FY2023 Simplified Ex-Post Evaluation Report of Japanese Grant Aid Project

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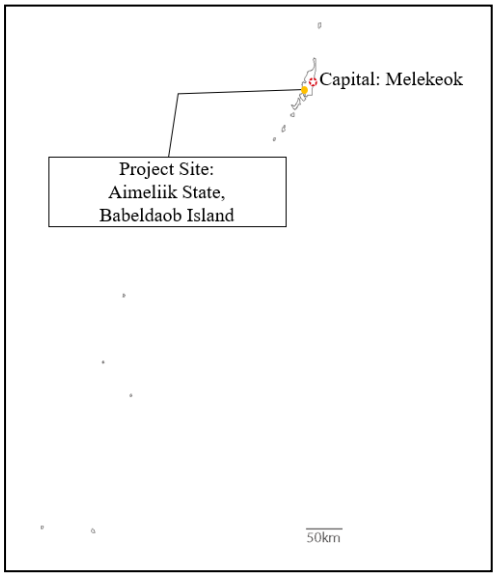
Duration of the Study: September 2023 – September 2024
Duration of the Field Study: November 19, 2023 – December 2, 2023

Country Name Republic of Palau	**The Project for the Construction of National Landfill**



Location of the Project Site
(Source: Prepared by the External Evaluator from the materials provided by JICA)

Landfill Developed Under the Project
(Source: Photo by the External Evaluator)

I. Project Outline

Background	In Palau, with the growth of the tourism industry leading to an increase in the number of tourists[1], the amount of waste brought to the M-Dock, a main waste disposal site located in Koror State, had increased. By 2015, the estimated daily waste intake at M-Dock had reached over 20 tons. M-Dock was converted into a landfill using the Fukuoka method[2] through a Japanese technical cooperation called "Improvement on Solid Waste Management in the Republic of Palau" conducted from 2005 to 2008. Subsequently, through another technical cooperation "The Project for Promotion of Regional Initiative Solid Waste Management (hereinafter referred to as J-PRISM)" (2011-2016), efforts such as raising the height of the embankment and improving staff's maintenance capabilities were made to prolong the life of M-Dock. However, by the end of 2017, the waste capacity had reached its limit. Moreover, as M-Dock is located within the urban area of Koror State and near the coast, concerns about adverse effects on hygiene and the environment such as odor, fire, rat infestation, and discharge of leachate into the sea were raised. Therefore, the development of a new landfill with appropriate waste management and minimization of environmental impact became an urgent issue.
Objectives of the Project	To promote sustainable waste management by constructing a new waste disposal site and providing heavy machinery and other equipment necessary for its maintenance in Babeldaob Island, thereby contributing to the improvement of the sanitary environment of each state and protection of the environment of Palau.
Contents of the Project	1. Project Site: Aimeliik State, Babeldaob Island 2. Japanese side: [Facilities] Landfill (area: 8ha, useful life: 20 years, Fukuoka method), Administrative Office and Garage (total area: 380m^2) [Equipment] Bulldozer (1 unit), Excavator (1 unit), Wheel Loader (1 unit), Dump Truck (1 unit), Compactor Truck (2 units), pH Meter (1 set), and Gas Analyzer (1 set) [Consulting Services] Detailed design, bidding assistance, procurement supervision, and construction supervision 3. Palau side (Contents other than procedures): Securing land for spoil disposal and roads accessible to heavy machinery, implementing resettlement action plan for residents affected by the new landfill usage, providing facilities such as power distribution, drainage, and telephone lines, procuring materials such as coral sand for water purification systems, implementing environmental management plans and monitoring, and removing unexploded ordnance.

[1] The number of tourists to Palau was around 83,000 in 2008, but peaked at 168,000 in 2015.
https://www.palaugov.pw/executive-branch/ministries/finance/budgetandplanning/immigration-tourism-statistics/

[2] Fukuoka method refers to a semi-aerobic landfill structure that promotes the decomposition of waste by allowing air circulation through leachate collection pipes inside the landfill layer, thereby activating microbial activity within the waste. Accelerating the decomposition of waste can suppress the generation of greenhouse gases such as odors and methane.

Implementation Schedule	E/N Date	16 May 2018 Revised: 15 April 2021	Disbursement Date	
	G/A or L/A Date	28 May 2018 Revised: 15 April 2021	Completion Date	13 November 2020
Project Cost	E/N Grant Limit / G/A Grant Limit Original Amount: 1,311 million yen, Revised Amount: 1,330 million yen, Actual Grant Amount: 1,311 million yen			
Executing Agency	Ministry of Public Infrastructure and Industries (hereinafter referred to as MPII)			
Contracted Agencies	Main Contractor: TOA CORPORATION Main Consultants: CTI Engineering International Co., Ltd., Eight-Japan Engineering Consultants Inc. (JV)			

II. Result of the Evaluation

Summary

This project aimed to promote sustainable waste management by constructing a new waste disposal site and providing heavy machinery and other equipment necessary for its maintenance in Babeldaob Island, thereby contributing to the improvement of the sanitary environment of each state and protection of the environment of Palau. This project was in line with Palau's sectoral development plans at the time of ex-ante evaluation and was also consistent with the development needs as it aimed to improve the waste management. Furthermore, this project was consistent with Japan's ODA policy and led to the realization of effects such as establishing an appropriate waste disposal system through collaboration with J-PRISM Phase 2[3] and a smooth environmental impact assessment through a preliminary survey on environmental impact funded by Taiwan, and the relevance and coherence of the project are high. Regarding project effectiveness, the indicators of quantitative effects anticipated at the time of ex-ante evaluation were mostly achieved. Waste that was buried in open dumpsites in each state of Babeldaob Island has been appropriately processed at only one newly developed landfill through this project. Additionally, the negative impacts on sanitary and environmental aspects around disposal sites that were used before were generally mitigated by the operation of the new landfill. Although some items of environmental monitoring have not been implemented, significant negative impacts were not observed at the time of the ex-post evaluation because, in terms of water quality, there are no problems with pH testing, and in terms of air quality, no occupational safety issues due to hazardous gases have been observed. There were no negative impacts on resettlement, land acquisition, gender aspects, the marginalized people, social systems, norms, and people's well-being. Therefore, the effectiveness and impact of this project are high. Efficiency is very high as both actual project cost and period were within the plan. Sustainability is moderately low due to remaining challenges in institutional and organizational aspects, environmental and social aspects, and preventative measures to risks.

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

Overall Rating[4]	**B**	**Relevance & Coherence**	③[5]	**Effectiveness & Impacts**	③	**Efficiency**	④	**Sustainability**	②

<Special Perspectives Considered in the Ex-Post Evaluation >

The project commenced in May 2018, however, after its initiation, the original plan was revised in April 2021 due to the impact of the COVID-19 pandemic, necessitating increases in the project cost and an extension of the project period. Consequently, performance comparisons were conducted based on the revised plan.

1 Relevance/Coherence

<Relevance>

・Consistency with the Development Policy of Palau at the Time of Ex-Ante Evaluation

The *National Solid Waste Management Plan* (2012-2017), which was the national waste management strategy of Palau at the time of ex-ante evaluation, outlined three key strategies for waste management: 1) promoting stakeholder engagement in activities such as policy development, capacity building, information sharing, and public education and awareness, 2) promoting waste reduction, and 3) improving existing waste management and disposal systems. Furthermore, the successor to this plan, the *National Solid Waste Management Strategy* (2017-2026), explicitly emphasized the need for the closure of existing waste disposal sites such as M-Dock and open dumpsites in each state of Babeldaob Island, as well as the establishment of new landfill facilities to replace them.

Therefore, it can be concluded that this project was in consistent with the sector development strategies at the time of ex-ante evaluation.

・Consistency with the Development Needs of Palau at the Time of Ex-Ante Evaluation

At the time of ex-ante evaluation, Palau was experiencing an increase in the number of tourists, and the impact of typhoons generating disaster waste, and achieving proper management of the increasing waste and minimizing its environmental impact was an urgent issue. By 2017, the amount of waste delivered to the M-Dock reached the limit of its waste disposal capacity at an estimated 20 tons per day, and measures such as embankment raising were undertaken to prolong its usage. Moreover, concerns regarding environmental impacts, such as

[3] It is an abbreviation of Japanese technical cooperation of the "Project for Promotion of Regional Initiative on Solid Waste Management Phase 2" (2017-2023). This project involved technical assistance aimed at further strengthening the waste management systems of nine target countries in the Pacific region. Activities included the formulation of strategies for enhancing waste management systems in each country, support for capacity building within organizations, the development of guidelines for disaster waste management, and the promotion of the 3Rs (reduce, reuse, recycle).

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

[5] ④: Very high, ③: High, ②: Moderately low, ①: Low

the emission of odors and the discharge of hazardous substances, were raised in the vicinity of open dumpsites in each state of Babeldaob Island, not limited to M-Dock. The construction of new disposal facilities and the consolidation of waste disposal activities were therefore deemed necessary.

Therefore, it can be said that this project was consistent with the development needs of Palau.

・Appropriateness of the Project Design/Approach

This project was planned to collaborate with J-PRISM Phase 2 from the planning stage of the project, and after the construction of the new landfill, technical training on operation and maintenance of the Fukuoka method, advice on the establishment of a household waste collection and transportation system in Babeldaob Island and Koror State, training on O&M of heavy equipment, and implementation of 3R awareness program, etc., were provided. The technical assistance provided in J-PRISM Phase 2 has generally resulted in the appropriate operation and maintenance of the waste disposal facilities established in this project, and the project effects, such as the establishment of a collection and transportation system for household waste in Babeldaob Island, have also been confirmed as the outcomes. In particular, after the completion of the project, waste collection in Babeldaob Island has been consolidated at the new disposal facility, which replaced the existing facility that was closed. Consequently, the support provided in J-PRISM Phase 2 for the establishment of a household waste collection and transportation system in Babeldaob Island contributed to the realization of a smooth waste collection service after the operation of the new landfill.

Thus, the lessons learned in the past that "it is important to enhance development spillover effects by linking the construction of a waste disposal facility with technical cooperation in an organized manner" have been fully utilized.

<Coherence>

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

Japan's development cooperation policy for Palau at the time of the ex-ante evaluation was the "Country Assistance Policy for the Republic of Palau" (formulated in April 2018). In the policy, environment, climate change and disaster prevention were set as a priority area, and it is explicitly stated that the focus is placed on improving the surrounding environment and public health through proper waste disposal and supporting environmental conservation. Furthermore, at the 8th Pacific Islands Leaders Meeting (PALM8) held in 2018, strengthening the foundation for resilient and sustainable development was listed as a major cooperation and support measure, which included the improvement of sanitary environment through further enhancement of waste management capacity such as the establishment of waste disposal sites.

This project provided support to the waste management sector, in line with Japan's development cooperation policy at the time of ex-ante evaluation.

・Internal Coherence

At the time of ex-ante evaluation, this project focused on implementing tangible components, such as constructing the landfill itself and procuring necessary heavy machinery and equipment. Meanwhile, J-PRISM Phase 2 focused on providing support on the intangible components including enhancing the operational and maintenance capabilities of the landfill with the Fukuoka method, supporting the establishment of a waste transportation and collection system within Babeldaob Island, providing training on heavy machinery operation, and establishing a system for collecting fees for commercial waste collection. Both projects were planned in advance to complement each other. Most of the support measures have achieved some results, but the establishment of the fee collection system for commercial waste was not realized at the time of the ex-post evaluation. It continues to be considered in J-PRISM Phase 3[6]. Through the collaboration of both projects, the continuous transportation, collection, and burial of waste generated within Babeldaob Island were achieved at the new landfill, confirming the synergistic effects of collaboration. Specifically, constructing a transport and collection system on Babeldaob Island with the support of J-PRSIM Phase 2 contributed to the achievement of the delivery volume, which is a quantitative indicator of effectiveness. It can also be said that training on heavy machinery operations contributed to the utilization rate of heavy machinery.

・External Coherence

It had been planned at the time of the ex-ante evaluation that an environmental impact study and Environmental Impact Statement (EIS) based on the preliminary survey of environmental impacts funded by Taiwan (2015) would be prepared and utilized for the project's environmental impact assessment. The environmental impact assessment was meticulously based on the contents of the preliminary survey, which resulted in the implementation of a robust environmental impact assessment and the smooth preparation of the EIS report. Therefore, it can be said that Taiwan's support contributed to the generation of the impact of the project, "Improvement of the sanitation environment and environmental conservation in Palau," especially in terms of environmental conservation around the landfill site.

<Evaluation Result>

In light of the above, the relevance and coherence of the project are high[7].

[6] J-PRISM Phase 3 is a technical cooperation project that aims to strengthen the Pacific region's self-reliant waste management and "3R+Return" mechanism by developing a strategy to introduce 3R+Return according to each country's circumstances, promoting the establishment of recycling associations and strengthening their capacity, supporting the promotion of recycling by developing export markets for recycled resources, further improving waste management capacity and building a system for cooperation within the region, based on the cooperation efforts in the Pacific region made during J-PRISM Phase 2.

[7] Relevance: ③, Coherence: ③

2 Efficiency

(1) Project Outputs

The outputs of the project were as follows, with no changes compared to the plan developed at the time of the ex-ante evaluation.

Table 1 Outputs of this project

Items	Contents
Waste disposal facilities	Landfill (area: 8ha, useful life: 20 years, Fukuoka method) Administrative Office and Garage (total area: 380m^2)
Equipment	Bulldozer (1 unit) Excavator (1 unit) Wheel Loader (1 unit) Dump Truck (1 unit) Compactor Truck (2 units) pH Meter (1 set) Gas Analyzer (1 set)
Consulting Services	Detailed design, bidding assistance, procurement supervision, and construction supervision
Soft Components	None

As for the items borne by the Palau side, only pH testing was conducted among the environmental monitoring items, and no aquatic plants were planted in the purification ponds, but other items were generally implemented appropriately.

(2) Project Cost

The project cost and project period were changed in 2021 due to the spreading of COVID-19 infection, with an additional grant given in 2021 to extend the construction period and to cover additional expenses, such as the construction cost.

The total project cost was 1,333 million yen, which was the same as the revised planned amount of 1,333 million yen (100% compared to the plan)[8].

(3) Project Period

The project period was 31 months from May 2018 to November 2020, which was in line with the revised plan period (100% compared to the plan)[9].

<Evaluation Result>

Both the project cost and the project period were within the plan. Therefore, efficiency of the project is very high.

3 Effectiveness/Impacts[10]

<Effectiveness>

(Quantitative Effects)

In this project, the daily amount of waste transported to the new landfill and the utilization rate of heavy machinery were set as quantitative indicators of effectiveness.

The daily amount of waste delivered to the new landfill did not meet the target. The volume of waste decreased due to a decline in the number of tourists[11], which is thought to be the primary source of waste generation due to the spreading of the COVID-19 infection. Since the landfill itself is being operated without significant problems, it is judged that the indicator has been generally achieved.

As for the utilization rate of heavy machinery, the rates for each type of machinery procured were monitored, and it was confirmed that they all exceeded the target value of 2 hours per day.

Additionally, the household waste collection rate in Palau[12] was checked as an additional indicator. According to the executing agency, although data for the entire country was not available, at the time of ex-post evaluation, the household waste collection rate on Babeldaob Island reached 100%.

It can be said that the sufficient operation of the landfill and heavy machinery developed through this project have been realized, contributing to the stable collection and disposal of waste.

[8] Even if the original planned amount of 1,314 million yen is used as a reference, the project cost was 101% of the planned amount, which was not a significant difference.

[9] Compared to the originally planned project period of 27 months from May 2018 to July 2020, this was an excess of four months (115% of the plan), which was not a significant excess.

[10] When providing the sub-rating, Effectiveness and Impacts are to be considered together.

[11] Tourist numbers in Palau dropped from a peak of 168,000 in 2015 to 41,000 in 2020 after the spreading of the COVID-19 infection.
https://www.palaugov.pw/executive-branch/ministries/finance/budgetandplanning/immigration-tourism-statistics/

[12] Percentage of households in the country that enjoy weekly household waste collection service.

Table 2 Quantitative Effects

Indicators	Baseline (2020)	Target (2023) 3 Years after Completion	Actual (2023) At the time of ex-post evaluation
Daily amount of waste transported to the new landfill (ton/day)	0	27.07	23.5
Utilization rate of heavy machinery (hour/day)	0	2*1	4~6*2*3

*1 The target utilization rate of heavy machinery was not based on elaborate calculations, but it was set based on the actual operation records at the old disposal site.
*2 The executing agency responded based on the operation records of each piece of heavy machinery. The records do not accurately exclude idling time during operations.
*3 As for reference, the operating rates for October 2023 were 5.8 hours/day for excavators, 4 hours/day for bulldozers, and 2.2 hours/day for wheel loaders
Source: Responses to the questionnaire by the executing agency

(Qualitative Effects)

As a qualitative effect of this project, it was anticipated that waste generated within Babeldaob Island, which had been processed by open dumpsites, would be appropriately handled at the new landfill.

Regarding the realization of the qualitative effect of this project, it was confirmed that waste generated within Babeldaob Island, which had previously been processed at open dumpsites in each state before project implementation, is now regularly collected through rounds conducted by private contractors commissioned by the executing agency after project completion, and then the waste is appropriately buried at the new landfill constructed through this project. Regarding the waste deposition rate, at the time of ex-post evaluation, burial had progressed up to the second section out of four sections within the landfill. However, according to the executing agency and project consultants, after completing burial up to the fourth section while conducting compaction as necessary, the surrounding embankments will be raised, and waste will be gradually stacked over the entire area of the landfill. Therefore, the waste deposition rate was considered within the expected range. Furthermore, there have been no significant issues such as interruptions in waste transportation for extended periods during disasters such as typhoons. Thus, there have not been any significant problems in terms of stable collection, even after consolidating waste disposal to a single location. Therefore, it is judged that waste from various states in Babeldaob Island continues to be appropriately handled even after transferring to the new landfill.

<Impacts>

(1) Intended Impacts

The anticipated impacts of this project were the improvement of the sanitary environment in each state of Babeldaob Island and environmental conservation in Palau.

Before the landfill constructed in this project became operational, waste was processed at the M-Dock in Koror State and open dumpsites in each state of Babeldaob Island. Each of these disposal sites was located near residential and commercial facilities, leading to adverse effects on the sanitary environment such as odors, infestations of flies, food damage by rats, fires, and smoke pollution. After the operation of the new landfill implemented in this project, all open dumpsites and M-Dock were closed, significantly reducing their negative impacts. Additionally, as there are no residents near the new landfill, it is believed that there is minimal impact on the sanitary environment. Therefore, it is considered that the sanitary environment in each state of Babeldaob Island has been improved through the implementation of this project.

Furthermore, concerns about coastal pollution caused by leachate released from M-Dock and open dumpsites have also been reduced by the operation of the new landfill. The new landfill is generally processed according to the expected leachate dilution process, and it is believed that there are minimal concerns about coastal pollution. Therefore, this project is judged to contribute to the conservation of the environment in Palau.

(2) Other Positive and Negative Impacts

1) Impacts on the Environment

The environmental and social consideration guideline applied to this project was the JICA Guidelines for Environmental and Social Considerations (published in April 2010), with an environmental category of B.

According to the interviews with the executing agency, environmental mitigation measures and monitoring during construction were appropriately conducted, and no negative impacts on the environment during and after construction were identified. It was also confirmed by the executing agency that there are no residents in the vicinity of the disposal site and that no major complaints or disputes have occurred during and after construction.

At the time of ex-post evaluation, while it was noted that only pH testing[13] among the scheduled environmental monitoring items[14] was irregularly conducted, no significant adverse environmental impacts were specifically identified. There is also no evidence of occupational safety issues for employees due to hazardous gases such as hydrogen sulfide and methane. The reason why some environmental monitoring items were not implemented was that there was insufficient awareness of the need for monitoring tests due to busy work schedules and the cost of purchasing consumable items such as simple COD test kits.

[13] A pH value of 6.5-8.5 was assumed as an acceptable range during the ex-ante evaluation, but no particular problems were observed as the pH value has remained between 4.2-8.6 for the last two years.

[14] Water quality test items were pH, electrical conductivity, COD, transparency, color, temperature and odor, while air quality test items were dust, methane and hydrogen sulfide.

2) Resettlement and Land Acquisition

Regarding the land acquisition for the new landfill, it was confirmed that procedures were in line with the Abbreviated Resettlement Action Plan (ARAP), ensuring that consultations with residents of Aimeliik State, where the disposal site is located, and compensation payments to them were conducted appropriately. At the time of ex-post evaluation, no significant complaints and disputes had arisen, and it is judged that no adverse impacts occurred.

3) Gender Equality

At the time of ex-ante evaluation of this project, there were no specific considerations regarding gender aspects. Additionally, as there are no residents near the new landfill, the impact on the residents, including women, was not able to be assessed. Since it can be said that the closure of the open dumpsite contributed to improve the sanitation environment for all residents regardless of gender, it is deemed that there are no negative gender impacts.

4) Marginalized People

It is believed that the implementation of this project will provide the benefit of waste disposal services to the entire community, including children, people with disabilities, and the elderly, without any significant negative impacts.

5) Social Systems and Norms, People's Well-being and Human Rights

There were no particular negative impacts observed in terms of social systems, norms, People's Well-being, and human rights resulting from the implementation of this project.

<Evaluation Result>

Therefore, the effectiveness and impacts of the project are high.

4 Sustainability

・Policy and System

At the time of the ex-post evaluation, Palau's national development plan for the waste sector was the same as at the time of the ex-ante evaluation, the National Solid Waste Management Strategy (2017-2026). The goals and actions of this strategy include 1) Data Management and Analysis, 2) Institutional Development, 3) Stakeholder Awareness and Public-Private Partnership, 4) Best Practice and Cost-Effective Approaches, 5) Human Capacity Development, and 6) Dissemination of Outcomes and Experiences. Regarding the waste disposal sites, it is explicitly stated that, in place of M-Dock in Koror State, one appropriately-sized disposal site will be developed and operated in Aimeliik State.

At the ex-post evaluation stage, the same sectoral development strategy as at the time of the ex-ante evaluation was still positioned as the policy. Confirmation was obtained from the executing agency that waste sector development would continue in line with this strategy.

Therefore, it can be said that sustainability in terms of policy and system is high.

・Institutional/Organizational Aspect

The operation and maintenance of the landfill facilities and equipment developed in this project are handled by the Division of Solid Waste Management (DSWM) of the Bureau of Public Works (BPW) under MPII. At the time of ex-post evaluation, under the management of the DSWM director, the operation and maintenance of the landfill is being conducted according to the following structure.

Table 1 Operation and Maintenance Structure for the Landfill

DSWM positions involved in the operation and maintenance of the landfill	Number of staff		
	At the time of ex-ante evaluation (April 2018)	At the time of defect inspection (November 2021)	At the time of ex-post evaluation (December 2023)
Supervisor	1	1	1
Heavy machinery operator	3	3	2
Security officer	0	2	1
General laborer	0	3	2
Mechanics	2	0	0
Weight Measurement	2	0	0
Facility Maintenance Management	2	0	0
Safety Management	2	0	0
Total	12	9	6

Source: Created by the external evaluator from the information provided by the executing agency, Preparatory Survey and Defect Inspection reports

At the time of ex-post evaluation, there are six staff members engaged in the operation and maintenance of the landfill, three fewer than at the time of the defect inspection conducted in 2021 and six fewer than at the time of the ex-ante evaluation, indicating a continuous downward trend in the staff numbers. In addition, according to the executing agency, while it is not necessarily required to fill the six reduced positions, a total of four positions are needed for stable operations: one heavy machinery operator, one engineer, and two general

laborers. However, the agency does not have the financial capacity to fill the required positions, and given the situation in Palau, where talented people are migrating overseas[15], it is unlikely that it will be able to secure the personnel needed to fill the positions.

With the current staffing levels, only basic tasks related to the operation and maintenance of the landfill, such as waste intake, compaction, specific processes of gas vent pipe extension unique to the Fukuoka method, and leachate circulation, are handled. There is no personnel capacity to respond to unforeseen events that could impact the operation of the disposal site. Furthermore, with no scheduled filling of the vacant positions, it is believed that there is a low possibility of establishing a sufficient operation and maintenance structure in the future.

Therefore, the sustainability of the institutional/organizational aspects is considered to be moderately low.

・Technical Aspect

Among the six staff members of DSWM, four have more than five years of experience, while two have less than three years, indicating that not all possess many years of experience. However, they have acquired experience in the operation and maintenance tasks of M-Dock, where the Fukuoka method was introduced during its operational phase, hence already possessing the fundamental knowledge and skills necessary for the operation and maintenance of the landfill utilizing the Fukuoka method implemented in this project. Furthermore, through collaboration with J-PRISM Phase 2[16], knowledge and skills are also acquired through training on the operation and maintenance of the Fukuoka method and on the operation and maintenance of heavy machinery, which are being utilized for the effective operation of the landfill. Operation and maintenance manuals have also been created and have been read as needed such as during the timing of switching landfill sections or extending gas vent pipes. On-the-job training for staff members is also consistently conducted within DSWM, with no significant issues observed regarding the transmission of knowledge and skills.

Therefore, it can be said that sustainability in terms of technical aspect is high.

・Financial Aspect

The financial situation of DSWM, which is responsible for the operation and maintenance of the landfill facility developed under the project, is as follows.

Table 2 Financial Statement of DSWM (Unit: US dollars)

	FY2021		FY2022		FY2023		FY2024
Items	Budget	Actual	Budget	Actual	Budget	Actual	Budget
Personnel expenses	137,460	78,600	176,835	200,700	192,688	164,533	265,163
Outsourced waste collection expenses	249,817	99,213	200,805	261,046	197,433	117,136	205,000
Consumables	35,352	30,353	34,406	33,896	46,592	32,515	33,000
Other expenses	64,371	22,576	89,422	91,797	98,287	53,753	98,306
Total	487,000	230,742	501,468	587,439	535,000	367,937	601,469

Source: Created by the external evaluator from the information provided by the executing agency

As shown in Table 4, most of the budget for the operation and maintenance of the landfill facility is for personnel expenses and waste collection expenses outsourced to private contractors, and it was confirmed that the budget has been allocated every year over the last three years. The finance resource illustrated above is fully covered by the revenue from Palau's CDL system (Container Deposit Legislation)[17], and the establishment of a fee collection mechanism for commercial waste in cooperation with J-PRISM Phase 3 is also being considered. Although actual annual expenditures fluctuate relative to the budget, there has been no shortage of operating funds in the past, and if there were to be a budget shortfall, the Ministry of Finance would consider additional budgetary measures, so there are no major concerns regarding financial resources.

Therefore, it is judged that sustainability in terms of finance is high.

・Environmental and Social Aspect

As mentioned in the environmental impact section, no major environmental problems were identified at the time of ex-post evaluation, but among the environmental monitoring items, only pH testing has been conducted, while the other items have not been implemented. Although there is a possibility that the pH test may partially detect abnormalities in water quality, there is no monitoring of air quality, and it is considered impossible to detect any changes in air quality, such as an increase in the concentration of methane gas and hydrogen sulfide generated from the wastes. According to the Environmental Quality Protection Board of Palau, the environmental laws in Palau do not require the implementation of environmental monitoring at any waste disposal sites. However, if there is an abnormality in water or air quality, there is no system in place to identify it in a timely manner, and possible negative environmental and occupational safety aspects may be overlooked[18].

[15] Information from "Country Assistance Policy for the Republic of Palau" (formulated in April 2018)

[16] The training provided during the J-PRISM Phase 2 implementation period included: training on the operation of a landfill with the Fukuoka method (once), training on operating waste collection vehicles and heavy equipment (three times), training on disaster waste management (once), support for the establishment of an interstate transportation system for waste (Continuous support during J-PRISM Phase 2), and support for developing a plan of M-Dock closure (Continuous support during J-PRISM Phase 2).

[17] The system allows consumers to pay a deposit when purchasing drinks and other beverages in cans or plastic bottles, and when consumers or collectors bring their used containers to designated locations, a portion of the deposit collected at the time of purchase is returned to them.

[18] During the defect inspection of this project (November 2021), discussions were held between the project consultant and the executing agency, and it was

Therefore, the sustainability in terms of environmental and social considerations aspect is judged to be moderately low.

・Preventative Measures to Risks

Two risks were identified that could affect the future operation of the landfill: the occurrence of fire and the disposal of medical waste in the landfill. As for the fire, it was confirmed that it occurred in April 2023. Although there were no injuries, it took approximately 18 hours to extinguish the fire because the landfill was not equipped with fire extinguishing facilities or fire prevention equipment, and no fire station or fire hydrant was located within a short distance from the site. The fire was probably caused by the generation of combustible gases such as methane gas, seasonal factors (fires tend to occur during the dry season from January to June), and converging fires caused by glass and other substances mixed within the waste, and it is also likely that the fire spread due to the lack of regular soil covering. According to the executing agency, they are considering the introduction of a hose that would allow leachate to be discharged directly into the fire, but other measures to prevent fires and extinguish them after they occur need to be further considered.

Regarding the disposal of medical waste, according to the executing agency, it is confirmed that medical waste was brought to the landfill in September 2023, and that it was buried in the ground, about 2 to 3 meters in depth, where the oldest waste had been deposited in the landfill. The medical waste was originally supposed to be disposed of in a dedicated incinerator[19] at the Belau National Hospital, but the incinerator has been out of service for the past five years due to breakdowns, and the waste was brought to the landfill. Another reason may be that Palau's national law does not clearly stipulate the handling of medical waste. According to the project consultant, although medical waste is supposed to be disposed of properly by the hospital, if it is brought in again, there are concerns about secondary infection to workers and outflow of hazardous materials, hence burying it in a different zone from general waste or covering it with soil are possible measures to be taken.

Although none of the above risks are considered to occur frequently and it is unlikely that there would be an immediate significant impact on the operation of the landfill, it is necessary to consider adequate countermeasures to address these risks in the future.

・Current Status of Operation and Maintenance

Regarding the operation of the landfill with the Fukuoka method, although the landfill is not covered with soil, the unique processes of the Fukuoka method such as the extension of the gas vent pipe and the circulation of leachate are being carried out without any problems. Although automobiles and electrical appliances have been brought into the landfill, there are no major problems at present, as an MOU has been concluded with a Korean company to process and export them as scrap metal on behalf of DSWM in exchange for leasing an area within the landfill. In addition, as mentioned in the effectiveness section, there is no concern about the waste deposition rate, and the possibility of exceeding the allowable volume at the landfill is considered to be low.

Regarding the equipment, each of the heavy machinery manufactured by Caterpillar Inc. procured in this project is equipped with a US standard exhaust gas sensor, and at the time of the ex-post evaluation, one bulldozer has stopped operating due to sensor activation. However, other heavy machinery was confirmed to be operating without any issues. All machinery is manufactured by Caterpillar Inc., and efforts to resume bulldozer operation are ongoing in collaboration with its representative in Guam which is nearest from Palau. Additionally, among the equipment procured for this project, a pH meter can be used without problems, and inspection materials are obtainable within Palau. However, regarding the gas detector, the English version of the manual was distributed during the implementation of this project and is also available on the manufacturer's website, but as the executing agency was only aware of the existence of the Japanese version, the equipment was not being used.

Furthermore, among the issues pointed out during the defect inspection[20], the restriction of entry of heavy equipment onto the management road, periodic cleaning of equipment, lifting of restrictions on exhaust gas sensors for wheel loaders, and processing specific to the Fukuoka method, these have been implemented, and the use of waste delivery data is expected to be materialized in the future in cooperation with J-PRISM Phase 3. On the other hand, the planting of aquatic plants into purification pond and covering soil on the landfill were not implemented at the time of ex-post evaluation. According to the executing agency, they needed to fully understand the necessity of planting aquatic plants in the purification ponds, and the existing operations remained unimplemented due to the complexity of the existing work. According to the project consultant, planting aquatic plants in the purification ponds is not that important in the series of purification and dilution processes of leachate, and it was introduced on an experimental basis and will not have a significant impact on the operation and maintenance of the landfill.

While some heavy machinery and equipment are not effectively utilized, and there are constraints in terms of procurement, they have continued to ask to the Guam representative of Caterpillar Inc. for repairing. Overall, the operation of the landfill can be managed without major issues, and no significant problems are observed in terms of operation and maintenance.

Therefore, it is concluded that the sustainability of the operation and maintenance status is high.

<Evaluation Result>

Based on the above, no problems were found in terms of policy and system, technical aspect, financial aspect, and operation and maintenance status, but the executing agency had some challenges in the institutional and organizational aspect, environmental and social considerations aspect, and preventative measures to risks. In addition, the prospects for improvement and resolution were not clear at the

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stressed that air quality testing is "an item to measure the impact on the working environment of the workers" and that "it is important to measure gases when working around the gas discharge pipes". It was then recommended that dust should be measured daily throughout the disposal site and that methane and hydrogen sulfide should be measured around the gas discharge pipes.

[19] It was introduced with the support of the Secretariat of the Pacific Regional Environment Programme (SPREP), an international organization that promotes intra-regional cooperation for environmental conservation in the Pacific Island region.

[20] Planting aquatic plants in vegetation purification ponds, restricting access of heavy machinery to the administration road, periodic cleaning of equipment, lifting gas sensor restrictions on heavy machinery, collecting, storing and analyzing waste delivery data, considering fee collection methods and future treatment of the Fukuoka method were pointed out.

time of ex-post evaluation. Therefore, the sustainability of the project effects is moderately low.

III. Recommendations & Lessons Learned

・Recommendations to Executing Agency

Effective use of heavy machinery and equipment

At the time of ex-post evaluation, the bulldozer procured for the project was not in operation due to the activation of a US standard exhaust gas sensor. Since heavy machinery is essential for proper landfill operations, including periodic waste compaction and soil covering, it must be inspected and maintained in coordination with the Guam representative for the manufacturer, Caterpillar Inc., to ensure that it always remains operational. In addition, the gas detectors procured under this project remained unused. Regular checks of the levels of methane gas, hydrogen sulfide, and other hazardous gases by the gas detector would minimize the impact on workers' health and prevent the outbreak of fires. The executing agency should familiarize workers with the English version of the gas detector manual so that they can properly use the gas detector.

Covering waste with soil

At the time of ex-post evaluation, no soil covering of the waste was in place. Since soil covering is effective in preventing fires, scattering of wastes, odors, and propagation of insects, it is necessary for the executing agency to ensure that soil covering is incorporated into landfill operations and implemented.

Implementation of environmental monitoring

At the time of ex-post evaluation, only pH testing was conducted as environmental monitoring, and no monitoring of air quality, such as gas detection, was being conducted. In Palau, domestic laws do not stipulate monitoring of water and air quality within the landfill facility. However, although there are circumstances in which it is difficult to obtain the necessary equipment for monitoring in Palau, air quality monitoring should at least be carried out to detect harmful gases such as methane gas and hydrogen sulfide that are retained inside the waste, to determine the degree of impact on the human health of workers and to prevent fires. Regarding the water quality, in addition to pH testing, simple tests for color, water temperature, and odor should also be performed.

Provision of fire protection equipment

At the time of ex-post evaluation, the executing agency was considering the installation of water hoses as a fire response measure, but no personal protective equipment such as protective clothing or masks were installed. Although Palau's domestic law does not mandate the provision of fire protection equipment, it is desirable to introduce fire protection equipment to ensure the safety of workers on site.

・Recommendations to JICA

None

・Lessons Learned

The importance of procuring heavy machinery and equipment that are capable of on-site maintenance and easy operation

Some of the heavy machinery procured in this project were rendered inoperable due to the activation of the exhaust gas sensors adhering to US standards. Additionally, gas detectors among the equipment procured in this project remained unused.

All the heavy machinery are manufactured by Caterpillar Inc., and they possess sufficient specifications for operating and maintaining the landfill. However, since there are no representatives in Palau, and local workers are unable to handle troubleshooting, coordination with the company's Guam representative was necessary for maintenance, resulting in a chronic inability to operate. Furthermore, the lack of awareness among the executing agency of the existence of the English-version operation manual for the gas detector was a reason for non-use.

It is crucial to procure heavy machinery and equipment used in the project that can be maintained locally as much as possible, to be aware of the existence of manuals and disseminate them appropriately so that local workers can easily operate them, and to establish a system that enables prompt response to any problems so that operations necessary for the business operation will not be interrupted. Additionally, there is room for consideration of introducing soft components that contribute to strengthening procurement capabilities and maintenance system.

IV. Non-Score Criteria

・Performance (Objective Perspective)

None

・Additionality

None

Photo 1: The Weight Scale at the Entrance of the Landfill
(Source: Photo by the External Evaluator)

Photo 2: The Excavator for Burying Waste
(Source: Photo by the External Evaluator)

(End)