The Republic of Mozambique

FY2020 Ex-Post Evaluation Report of Technical Cooperation Project

"Project for Improving Research and Technology Transfer Capacity for Nacala Corridor Agriculture Development, Mozambique"

External Evaluator: Haruo Ito, ICONS Inc.

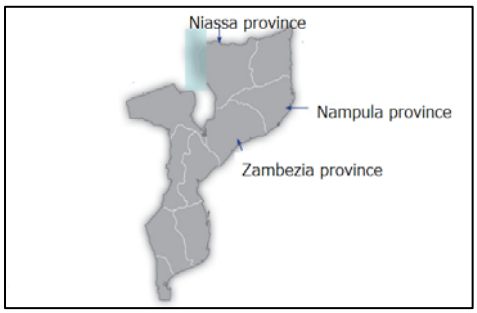
0. Summary

The tropical savannah region in the northern part of Mozambique, blessing with a sufficient amount of rainfall and a vast area of farmland, has high potential for expanding agricultural production. However, the extensive agriculture is practiced in much of the region and the productivity of both subsistence and commercial crops is not high. Under these circumstances, this project aimed to develop an appropriate agricultural development model for sustainable agriculture through improving the regional agricultural productivity mainly among small-scale farmers. Therefore, the project has improved the research capacity of the agricultural research institutes in the northeast and northwest regions under the Agricultural Research Institute of Mozambique (hereinafter referred to as "IIAM"), and transferred new agricultural technologies to pilot farmers through the triangular cooperation with Brazil which has a tropical savannah area with natural conditions similar to those of the project target area, and has expertise in agricultural development in that area. The evaluation found that the objective of the project is fully consistent with the development policy of Mozambique which aimed at improving agricultural productivity and competitiveness, and the development needs of the region. The project is also relevant with Japan's aid policy as well as the diplomatic strategy of the Brazilian government which include the promotion of the triangular cooperation, thus, the relevance of this project is high. As for the effectiveness and impact of the project, some outputs were not achieved because a part of the activities were discontinued in the middle of the project owing to the tight budget of the Brazilian aid agency, the partner in the triangular cooperation. However, considering that the project purpose and overall goal have been achieved and that other positive impacts were identified, such as increases in yields and farm incomes by using appropriate agricultural technologies, the effectiveness and impact of the project are high. On the other hand, actual project period and cost were exceeded the plan. Even though the increase in project period and cost due to the transfer of activities from the Brazilian side to the Japanese side are considered as an external factor, other factors such as a delay in the construction of the soil and crop analysis laboratory with increased expenses by the Japanese side also caused these increases. Therefore, the efficiency of the project is fair. The political and technical sustainability of the project is assured, allowing to continue research and extension activities of appropriate agricultural technologies transferred by the project. However, some issues have been identified in the institutional/organizational sustainability of the technical transfer from extension workers to farmers, and in the financial sustainability, such as securing the maintenance costs of the procured equipment. Therefore, the

sustainability of the project is fair.

Based on the above, the project is evaluated as satisfactory.

1. Project Description



Project locations (three northern regions)

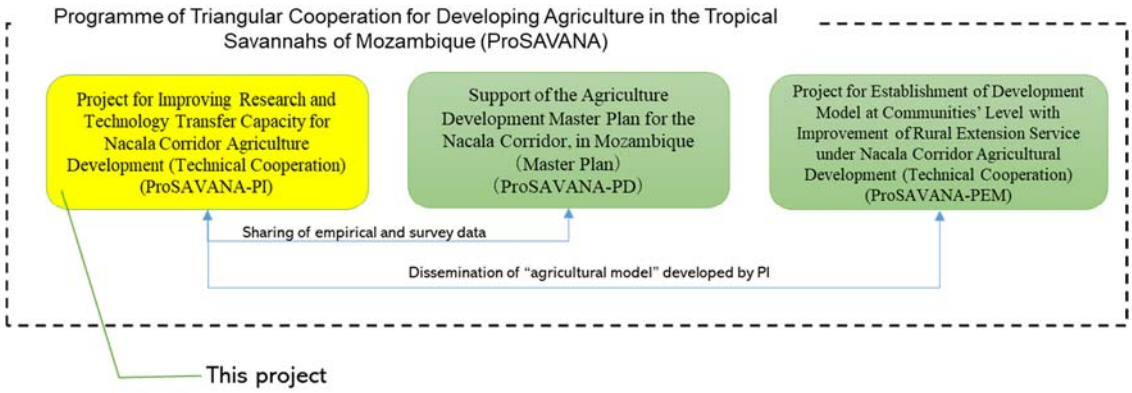
Training by IIAM staff

1.1 Background

The tropical savannah region in northern Mozambique is blessed with a sufficient amount of rainfall and a vast area of farmland and, therefore, has high potential for expanding agricultural production. However, the extensive agriculture is practiced in much of the region, resulting in low productivity for both subsistence and commercial crops. In addition, there are two agricultural research institutions under the umbrella of IIAM, the Institute of Agricultural Research of Mozambique Northeast Zonal Center (hereinafter referred to as the "IIAM CZnd") and the Institute of Agricultural Research of Mozambique Northwest Zonal Center (hereinafter referred to as the "IIAM CZno"), which are located in Nampula and Niassa provinces, respectively. However, owing to lack of a research capacity to the development of regionally appropriate agricultural technologies, these research institutes had difficulties in contributing to the improvement of agricultural productivity. In contrast, the Cerrados region in Brazil, which has similar conditions with large areas of uncultivated tropical savannah, has achieved an increase in grain production. The Cerrados agricultural development project, a joint initiative with Japan since the 1970s, has been implemented successfully and, as a result, many Brazilian engineers were trained and agricultural technologies developed. Consideration was given to the transfer of their knowledge and the technologies they developed to the savannah region of Mozambique. However, the socio-economic environment in Brazil and Mozambique is very different, confirming the need for a specific "agricultural development model" for farmers in the Nacala Corridor area that would help to select appropriate crops for the region. In order to achieve the goal, "accumulating the results of experimental research" and "implementing pilot projects" were identified as the most effective approaches. As a start, the project was requested for improving the research capacity of IIAM and demonstrating new agricultural technologies on the pilot farms.

As shown in Figure 1, the project was implemented in cooperation with the *Support of the*

Agriculture Development Master Plan for the Nacala Corridor in Mozambique (hereinafter referred to as "ProSAVANA-PD") and *Project for Establishment of Development Model at Communities' Level with Improvement of Rural Extension Service under Nacala Corridor Agricultural Development in Mozambique* (hereinafter referred to as "ProSAVANA-PEM") which are constituent projects of the *Programme of Triangular Cooperation for Developing Agriculture in the Tropical Savannahs of Mozambique* (hereinafter referred to as "ProSAVANA"). Specifically, this project planned to use the land map developed by ProSAVANA-PD and to disseminate the research results by using extension workers trained by ProSAVANA-PEM.



Source: drawn by the evaluator

Figure 1 Collaboration among ProSAVANA projects

1.2 Project Outline

Overall Goal		Appropriate agricultural technology is adopted in Nacala Corridor
Project Purpose		Appropriate agricultural technology is developed and transferred in Nacala Corridor
Outputs	Output 1	Capacity of IIAM research centers in Northeast and Northwest is strengthened
	Output 2	Natural resources and socio-economic conditions in Nacala Corridor are evaluated
	Output 3	Soil improvement technology for Nacala Corridor is developed
	Output 4	Appropriate cultivation technology for Nacala Corridor is developed
	Output 5	Technology transfer activities for extension workers are implemented on newly developed/validated agricultural technologies
Total cost (Japanese Side)		1,196 million JPY
Period of Cooperation		May 2011-November 2017 (Of which extension period: June 2016 - November 2017)
Target Area		21 districts in Niassa, Nampula, and Zambezia Provinces
Implementing Agencies		Ministry of Agriculture and Food Security (MASA[1]) Institute of Agricultural Research of Mozambique (IIAM)
Other Relevant Agencies/ Organizations		Brazilian Cooperation Agency (ABC) Brazilian Agricultural Research Corporation (Embrapa)

[1] In February 2020, the Ministry of Agriculture and Food Security was renamed the Ministry of Agriculture and Rural Development (MADER).

Consultant/ Organization in Japan	NTC International Co., Ltd. Japan International Research Center for Agricultural Sciences (JIRCAS)
Related Projects	【Technical Cooperation】 – Support of the Agriculture Development Master Plan for the Nacala Corridor, in Mozambique (2012-2020) – Project for Establishment of Development Model at Communities' Level with Improvement of Rural Extension Service under Nacala Corridor Agricultural Development in Mozambique (2013-2020) – Project for Nacala Corridor Economic Development Strategies in the Republic of Mozambique (2012-2016)

1.3 Outline of the Terminal Monitoring

1.3.1 Achievement of Project Purpose at the Terminal Monitoring

The terminal monitoring[2] conducted in September 2017, determined that the project was on track to meet the sole indicator of the project purpose, namely, that "appropriate agricultural technologies are validated by IIAM and transferred to more than 100 extension workers." As a result, the project was considered to be highly likely to achieve the project purpose.

1.3.2 Achievement of Overall Goal at the Terminal Monitoring

At the time of the terminal monitoring of the project, the prospects for achieving the overall goal were not evaluated. To achieve the overall goal, it was identified that project activities such as continuation of the project activities of research, awareness-raising, dissemination activity, sharing of research results and knowledge, and human resource development were needed to be strengthened.

1.3.3 Recommendations from the Terminal Monitoring

The project was decided to be terminated in November 2017 as planned, as the project had achieved the prescribed outputs, and the project purpose was expected to be accomplished. The following items were recommended for the remaining period and for the post-project period.

<u>Recommendations for the remaining project period</u>

The soil and crop analysis training and Nacala Corridor Agricultural Research Meeting[3] (hereinafter referred to as "ARM") should be continued by the project personnel. It was also necessary to conduct wrap-up meetings and presentations of the results of theme-based training and to compile the completion report. For IIAM, it was also recommended that someone be

[2] The terminal evaluation was conducted for the project in December 2015, but because a one and half-year extension was agreed upon at that time, another terminal monitoring was conducted in September 2017.

[3] Agricultural Research Meeting in the Nacala Corridor (ARM-Nacala Corridor), a public research meeting for the Nacala Corridor region, was held to build the capacity of project stakeholders, share information, and strengthen collaboration with relevant organizations. The meeting was attended by representatives from IIAM, the Provincial Directorate of Agriculture and Food Security (DPASA), the International Institute of Tropical Agriculture (IITA), universities, agricultural colleges, and civil society organizations.

assigned to take charge of each activity, such as reviewing the fees for soil analysis, establishing the system to ensure maintenance costs are met, and approving various manuals.

Post-project recommendations

It was recommended that the IIAM continues its activities, such as dissemination of research results and human resource development, as well as securing the necessary budget for ongoing operations.

2. Outline of the Evaluation Study

2.1 External Evaluator

Haruo Ito, ICONS Inc.

2.2 Duration of Evaluation Study

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

Duration of the Study: October, 2020-February, 2022

Duration of the Field Study: April 19, 2021-May 19, 2021 (Remote)

September 22, 2021-October 15, 2021 (Remote)

2.3 Constraints During the Evaluation Study

Owing to the impact of the COVID-19 pandemic, the first and second field studies were conducted remotely using a research assistant. The evaluators were not able to visit the facilities and interview the beneficiaries as planned during the field studies so their evaluation was based on the reports of the assistant. As the evaluation had to be made based on the reports from research assistant, questionnaires and photographs were also used to the extent possible. However, the information on the operation and maintenance conditions of facilities and equipment that require visual inspection may not fully reflect the actual situation in the field.

3. Results of the Evaluation (Overall Rating: B[4])

3.1 Relevance (Rating: ③[5])

3.1.1 Consistency with the Development Plan of Mozambique

Before the planning of the project, at a cabinet meeting in 2006, the government of Mozambique decided to prioritize food security and, based on this, the *Green Revolution Strategy* was formulated in 2007 to increase food production and employment. The aim of this strategy was to spur production, especially for basic crops, and to increase productivity. Based on this strategy, the cross-ministerial *Food Production Action Plan (PAPA: 2008-2011)* was formulated

[4] A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

[5] ③: High, ②: Fair, ①: Low

in 2008 in response to the international experience in food security. The plan envisioned addressing all the stages within the food production value chain: cultivation, harvesting, storage, processing, and marketing. Furthermore, the *Strategic Plan for Agricultural Development (PEDSA: 2010-2019)*, formulated in March 2010, included "improving agricultural productivity and competitiveness" as one of the five major goals. In addition, the *IIAM Strategic Plan (2011-2015)* set the goal of increasing agricultural productivity by 6%, which had declined during the previous 15-20 years, by developing and transferring appropriate agricultural technologies to farmers. Therefore, this project that aimed to increase agricultural productivity through the development and dissemination of agricultural technologies suitable for the target area was in line with the development policy of the government of Mozambique at the time of planning (in 2011).

In addition to the above-mentioned the *Strategic Plan for Agricultural Development (PEDSA: 2011-2020)*[6], at the time of project completion in 2017, the project was consistent with the *National Agricultural Investment Plan (PNISA: 2013-2017)*, the investment plan intended to support the implementation of the *PEDSA*, which aimed at developing appropriate agricultural technologies and disseminating them to farmers. The *IIAM Annual Plan,* at the time of project completion (in 2017), included the goal of developing and disseminating appropriate agricultural technologies needed by individual farmers and private contractors in the region, which is aligned with the objectives of this project; thus, the project is highly consistent with the development policy.

3.1.2 Consistency with the Development Needs of Mozambique

Although approximately 80% of the country's working population was engaged in the agricultural sector, only 16% of the country's land area was cultivated. The Nacala Corridor is a tropical savannah region with high agricultural potential, and 720,000 farmers, accounting for 24% of the total number of farmers in the country, were located in the corridor. Therefore, relevance of the region selection was also confirmed. The IIAM CZnd in Nampula Province and the IIAM CZno in Niassa Province are located in the target area, but their research facilities and equipment were limited, and it was pointed out at the time of planning that the analytical capacity of the researchers was insufficient, which hindered the development of agricultural technologies suitable for the region.

As for the completion of the project, the GNP of the agricultural sector in the country was 23% of the country's GNP, and it remained an important sector in which 80% of the working population was engaged[7]. The average land area owned by each household in the target area was 1.0 ha, which was lower than the national average (1.3 ha), and the poverty rate was also higher than the

[6] At the time of planning, "PEDSA: 2010–2019" was identified as a draft strategy, but later "PEDSA: 2011–2020" was published as the official strategic plan.
[7] Source: National Institute of Statistics (INE), *Basic Agriculture and Food Indicators 2015-2019* (2020)

national average. Most farmers were growing their own food, mainly maize and cassava, and the importance of improving agricultural productivity through the development and dissemination of appropriate technologies in the target areas was confirmed.

3.1.3 Consistency with Japan's ODA Policy

The contribution of the project fell within "corridor development support" and "agricultural development," which are sub-items of the *Regional Economic Revitalization* program in the priority aid areas (Regional Economic Revitalization, Environment and Climate Change Countermeasures, and Administrative Capacity Building/Institutional Development) agreed upon at the 6th Japan-Mozambique Policy Conference in March 2011. Furthermore, the goals of the project were aligned with the promotion of triangular cooperation in "capacity building for increased food production and agricultural productivity" and "expansion of partnerships" in Africa, as stated in the *Yokohama Action Plan* at the Fourth Tokyo International Conference on African Development (TICAD IV) in 2008. The project, which was implemented as a triangular cooperation initiative with Brazil, was part of the Japan-Brazil Partnership Program (JBPP[8]), a framework signed in 2000 to effectively promote triangular cooperation between Japan and Brazil in Portuguese-speaking Africa and to strengthen Brazil's capacity as a development partner.

3.1.4 Consistency with Brazil's ODA Policy

As part of Brazil's foreign policy strategy, diplomatic relations with Africa have been strengthened since President Lula took office in 2003, with presidential visits to Africa and the opening of a number of embassies in the region. In 2010, international cooperation was promoted through the Brazil-Africa Policy Dialogue, inviting agriculture ministers or senior officials from approximately 50 African countries with a particular focus on food security.

3.1.5 Appropriateness of the Project Plan and Approach

As Brazil uses the same official language as Mozambique, Portuguese, and has developed agricultural research under similar natural conditions, the Mozambique side stated during the evaluation that the advantage of Brazilian participation in the triangular cooperation in terms of training and capacity building of researchers was clear. On the other hand, because Japan and Brazil, as equal partners, divided the responsibility between the two countries, unclear lines of command and unclear division of responsibilities made it difficult to coordinate training schedules and project expenses. Consequently, there was room for improvement in the implementation of the triangular cooperation. In addition, because of the sharp budget cuts from the Brazilian Cooperation Agency (ABC) in response to the stagnation of the Brazilian economy[9], many

[8] Source: https://www.br.emb-japan.go.jp/files/000441270.pdf (accessed on August 25, 2021)

planned inputs from the Brazilian side were cancelled; therefore, some activities were removed and indicators had to be reset in the Project Design Matrix (hereinafter referred to as "PDM"). Appropriate changes to achieve the original project purpose, such as reallocating some of the Brazilian activities to the Japanese side were also made to the project plan over the approval by the Joint Coordinating Committee (JCC). Despite external factors, such as the withdrawal of Brazil due to their economic crisis, an appropriate approach was adopted in the project.

In summary, the project was highly relevant to Mozambique's development policies and development needs, as well as to the aid policies of Japan and Brazil. Furthermore, the restructuring of the project plan caused by Brazil's withdrawal has been properly implemented. Therefore, the relevance of this project is high.

3.2 Effectiveness and Impact[10] (Rating: ③)

3.2.1 Effectiveness

With regard to the project purpose indicator, the joint terminal evaluation between the Ministry of Agriculture and Food Security (MASA) and JICA conducted in December 2015 found that the indicator (number of trainees:100) was achieved quantitatively as there were 218 trainees at the time of the terminal evaluation, but qualitatively, the technical transfer of knowledge was not as effective, as it was pointed out that "the training provided was not so comprehensive that farmers were not able to acquire the developed agricultural technologies" and that "it is assumed that the level of understanding is limited in a one-time training." Therefore, in this ex-post evaluation, a beneficiary survey[11] of extension workers (responsible for the dissemination of agricultural technologies in the target areas) and farmers (as beneficiaries) was undertaken to assess their understanding and the degree of technology acquisition. This information was used as supplementary material in the evaluation of the achievements of the project purpose.

3.2.1.1 Achievement of Project Purpose

As shown in Table 1, the indicator was achieved against the project purpose indicator of more than 100 extension workers trained, as a total of 393 extension workers received training during the project period. As mentioned in section 3.2.1.3, "Achievement of Outputs", it was also confirmed that the following documents, approved by the implementing agency, IIAM, were used for the training: *Land Use Plan*, *Guidelines of Research Center Management*, *Soil Improvement*

[9] The Brazilian economy experienced almost zero growth in 2014 and negative growth in 2015 and 2016 for the first time since the Great Depression, and these economic conditions forced ABC to withdraw from the project.
[10] Sub-rating for effectiveness is to be put with consideration of impact.
[11] For the survey sample, extension workers and farmers were selected from four districts in Nampula Province (Mohito, Murizae, Namigonha, and Naphome) and three districts in Niassa Province (Lione, Metamba, and Metande), based on the list of training participants. Two women out of 10 extension workers and 12 women out of 30 farmers were selected. (Selecting as many as half of the female participants was attempted, but the absolute number of women, especially among extension workers, was too small to achieve this ratio.)

Manual, and *Crop Manual*. Furthermore, as mentioned in section 3.2.1.2, the results of the beneficiary survey of extension workers and farmers revealed a sufficient degree of knowledge and understanding of the new technologies was acquired by the trainees, a target which was initially considered doubtful. Therefore, it can be concluded that the project purpose, "Appropriate agricultural technology is developed and transferred in Nacala Corridor" has been achieved.

Table 1 Achievement of project purpose

Indicator	Actual
Appropriate agricultural technologies will be certified by IIAM, and technology will be transferred to more than 100 extension workers	Manuals on agricultural technologies were approved by IIAM, and 393 extension workers were trained using these manuals

3.2.1.2 Results of Beneficiary Surveys Related to Training

According to the results of the beneficiary survey of the extension workers and farmers who received the training during the project period, all (100%) of the surveyed extension workers (10) and farmers (30) answered "Yes" to the question "Are you satisfied with the content of the training you received?" Specifically, 43% of the farmers answered that "the training was well organized and easy to understand," 27% stated that "they could learn new techniques," and 23% stated that "the training was practical and easy to implement." In addition, 14 out of 30 farmers (47%) surveyed actually used the appropriate technologies learned in the training on soil improvement, crop cultivation, and prevention of livestock diseases; the reasons given were that "the agricultural technologies have improved productivity" and "readily available materials can be applied." On the other hand, reasons due to economic conditions such as "difficulty in purchasing some materials and equipment, such as fertilizers, pesticides, and livestock vaccines," were given for not using these technologies. Considering the high level of satisfaction with the training content and the fact that only the cost of materials and equipment is a disincentive for the use of technology, it can be concluded that the level of knowledge and skill acquisition by farmers in the training of this project is acceptable.

Table 2 Number and percentage of farmers using appropriate agricultural technologies

(Unit: person)

	Using	Not using
IIAM CZnd areas	9	6
IIAM CZno areas	5	10
Total	14 (47%)	16 (53%)

Source: Beneficiary survey

3.2.1.3 Project Outputs

(1) Output 1: *The capacity of IIAM CZnd and IIAM CZno is strengthened.*

For output 1, almost all of the indicators related to the research structure of the IIAM regional centers were achieved. Owing to Brazil's withdrawal, the activity and indicator for the multipurpose laboratory in the IIAM CZno, originally planned to be constructed by Brazil, were changed from "construction" to "development of a construction plan." With the developed construction plan, the IIAM CZno reached out to other development partners, but construction has not yet been realized. The impact of this is a possible decline in the effectiveness of the development of agricultural technologies due to the lack of the anticipated laboratory. On the other hand, the terminal evaluation in 2015 suggested that there were some problems in improving the technical transfer capacity of the IIAM staff (project counterparts), but the results of the beneficiary survey in the ex-post evaluation showed the high satisfaction of extension workers and farmers with the training provided by IIAM during the project, which means that their capacity for technical transfer had been improved to a certain extent by the end of the project.

BOX Technical transfer in the research-based technical cooperation project

Among the counterparts in the project, many researchers showed interest in the research using the latest experimental equipment. However, there were differences in the ability to acquire the basic knowledge and techniques required to conduct the research using the latest technology. Therefore, we focused on raising the research capacity by providing guidance on the basic content and spending time on understanding the importance of these basics. Ownership of researchers toward the project was strengthened by engaging them as authors, providing opportunities to present their research overseas and holding contests to solicit research themes and distribute the budget to the winners (Japanese expert).

(2) Output 2: *Natural resources and socio-economic conditions of the Nacala Corridor are evaluated.*

Most of the indicators for output 2 were achieved. Soil, vegetation, and meteorological data in the "*Report and Database on Natural Resources*" were presented and approved at the *10th African Crop Science Conference* held in September 2011. On the other hand, the collection and analysis of water resource data and landscape data were not carried out by the Brazilian side due to their withdrawal from the project. The data collected by the Japanese side were stored in the shared computers in the soil and crop analysis laboratory for researchers to review and use. For the *Report on Socio-economic*, some pilot areas in Zambezia Province were selected where soybean is widely cultivated, and the profitability of soybean was surveyed and analyzed. The results were presented and approved at the Internal Annual Meeting on Research Achievements and Planning (hereinafter referred to as "IAMRAP") and the ARM. These results were finally compiled into a

database for the Decision Support System[12] (hereinafter referred to as "DSS").

(3) Output 3: *Soil improvement technology for the Nacala Corridor is developed*

The indicators for the development of the soil improvement technology of Output 3 were achieved. The results of the fertilizer application, soil improvement, and soil conservation tests conducted for the activities related to the output were presented as a research paper, and a draft of the *Soil Improvement Manual* was prepared, based on the results. The Manual was reviewed by counterparts and peer-reviewed by the committee formed by three senior researchers of IIAM and approved by IIAM in October 2017. The results of the beneficiary survey in this ex-post evaluation also indicated that extension workers and farmers were highly satisfied with the training using the *Soil Improvement Manual*.

(4) Output 4: *Appropriate cultivation technology for Nacala Corridor is developed.*

Output 4 indicators were achieved with the development of appropriate cultivation techniques for crops. Based on the results of the crop cultivation experiments, a draft cultivation manual for soybean, peanut, sorghum, and potato was prepared and authored by IIAM researchers; this was approved by IIAM in October 2017 after counterpart review and committee peer review. Initially, a seed bank and demonstrations of seeds were planned with the support of the Brazilian side in order to develop an appropriate seed multiplication system, but these were not implemented. The establishment of the seed bank, especially the development of quality seeds, was expected to further increase agricultural productivity. However, as some of the activities, such as the seed demonstrations, were implemented with the USAID-funded component of the project budget, and appropriate cultivation techniques were developed through experiments on crop cultivation in the project, it was confirmed that the cancellation of those Brazilian activities was not an obstacle to the achievement of this output.

(5) Output 5: *Technology transfer activities for extension workers are implemented on newly developed/validated agricultural technologies.*

Indicators of output 5 for the technology transfer of agricultural technologies to extension workers were achieved. IAMRAP, ARM, field days, and various training programs were conducted as opportunities for technical transfer to extension workers. Moreover, DSS (Ver.1) was developed, based on the results of farmer field trials, and was explained to a wide range of stakeholders at the ARM in October 2017 and approved. Nevertheless, the necessity for further capacity building for IIAM researchers and extension workers on the DSS was stated by IIAM.

[12] The DSS is the combination of the crop yield prediction model (AquaCrop) and the linear programming model (BFMmz). By using the computer program, outputs (type of crop, planted area, cropping style) that can maximize agricultural income are calculated from the inputs (farmer's location, management area, labor force, crops to be cultivated), and the results are presented to farmers.

However, as various training sessions were conducted as planned and the participants were highly satisfied with them, output 5 is evaluated as almost achieved.

As mentioned above, the indicator of the project purposes was achieved, and the beneficiary survey showed that the extension workers and farmers were highly satisfied with the training and understood the agricultural technology they acquired. In addition, the cessation of activities on the Brazilian side due to external factors did not hinder the achievement of the project purpose, and thus, the effectiveness of the project is considered high.

3.2.2 Impacts

In order to evaluate the impact, the continuity of the project purpose of "Appropriate agricultural technology is developed and transferred in Nacala Corridor" and the degree of achievement of the resulting overall goal of "Appropriate agricultural technology is adopted in Nacala Corridor" were assessed. In regard to the degree of achievement of the overall goal, its promoting and inhibiting factors were also analyzed through evaluating the synergy effect with ProSAVANA-PEM, another component of ProSAVANA, which was implemented to enhance the extension mechanism at the community level to disseminate the agricultural technologies developed by this project.

3.2.2.1 Continuity of Project Purpose

In evaluating the continuity of the project purpose "Appropriate agricultural technologies are developed and transferred to the Nacala Corridor region", three points were confirmed: (1) continuity of strengthening the research system in IIAM; (2) preparation of tools for technical transfer; and (3) continuity of technical transfer to extension workers and farmers.

In 2020, 93 agricultural trials were conducted at the IIAM CZnd using the soil and crop analysis laboratory established under the project, and 88 agricultural trials were conducted at the IIAM CZno. In addition, three socioeconomic surveys were conducted at the IIAM CZnd[13]. The ex-post evaluation also identified that a number of new manuals, brochures, posters, and newsletters were developed by both centers, using the results of the project[14]. In terms of technical transfer by IIAM to extension workers and farmers, 2,674 and 78 extension workers and farmers[15] were trained in IIAM CZnd and CZno, respectively, using the *Soil Improvement Manual* prepared by the project.

[13] In the first quarter (January-March) of 2021 at the IIAM CZno, the number of agricultural trials has decreased by 30% and seed production by 73% compared to those of the previous year owing to budget cuts and infection control measures resulting from the financial emergency caused by the COVID-19. In addition, training for agricultural extension workers and farmers, field activities, and fairs have been postponed as a precautionary measure to prevent infection and have therefore not been implemented.

[14] Manuals for extension workers and farmers are in great demand and are currently being used as the basis for training of extension workers under the SUSTENTA implemented by MADER.

[15] Owing to the delay in budget allocation for 2020, the number of trained extension workers and farmers was only 78 compared to the planned 704.

On the other hand, with regard to training of farmers by extension workers, based on the results of the beneficiary survey in the ex-post evaluation, only 10 farmers (33%) out of 30 responded that they had received training and support from extension workers, owing to the lack of access to farmers by extension workers (such as due to vehicles and fuel costs) and the negative effect of COVID-19. IIAM is not in charge of the transfer of technology from extension workers to farmers, but is in charge of the Provincial Directorate of Agriculture and Fisheries (hereinafter referred to as "DPAP") and its subordinate organization, the District Services of Economic Activities (hereinafter referred to as SDAE) to which the extension workers belong[16]. However, as mentioned above, there are some issues, such as the fact that the training and support provided by the DPAP and SDAE reached only a few farmers. On the other hand, the IIAM officials pointed out that the challenge of continuity of technical transfer to extension workers and farmers are now being solved through the SUSTENTA program implemented by MADER.

As mentioned above, considering (1) the continuity of strengthening the research system in IIAM, (2) the preparation of tools for technical transfer, and (3) the challenge of continuity of technical transfer to extension workers and farmers is being reserved, it was evaluated that the continuity of project purpose is acceptable.

3.2.2.2 Achievement of Overall Goal

As shown in "continuity of project purpose", IIAM has continued to provide training to extension workers and farmers using the guidelines and manuals developed by the project, and as a result, as shown in Table 3, the indicator for the overall goal has been achieved, accomplishing the overall goal "Appropriate agricultural technology is adopted in Nacala Corridor."

At the time of project planning, the number of farmers in the target area was estimated to be 720,000[17], and the indicator for overall goal was that 72,000 farmers, accounting for 10% of the total, would adopt the appropriate agricultural technologies. The beneficiary survey in the ex-post evaluation identified that, on average, 150 farmers were covered by one extension worker, 33% of farmers had received support from extension workers, and 47% of farmers had used the training content. In addition, by the time of the ex-post evaluation (in 2020), three years after the completion of the project, 3,559 extension workers had received training (393 during the project and 3,166 after the completion of the project[18]). By calculating these figures, about 83,000

[16] As a result of the decentralization policy, extension workers belonging to the extension offices of the Ministry of Agriculture were vested in provinces. The provincial government has set up agricultural extension sections in the SDAE of agricultural departments in each district and assigned extension workers there.
[17] Source: ProSAVANA-PEM project ex-ante evaluation table. The number of farmers in the target area at the time of ex-post evaluation has not been calculated; therefore, the evaluation judgment is based on the number calculated at the time of planning.
[18] Includes participants in training conducted in collaboration with ProSAVANA-PEM.

farmers[19] have used agricultural technology, accounting for 11.5% (83,000/720,000) of the farmers in the target area. Thus, it is estimated that the target value of 10% has been reached.

Table 3 Achievement of overall goal

Indicator	Actual
At least 10% of farmers in the target area apply IIAM-approved appropriate agricultural technologies.	At the time of the ex-post evaluation, it was estimated that about 11.5% of the farmers have applied the training contents, and thus, the indicator is likely to have been achieved.

3.2.2.3 Synergy with Other ProSAVANA Projects

In the project, in collaboration with ProSAVANA-PEM, one of the ProSAVANA projects, intercropping of superior varieties of cassava and peanut and comparative display of superior legume varieties were undertaken, and technical transfer to the farmers supported by ProSAVANA-PEM was implemented. After the completion of the project, DPAP, the counterpart of ProSAVANA-PEM, also provided training from IIAM researchers to extension workers and extension workers to farmers, using the manuals prepared during the project. On the other hand, the IIAM staff stated that collaboration has been limited, as SDAE could not participate in the annual joint liaison meeting for planning the dissemination activities owing to the lack of budget for SDAE and extension workers from DPAP after the completion of ProSAVANA-PEM.

3.2.2.4 Other Positive and Negative Impacts

(1) Increase yields and farmer incomes by using agricultural technologies

In the project, as a result of adopting appropriate technology from the project in the fields of IIAM CZnd and CZno, relatively high yields of 1,800-1,900 kg/ha for maize, 200-500 kg/ha for cowpea, and 1,400-1,500 kg/ha for Zambonae varieties of soybean were recorded in the completion report. Furthermore, using the DSS allowed farmers to accurately predict yields of soybean, maize, and cowpea; 81% of the farmers in the group that voluntarily referred to the DSS for crop planning (only 31% in the group that did not refer to the crop plan) had increased their income from farming.

Similarly, the beneficiary survey in the ex-post evaluation indicated that all 14 farmers who adopted the appropriate agricultural technology of the project reported an increase in yield, thereby increasing farm income. As shown in the table below, the increase in yield per hectare (ha) was approximately 2 to 3.5 times, and the increase in income per crop season was 2.5 to 5.5

[19] 150 (number of farmers covered by one extension worker) x 3,559 (number of extension workers who received training) x 0.33 (dissemination rate from extension workers to farmers) x 0.47 (implementation rate of training content by farmers) = 83,000 farmers.

times[20] more in each area. In particular, the income of farmers in the IIAM CZno areas who received training in infectious disease control for the protection of livestock which greatly contributes to generating income and have been practicing it has increased significantly.

Table 4 Yield and income of farmers utilizing appropriate agricultural technologies

	Yield per hectare (kg/ha)			Revenue per crop season (MZN*/season)		
	Before utilization**	After utilization	Increase rate	Before utilization	After utilization	Increase rate
IIAM CZnd area (Average of 9 farmers)	730	1,433	196%	4,713	12,067	256%
IIAM CZno area (Average of 4 farmers)	16	55	344%	648	3,560	550%

Source: Beneficiary survey
*Note: Metical, the currency of Mozambique, (calculated at 1 MZN = 1.78 JPY as of October 22, 2021)
**Note: The exact years before and after utilization of appropriate agricultural technology cannot be specified because the timing of training by IIAM varies from farmer to farmer.

(2) Impact on the natural environment[21]

One of the outcomes of the project was the assessment of the natural resources, and based on this assessment, soil improvement and selection of crops and varieties were implemented. Specifically, although there were no facilities in Mozambique that could properly dispose of reagent effluents before the project, the IIAM CZnd used a soil analysis method with hazardous reagent effluents, and these were disposed without treatment. Therefore, the project adopted a method of soil and crop analysis without the use of these harmful reagents and compiled into soil improvement and crop variety selection manuals. It was concluded that the project had not caused any negative impacts and generated a positive impact on the natural environment.

(3) Resettlement and land acquisition

The soil and crop analysis laboratory established in the IIAM CZnd was built within the existing facility and did not cause any issues in terms of relocation of residents or land acquisition.

(4) Poverty reduction

This project aimed at sustainable agricultural development through improving agricultural productivity in the region, mainly among small-scale farmers, and thus the main target was the poverty group. During the workshop at the beginning of the project, it was also revealed that small-scale farmers are unable to purchase improved seeds owing to poverty and thus are using seeds with low productivity in target areas. Therefore, the socio-economic survey was setting up

[20] According to the *Yearbook 2020*, the per capita GDP of Nampula, one of the target provinces of the project, has increased by 109% between 2016 and 2019, while the income of farmers using appropriate technology has shown a higher increase.
[21] The summary of ex-ante evaluation for the project was prepared in January 2011; however, the environmental category based on the *JICA Environmental and Social Consideration Guidelines* was not determined.

as a project activity to detail the household and technology levels or farmers, and to propose technologies that small-scale farmers could adopt so that the project outputs can be fairly distributed. It can be inferred that this provides an important means of alleviating poverty and increasing food security in rural areas where poverty is widespread.

(5) Gender equality

Agriculture is a major industry in the Mozambican economy, with more than 80% of the population working in the agricultural sector, 90% of which are women. Many of the participants in the farmer training program were also women. Furthermore, the number of staff in the IIAM CZnd was 173 (in 2020), of which 47 (27%) were women. Of the 172 undergraduate (bachelor) and graduate (master) students accepted by the IIAM CZno for internships, 53 (31%, in 2020) were female students, indicating that the project contributed to gender equality.

From the above, regarding the effectiveness and impact of the project, although the Brazilian activities were discontinued in the middle of the project, it did not hinder the achievement of the outputs, and the project purpose was achieved at the end of the project; therefore, the effectiveness of the project is high. As for the impact, the indicator for the overall goal – the utilization of appropriate technology by farmers – was achieved. As a result, positive impacts such as increased yield and income for some farmers were also confirmed. Therefore, the effectiveness and impact of the project are high.

3.3 Efficiency (Rating: ②)

3.3.1 Inputs

Because of the triangular cooperation among Japan, Brazil, and Mozambique, the project provided each input using the respective budgets from each country. Thus, when the Brazilian input was withdrawn in 2015, the activity plan in the PDM was revised, the project period was extended, and additional budget from the Japanese side was added to compensate for the reduction in funding. As a result, it has contributed to the continuation of activities after project completion, and had an ongoing impact on the field level.

Table 5 Inputs from the Japanese and Mozambican sides

Inputs	Plan	Actual (As of the project completion)
(1) Experts	2 Long-term (120 Man Month (MM)) 7 Short-term (140 MM) Soil analysis, fertilization technology, soil conservation, cultivation, land use planning, soil microorganisms, and water	1 Long-term 25 Short-term* (Total: 218.42 MM)

	resources.	
(2) Trainees received	Training in Japan	Training in Japan: 4 participants (2013:1, 2014:1, 2016:2) International academic conferences: 3 participants (Uganda (2013):1, Burkina Faso (2016):2)
(3) Equipment	Four-wheel drive vehicles, construction of experimental buildings, improvement of irrigation facilities at the agricultural experiment stations, and research equipment.	Facilities: soil and crop analysis laboratory, well, and generator shed Major equipment: soil analysis experimental equipment, equipment for cultivation tests, meteorological observation-related equipment
(4) Local expenses	Seminar and workshop expenses, etc.	Local business enhancement expenses: 125 million JPY[22] Consultant activity expenses: 22 million JPY[23]
(5) Japanese Side Total Project Cost**	600 million JPY	1,196 million JPY
(6) Mozambique Side Total Project Cost	Local cost, counterpart salaries	IIAM CZnd[24]: 87 million JPY[25] IIAM CZno: 45 million JPY[26] (Counterpart salaries, electricity, communication, transportation, fuel, etc.)

Source: Documents provided by JICA
*Note: Including one interpreter
**Note: Total expenses of (1) to (4)

Table 6 Inputs on the Brazilian side

Inputs	Plan	Actual (As of the project completion)
(1) Experts	Short-term (50 MM) Research and extension technology, infrastructure technology, seed multiplication system technology, livestock production technology, natural environment analysis, technical transfer, etc.	Total of 46 short-term experts (89.6 MM)
(2) Trainees received	Training in Brazil	6 participants in Brazil (twice in 2012, once in 2013, 3 times in total)
(3) Equipment	Construction of laboratory buildings, research equipment, nursery and seed-related machinery for smallholders	PCs, printers, and vehicles Total of 6 items of equipment
(4) Local expenses*	-	Activities funded by the Brazilian Cooperation Agency (ABC): 141 million JPY[27] Cost of dispatching experts by

[22] 1,094,852 USD (calculated at the rate as of October 22, 2021, 1 USD = 113.95 JPY)
[23] 192,601 USD (calculated at the rate as of October 22, 2021, 1 USD = 113.95 JPY)
[24] As for the operation and management fees paid by the IIAM CZnd to the project, the amounts up to the time of the 2015 joint end-of-term evaluation assessment are shown because the actual results for 2016 and 2017 were not available.
[25] 48,968,085 MZN (as of October 22, 2021, calculated at 1 MZN = 1.78 JPY)
[26] 25,476,479 MZN (as of October 22, 2021, calculated at 1 MZN = 1.78 JPY)
[27] 1,239,833 USD (calculated at the rate as of October 22, 2021, 1 USD = 113.95 JPY)

		Brazilian Agricultural Research Corporation (Embrapa): 25 million JPY[28]

Source: Documents provided by JICA
*Note: Total expenses of (1) to (3)

3.3.1.1 Elements of Inputs

As for the project input from the Japanese side, one long-term coordinator and 25 short-term experts were dispatched. The change in the dispatch of short-term experts compared to the original plan was the increase in the number of experts to replace the Brazilian activities due to the withdrawal of their participation in 2015 and the increase in the number of experts for the construction and management of the new soil and crop analysis laboratory in the IIAM CZnd (the original plan was to renovate the existing facility). Inputs related to attendance at academic conferences that were not initially planned were also generated. The increase in inputs due to the withdrawal of the Brazilian side is evaluated to have been appropriate in response to external factors and in order to achieve the project purpose. Moreover, the allocation of additional personnel for the establishment of the new soil and crop analysis laboratory was also an essential input to improve the quality of the project's research and to secure income for the center through the provision of analysis services.

Regarding inputs from Brazilian side, a total of 46 experts, including coordinators, were dispatched for a longer period than planned until their withdrawal in 2015. The initially planned multipurpose laboratory in IIAM CZno, with financial support from Brazil was not realized and its blueprints having only been completed owing to their withdrawal.

As for the input from the Mozambican side, personnel costs of the researchers and the utility costs in IIAM CZnd and CZno were covered by the budget from each center as originally planned.

3.3.1.2 Project Cost

The project cost was 1,196 million JPY, significantly exceeding the planned amount of 600 million JPY (199% of the planned amount). The reason, as mentioned earlier, was the withdrawal of Brazil from the project, resulting in Japanese experts being added to help ensure implementation. The increase in project costs due to Brazil's withdrawal because of the severe economic crisis can be categorized as an external factor, as it was not initially expected. Thus, taking this increase in the project cost into account is not appropriate for determining efficiency. Initially, the existing soil and crop analysis laboratory was planned to be renovated, then, however, in order for the IIAM CZnd to fulfill its role as the core agricultural experiment station in the region, the soil and crop analysis laboratory was newly built, and the equipment and materials were set to specifications appropriate for that role. As a result, the costs for equipment and

[28] 2,150,400 USD (calculated at the rate as of October 22, 2021, 1 USD = 113.95 JPY)

materials and for the dispatch of specialists in construction supervision increased. This was exacerbated by significant delays in the construction of the laboratory due to unseasonable weather (torrential rain), which resulted in having to extend the employment period of construction supervisors as well as increase the dispatch period of experts involved in cultivation tests. These increases in project costs[29] for reasons other than Brazil's withdrawal were taken into account in the evaluation of the project efficiency.

3.3.1.3 Project Period

As a result of the terminal evaluation in 2015, the project was extended by 1.5 years from the planned 5 years to 6 years and 6 months (130% of the planned period); therefore, the project period exceeded the plan. The main reason for the extension of the project, same as the project cost, was the substitution of Brazilian activities by the Japanese side on Brazil's withdrawal, which can be classed as an external factor. The extension of the project period to compensate for the delay in the accumulation of soil and plant data, as well as the development and dissemination of the DSS model caused by the delay in the construction of the soil and crop analysis laboratory, and delays in upgrading specification equipment on the part of the Japanese were considered as factors of increase in the project period rather than external factors in the evaluation of the project's efficiency.

As above, the project cost was significantly higher than planned and the project period was exceeded the plan, but this did not reduce the efficiency of the project because the main reason can be summarized as the external factor of the Brazil's withdrawal due to the historical deterioration of their economy. However, the project cost and period were increased not only by the external factor but also by the delay of the construction of the soil and crop analysis laboratory and upgrading in specifications equipment, which were the activities of Japanese side. Therefore, the efficiency of the project is fair.

3.4 Sustainability (Rating: ②)

3.4.1 Policy and Political Commitment for the Sustainability of Project Effects

At the time of the ex-post evaluation, the final draft of *Strategic Plan for Agricultural Sector Development II (2021-2030) (PEDSA II)*, the successor to the *Strategic Plan for Agricultural Sector Development (2011-2020) (PEDSA)*, was formulated. The *National Agricultural Sector Investment Plan (PNISA II)* has been formulated which showed the budget estimation for the actual implementation of the *PEDSA II*. The political sustainability of the project is considered to

[29] Since the extension of the period for dispatching experts was related to both the reasons for withdrawal from Brazil and the delay in the construction of the soil test laboratory, it was difficult to calculate the labor cost and other costs separately, so they were evaluated together.

be high, as PEDSA II states that IIAM will implement the areas related to agricultural commodity prioritization, cash crop production, sustainable livestock management, establishment and operation of agricultural information systems, promotion of agricultural value chain research, and sustainable soil management in collaboration with other relevant institutions among priority programs aimed at increasing agricultural productivity.

3.4.2 Institutional/Organizational Aspect for the Sustainability of Project Effects

As a result of the project, the *Guidelines of Research Center Management* were prepared to help guide the continued operation and management of the IIAM CZnd and CZno. Operation and maintenance personnel were also appointed to the soil and crop analysis laboratory in the IIAM CZnd, and the facilities and equipment are being operated and managed in accordance with the *Guidelines of Research Center Management*. In addition, the project provided several training sessions, including on-the-job training, were conducted for the counterparts such as researchers and technicians of the IIAM CZnd and CZno. Of the 30 counterparts, 26 (87%) continued to work at IIAM and provided agricultural technical services in response to the needs in the field. The revision of the service fee in accordance with the recommendations of the *Guidelines for the Operation and Management of Agricultural Experiment Stations* has brought stable income to both regional centers.

With regard to the dissemination system for farmers, the IIAM regional center officials reported difficulties in collaboration between different organizations such as research and extension agencies although communication with SDAE was smooth, owing to lack of budget from DPAP, SDAE staff could not participate in the liaison meeting to discuss the annual joint extension plan between IIAM and SDAE. One extension worker was assigned to each community, and each one is supposed to be responsible for an average of 250 farmers[30]. However, according to the beneficiary survey in the ex-post evaluation, the average number of farmers actually supported by each extension worker is 150, which is only about 60% of the stipulated number; this is because of the lack of DPAP support for access to farmers and fuel costs, and the recent impact of COVID-19.

As mentioned above, although there are no issues with the implementation system of the activities in the IIAM CZnd and CZno that were strengthened by the project, there are some challenges in the implementation of the extension workers' activities, indicating that there are some challenges to sustainability in the institutional/organizational aspect of the project.

[30] The number of farmers is stipulated in the *Master Plan for Agricultural Extension (2007-2016*) issued by the National Agricultural Extension Service (DNEA), MADER; the figure remained unchanged at the time of the ex-post evaluation.

3.4.3 Technical Aspect for the Sustainability of Project Effects

It was confirmed that continuous capacity building of the staff was implemented in both IIAM regional centers through IAMRAP and internal training. In the ex-post evaluation beneficiary survey, all the extension workers surveyed expressed high satisfaction with the training provided by the staff of the IIAM CZnd and CZno, indicating that their research and extension staff had a sufficient level of skills. Furthermore, various manuals for extension workers and farmers, developed under the project, are also confirmed to be still used in extension activities and in developing new extension manuals and guidelines as references. Although the data for DSS should be accumulated by increasing the number of crop types and correcting the model, researchers and extension workers should become familiar with the method through field practice. However, due to insufficient technical transfer during the project, the filed practice has not been carried out since the completion of the project owing to the lack of personnel who can teach DSS. The IIAM therefore suggested the necessity for further technical transfer in order to achieve widespread dissemination at the field level.

Training and capacity building in IIAM have still been implemented and the manuals and guidelines developed in this project have been used. Although the dissemination of DSS requires further capacity building for researchers and extension workers, the high level of satisfaction of extension workers attending IIAM training sessions indicates that the technical sustainability of IIAM researchers and staff is high.

3.4.4 Financial Aspect for the Sustainability of Project Effects

The main income of the IIAM CZnd and CZno is derived from the budget of the IIAM headquarters, state government, and development partners and self-generated revenue from their various services. As shown in the table below[31], the budget of the IIAM CZnd has been decreasing owing to the termination of support from development partners and the difficulty in providing some services because of the breakdown of laboratory equipment. On the other hand, the budget of the IIAM CZno had increased by 2020 owing to an increase in personnel costs associated with the hiring of new researchers and the promotion of existing researchers; however, a difficult financial situation was reported as the budget for 2021 was reduced by about 30% compared to that of the previous year owing to the impact of COVID-19.

The necessary budget of the soil and crop analysis laboratory in the IIAM CZnd for the project activities was funded by the Japanese side, including the cost of operation and maintenance during the project period, and then the IIAM CZnd was to secure the operation and maintenance cost after the completion of the project. The IIAM had planned to pool the income from the various services provided by the regional centers and allocate it to the maintenance and management costs,

[31] We were unable to obtain the income and expenditure information for each center; thus, only the budget is shown in Table 7.

but due to the breakdown of many of the analytical equipment, including the soil analysis experimental equipment[32] procured by the project, due to unstable power supply and other force majeures, the IIAM pointed out that they were unable to generate the expected incomes and fell into the budget shortfall, resulting in the negative cycle.

Table 7 Budget trends of the IIAM CZnd and CZno

(Unit: MZN)

	2016	2017	2018	2019	2020
IIAM CZnd	62,528,230	52,714,790	48,549,830	39,706,271	28,579,725
IIAM CZno	27,629,911	31,895,830	43,334,639	43,033,430	56,191,321

Source: Questionnaire

As described above, policy/political commitment and technical sustainability have been ensured for the continuation of the research and extension activities that assist in transferring appropriate agricultural technologies to the farmers through the project. On the other hand, there are some minor problems within the institutional/organizational component concerning the technical transfer by extension workers, and within the financial component, regarding the operation and maintenance costs of the equipment. Therefore, the sustainability of the project effects is evaluated as fair.

4. Conclusion, Lessons Learned, and Recommendations

4.1 Conclusion

The tropical savannah region in the northern part of Mozambique, blessing with a sufficient amount of rainfall and a vast area of farmland, has high potential for expanding agricultural production. However, the extensive agriculture is practiced in much of the region and the productivity of both subsistence and commercial crops is not high. Under these circumstances, this project aimed to develop an appropriate agricultural development model for sustainable agriculture through improving the regional agricultural productivity mainly among small-scale farmers. Therefore, the project has improved the research capacity of the agricultural research institutes in the northeast and northwest regions under the IIAM and transferred new agricultural technologies to pilot farmers through the triangular cooperation with Brazil which has a tropical savannah area with natural conditions similar to those of the project target area, and has expertise in agricultural development in that area. The evaluation found that the objective of the project is fully consistent with the development policy of Mozambique which aimed at improving agricultural productivity and competitiveness, and the development needs of the region. The

[32] At the time of the Ex-post evaluation, the JICA Mozambique office followed up on the selection of a contractor for the repair and maintenance training of the soil analysis experimental equipment, and those will be implemented within the fiscal year of 2021.

project is also relevant with Japan's aid policy as well as the diplomatic strategy of the Brazilian government which include the promotion of the triangular cooperation, thus, the relevance of this project is high. As for the effectiveness and impact of the project, some outputs were not achieved because a part of the activities were discontinued in the middle of the project owing to the tight budget of the Brazilian aid agency, the partner in the triangular cooperation. However, considering that the project purpose and overall goal have been achieved and that other positive impacts were identified, such as increases in yields and farm incomes by using appropriate agricultural technologies, the effectiveness and impact of the project are high. On the other hand, actual project period and cost were exceeded the plan. Even though the increase in project period and cost due to the transfer of activities from the Brazilian side to the Japanese side are considered as an external factor, other factors such as a delay in the construction of the soil and crop analysis laboratory with increased expenses by the Japanese side also caused these increases. Therefore, the efficiency of the project is fair. The political and technical sustainability of the project is assured, allowing to continue research and extension activities of appropriate agricultural technologies transferred by the project. However, some issues have been identified in the institutional/organizational sustainability of the technical transfer from extension workers to farmers, and in the financial sustainability, such as securing the maintenance costs of the procured equipment. Therefore, the sustainability of the project is fair.

Based on the above, the project is evaluated as satisfactory.

4.2 Recommendations

4.2.1 Recommendations to the Implementing Agency

Budgeting for renewal of laboratory equipment and purchase of consumables and reagents

It was observed that much of the equipment procured to the IIAM CZnd and CZno was out of order, and the inability to purchase consumables and reagents due to insufficient budgetary allocations has hindered research and service provision at the IIAM CZnd and CZno. Therefore, it is recommended that the IIAM and the provincial government provide budgetary support to the IIAM CZnd and CZno for upgrading of laboratory equipment and purchasing of consumables and reagents. It is also recommended that both regional centers develop a budget plan for the allocation of their own income generated from technical services towards the maintenance of laboratory equipment and purchase of consumables and reagents. They should ensure that these budgets are secured.

Establishment of a multipurpose laboratory in the IIAM CZno

The construction of the multipurpose laboratory in the IIAM CZno, which was originally planned to be built and funded by Brazil, was discontinued within the project, and the activities and indicators were revised to the drawing up of a construction plan only. Based on this developed

plan, the IIAM CZno approached other development partners but it has not yet been realized. The researchers from the center claim that the laboratory is expected to play an important role in the development of agricultural technologies in the region, and that it is indispensable for acquiring data to refine the agricultural technologies and DSS model developed in the project. Thus, continued advocacy is required to secure government funding or support from development partners.

Support for the activities of extension workers and expansion of training for farmers

It was observed that some of the activities of extension workers who are responsible for dissemination training of agricultural technologies developed under the project have not been carried out, mainly owing to unreliable salary and difficulty in accessing some farmers. Therefore, it is recommended that the IIAM CZnd and CZno continue to consult with DPAP to support extension workers in disseminating the technologies to farmers. At the same time, IIAM training programs should expand their targets as much as possible by involving farmers as direct beneficiaries.

4.2.2 Recommendations to JICA

Conduct supplemental training on DSS

The IIAM suggested that the IIAM researchers and engineers need to acquire more knowledge and practice so that the accuracy of the DSS model introduced by the project can be improved through continuous data collection and analysis. As for technical transfer to extension workers and farmers, IIAM extension staff need to deepen their understanding and experience of DSS through practice. However, due to the insufficient level of technical transfer during the project, this has not been carried out since the completion of the project owing to the lack of personnel who can teach DSS. Therefore, it is recommended that supplementary training for IIAM researchers and engineers be provided, such as training in Japan or the dispatch of short-term DSS experts to the region.

4.3 Lessons Learned

Lessons from triangular cooperation with equal partners

Triangular cooperation usually focuses on the use of third-country resources for some parts of a project, such as training in third countries and the dispatch of third-country experts. The project applied a new approach where the ProSAVANA, including the project, was implemented as an equal partnership between Japan and Brazil. The withdrawal of the Brazilian side from the project was due to external factors such as the unprecedented economic crisis in Brazil, but it also brought to the surface the risk of a financially unstable third country bearing the cost of the project and implementing the project as an equal partner through triangular cooperation, a risk even without

an economic crisis. In addition, the equal intervention from both Japanese and Brazilian expert teams may make project management more difficult owing to technical disagreements and fragmentation of each activity. Triangular cooperation with equal partners has the merit of increasing efficiency through budget sharing and securing the ownership of the partner country; however, when using this approach, it is necessary to consider how to respond to the financial risks of the partner country or its donor agency and to clarify the chain of command and sharing of roles within the project.