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| Country Name | The Project on Rice Research for Tailor-Made Breeding and Cultivation Technology Development in Kenya |
| Republic of Kenya | |

I. Project Outline

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| Background | <p>In Kenya, approximately 80% of rice production came from irrigated paddy fields. Rice production has been affected by various stresses, including water shortages in irrigated areas, rice blast, rice yellow mottle virus, chilling damage in the highlands and drought in the drylands. In addition, one of the constraints against expansion of rice production has been the underdevelopment of farming technologies tailored to the soil, growing environment and rice variety. Under these circumstances, it was necessary to develop rice varieties that could be adapted to various biotic and abiotic stresses in the diverse growing environments of the country, as well as to conduct research on cultivation technologies to reveal the potential of these rice varieties to be developed and to enable sustainable rice cultivation.</p> | | |
| Objectives of the Project | <p>Through i) development of system to develop rice varieties, ii) verification of locally available varieties as breeding materials, iii) production of breeding lines carrying useful Quantitative Trait Locus (QTL), iv) verification of improved cultivation technologies, and v) development of cultivation technologies to maximize potentials of variety characteristics, the project aims at building a base of rice breeding and cultivation technology development, thereby contributing to development of rice varieties adapted to Kenya and verification of local adaptability of the developed cultivation technologies in farmers' field.</p> <ol style="list-style-type: none"> Expected Overall Goal: Rice varieties adapted to Kenya are developed and local adaptability of cultivation technologies is verified in farmer's fields. Project Purpose: A base of rice breeding and cultivation technology development is built. | | |
| Activities of the Project | <ol style="list-style-type: none"> Project Site: Kenya Agricultural and Livestock Research Organization (KALRO) Mwea Center (Mwea Division, Mwea East Sub-County, Kirinyaga County) Main Activities: i) Developing a system for maintaining and preserving varieties, ii) QTL analysis on useful agronomic traits, iii) Drafting a rice variety development plan, iv) Developing methods of improving cultivation technologies, v) Developing cultivation technologies to maximize potential of variety characteristics, and so on. Inputs (to carry out above activities) <ul style="list-style-type: none"> Japanese Side 1) Experts: 14 persons 2) Trainees Received: 15 persons 3) Equipment: Vehicles, agricultural machinery, measuring equipment and so on 4) Local Cost: Cost for construction and restoration of experimental fields, research facilities, laboratory green house, water reservoir, irrigation canal, etc., and cost for local support staff, cost for purchase of goods, travel expenses, communication cost and miscellaneous. <div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>Kenyan Side</p> <ol style="list-style-type: none"> Staff Allocated: 16 persons Facilities: Office space, upland rice farm, store/multipurpose rooms and rice research laboratory in KALRO Mwea Center, lowland and upland rice farms and farm office at Kirogo Experimental Farm Operation cost: Costs for soil transport, operation and maintenance cost for the newly constructed rice research laboratory building, and so on. </div> </div> | | |
| Project Period | (ex-ante) May 2013 - April 2018 (60 months) (actual) 22 May 2013 – 21 May 2018 (60 months) | Project Cost (Japanese side only) | (ex-ante) 353 million yen, (actual) 323 million yen |
| Implementing Agency | Kenya Agricultural and Livestock Research Organization (KALRO), Ministry of Agriculture, Livestock and Fisheries (MoALF) (MoALF was reorganized to the Ministry of Agriculture and Irrigation and the State Department of Agricultural Research was newly established in 2018, and reorganized to Ministry of Agriculture and Livestock Development (MoALD) in 2022.) | | |
| Cooperation Agency in Japan | Nagoya University, Okayama University, Shimane University, and Yamagata University | | |

II. Result of the Evaluation

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| 1 Relevance/Coherence |
| <p>[Relevance]</p> <p><Consistency with the Development Policy of Kenya at the Time of Ex-Ante Evaluation ></p> <p>The project was consistent with the development policies of Kenya, such as “Kenya Vision 2030” (2008-2030), “the Agriculture Sector Development Strategy (ASDS)” (2010-2020) focusing improving agricultural production and productivity at the time of ex-ante evaluation. In addition, “the National Rice Development Strategy (NRDS)” (2008-2018) focuses promotion of rice production to enhance food security and improve farmers' livelihoods.</p> <p><Consistency with the Development Needs of Kenya at the Time of Ex-Ante Evaluation ></p> <p>The project was consistent with the development needs of Kenya at the time of ex-ante evaluation. As mentioned above (“Background”), developing rice varieties that could be adapted to various biotic and abiotic stresses in the diverse growing environments of the country, and to conduct research on cultivation technologies to reveal the potential of the rice variety to be developed was urgently required in order to</p> |

¹ SATREPS: Science and Technology Research Partnership for Sustainable Development

enable sustainable rice cultivation.

<Appropriateness of Project Design/Approach>

The project design/approach was appropriate. No problem attributed to the project design/approach was confirmed.

At the beginning of the project, it was found that the laboratory existing at the time was old and insufficient to host the SATREPS project. KALRO, therefore, requested the construction of a new modern laboratory through the counterpart funds of food aid (KR: Kennedy Round) provided by the government of Japan in order to enhance project outputs. In addition, the SATREPS project provided an opportunity for the vulnerable to jointly participate in the project activities during the on-farm and on-station research and this gave them a learning experience in results of which they adopted in their own farms through observation.

<Evaluation Result>

In light of the above, the relevance of the project is ③².

[Coherence]

<Consistency with Japan's ODA Policy at the Time of Ex-Ante Evaluation>

The project was consistent with the Japan's ODA policy to Kenya at the time of ex-ante evaluation. Agricultural development is identified as one of the priority areas in "the Country Assistance Policy for Kenya (2012). Also, at the Fourth Tokyo International Conference on African Development (TICAD IV) held in May 2008, the Coalition for African Rice Development (CARD) was established to promote rice development in African countries for doubling rice production in Africa by 2018.

<Collaboration/Coordination with JICA's other interventions>

The collaboration/ coordination between the project and another technical cooperation project, the Rice-based and Market-oriented Agriculture Promotion Project (RiceMAPP) (2012-2017), was planned at the time of ex-ante evaluation and was implemented, the positive effects expected were confirmed at the time of ex-post evaluation. The SATREPS project utilized knowledge and experiences through the manuals and guidelines developed for rice cultivation techniques, also actively involved in the project activities of RiceMAPP to enhance delivery following their improved capacity.

<Cooperation with other institutions/ Coordination with international framework>

Any cooperation/coordination with other development partners was not clearly planned at the time of ex-ante evaluation or during the project period.

<Evaluation Result>

In light of the above, the coherence of the project is ③.

[Evaluation Result of Relevance/Coherence]

In the light above, the relevance/coherence of the project is ③.

2 Effectiveness/Impact

<Status of Achievement of the Project Purpose at the Time of Project Completion>

At the time of project completion, the Project Purpose was achieved as planned. In terms of academic results of the research activities by KALRO under the SATREPS project (Indicator 1), six research officers of KALRO obtained Ph. D. and five of them obtained Ph. D. from universities in Japan. In addition, nine research officers of KALRO obtained MSc and two of them obtained MSc from university in Japan(Indicator 1). The plan for developing rice varieties was approved by the Project Steering Committee (PSC) and issued in June 2018 (Indicator 2). A manual of verification test on the improvement of cultivation technologies was developed and published (Indicator 3).

<Continuation Status of Project Effects at the Time of Ex-Post Evaluation>

By the time of the ex-post evaluation, the project effects have been continued. The plan for developing rice varieties has been implemented well leading to the two varieties undergoing National Performance Trial (NPT) which is essential for them to be released in the market and will be registered in Kenya soon and another two that will undergo NPT in 2024. It is understood from the project perspective that its implementation creates more value, and that is vital. KALRO has continued to utilize the system developed by the SATREPS project for breeding of the newly improved rice varieties. KALRO has also continuously utilized some of the locally available varieties, whose usefulness were verified by the SATREPS project as parents in the rice breeding program while the International Rice Research Institute (IRRI) has been utilizing some of these lines for salinity tolerance screening. During the project implementation of the SATREPS project, NERICA³-1, 4, 10 and 11 which largely grow in the saline coastal areas, were established to be cold tolerant and in subsequent collaborative work with Nagoya University, NERICA-4 became commonly used as a check. IRRI requested to use these lines for evaluation for salinity tolerance alongside its own materials through an activity that has been ongoing since May 2023. In addition, KALRO has been using the breeding lines carrying useful QTLs developed by the SATREPS project in breeding improved varieties and screening them for biotic and abiotic stresses tolerance such as rice blast disease, salinity and cold. Nagoya University also utilizes them for screening in its ongoing activities. The cold tolerance evaluation system developed by the SATREPS project has been in use by KALRO and Nagoya University in their ongoing collaboration activities. KALRO also has been using the system for soil nutrient deficiency (long-term fertility trials) developed by the SATREPS project for demo nutrient deficiency in rice and training farmers on proper nutrient deficiency management. While the system was done during the project, basic nutrient management in rice brochure was developed in 2019. For water management, the Alternate Wetting and Drying (AWD) system, a water saving irrigation technology, which had been verified during the SATREPS project was disseminated by RiceMAPP to the farmers.

Nagoya University together with KALRO started the Axis Project to improve seed production and research infrastructure for evaluation of promising rice lines at multiple locations (KALRO Kibos, KALRO Mtwapa and KALRO Mwea). Also, Nagoya University in collaboration with KALRO conducted a research project dubbed "Characterization and genetic analysis for stress tolerance in rice lines carrying chromosome segments of *Oryza Longistaminata*" to evaluate the Longistaminata Chromosome Segment Introgression Line (LCSILs) developed during the SATREPS project for various abiotic and biotic stress tolerances. In addition, Nagoya University and KALRO have jointly conducted verification of agronomic performance of CO3 (IR124713-1) line (which is a cold tolerant line) in farmers' fields. The CO3 line was one of the improved varieties developed during the project. Currently, the line is being evaluated in NPT by Kenya

² ④ : very high, ③ : high, ② : moderately low, ① : low

³ New Rice for Africa (NERICA) is a set of interspecific hybrid rice varieties developed by the Africa Rice Center (AfricaRice) in order to improve the yield of African rice varieties.

Plant Health Inspectorate Service (KEPHIS) in preparation for release as a new variety.

KALRO continues to utilize the research facilities/equipment to collect data on research activities implemented in rice projects such as Strengthening the Rice Sector in East Africa for Improved Productivity and Competitiveness of Domestic Rice (EARiSS) Project supported by International Fund for Agricultural Development (IFAD) in 2020-2022 on “adaptation of appropriate rice technologies and innovations to address emerging rice value chain constraints, strengthen functional linkages among key rice stakeholders using multi-stakeholder innovation platforms (IPs), and improve capacity of farmers and other rice value chain actors” and the International Foundation for Science (IFS) project on “Evaluation of the effect of farmer tillage practices on the expression and function of root developmental traits and its impact on the growth and yield of upland rice in central Kenya”. KALRO and Nagoya University continue to conduct joint research by utilizing the research facilities/equipment provided by the SATREPS project and manuals prepared by the SATREPS project. There was confirmation by both organizations that this will continue in the future. In addition, university graduate students not only from Kenya but also Gahan have been using the research facilities and equipment in the laboratory to conduct their experiments on rice blast disease screening and genotypic diversity evaluation of mutagenic rice lines. Also, the facilities have been utilized for trainings of students, the majority of whom have graduated with various degrees and have been applying the knowledge gained in many nodes of the economy. It has continued to be used for regional trainings in agriculture and other sectors of the economy and remains a benchmark datum for startups endeavors from even various regions. The following organizations have frequently utilized the facilities for this purpose: National Irrigation authority (NIA), Jomo Kenyatta University of Agriculture and Technology (JKUAT), University of Nairobi, Kenyatta University, Embu University and Egerton University.

<Status of Achievement for the Expected Overall Goal at the Time of Ex-Post Evaluation>

At the time of ex-post evaluation, the Overall Goal has been mostly achieved. The two new rice varieties, IR124675-13 (a higher yielding upland rice variety for rainfed ecology) based on NERICA -1 and IR124713-1 (a moderate cold tolerant variety for lowland irrigated ecology) based on Basmati-370, were developed. Although no clear target value for the indicator 1 was set, according to the Terminal Evaluation Report, both sides of Kenyan and Japanese researchers involved in the SATREPS project indicated higher possibility that 4 new rice varieties will be developed within 3 to 5 years after the project completion (Indicator 1). Although KALRO has been unable to conduct these verification tests in farmers’ fields due to lack of funds, RiceMAPP verified the same technologies developed by the SATREPS project at the Mwea Irrigation Agricultural Development (MIAD) Research Station and disseminated to about 2,700 farms the Mwea Irrigation Scheme by 2018,. While verification tests in farmer fields were not conducted, the developed varieties are right on course to attain registration and production for dissemination (Indicator 2).

Efforts for the utilization of research outcomes of the SATREPS project have been progressed. The two new rice varieties developed, which are improved NERICA-1 with gene improvement for grain number and higher yielding, and improved Basmati-370 with enhanced tolerance which have recently passed successive NPT for determination of value of cultivation and use, currently, the Distinctiveness, Uniformity and Stability (DUS) test is conducted to enable the production of seeds as new varieties for release to the market by July 2024 as mentioned above. They have good grain quality, high number of spikelets per panicle, strong culm, appreciable disease tolerance and right plant phenotypes and architecture. The NPT and DUS test processes get financial support from Nagoya University while KALRO provides logistical support such as the registration upon completion of DUS. As mentioned above, the cultivation technologies that have been adopted by farmers were disseminated through farmer training during filed days conducted by KALRO and other stakeholders in the rice sector. While KALRO has not made any deliberate attempts at dissemination of these technologies, other JICA projects RiceMAPP and “the Capacity Development Project for Enhancement of Rice Production in Irrigation Schemes (CaDPERP)” (2019-2024) have actively disseminated same technologies to farmers in Ahero Irrigation Scheme and West Kano Irrigation Scheme in addition to Mwea Irrigation Scheme. In particular, CaDPERP disseminated to about 2,700 farms (approximately 30% of the Mwea Irrigation Scheme) by 2018 and currently having trials in about 200 farms. KALRO and Nagoya University have further developed the intermediate lines and two of them have been presented to KEPHIS for NPT in preparation for their release. Also, KALRO has been utilizing the breeding lines carrying QTLs in their rice breeding programs for rice blast disease, high yields, cold tolerance and salinity tolerance. Furthermore, a roadmap for variety development from the intermediate lines developed during SATREPS project has been created.

<Other Impacts at the Time of Ex-Post Evaluation>

Some positive impacts have been confirmed at the time of ex-post evaluation. In terms of the research capacity of KARLO, the researchers have undergone training that equipped them with better skills to implement the research activities under the SATREPS project, in addition to the state-of-the-art research equipment that have been procured and installed at KALRO Mwea enhancing the capacity of the researchers to generate quality data and information. In addition, through training of students, staff members who develop thesis and publish papers that are in their repositories and open access portals. More importantly, the knowledge gained has been used to enhance scientific literacy as they become better researchers, lecturers and trainers in knowledge dissemination to the extension service providers and farmers and other value chain players. Through the SATREPS project, the following organizations/ institutions have improved or enhanced their scientific literacy: Kenya Agricultural and Livestock Research Organization (KALRO), The University of Nairobi, Kenyatta University, Jomo Kenyatta University of Agriculture and Technology, Embu University, Kenya Methodist University, Egerton University, Maseno University, Lake Basin Development Authority, National Irrigation Authority, Taita Taveta University, Pwani University, South Eastern Kenya University, Teachers Service Commission (TSC). There has been also a lot of collaboration with regional research bodies in the area of training and knowledge acquisition, exchange benchmarking and learning, research and exchange of germplasm. Other institutions that have enhanced their scientific literacy are African Centre for Crop Improvement (ACCI), West Africa Centre for Crop Improvement (WACCI) through training of students and production of research thesis and papers and conferences attendance. Others include IRRI, ICIPE, CABI, Biotechnology Innovation Center (BeCA), and so on through collaborations and knowledge sharing.

In addition, according to KARLO, there have been positive impacts on the vulnerable persons who were (and still are) engaged in the SATREPS project and through wages, have become empowered with improved livelihoods – school fees, medical bills, can hire land and undertake agricultural production and agribusiness. These benefits across gender strata and age groups that greatly impact positively to their socio-economic wellbeing. In addition, there was no discrimination as all ethnic groups were engaged and continuing to have opportunities to work and used the technologies, information, systems, facilities introduced by the SATREPS project for shared prosperity. The gender aspects were observed in consideration for the youth male and female, aged male and female. Other special groups such as people living with disabilities (PWD) also participated in the project activities without any intended prejudice. This ensured that everyone had equal

opportunity to improve their livelihoods regardless of gender identity.

No negative impacts on the environment have been observed.

<Evaluation Result>

In light of the above, the effectiveness/impact of the project is ③.

Achievement of Project Purpose and Overall Goal

| Aim | Indicators | Results | Source |
|---|---|--|---|
| (Project Purpose) A base of rice breeding and cultivation technology development is built. | Indicator 1 A least four of Ph. D. and MSc candidates in KALRO (one breeding, two agronomy and one soil science) submit theses or dissertations to universities. | Status of the Achievement (Status of the Continuation): (Project Completion): achieved as planned (continued) ➤ Six research officers of KALRO obtained Ph.D. (Five Ph. D. from universities in Japan) ➤ Nine research officers of KALRO obtained MSc (two MSc from university in Japan) (Ex-Post Evaluation) Refer to institutional/organizational and technical aspects of “Sustainability”. | Terminal Evaluation Report JST Terminal Report |
| | Indicator 2 A plan for developing rice varieties is approved by the PSC (Project Steering Committee) for implementation. | Status of the Achievement (Status of the Continuation): achieved as planned (continued) (Project Completion) The draft of the plan was prepared and was approved at the PSC meeting in April, 2018 and issued in June 2018. (Ex-Post Evaluation) The Plan is being implemented well leading to the two varieties undergoing NPT and will be registered in Kenya soon and another two that will undergo NPT in 2024. | Terminal Evaluation Report, KALRO |
| | Indicator 3 A manual of verification test on the improvement of cultivation technologies is developed. | Status of the Achievement (Status of the Continuation): achieved as planned (continued) (Project Completion) The manual was developed and published. (Ex-Post Evaluation) KALRO and Nagoya University continue to conduct joint research by utilizing these manuals and there was confirmation by both organizations that this will continue into the future. | Terminal Evaluation Report KALRO |
| (Expected Overall Goal) Rice varieties adapted to Kenya are developed and local adaptability of cultivation technologies is verified in farmer’s fields. | Indicator 1 XX rice varieties are developed. | Status of the Achievement: partially achieved (Ex-Post Evaluation) The following varieties were developed. ➤ IR124713-1 (a moderate cold tolerant variety for lowland irrigated ecology) ➤ IR124675-13 (a higher yielding upland rice variety for rainfed ecology) Although no clear target value for the indicator 1 was set, according to the Terminal Evaluation Report, both side of Kenyan and Japanese researchers involved in the SATREPS project indicated higher possibility that 4 new rice varieties will be developed within 3 to 5 years after the project completion. | KALRO, Terminal Evaluation Report |
| | Indicator 2 Verification tests of cultivation technology are conducted in 10 farmers’ field. | Status of the Achievement: achieved as planned (Ex-Post Evaluation) Although KALRO has been unable to conduct these verification tests in farmers’ fields due to lack of funds, RiceMAPP verified the same technologies developed by the SATREPS project at the Mwea Irrigation Agricultural Development (MIAD) Research Station, and disseminated to about 2,700 farms (approximately 30% of the Mwea Irrigation Scheme) by 2018. | KALRO, CaDPERP |

3 Efficiency

Both the project cost and the project period within the plan/ as planned (the ratio against the plan:91 % and100 %, respectively).

| | Project Cost (Japanese side only, yen) | Project Period (months) |
|----------------|--|-------------------------|
| Plan (ex-ante) | 353 million | 60 |
| Actual | 323 million | 60 |
| Ratio (%) | 91 | 100 |

Outputs were produced as planned.

In the light above, the efficiency of the project is (4).

4 Sustainability

<Policy Aspect>

“The Second National Rice Development Strategy (NRDS-II)” (2019-2030) aims to increase domestic rice production from 128,000t to 846,000t through expanded rice production area, enhance on-farm productivity and so on. Also, development of a working seed system is one of the priority areas for the implementation. “The Agriculture Sector Transformation and Growth Strategy (ASTGS)” (2019-2029) aims at developing and transforming the agriculture sector towards achievement of widespread food and nutrition security, rice is one of the prioritized value chains. In addition, “the Seed Act Cap. 326” under MoALD focuses on regulating seed materials for various value chains including rice in order to ensure quality seeds to be distributed to farmers. Therefore, it is expected that the policy support for the research activities related to rice production will continue for long-term.

<Institutional/Organizational Aspect>

The “KALRO Strategic Plan” (2022-2027) clarifies the KALRO’s responsibilities, including dissemination of materials that have been developed through various projects and materials accessed by farmers. KALRO has been playing important roles including improvement of seed system, advisory application system, increase in partnership, growing interest among stakeholders due to the SATREPS project. Given the important role played by KALRO in the policies of the agriculture sector, it is expected that this organizational/institutional arrangement will be maintained in the future. KALRO is also supporting farmers to improve their productivity by using tractors, also providing soil analysis services to rice farmers cooperatives such as Mwea Rice Growers Multi-Purpose Society Limited (MRGM). The basic field systems at Kirogo Station whose weather station, reservoir and electricity that were installed by the SATREPS project have been being utilized by other projects of other development partners such as, IRRI to disseminate and validate cultivation technologies in farmers’ fields.

In additions, the establishment and strengthening of the Rice Promotion Program (RiPP) Unit at the MoALD has set a strong path for nationwide rice development and a potential to expand the gains of the SATREPS project across Kenya.

<Technical Aspect>

The research capacity was greatly enhanced through provision of modern laboratory and experimental facilities, which enabled quality data collection and precision in both conduct of the experiment. The researchers have been continuously improving their research capacity through attending training program on breeding modernization conducted by IRRI, training on genetic gain and data management organized by the International Maize and Wheat Improvement Center (CIMMYT) and other domestic and international scientific conferences. Further, some of the current staff have been trained through SATREPS project and continue to work and train others as way of mentorship for good succession thus sustaining the facilities and there is continued collaboration between personnel who were trained under the SATREPS project but working in different institutions which will enhance research sustainability as new personnel learn and become part of the group, which will enhance research sustainability as new personnel learn and become part of the group.

Government authorities in Kenya, such as universities, colleges, national and county governments, and other agencies have been utilizing the facilities to implement scientific literacy through trainings and student attachments, in the facilities installed by the SATREPS project. The research facilities have been springboard as research program have a hub for actualizing their objectives and thus easily implemented for improvement of the socio-economic well-being of value chain players. Additionally, scientists have been considered for longtime trainings by the government, exchange programs with other countries on rice. Those facts will support the sustainable improvement of scientific literacy.

The researchers have been able to keep their skills and knowledge through utilization of the research facilities mostly to conduct their research activities in the ongoing rice projects such as EARiSS, IFS, the Biotechnology and Biological Sciences Research Council (BBSRC) under the UK Research and Innovation and in collaboration with IRRI. There is deliberate continuous capacity building on operation and maintenance (O&M) of research facilities and equipment to researchers and new research staff members who join KALRO.

<Financial Aspect>

KALRO has expected that funding is going to continue through the government of Kenya since rice has become a priority crop under the current regime towards the achievement of its “Bottom-up Economic Transformation Agenda (BETA) Plan” for food security. KALRO will continue to generate some funding through competitive grant proposals or sale of research by-products and charging some nominal fee for attachés in the laboratory or training in the fields. Due to climate change, breeding should continue to help adapt and funding will do so with it. For procuring necessary research equipment, Nagoya University has continued to support KALRO with provisions of a combine harvester, a small rice mill, seed dresser, and so on. In addition, leveraging on the continuity of collaboration with Nagoya University to continue with such activities. KALRO Mwea has received three researchers (2019) and two researchers (2023) from Nagoya University for continuation of these activities. The fact indicates that Nagoya University has covered personnel cost in-kind by dispatching researchers for the research activities by KALRO. Also, KALRO continues to fund raising through research proposals that have enhanced unintended funds.

For covering the O&M cost of the research equipment installed by the SATREPS project, KALRO provides soil analysis services to individual farmers/farmer organizations (at a rate of 1,500 Kenyan Shillings (KES)/sample). Also, other institutions utilize the conference and training facilities at 15,000 KES/day besides the bench fee for students/non-staff researchers (= 50,000KES/year) who use the laboratory. These finances have been usually ploughed back for O&M such as replenishment of materials and maintenance of the facilities/equipment for example, in the Molecular Lab and General Lab, some of the key equipment (deep freezer, Incubator/Growth Chamber, etc.) that suffered severe damage due to a serious nationwide power outage were repaired by KALRO Mwea. KALRO is confident that these financial sources will continue to cover the O&M costs since there will be increased service provision due to the larger capacity of the new laboratory and plans to recruit new technical staff.

There is no deliberate budgeting by the parent organization to further the utilization of the research outcomes. However, the government of Kenya has provided funds (extended by the World Bank) for dissemination of the developed technologies. Korea-Africa Food & Agriculture Cooperation Initiative (KAFACI), Korea Program for International Cooperation in Agricultural Technology (KOPIA) under the Korea International Cooperation Agency (KOICA), International Foundation for Science (IFS) are some of the many collaborations that the institution expects to continue, and they are all utilizing the facilities installed by the SATREPS project.

Although there is no clear pathway to obtaining these funds and sustaining them for the activities, the release of varieties will trigger seed production by either KALRO itself or through licensing other seed merchants who will pay some royalties that can be ploughed back for sustainability. It is expected that a modest fee can be charged on use of the molecular laboratory, implements and revenue generated if recycled could create kind of a revolving fund for sustainability.

<Environmental and Social Aspect>

Monitoring of the project activities was conducted and those related to some of the research facilities do produce products that may affect the environment. The SATREPS project, however, anticipated this from the onset and put in place environmental safeguards to mitigate the impact. Mitigation measures have also been taken to reduce surface runoff from the facilities that could cause destructive activities like soil erosion, production of noxious gases from standing sludge/waters, reduced flooded rice production to lower emission of methane gases.

<Evaluation Result>

In light of the above, slight problems have been observed in terms of the financial aspect of the implementing agency. Therefore, the sustainability of the project effects is ③.

5 Summary of the Evaluation

The project achieved the Project Purpose for building a base of rice breeding and cultivation technology development and partially achieved the Overall Goal for development of rice varieties adapted to Kenya and verification of local adaptability of cultivation technologies in the farmers' field.

Considering all of the above points, this project is evaluated to be highly satisfactory.

IV. Recommendations & Lessons Learned

Recommendations for Implementing Agency:

- To address insufficient funding and human resources, KALRO should promote external collaboration alongside internal budgeting and human resources. KALRO has built relationships with a number of institutions through the SATREPS project and should not only continue to work with JICA and Nagoya University though should also work to promote collaboration with other countries and international organizations, such as IRRI and KOICA, with whom it has worked through the SATREPS project.
- It is recommended that researchers who have obtained their Ph.D. through the SATREPS project should contribute to continuation of the related research activities to utilize the research outputs and to disseminate the technologies developed by the SATREPS project and efforts for obtaining research funding with their own SATREPS results and research plans.

Lessons Learned for JICA:

- According to KALRO, there were no sufficient financial and human resources to conduct activities for utilization of the research outcomes in the manner that was planned. KALRO did not have both of sufficient budget and technical capacity to conduct extension since almost all officers at KALRO are researchers. JICA should consider the prevailing nature of the implementing agency at the project design stage and proper framework put in place to cover the inadequacies. For example, close collaboration with other JICA project (RiceMAPP) was necessary since the exact same rice cultivation technologies were developed by the project during the same period. RiceMAPP was a technical cooperation project aiming at extension, so experts and counterparts had strong capacity to disseminate farmers fields with much ease. This would have reduced the project cost but with better impact.
- Linkages with subsequent projects within MoALD should be considered during project implementation to ensure continued budget support. For example, the National Agricultural and Rural Inclusive Growth Project (NARIGP) (2019-2025) funded by the World Bank, aims to promote sustainable agriculture and rural inclusive growth within MoALD. The idea is to work closely with MoALD to ensure that the project's budget is secured in subsequent projects, so that the project's impact continues after the project completion.
- The ongoing technical cooperation project "CaDPERP2" (2024-2028) aims at dissemination of selected varieties to farmers and the upstream activities such as development varieties have been conducted by KALRO and IRRI. It is an ideal system that the research institutions can devote to develop new varieties and MAID and AIRS conduct selection and dissemination of the varieties and provide technical services. However, establishment of the collaboration system between R&D and extension services may require a lot of efforts because the rice extension system needs involvement of MoALD, the Ministry of Irrigation and local governments. Therefore, JICA needs to carefully consider incorporation of a component to establish a extension system for new variety under collaboration with research institutions at the time of project planning.



Various equipment procured and installed in the main laboratory by the SATREPS Project



Basic field systems that continue to be used for research on soil moisture, soil nutrients, root morphology, etc.