil salinity. To help address such issues, EMU is collaborating with other organizations to provide farmers with instructions about the type of seeds that match the soil conditions, the right amount of water and agricultural chemicals for each crop, etc. Further, Local Government Agency extension workers have, as part of a series of extension activities, offered rapid soil test kits to confirm soil health and sensitized on the appropriate use of agricultural chemicals.

4) Water Conflicts

According to the final report of the Project on the Revision of National Irrigation Master Plan in the United Republic of Tanzania[9], water conflicts tended to increase in recent years in basins prone to water stress. Those conflicts can, as it further points out, be summarized into conflicts between the irrigation and other sectors, between stationary cultivators and grazing farmers, and between farmers upstream and downstream rivers or irrigation schemes. As confirmed in interviews conducted during field surveys, some farmers are often obliged to cultivate vegetables, though hoping to grow rice, because of improper management and distribution of water between the upper and lower watersheds, preventing irrigation water from reaching downstream areas.

[8] National Climate Change Statistics Report 2019, Tanzania Mainland: https://unstats.un.org/unsd/envstats/Compendia/Tanzania%20NCCSR%202019.pdf

[9] The project on the Revision of National Irrigation Master Plan in the United Republic of Tanzania: Final Report (JICA, 2018): https://libopac.jica.go.jp/images/report/P1000036745.html

6.4.4 Proposed Plans for Future COBSI Approach Cooperation

(1) Target Areas

Small-scale irrigation potential in Tanzania was identified as high to medium particularly in Kilimanjaro, Tanga, Mbeya, Songwe, and Morogoro Regions based on field surveys and interviews with concerned stakeholders (cf. Figure 6.4.6). The northern highland areas of Kilimanjaro and Tanga Regions have high annual rainfall and a larger number of small rivers of suitable sizes and flows for COBSI than those in the plains. The topography is mountainous to hilly with sufficient enough gradients for gravity irrigation to the fields. The Lushoto District in Tanga Region is a major vegetable-growing area where, according to NIRC officials, about 85% of irrigable areas are small-scale (less than 500 ha) and about 50% estimated to be less than 50 ha.

Figure 6.4.6 COBSI-Applicable tream (Mbeya Region)

Source: JICA Survey Team (June 2022)

Mbeya Region in the western part of Tanzania, near the border with Zambia, is also known as the breadbasket of the country. There, the field survey team visited sites where farmers' groups practice irrigated agriculture using simple weirs constructed with locally available materials, similar to COBSI's, and cover irrigable potential areas ranging from a few hectares to the 100-hectare level where diversified crops are grown, including rice and horticultural crops. There is, thus, potential for COBSI expansion in this region, and for sites where simple weir-irrigated agriculture is already in practice, it is possible to consider starting off with the construction of permanent weirs through the COBSI upgrade system.

On the other hand, potential for COBSI expansion was low in Pwani Region mainly due to inadequacy of its natural conditions (river size, late-dry-season river discharge, topographical conditions, etc.). This region is flat, with large and medium-sized rivers meandering downstream at a gentle gradient. During the dry season, the discharge of streams connecting to and flowing into those rivers decreases, leaving much of the water in the river bed. As a consequence, agriculture is usually irrigated by pumping water from natural ponds in such rivers. Water also used to be pumped up to storage tanks and flowed by gravity to fields in irrigation schemes constructed in the past with Japanese assistance, making potential for COBSI introduction in such conditions low.

In the central highlands, areas where annual precipitation is below 750 mm are spread out. On the other hand, the northern and southern regions have mountainous areas with high annual precipitation, identified through field surveys as suitable for developing COBSI, though on a small rather than a large scale due to restricting topographical conditions. Candidate areas for the COBSI approach are 1) northern areas such as Kilimanjaro and Tanga Regions (excluding the central highlands and coastal plains of Pwani Region), 2) southern areas such as Mbeya and Morogoro Regions (including Iringa and Ruvuma Regions where no field surveys were conducted), and 3) western areas such as Kigoma and Rukwa Regions which could not be surveyed either.

It is worth noting that there may be other small irrigation potential areas in addition to those in this report but could not be surveyed in the field, as survey activities were limited by COVID-19 and travel safety restrictions.

(2) Proposed Plans and Concept

Irrigation administration in Tanzania is the responsibility of NIRC who mainly focuses on medium- and large-scale schemes. Small-scale development such as COBSI is also their responsibility, though the situation seems to have practically slipped out of hand. Irrigation services provided by NIRC include provision of expertise, promotion of water users' organization, efficient utilization, equipment provision, maintenance, and marketing. In addition, NIRC registers traditional irrigation schemes and grades them into "improved" schemes. In view of all those points, NIRC's activities are similar to COBSI's dissemination methods.

The Survey Team, thus, proposes that NIRC continues to be in charge of medium- and large-scale irrigation development, while COBSI covers traditional irrigation schemes and smaller-scale areas, a division of tasks proposed to promote efficient and effective irrigation development. According to interviews at the Songwe Regional Office, percentages of farmers benefiting from irrigation development are 5% for large-scale, 5% for medium-scale, and the remaining 90% for small-scale schemes. Since smallholders support still seems insufficient, expansion of the COBSI approach in the country is deemed very significant.

COBSI will be in charge of rehabilitating traditional irrigation schemes as well as developing smaller schemes based on the following intervention perspectives: 1) The government does not need large amounts to fund irrigation development; 2) Water management and facilities maintenance can be conducted sustainably at farm level, as the technology and knowledge will remain among farmers' groups and front-line agricultural extension officers; 3) Dry-season irrigated horticultural crop production contributes to improvement of smallholders' livelihoods, and 4) COBSI can contribute to irrigated area expansion through small-scale irrigation scheme development as well as to capacity building of government officials (irrigation engineers, agronomists, and market, nutrition, and extension officers at the end of the line). A proposed draft concept of the COBSI approach in Tanzania is shown in Figure 6.4.7 below.

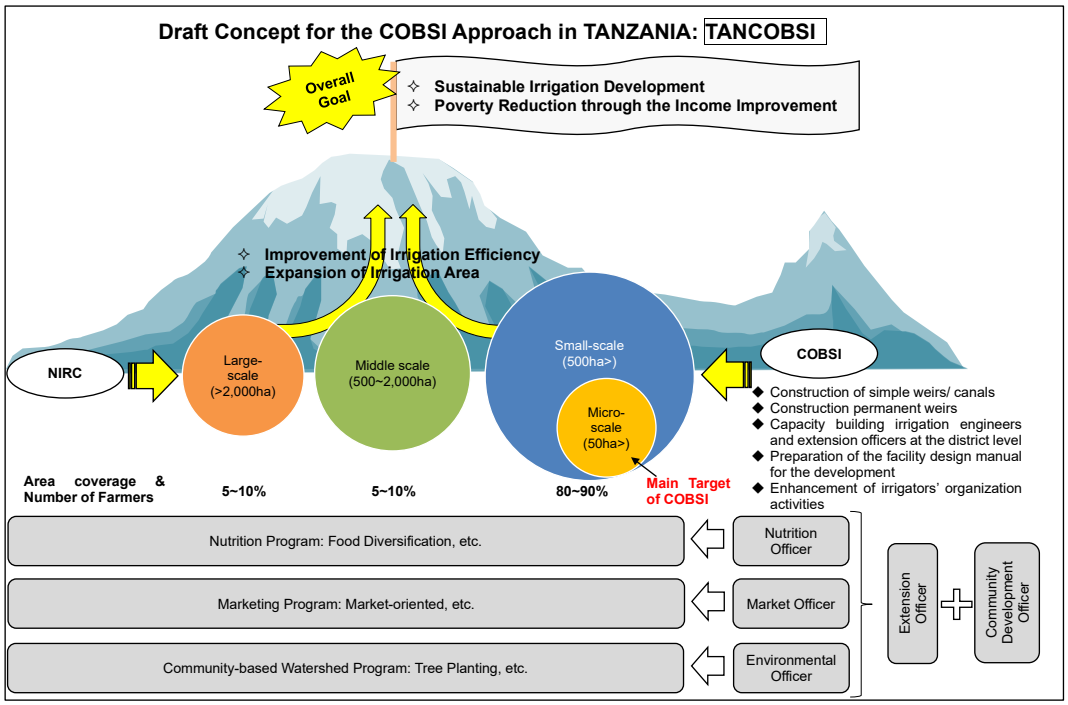


Figure 6.4.7 Concept of the COBSI Approach for Tanzania (Draft)

Source: JICA Survey Team

NIRC classifies irrigated development areas into three categories: Large (more than 2,000 ha), medium (500 to 2,000 ha), and small (less than 500 ha). COBSI is classified as small-scale, though it can target even smaller schemes of less than 50 ha per site. As mentioned above, NIRC is also responsible for the latter level but is focusing more on development of "small-scale" schemes larger than 200 ha. In that regard, they have yet to provide sufficient irrigation development and services to micro-scale areas of 50 ha or less. In the absence of precise statistical data, area sizes are estimated to be 5-10% for large-scale, 5-10% for medium-scale, and 80-90% for small-scale. In future cooperation, COBSI should be introduced as part of the small-scale irrigation development category, aiming to contribute to increasing irrigated areas and smallholders' income, while improving the capacity of government officials.

The overall goals are sustainable irrigation development and poverty reduction through income improvement based on national targets as expected results of enhancement of irrigation efficiency and expansion of irrigated areas. The COBSI approach would also contribute to improving simple weirs and earthen canals, constructing permanent weirs alongside preparation of related design manuals, developing the capacity of irrigation engineers and extension officers, and strengthening farmers' organizations.

To head more effectively toward those overall goals, the project will collaborate with the concerned agencies to incorporate nutrition improvement, market orientation through SHEP, and watershed conservation programs into training, with the expectation of synergistic effects.

Based on this policy, proposed future COBSI cooperation and support for irrigation development in Tanzania are shown in Table 6.4.3 below.

Table 6.4.1 Proposed COBSI Approach Plans contributing to Irrigation Development in Tanzania

Items	Plan-1 Existing Irrigation Facilities Sites (Traditional Irrigation Schemes: Registered/Unregistered)	Plan-2 Non-Developed Sites
Concept Summary	Construction of permanent weirs and strengthening of water management and maintenance to increase vegetable and rice production	Construction of simple and permanent weirs and strengthening of water management and maintenance to increase vegetable and rice production
Component Package	Small-scale irrigation development (permanent weirs)	Small-scale irrigation development (simple weirs, earthen canals, permanent weirs)
Soft Component Package	・ Capacity building of irrigation technicians and extension workers ・ Development of manuals on water management and operation/maintenance capacity ・ Provision of training on water management and operation/maintenance ・ Promotion of E-extension and dissemination by farmers themselves (FFS and FFD) ・ Promotion of training on horticulture crop production, including a topic on the appropriate use of agricultural chemicals ・ Introduction of Market-oriented, SHEP approach ・ Introduction of community-based watershed conservation (fencing and ditch) ・ Promotion of training for nutrition improvement ・ Introduction of the concept of water rights	

Source: JICA survey team.

(3) Implementation Structure (Draft)

The proposed implementation structure for the COBSI approach is shown in Figure 6.4.8 below. NIRC will be the main implementation agency and unit for irrigation development, while MOA and PoRALG—in charge respectively of overall National-level agricultural policy and Provincial and District local governance—will be the cooperating agencies. Irrigation, extension, market, nutrition, and environmental staff are located in the District Office, whereas agriculture-related extension activities destined to farmers are under the control of the District Local Government Authorities (LGA). In actual dissemination activities, the scope of involvement of PoRALG and LGAs is, therefore, large enough to make it necessary to keep in close contact with them. Possible coordination issues between NIRC and PoRALG could be solved through, for example, the crucial inclusion of PoRALG Director as a project's Joint Coordination Committee (JCC) member to help clarify the division of roles. As for the main implementation agency, NIRC is considered as the number one candidate, but it should be noted that PoRALG may also be a potential one.

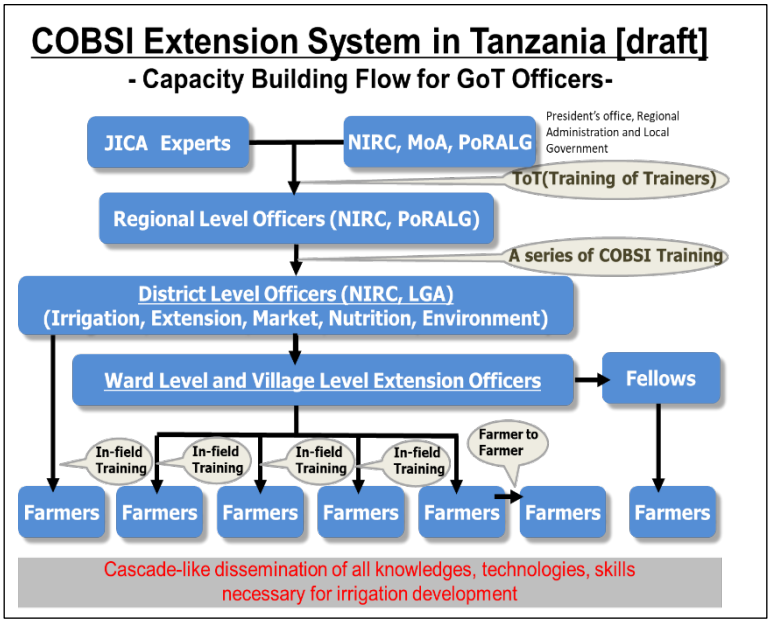


Figure 6.4.8 Implementation Structure for the COBSI Approach in Tanzania (Draft)

Source: JICA Survey Team

The COBSI approach extension system is divided into Central, Regional/District, and Local (dissemination to farmers) levels. JICA experts and Central-level government officials like NIRC will

work together to conduct ToT with Regional-level officials to produce training instructors. Then, District-level government officials (irrigation, extension, markets, nutrition, and environment officers) as well as Ward-level extension officers will in turn receive direct training by the abovementioned instructors, followed by expansion to farmers' groups. This training will include KOT, MTT, and an AEW training which is to be held three times a year.

6.5 Madagascar

6.5.1 Field Survey Outline

(1) Survey outline

The Team conducted field surveys in Madagascar from July 16 to 31, 2022 and collected information from organizations listed in Table 6.5.1 below. The surveys targeted four (4) Central Highlands Regions—namely Itasy, Vakinankaratra, Amoron'i Mania, and Bongolava, because detailed preliminary satellite image analysis identified them as having relatively high small-scale irrigation development potential. Other selection criteria were travel restrictions set by the JICA Madagascar Office (e.g. within 8 hours' drive each way from/to Antananarivo, the capital city). The Team surveyed natural conditions such as hydrology and topography, conditions of existing irrigation sites/facilities, of farmlands and farming, and of markets alongside interviews with farmers.

Table 6.5.1 Visited Organizations for Information Collection (Madagascar)

Categories	Visited Organizations
Malagasy Government	✓ **Ministry of Agriculture and Livestock (MINAE)** Directorate General of Agriculture (DGA), Rural Engineering Directorate (DGR), Plant Production Support Directorate (DAPV), Environment, Climate and Emergency Response Department (SECRU) ✓ **Ministry of Water** - Directorate General for Water (DGEau)
Others	✓ Project for Promotion of Productivity Improvement and Industrialization of the Rice Sector (PAPRIZ) ✓ Food and Nutrition Improvement Project (PASAN)

Source: JICA Survey Team

(2) Potential Areas for Small-Scale Irrigation

Figure 6.5.1 presents the distribution of potential small-scale irrigation sites in Madagascar based on detailed satellite image analysis results. The country's annual rainfall exceeds 1,000 mm, except for the southwestern region where much lower precipitation is indicative of low potential. However, small-scale irrigation development potential in the rest of Madagascar was generally identified as high relative to surface runoff, topographic gradient, soil types, populations, and land use. A total of thirty-seven (37) irrigation sites in the abovementioned 4 Regions were covered by the field survey team (cf. Figure 6.5.2).

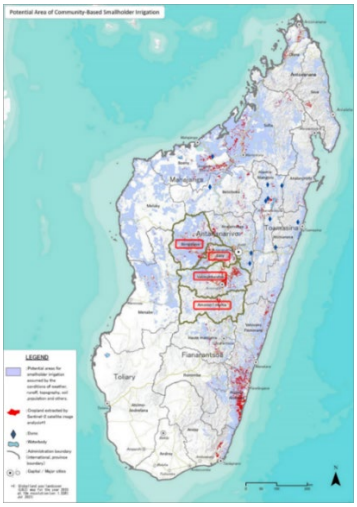


Figure 6.5.1 Distribution Map for Potential Small-Scale Irrigation Development Sites (Madagascar)

Source: JICA Survey Team (July 2022)

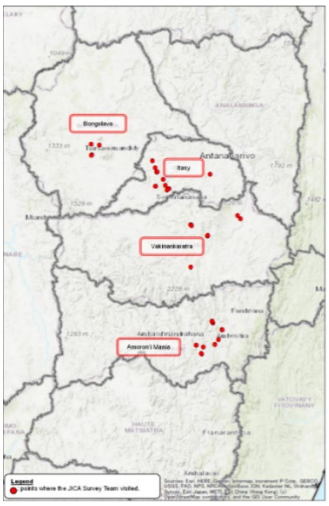


Figure 6.5.2 Location of Surveyed Sites

Source: JICA Survey Team (July 2022)

6.5.2 National Development Plans and Legal Frameworks Related to the COBSI Approach

(1) National Development Plan (2015-2019)

The *"Plan National de Développement (PND)"* 2015-2019, which aims for equitable economic growth, was approved in January 2015. This PND emphasized 1) Governance, law, security, decentralization, democratization, and national unity; 2) Stable macro-economic and national development; 3) Inclusive growth and rural development; 4) Human resources development for nationwide development, and (5) Value addition of natural resources and strengthening of resilience against natural disasters. It prioritized the agriculture sector for economic growth and paid attention to the improvement of irrigation and other agricultural production facilities, modernization of farming, and expansion of markets.

In 2014, the government issued the new National General Policy (*"Politique Générale de l'Etat – PGE"*) for 2014-2019, setting thirteen (13) strategic objectives: 1) Stable macro-economy; 2) Financial innovation; 3) Private sector development and business environment improvement; 4) Foreign trade promotion; 5) Infrastructure development and communication enhancement; 6) Environmental conservation; 7) IT innovation; 8) Sectoral public policy development; 9) Human resources development; 10) Governance and decentralization; 11) Public sector reform; 12) Social business, and 13) Further citizen's participation. Similarly to the previous PGE drafted by the last Administration, the current PGE set a goal to make of Madagascar an economically emerging country. A newly planned PND (2019-2023) was under formulation to help materialize that goal according to JICA's "Country Analysis Paper, Madagascar" (2019).

(2) Legal Frameworks on Environmental and Social Considerations

The Malagasy Environment Charter stipulates that "public or private projects that have potential risks of negative impacts on the environment shall be subjected to environmental impact surveys." As per this Charter, project proponents need to prepare an Environmental Impact Assessment (*"Etude d' Impact Environmental – EIE"*) or an Environmental Commitment Plan (*"Programme d' Engagement Environnemental – PREE"*) report based on the type, scale, and location of projects and obtain the related environmental permit in advance.

The final decision on the project categorization is made by National Office for the Environment (*"Office National pour l'Environnement – ONE"*)—which is an autonomous entity under the Ministry of Environment and Sustainable Development (*"Ministère de l'Environnement et du Développement Durable – MEDD"*)—based on the type, scale, and location of projects described in "Screening Forms" prepared by project owners. If a project requires preparation of an EIE ("EIE-type project") as a result of screening, EIE documents are appraised and approved by ONE, but if it is, instead, subject to a PREE ("PREE-type project"), then the related documents are evaluated by the project owner's environmental department. Considering the COBSI Approach targets irrigation areas of 50 ha and under per site, neither an EIE nor a PREE applies to it. When implementing the project, however, it is necessary to confirm this point with ONE again for adequate environmental and social considerations. Detailed information on this section is provided in "Appendix 2-5 Madagascar".

6.5.3 Survey Results (Current Situation/Identified Issues)

(1) Irrigation, Water Management and Maintenance

Madagascar is estimated to have a total irrigation potential area of around 1,517,000 ha, 786,000 ha (52%) of which has already been developed. Many simple weirs—traditional weirs constructed at farmer level—were identified through the field surveys, ranging from a type involving use of wood, grass, and soil with few intake weirs to a more advanced version using stones and sandbags (cf. Figure 6.5.3). Besides those, the State constructed reinforced concrete irrigation facilities in the 1980s and 1990s, but—of the ones visited—many were left in damaged condition due to aging and inadequate maintenance. Construction of such facilities require a certain level of technology, but some collapsed or were destroyed due to inappropriate design or installation locations (cf. Figure 6.5.4). Farmers' groups reconstructed some of such facilities, though mostly as an emergency measure, though they were not fully functional after repair, as users could not obtain the necessary amount of irrigation water.

Figure 6.5.3 Masonry-Type Traditional Weir (Amoron'i Mania Region)

Source: JICA Survey Team (July 2022)

Figure 6.5.4 Partially Collapsed Reinforced Concrete Permanent Weir (Vakinankaratra Region)

Source: JICA Survey Team (July 2022)

As mentioned, the Survey Team confirmed that there were already irrigation facilities in various forms, from simple facilities to permanent structures, and farmers were irrigating agriculture in different ways as seen through field surveys of four (4) Regions in the central highlands. The irrigation potential of the area is high, and the need for irrigation improvement is expected to continue to increase.

Traditional farmers' groups in upstream areas, where water is plentiful, practice rice cultivation even during the dry season, while horticulture tends to be zoned downstream where irrigation water becomes scarce easily. Despite that, cases were observed where tomatoes and cabbages were excessively irrigated when there was sufficient water, besides concerns about fertilizer use and soil runoff (cf. Figure 6.5.5). Water management and operation/maintenance knowledge and capacity often need to be improved so as to instill appropriate irrigation habit.

Figure 6.5.5 Farmer Irrigating a Vegetable Field (Itasy Region)

Source: JICA Survey Team (July 2022)

(2) Extension Activities and Farmers' Organizations

There needs to be more extension personnel to provide technical guidance on farming and other related issues in Madagascar. Many interviewed farmers answered that they had never received training from

any extension officers. Interviewed regional officials explained, in response, that there was a lack of equipment and materials such as motorcycles, spare parts, and fuel as well as computers, printers, and inputs (seeds, fertilizers, and pesticides), which hampers cultivation technology dissemination. Nationwide organizations/associations such as FIFATA[10] are there to support farmers' production activities in compensation, but they are still not sufficient.

Many farmers' organizations are traditional water management groups, and only a limited number of irrigation groups have WUAs. Setting up WUAs is one of the government's criteria for constructing irrigation facilities. However, even WUAs for whom concrete weirs were constructed are facing issues regarding water fee collection and maintenance activities which are deemed insufficient.

(3) Farming and Marketing

Almost all farmers are rice farmers, but some do not rely on that only, producing potatoes and cassava as alternative crops. During the rainy season, most farmers grow rice and vegetables in a limited area mostly for self-consumption while the surplus, especially of rice, gets sold. In the dry season, they extensively produce vegetables, beans, and potatoes using irrigation water, dry-season horticulture being one source of cash besides livestock sales and fish farming using the same water. It is worth noting, however, that rainfed rice paddy yields are declining due to recent impacts of climate change.

Figure 6.5.6 Local Market in Rural Area of Madagascar

Source: JICA Survey Team (July 2022)

There are areas where specific vegetables are produced in abundance, like ginger in the eastern part, onions and peppers in the south, and cucumbers and strawberries around Antananarivo. Prices of some crops (e.g. tomatoes, lettuce) are rainy-season high, some (e.g. cucumbers, leeks, peppers, cowpeas) dry-season high, while those of others like ginger do not change much all year round. Various crop-dependent distribution channels were observed where i) a farmer transports crops to the market, ii) a middleman buys crops in the village and transports them to and retails them in town, or iii) a farmer sells their crops at the market themselves. The farmers seemed to be at different performance levels, some having the potential to earn good profits by seeking market information, while others simply do not.

[10] *"Fikambanana Fampivoarana ny Tantsaha"* (Malagasy for Association for the Progress of Farmers)

(4) Environmental and Social Considerations

1) Low Forest Cover

The four (4) Central Highlands Regions' arid zones where field surveys were conducted—namely, Itasy, Vakinankaratra, Amoron'i Mania, and Bongolava—were originally characterized by low forest cover, though logging for firewood, charcoal and housing has diminished it to only a few percent (cf. Figure 6.5.7). In addition, upstream watersheds where lands are cultivated, rainfall causes a lot of soil erosion, obstructing weirs and canals downstream with sediment and causing concerns about related impacts on the river environment. According to a DREDD[11] officer, this low forest cover is also a factor of soil degradation.

Figure 6.5.7 Central Highlands Arid Zone in Madagascar

Source: JICA Survey Team (July 2022)

In Madagascar, logging out of natural forests is prohibited by the national legislation, and the cutting of reforested trees requires—in principle—a permit from the DREDD, though cases of unpermitted cuts are known to exist. Despite that, some regions conduct community-wide tree planting activities with the national budget for watershed conservation and soil improvement (cf. Figure 6.5.8).

Figure 6.5.8 Tree Planting Activity in Madagascar

Source: JICA Survey Team (July 2022)

2) Impacts Caused by Climate Change

Having undergone significant drought and food insecurity or famine in 2021, Madagascar is one the countries drastically affected by climate change in recent years[12]. As confirmed through field survey interviews, some farmers recognize the impacts of climate change on the rain pattern and, consequently, on their agricultural activities, specifically those struggling with water control—for example when they cannot irrigate farmlands during soil preparation, or when fields are flooded by heavy rain.

(5) Nutrition

JICA has conducted a food and nutrition improvement project (known as "PASAN" or *"Projet d'Amélioration de la Sécurité Alimentaire et de la Nutrition"*) since The JICA has conducted a food and nutrition improvement project (known as "PASAN" or *"Projet d'Amélioration de la Sécurité Alimentaire et de la Nutrition"*) since 2019 in Itasy, Vakinankaratra, and Amoron'i Mania Regions where field surveys were conducted. It has been reported that malnutrition is particularly prevalent in rural areas where the diet is heavily dominated by carbohydrates and lacking diversity. The field surveys also confirmed that most farmers ate three (3) meals per day, though mainly rice with small amounts of side dishes. Farmers who cultivate vegetables besides rice keep only a limited amount for self-consumption but sell most of them, as they may be an important source of cash, especially in the dry season. There should, thus, be plenty of room for

[11] Abbreviation for *"Direction Régionale de l'Environnement et du Développement Durable"* (Regional Directorate of the Environment and Sustainable Development), a regional agency of MEDD.
[12] UN News : https://news.un.org/en/story/2021/10/1103712

improvement of farmers' nutritional conditions in those and similar areas.

6.5.4 Proposed Plans for Future COBSI Approach Cooperation

(1) Target Areas

All surveyed regions had potential sites accepting the COBSI approach. Areas near the southwestern region were identified as COBSI candidates based on detailed satellite image analysis results, on 4 Regions' field survey outcome, and on interviews with MINAE officials (cf. Figure 6.5.9).

(2) Proposed Plans and Concept

Figure 6.5.9 presents the draft concept of the COBSI approach in Madagascar where irrigation development is classified into three categories: Large (1,000 ha or more), medium (200 ha to 1,000 ha), and small (50 ha to 200 ha), the DGR targeting schemes of 50 ha and above, though micro-scale schemes—even smaller than small-scale ones—are yet to be included in their scope of development. The Survey Team categorized the list of sites sourced from DGR 2013 National Data on "registered sites" and identified a total of 1,169,000 ha of farmlands, 42% of which falls under the "large" category, 24% under "medium", 22% under "small", and 12% "micro-scale". Many unregistered micro-scale sites exist, and it is assumed that schemes smaller than 50 ha might actually account for more than 50% of the aforementioned total.

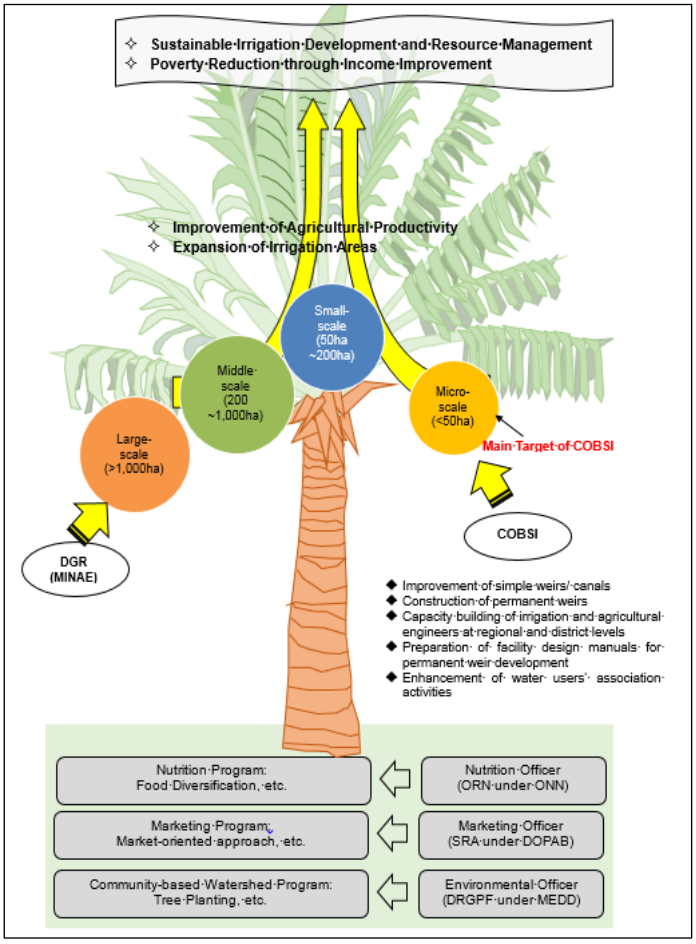


Figure 6.5.9 Proposed Concept of the COBSI Approach in Madagascar
Source: JICA Survey Team (2022)

The COBSI approach could contribute to Madagascar's irrigation development, taking into account the following aspects: i) Natural conditions are favorable for introducing COBSI; ii) Many facilities are inadequately constructed and water management/maintenance capacity is not yet sufficient despite the existence of COBSI-potential irrigation sites of a few to several dozen hectares, and iii) COBSI could potentially cover the irrigation development of micro-scale schemes also targeted by the concerned ministry in the future.

MINAE's Directorate of Rural Engineering and COBSI approach projects could work together on "Irrigation Area Expansion" and "Agricultural Productivity Improvement" to achieve the overall goals of "Sustainable Irrigation Development and Resource Management as well as Poverty Reduction through Income Improvement". The approach would, then, include i) improvement of simple weirs and canals, ii) construction of permanent weirs and development of related design manuals, iii) strengthening

of the capacity of irrigation engineers and extension personnel, and iv) strengthening of the capacity of farmers' organizations. In addition, the project would synergistically work with all concerned agencies to incorporate nutrition improvement, market orientation through SHEP, and watershed conservation in training programs to achieve the abovementioned overall goals more effectively.

Based on all those points, COBSI approach plans—which are expected to contribute to Madagascar's irrigation development—are, thus, put forward in Table 6.5.2 below.

Table 6.5.2 Proposed COBSI Approach Plans Contributing to Irrigation Development in Madagascar

Concept	**Plan A** COBSI Approach Project	**Plan B** Rehabilitation of Existing Irrigation Facilities + Water Management/ Maintenance Enhancement	**Plan C** Incorporation of COBSI components into Ongoing/ Planned Project (Esp. Permanent Weirs + Water Management/ Maintenance Enhancement)
Content	Implementation of the COBSI Approach (Full package)	Rehabilitation of several existing irrigation facilities (e.g., mid-scale ones) and Technical Cooperation on water management/ maintenance enhancement	Incorporation of COBSI Components (small-scale irrigation development) into ongoing/ planned projects containing water management components and/ or farmers' organizations enhancement.
Rationale	• High irrigation potential; experiences in irrigation development • Many farmers' groups build "traditional weirs", so should have sufficient enough skills to construct COBSI "simple weirs". • Since the Government and donor agencies support mainly construction of permanent weirs, the focus should be put on upgrading existing traditional weirs to permanent ones. • COBSI simple weirs to be disseminated farmer-to-farmer. • Strengthening water management/ maintenance capacity as an improvement • Focus put on i) irrigation for rice production during the rainy season and ii) for horticulture during the dry season. • Watershed protection to be included, taking into account Madagascar's environmental situation in.	• Many irrigation facilities require rehabilitation; rehabilitation of mid-scale irrigation facilities tends to fall behind, given that DGR mostly covers schemes of more than 50 ha. • Improvement in water management/ maintenance required	• Irrigation being essential to increase agricultural production, many small or traditional irrigation facilities need to be expanded and improved. • Deemed insufficient, capacity for water management/ maintenance to be strengthened along with rehabilitation of irrigation facilities.

Concept	**Plan A** COBSI Approach Project	**Plan B** Rehabilitation of Existing Irrigation Facilities + Water Management/ Maintenance Enhancement	**Plan C** Incorporation of COBSI components into Ongoing/ Planned Project (Esp. Permanent Weirs + Water Management/ Maintenance Enhancement)
Activities (Examples)	• COBSI (Simple weir + Permanent weir) • Water Management/ Maintenance • Cultivation/ Marketing • Strengthening of farmers' organizations、 • Environmental/ Social considerations; watershed protection/ management; soil conservation • Nutrition improvement	• Rehabilitation of irrigation facilities (targeting several mid-scale permanent irrigation infrastructure with the possibility of utilizing grant projects, community grant projects and/ or grassroots grants) • Technical Cooperation on water management/ maintenance enhancement	• Incorporating the following components in ongoing/ planned projects: • Small-scale irrigation development (mainly upgrade of traditional/ simple weirs to permanent ones) • Water management/ maintenance enhancement

Source: JICA Survey Team

(3) Implementation Structure (Draft)

Figure 6.5.10 presents the proposed implementation structure for the COBSI approach in Madagascar. MINAE's Directorate General of Agriculture would be the leading implementation agency, with ONN and MEDD as cooperating agencies respectively for nutrition improvement and for watershed conservation. The COBSI approach dissemination system is layered into Central, Regional/ District, and Local (farmers-to-farmer) levels. Firstly, Central government (e.g. DGA) officials and JICA experts train Regional/ District-level officers through ToT to become "trainers" who will, in turn, conduct training for farmers' group leaders and farmers' organizations (e.g. FIFATA) who are next in line for dissemination to farmers' groups and as far down as individual farmers.

This training includes KOT, MTT, and an AEW, so one (1) cycle of the training course includes three series of training sessions per year for farmers' groups. Understanding that there is a shortage of extension personnel (officers/agents) in Madagascar, the training could be conducted directly with the farmers' group leaders and farmers' organizations like FIFATA instead of extension agents.

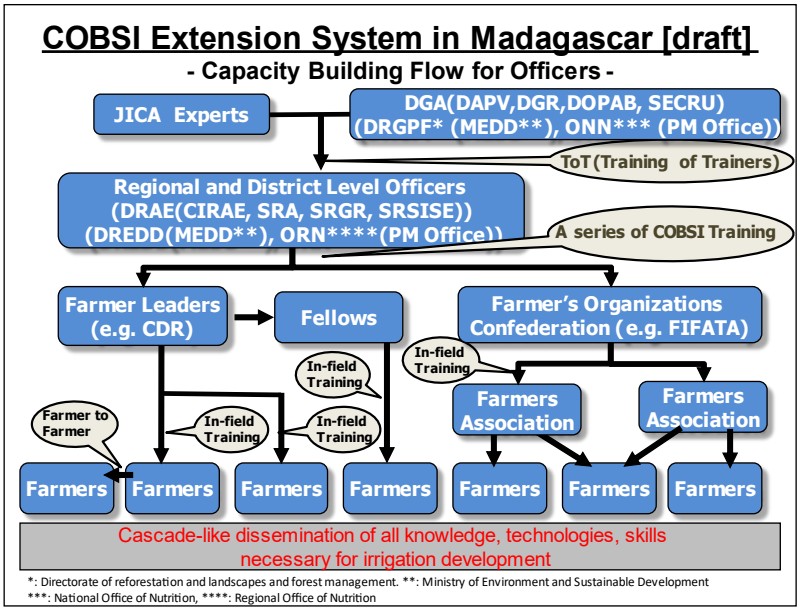


Figure 6.5.10 Implementation Structure for the COBSI Approach in Madagascar (Draft)
Source: JICA Survey Team

6.6 Summary

Based on the results of the field surveys conducted in the five (5) countries mentioned above, Table 6.6.1 presents requirements/issues to be considered for where the COBSI approach could be applied. This table could be utilized as a country-specific checklist of requirements to be met or considered to allow for implementation of this approach.

Table 6.6.1 Requirements/Issues to Be Considered for where the COBSI Approach Could be adopted

Items	Requirements/Issues for Consideration
Prerequisite	**River water flows with 1-2m width even in the dry season** (up to 10m width is easy to handle).
Policy	Emphasized keywords: **Food security, poverty alleviation, agricultural product increase, horticulture, smallholder**
Irrigation Status	・ High underdeveloped to irrigable area ratio ・ Ongoing development of medium/large irrigation sites, but neglected micro/small-scale schemes ・ Higher micro/small-scale irrigation potential in comparison with irrigable areas
Structure/ System	Existence of "**personnel to disseminate**" the COBSI approach through either 1) **Government/government-related extension personnel available as far down as the smallest administrative unit** (e.g. Côte d'Ivoire), or 2) **Limited but functional government/government-related extension personnel, farmers' groups/farmers' associations supporting smallholder** farming activities Note: Transportation (e.g. motorcycles) and fuel requirements to be met for more favorable condition
Agricultural Products	COBSI approach entry point simple/permanent weirs more suitable for "**horticultural crop production**" **which requires a smaller amount of water** than rice cultivation 1) "**Horticultural crops**" recommended, as **producible/sellable in a short cycle** 2) Simple/permanent weirs usable on their own for "**supplemental irrigation**" of rice cultivation ONLY
Environmental Consideration	・ Note on local material procurement for simple weir installation (e.g., regulations related to tree cutting) ・ Distribution and effective use of water resources within watersheds ・ Equitable water resources distribution and efficient use required to prevent recurrence of water conflicts occurring in recent years due to increasing water demand ・ Water rights emphasized especially with entities using dams to retain and divert large amounts of water, e.g. medium- and large-scale irrigation areas Note: As yet water rights have not been emphasized in target countries for micro/small-scale irrigated areas of a few to several dozen hectares that COBSI handles. Understanding that irrigation development starts upstream, attention needs to be paid to various regulations related to water rights in target countries as well as the status of simple/permanent weir installation, etc. to be shared with all concerned institutions.
Linkage/ Collaboration with Existing JICA Clusters	**1) Limited contribution of COBSI to CARD/SHEP projects** ・ COBSI limited as an add-on to CARD/SHEP projects if implemented as an entry point for year-round cultivation through simple/permanent weirs away from rainfed agriculture ・ CARD projects: COBSI could support rice cultivation through simple/permanent weirs but ONLY as "supplemental irrigation". ・ SHEP projects: SHEP projects target "already irrigated fields", with limited opportunities to select COBSI-effective, "to-be irrigated" sites. **2) Effectiveness of COBSI in further expanding CARD/SHEP/IFNA project sites** COBSI could reach areas not likely to be targeted by CARD/SHEP/IFNA projects. ・ CARD projects: Using COBSI as "supplemental irrigation" ・ SHEP/IFNA projects: Using the COBSI's entry-point simple/permanent weirs as a "foundation" to promote activities such as SHEP and nutrition improvement (e.g. E-COBSI in Zambia)

Source: JICA Survey Team

When the basic requirements in Table 6.6.1 are met, activities listed in Table 6.6.2 below could be implemented based on the targeted sites' situations and issues. Target sites could be classified into three categories: a) "Non-irrigated" cultivated land (including arable land); b) "Irrigated" cultivated land (including arable land), and c) Already developed irrigation site (permanent irrigation site). Variations of the COBSI approach could be developed according to each situation.

Table 6.6.2 Status/Issues and Expected Activities for Targeted Sites with Small Streams (Draft)

Items	Category A Site Condition	Category B Site Condition	Category C Site Condition
Category	"Non-irrigated" cultivated land (including arable land)	"Irrigated" cultivated land, (including arable land)	Developed irrigation site (permanent irrigation site)
Status/ Issues related to small-scale Irrigation	・ Inefficient irrigation using buckets and watering cans/ minimal irrigated area/ ineffective use of water resources ・ Frequent flood damage due to inadequate drainage canals (IVS: Sierra Leone)	・ Farmers' groups already acquainted with irrigation and practicing irrigated agriculture through simple weirs and canals ・ Possibility of upgrading existing traditional weirs to permanent weirs ・ Lack of water management/maintenance capacity	・ Irrigation facilities installed from reservoirs to fields, but still with fair water distribution ・ Irrigation facilities requiring adequate maintenance/ management ・ Insufficient drainage canal cross-section sizes and inadequate maintenance and management resulting in frequent flooding (waterlogging) damage
Concept	・ Initiating irrigated agriculture by installing a simple weir and an earthen canal as an entry point for COBSI activities, with the aim of increasing horticultural crop production ・ Partially contributing to supporting rice production	Increasing horticultural crops/ rice production through construction of a permanent weir and enhancing water management/ maintenance capacity	Increasing horticultural crop/rice production by enhancing water management and maintenance capacity
Hard Component Activities	・ Simple weir/canal installation ・ Permanent weir construction 【Original COBSI】	・ Permanent weir construction ・ Management/maintenance capacity enhancement to utilize existing weirs/canals fully	Water management and drainage canal maintenance techniques introduction based on COBSI technology
	Common Activity: Aquaculture promotion (Multipurpose irrigation water also usable for new fishponds which could improve nutrition)		
Soft Component Activities (weight of activities dependent on situations)	・ Capacity building of irrigation engineers/officers and extension officers ・ Development of a water management/facilities maintenance manual ・ Capacity building of famers' groups, promotion of E-Extension/Farmers Field School and Farmer-to-Farmer Dissemination ・ Training on agricultural production (including Bokashi composting, adequate use of Agrochemicals, organic pesticide trial) ・ Introduction of SHEP ・ Introduction of community-based watershed protection (fence construction, sediment ponding) ・ Training on nutrition improvement ・ Introduction of the concept of water rights		

Source: JICA Survey Team

As seen in Malawi and Zambia, the COBSI approach increases smallholders' resilience by securing irrigation water for the dry season, thus helping them break off dependency on rainfed farming through COBSI technology as an entry point. Additionally, COBSI's "(non-fixed) low-skill, low-cost technology" feature perfectly suits smallholders, as i) simple weirs can be installed/re-installed by using locally available natural materials, ii) their structure and materials are "not fixed" but adaptable to various situations as long as they "block the water" for irrigation, and iii) they are user-friendly and self-maintainable/self-manageable. In other words, the COBSI approach offers plenty of room for maneuver and flexibility.

As long as a river/stream with a width of a few meters continues flowing during the dry season, the

approach can be optimized by maximizing the use of on-site locally available goods (e.g. materials and systems) and human resources (e.g. smallholders' experience and knowledge), as there are no predetermined standards that have to be complied with. Furthermore, the COBSI approach is not just about "irrigation techniques"; it is a learning process building the foundation for smallholders to leap to the next stage by strengthening their groups through adequate water management and maintenance work, cultivating a grow-to-sell farming attitude, and contributing to nutrition improvement. It is, in other words, a "comprehensive irrigation development program packed with a series of activities to enable smallholders to improve their livelihoods".

CHAPTER 7 EXPANDING THE COBSI APPROACH ACROSS SAA: THE WAY FORWARD

7.1 Proposals to Expand the COBSI Approach across SSA

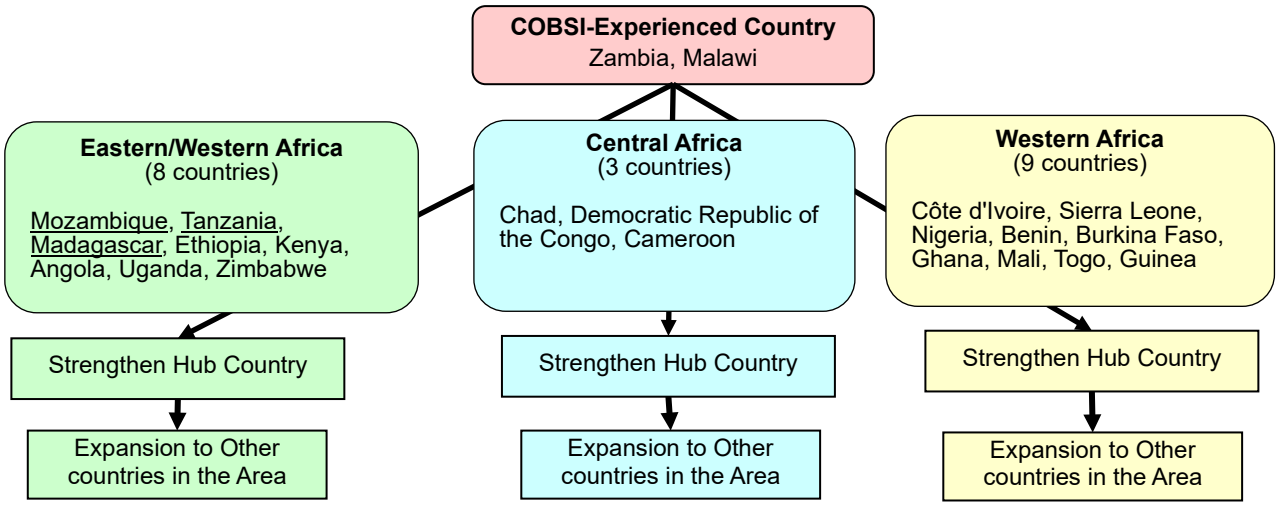
This chapter proposes ways to expand the COBSI approach across SSA, targeting the twenty (20) countries identified as having high potential for implementing COBSI projects in the second selection. Twenty-two (22) countries, including Malawi and Zambia, were originally considered in that round of selection, but they were eventually excluded, being both "COBSI-experienced nations", hence the final count as indicated in Table 7.1.1.

Table 7.1.1 Identified Countries for Expansion of the COBSI Approach

Regions	Identified Countries
Eastern/ Western Africa (8 countries)	Angola, Ethiopia, Kenya, Madagascar, Mozambique, Tanzania, Uganda, and Zimbabwe
Central Africa (3 countries)	Cameroon, Chad, and Democratic Republic of the Congo
Western Africa (9 countries)	Benin, Burkina Faso, Côte d'Ivoire, Ghana, Guinea, Mali, Nigeria, Sierra Leone, and Togo

Source: JICA Survey Team

One way to expand the COBSI approach is to select the targets and implement projects by country sequentially, as was the case in Malawi and Zambia, but that would require significant time to cover all chosen SSA countries. Instead, a regional approach could be taken by dividing SSA into Eastern, Southern, Western, and Central Africa, and expanding within each region or area. Each area would, then, select a hub country and start implementing the approach from there; the other regional members would be approached via that hub country once the latter is well-capacitated (cf. Figure 7.1.1).



Note: Underlined are countries where COBSI field surveys were conducted.

Figure 7.1.1 COBSI SSA Expansion Approach (Idea)

Source: JICA Survey Team

Each country would implement two phases of the COBSI approach project. The first would be the pilot phase which focuses on developing COBSI model sites in high-potential areas as well as the capacity of the project's counterparts to make them become "COBSI Master Trainers". The second phase would expand the target areas within the country based on the knowledge and experience gained by the COBSI

Master Trainers from the pilot phase. One suggestion is that Master Trainers from Zambia are dispatched to train hub countries so as to fully utilize their knowledge to further expand the COBSI approach.

Regional hub countries could be selected based on the results of the third-country training as described in section 7.2 below, though field-surveyed countries are also of high potential. In-country training could be implemented in countries with high potential for implementing COBSI projects. The following sections outline the ideas behind "third-country" and "in-country" training in target countries.

7.2 Third-Country Training

Training in the third country, Zambia, would be conducted by taking a similar approach to JICA's "Knowledge Co-Creation Program (KCCP)" conducted in the country. The training would be a combination of lectures and practical courses including site visits to ongoing COBSI sites and field training so that participants from those high-potential countries could acquire techniques related to the approach. Each participant would develop an action plan and implement it once they return to their home country. Trainers would monitor the progress of the action plan, whereas participants would share achievements, findings, and issues while implementing the action plan. JICA could utilize the results of the action plans for selecting countries to implement the pilot project. The third-country training would become more effective if it could run several years as a "cycle" like the KCCP—not just one-year one-shot training—to increase the number of "COBSI seeds". Table 7.2.1 presents the content of the idea behind third-country training.

There are two significant advantages to this proposal. First, training participants could visit actual COBSI sites to observe existing simple/permanent weirs, related canals, and farming situation, and listen directly to the voice of and learn from on-field actors such as irrigation officers, extension workers, and farmer groups. For example, a group of officers from Mozambique visited a COBSI site in Zambia. They deepened their understanding that the COBSI approach is not only about irrigation technology, but also a "comprehensive approach" that includes water management/facilities maintenance, farmer group enhancement, market orientation through SHEP, and nutritional improvement. Secondly, third-country training could combine several countries—for instance ten (10)—in one training course, which would allow training organizers to understand which COBSI technological and methodological component suits each country best through action plans developed and implemented by training participants.

Table 7.2.1 Third-Country Training Program (Idea)

<table>
<tr><th>Item</th><th>ontents</th></tr>
<tr><td>Participants</td><td>➢ Training of Master Trainers Candidates for Targeted Countries
1) Province/ District/ sub-District Government Personnel from the Irrigation Department (Decision-Making Level Personnel, e.g., Head of the Irrigation Department)
2) Province/ District/ sub-District Government Personnel from the Extension Department (Decision-Making Level Personnel, e.g., Head of the Extension Department)
3) Province/ District/ Sub-District Government Personnel capable of providing on-site guidance to smallholders (irrigation/ extension officer)</td></tr>
<tr><td>Trainers</td><td>・ Zambia E-COBSI Human Resources: e.g. Master Trainers
・ Japanese Experts</td></tr>
<tr><td>Training Contents (1 year)</td><td>➢ 1st Time: 2-week Training (In Zambia: Dry Season or April)
<table>
<tr><th></th><th>Contents</th><th>Days</th></tr>
<tr><td>I</td><td>Lectures/ Practical exercises (simple weir construction and waterway alignment methods, water management, farmers' organization enhancement, nutritional improvement)</td><td>2-3 days</td></tr>
<tr><td>Ii</td><td>Attending ongoing COBSI approach activities</td><td>2 days</td></tr>
<tr><td>Iii</td><td>Field practical</td><td>2-3 days</td></tr>
<tr><td>Iv</td><td>Drafting action plans</td><td>1.5 day</td></tr>
<tr><td>V</td><td>Follow-up and monitoring methods</td><td>0.5 day</td></tr>
</table></td></tr>
</table>

Item	ontents
	➢ **2nd Time: 2-day Mid-term Follow-Up Workshop** (Online workshop: July) ・ Sharing of i) the Action Plan's progress and ii) issues identified while implementing the Action Plan ・ Discussions on the way forward ➢ **3rd Time: 2-days Feedback Workshop** (Online workshop: November) ・ Sharing of i) the Action Plan's results and ii) issues identified while implementing the Action Plan ・ Discussions on the way forward
Training Cycle	・ Conduct yearly (cf. JICA's KCCP) ・ Separate training courses for English-speaking and French-speaking regions (e.g. every other year, bearing in mind the implementation method) ・ Consider the training timing, as the dry season is different in the Eastern/ Southern and Central/ Western regions

Source: JICA Survey Team

7.3 Targeted Countries In-Country Training

"In-country training" would be conducted in countries with exceptionally high potential for implementing COBSI projects. Such high-potential countries could be identified based on action plan results if third-country training had been held prior to this training. If no third-country training was scheduled, countries selected for field surveys may, then, be given higher priority. In-country training, outlined in Table 7.3.1 below, is to be held only once and in the target country.

The advantage of the in-country training is that Japanese experts could get a deeper understanding of the situation by visiting the target country. Japanese experts and training participants, as a team, could develop a more suitable COBSI package for a particular country by seeing potential sites to identify locally available materials for simple weirs, ascertain whether smallholders have already established similarly simple weirs using some other materials, and fine-tune such identical weirs to become a "COBSI simple weir".

Table 7.3.1 Target Country In-Training Program (Idea)

<table>
<tr><th>Item</th><th>Contents</th></tr>
<tr><td>Participants</td><td>➢ Training of Master Trainers
1) Central Government Personnel from the Irrigation Department (Decision-Making Level Personnel, e.g., Head of the Irrigation Department)
2) Province/ District/ sub-District Government Personnel from the Extension Department (Decision-Making Level Personnel, e.g., Head of the Extension Department)
3) Province/ District/ sub-District Government Personnel capable of providing on-site guidance to smallholders (irrigation/ extension officer)</td></tr>
<tr><td>Trainers</td><td>・ Zambia E-COBSI Human Resources: e.g. Master Trainers
・ Third-Country Training Participants described in Table 7.1.2, if any
・ Japanese Experts</td></tr>
<tr><td>Training Contents</td><td>➢ 1st Training: 1-week Basic Training (In target country: Dry Season)
<table>
<tr><th></th><th>Contents</th><th>Days</th></tr>
<tr><td>i</td><td>Lectures/ Practical exercises (simple weir construction and waterway alignment methods, water management, farmers' organization enhancement, nutritional improvement)</td><td>2-3 days</td></tr>
<tr><td>ii</td><td>Field practical</td><td>2 days</td></tr>
<tr><td>iii</td><td>Drafting action plans</td><td>1.5 day</td></tr>
<tr><td>iv</td><td>Follow-up and monitoring methods</td><td>0.5 day</td></tr>
</table>
➢ 2nd Training: 1-day Mid-term Follow-up Workshop (Online workshop: Mid-term between 1st and 3rd training)</td></tr>
</table>

	· Sharing of i) the Action Plan's progress and ii) issues identified while implementing the Action Plan · Discussions on the way forward · The workshop would be more effective if JICA Office could visit the developed site beforehand. ➢ **3rd Training: 1-day Review Workshop** (In target country: End of dry season) · Sharing of i) the Action Plan's results and ii) issues identified while implementing the Action Plan · Discussions on the way forward *Note: Visit of developed sites based on pre-workshop Action Plan*

Source: JICA Survey Team

7.4 Training in Japan

Although there are no particular obstacles to the possibility of training in Japan in terms of classroom lectures, it would be difficult to find appropriate candidate locations to hold field practical training and organize on-site visits to existing COBSI sites if it is to be held *in Japan only*. On-site visits and practical training are necessary to make it more effective and produce the intended results through the participants. Consequently, additional training in Zambia complementing that held in Japan—as is the case with the current SHEP subject-specific training—is deemed necessary, as it is believed to have the same effectiveness and achieve similar results as "third-country training". In that regard, training in Japan *with additional training in Zambia* will be proposed.

Japan-based training content would be based on Tables 7.2.1 and 7.3.1 above, and related candidate facilities to be visited and field training locations pertaining to simple weirs are suggested as follows:

1) "Hamura Intake Weir", Tokyo
   Although it is larger than a COBSI simple weir, it is of a type similarly "built to be allowed to break" and is made of logs, tree branches, rubble, etc.
2) Fascine construction, Miyagi Prefecture
   Miyagi Prefecture has provided on-site training on fascine construction methods in Japan to irrigation sector officials from Malawi as part of a JICA Partnership Program on "technology using local wood and stones". Fascines are one of traditional Japanese methods of preventing riverbank erosion by combining bundles of tree branches and wooden poles or stones.

Training in Japan will give participants the opportunity to visit "land improvement districts" where, in terms of farmers' organizations and maintenance management, they can hear stories of difficulties, challenges, or conflicts among farmers or between administrators and members and hear about or witness in situ maintenance activities such as removal of silt in smaller (preferably earthen) canals.

It would, furthermore, be very beneficial to incorporate COBSI introduction concepts and activities into SHEP and IFNA training in Japan in the same way as E-COBSI—currently under implementation in Zambia—also integrates training on SHEP and nutrition improvement which have a very close affinity with the project and are expected to produce constructive synergistic effects. It would still be easier to collaborate with them when COBSI projects will be implemented in the future, since they would have already understood COBSI's holistic concept.

CHAPTER 8 STUDY ON THE POSSIBILITY TO CONSIDER GCF FOR POST E-COBSI IN ZAMBIA

8.1 Background of the Survey

E-COBSI, the JICA technical cooperation project in Zambia, E-COBSI, is scheduled to end in February 2024. COBSI, which originated in Malawi, has been applied in Zambia by JICA - first as a development study (COBSI-S: 2009-2011), then as a technical cooperation project (T-COBSI: 2014-2017) targeting three provinces, and then E-COBSI (2019 onward) expanding the target to 6 provinces. COBSI projects in Zambia evolved as a comprehensive COBSI approach by incorporating SHEP, a market-oriented agriculture that shifts the smallholders' mind from "grow and sell" to "grow to sell", and nutrition improvement activities. JICA is scheduled to close its corporation with Zambia on the COBSI approach and expects the Government of Zambia to continue to expand the COBSI approach within Zambia by itself.

This study examines the possibility of utilizing the funding of Green Climate Fund (GCF) for post E-COBSI project, hereafter Post E-COBSI, by understanding the characteristics of GCF in its funding and approval process and issues that have to take under consideration to decide whether GCF would be suitable for Post E-COBSI. Once determined, the study would support developing the project and application process for GCF.

8.2 Examining the Possibility to Propose GCF for Post E-COBSI

8.2.1 Characteristics of GCF

(1) Strategic Result Areas and Investment Guideline

GCF [1] the world's largest climate fund, is mandated to support developing countries to raise and realize their Nationally Determined Contributions (NDC) ambitions towards low-emissions and climate-resilient pathways. GCF aims to support paradigm shifts in "climate mitigation" and "climate adaptation efforts". Climate change mitigation interventions seek to reduce the release of greenhouse gas emissions or to increase the capacity of carbon sinks, and climate adaptation efforts aim to improve the resilience of communities and ecosystems to climate change. GCF is committed to achieving balanced funding, 50:50, between mitigation and adaptation initiatives. GCF seeks to have an impact within eight mitigation and adaptation result areas, four in each (Table 8.2.1).

Table 8.2.1 GCF Strategic Result Areas

Mitigation: Reduce Emission	Energy Generation & Access
	Low-Emission Transport
	Buildings, Cities, Industries, and Appliances
	Forestry and Land Use
Adaptation: Increase Resilience	Most Vulnerable People and Communities
	Health, Well-Being, Food, and Water Security
	Infrastructure & Built Environment
	Eco-Systems & Ecosystem Service

Source: JICA Survey Team based on GCF Information

[1] The 16th Conference of the Parties (COP16) in 2010 decided to establish GCF and designated it as a commissioning organization at COP17 in 2011. In its establishment, 43 countries pledged approximately USD 10.3 billion, with the Japanese Government confirming its contribution of USD 1.5 billion. GCF started its activities in May 2015.

As of December 2022, 209 public and private sector projects[2], excluding projects with GCF investments of USD 10 million or less, have been approved and either under or completed implementation. About half of the adaptation projects are designed to target vulnerable countries, including least developed countries, small island developing states, and African countries. In terms of the number of projects and investment amounts in each investment area, the number of mitigation projects tends to be small, but the size of each project is large, while the number of adaptation projects tends to be large, but the size of each project is small.

GCF has six "investment criteria" that guide GCF stakeholders in developing, assessing, and approving projects.; 1) impact potential, 2) paradigm shift potential, 3) sustainable development potential, 4) needs of the recipient, 5) country ownership and 6) efficiency and effectiveness. Each investment criteria is defined with related indicators (Table 8.2.2). GCF puts emphasis on "climate rationale", how the proposed project will contribute to climate change, and "why the project should be funded by GCF, not by other organizations, and "Co-financing" is essential. These points should be taken into consideration while submitting funding proposals to GCF.

Table 8.2.2 GCF Investment Guideline

	Investment Criteria	Indicator
1	Impact Potential	Mitigation impact indicator
		Adaptation impact indicator
2	Paradigm Shift Potential	The potential of Scaling Up/ Replication
		Overall Contribution to the global low-carbon development pathway
		Potential for Knowledge and Learning
		Contribution to the Creation of an Enabling Environment
		Contribution to the Regulatory Framework and Policies
		Overall Contribution to Climate-resilient Development Pathway
3	Sustainable Development Potential	Environmental/ Social/ Economic Co-Benefits
		Gender-sensitive Development Impact
4	Needs of the Recipient	Vulnerability of the Recipient Country to Climate Change
		Vulnerable Group and Gender Aspects
		Social/ Economic Development Level of the Country and Affected Group
		Absence of alternative sources of financing
		Need for Strengthening Institutions and Implementation Capacity
5	Country Ownership	National Climate Strategy/ Coherence with Existing Policies
		Capacity of the Implementing Entities, Intermediaries, and Executing Entities
		Engagement with Civil Society Organizations/ Other Stakeholders
6	Efficiency and Effectiveness	Cost Benefit/ Effectiveness on Financial/ Non-Financial Aspects
		Degree of Co-Finance
		Financial Feasibility, and Other Financial Indicators
		Industry Best Practices

Source: JICA Survey Team based on GCF documents (Revised criteria as of Nov. 2020)

(2) Funding through Accredited Entity (AE)

GCF facilitates the funding through "Accredited Entities (AEs)" accredited by the Board for projects and programs. AEs work alongside countries to develop funding proposals aligned with GCF investment framework and result areas, submit the funding proposals to GCF, and manage/ monitor the projects and programs. 114 organizations are accredited as of December 2022, with a variety of private or public, non-governmental, sub-national, national, regional, and international. AEs are

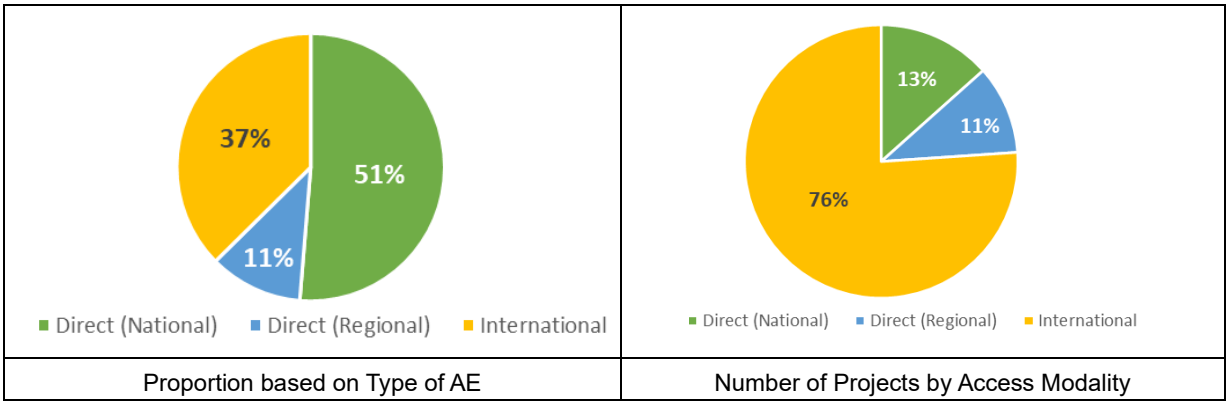
[2] 216 projects are approved, either under progress or completed, including GCF investments of USD 10 million or less. Of 216 projects, 72 are mitigation projects, 86 are adaptation, and 58 are crosscutting (mix of mitigation and adaptation). Of 216 projects, 166 are public-sector projects, and 50 are private-sector.

categories in either "International Access Entities (IAEs)" that can operate internationally or "Direct Access Entities (DAEs)" that can work in specific countries or regions (Table 8.2.3). While the ratio of IAEs to DAEs is about 4:6, around 80% of the approved projects are proposed by IAEs. GCF emphasizes building the capacity of DAEs to develop climate finance proposals, and it has been the continuous agenda at the GCF Board meeting that is held three times a year.

Table 8.2.3 Type of AE

Type	Accredited Entity (Example)	
International Access Entity	International Organization	Word Bank, Asian Development Bank, UNDP
	Government Development Agency	JICA, Agence Française de Développement
	Non-governmental Organization	Conservation International, Save the Children
	Private Sector	Ecobank, MUFG Bank, Ltd
Direct Access Entity	Regional Organization	Caribbean Development Bank Micronesia Conservation Trust
	Government Institutions	Ministry of Water and Environment (Uganda) Small Industries Development Bank of India PT Sarana Multi Infrastruktur (Indonesia)
	Private Sector	JS Bank Limited (Pakistan)

Source: JICA Survey Team based on GCF HP



Proportion based on Type of AE | Number of Projects by Access Modality

Figure 8.2.1 Proportion and Approved Project per Type of AE

Source: JICA Survey Team based on GCF HP

(3) Type of Funding

The GCF has five financial instruments; grants, loans, guarantees, equity, and results-based payments for REDD+[3] projects. The project size ranges from USD 10 million or less (micro projects), USD 10 million to 50 million (small projects), USD 50 million to 250 million (medium projects), a total project cost above USD 250 million (large-scale projects). About 80% of the financial support is either grant or loans, and about 70% of the projects are small to medium in sizes.

[3] REDD+ is a framework created by the UNFCCC Conference of the Parties (COP) to guide activities in the forest sector that reduces emissions from deforestation and forest degradation, as well as the sustainable management of forests and the conservation and enhancement of forest carbon stocks in developing countries.

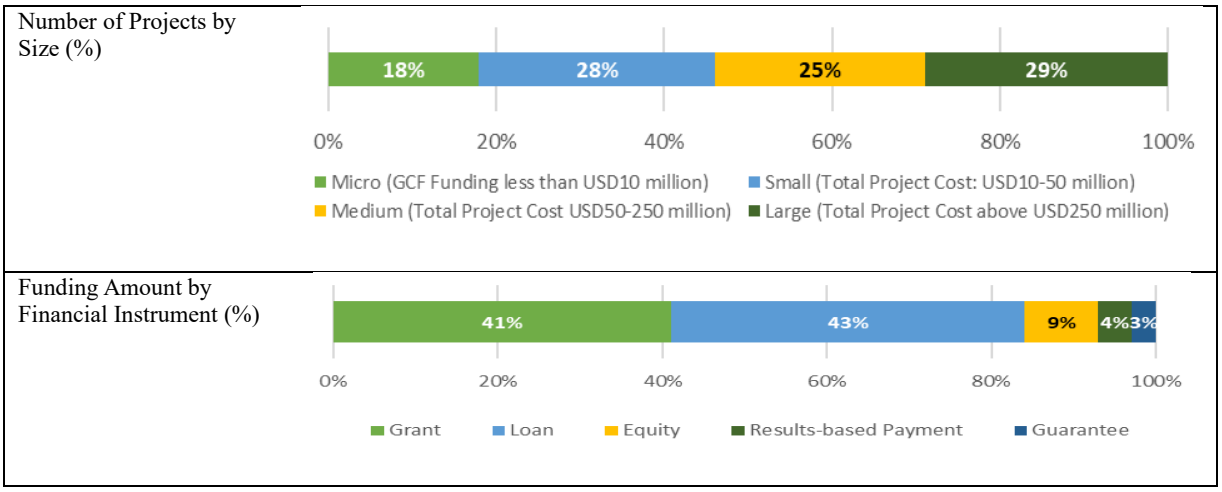


Figure 8.2.2 Number of Projects by Size and Funding Amount by Financial Instrument (%)

Source: JICA Survey Team based on GCF HP

A project or program proposal that requires a GCF contribution of up to USD 25 million[4], with minimal environmental and social risks and impacts could be applied with the Simplified Approval Process (SAP). The requirement for SAP is in the following Box 1.

Box 1：Project/ Program that could be applied with SAP

- **Ready for scaling up** and have the **potential for transformation and promoting a paradigm shift to low-emission and climate-resilient development**.
- **GCF contribution is up to USD 25 million** out of the total project cost.
- **Environment and social risks and impact are either zero or minimal.**
- **Co-Finance** (Include In-kind contribution)

(4) Approval Process

GCF examines the Funding Proposal (FP), which includes 14 attachments and others as necessary documents, submitted by AE/ DAE and approves them at the GCF Board Meeting. GCF designates a government institution as a "National Designated Authority (NDA)[5]" for each country, and AE/ DAE is to consult thoroughly with NDA while developing FN to increase country ownership. NDA's non-Objection has to be attached when submitting FP. "Simplified Approval Process (SAP)" is applied to projects where GCF contribution is up to USD 25 million (Note: USD 10 million or till July 2022) and with low environmental and social risks (Figure 8.2.3). The main difference between the SAP and regular projects is the submission of a concept note (CN) at the time of project formation; in the SAP process, AEs/ DAEs submit a CN to the GCF Secretariat before submitting the FP. FP would be developed by incorporating GCF's comment to CN, which would ease the response for FP. In addition, the required supporting documents are fewer than those for regular projects.

[4] Used to be USD 10 million till July 2022 and was amended to USD 25 million at GCF Board meeting held on July 2022.

[5] NDA serves as the interface between the country and GCF, providing broad strategic oversight of the GCF's activities in the country and communicating the country's priorities for financing low-emission and climate-resilient development. NDA for Zambia is the Ministry of National Development Planning.

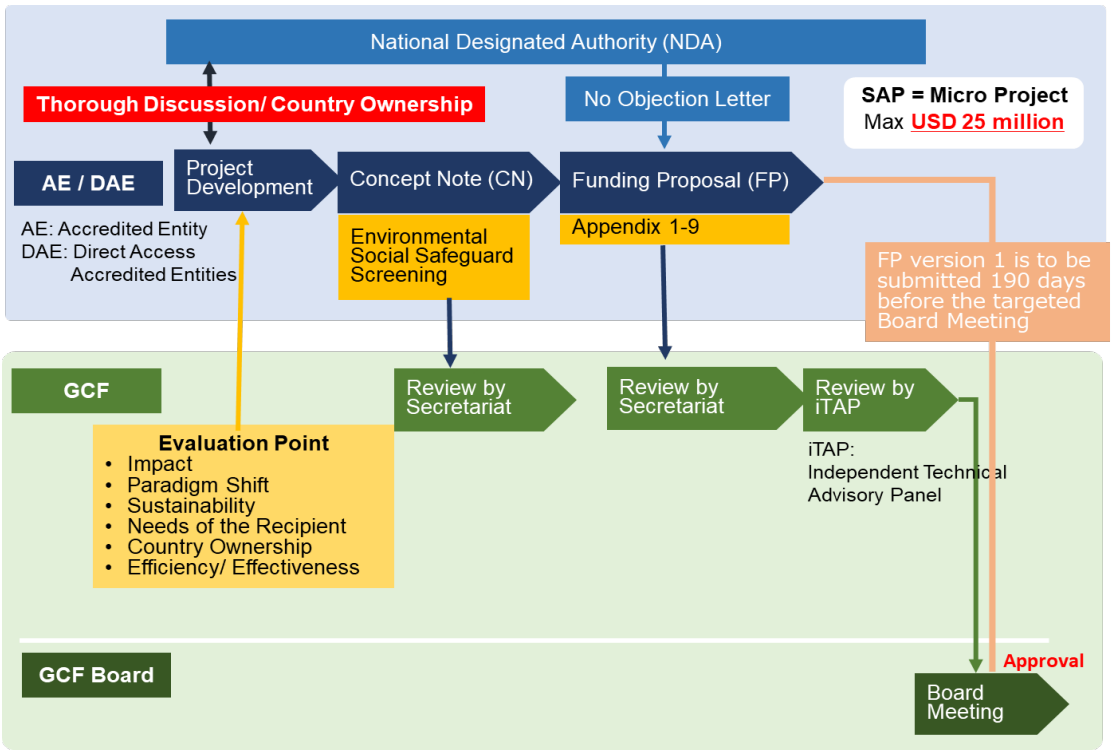


Figure 8.2.3 Approval Process for SAP

Source: JICA Survey Team based on GCF Documents

Though the approval process and documents required for SAPs are simpler than the regular projects, GCF is under discussion to review SAP process as it has taken 574 days on average[6] to get it approved from the submission of CN, which is similar to the regular projects. As of October 2022, GCF approved 24 SAP projects, 5 mitigation projects, 14 adaptation, and 5 crosscutting. GCF Secretariat reviews the submitted CN in 2 to 3 weeks, FP for 4 to 6 weeks and 3-6 weeks for the Independent Technical Advisory Panel (ITAP) and these timeframes are respected. However, it became aware that the timeframe mentioned is for the "first comment" and lengthy back-and-forth correspondents and work revision starts. Each step requires enormous effort and time to get agreed upon and to move on to the next step[7].

8.3 Issues Confirmed while Seeking Possibilities to Propose Post E-COBSI to GCF

8.3.1 Policies, Strategies, and INDC of the Government of Zambia

The development plan of Zambia is the 7th National Development Plan 2017-2021, and National Irrigation Policy and Strategy (NIPS) formulated in 2004 presents the details of the irrigation development. The Zambia Irrigation Policy 2030 aims to contribute to sustainable national economic growth and development through enhanced irrigated agricultural production and productivity, and the goals and outcomes are consistent with E-COBSI activities. In addition, Zambia's INDC (2015) lists 3 areas and 11 priority activities for climate change response, and it has been identified that the COBSI

[6] Out of 23 SAP projects, the minimum was 105 days and the maximum for 1,597 days for approval.

[7] The findings are based on the questionnaire survey conducted via JICA Office for Climate Change, Global Environment Department to those who have been involved in developing CN/ FP that JICA submitted. This has also been one of the agenda of GCF Board meeting.

approach contributes to 2 of these areas and 4 priority activities.

8.3.2 E-COBSI 3-Years Action Plan (Expected to be formulated in its Final Year)

E-COBISI plans to develop a post-project three-year Action Plan to expand E-COBSI activities across Zambia further. As the 3-year action plan is scheduled to be formulated in the first half of the Project's final year (2023), it has yet to be developed. Relevant E-COBSI stakeholders are on the common understanding that E-COBSI activities, training and monitoring, would extend to those districts not targeted with the Project to expand the irrigation area further.

World Bank (WB) developed a 5-year budget support program[8] with the Ministry of Agriculture, and it was identified that the construction cost for COBSI permanent weir is within the program. Due to the budget, E-COBSI could only upgrade one simple weir to a permanent weir per province for three so-called "new provinces" WB program would allow those E-COBSI stakeholders to further upgrade simple weir by utilizing their knowledge and skills acquired through E-COBSI as securing construction cost for the permanent weir have been a constant concern. Upgrading the simple weir to the permanent weir would be reflected in the coming 3-year action plan.

8.3.3 AE of GCF Project

(1) GCF projects in Zambia

There are four GCF projects under implementation in Zambia as of December 2022: three are mitigation projects[9] and one is an adaptation project, namely "Climate resilience of agricultural livelihoods in Agro-Ecological Regions I and II in Zambia: SCRALA (October 2018 - September 2025) implemented by the Ministry of Agriculture with UNDP as AE. As understanding that Post E-COBSI, if going to be proposed to GCF, would be an adaptation project with the result area of "health, well-being, food, and water-security", interviews were conducted with SCRALA focal persons, from the Ministry of Agriculture and UNDP officials, to understand the issues of their concern while implementing and managing GCF project. The summary of the finding is in the following Box 2.

Box 2: Interview with SCRALA Focal Persons - GCF Project which UNDP is AE

- As an AE of the project, UNDP set up a **permanent project unit in the Ministry of Agriculture** that oversees the project and supports/ leads the planning/ operation/ monitoring to ensure smooth implementation. **UNDP employs this unit, and GCF covers the cost**. This unit is different from the Project Board/ Steering Committee (a joint committee with Zambian national officials and UNDP) and **independent of the Implementing Agency (Ministry of Agriculture)**.
- SCRALA covers 16 districts of five provinces (Eastern, Lusaka, Muchinga, Southern and Western). The project **dispatch assistant officer to each district, who UNDP employs**. Assigning assistant officers to the districts is to support the districts with the project activities and to ensure quick response to whatever is happening at the field level.
- **Environmental issues are under AE jurisdiction, not with the Ministry of Agriculture, so UNDP assigns an environmental officer.**
- **The frequency of the communication, volume, and required content of reporting to the GCF is outstanding** compared to other international organizations/ partner organizations. As the **role of AE is to be accountable to the GCF**, extensive support to the Ministry of Agriculture is required to prepare reports with such volume and detail. **AE is the one to be questioned when something goes wrong**, not the Implementing Agency (Ministry of Agriculture).
- GCF headquarter usually sends a mission every year. The mission's schedule would be informed on short notice, for example, arriving in three days. For the past year, no monitoring missions came due to the coronavirus situation.

[8] "Zambia Growth Opportunities Program", a five-year program, was approved in July 2022. The program aims to promote agricultural diversification, sustainability, and jobs in the agri-food sector of Zambia.

[9] Two projects are targeting multiple countries.

(2) JICA

JICA, the AE of the GCF, has submitted seven CNs so far (Table 8.3.1). The project in Timor-Leste was approved in March 2021, and the Maldives in July 2021. Timor-Leste project took 721 days (around two years) from the submission of CN. The Maldives project took 1,031 days (around three years) – though it was submitted as an SAP project at the time of CN but changed to a medium-scale project at FP. Timor-Leste project, for example, CN version 1 was submitted in March 2019, the FP version 1 in June 2020. FP, including attachments, continued its revision up to version 12 (February 2021) to get it approved at the Board Meeting.

Table 8.3.1 List of Projects which JICA submitted to GCF

	Country	Name of Project	Area	Note
1	Maldives	Building Climate Resilient Safer Islands in Maldives	Mitigation	・ CN v.1: November 2018 ・ Approved on 1st July 2021 (FP165)
2	Timor--Leste	Community-based Landscape Management for Reduction of Deforestation and Strengthening of Climate Resilience of Local Livelihoods in the Important Watersheds	Adaptation→ Mitigation[10]	・ CN v.1: March 2019 ・ Approved on 18th March 2021 (SAP032)
3	Mongolia	Resilience Building and Solution to Zud	Mitigation	・ CN v.1: July 2019
4	Multiple Counties (Angola, Botswana, Namibia, Zambia)	SADC Program for Indigenous Forest Landscape Restoration through Transboundary Fire Management in Kavango-Zambezi Trans-frontier Conservation Area	Mitigation	・ CN v.1: March 2020
5	Vietnam	REDD-plus results-based payments for results period of 2014	REDD+	・ CN v.1: Sept. 2018 ・ REDD+ Result-based Payment
6	Republic of Lao	REDD+ RBP for results period 2015 – 2018	REDD+	・ CN v.1: Sept. 2018 ・ REDD+ Result-based Payment
7	Vanuatu	Project on Zero Emission Electricity System in Vanuatu	Mitigation	・ CNv.2.2: Feb. 2021

Source: JICA Survey Team based on GCF Documents (as of August 2021)

A questionnaire survey was conducted on those involved in developing JICA's CN and FP through the Climate Change Office of the Global Environment Department of JICA. The following issues were identified, which are to be considered if JICA would be the AE to submit Post E-COBSI project to GCF (Box 3).

Box 3: Issues related to the Development and Process of CN/ FP
(Findings from the Questionnaire Survey on those involved in JICA proposed GCF projects)

- Timor-Leste project **recruited experts to prepare FP attachment, namely the environmental impact assessment and gender analysis/action plan**.
- Involving other organizations who could jointly be the co-financer was considered. However, the idea was not realized as it was found to be **difficult to conclude with other organizations on what activities to be done by whom, the budget, and the division of roles and responsibilities**.
- "Adaptation projects" has to clarify the impact of climate change on the target area and explain how the proposed project will contribute to climate change. **Knowledge and skills in downscaling climate change models** are required, preferably with collaborating resources from research institutions and universities.
- **The comments from GCF on FP and appendixes were enormous and required intensive work to respond to the inquiries**. For the team to respond promptly under a tight schedule, it is better to divide the team into different roles, such as 1) those who focus on the "story" that GCF is looking for and revise the documents accordingly, 2) those who support in providing similar existing projects, and 3) those who

[10] Proposed as adaptation project in CN and changed to mitigation project for FN.

collect and analyze further information and documents based on the above.

8.3.4 Characteristics of GCF Projects and Issues for Consideration

So far, JICA has two GCF projects, the Timor-Leste project approved in March 2021 and the Maldives approved in July 2021, and 5 other projects lined up. JICA is accumulating experience and knowledge on "how to get the proposed project approved" and would start its experience on "how to manage the GCF project as being an AE" with the approved projects. Based on 8.2 to 8.3.3 above, Table 8.3.2 summarizes the characteristics of GCF projects and issues for consideration.

Table 8.3.2 Characteristics of GCF Project and Issues for Consideration while Developing a Project

Characteristic	Note
1. Uniqueness of GCF	
・ "Micro project" is less than 10 million USD and could apply for SAP if the GCF financing is less than 25 million USD. The size of the GCF project is larger than JICA technical cooperation project. ・ GCF finances activities such as i) activities related to "climate change", ii) scaling up, iii) impact survey.	1) Post E-COBSI activities could be partially financed by GCF which results in reducing the burden of AE/ Government agencies. 2) Co-financer, either AE, Government agencies of the targeted country, or development partners, is a "must". →Activities such as SHEP training and nutritional training are most likely to be financed by Co-Financers.
2. Process for Approval	
If the GCF financing is less than 25 million USD (note: used to be 10 million USD till July 2022), SAP could be applied	1) Though SAP is meant to be a "Simplified Approval Process", it might take around 2 years from submission of CN v.1 to FP approval, which is a lengthy process that might not be that much different from the regular project. 2) JICA GCF project (Project in Timor-Leste) recruited environment assessment expert and gender expert to develop FP and required attachments (total 9 attachments).
3. Management of the Project	
Accountability to GCF is one of the roles and responsibilities emphasized. `Project management is important.	1) To ensure the accountabilities and responsibilities of AE, there would be a shift in position, from being a "donor" to "implement agency/ manager/ quality control". An Independent Unit may require to be set up beside the project management unit, the joint management unit with AE, and the Government agencies (GCF would also finance the cost of those human resources). 2) In order to ensure the role of being AE, AE is required to allocate a certain number of staff in charge along with financial contributions. 3) GCF requires thorough communication and detailed reporting, which UNDP has commented as "heavy workload".

Source: JICA Survey Team

8.4 Post E-COBSI Project

8.4.1 Develop Post E-COBSI Project based on the Idea to propose to GCF

By taking into account the uniqueness of GCF projects, the following four options were identified as Post E-COBSI; 1) propose to GCF with JICA as being AE with the Government of Zambia as co-financer, 2) the Government of Zambia as DAE propose to GCF co-financed by JICA is, 3) the Government of Zambia secure the Post E-COBSI activity cost based on the 3-year action plan from its own budget, and 4) seek for other financings, such as Adaptation Fund.

(1) Proposing Post E-COBSI to GCF.

The Ministry of Agriculture expressed its interest in proposing Post E-COBSI to GCF to further

expand the COBSI approach across the country by understanding the COBSI approach's effectiveness and being familiar with the GCF project as being the implementing agency for SCRALA. The Post E-COBSI project to be proposed to GCF was developed in collaboration with the Ministry of Agriculture (Figure 8.4.1).

The proposed Post E-COBSI project is to strengthen the resilience of small-scale farmers to climate change with E-COBSI activities along with the early warning system. The theory of change for this adaptation project is "**IF** the small-holder farmers who rely on rainfed agriculture adopt community-based small-holder irrigation (COBSI) package and receive the early warning information, **THEN** the small-holder farmers could increase their resilience with access to the irrigated water during the dry season which implies that they could cultivate throughout the year, and could increase their profit and their nutrition status, **BECAUSE** COBSI approach is a combination of very simple techniques to secure water for agricultural use by utilizing locally available materials, "grow crops to sell" not "grow and sell", and improve the nutrition status based on the information, as well as be prepared to take necessary actions based on the weather information received from the early warning system."

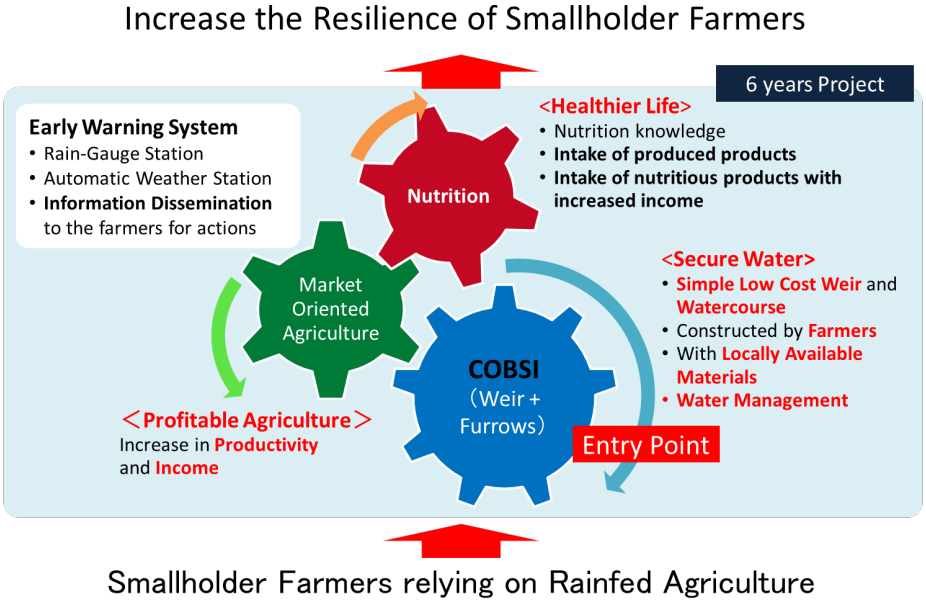


Figure 8.4.1 Post E-COBSI Project to be proposed to GCF (Concept)

Source: JICA Survey Team

Activities related to the early warning system are already being implemented with SCRALA, the GCF project, which UNDP is AE, and WB project with the Ministry of Environment. The GCF emphasizes taking good practices for expansion, and both E-COBSI activities and the early warning system have been practiced in Zambia.

(2) Project Target Area

Post E-COBSI, if proposed to GCF, would target 8 provinces/ 78 districts, expanding E-COBSI targets 6 provinces/ 45 districts (Table 8.4.1). The Ministry of Agriculture is well aware of the suitable site for COBSI, and 2 provinces and 33 districts have been identified for Post E-COBSI.

Table 8.4.1 Post E-COBSI Target Provinces/ Districts

Province	Northern	Luapula	Muchinga	Copperbelt	North-western	Central	Eastern	Western
No. of District	11 (9+2)	11 (8+3)	9 (7+2)	10	11 (8+3)	12 (3+9)	8	6
District	Kasama	Chembe	Isoka	Chilila-bombwe	Ikelenge	Chitambo	Chandiza	Kaoma
	Lunte	Chipili	Kanchibiya	Chingola	Kalumbia	Mukushi	Katete	Limulunga
	Lupososhi	Kawambwa	Luvuchimanda	Kalulushi	Kasempa	Selenge	Lumezi	Luampa
	Luwingu	Mansa	Mafinga	Kitwe	Manyinga	Chibombo	Lundazi	Lukulu
	Mbala	Milenge	Mpika	Luanshya	Mufumbwe	Chisamba	Lusangazi	Mongu
	Mporokoso	Mwansa-Bombwe	Nakonde	Lufwanyama	Mushindamo	Itezhi-Tezhi	Petauke	Nkeyema
	Mungwi	Mwense	Shiwang'andu	Masaiti	Mwinilunga	Kabwe	Sinda	
	Nsama	Nchelenge	Chama	Mpongwe	Solwezi	Kapiri Mposhi	Vubwi	
	Senga Hill	Chiengi	Chinsali	Mufulira	Chavuma	Luano		
	Kaputa	Chifunabuli		Ndola	Kabompo	Mumbwe		
	Mplungu	Samfya			Zambazi	Ngabwe		
						Shibuyunji		

Note 1: Those province/ district added from E-COBSI are defined in orange cell/ red text.
Note 2: Target area for Mongu District of Western Province is western part of the district.

Source: JICA Survey Team

(3) Activities

For COBSI-related activities, the target provinces and districts would be divided into four groups, and activities would be modified according to the group's character (Table 8.4.2). The activities for those provinces and districts targeted by E-COBSI, namely "Follow-Up (FU) province[11] (3 provinces/ 24 districts"" and "New Provinces (3 provinces/ 21 districts)", are the construction of permanent weir, water management, maintenance, and farming. COBSI full package activities, including simple weir, water management, maintenance, permanent weir, SHEP, and nutrition awareness, applied in E-COBSI "New provinces" would be for newly added provinces/ districts for Post E-COBSI (2 new provinces/ 14 districts and 19 districts which were not covered by 5 E-COBSI target provinces). COBSI full package would also be provided to those officers who did have a chance to participate under Development Study (COBSI-S: 2009-2011), T-COBSI (2014-2017) and E-COBSI.

Activities related to the early warning system would include the installation of rain-gauge stations per camp, the installation of automatic weather stations per district, and the dissemination of the analysis of the data to farmer-friendly information via radio and other means.

Table 8.4.2 Activity per Target Group

Group		Target Province/ District	Activity
G1	E-COBSI FU Provinces (T-COBSI targeted provinces/ districts)	3 provinces/ 24 districts	Permanent weir Water Management Cultivation Techniques
G2	E-COBSI New Province	3 provinces/ 21 districts	Simple weir (continue) Permanent weir Water management Cultivation techniques
G3	Post E-COBSI Newly Added Provinces/ Districts	2 provinces/ 14 districts	E-COBSI Activities ・ Kick-off training ・ Simple weir ・ Water management ・ SHEP ・ Nutrition ・ Permanent weir
	Districts that were not targeted in E-COBSI target province	5 provinces/ 19 districts	
G4	Province/ District officer who had yet participated trainings organized by either COBSI-S, T-COBSI, E-COBSI	6 provinces/ 45 districts	

Source: JICA Survey Team

[11] "FU provinces" are those targeted at T-COBSI, the predecessor project of E-COBS. "New provinces" are those newly added provinces and districts for E-COBSI

(4) Expected Results of Post E-COBSI Project if proposed to GCF

If proposed to GCF, the developed Post E-COBSI project estimates that the **direct beneficiaries are around 510,000 people (102,000 households) and indirect beneficiaries for 6,009,000 (about 39% of the population)**. Approximately **1,200 extension officers would be trained** and could become the change agents to support the farmers with COBSI full package, around **5,000 simple weirs constructed**, and expanding the **irrigated area by about 5,100 ha**. About 1,600 rain-gauge stations (1 rain-gauge station/ camp) and 68 automatic weather stations (1 station/ district) would be installed, enabling those residing in the target areas to prepare well based on information they receive through the early warning system.

The expected number of the simple weirs and the irrigated area is based on the T-COBSI results; an average of four simple weirs were constructed per extension office together with the farmers, and the irrigated area per simple weir was about 1 ha. As E-COBSI, after the end of the two dry seasons, constructed 662 simple weirs and developed 1,881 ha irrigated area (about 2.8 ha/weir), the irrigated area is expected to be more than as have been estimated.

8.4.2 Defining Entity to propose to GCF

(1) JICA to be AE to propose to GCF

Although the discussion on Post E-COBSI initially developed based on proposing to GCF as JICA being AE, JICA found out from the findings of the study that the roles and responsibilities of being AE were more than anticipated and became contradictory to the initial ideas, which was "the Government of Zambia to lead the post E-COBSI activities." It has been decided that "JICA would not propose to GCF as AE".

(2) The Government of Zambia to be DAE and propose to GCF

The consultations with the Ministry of Agriculture were held as JICA decided not to be the AE to propose GCF, and the Government of Zambia expressed its interest in proposing GCF as being DAE. Based on this decision, the following measures in Box 4 were taken and guiding documents (Attachment 8) for the Ministry of Agriculture were shared in April 2022, which includes the contents of Post E-COBSI, procedures to propose GCF, reference documents, and issues for consideration.

Box 4: Measures taken for the Government of Zambia to propose GCF as being DAE

JICA	Confirm with JICA whether JICA would be the co-financer to support those activities which GCF would not finance (Example: SHEP training, Nutrition training, Technical support on permanent weir design and construction management)
The Ministry of Agriculture (MOA)	• Explain GCF's Project Preparation Facility (PPF[12]) that supports DAE financially and technically in preparing the project and program funding proposal. • Examine MOA's proposal development team structure. • CN to be prepared by MOA with their internal team. • FP to be prepared by utilizing PPF and recruiting a lead consultant with the WB budget support project.

[12] PPF is specially designed to support DAE in preparing the funding proposal for the micro/ small-sized category. PPF supports activities such as 1) pre-feasibility and feasibility, and project design, 2) environment, social, and gender studies and 3) risk assessment. The activities have to contribute directly to the development of one particular project and be submitted as part of the Funding Proposal package. Support is available through two modalities: 1) PPF funding which DAE receives the funding, organizes the procurements/ implementation and reporting (maximum funding for SAP is USD 300,000), or 2) PPF service requested to those eight registered consulting firms to conduct the concerned activities.

(3) DAE of Zambia yet to conclude Accreditation Master Agreement with GCF

GCF approved Development of Bank of Zambia (DBZ) as DAE[13] of Zambia in July 2021. However, MOA found out that the Accreditation Master Agreement (AMA: a comprehensive accreditation arrangement that defines specific rights and obligations) with the GCF has yet been concluded[14] till now. DAE is unable to submit proposal to GCF without AMA signed and the timeline of when AMA would be concluded is unknown. Thus, the Post E-COBSI project proposed to GCF was taken back to the drawing board.

8.5 Post E-COBSI Project (Idea) based on the Result of the Survey

Though the proposal to GCF has been placed back on the drawing board, the followings are Post E-COBSI ideas for JICA to consider by taking into account the developed Post E-COBSI project, if proposed to GCF, and the construction cost for COBSI permanent weir could be covered by WB budget support program with MOA.

The Post E-COBSI could be a pre-cluster sort of program, with three pillars; 1) further expand E-COBSI activities across Zambia (simple weir, water management, SHEP and nutrition; excluding activities related to permanent weir; target area to be 8 provinces/ 78 districts, same as Post E-COBSI project, if proposed to GCF), 2) supporting permanent weir design and construction management which would supplement WB budget support program (8 weirs/province/year x 6 provinces = 48 permanent weirs), and 3) create a platform for the COBSI approach with third-country training for SSA countries and Zambia to be the hub of the platform (Figure 8.5.1).

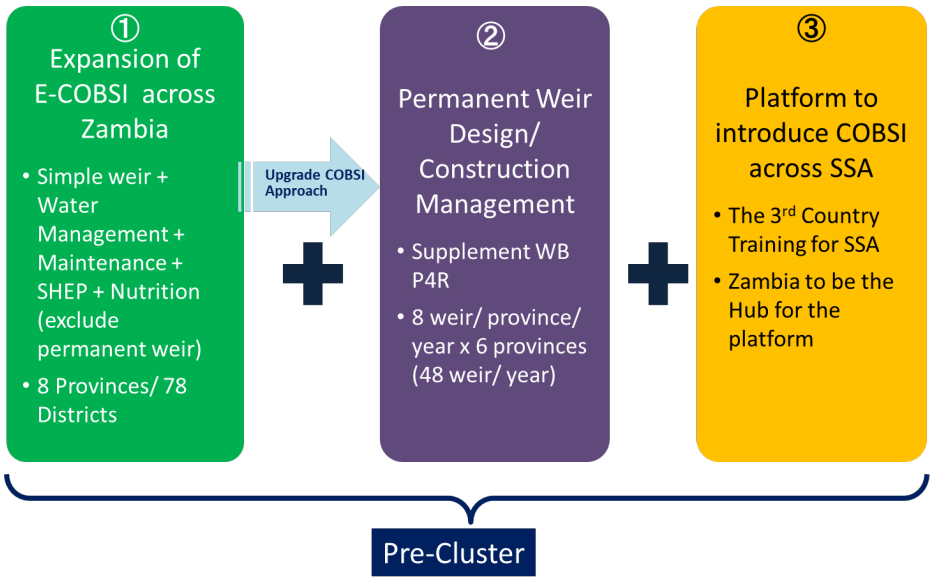


Figure 8.5.1 Redefining Post E-COBSI Project (Idea) based on the Survey Result

Source: JICA Survey Team

The outline of the WB budget support program, namely PforR, for MOA is in Box 5. WB and MOA

[13] Zambia National Commercial Bank PLC (ZANACO) is under approval to be DAE.

[14] Awaiting for DBZ to submit the following two sets of documents: 1) reports of the internal audit function by a third party; 2) minutes of the last two meetings of the committee for the ethics function. For reference, JICA was approved as AE in July 2017, AMA was signed in May 2018, and AMA was issued in April 2019.

discussed the effective budget allocation for the coming five years, and WB would disburse the fund (total of USD 295 million) to MOA based on the achievement of MOA. The budget for the irrigation sector was small, around 3.5%, for the past 5 years, although it has a high return on investment. The budget allocation for the irrigation sector is now revised to be 6.4% from the year 2022 to 2026. WB plans to allocate 21% of its total budget to the irrigation sector. The irrigation sector is the second largest among the other 8 sectors within P4R. MOA introduced E-COBSI to the WB mission team developing the budget support program. The mission team found the uniqueness of the COBSI approach and agreed to include the construction cost to upgrade the simple weirs to permanent weirs for the irrigation sector of the program.

Box 5: WB "Zambia Growth Opportunities Program for Results: PforR（P4R）"

- Budget support program for MOA. Disbursement takes place on certain achievements.
- Program period: Year 2022 – 2026 (5-year program, approved in July 2022)
- The current budget plan weighs heavily on FISP. Modification in budget allocation by increasing the budget allocation to those activities that have a high return on investment, and "to promote agricultural diversification, sustainability and jobs in the agri-food sector of Zambia".
- Total USD 1,737 million (The Government of Zambia 83.1%, **WB/IDA16.9% (USD 295 million)**)
- "3 Result Areas (RA)" and "9 Disbursement Linked Indicators (DLI)". **Irrigation Sector in RA3, DLI 8**.
- The Government Irrigation Budget allocation: Year 2018 to 2022 - 3.5%. Modify to 6.4% allocation for Year 2022 to 2026.
- **Budget for DLI 8: USD 62 million** (WB/IDA）. 21% of WB/IDA budget (2 largest portions).
  - **USD 40 million** (Disbursement: USD16,000 per 1% increase in irrigation budget)
  - USD 17 million (Disbursement: USD 50,000 per water user agreement)
  - USD 5.5 million (Disbursement: Irrigation Development Guidelines developed/ approved by 2023 - USD 1.5 million, Masterplan developed/ approved by 2024 – USD 2 million)
- Activities related to COBSI permanent weir: **Upgrade 8 simple weir/ province x 6 provinces (E-COBSI targeted provinces) to permanent weir by 2023 (total of 48 permanent weir).**

8.6 Issues for Consideration for JICA while considering GCF for Projects related to Agriculture/ Rural Development

GCF finances micro, small, medium, and large projects and could apply for SAP if the proposed project requires a GCF contribution of up to USD 25 million. By understanding the project size for JICA technical cooperation, GCF could be the fund further to scale up the positive results of the existing project. JICA is in the stage of acquiring knowledge on the GCF approval process and implementation, as only 2 projects have been approved so far. JICA has yet to propose any project GCF related to the agriculture and rural development sector (as of December 2022). Though the agriculture and rural development sector are well linked to the GCF adaptation sector and climate change, there are issues to be considered while developing a project by understanding the uniqueness of the fund. Box 6 presents the summary of issues for consideration.

Box 6: Issues for Consideration for JICA while Considering GCF for project related to Agriculture/ Rural Development

- GCF finances projects that contribute to "**climate change**".
- GCF **does not finance the entire proposed project**. **Co-Finance is a "must"**. JICA is to consider its co-financing proportion by **combining schemes such as technical cooperation projects or grants projects**.
- **GCF finance "climate change action" components/ activities**. The project proposes to GCF for JICA's agriculture and rural development projects is likely to become a cross-departmental project, including those activities that JICA's Global Environment Department is in charge of.
- GCF defines the following as examples of "climate change action" which could be taken for agriculture sector related projects;

Mitigation	• Sustainable and effective agricultural production management to reduce emissions from farmland and soil • Reduction of GHG emissions from livestock as it contributes approximately 4-7% of total GHG emissions. • Agricultural production without deforestation/ peatland protection • Food loss control in the supply chain as it contributes approximately 8% of GHG emissions.
Adaptation	• Weather Index/ Agriculture Index • Climate Smart Agriculture/ Conservation Agriculture • Early Warning System, etc.
Cross-Cutting	• Integrated Water Resources Management (IWRM) • Climate Resilient Water and Sanitation/ Hygiene (CR-WASH) • Integrated Drought Management (IDM), Integrated Flood Management (IFM)

- The project size to be at least "**USD 25 million financed by GCF (revised in July 2022) and Co-Finance portion**" to maximize the efforts required to go underway the **lengthy process and time required for approval**.
- Consider "**responsibilities and efforts" required for being AE**.

CHAPTER 9 RICE CULTIVATION MAPPING

At the Fourth Tokyo International Conference on African Development (TICAD 4, 2008), the Coalition for African Rice Development (CARD) was established as a platform for exchanging views on the promotion of rice cultivation in Africa. CARD's first phase, which began in 2008, has spurred increase in rice production from 14 to 28 million tons across sub-Saharan Africa.

Following the success of the first phase, the Seventh TICAD (2019) decided on a period of 11 years (2019-2030) for the second phase to increase rice production by another 56 million tons. The number of participating countries also increased by 9, from 23 in the first phase to 32 in the second phase. At this point, country-specific targets have been set and strategies are being developed to achieve individual goals.

In the first phase of the production enhancement through a "cultivation environment" approach, a variety of selection and cultivation techniques were promoted according to cultivation environments such as irrigated paddy fields, rainfed lowland or upland areas, etc. In rainfed upland areas, which are the subject of this analysis, promotional activities for the dissemination of the "New Rice for Africa" or NERICA have become fundamental.

NERICA cultivation is a major factor in increasing rice production in the second phase. However, despite the fact that cultivated areas in sub-Saharan Africa exceeded 1.4 million hectares, production was only 2.95 million tons, with an average yield of no more than 2.10 tons/ha (less than the 2.64 tons/ha rice production across Africa); some CARD participating countries' production was even found to be less than 1 ton/ha (JAICAF 2019, Africa Rice Center 2013 data).

Considering that NERICA is essentially a high-yield variety, those low-yielding areas indicate that there are fundamental problems, such as cultivation management, that are not suited to the environment. It is expected that the dissemination of appropriate cultivation methods in such areas will lead to an increase in rice production in Africa as a whole.

In this analysis, a "Rice Cultivation Map (RCM)" of upland areas suitable for NERICA was prepared as a basic reference for developing strategies to achieve the second phase goals and to improve rice cultivation in sub-Saharan Africa. This RCM should facilitate the selection of such areas in participating countries and enable technical assistance taking into account local cultivation risks. It is believed that the diffusion of cultivation management suited to the local environment will help increase the high-yield performance of NERICA and lead to stronger monoculture farming.

9.1 Rice Cultivation Mapping Outline

The RCM is a cultivation risk distribution map composed of spatial information (daily rainfall and temperatures as well as pH distribution) analyzed based on satellite data and NERICA cultivation conditions such as rainfall, temperatures, soil pH conditions, etc. (cf. Table 9.1.1), which are the results of the in-situ survey conducted in each of the 32 CARD participating countries.

Table 9.1.1 Cultivation Conditions of NERICA

■Drought Risk	Not suitable for rainfed cultivation	Drought risk: High (difficult to recommend cultivation)	Drought risk: Medium (possible to recommend cultivation)	Drought risk: Low (actively recommend cultivation)	
Precipitation (0-100 days after seeding)	< 15mm/5day	15～20mm/5day	20～25mm/5day	> 25mm/5day	
■High-Temperature Sterility Risk	Unsuitable for cultivation	Sterility Risk: Very High	Sterility Risk: High	Sterility Risk: Medium	Sterility Risk: Low
Average temperature (55-75 days after seeding)	> 50℃	45~50℃	40~45℃	35~40℃	< 35℃
■Cool Summer-induced Sterility Risk	Unsuitable for cultivation	Cold damage risk: Very High	Cold damage risk: High	Cold damage risk: Medium	Cold damage risk: Low
Average temperature (55-75 days after seeding)	< 15℃	> 15℃ or < 17℃	> 17℃ or < 19℃	> 19℃ or < 22℃	> 22℃
■Optimum Temperature during Vegetative Growth Phase	Unsuitable for cultivation	Poor growth risk: High	Poor growth risk: Medium	Poor growth risk: Low	Poor growth: Optimal growing temperature
Average temperature (0-55 days after seeding)	< 12℃ or > 50℃	12~16℃ or 45~50℃	16~19℃ or 40~45℃	19~25℃ or 35~40℃	25~35℃
■Optimum Temperature during Ripening Period	Unsuitable for cultivation	Poor ripening risk: High	Poor ripening risk: Medium	Poor ripening risk: Low	Optimum ripening temperature
Average temperature (76 to 100 days after seeding)	< 10℃ or > 50℃	10~18℃ or 43~50℃	18~20℃ or 36~43℃	20~22℃ or 30~36℃	22~30℃
■Soil Suitability	Soil suitability: No adequacy	Soil suitability: Medium adequacy	Soil suitability: Good adequacy		
Soi l pH	< 4.5 or > 7.0	4.5 – 5.5	5.5 -7.0		

Source: JICA Survey Team

The precision of the RCM depending on the accuracy of time-series spatial data, it was crucial to ensure that the data selected for the analysis were available and highly accurate, using TAMSAT (4 km grid: Univ. Reading, NCAS and NCEO) for daily rainfall and CHIRTS (5 km grid: Climate Hazards Center [CHC]) for air temperature. Moreover, geospatial data such as soils, land cover maps, and national parks/nature reserves were also collected.

The following steps were taken to analyze the data:

(1) Arranging meteorological data

For precipitation and air temperature, high-resolution meteorological reanalysis data from TAMSAT and CHIRTS were used to analyze annual variation in upland rice cultivation and cultivation stages. Three (dry, normal, and wet) years were selected from publicly available data for the past 20 years (2000-2020) and arranged into both daily and pentad data.

(2) Determining the start of the rainy season (seeding time for cultivation)

Since an analytical condition—set as the seeding time of NERICA—is the beginning of the rainy season, the timing of the first and second rainy seasons for each of the dry, normal, and wet years was determined based on the starting date of the maximum dry season[1] (cf. Figure 9.1.1).

[1] The 1st rainy season was detected by referring to the starting date of the maximum dry season and the 2nd rainy season by shifting the starting point 100 days (NERICA growth period) after the beginning of the 1st rainy season. The duration of the rainy season was different for each grid, with the post-maximum-dry-period 1st rainy season corresponding to the high rainy season and the subsequent 2nd rainy season corresponding to the low rainy season in both the Southern and Northern Hemisphere countries. The 1st and 2nd rainy seasons in the analysis were not arranged in calendar order starting on January 1st, but, rather, in order of the day, which was different for each grid.

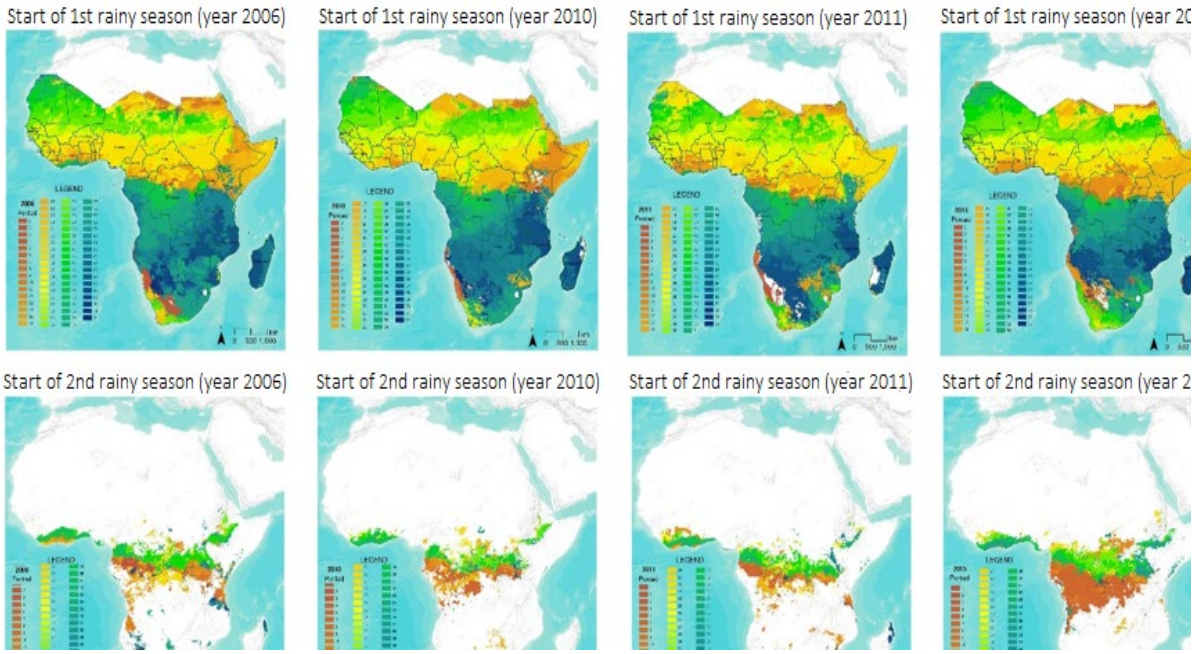


Figure 9.1.1 Start of 1st and 2nd Rainy Seasons (Seeding Times)

Source: JICA Survey Team

(3) Analyzing drought risks

Rainfall data were collected for 100 days from the start of the first and second rainy seasons in dry, normal, and wet years, and the rainfall distribution during these growing periods was used to identify areas where cultivation is difficult and create drought risk maps for areas where cultivation is possible (Figure 9.1.2).

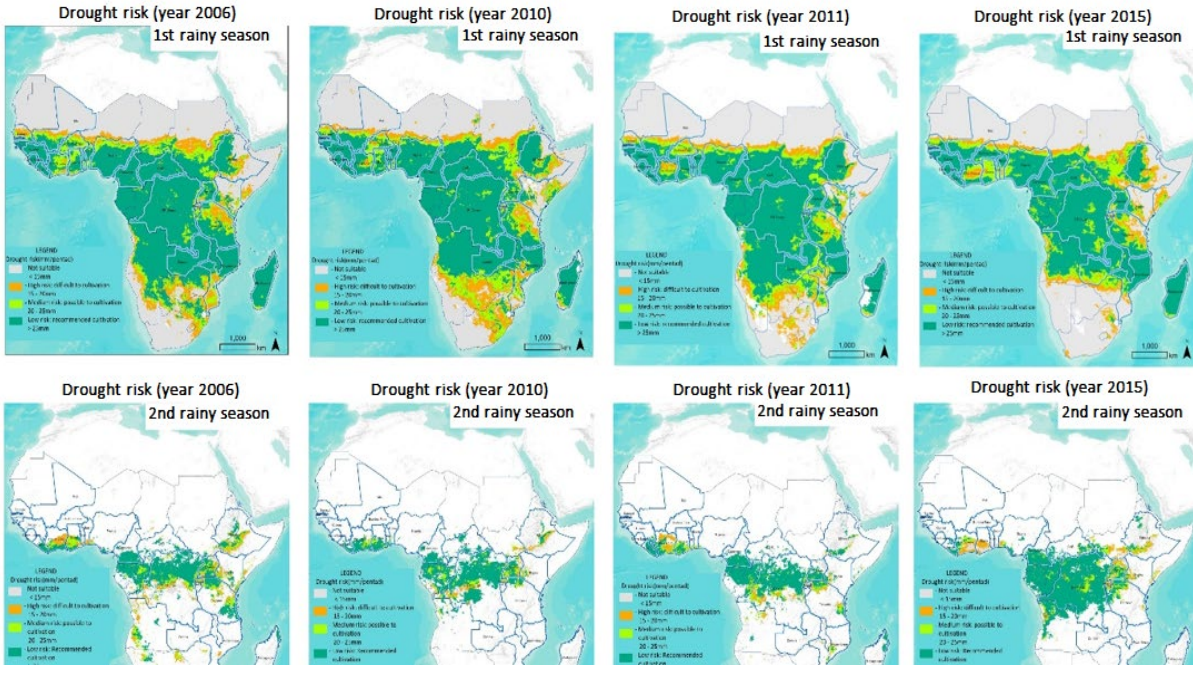


Figure 9.1.2 Drought Risk Distribution (1st and 2nd Rainy Season)

Source: JICA Survey Team

(4) Analyzing temperature risks

In areas where upland rice cultivation is possible, pentad maximum and average temperature data for first and second rainy seasons in dry, normal, and wet years were compiled for each upland rice cultivation stage, and cultivation (sterility and growth) risks were determined based on temperature distribution by cultivation stage. (Figures 9.1.3 to 9.1.6).

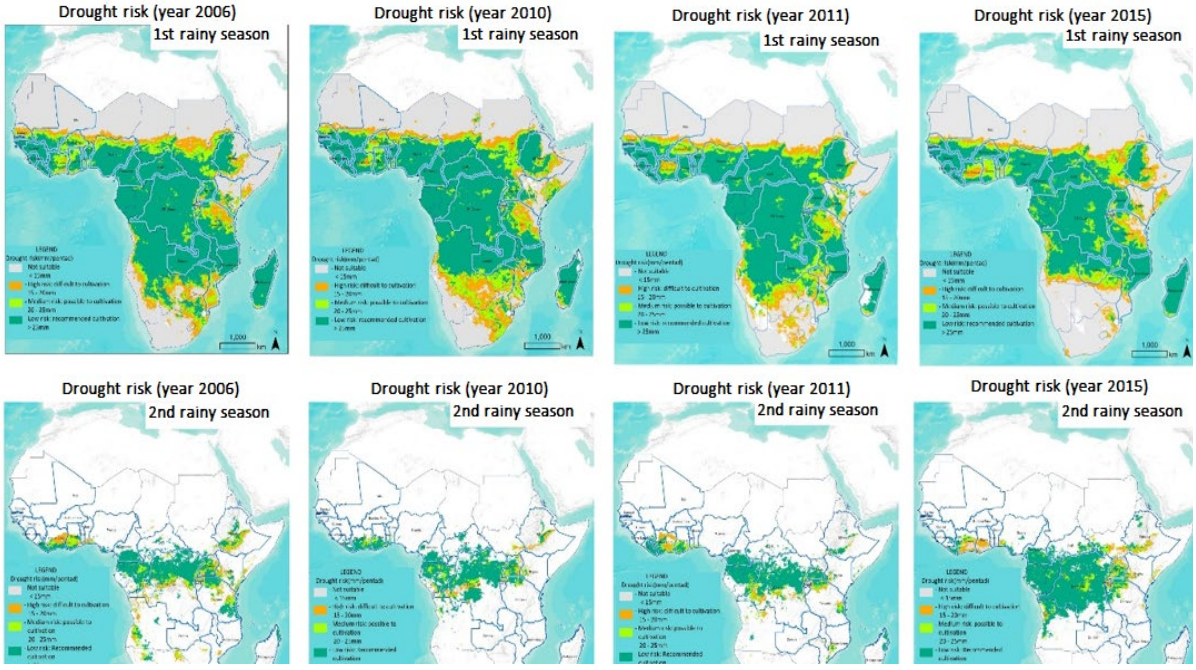


Figure 9.1.3 High Temperature Sterility Risk Distribution (1st and 2nd Rainy Seasons)

Source: JICA Survey Team

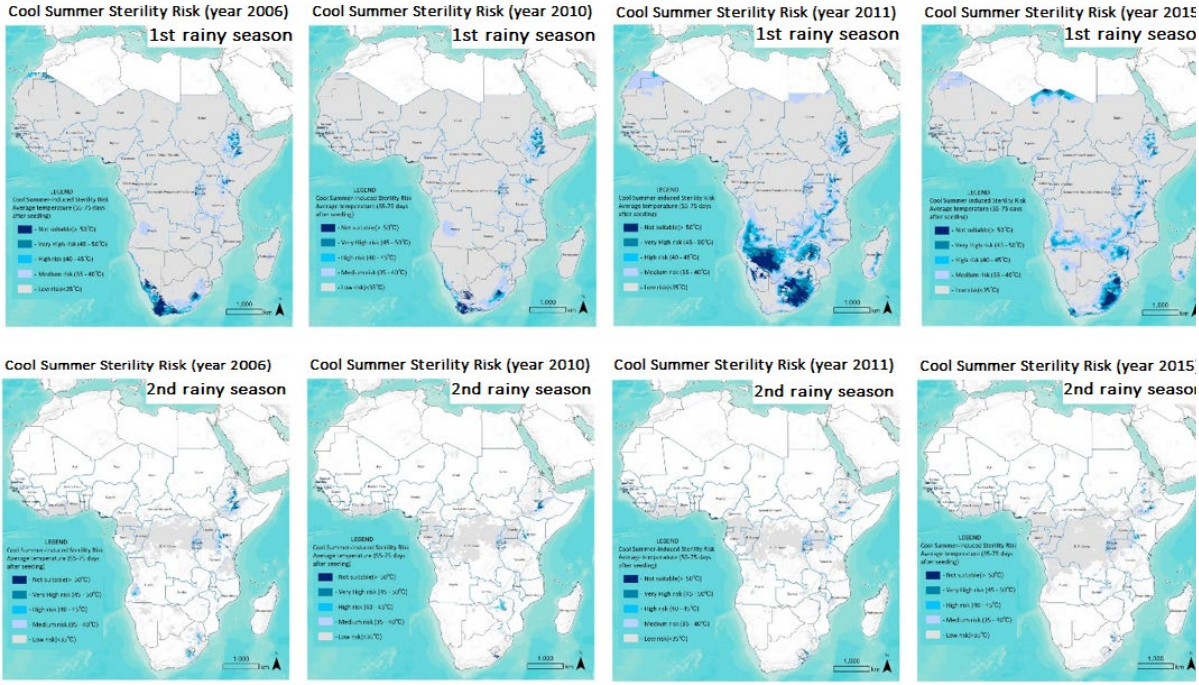


Figure 9.1.4 Cool Summer induced Sterility Risk Distribution (1st and 2nd Rainy Seasons)

Source: JICA Survey Team

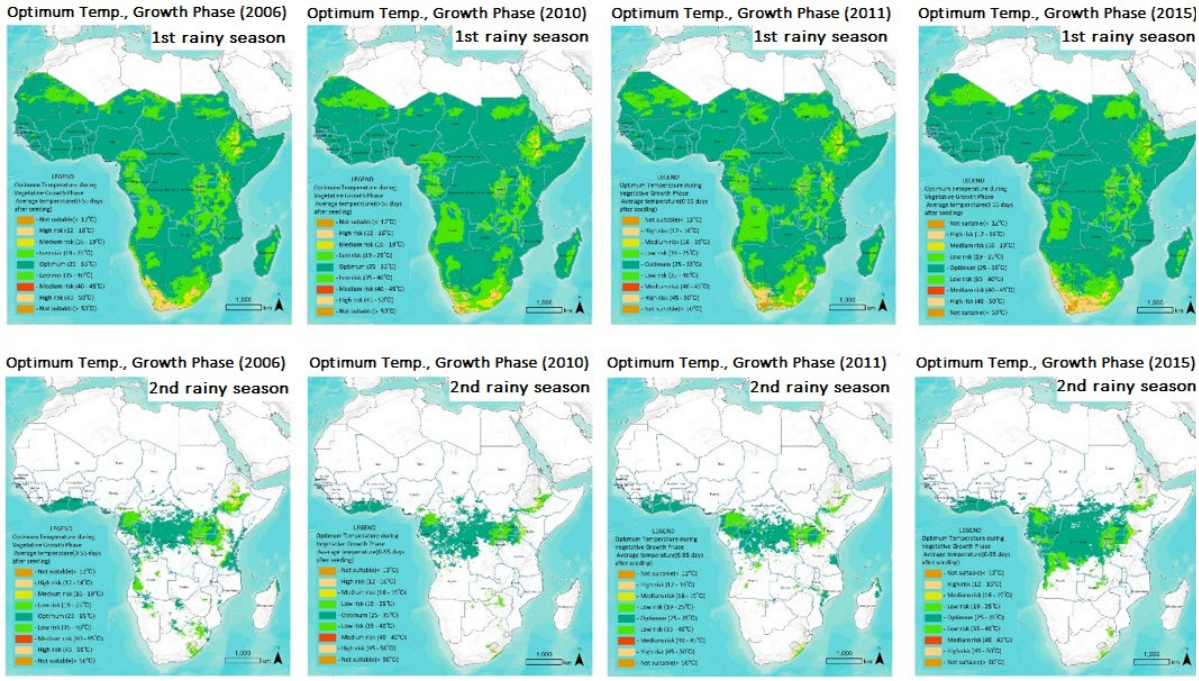


Figure 9.1.5 Optimum Temperature Distribution during Vegetable Growth Phase (1st and 2nd Rainy Seasons)

Source: JICA Survey Team

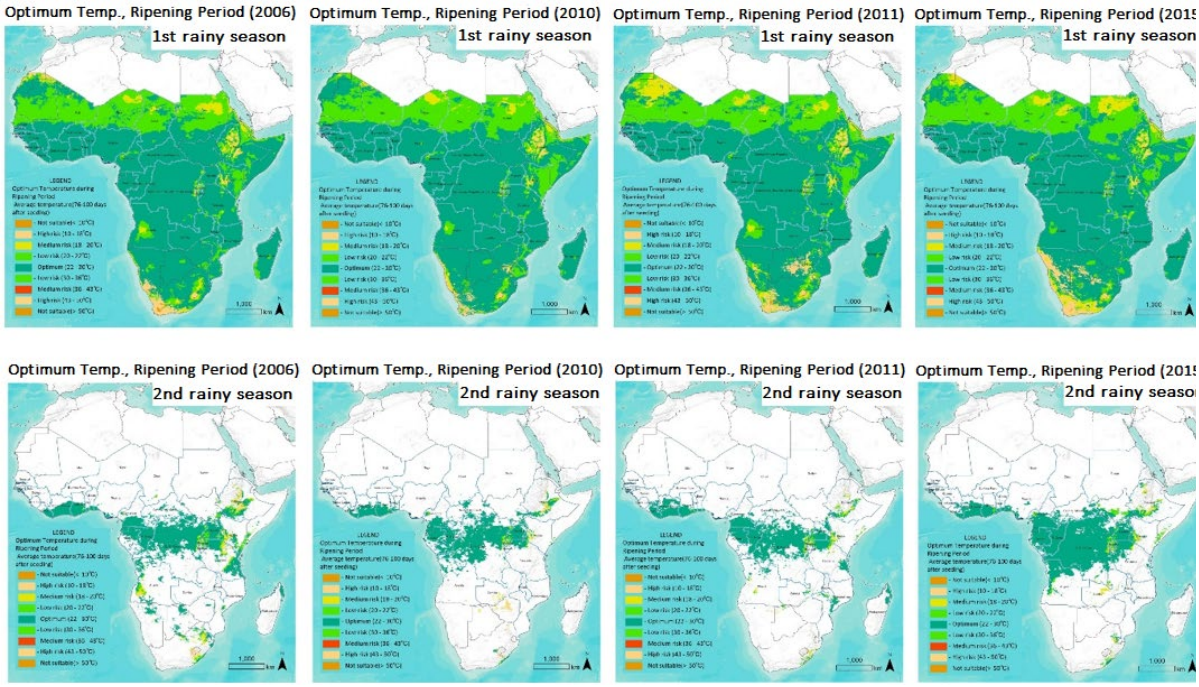


Figure 9.1.6 Optimum Temperature Distribution during Ripening Phase (1st and 2nd Rainy Seasons)

Source: JICA Survey Team

(5) Compiling soil and land cover information

Drought and temperature risks were integrated with overlaying soil pH, and suitable cultivation areas were selected for the entire sub-Saharan region. A suitable cultivation map was then created by adding information such as paddy field distribution and on existing farmlands and wetlands.

The above steps (1) to (5) were used to assess the risks of NERICA cultivation across the sub-Saharan region for the past 20 years including dry, normal, and wet years. For Kenya, a continuous analysis was conducted over 10 years (20 growing seasons in first and second rainy seasons), from 2006 to 2015, in order to track the details of annual changes. When a growing season spread over the year (January-December) in the continuous analysis, meteorological data from the following year were used to match that growing season.

9.2 Rice Cultivation Map of Suitable Areas for Upland Rice (NERICA) Cultivation

An "RCM of suitable areas for upland rice (NERICA) cultivation" was prepared for Kenya as a precedent, classifying drought, hot sterility, cold injury, poor growth, and ripening risks according to meteorological conditions and soil property (Table 9.1.1 and ISRIC SoilGrids).

Before this work, Kenya had prepared a map for the "Estimation of Potential Area for Upland Rice Production in Kenya" (Nougyo, Hatachi. vol. 676, 2015) based on NERICA cultivation studies and reproduced satellite rainfall data (Figure 9.2.1, right map).

The compilation of the RCM was a follow-up of the results of this previous research and a comparison was made with the existing map—in its preparation—to confirm whether there were problems in the applied procedure (Figure 9.2.1, left map).

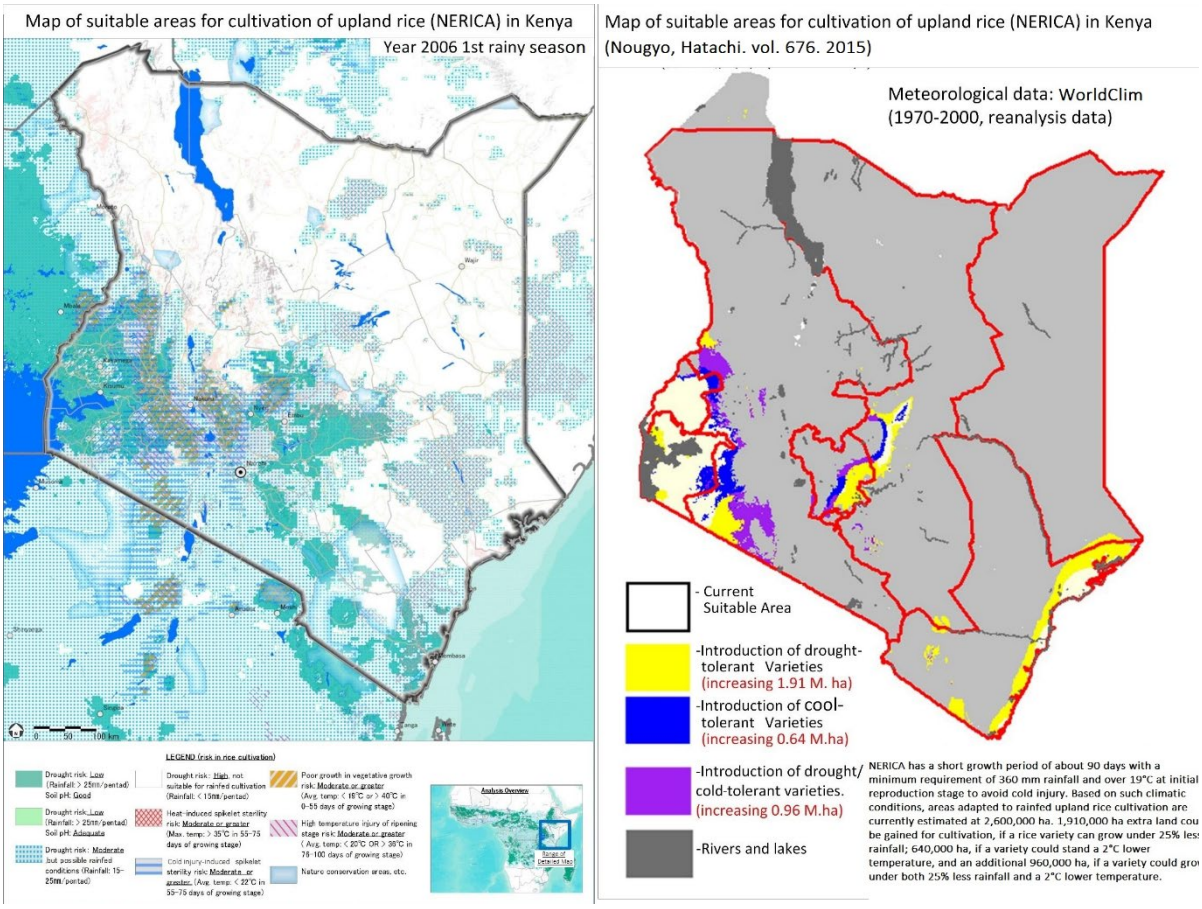


Figure 9.2.1 Comparison of Suitable Areas for Cultivation of Upland Rice in Kenya

Source: JICA Survey Team

As observed through both the existing research results and the RCM, the distribution of cultivation risks is highly dependent on meteorological data used in the analysis in central and eastern coastal areas near the cultivation limit (with restricted-to-low rainfall), but the location of suitable cultivation areas is generally concentrated in western, central, and eastern coastal areas. The differences can be explained in detail by gaps in the timing of the analysis, the accuracy and duration of the meteorological data, and the conditions under which they were applied.

The same procedure was extended to the CARD participating countries of phases 1 to 3, and detailed maps of suitable areas for upland rice (NERICA) cultivation were created for 32 countries: 128 maps comprising 2 years of analysis (dry and wet years) and 2 (first and second) wet seasons (Appendix 4).

9.3 Identification of Potential Rice Cultivation Areas and Compilation of Areas by Cultivation Conditions

Calculated based on the RCM of suitable areas for upland rice (NERICA) cultivation, potential rice cultivation areas were identified and compiled according to the following procedure:

(1) After excluding natural reserves and urban areas where farmland development is difficult, two potential areas were selected based on drought risks with pentad rainfall during the cultivation period:

- "Cultivable areas" (pentad rainfall: 15-25 mm, medium drought risk);
- "Recommended areas for cultivation" (pentad rainfall: > 25 mm, low drought risk).

(2) "Recommended areas for cultivation" were divided into two based on soil pH: One with medium soil suitability (pH 4.5-5.5) and the other with good soil suitability (pH 5.5-7.0). Three categories were then determined based on both drought risks and soil pH, namely (1) medium drought risk, (2) low drought risk + medium soil suitability, and (3) low drought risk + good soil suitability.

(3) Categories (1) to (3) were overlaid on the temperature risk areas (consisting of High-temperature sterility risk, Cool summer-induced sterility risk, Optimum temperature during vegetable growth phase, and Optimum temperature during ripening phase), and combined into two categories: "Low" and "Medium" temperature risks.

(4) These 6 categories (3 categories based on drought and soil pH x 2 categories based on temperature risks) were subject to aggregation of the first and second rainy seasons (Table 9.3.1).

In the results of the 6 categories shown in 2020 (selected as an average year having average annual rainfall from 2000 to 2020), recommended areas for upland rice (NERICA) cultivation with low drought, low-temperature risks, and good soil suitability (Section [3] of Table 9.3.1) are extensively located in Angola, Central African Republic, Madagascar, Nigeria, and Zambia, and are widely recognized throughout the country's land mass. In all of the 32 CARD countries, recommended areas were larger in the first than in the second rainy season.

Table 9.3.1 Areas calculated by risk classes in NERICA cultivation (2010, 1st and 2nd rainy seasons)

CARD Participating Countries	①Drought risk：Midium Rainfall 15-25 mm/pentad Target year: 2010 Unit: 10,000 hectares				②Drought risk：Low Soil suitability: Yes (pH: 4.5 to 5.5) Rainfall: >25 mm/pentad Target year: 2010 Unit: 10,000 hectares				③Drought risk：Low Soil suitability: Good(pH: 5.5 to 7.5) Rainfall: >25 mm/pentad Target year: 2010 Unit: 10,000 hectares			
	Temp. risk(Low)		Temp. risk (Yes)		Temp. risk(Low)		Temp. risk (Yes)		Temp. risk(Low)		Temp. risk (Yes)	
	1st rain seazon	2nd rain seazon	1st rain seazon	2nd rain seazon	1st rain seazon	2nd rain seazon	1st rain seazon	2nd rain seazon	1st rain seazon	2nd rain seazon	1st rain seazon	2nd rain seazon
Angola	1,316	197	0	3	4,773	320	570	3	4,519	131	871	15
Benin	178	38	0	0	6	4	0	0	972	57	0	0
Burkina Faso	1,712	1	10	0	1	0	0	0	859	0	0	0
Burundi	29	4	71	1	8	0	42	0	44	1	43	0
Cameroon	124	11	1	0	2,657	1,145	164	45	1,312	48	93	3
Central African Republic	59	11	1	0	1,200	191	0	0	4,293	675	1	0
Chad	1,746	1	529	1	3	0	0	0	2,948	58	2	0
Cote d'Ivoire	834	352	0	0	1,156	691	0	0	1,214	481	0	0
Democratic Republic of the Congo	1,023	1,899	33	40	18,546	8,425	405	174	1,839	404	88	45
Ethiopia	2,672	377	861	339	130	0	544	3	1,823	48	1,989	337
Gabon	128	386	0	0	2,309	1,378	25	0	127	34	0	0
Gambia	2		0		19		0		89		0	
Ghana	795	263	0	0	389	379	0	0	1,090	432	0	0
Guinea	7	0	0	0	1,662	5	2	0	828	0	0	0
Guinea-Bissau	19		0		301		0		22		0	
Kenya	1,001	166	727	106	64	19	85	26	359	62	288	82
Liberia	3	1	0	0	960	390	0	0	4	1	0	0
Madagascar	549	1	142	1	1,213	3	0	0	4,122	1	57	1
Malawi	316		31		44		2		500		4	
Mali	1,782		114		47		0		2,363		0	
Mozambique	2,513	0	377	0	173	0	4	0	3,758	0	74	0
Niger	1,645		119		0		0		41		1	
Nigeria	1,483	0	0	0	1,088	5	13	0	6,352	26	24	0
Republic of Congo	301	584	0	0	2,580	1,360	11	0	371	187	0	0
Rwanda	102	81	62	57	9	5	26	5	9	3	8	7
Senegal	751		9		205		0		791		0	
Sierra Leone	4	0	0	0	698	1	0	0	19	0	0	0
Sudan	4,726	0	238	0	16	0	0	0	1,038	0	0	0
Tanzania	3,476	226	221	9	504	45	83	0	2,542	216	243	6
Togo	101	41	0	0	17	5	0	0	431	82	0	0
Uganda	720	629	36	55	133	85	45	24	949	564	37	26
Zambia	359	0	0	0	2,251	0	45	0	4,488	0	55	5

Source: JICA Survey Team