Republic of Mauritius

FY2021 Ex-Post Evaluation Report of Japanese Grant Aid Project

"The Project for Improvement of Meteorological Radar System (I) (II)"

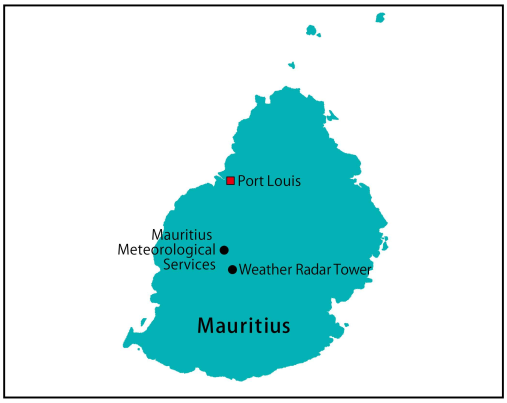
External Evaluator: Koichiro Ishimori, Value Frontier Co., Ltd

0. Summary

The project was intended to strengthen the monitoring capability of meteorological phenomena, such as cyclones, by developing a meteorological radar system in Mauritius, thereby contributing to reducing the damage from natural disasters. The relevance of the project corresponds to all three perspectives of coherence: 1) development policies, 2) development needs, and 3) appropriateness of the project plan and approach. Regarding coherence, it is confirmed that the project is 1) coherent with the development cooperation policies of Japan, and 2) aligned with the JICA's technical cooperation project, the Project for Enhancing Meteorological Observation, Weather Forecasting and Warning Capabilities (2019 – 2024) as an internal coherence. It is also confirmed as an external coherence that the project is 3) coherent with the policy of the U.N. World Conference on Disaster Risk Reduction. Therefore, its relevance and coherence are high. The efficiency of the project is moderately low because the project cost is assumed to have slightly exceeded the planned cost, and the project period significantly exceeded the planned period. Regarding effectiveness, the actual values achieved the target values for all quantitative indicators, and some of them surpassed the target values. Capacity-building activities supported the realization of quantitative effects. Regarding impacts, Mauritius Meteorological Services (MMS) is now able to swiftly provide precise weather information because of the project, which enables the National Disaster Risk Reduction and Management Centre (NDRRMC) and media to swiftly provide precise weather information for the people. Moreover, the provision of weather information helps the people and workers in the tourism sector to take emergency measures against disaster damage. Additionally, the implementations of the project and JICA's other technical cooperation projects in Mauritius have not only fostered momentum to establish but actually established "Disaster Risk Reduction Management Platform" targeting Southwest Indian Ocean and Southeast African regions, and the activities are now conducted at the platform on an even larger scale than when it was established. Since regional activities tackling regional issues are beyond what the original plan expected, the effectiveness and impacts of the project are very high. Although there is a slight issue in the institutional/organizational aspect of the operation and maintenance of the project, it is highly likely to be resolved. Therefore, the sustainability of the project effects is high.

In light of the above, this project is evaluated to be highly satisfactory.

1. Project Description



Project Locations
(source: External Evaluator)

Meteorological radar tower
(source: External Evaluator)

1.1 Background

Mauritius is an island country located in the Southwest Indian Ocean, where cyclones occur frequently, and is vulnerable to natural disasters, such as rainstorms, high tides, floods, and landslides caused by cyclones. Before the project was implemented, Mauritius's tourism industry, enjoying a rich natural environment, shared approximately 17%[1] of the GDP and employed approximately 17%[2] of the working population. Its agriculture sector strongly affected by nature shared only approximately 3%[3] of the GDP and employed approximately 7%[4] of the working population. Therefore, cyclones significantly affected the economy. Under such circumstances, there were concerns that global warming in recent years would intensify the forces of cyclones and that the damage caused by natural disasters would become more severe than ever. Therefore, developing appropriate countermeasures against disasters, such as cyclones, was a pressing agenda in Mauritius.

1.2 Project Outline

The objective of this project is to strengthen the monitoring capability of meteorological phenomena, such as cyclones, by developing a meteorological radar system in Mauritius, thereby contributing to reducing the damage from natural disasters.

<Grant Aid Project>

Grant Limit / Actual Grant Amount	(I) 1,079 million yen, 1,150 million yen (modified) / 1,150 million yen (II) 190 million yen / 190 million yen

1 https://www.statista.com/statistics/1262269/contribution-of-travel-and-tourism-to-gdp-in-mauritius/
2 https://www.statista.com/statistics/1262276/share-of-employment-in-travel-and-tourism-in-mauritius/
3 https://data.worldbank.org/indicator/NV.AGR.TOTL.ZS?locations=MU
4 https://data.worldbank.org/indicator/SL.AGR.EMPL.ZS?locations=MU

Exchange of Notes Date /Grant Agreement Date	June 2013, December 2013 (the 1st modification), November 2015 (the 2nd modification), March 2018 (the 3rd modification) / June 2013, December 2013 (the 1st modification), November 2015 (the 2nd modification), March 2018 (the 3rd modification)
Executing Agency	Mauritius Meteorological Services (MMS)
Project Completion	March 2019
Target Areas	Vacoas (MMS HQs) Trou aux Cerfs (Meteorological radar tower site)
Main Contractors	Joint venture of Marubeni Corporation and Shimizu Corporation
Main Consultants	Joint venture of International Meteorological Consultant Inc. and Japan Weather Association
Preparatory Survey	October 2011 – August 2012
Related Projects	JICA "the Project for Enhancing Meteorological Observation, Weather Forecasting and Warning Capabilities (2019 – 2024)"

2. Outline of the Evaluation Study

2.1 External Evaluator

Koichiro Ishimori, Value Frontier Co., Ltd

2.2 Duration of Evaluation Study

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

Duration of the Study: October, 2021 – November, 2022

Duration of the Field Study: January 17, 2022 – January 28, 2022, April 9, 2022 – April 14, 2022

3. Results of the Evaluation (Overall Rating: A[5])

3.1 Relevance/Coherence (Rating: ③[6])

3.1. 1. Relevance (Rating:③)

3.1.1.1 Consistency with the Development Plan of Mauritius

The national development plan at the time of ex-ante evaluation, "*Mauritius Strategy for the Further Implementation of the Programme of Action for the Sustainable Development of Small Island Developing Countries (2005)*," mentioned strengthening the early warning capability of meteorological phenomena, such as cyclones, to reduce damage caused by natural disasters, and so did "*Mauritius Strategy for Implementation -National Assessment Report 2010- (2010).*" Furthermore, the sector plan, "*A Climate Change Action Plan (1998)*," referred to the importance of the roles to be played by Mauritius Meteorological Services (MMS), together with the importance of data collection in response to climate change, development of basic documents for

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

[6] ④: Very High、③: High, ②: Moderately Low, ①: Low

monitoring, assessment of vulnerabilities and risks, and development of capabilities and technologies.

The national development plan at the time of ex-post evaluation, "*Mauritius Vision 2030 - Innovative and Globally Competitive- (2017)*," attempts to shift the country's industrial structures from the primary industry to the secondary and tertiary industries, especially financial, information and communication, and tourism industries. Although the plan does not mention strengthening the early warning capability of meteorological phenomena, it is indispensable to promote the tourism industry enjoying a rich natural environment, such as the development of beach resorts. Furthermore, the sector plan, "*Update of the Nationally Determined Contribution of the Republic of Mauritius (2021)*" updated from "*Intended Nationally Determined Contribution for the Republic of Mauritius (2015)*," mentions the importance of the MMS swiftly providing precise weather information to continuously respond to climate change.

In sum, since the project was intended to strengthen the monitoring capability of meteorological phenomena, such as cyclones, at the MMS, it is consistent with the development policies of Mauritius both at the time of ex-ante and ex-post evaluation.

3.1.1.2 Consistency with the Development Needs of Mauritius

In Mauritius, the meteorological radar system, which was installed with support from the United Nations Development Programme (UNDP), began observations in 1979. However, it stopped its operation owing to damage by Cyclone Dina in 2002 and termination of spare parts provision by makers. Since then, the MMS had no choice but to rely on low-resolution satellite images by the meteorological satellite METEOSAT which the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) was operating, and radar images with limited monitoring areas by the meteorological radar that neighboring French territory Réunion was operating to monitor natural phenomena, such as cyclones. Consequently, it was unable to swiftly provide precise weather information for the entire country.

According to the MMS statistics at the time of ex-post evaluation, the total number of cyclones that occurred from 1981 to 2000 in Southwest Indian Ocean where Mauritius is located was 67, that is, 3.35 on average per year. However, it became 102 for the next 20 years from 2001 to 2020, that is, 5.1 on average per year, which is an increasing trend. Especially for the recent three years from 2018 to 2020, it was 24, that is, eight on average per year. This average is almost double that over the past 40 years. Global warming increases the seawater temperature, and the higher the seawater temperature, the stronger the updraft. Since this results in intensifying the forces of cyclones, it is expected that damage by cyclones will become more severe in the future. Therefore, swift provisions of precise weather information are important not only for the safety of the people but also for tourism and agriculture that depend on nature.

In sum, since the project was intended to strengthen the monitoring capability of meteorological phenomena by developing a high-resolution meteorological radar system with wide monitoring areas at the MMS, it is consistent with the development needs of Mauritius, both at the time of ex-ante and ex-post evaluation.

3.1.1.3 Appropriateness of the Project Plan and Approach

The ex-post evaluations of similar projects in the past indicated the importance of developing capabilities for radar analyses by weather forecasters and electric facility management by engineers through capacity-building activities. Therefore, the project also conducted capacity-building activities, including the same content, and brought about the realization of effects. Thus, the project plan was considered appropriate.

3.1.2 Coherence (Rating:③)

3.1.2.1 Consistency with Japan's ODA Policy

Yokohama Action Plan (2008) of *the 4th Tokyo International Conference on African Development (TICAD)* emphasized "developing an early warning system" as one of its five priorities, "Addressing Environmental/Climate Change issues." Additionally, the summary by the chair of TICAD IV indicated "the necessity of giving appropriate attention to the specific needs of Small Island Developing States." Therefore, *the Project Plan (2012)* of *the Country Assistance Policy for Mauritius* prioritized cooperation programs related to "environment, climate change, and disaster prevention."

The project was intended to develop an early warning system for meteorological phenomena, such as cyclones, as part of the measures for climate change in an island country that *Yokohama Action Plan (2008)* emphasized. Therefore, it was coherent with Japan's development policies at the time of ex-ante evaluation.

3.1.2.2 Internal Coherence

No JICA project was implemented before ex-ante evaluation of the project.

The JICA's technical cooperation project, the Project for Enhancing Meteorological Observation, Weather Forecasting and Warning Capabilities (2019 – 2024), which is being implemented at the time of ex-post evaluation, has been assisting the MMS in issuing different warnings depending on areas by using the high-resolution meteorological radar system with wide monitoring areas that the project developed. Therefore, it is trying to help the MMS staff to improve their capabilities for meteorological monitoring and early warnings. However, the technical cooperation project has been experiencing delays owing to the spread of COVID-19. Consequently, it has not yet realized any expected outcomes and synergies through collaboration with the project, for example, the MMS issuing different warnings depending on areas. Nevertheless, both the project and the technical cooperation project are intended to improve the monitoring capability of meteorological phenomena at the MMS and collaborate with each other to reduce damage caused by natural disasters. Thus, internal coherence is confirmed at the time of ex-post evaluation.

3.1.2.3 External Coherence

Hyogo Framework for Action (2005) of *the 2nd U.N. World Conference on Disaster Risk Reduction (WCDRR)* that was designated at the time of ex-ante evaluation emphasized "Developing early warning systems that are people centered, in particular systems whose warnings are timely and understandable to those at risk" in one of its five priorities, "identify, assess, and monitor disaster risks and enhance early warning."

Sendai Framework for Disaster Risk Reduction (2015) of *the 3rd WCDRR* that was designated at the time of ex-post evaluation emphasized "promoting real-time access to reliable data, make use of space and in situ information, including geographic information systems (GIS), and enhance the collection, analysis and dissemination of data" in one of its four priorities, "Understanding disaster risk."

In sum, the project is aligned with priorities emphasized by *Hyogo Framework for Action (2005)* and *Sendai Framework for Disaster Risk Reduction (2015)* of the WCDRR. Thus, external coherence is confirmed at the time of ex-ante and ex-post evaluation.

In conclusion, regarding relevance of the project, the project responds to three perspectives: 1) relevance to the development plan, 2) relevance to the development needs, and 3) appropriateness of the project plan and approach. Regarding coherence, coherence with TICAD and the country assistance policy is recognized as coherent with Japan's development assistance policy. Regarding internal coherence, JICA's technical cooperation project, the Project for Enhancing Meteorological Observation, Weather Forecasting and Warning Capabilities (2019 – 2024), is recognized as collaboration with the project. However, no outcomes or synergies have yet been realized through concrete collaboration with the project. Additionally, regarding external coherence, the project is recognized as coherent with the WCDRR policy. However, no outcomes or synergies have yet been realized through concrete collaboration with the project. Therefore, its relevance and coherence are high.

3.2 Efficiency (Rating: ②)

3.2.1 Project Outputs

The physical outputs of the project were realized as planned.

Table 1: Planned and actual outputs

	Planned outputs		Actual outputs	
	MMS HQs	Observatory	MMS HQs	Observatory
Facilities				
Meteorological radar tower	—	1	—	As planned
Equipment				
Meteorological radar system	—	1 set	—	As planned
Meteorological radar data display system	1 set	1 set	As planned	As planned
Meteorological data communication system	1 set	1 set	As planned	As planned

Source: Materials provided by JICA and MMS

The original outputs from capacity-building activities were technical assistance related to 1) to 3) only in Table 2. However, technical assistance related to 4) to 9) was also added to the activities based on the request from the MMS and its necessity.

Table 2: Planned and actual outputs from the capacity-building activities

	Planned outputs	Actual outputs
1) Meteorological radar check-ups, fault finding, remedy and recovery	1.3MM	As planned
2) Meteorological operation and maintenance	1.3MM	As planned
3) Meteorological radar observation	1.0MM	As planned
4) Basic knowledge on meteorological radar	—	0.2MM
5) Reflection of meteorological radar product into weather forecast operation	—	0.5MM
6) Meteorological data communication system operation, check-ups, fault finding, remedy and recovery	—	0.1MM
7) Power backup system operation, check-ups, fault finding, remedy and recovery	—	0.1MM
8) Meteorological radar management techniques using measuring instruments	—	0.3MM
9) Web server fault finding, and releasing meteorological radar product in the web site	—	0.1MM
Total	3.6MM	4.9MM

Source: Materials provided by JICA and MMS

3.2.2 Project Inputs

3.2.2.1 Project Cost

The planned project cost on the Japanese side was 1,079 million yen, and that on the Mauritian side was 191 million yen; thus, the planned total project cost was 1,270 million yen.

However, the actual project cost on the Japanese side was expected to exceed the grant limit of 1,079 million yen owing to the sharp depreciation of the yen. Therefore, the project was divided into two phases. Nevertheless, Phase I resulted in 1,150 million yen, and Phase II in 190 million yen. Thus, the actual project cost on the Japanese side was 1,340 million yen, 261 million yen higher than the grant limit[7]. However, it was an appropriate response because all the constructed

[7] Owing to the sharp depreciation of the yen (79.89 yen per U.S. dollar at the time of the cabinet meeting in March 2013 to 99.43 yen per U.S. dollar at the time of the cabinet meeting in October 2013), the construction cost of facilities was expected to increase. Therefore, in December 2013, the project cost on the Japanese side was increased at the 1st amendment of E/N and G/A to 1,150 million yen (facility: 451 million yen, equipment: 583 million yen, design and supervision: 115 million yen). Although the total project cost on the Japanese side was 1,149 million yen, the amended

facilities and procured equipment that the project had planned were indispensable for realizing the project effects. Meanwhile, details of the project cost on the Mauritian side were missing in many items, and thus, the precise amount was unknown. However, the valued added tax, the largest expenditure item on the Mauritian side, was approximately 19 million Mauritian Rupees (MUR) and was less than planned. Therefore, even if the actual cost of missing items was to some extent higher than the planned cost, it was assumed that the actual project cost on the Mauritian side would be less than the planned cost of 191 million yen.

In sum, while the actual project cost on the Japanese side was higher than planned, it is assumed that the actual project cost on the Mauritian side was within the planned cost. Therefore, it is assumed that the actual total project cost on both sides was less than 1,531 million yen (1,340 million yen on the Japanese side and 191 million yen on the Mauritian side) and was higher than 100% and lower than 125% of the planned total project cost. As it is assumed to have slightly exceeded the plan, efficiency of the project cost is evaluated to be high.

Table 3: Planned and actual project cost

	Planned cost	Actual cost			
Total project cost	1,270 million yen	1,478 million yen			
Project cost on the Japanese side	1,079 million yen[8]	1,340 million yen			
	Construction of facilities：385 million yen	(I)	678 million yen	(II)	0 million yen
	Procurement of equipment：578 million yen	(I)	380 million yen	(II)	162 million yen
	Design and supervision：115 million yen	(I)	92 million yen	(II)	28 million yen
Project cost on the Mauritian side	191 million yen (≒MUR 67,729,538[9])	138 million yen (≒MUR 42,836,453[10])			
	Connection of electricity to the new meteorological radar tower: MUR 583,338	MUR 1,372,975			
	Connection of water to the new meteorological radar tower: MUR 102,000	MUR 58,072			
	Connection of telephone to the new meteorological radar tower: MUR 30,000	Unknown			
	Connection of internet to the new meteorological radar tower: MUR 48,000	Unknown			
	Value added tax: MUR 60,000,000	MUR 40,990548			
	Dismantle of the existing meteorological radar tower: MUR 252,000	MUR 212,458			
	Clearance of the existing meteorological observation system: MUR 840,000	MUR 202,400			
	Relocation of the existing communication line: MUR 754,200	Unknown			

grant limit of E/N and G/A was made at 1,150 million yen. Furthermore, owing to the continuation of the sharp depreciation of the yen (99.43 yen per U.S. dollar at the time of the cabinet meeting in October 2013 to 119.08 yen per U.S. dollar in July 2015), the bidding of construction of facilities and procurement of equipment became unsuccessful and was retried by reducing some equipment from the scope. However, the equipment reduced from the scope were meteorological radar data display system and meteorological data communication system and were the basis of meteorological radar system. Thus, 190 million yen (equipment: 162 million yen, design and supervision: 28 million yen) was added as the phase II.

8 The total project cost on the Japanese side was 1,078 million yen, however, the grant limit of E/N and G/A was made to be 1,079 million yen.

9 Calculated at the exchange rate of 2.825 yen per MUR during the preparatory survey in February 2012.

10 Recalculated at the IFS rate (annual average) from 2013 to 2019.

	Renovation of the existing security office: MUR 800,000	Unknown
	Installation of air conditioner at the existing office: MUR 200,000	Unknown
	Renovation of the existing gates, fences, lighting facilities in and around the site: MUR 4,000,000	Unknown
	Gardening: MUR 120,000	Unknown

Source: Materials provided by JICA and MMS

3.2.2.2 Project Period

While the planned project period was 23 months from June 2013 (signing G/A) to April 2015, the actual project period was 70 months from June 2013 (signing G/A) to March 2019, which was 304% of the planned period. Since the actual project period significantly exceeded the planned period, efficiency of the project period is evaluated to be low.

Table 4: Reasons for delays

Period	Reasons for delays
From G/A to Detailed Design (D/D)	The sharp depreciation of the yen necessitated recalculation of the project cost and the following amendment of the grant limit of E/N and G/A, resulting in 6 months of delay.
D/D (including bidding period)	The successful applicant of the 1st bidding received suspension measures of participating in the bidding for another project and lost the qualification for participating in the bidding of the project. The successful applicant of the 2nd bidding declined the bidding owing to the sharp depreciation of the yen. These resulted in 22 months of delay in D/D including bidding period.
Construction	Preparation for construction and design change of piling work owing to finding of cavity under the ground resulted in 19.5 months of delay.

Source: Materials provided by JICA and MMS

In conclusion, while the efficiency of the project cost is high, the efficiency of the project period is low. Therefore, the efficiency of the project is moderately low.

3.3 Effectiveness and Impacts[11] (Rating: ④)

3.3.1 Effectiveness

Since the project was intended to strengthen the monitoring capability of meteorological phenomena, such as cyclones, the external evaluator analyzed in the following quantitative and qualitative effects what has been strengthened and the method adopted for that.

3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

[11] Sub-rating for Effectiveness is to be put with consideration of Impacts.

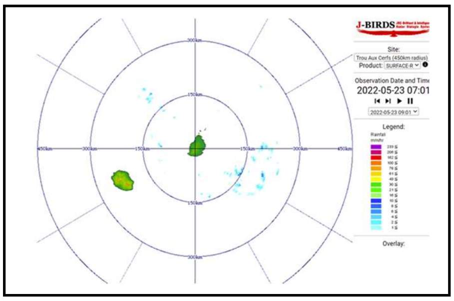
Table 5: Quantitative effects (operation and effect indicators)

Indicator	Baseline values 2012	Target value 3 years after completion 2022	Actual value Year of completion 2019	Actual value 1 year after completion 2020	Actual value 2 years after completion 2021	Actual value 3 years after completion 2022
1) Wind direction/ speed and rainfall intensity	-	Within a radius of 200 km (Observation of wind speed up to 75 m/s maximum)	Within a radius of 200 km (Observation of wind speed up to 233 m/s maximum)			
		Within a radius of 450 km (Detection of rainfall whose intensity is more than 1 mm/h)	Within a radius of 450 km (Detection of rainfall whose intensity is more than 1 mm/h)			
2) Spatial resolution and observation interval of rainfall data	Only main island of Mauritius; 9.85 km mesh; 30 mins interval	Within a radius of 450 km; 2.5 km mesh; 10 mins interval	Within a radius of 450 km; 2.5 km mesh; 10 mins interval			
3) Observation interval of image on location and route of cyclone	15-30 mins interval (METEOSAT)	1 min interval (PPI mode)10 mins interval (CAPPI mode)	30 seconds interval (PPI mode) 10 mins interval (CAPPI mode)			
4) Observation of disturbance and wind shear by meteorological radar system	Impossible (Visual observation only)	Within a radius of 200 km	Within a radius of 200 km			
5) Provision of information via internet on disturbance and wind shear for the int'l airport	-	Possible	Possible			
6) Short-term prediction on trends of rain clouds	-	1-2 hours	1-2 hours			
7) Identification of areas with more than 100 mm of rainfalls within 12 hours	-	Possible (based on specified time cumulative rainfall data)	Possible (based on specified time cumulative rainfall data)			

* The actual values above are the values that the project has been achieving since the completion of the project until the time of ex-post evaluation.
Source: Materials provided by JICA and MMS

1) Wind direction/speed and rainfall intensity

Before the project, there were no means of measuring wind direction/speed and rainfall intensity. After the project, as long as the wind speed is up to 233 m/s, surpassing the target value of 75 m/s maximum, it became possible to observe the area within a radius of 200 km. Additionally, as long as the rainfall intensity is more than 1 mm/h, as planned, it becomes possible to observe the area within a radius of 450 km.



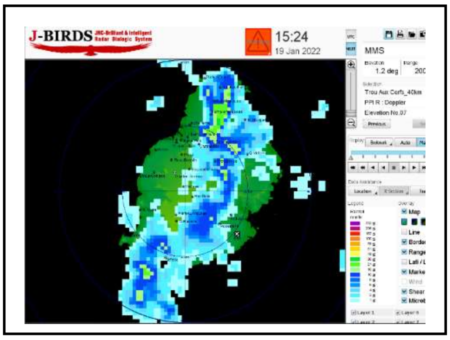
Radar Image

2) Spatial resolution and observation interval of rainfall data

Before the project, the MMS observed rainfall data by rain gauges installed on the island. Therefore, the observation areas were limited to the areas where they were installed. Additionally, the observation was made in 9.85 km mesh and in every 30 minutes. After the project, the observation areas are stretched as planned to a radius of 450 km, centered around Mauritius, and the observation is made in a 2.5 km mesh and every 10 minutes.

3) Observation interval of image on location and route of cyclones

Before the project, the MMS observed location and route of cyclones using low-resolution satellite images with 15 to 30 minutes interval by the METEOSAT that the EUMETSAT was operating. After the project, PPI mode[12] allows the MMS to observe them with 30 seconds interval, surpassing the target values of 1 minute interval, as the right image, and CAPPI mode[13] allows the MMS to observe them with 10 minutes interval as planned.



PPI Mode Image

4) Observation of disturbances[14] and wind shear[15] by the meteorological radar system

Before the project, the MMS was unable to observe disturbances and wind shear using the meteorological radar system. After the project, it is possible to observe them within a radius of 200 km, as planned.

5) Provision of information via internet on disturbances and wind shear for the international airport

Before the project, the MMS was unable to provide information on disturbances and wind shear for the international airport. After the project, it is possible to do it as planned. The MMS provides information for the airport four hours before all aircrafts that are expected to depart or arrive.

6) Short-term prediction on rain cloud trends

Before the project, the MMS was unable to make a short-term prediction of rain cloud trends. After the project, it is possible to make a prediction one to two hours ahead, as planned.

7) Identification of areas with more than 100 mm of rainfall within 12 hours

Before the project, the MMS was unable to identify areas with more than 100 mm of rainfall within 12 hours. After the project, it is possible, as planned.

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[12] PPI stands for Plan Position Indicator and is a mode to collect high-altitude data by making a radar rotate 360 degrees at a certain elevation angle.

[13] CAPPI stands for Constant Altitude Plan Position Indicator and is a mode to collect a certain altitude data by making a radar rotate 360 degrees at multiple elevation angles.

[14] Disturbance is a relatively small atmospheric turbulence that changes in real time.

[15] Wind shear is a rapid variation in direction or wind speed between two different points in either vertical or horizontal direction in the atmosphere.

In sum, the project has been achieving the target values in all operation and effect indicators from the year 2019, the year of completion, to 2022, the time of ex-post evaluation. Especially, the actual values of indicators 1) and 3) surpassed the target values. Therefore, it can be said that the monitoring capability of meteorological phenomena has been strengthened to a greater extent than in the originally planned project.

3.3.1.2 Qualitative Effects (Other Effects)

Capacity-building activities 1) to 4) and 6) to 8) out of 1) to 9) are technical assistance related to the operation and maintenance of the meteorological radar system, all of which have supported the achievement of the quantitative effects 1) to 4) and 6) to 7). Capacity-building activities 5) and 9) provide technical assistance related to processing and releasing meteorological radar information, both of which have been supporting the achievement of the quantitative effect 5).

The ex-ante evaluation sheet indicated as qualitative effects improvement in the awareness of disaster prevention, implementation of early evaluation, and reduction of human and economic losses. However, to achieve these goals, it is necessary to conduct awareness activities on disaster prevention and evacuation drills at schools and offices. Since the project did not include any such activities, the external evaluator did not analyze the qualitative effects indicated in the ex-ante evaluation sheet[16].

3.3.2 Impacts

This project was intended to contribute to reducing the damage caused by natural disasters. Therefore, the external evaluator analyzed the contributions and the method adopted in the following qualitative impacts.

3.3.2.1 Intended Impacts

1) Enabling precise and swift issuance of alerts through swift provision of precise weather information.

Before the project, the MMS issued warnings based on rainfall data collected every 30 minutes by rain gauges installed at 21 locations on the island. Therefore, it was neither possible to collect precise weather information in areas without rain gauges nor issue swift alerts. However, with the meteorological radar system by the project, the MMS is now able to collect precise weather information and swiftly provide them for the National Disaster Risk Reduction and Management Centre (NDRRMC). Consequently, NDRRMC can also issue precise and swift alerts.

The JICA's technical cooperation project, the Project for Enhancing Meteorological Observation, Weather Forecasting and Warning Capabilities (2019 – 2024) is intended to set different warning

[16] There are problems with the indicator settings, the external evaluator does not put a negative consideration on them because they do not affect the project per se.

standards depending on the four regions into which Mauritius is divided, and to enable the MMS to issue more precise warnings. However, as mentioned before, the technical cooperation project has been experiencing delays owing to the spread of COVID-19. Consequently, no impact has yet been realized through collaboration with the project at the time of ex-post evaluation.

2) Enabling avoidance of unnecessary outing and reinforcement of such facilities as houses, in advance through provision of information on the forces and expected routes of cyclones via media.

Before the project, the MMS had no choice but to rely on low-resolution satellite images by the METEOSAT and radar images with limited monitoring areas by the meteorological radar that neighboring French territory Réunion was operating to collect information on the forces and routes of cyclones. However, with the meteorological radar system by the project, the MMS can precisely collect information on cyclones within a radius of 450 km. Consequently, it is now able to provide such information to all its stakeholders and public through its own homepage, and broadcasts and newspaper articles by media with which the MMS collaborates, including the national television and radio station. Additionally, the MMS issues four levels of cyclone warnings in scale, and the NDRRMC coordinates operations with the entities that have the power to give directions depending on the level, including shutting down schools and government offices. Consequently, they help the people to take emergency measures against disaster damage[17].

3) Enabling tourism and agricultural workers take early measures against disasters through provision of swift and precise weather information.

Using the meteorological radar system by the project, the MMS can swiftly collect precise weather information. Consequently, the MMS is now able to swiftly provide it for tourism workers through the Tourism Board with which the MMS collaborates. As cited in the article below, the provision of such information helps tourism workers to take emergency measures against disasters. Meanwhile, it seems that agricultural workers do not take any emergency measures against such disasters such as cyclones because there are hardly any such measures that they can take.

Currently, the NDRRMC is implementing a project to disseminate alerts based on cyclone warnings that the MMS issues to all the people. As of 2022, the number of cell phones registered in Mauritius is 1.9 million, which exceeds the number of its population, 1.26 million people. In theory, this means that one person has more than one cell phone. Therefore, it is planning to develop by 2025 a system to send alerts based on cyclone warnings with short mail to the people with cell phones and smartphones.

[17] Having received information on cyclones, Mauritian people were taking emergency measures against disasters to the extent possible even before the project. Therefore, it should be noted that it does not necessarily mean that the project has made it possible for the people to do them.

 	
According to the staff working at Mauritian Wildlife Foundation that provides marine transport services to Ile aux Aigrettes designated as a natural protected area, it takes such emergency measures against disasters as putting its owned ships on land when it receives cyclone warnings from the Tourism Board for which MMS provides weather information. According to a travel agency that provides diving tour services and others, it also takes the same emergency measures.	According to the farm owner producing sugarcane that is a major agricultural product in Mauritius, there are hardly any emergency measures against cyclones that he can take, and thus he cannot do any.

3.3.2.2 Other Positive and Negative Impacts

The project was classified as Category C because it was not in the sectors that were prone to have negative effects indicated in the JICA Guidelines for the Confirmation of Environmental and Social Consideration (April 2010).

1) Impacts on the Natural Environment

The Ministry of Environment and Sustainable Development exempted the project from environmental impact assessment based on the Environment Protection Act (2002). The Ministry of Health and Quality of Life gave the MMS a health permit under the following conditions, and the MMS satisfied all the conditions.

I. Connecting water supply to the building of meteorological radar tower;

II. Installing appropriate drainages at the building of meteorological radar tower;

III. Obtaining a permit from the Wastewater Management Board on the collection and disposal of wastewater drained from the building of a meteorological radar tower;

IV. Appropriate collection and disposal of wastes generated from the building of a meteorological radar tower;

V. Controlling noises coming from devices inside the building of meteorological radar tower under the level that the Environment Protection Act (2002) designates; and

VI. Keeping appropriate light and ventilation inside the building of meteorological radar tower.

2) Resettlement and Land Acquisition

There was no resettlement or land acquisition because the meteorological radar tower had been rebuilt at the existing site.

3) Gender

The percentage of households with a television in Mauritius was 97.4% in 2012 before the project and 98.4% in 2020[18]. In short, almost all households in Mauritius had television even before the project. Additionally, as of 2022, one Mauritian person has more than one cell phone or smartphone. In Mauritius, women can access weather information without any problems because they enjoy the freedom to watch television and have communication devices, such as smartphones. Therefore, the project had no positive or negative impact on women.

4) Minorities

As mentioned above, everybody can access weather information without any problems in Mauritius. Therefore, the project had no positive or negative impact on the socially vulnerable population.

5) Social system, norms, and well-being

None

6) Other Unintended Positive/Negative Impacts

In March 2019, Cyclone Idai hit Southeast Africa and caused disasters that affected over three million people. It was the time when the project and the JICA's technical cooperation project, The *Project* for Landslide Management, were already complete, and the JICA's technical cooperation project, the Project for Enhancing Meteorological Observation, Weather Forecasting and Warning Capabilities, was about to start. Consequently, there was a feeling of momentum in Mauritius to spread its know-how on measures against disasters to neighboring countries. Thus, in July 2019, "Disaster Risk Reduction Management Platform" comprising four countries in Southwest Indian Ocean (Mauritius, Madagascar, Comoros, and Seychelles) and three countries in Southeast Africa (Mozambique, Malawi, and Zimbabwe) was established under the leadership of JICA and the government of Mauritius. Although its activities slowed owing to the spread of COVID-19, an online workshop was held with a new member of South Africa in January 2022. In the workshop, the participating countries shared numerous forms of knowledge. The knowledge was about contributions to disaster risk reduction by the MMS, the importance of disaster risk reduction, the experience of Cyclone Idai, and the importance of disaster education. Thereafter, it discussed disaster risk reduction in South African and Indian regions. These regional activities to tackle regional issues were not included in the original plan, and thus surpassed the original plan.

The project has achieved all target values in the quantitative effects 1) to 7) of effectiveness, and some of the actual values surpassed the target values. Capacity-building activities 1) to 9) have been supporting the achievement of quantitative effects 1) to 7) and realizing qualitative effects.

[18] Statistics Mauritius, "Availability of ICT to households, 2006 – 2020"

Regarding impacts, the MMS can swiftly provide precise weather information because the project makes it possible for the NDRRMC and media to swiftly provide precise weather information for the people. Moreover, the provision of such information contributes to helping the people and tourism workers to take emergency measures against disasters. The project has not realized any impact through collaboration with JICA's technical cooperation project, the Project for Enhancing Meteorological Observation, Weather Forecasting and Warning Capabilities. However, the project and the multiple technical cooperation projects have built a feeling of momentum to establish "Disaster Risk Reduction Management Platform" in Southwest Indian Ocean and Southeast African regions and have led to its establishment. Furthermore, it now performs its activities on a larger scale than before. These regional activities to tackle regional issues were not included in the original plan, and thus surpassed the original plan. In sum, this project has achieved its objectives more than it was planned. Therefore, effectiveness and impacts of the project are very high.

3.4 Sustainability (Rating: ③)

3.4.1 Policy and System

The National Disaster Risk Reduction and Management Policy 2020-2030 (2020) at the time of ex-post evaluation highlights the importance of continuously improving resilience against disasters in the development process of Mauritius, and considers that preparations for disasters and early warnings in many forms are indispensable to avoid or reduce the effects by disasters. According to the NDRRMC that has made the policy, 98% of those who have been affected by disasters from 1960 to 2018 are owing to cyclones. Therefore, the relevance of the project to the effects that the project has realized, that is, strengthening the monitoring capability of meteorological phenomena, such as cyclones, is continuously confirmed.

3.4.2 Institutional/Organizational Aspect

The MMS was under the umbrella of the Ministry of Defense and Internal Affairs at the time of ex-ante evaluation. Later, it came under the umbrella of the Ministry of Environment, Waste Management, and Climate Change in December 2014, and thereafter, the Ministry of Local Government and Disaster Risk Management in February 2020. However, there has been no change in the institutional and organizational aspects of the MMS. The permanent staff at the MMS increased from 115 at the time of ex-ante evaluation to 140 at the time of ex-post evaluation. Two communication engineers and seven electronic technicians in the operational meteorology department are in charge of operating and maintaining the meteorological radar system that the project developed. The planned positions of one system engineer and three other electronic technicians have not been filled. However, there is no institutional and organizational problem because the budget for filling the positions is likely to be approved in the budget of the new fiscal year from July 2022 to June 2023.

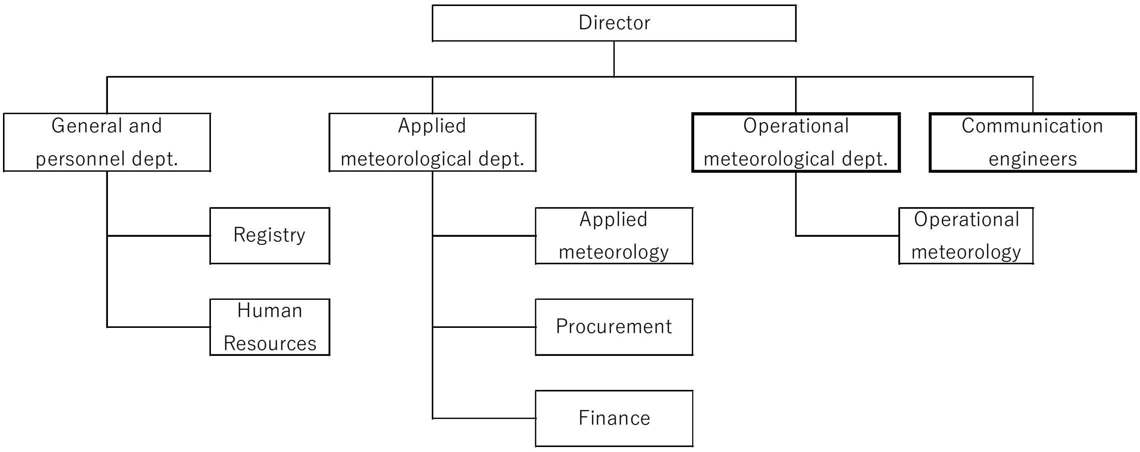

Chart 1: Organigram of the MMS

Source: Materials provided by MMS

3.4.3 Technical Aspect

Capacity-building activities have developed a routine maintenance manual (routine maintenance procedure using gauges, meteorological Doppler radar system manual, radar system maintenance book), spare parts replacement procedures (spare parts replacement and operation procedure), and fault response manual (fault finding, remedy, recovery procedure, and procedure responding to serious faults). The MMS conducts regular maintenance of each piece of equipment and provides training for its staff on the manuals in case of necessity. Additionally, since the JICA's technical cooperation, the Project for Enhancing Meteorological Observation, Weather Forecasting and Warning Capabilities (2019 – 2024), continues to strengthen MMS staff members' monitoring capability of natural phenomena, it is expected that the MMS will improve its technical capability. Therefore, there is no technical problem.

3.4.4 Financial Aspect

The annual budget of the MMS decreased from 145 million Mauritian Rupees in 2019 to 116 million Mauritian Rupees in 2021 owing to the effects by COVID-19. Meanwhile, the annual operation and maintenance costs at the MMS HQs and Trou aux Cerfs observatory were almost the same as planned. However, according to the MMS, the annual operation and maintenance costs at present are sufficient to operate and maintain the meteorological radar system that the project has developed. Moreover, as described below, the facilities and equipment that the project constructed and procured are well operated and maintained. Therefore, there is no financial problem.

Table 6: The annual budget of the MMS

(Unit:1,000 MUR)

	First year of completion of the project (July 2019 －June 2020)	Second year of completion of the project (July 2020 －June 2021)	Third year of completion of the project (July 2021 －June 2022)
Total budget	145,500	109,000	116,000
Planned operation and maintenance costs	694	730	1,495
Actual operation and maintenance costs	646	772	—

Source: Materials provided by JICA and MMS

3.4.5 Environmental and Social Aspect

There was no problem with environmental and social considerations from the implementation period of the project until the time of ex-post evaluation.

3.4.6 Preventative Measures to Risk

There was no risk, such as a hit by a super cyclone, negatively affecting the achievement of the project effects from the implementation period of the project until the time of ex-post evaluation.

3.4.7 Status of Operation and Maintenance

The MMS performs daily clean-up work and security work at the meteorological radar tower and also performs regular check-ups (repairs for abrasions, damages, and deteriorations) of the meteorological radar system at the HQs and observatory. There is no problem with the operation and maintenance of facilities and equipment. Additionally, the MMS signed the agreement of "Spare Parts Supply Contract" agreement with the maker of the meteorological radar system on March 6, 2019. The contract period of supplying PC equipment that the MMS can easily procure in Mauritius is over on March 5, 2022. However, the contract period for supplying spare parts and consumables of the mainstay system is valid until March 5, 2034. Therefore, there is no problem with procurement of spare parts.

In conclusion, a slight issue has been observed in the institutional/organizational aspect. However, there are good prospects for resolution. Therefore, sustainability of the project effects is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

The project was intended to strengthen the monitoring capability of meteorological phenomena, such as cyclones, by developing a meteorological radar system in Mauritius, thereby contributing to reducing the damage from natural disasters. The relevance of the project corresponds to all three perspectives of coherence: 1) development policies, 2) development needs, and 3) appropriateness of the project plan and approach. Regarding coherence, it is confirmed that the project is 1) coherent with the development cooperation policies of Japan, and 2) aligned with the JICA's technical cooperation project, the Project for Enhancing Meteorological Observation, Weather Forecasting and Warning Capabilities (2019 – 2024) as an internal coherence. It is also confirmed as an external coherence that the project is 3) coherent with the policy of the U.N. World Conference on Disaster Risk Reduction. Therefore, its relevance and coherence are high. The efficiency of the project is moderately low because the project cost is assumed to have slightly exceeded the planned cost, and the project period significantly exceeded the planned period. Regarding effectiveness, the actual values achieved the target values for all quantitative indicators, and some of them surpassed the target values. Capacity-building activities supported the realization of quantitative effects. Regarding impacts, the MMS is now able to swiftly provide precise weather information because of the project, which enables the NDRRMC and media to swiftly provide precise weather information for the people. Moreover, the provision of weather information helps the people and workers in the tourism sector to take emergency measures against disaster damage. Additionally, the implementations of the project and JICA's other technical cooperation projects in Mauritius have not only fostered momentum to establish but actually established "Disaster Risk Reduction Management Platform" targeting Southwest Indian Ocean and Southeast African regions, and the activities are now conducted at the platform on an even larger scale than when it was established. Since regional activities tackling regional issues are beyond what the original plan expected, the effectiveness and impacts of the project are very high. Although there is a slight issue in the institutional/organizational aspect of the operation and maintenance of the project, it is highly likely to be resolved. Therefore, the sustainability of the project effects is high.

In light of the above, this project is evaluated to be highly satisfactory.

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

Since April 2019, the MMS has been being able to collect and gather detailed meteorological data, which was unable before, because of the meteorological radar system that the project developed. The data could contribute not only to promoting an understanding of meteorological phenomena, such as cyclones, but also to reducing disaster damage caused by cyclones. Therefore, it is expected that the MMS should promote an understanding of meteorological phenomena, such as cyclones, by conducting research using the gathered meteorological data in collaboration with research institutions inside and outside the country.

4.2.2 Recommendations to JICA

"Disaster Risk Reduction Management Platform" comprising four countries in Southwest Indian Ocean and four countries in Southeast Africa could contribute not only to promoting an understandings of meteorological phenomena such as cyclones in the regions but to reducing disaster damage caused by cyclones. It is expected that the JICA Madagascar Office that supports activities by the platform should assist the MMS in collaborating with and establishing research teams with research institutions inside and outside the country.

4.3 Lessons Learned

Appropriate indicator settings

The ex-ante evaluation sheet indicated as qualitative effects improvement in the awareness of disaster prevention, implementation of early evaluation, and reduction of human and economic losses. However, to achieve these goals, it is necessary to conduct awareness activities on disaster prevention and evacuation drills at schools and offices. However, this project did not include any such activity. When setting indicators at the time of planning, it is important to set appropriate indicators based on the project activities.

5. Non-Score Criteria

5.1. Performance

5.1.1 Objective Perspective

JICA built cooperative relationships with the MMS through smooth communication from the time of planning to the implementation period of the project.

5.2. Additionality

Initially, the participating countries in "Disaster Risk Reduction Management Platform" were four countries in Southwest Indian Ocean (Mauritius, Madagascar, Comoros, and Seychelles) and three countries in Southeast Africa (Mozambique, Malawi, and Zimbabwe). JICA had offices in four counties, excluding Mauritius, Comoros, and Seychelles, and had networks with disaster-related ministries. In addition, it has completed or implemented disaster-related projects in Mauritius, Seychelles, and Mozambique[19]. This created a feeling of momentum to establish the platform, eventually resulting in its establishment. Without mentioning the contributions under the initiatives of the Mauritian government, the contributions made by JICA to expand the project to activities in the regions were also huge.

(End)

[19] In Mauritius, there were the JICA's technical cooperation project and the Project for Landslide Management. In Seychelles, there was the JICA's technical cooperation project, Project for the Study for Coastal Erosion and Flood Control Management. In Mozambique, there was the JICA's technical cooperation project, Project on Strengthening Resilience in Cyclone Idai-Affected Areas.