

Republic of Rwanda

FY2021 Ex-Post Evaluation Report of Grant Aid Project

“The Project for Development of Irrigation Scheme in Ngoma District”

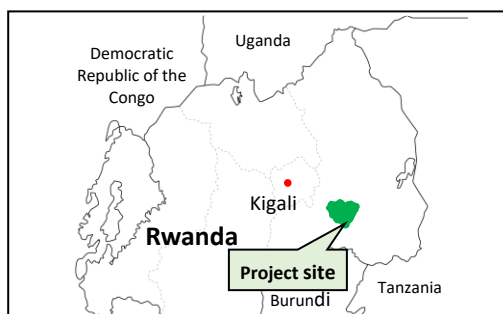
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## 0. Summary

The project aimed to promote efficient use of agricultural water and intensive agriculture by developing irrigation facilities in Rurenge and Remera Sectors, Ngoma District, Eastern Province, and thereby contribute to improving agricultural productivity. The project was consistent with the development plan and needs of the Republic of Rwanda both at the time of planning and ex-post evaluation, and its relevance can be confirmed. The project was consistent with Japan’s ODA policy for Rwanda. Although it was not envisaged at the time of planning, it was consistent with other projects of the Japan International Cooperation Agency (JICA) and with other development partners. Therefore, the relevance and coherence are high. The project produced outputs almost as planned, and although the project cost and project period slightly exceeded the plan, the efficiency of the project is high. Among the expected effects, the irrigated area was in line with the plan, and the time required for irrigation was also improved; however, the total planted area did not reach the target value. On the other hand, the expected impact, such as an increase in agricultural gross income, was achieved by shifting to more profitable crops; however, the impact of the chia seed, which does not use irrigation water, was significant. Therefore, the effectiveness and impact of the project are moderately low. The operation and maintenance of the project facilities has some minor problems in institutional/organization and financial aspects as well as the status of operation and maintenance; however, they are expected to be improved/solved, and therefore, the sustainability of the project effects is high. In light of the above, the project is evaluated to be satisfactory.

## 1. Project Description



Project Location<sup>1</sup>



Hillside farmland surrounding marshland<sup>2</sup>

<sup>1</sup> Source: 3kaku-K

<sup>2</sup> Taken by the external evaluator

## 1.1 Background

Agriculture and rural development were key industry sectors driving Rwanda's economic development and poverty reduction. Rwanda's *Strategic Plan for Agricultural Transformation (2013-2017)* (hereinafter referred to as "SPAT III") aimed to reduce poverty, improve nutrition, and shift from subsistence to knowledge-intensive agriculture, and positioned the promotion of irrigated agriculture as a key issue, with irrigation development as one of the subprograms.

Meanwhile, most of the land in Rwanda is hilly and suffers from low agricultural productivity and food shortages due to soil erosion and degradation during the rainy season and inadequate irrigation systems on hillside land. Therefore, to effectively implement SPAT III, the Government of Rwanda developed the "Land-husbandry, Water-harvesting, and Hillside-irrigation Project" (hereinafter referred to as "LWH") to improve agricultural production and sustainable growth and to commercialize and diversify agricultural products in a market-oriented manner. The Ministry of Agriculture and Animal Resources, the then implementing agency of LWH, planned to construct about 100 agricultural reservoirs and develop 10,000 ha of irrigation areas under the plan.

Against this background, the Government of Rwanda requested Japan a grant aid project for constructing a reservoir and irrigation facilities based on the LWH.

The Ngoma 22, a site of the project, consists of 265 ha of hillside farmland and 35 ha of marshland paddy field. The farmers there irrigated their fields only by drawing water from small canals flowing through the marshland and spring water scattered at the foot of the mountains and mainly cultivated maize and beans with rainwater for subsistence. Rice cultivation was carried out in the marshland paddy field; however, there were only earthen channels using small rivers, and facilities such as gates and diversion works for water intake and diversion had not yet been developed.

## 1.2 Project Outline

The objective of this project is to promote the efficient use of agricultural water and intensive agriculture by constructing irrigation facilities in Rurenge Sector and Remera Sector, Ngoma District, Eastern Province, thereby contributing to the improvement of agricultural productivity.

Grant Limit / Actual Grant Amount	1,549 million yen / 1,548 million yen
Exchange of Notes Date /Grant Agreement Date	August 2014 / September 2014
Executing Agency(ies)	(Initially) Ministry of Agriculture and Animal Resources (At the time of ex-post evaluation) Rwanda Agriculture and Animal Resources Development Board
Project Completion	November 2016
Target Area	Nine villages in Rurenge and Remera Sectors, Ngoma District, Eastern Province (Site Name: Ngoma 22)
Main Contractor(s)	Konoike Construction Co., Ltd.
Main Consultant(s)	Sanyu Consultants Inc.
Preparatory Survey	August 2013 – May 2014
Related Projects	[Technical Cooperation] “Smallholder market oriented agriculture project” (October 2014 – June 2021) “Project for Water Management and Capacity Building” (April 2019 – March 2025)

## 2. Outline of the Evaluation Study

### 2.1 External Evaluator

Nomoto, Ayako, International Development Center of Japan Inc.

### 2.2 Duration of Evaluation Study

This ex-post evaluation study was conducted with the following schedule.

Duration of the Study: October 2021 – December 2022

Duration of the Field Study: February 16, 2022 – March 9, 2022, May 25, 2022 – May 30, 2022

### 2.3 Constraints during the Evaluation Study

Some of the indicators to measure the quantitative effects and impacts of the project were only analyzed qualitatively because the executing agency did not capture their definitions or collect

data.

### **3. Results of the Evaluation (Overall Rating: B<sup>3</sup>)**

#### 3.1 Relevance/Coherence (Rating: ③<sup>4</sup>)

##### 3.1.1 Relevance (Rating: ③)

###### 3.1.1.1 Consistency with the Development Plan of the Republic of Rwanda

The project has been consistent with the development plan of the Government of Rwanda for developing productive agriculture and irrigation infrastructure both at the time of planning and the ex-post evaluation.

At the time of planning, Rwanda's long-term national development plan, *VISION 2020*, planned to promote agriculture based on high productivity, high-value addition, and market needs. In addition, SPAT III (2013-2017) identified the promotion of irrigated agriculture as a key issue, with the goals of poverty reduction, improved nutrition, and a shift from subsistence agriculture to higher value-added agriculture. To effectively implement SPAT III, the Government of Rwanda developed the LWH, which is a program that aims to improve agricultural production, achieve sustainable growth, and commercialize and diversify agricultural products in a market-oriented manner. This project was requested based on the LWH.

At the time of ex-post evaluation, *VISION 2050*, the successor policy to *VISION 2020*, plans to promote market-led, high-tech, irrigation-maximizing agriculture. The *Strategic Plan for Agriculture Transformation 2018-24* (hereafter referred to as "PSTA 4"), the successor policy to SPAT III described above, continues to transform from subsistence agriculture to a knowledge-based, value-creating sector that contributes to the national economy and ensures food and nutrition security. The policy's Priority Area 2: Productivity and Resilience focuses on promoting sustainable and resilient production systems for crops and aims to increase the irrigated area from 48,508 ha to 102,284 ha with focused investments in improving land productivity. Rwanda Agriculture and Animal Resources Development Board (hereinafter referred to as "RAB"), the executing agency, has developed the *RAB Strategic Plan (2020-2024)* based on PSTA 4 above. Promoting sustainable and resilient agricultural production systems is one of the pillars of this plan's strategy, including focused investments in land productivity enhancement and irrigation infrastructure development.

###### 3.1.1.2 Consistency with the Development Needs of the Republic of Rwanda

The project has been consistent with the development needs for irrigation development and productivity improvement both at the time of planning and ex-post evaluation.

At the time of planning, agriculture in Rwanda accounted for about 30% of GDP, approximately

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<sup>3</sup> A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

<sup>4</sup> ④: Very High, ③: High, ②: Moderately Low, ①: Low

80% of the population was engaged in agriculture, and the agriculture industry was growing at about 5%. However, the arable land is small, and most are hilly, so irrigation development had not progressed, and productivity and profitability were low. In Ngoma District, Eastern Province, which includes the project site, rainwater was not effectively used for irrigation, and the crop yield was low. The farmers in the project site were small and had no room to expand their farmland, and the irrigation facilities had not been developed yet. However, it would have been beneficial to increase production by increasing yield.

At the time of ex-post evaluation, agriculture accounted for 24% of GDP (2021) and 67.8% of the working population (2020) and remained an important part of the economy. Rwanda's arable land area was small at 0.4 ha/household (2020), and as stated in the development policy, productivity improvement was a challenge. The arable land area in Ngoma District was also small at 0.5 ha/household (2020) and 69% of all farmers had less than 0.5 ha/household (2018). Furthermore, 78.9% of all farmers in the district grew maize (compared to the national average of 67.7%), and 88.6% grew beans (compared to the national average of 88.6%) and were dependent on traditional crops<sup>5</sup>. Thus, even at the time of ex-post evaluation, there is a need to increase productivity and shift to value-added crops.

### 3.1.2 Coherence (Rating: ②)

#### 3.1.2.1 Consistency with Japan's ODA Policy

At the time of planning, this project was in line with Japan's ODA policy. The *Country Assistance Policy for the Republic of Rwanda (April 2012)* positioned agricultural development (high value-adding and business development) as a priority area. The policy stated that, considering the current situation in which small-scale farming with little arable land was practiced, assistance covering all aspects from the field (production technology) to policy would be provided to make this sector an essential industry for promoting economic growth. The assistance included improving agricultural productivity through the development of food production infrastructure.

#### 3.1.2.2 Internal Coherence

The technical assistance "Project for Water Management and Capacity Building" (hereinafter referred to as "WAMCAB") (April 2019 - March 2024), which was not planned at the time of the ex-ante evaluation of this project; however, started after the project completion and synergies were observed.

WAMCAB has identified the project site as one of the areas to be supported and is working to strengthen the maintenance and management system of the developed irrigation facilities. After

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<sup>5</sup> Sources at the time of the ex-post evaluation: *Gross Domestic Product-2021* (National Institute of Statistics of Rwanda: NISR), *ILOSTAT, Agricultural Household survey Report 2020* (NISR), *Comprehensive Food Security & Vulnerability Analysis* (NISR et al.)

the completion of the construction of facilities under the project, there was a long period (2016-2018) when the irrigation facilities subject to maintenance and management could not be used due to the delay in the start of the utilization of the reservoir because of unfavorable weather conditions, and the Irrigation Water Users Organization (hereinafter referred to as “IWUO”)) did not function. WAMCAB restructured the IWUO, and at the time of the ex-post evaluation, the IWUO was operating and maintaining the irrigation facilities (as detailed in Section “3.3 Effectiveness and Impacts” and Section 3.4 “Sustainability”). The WAMCAB’s strengthening of IWUO capacity has generated synergies in terms of the effectiveness and impact of the project.

### 3.1.2.3 External Coherence

At the time of planning, the World Bank, the United States, and Canada supported the Government of Rwanda’s LWH from 2010 to 2015, which was consistent with the project implemented under the LWH. At the time of the ex-post evaluation, the “Sustainable Agriculture Intensification and Food Security Project” (hereinafter referred to as “SAIP”), a follow-on project to LWH, was being implemented with the support of the World Bank. SAIP aims to improve agricultural productivity, market access, and food security and continues to be highly consistent with the project. Further, there was coordination with the SAIP, including the implementation of the terracing of hillside farmland which was the responsibility of the Rwandan side. However, the implementation of the above works was not planned at the time. RAB also conducted land husbandry to protect the catchment of Ngoma 22.

Concerning the international framework, Goal 2: Zero Hunger of the Sustainable Development Goals (SDGs) states that “By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding, and other disasters and that progressively improve land and soil quality.” Thus, the project is consistent with the SDGs.

From the above, regarding the relevance, the project is consistent with Rwanda’s development plan and development needs (irrigation development and productivity improvement). Regarding coherence, the project is consistent with Japan’s ODA policy, and internal coherence and external coherence are also found, although they were not planned at the planning stage. Therefore, its relevance and coherence are high.

## 3.2 Efficiency (Rating: ③)

### 3.2.1 Project Outputs

The outputs from the Japanese side of the project are mainly facility construction (reservoir, pumping station, main canals, secondary canal network, discharge tanks, regulating tanks,

drainage boxes, plot construction for paddy field), procurement of equipment (5 pumps, solar panels, hoses, etc.) and capacity building program (soft component). Figure 1 shows the location of the irrigation facilities developed under the project.

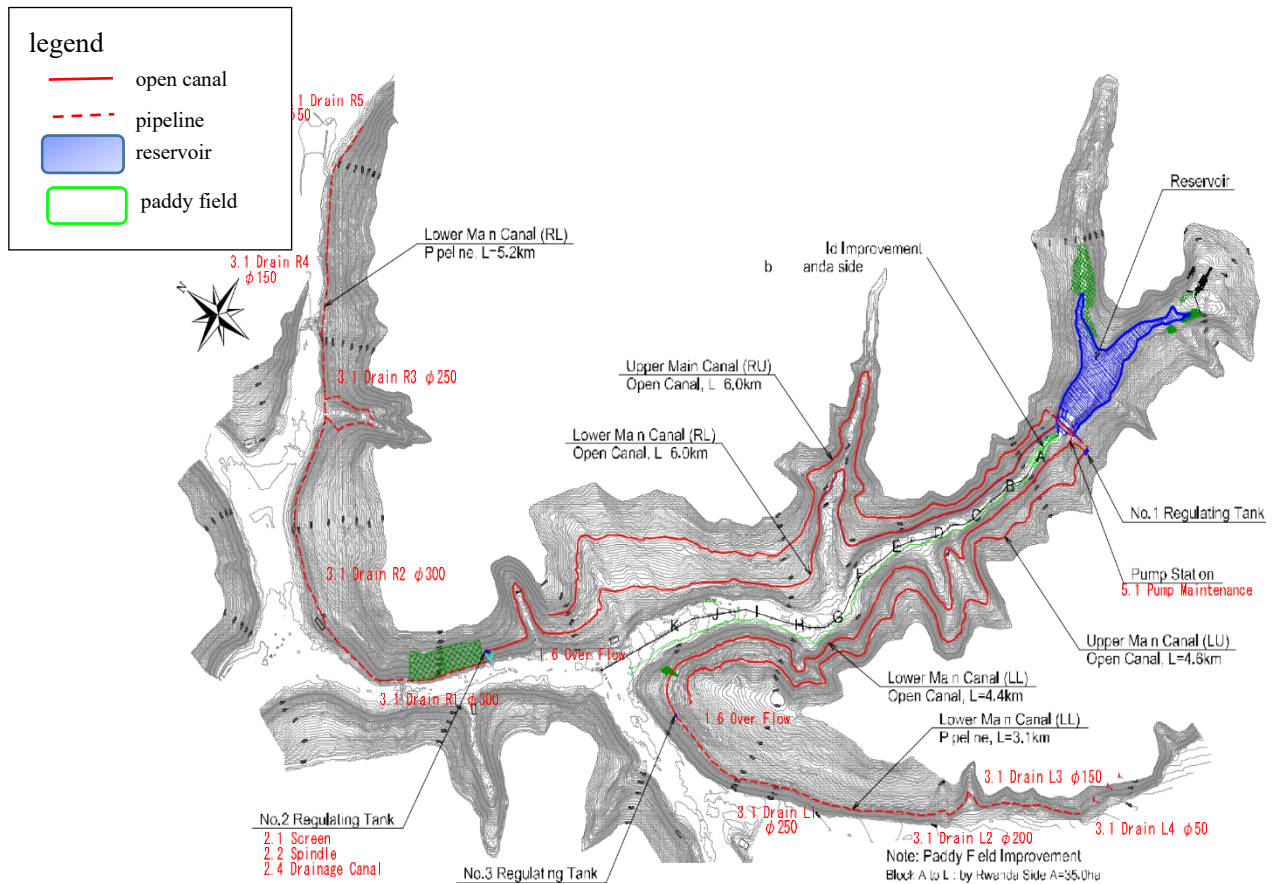


Figure 1 Location of irrigation facilities<sup>6</sup>

Irrigation facilities were constructed as shown in Table 1, and outputs were produced almost as planned. The Japanese side canceled the plot construction of the paddy field because the total project cost would exceed the grant amount due to the exchange rate fluctuation, and the Rwandan side bore the plot construction work. At the time of the defect inspection in July 2018, the completion of plot construction of the paddy field was confirmed. In addition, to implement the project within the maximum amount of the grant due to exchange rate fluctuations, it was decided to exclude heavy machinery for paddy field plot construction (tractors, levelers, ditch diggers), boats for dam maintenance, and other equipment not directly affecting the construction of irrigation facilities from the procured equipment. This change was unavoidable and appropriate.

<sup>6</sup> Compiled by the external evaluator from documents provided by JICA.

Table 1 Outputs (Japanese side)

Facility	Plan	Actual
1. Dam and reservoir	<ul style="list-style-type: none"> <li>• Storing capacity : 960,000m<sup>3</sup></li> <li>• Bank height : 14.9m</li> <li>• Dam type : Homogeneous fill dam</li> <li>• Spill way : RC type, Rectangular open canal</li> <li>• Discharge facilities for low water level: 1 set</li> <li>• Intake facilities on both banks: 1 set</li> <li>• Other ancillaries: 1 set</li> </ul>	As planned
2. Pump station	<ul style="list-style-type: none"> <li>• Pump house: RC type, Direct foundation</li> <li>• Pump equipment: Horizontal centrifugal pump (11kw×5 pumps)</li> <li>• Solar panel: 280W、24V、153 panels</li> </ul>	[Modification] Solar panel: 181 panels
3. Main irrigation canal (Open canal, Pipeline)	<ul style="list-style-type: none"> <li>• Open canal: Concrete lining, Length 18.7km</li> <li>• Pipeline: Length 8.1km</li> <li>• Diversion box, Drainage facilities: 1 set</li> </ul>	[Modification] <ul style="list-style-type: none"> <li>• Open canal: Length <b>21.0km</b></li> <li>• Pipeline: Length <b>8.3km</b></li> </ul>
4. Discharge tank	<ul style="list-style-type: none"> <li>• No.1 Discharge tank: 3.75m×2.0m</li> <li>• No.2 Discharge tank: 3.75m×2.0m</li> <li>• No.3 Discharge tank: 2.0m×2.0m</li> </ul>	As planned
5. Regulating tank	<ul style="list-style-type: none"> <li>• No.1 Regulating tank: RC type, Capacity 1,500m<sup>3</sup></li> <li>• No.2 Regulating tank: RC type, Capacity 330m<sup>3</sup></li> <li>• No.3 Regulating tank: RC type, Capacity 120m<sup>3</sup></li> </ul>	As planned
6. Drainage box	<ul style="list-style-type: none"> <li>• Drainage collection box: 185 boxes, Drainage canal</li> </ul>	[Modification] <ul style="list-style-type: none"> <li>• Drainage collection box: <b>219</b> boxes</li> </ul>
7. Secondary canal and on-farm facilities	<ul style="list-style-type: none"> <li>• Pipeline: Length 26.7km</li> <li>• Hydrant: 1 set</li> </ul>	[Modification] <ul style="list-style-type: none"> <li>• Pipeline: Length <b>26.2km</b></li> </ul>
8. Plot construction for existing paddy field	<ul style="list-style-type: none"> <li>• Plot construction: 1 set</li> <li>• Diversion box: 12 places</li> <li>• Irrigation canal/drain and O&amp;M road: 3.85km</li> </ul>	[Modification] <ul style="list-style-type: none"> <li>• Plot construction: Plot construction was canceled. Rwanda was to bear the cost of the work.</li> </ul>

Source: Materials provided by JICA

Under the soft component, activities (technology transfer) on “IWUO Operational Capacity Strengthening,” “Inland Aquaculture,” “Irrigation Facility Maintenance and Water Management,” “Farming Technology (Horticulture),” “Farming Technology (Paddy),” and



“Water Storage Test” were carried out to RAB staff, IWUO Executive Committee members, IWUO member representatives, District Irrigation Steering Committee (hereinafter referred to as “DISC”), Sector agronomists, and others as planned. The post-training tests and questionnaires on training materials and understanding showed that the training was well understood and outputs were achieved.

As for the Rwanda side’s outputs, the plot construction of the paddy field and terracing works of hillside farmland had already been implemented at the time of the ex-post evaluation; however, the safety fence had not yet been implemented. According to the executing agency, they plan to apply for the budget in the new fiscal year (from July 2022).

### 3.2.2 Project Inputs

#### 3.2.2.1 Project Cost

Table 2 shows the planned and actual project costs. While the planned project cost for the Japanese side was 1,549 million yen, the actual cost was 1,548 million yen (195 million yen for design and construction supervision and 1,353 million yen for the construction work), which was 100% of the planned cost and within the plan. The project cost on the Rwandan side was scheduled to be approximately 60 million yen; however, the actual cost was 144 million yen. The actual cost on the Rwandan side significantly exceeded the plan due to securing land, compensation for residents, terracing of hillside farmland, and plot construction of the paddy field that was changed from the Japanese side to the Rwandan side.

The total project cost for the Japanese and Rwandan sides was 105% of the plan, which slightly exceeded the plan.

Table 2 Project cost

	Plan	Actual	Ratio against the plan
Japanese side	1,549 million yen	1,548 million yen	100%
Rwandan side	Approx. 60 million yen	144 million yen	240%.
Total	Approx. 1,609 million yen	1,692 million yen	105%.

Source: Documents provided by JICA for planned and actual figures for the Japanese side. The actual figure for the Rwandan side was provided by the executing agency.

Note: Actual project cost of the Rwandan side was 940 million Rwanda francs (Rwf), converted to yen using the 2014-2016 average IFS rate.

### 3.2.2.2 Project Period

While the project period was planned to be 23 months (including the detailed design and bidding period), the actual project period was 27 months, slightly exceeding the plan (117% of the plan). The project period exceeded the plan mainly due to the following reasons. (1) The detailed design required a review of the project components, which took time to coordinate with the executing agency, resulting in a one-month delay in the bidding period from the original plan and a one-month delay in the completion accordingly. (2) As a result of checking the geological conditions beneath the dam, the thickness of the defective soil was thicker and broader than initially expected; it was found to be necessary to excavate the defective soil and replace it with good-quality soil. As a result, the work schedule was reviewed, and a three-month extension was necessary.

Therefore, efficiency of the project is high.



Solar panels for pump operation



Pumps



Reservoir

## 3.3 Effectiveness and Impacts<sup>7</sup> (Rating: ②)

### 3.3.1 Effectiveness

#### 3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

“Irrigated area (hillside farmland),” “Planted area (hillside farmland),” and “Irrigation time savings for paddy cultivation” were set as the operation and effect indicators of the project. Of these, “Irrigated area (hillside farmland),” as the operation indicator, was achieved in the project completion year of 2016.

<sup>7</sup> When providing the sub-rating, Effectiveness and Impacts are to be considered together.

Table 3 Operation Indicator

	Baseline value	Target value	Actual value		
	2013	2019	2016	Revised target year 2020	Year of the ex-post evaluation 2021
		3 Years After Completion	Completion Year	4 Years After Completion	5 Years After Completion
Indicator 1 Irrigated Area of hillside farmland (ha)	26	265	265	265	265

Source: documents provided by JICA (target value), documents provided by the executing agency (actual values)

The effect indicator, “Planted area (hillside farmland),” is shown in Table 4. It was assumed that it would take one year from the completion of dam construction to water storage and start of the operation; that is, the target year for operation and effective indicators was set as “three years after project completion.” However, due to the unforeseen weather condition that the precipitation in 2016 was lower than the most severe drought year in the past 30 years, the minimum water level of the reservoir was not reached, and the reservoir was put into operation two years after the completion of the dam construction (in July 2018). Therefore, the target year was set to 2020, one year later than the planned 2019, three years after the completion of the project.

The total planted area did not meet the target value in the revised target years 2020 and 2021 (51% and 65% of planned); however, the area planted in 2022 was 89% of the target. In Rwanda, cropping is carried out in three seasons: Season A (August to January), Season B (February to May), which are rainy seasons, and Season C (June to August), the dry season. The implementation of the project has made it possible to plant crops in Season C (dry season), even in hillside farmland; however, the increase in the planted area has been limited to a certain extent. On the other hand, as described in “3.3.1.2 Qualitative Effects,” in Seasons A and B (rainy season), there has been a shift from conventional crops such as maize and beans to a new crop, chia seed. The area planted with chia seed increased significantly in Seasons A and B to a total of 195 ha in 2021 and 317 ha in 2022, which greatly impacted the increase in area planted in 2022.

There are two main reasons why the total planted area did not reach the plan in 2020 and 2021. Firstly, pipelines after the No. 2 and No. 3 regulating tanks had not been functioning due to blockages caused by the inflow of grass and trees of unexpected size and sediment. As a result, 60 to 100 ha of the pipeline area has not been planted in Season C (dry season). RAB identified a blockage in pipelines in the spring of 2020. However, according to the interviews at the site

(WAMCAB staff, IWUO, and farmers<sup>8</sup>), the pipelines have not been used since the completion of the project, and there was no communication among the parties concerned (RAB, IWUO, DISC, etc.) regarding the situation. Nonetheless, in May 2022, based on the construction supervision by the project consultant, the local contractor carried out the installation of screens on the regulating tanks to prevent the inflow of sediment and foreign materials from the regulating tanks to the main pipelines and the installation of flushing functions (9 places) on the main pipelines. As a result, it is expected that the pipelines will be reopened to water and that crop planting will occur. Secondly, planting new crops in Season C (dry season) has not progressed. At the time of planning, from the viewpoint of marketability, productivity, and food security, it was planned to plant traditional crops such as maize and beans in Seasons A and B (rainy season) and to plant new crops such as vegetables in Season C (dry season). The new vegetable crops were to be grown in the hillside farmland; however, the barriers for farmers to change from staple crops to new crops are high as it requires knowledge and funds. It is taking time to expand the area for new crops. The executing agency, RAB, will continue to guide farmers.

According to RAB and farmers, the impact of COVID-19 has been minimal. According to RAB, the government has allowed farmers to continue their activities during the lockdown period. However, restrictions on the movement of goods and services have restricted access to markets, resulting in a slight impact on the area planted.

Table 4 Effect Indicators

	Baseline value	Target value	Actual value		
	2013	2019	Revised target year 2020	Year of the ex-post evaluation 2021	Year of the ex-post evaluation 2022
		3 Years After Completion	4 Years After Completion	5 Years After Completion	6 Years After Completion
Indicator 1 Planted area of hillside farmland (ha)	99	610	312	398	542
(Breakdown)					
Season A	—	—	89	165	291
Season B	—	—	115	170	235
Season C	—	—	108	63	17

<sup>8</sup> A qualitative survey of farmers: A total of 35 farmers (18 males and 17 females) (average farmland size 0.7 ha) from (1) Rurenge Sector hillside farmers, (2) Rurenge Sector marshland rice farmers, (3) Remera Sector hillside farmers, (4) Remera Sector marshland rice farmers and (5) Remera Sector hillside farmers (land subject to pipelines) were interviewed on the effectiveness and impact of the project.

Source: documents provided by JICA (target value), documents provided by the executing agency (actual values)

Note: In 2022, Season A is August 2021 - January 2022, Season B is February - May 2022, and Season C is June - August 2022.

In addition, “Irrigation time savings for paddy cultivation (man-day/ha)” is listed in the ex-ante evaluation sheet as an indicator. However, this indicator could not be obtained because the executing agency did not have a system to collect and monitor the indicator and did not measure the data accordingly. Interviews with marshland rice farmers confirmed the reduction of labor hours. They no longer have to wait for water because water is now distributed according to a timetable. Besides, they had to wait for water for eight hours before the project was implemented, but now it takes less than 30 minutes to irrigate one plot (4 ares).

### 3.3.1.2 Qualitative Effects (Other Effects)

#### (1) Change of crop

The project was expected to shift to more profitable crops in the hillside farmland. In the hillside farmland, traditional crops such as maize and beans had been grown under rainfed conditions. However, after the implementation of the project, vegetables (cabbage, tomato, carrot, red pepper, etc.) and fruits were grown during season C, which is the dry season.

Especially profitable chia seeds have been introduced in recent years. Of the approximately 1,068 members of the target IWUOs, 323 had introduced chia seeds at the time of the ex-post evaluation. The area planted with chia seeds increased significantly from 15 ha in 2020 (season B only) to 195 ha in 2021 and 317 ha in 2022 (seasons A and B combined), indicating a significant change in cropping patterns. Chia seed is grown in the rainy season (seasons A and B) and can be grown without irrigation water; however, the contract with a buyer requires the land to be irrigated (since insufficient water at the time of sowing and transplanting may delay growth). The irrigation facility development by the project was the trigger for the change of crop type.

#### (2) Strengthening of Irrigation Water Users Organization (IWUO)

As a result of the soft component, it was expected that IWUO would be operated sustainably and soundly after the completion of the project. As a result, RAB, Ngoma DISC, and other concerned agencies would steadily play their roles to sustainably maintain the facilities developed under the project. Irrigation at the right time and amount to meet the demands of IWUO members was expected. Further, it was expected that 100% of the water use fees would be collected and the funds would be used for maintenance.

However, the qualitative effect in terms of strengthening IWUO was limited. At Ngoma 22, the project site, IWUO did not exist before the implementation of the project. Although the soft component of the project supported the establishment of IWUO, interviews with RAB and

farmers indicated that after the completion of the project, until April 2019, when WAMCAB, a technical cooperation project, started working at the site, IWUO was not functioning. Due to the delay in the start of the utilization of irrigation water as described in “3.3.1.1 Quantitative Effects” and the significant time lag between the project completion and the start of irrigation, IWUO did not conduct proactive activities, such as regular cleaning and maintenance of the pipelines. The lack of functioning IWUO can be said to be a contributing factor to the blockage of the pipelines. As discussed in Section “3.4 Sustainability,” IWUO was operating at the time of the ex-post evaluation; however, this cannot be attributed to the effects of the soft components.

### (3) Strengthened farmer ownership of irrigation facilities

Farmers’ ownership of irrigation facilities was also observed. However, this fostering was also influenced by the WAMCAB and cannot be attributed to the project. The WAMCAB magnified the IWUO and organized the end-users into groups. The farmers now have a high sense of ownership because they plan and apply for water allocation from the bottom up, from the irrigation unit (consisting of five or six farmers), the water use team (composed of five or six irrigation units), and to the zone committees. Besides, they send representatives to the IWUO General Assembly. Ownership has also been further enhanced by members cleaning the main and secondary canals once a month or as needed as community work.

## 3.3.2 Impacts

### 3.3.2.1 Intended Impacts

Among the effects assumed in the ex-ante evaluation sheet, “main crop unit yield,” “agricultural gross income,” “stabilization of residents’ living and livelihood, and cooperation between hillside farmers and paddy farmers” were classified as the impacts.

#### (1) Quantitative effects: main crop unit yield

Table 5 shows the yield of the main crops before and after the implementation of the project. The target values were almost achieved among the main crops except for carrots. As for carrots, few farmers are still planting carrots, and RAB will continue to encourage them to grow carrots which have high productivity. The average unit yield of chia seed is about 1.2 t/ha in the project area (Season A and Season B in 2021). Since the average unit yield of chia seed is 450-1,250 kg/ha<sup>9</sup>, it can be said that the unit yield of chia seed is relatively high in the project area.

As for paddy rice, interviews with farmers confirmed that they did not have enough water before the project was implemented, but now that they have enough water, their yield has increased.

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<sup>9</sup> Source: Data provided by the executing agency and <https://www.agrifarming.in/chia-seeds-cultivation-sabja-farming> (accessed on March 8, 2022)

Table 5 Main Crop Unit Yield

	Baseline value	Target value	Actual value		
	2013	2019	2016	Revised target year 2020	Year of the ex-post evaluation 2021
		3 Years After Completion	Completion Year	4 Years After Completion	5 Years After Completion
Indicator 1 Main Crop Unit Yield (kg/ha)					
1-1Paddy (% of target)	4,000 -	6,000 -	4,000 67%	5,300 88%	5,500 92%
1-2Maize (% of target)	2,000	5,000	0 0%	4,500 90%	5,000 100%
1-3 Carrot (% of target)	10,000	25,000	0 0%	14,000 56%	15,000 60%
1-4 Tomato (% of target)	10,000	20,000	0 0%	30,000 150%	31,500 157%
<Reference> Chia seed	-	-	-	600	1,240

Source: documents provided by the executing agency

Note: (i) maize: seasons A, B; (ii) carrots and tomatoes: seasons A and B in 2019, season C in 2020, 2021; (iii) chia seeds: season B in 2020, seasons A, B in 2021

## (2) Agricultural gross income

In the ex-ante evaluation sheet, the agricultural gross income per household (Rwf/year/household) was set as the quantitative effect; however, RAB did not collect this data. Nonetheless, almost all farmers interviewed indicated that the amount of gross income had increased compared to before the project was implemented.

The impact of chia seeds on improving agricultural gross income is significant especially, based on interviews with farmers. Although chia seeds do not use irrigated water, being on irrigated land is a prerequisite for contracts with the buyer. The farmers belong to KOTUNGO, an agricultural cooperative specializing in chia seeds (all members are IWUO members). Under the contract between the buyer and KOTUNGO, they jointly purchase seeds and ship the products, thereby increasing their cash income<sup>10</sup>. Rice is also jointly sent to the market through the rice cooperative that has existed for a long time, while other crops are consumed at home or sold privately.

<sup>10</sup> During the field visit under this ex-post evaluation study, no negative information was obtained from farmers, KOTUNGO, IWUO, Sector agronomists, WAMCAB, and RAB. Most of the farmers interviewed were satisfied with the gain from the chia seed. However, after the information collection, RAB told us that after the success in the first year, farmers registered economic losses due to unstructured market.

The farmers interviewed reported many positive impacts of increased agricultural gross income, including improved quality of life and increased investment in agriculture. All the farmers talked about how their increased cash income has enabled them to renovate their houses, buy motorcycles, pay for their children's education, and pay for medical health care. They have also been able to purchase livestock such as cattle and goats, purchase new farmland, hire people at cropping and harvest time, and make other agricultural investments. The ability to borrow money from banks has also contributed to the increase in agricultural investment. Belonging to agricultural cooperatives has enabled many farmers to have personal bank accounts, and as a result, they have been able to borrow money from banks.

Furthermore, it was reported that before the implementation of the project, vegetables were purchased from the market. However, they can cover their consumption now. And before the implementation of the project, there was malnutrition because vegetables could not be purchased. However, they can grow vegetables in season C now, so they are well-nourished after the implementation of the project.

### (3) Cooperation between different communities and between hillside farmers and marshland paddy farmers

As a qualitative effect, increased cooperation between the different communities (Rurenge and Remera sectors) and between hillside and paddy farmers was expected. According to interviews with farmers, information sharing has been achieved through participation in IWUO General Assembly and other activities, and trust between different sectors and marshland and hillside farmers was built.

### (4) Differences in benefits by beneficiaries

As mentioned above, chia seed is grown in seasons A and B and can be grown without irrigation water; however, the contract with the buyer is conditional on the land being irrigated. Since land under the pipelines that are not currently irrigated also meets this condition, farmers there also participated in the cultivation of chia seeds and their joint shipment at the farmers' cooperative. They were satisfied with the increase in gross income from chia seeds. However, although they were satisfied with the revenue from chia seeds, they considered it more desirable if they could plant the crops during season C (dry season), considering the needs for food security. They are not complaining as they are not paying for water but feel they are not enjoying the same benefits as the farmers under the open canals. However, it is expected that the measure to resume pipeline water supply (implemented in May 2022) will enable farmers in the pipeline areas to plant crops in Season C (dry season).

In addition, farmers who do not own much land have not been able to grow chia seeds because the contract for the chia seeds buyer requires the ownership of farmland over a certain area (0.5



ha). However, according to interviews with farmers, farmers who do not grow chia seeds are satisfied because they can now plant in Season C (dry season), and their gross income had increased compared to before the project was implemented. The agricultural cooperative encourages farmers with small holdings to receive the benefits of chia seeds through co-cropping.

### 3.3.2.2 Other Positive and Negative Impacts

#### (1) Impacts on the Natural Environment

The project does not fall under the large-scale category under the agricultural sector, and hydropower, dam and reservoir sector in *the Guidelines for Environmental and Social Considerations of the Japan International Cooperation Agency* (formulated in April 2004). The undesirable impacts on the environment were considered insignificant, and the project does not fall under the sensitive characteristics and areas listed in the said guidelines; therefore, the project was classified as Category B. RAB did not monitor the irrigation facilities during construction and in service as the negative impacts on the natural environment were considered low, and adverse impacts on the natural environment during the operation were minimum. According to interviews with RAB, IWUO, and farmers, there have been no adverse effects on noise, water quality, or water quantity during construction and after service.

#### (2) Resettlement and Land Acquisition

At the time of planning, it was assumed that the project would result in the acquisition of approximately 4 ha of private land and submergence of 22 ha in the marshland (state-owned land); however, no resettlement would occur. According to the executing agency, resettlement has not happened. The evaluator attempted to confirm the details of land acquisition and compensation for private land; however, the response was not obtained during this ex-post evaluation. According to the executing agency, adequate compensation was provided in accordance with Rwandan law. Some farmers used the submerged state-owned lands as paddy field informally, but according to Rwandan law, such cases were not compensated. However, the area of paddy field has recovered after the plot construction, and the paddy farmers who were allocated land due to the plot construction have not lost any land for cultivation. In addition, according to the IWUO president, the acquisition of land and submerged land has not caused any negative impact on the farmers.

#### (3) Gender Equality, Marginalized People, Social Systems and Norms, Human Well-being and Human Rights, and others

According to the farmers' interviews, the project positively impacted women. In the marshland rice farmers, women were put off getting water compared to men because of the limited amount of water before the project implementation; however, after the project completion, women have equal access to irrigation water because there is enough water. There are no conflicts over water

accordingly.

#### (4) Unintended Positive/Negative Impacts

The main canals of the project consist of a lower main canal that uses the dam weir level as it is and delivers water by gravity and an upper main canal that pumps the water and then forwards it by gravity. In this project, a solar system was installed as the primary power source for pump operation.<sup>11</sup> According to RAB, the solar system is installed in other irrigation schemes in their project (Small Scale Irrigation Project) because the electricity cost is low (irrigated area: about 800 ha).

Thus, among the expected effects, the irrigated area was as planned, and the time required for irrigation also improved. The total planted area reached 89% of the target in 2022 but did not reach the target in 2020 (target year) and 2021. This situation happened mainly because some irrigation facilities were not utilized due to the blockage of pipelines.

Meanwhile, the expected impact, such as an increase in agricultural gross income, was achieved by shifting to a more profitable crop, chia seed, for which irrigated land is a prerequisite for contracts with the buyer, and chia seeds contribute to an increase in agricultural gross income. It seems natural for farmers to choose chia seeds to increase their income. However, it is difficult to say that it is an appropriate use of irrigated land, although it is evaluated that the project has added the value of “irrigated land” for the site for chia seed production. The project’s negative social, environmental, and economic impacts are considered negligible.

In light of the above, the project has achieved its objectives only to a certain extent. Therefore, effectiveness and impacts of the project are moderately low.

### 3.4 Sustainability (Rating: ③)

#### 3.4.1 Policy and System

As mentioned in “3.1.1.1 Consistency with the Development Plan,” sustainability in terms of policy and system is ensured, as increased irrigated area, increased land productivity, and value-added agriculture are targeted in PSTA4 and the *RAB Strategic Plan*.

#### 3.4.2 Institutional/Organizational Aspect

##### (1) Irrigation Water Users Organization (IWUO)

The irrigation facilities developed under the project are operated by the Irrigation Water Users

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<sup>11</sup> Under the unique topographical conditions of Rwanda, where narrow river basins exist between hills, the topographical survey revealed that the area that could be irrigated only by gravity irrigation was significantly insufficient for planned purposes. The introduction of relatively inexpensive solar pumping systems (distributed in several locations) was planned. After a comparative study of the layout of pumping facilities, including solar pumps and power supply facilities, it was decided that the current integrated installation of a water storage pumping station (solar power generation plus commercial electricity) would enable a stable supply of irrigation water for a small monthly expense, and the project would quickly produce benefits and be highly sustainable, leading to the adoption of the system.

Organization (IWUO). The Government transferred the facilities to District which ensures right management by IWUO. With the support of WAMCAB, the technical cooperation project, the IWUO has been restructured and functioning as a water users' association with farmers in the project site (Ngoma 22) and a site called Mwamba. At the time of ex-post evaluation, about 1,800 households (including 1,068 households in Ngoma 22, the project site) were members of the IWUO. The Executive Committee (President, Finance Officer, and Infrastructure Officer), under the IWUO General Assembly, has functioned. In addition, Dispute Resolution Committee and Audit Committee have been formed, with committee members drawn from both marshland and hillside areas.

The General Assembly is held twice a year with representatives of 12 zones (5 from each zone), six zones each of hillside and marshland. The agenda of the General Assembly includes financial reports, IWUO rule changes, audit reports, and reports on maintenance and others. The paid staff consists of a pump operator, a manager, security guards, cleaners, and water distribution management.

#### (2) Rwanda Agriculture and Animal Resources Development Board (RAB)

The executing agency, RAB, has supported the IWUO through its headquarters and field office, Ngoma Station.

The Land Husbandry, Irrigation Innovation and Technology Transfer Department is in charge at the RAB headquarters. The Department has 52 staff members, three of whom are involved in the project: the Head of the Department, the Land Husbandry and Irrigation Innovation Specialist, and the IWUO Specialist. At the time of the project's completion, an IWUO Support Unit in RAB was responsible for establishing and operating IWUOs. However, it does not exist as a unit, and there is one IWUO specialist at the headquarters. This specialist supervises irrigation schemes across the country, checks their financial status and accounts, and coordinates them.

At the field level, at the time of the ex-post evaluation, the Ngoma Station supports the project. The station covers three districts, including Ngoma District. An electrical engineer, a small-scale irrigation engineer, and an agricultural officer will provide the necessary support for irrigation.

RAB has limited staff at both headquarters and Ngoma Station compared to the volume of work and cannot conduct regular follow-ups of the IWUO and project facilities; however, it is supposed to provide support when requested by the IWUO. RAB's undertakings are complemented by DISC, Sector agronomists, IWUO etc. As indicated in "3.3.1.1 Quantitative Effects," coordination issues have existed, and the IWUO has not immediately informed RAB of any problems with the facilities; however, these mechanisms are also expected to be improved through strengthening them through WAMCAB. According to RAB, they are also planning to increase the number of staff through reorganization.

### (3) District

In Rwanda, DISC coordinates all irrigation-related activities, approves irrigation facility repairs, etc. The sector agronomists, agricultural cooperatives, IWUOs, etc., attend the DISC meeting. DISC did not have meetings for the past two years due to COVID-19. However, DISC resumed in May 2022 and is expected to continue functioning.

Thus, sustainability of the institutional/organizational aspect is generally ensured. However, there are some issues, such as a shortage of personnel.

#### 3.4.3 Technical Aspect

The technical cooperation project, WAMCAB, which aims to “improve the irrigation management capacity of IWUOs,” is being implemented until 2025 and is expected to continue strengthening IWUOs’ operational capacity, maintenance capacity, and farming techniques. In addition to experts, WAMCAB hires a manager for the IWUO at Ngoma 22 to support the day-to-day management of the IWUO. WAMCAB will also provide technical guidance (on-the-job training) to the IWUO on current facility deficiencies, as discussed below.

RAB hires professional pump operator and water distribution superintendents and contracts a security company to provide security for irrigation facilities. Going forward, this should be catered by IWUO.

As for the solar system, the electrical engineer at the RAB Ngoma Station has expertise in solar systems and will be on hand to address any issues that arise.

Thus, capacity strengthening through the technical cooperation project has continued, and technological sustainability has generally been ensured.

#### 3.4.4 Financial Aspect

For IWUO, water use fees of about Rwf 7 million per year (Rwf 7.7 million in 2021) are collected and used for minor repairs of facilities, and other necessary maintenance costs are being paid. For marshland rice farmers and chia seed farmers, water use fees are automatically deducted from the sales proceeds paid to farmers by the agricultural cooperatives which ship the crops jointly. Thus, collection of water fees is assured. However, water use fees are not paid for crops that do not go through agricultural cooperatives, and there are about 215 farmers who have not paid the water use fees in season B of 2021. Raising awareness, capturing, and collecting fees is being conducted by IWUO and WAMCAB for these farmers.

As for IWUO’s paid staff, the manager is employed and paid by WAMCAB; from April 2022, IWUO will also pay part of the salary, and according to RAB, IWUO has the ability to pay the manager’s salary in the future. In addition, the wages of security guards (reservoirs, canals, etc.)

and cleaning personnel are paid by the IWUO.

RAB pays part of the costs for the operation and maintenance of the project facilities, including the cost of electricity<sup>12</sup> for pump operation, personnel costs for a pump operator and water distribution managers, and security costs (mainly contracting a security company to provide security for solar panels, pump facilities, etc.). According to RAB, fuel and personnel expenses for the past three years totaled approximately Rwf 402 million. In addition, over the past three years, about Rwf 94 million has been spent on purchasing spare parts such as valves, air vents, and hoses. In addition, RAB has a Government Funded Irrigation (GFI) budget, which is a source of funding for the repair of government irrigation facilities, and can be used to repair the project facilities as required.

Thus, financial sustainability is mostly ensured; however, there are some issues, as some water use fees have not been collected.

#### 3.4.5 Environmental and Social Aspect

No environmental or social concerns were identified at the time of the ex-post evaluation. Therefore, there are no sustainability risks in this aspect.

#### 3.4.6 Preventative Measures to Risks

No other sustainability risks were found.

#### 3.4.7 Status of Operation and Maintenance

As for daily maintenance, the regulating tanks, diversion boxes, drainage collection boxes, and solar panels are cleaned and maintained monthly by IWUO-paid staff and temporary workers. The open canals are cleaned twice a month during the dry season and once a week during the rainy season. Spare parts are managed and obtained by RAB.

As for the status of the facilities, in addition to the elimination of the blockage of the main pipeline as described in “3.3.1.1 Quantitative Effects,” the following problems were observed during the ex-post evaluation: (1) slope collapse due to erosion caused by sediment inflow and overflow from the open canals during heavy rain. (2) partial pump failure (although the primary power source is a solar panel, a problem with the soft starters that control the voltage when commercial power from the grid is used causes problems in the operation of one pump). RAB will apply for a budget for the new fiscal year (from July 2022), and RAB will purchase the soft starters and repair the slope collapse.

Other deficiencies, such as inadequate drainage at the end of open canals and partial blockage of secondary canals due to insufficient cleaning and difficulty in desludging, will be addressed by

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<sup>12</sup> After the field visit, RAB informed us the cost of electricity is now under the IWUO.

the IWUO with technical guidance and support from the WAMCAB.

As described above, the operation and maintenance status of the facilities was not satisfactory at the time of the ex-post evaluation; however, improvements are expected, and therefore, no problems were found.

Thus, slight issues have been observed in the institutional/organizational and financial aspects, including the current status of operation and maintenance; however, there are good prospects for improvement/resolution. Therefore, sustainability of the project effects is high.

## **4. Conclusion, Lessons Learned and Recommendations**

### 4.1 Conclusion

The project aimed to promote efficient use of agricultural water and intensive agriculture by developing irrigation facilities in Rurenge and Remera Sectors, Ngoma District, Eastern Province, and thereby contribute to improving agricultural productivity. The project was consistent with Rwanda's development plan and needs both at the time of planning and ex-post evaluation, and its relevance can be confirmed. The project was consistent with Japan's ODA policy for Rwanda. Although it was not envisaged at the time of planning, it was consistent with other projects of JICA and with other development partners. Therefore, the relevance and coherence are high. The project produced outputs almost as planned, and although the project cost and project period slightly exceeded the plan, the efficiency of the project is high. Among the expected effects, the irrigated area was in line with the plan, and the time required for irrigation was also improved; however, the total planted area did not reach the target value. On the other hand, the expected impact, such as an increase in agricultural gross income, was achieved by shifting to more profitable crops; however, the impact of the chia seed, which does not use irrigation water, was significant. Therefore, the effectiveness and impact of the project are moderately low. The operation and maintenance of the project facilities has some minor problems in terms of institutional/organization and financial aspects as well as the status of operation and maintenance; however, they are expected to be improved/solved, and therefore, the sustainability of the project effects is high. In light of the above, the project is evaluated to be satisfactory.

### 4.2 Recommendations

#### 4.2.1 Recommendations to the Executing Agency

##### (1) Responding to irrigation facility failures

At the time of the ex-post evaluation, some of the facilities and equipment, such as pump station equipment (e.g., soft starters) and slope collapses, were defective. It is recommended that RAB should allocate in the FY2022/2023 budget (from July) the amount necessary for these repairs

and take necessary measures. It is also recommended that the safety fence, which was to be installed upon project completion as an expense to be borne by Rwanda, be installed in the FY2022/2023 budget.

#### (2) Maximizing the use of agricultural land

The planted area has not reached the target, especially concerning Season C. It is expected that the area planted in season C will increase as a result of the pipeline rehabilitation. RAB should provide appropriate outreach and technical guidance to farmers to increase the planting of new crops and maximize land use.

#### 4.2.2 Recommendations to JICA

It is desirable to follow up on RAB response items and IWUO response items with WAMCAB support for the planned measures on the irrigation facility failures.

#### 4.3 Lessons Learned

##### The necessity of cooperation with technical cooperation projects during and after completion of the project and technical assistance after completion of the project

If the operation and maintenance organization (user organization) has not been established before the project implementation, short-term support through training by the soft component during the project implementation is not sufficient. Long-term support in cooperation with the technical cooperation project or longer-term soft component beyond the completion of facility construction is desirable.

In the project area, the IWUO was not yet established before the implementation of the project, so the members (farmers) did not have experience, knowledge, and skills in IWUO operation. In addition, it took time for the reservoir to reach the minimum water level due to unfavorable weather conditions. There was a gap between the project completion (November 2016) and the actual availability of irrigation functions (July 2018). IWUO was not able to experience the maintenance of the facilities during that time. As a result, the IWUO was not functional until WAMCAB, the technical cooperation project, was on site in 2019, and regular cleaning and maintenance were not performed, leading to sediment deposition and pipeline malfunction. At the time of the ex-post evaluation, the IWUO had significantly improved its operational and maintenance capacity with the help of WAMCAB. However, to ensure appropriate organizational operation and maintenance, the IWUO should be supported by the technical cooperation project at a more appropriate time, during or immediately after the completion of infrastructure development under the grant aid project. Or, it is necessary to implement longer-term soft components and provide long-term support.

### Need to set appropriate indicators

In the project, agricultural gross income and irrigation time savings were set as operation and effect indicators; however, the executing agency did not have a system to collect and monitor them. It is necessary to set indicators that can be collected regularly after thorough consultation with the executing agency. In addition, regarding the total planted area of hillside farmland, one of the operation and effect indicators, the planted area per season (rainy season and dry season), was not set. The effect of season C, which is considered to obtain the most significant benefits on the planted area of hillside farmland due to irrigation, could not be accurately observed. When setting the indicators, it is necessary to break down the area per season.

## **5. Non-Score Criteria**

### 5.1. Performance

#### 5.1.1 Objective Perspective

JICA played an essential role and provided necessary support to the executing agency by giving them technical advice and implementing the project transparently through regular technical and financial reports, etc. JICA Rwanda Office and headquarters visited the sites several times and communicated well with the executing agency.