FY2013

Feasibility Studies on Joint Crediting Mechanism Projects towards Environmentally Sustainable Cities in Asia

Project Report: Demonstration Project on Integrated Adaptation and Mitigation Measures in a "Low-Carbon/Resilient Model for Small Island Countries"

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Summary

1. Purpose of Project

For the work implemented under this project, we conducted a major feasibility study to formulate a large-scale proposal for broad implementation of a package of activities in urban and rural areas, by coordinating Japanese technologies and programs and adapting them to local conditions, and establishing operations and maintenance systems, together with Japanese research institutes, local governments, private companies, and universities, etc. The area targeted is small Island Countries in the South Pacific (Palau in particular) and the aim is to seek linkages between adaptation and mitigation measures for climate change, which is a critical issue in this region, as well as to develop approaches that will contribute to the creation of sustainable, low-carbon societies, and the development of a "low-carbon model for island countries."

2. Achievements of Project

(1) The Significance of a Low-Carbon/Resilient Model for Small Island Countries

The Intergovernmental Panel on Climate Change (IPCC) released the Working Group I Report of its Fifth Assessment Report (AR5) in September 2013, clarifying the status of climate change being observed around the world, and future projections of temperature increases, sea-level rise, and extreme events, etc. The importance of adaptation to climate change is becoming clearer than ever before, and greater efforts at mitigation are also being demanded as the most effective adaptation policy. The time has come for countries and regions of the world to see adaptation and mitigation not separately, but as a part of integrated climate policy, and to take action now. Meanwhile, even though the concept of integration of adaptation and mitigation has been suggested, there are still relatively few major concrete examples of actual implementation. Thus, it is worthwhile for projects like this project one to create the path forward, take action and produce results, by asking how island countries, as policy-making entities, can best integrate adaptation and mitigation.

South Pacific island countries are taking sustainable development as an important challenge, but their vulnerability to climate change threatens to interfere with those objectives. Also, the greenhouse gas emissions of these countries are not high, but the introduction of mitigation actions such as the use of renewable energy would have great potential to increase the climate tolerance of those countries and to make their societies and economies more wealthy and resilient. It is also important that as these island states are most vulnerable to climate change, they are able to demonstrate their own efforts, while calling for further mitigation efforts by the rest of the world. Japan has a close relationship with South Pacific island countries, and now is a good time to support the creation and promotion of models for integrated adaptation and mitigation efforts.

(2) Status of Adaptation and Mitigation in South Pacific Island Countries

South Pacific island countries are in a region of the world where adaptation to climate change is most urgent, due to the region's natural and societal features (low-lying land, the concentration of industry and infrastructure in coastal areas, etc.). Projected impacts of climate change include sea-level rise and extreme events like cyclones and droughts, as well as the resulting damage to the natural environment, society and economies. Against this, a variety of efforts are underway, such as the formulation of NAPAs, and development of action plans with support from the UNDP and SPREP. JICA and other aid agencies are engaged in individual projects (e.g., coastal disaster prevention, coral reef conservation, etc.). However, all of these efforts are still limited to just a small subset of countries, regions and sectors.

Meanwhile, in terms of mitigation efforts, while the GHG emissions from these countries are small, they have a strong awareness of their need to reduce dependence on imported fuels and to reduce energy costs, and a strong awareness of energy conservation and renewable energy. They are undertaking a variety of efforts, including the preparation of NAMAs, the setting of numerical targets for the use of renewable energy, and individual projects including some assisted by aid agencies (examples include the introduction of photovoltaic power generation, improvement of waste management, etc.). However, as with adaptation, efforts are still limited to a subset of countries and regions.

In addition, regarding support for individual countries' efforts for adaptation and mitigation in the region, based on local interviews, the various projects are not necessarily being run effectively and efficiently as a whole. There are issues with redundancy of aid, a mismatch between need and the size of facilities, a lack of consideration of sustainable after-care systems once a project has been completed, and a failure to design aid that incorporates all the stages up to private sector involvement.

(3) Status of Adaptation and Mitigation in Palau

Palau is the subject of our study this fiscal year on a Low-Carbon/Resilient Model for Small Island Countries, and here too, a variety of specific issues have emerged in terms of both adaptation and mitigation With regard to adaptation, flood damage from typhoons and tidal surges has been reported in recent years, and most recently, the need for both hard and soft disaster prevention measures (prevention, emergency response, recovery and reconstruction, etc.) has become a pressing issue after, for example, the serious damage experienced by Palau's northernmost remote island of Kayangel from Typhoon No. 30 (Haiyan) on November 7, 2013. A variety of impacts are beginning to appear, affecting food production and water resources, as well as coral reefs and other natural ecosystems. In particular, in Palau, where tourism is the main industry, impacts on natural ecosystems such as coral reefs—which are the foundation of important tourism resources and marine resources—could result in significant socioeconomic losses to the country. This makes it essential to develop actions as soon as possible, from the perspective of prevention.

As for mitigation, it is essential to shift away from a dependence on imported diesel fuel and move toward energy self-sufficiency with the use of renewable energy; other challenges include dealing with the aging and inefficient water supply infrastructure, and the need to promote and introduce energy-efficient facilities and equipment. Moreover, proper waste disposal and the efficient use of resources is important in Palau, where landfill sites are reaching their limits—not only to reduce greenhouse gas emissions, but also from the perspective of preventing environmental pollution. Pioneering efforts relating to the 3Rs (reduce, reuse, recycle) can be seen in some areas, such as in Koror State, and they are spreading to other areas, but it is essential to actively promote proper waste disposal and the effective use of resources.

(4) Key Directions for the Low-Carbon/Resilient Model for Small Island Countries

Below are the key directions envisioned for the Low-Carbon/Resilient Model for Small Island Countries.

- Greatest Possible Use of Renewable Energy
- Construction of Resilient, Weather-Resistant Power Transmission/Distribution Networks and Communication Systems
- Mainstreaming Adaptation and Disaster Reduction into Proper Waste Management, 3Rs + Return
- Development of Low-Carbon Vehicles and Boats
- Making the Land and Infrastructure More Resilient by the Protection and Restoration of Coral Reefs and other Natural Resources
- Tourism and Industry Promotion and Collaboration
- Development of Sustainable After-Care Systems and Training of Technical Personnel
- Attention to Legislation, Systems, Customs, Education, Participation

The following three approaches are envisioned for future efforts to implement and spread the Low-Carbon/Resilient Model for Small Island Countries.

- Adoption of the Phased Approach
- Development of Individual "Models" and Sustainable/Scalable "Schemes"
- Attention to Business Sustainability (Creation of Merits for both Government and Industry)

(5) Low-Carbon/Resilient Model for Small Island Countries Envisioned for Palau

Below, we describe a Low-Carbon/Resilient Model for Small Island Countries as envisioned for Palau.

- Evacuation facilities that utilize renewable energy

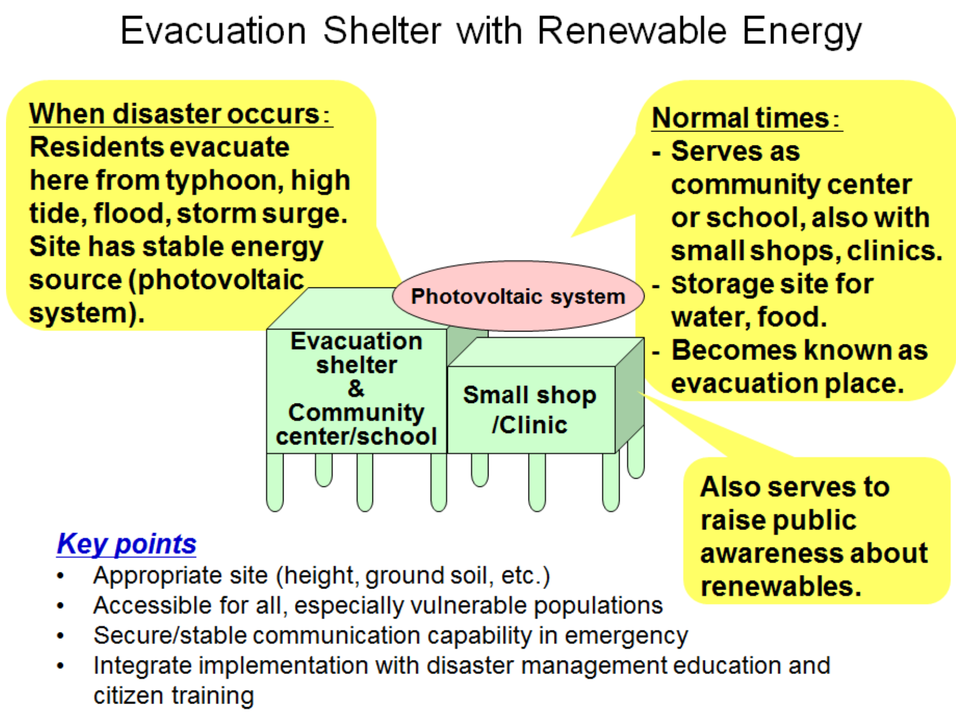
・Extensive damage has occurred to buildings in Palau due to typhoons in recent years. It is a pressing issue to ensure that there are evacuation facilities able to handle the intensification of extreme events due to climate change.

・Construct new evacuation facilities (or designate existing facilities to be used for evacuation) to protect residents from disasters (storm surges, flooding, storm damage, etc.), to introduce solar power to the facilities.

・During normal times, use community facilities and schools as usual, during disasters use them as evacuation facilities with backup power systems.

・Also, use the facilities as centers for local residents for disaster preparedness education, and to learn about climate adaptation. Support community participation in "soft" (institutional) measures by the government, such as the creation of a hazard map of the region, and the introduction of early warning systems.

・Also, in the future, by combining water purification facilities and the like with clinics and shops, they can be used as a base for disaster prevention, by supplying electricity and water during normal times, and also carrying everything from food to disaster preparedness supplies. It may also be possible to boost business sustainability by combining these with PFI projects, and so on.



(6) Ideas for Promotion of Japanese Technology Introduction

In terms of disaster response of evacuation facilities, etc., the National Emergency Management Office (NEMO) in Palau formulated the "National Disaster Risk Management Framework 2010" in 2010, outlining measures that include securing the availability of evacuation shelters, introducing early warning systems, and educating the population on disaster preparedness.

Japan has always been exposed to natural disasters, and also has advanced technology, in terms of both hard (physical) and soft (institutional) solutions. In term of hard solutions, examples include evacuation shelters and evacuation towers, etc., and in terms of soft solutions, Japan has built up expertise in real-time flood prediction based on information systems, and early warning systems, etc. Meanwhile, Japan has not only advanced technology, but also an abundance of activities such as the use of conventional technologies since ages past, and flood fighting teams created through the cooperation of local residents. Japan also has a wealth of soft methodologies, including hazard maps, hazard district zoning, and sets of architectural standards. In the years since the Great East Japan Earthquake (March 2011), considerable further progress has been made in Japan, with even more emphasis on self-help and mutual assistance, and the development of more practical packages of tools for community disaster prevention based on community participation. More recently, Japan has been supporting reconstruction efforts in areas affected by typhoon Haiyan that hit the Philippines in November 2013. In Palau, Japan has supported the reconstruction plans for Ngarchelong Elementary School on Babeldaob Island. It can be tremendously effective to transfer these kinds of experiences and techniques to developing countries in an integrated way.

As for photovoltaic power, in Palau, successful examples of introducing this technology already exist, but they just evident in a limited number of public facilities, not yet ready for broader roll-out. Meanwhile, the potential to introduce photovoltaics would appear to be high, with good basic profitability, considering the high electricity prices in Palau (business owners now pay over 40 yen per kilowatt-hour).

Technologies for photovoltaics and storage batteries need to be able to withstand salt, storm and typhoon damage, especially when being introduced in islands regions like Palau. Japan has examples of equipment manufacturers that sell household/residential photovoltaic generation systems with enhanced capacity to withstand salt damage and typhoons that occur in places with climates like Okinawa. In this respect, as it has been developed and introduced under roughly similar regional conditions—island territories often affected by typhoons—one could say that Japanese technology in this field is superior to that of European countries. Thus, it is important to recognize the excellence of Japanese photovoltaic generation and storage battery technologies.

In addition, many examples already exist in Japan where photovoltaic power generation has been incorporated into evacuation facilities. Japan's experience of combining these two components as a package can offer an effective and multifaceted approach to using these technologies.

(7) Technical Specifications

The details of technology transfer are based on scenarios of evacuation facilities being equipped with photovoltaic generation equipment. The photovoltaic generation system is combined with a storage battery to function as an emergency power supply at the time of a disaster. Two basic cases are envisioned: an existing facility (a school that is suitable to also function as a shelter), and a new evacuation facility (built on a piloti design that also incorporates photovoltaic power generation). For existing facilities, two versions of photovoltaic system are presented (4- and 8-kilowatts). In total, three cases are presented.

・ Case 1: Install photovoltaic system at an existing facility (4 kW) (large scale roll-out, 20 locations)
・ Case 2: Install photovoltaic equipment at an existing facility (8 kW) (large scale roll-out, 4 locations)
・ Case 3: Install photovoltaic equipment at a new facility (8 kW) (large scale roll-out, 1 locations)

At present, it may be possible to apply Japan's "Subsidy Program for Project Equipment Using the Bilateral Credit System," which can reduce the sense of burden of local project entities, with prior support funds providing half of the funds at the investment stage. The project organization structure envisioned is an international consortium consisting of the consortium leader, project developers, local project entities, and local consultants. For the project process we plan to conduct an additional feasibility study in fiscal 2014 to follow this one, and then to implement Case 1 and Case 2 in fiscal 2015, and Case 3 in fiscal 2016. In parallel, we plan to continue consultations with SPREP to consider schemes moving toward large-scale deployment of JCM projects.

(8) Greenhouse Gas Reduction Benefits and Co-Benefits

The greenhouse gas reductions of this project (large scale roll-out, 25 locations) would be approximately 126 t-CO_2. The co-benefits of this project can be expected to be as follows.

● Benefits in Host Country
・ Enhanced disaster response capability
・ Reduction in environmental impacts
・ Employment
・ Community development
● Benefits in Japan
・ Development of integrated adaptation-mitigation models for Japan (reverse import)
・ Business development for Japanese companies in developing countries

(9) Consideration of a Framework toward a Demonstration Project

Items requiring further study for a demonstration project in the next fiscal year are listed below.

● Feasibility study for introduction of photovoltaic power generation combined with evacuation facilities in Palau
・ Review Palau's disaster prevention plans and systems (special emphasis on development plans for evacuation facilities, etc.).
・ Make assumptions of external forcing levels due to future climate change (utilize simulations of storm surge damage and wind damage based on Philippine typhoon No. 30 (Haiyan) of 2013).
・ Consider location, specifications, and costs for target evacuation facilities.
・ Consider procurement methods, specifications, and costs of photovoltaic generation equipment and

storage batteries.

- Consider the personnel, organization, and funds needed to operate and maintain the facilities after installation.
- Consider applicable support schemes from Japan, and prepare to make applications.
- In conjunction, also consider "soft" disaster prevention measures that should be supported, and mechanisms for continuation of funding (e.g., evacuation training programs with the idea of time lines, introduction of early warning systems, etc.).
- Consider the possibility of additional functions as a business model for the future (e.g., water supply from water purification equipment incorporated into plans).
- Share information and interact with Japanese local governments that have advanced initiatives for disaster prevention, adaptation, and mitigation.

● Consideration of schemes for large-scale roll-out under JCM in South Pacific islands region

- Consider effective and efficient schemes (personnel arrangements, funding sources, etc.).
- Discuss and coordinate with SPREP.
- Discuss and coordinate with IGES (on collaboration with LoCARNet, etc.).
- Discuss and coordinate with APAN.
- Identify candidate countries and projects (as candidates for feasibility studies in FY2015).

1. Basic Information about Project

1.1. Purpose of Project

For the work implemented under this project, we conducted a major feasibility study to formulate a large-scale proposal for broad implementation of a package of activities in urban and rural areas, by coordinating Japanese technologies and programs and adapting them to local conditions, and establishing operations and maintenance systems, together with Japanese research institutes, local governments, private companies, and universities, etc. The area targeted is small Island Countries in the South Pacific (Palau in particular) and the aim is to seek linkages between adaptation and mitigation measures for climate change, which is a critical issue in this region, as well as to develop approaches that will contribute to the creation of sustainable, low-carbon societies, and the development of a "low-carbon model for island countries."

1.2. Description of Project

1.2.1. Identifying the Adaptation Needs of Island Countries

From existing literature and other sources we identified the greatest needs for adaptation in island countries and summarized them, by sector and by type of area. Together with the information about adaptation needs, we also summarized information relating to impacts and vulnerabilities.

1.2.2. Identifying the Mitigation Needs of Island Countries Related to Adaptation

We summarized the mitigation measures indicated by the target countries, and identified those mitigation needs that can be expected to have beneficial impacts if adaptation initiatives (based on adaptation needs confirmed in Section 1.2.1) were to be combined with reductions of the greenhouse gases emitted from implementation of adaptation measures. This work we conducted based on interviews and existing literature, etc.

1.2.3. Listing of Japanese Adaptation Technologies that Respond to Needs

We prepared a list of Japanese adaptation technologies that have the potential to be applied to address the adaptation needs identified in Section 1.2.1. Based on interviews with Japanese universities, research institutions, and corporations, we prepared a list of technologies with a special emphasis to those that can realistically be transferred to Island Countries.

1.2.4. Listing of Japanese Low-Carbon Technologies that Respond to Needs

We prepared a list of Japanese low-carbon technologies that have the potential to be applied to address the mitigation needs identified in Section 1.2.2. Based on interviews with Japanese universities, research institutions, and corporations, we prepared a list of technologies with a special emphasis to those that can realistically be transferred to Island Countries. In the process, we summarized some "locally-applicable technologies," considering the situation in Japan, including the essential policies and programs associated with the introduction and maintenance of these low-carbon technologies.

1.2.5. Design of a Low-Carbon Model for Island Countries that Can Be Applied in a Broad Area and as a Package

We considered effective combinations of adaptation technologies and low-carbon technologies, and based on this analysis, designed a "Low-Carbon Model for Island Countries," that can be applied in a broad area and in an integrated way. We also considered a specific example, using Palau as the subject.

1.2.6. Consideration of Specific Project Schemes

Based on the model being considered, we developed detailed schemes as projects to implement on the island of Palau. We considered various aspects, including technology specifications (noting improvements needed for introduction in island countries, and their potential for being achieved), implementation system (for a sustainable and stable organization structure), funding schemes (for ongoing and stable funding), and implementation schedules (considering advice from private sector, and host-country governments, etc.), etc.

1.2.7. Consideration of Co-Benefits and Greenhouse Gas Reduction Benefits of the Project

We summarized the greenhouse gas reduction effects of the project, as well as co-benefits. For greenhouse gas emission reductions, we considered simple and reliable methodologies to calculate reductions that could contribute to the JCM program. Regarding co-benefits, in addition to benefits in the host country, we also considered the benefits in Japan from technology transfers. We considered these points from various angles, based on discussions with related organizations and the private sector.

1.2.8. Consideration of a Framework for a Demonstration Project

For implementation of the project, we considered the content, implementation structure, budget, and other factors of a demonstration project that could be implemented in the next fiscal year.

1.2.9. Site Visits

We implemented site visits four times (twice each in Palau and Samoa). During the second visit to Palau, we held a half-day local workshop with the participation of relevant organizations, and coordinated discussions to ensure feasibility of the demonstration project for the subsequent fiscal year.

1.2.10. Preparation of Work Report

We prepared a report summarizing the results of work described in Sections 1.2.1 through 1.2.9 above.

1.2.11. Preparation of Monthly Report

During the project (July 2013 through March 2014), we prepared and submitted monthly reports.

1.2.12. Cooperation with Related Activities

In order to smoothly implement the activities related to this project, we conducted the following cooperative activities:

- Preparation of documentation related to the findings (excluding the study report)
- Attendance at committee meetings organized by Mizuho Information and Research Institute, and preparation of documentation required for committees, etc.
- Preparation of documentation and handling of interviews related to Government of Japan budgets associated with commissioned tasks.
- Preparation of documentation, provision of information, handling of interviews, and attendance at committee meetings relating to post-project evaluation.
- Preparation of reports and associated documentation for project presentations, etc., organized by Mizuho Information and Research Institute after completion of commissioned tasks.

2. Summary of Key Information on the Island Countries in this Study

2.1. Island Countries in this Study

To determine the South Pacific island countries to be covered by this study, we first reviewed the target countries and current state of activities of the following major organizations and frameworks associated with countries in the region.

- Secretariat of the Pacific Regional Environment Programme (SPREP)
- Secretariat of the Pacific Community (SPC)
- SPC Applied Geoscience and Technology Division (SOPAC)
- Pacific Islands Forum (PIF)
- Pacific Islands Centre (PIC)
- Pacific Islands Leaders Meeting (PALM)
- Alliance of Small Island States (AOSIS)

Next, we considered the range of countries recognized as being part of Oceania by entities such as the Asian Development Bank (ADB), Japanese Ministry of Foreign Affairs, and the Japan External Trade Organization (JETRO), and identified 13 countries recognized as being South Pacific island countries by the largest number of organizations and entities.

2.2. Overview of Island Countries and Initiatives relating to Climate Change

Based on the work in Section 2.1, we settled on the following 13 island countries to be covered by this study.

Table 2.2-1. Island Countries for This Study (listed in alphabetical order here and below)

Country	Population (as of 2011) (Persons)	Area (km^2)
Cook Islands	30,000	237
Federated States of Micronesia	111,542	700
Papua New Guinea	7,013,829	462,000
Independent State of Samoa	183,874	2,830
Kingdom of Tonga	104,509	720
Republic of Fiji	868,000	18,270
Republic of Kiribati	100,000	730
Republic of Nauru	10,000	21.1
Republic of Palau	20,609	488
Republic of the Marshall Islands	54,816	180
Republic of Vanuatu	250,000	12,190
Solomon Islands	540,000	28,900
Tuvalu	9,800	25.9

We summarized the climate change initiatives of these countries based on various factors, including the status of reporting on each country's relevant programs and reports, climate change initiatives of SPREP and SOPAC, etc.

Below is a summary of the status of reporting on each country's relevant programs and reports. All countries publish National Communications (NC) based on the United Nations Framework Convention on Climate Change. Samoa, Kiribati, Vanuatu, the Solomon Islands, and Tuvalu have completed their National Adaptation Programmes of Action (NAPAs), and all of them have analyzed future projected impacts and vulnerabilities and have identified high-priority adaptation measures. Papua New Guinea and the Marshall Islands have completed Nationally Appropriate Mitigation Actions (NAMAs) and have clearly specified reduction targets for GHG or CO_2 emissions. The Cook Islands, Tonga, and Marshall Islands have written Joint National Action Plans (JNAPs), which are being prepared for the South Pacific region for integration of adaptation and disaster risk management, with the support of the United Nations Development Programme and SPREP.

Table 2.2-2. Status of Publication of National Reports

Country	NC	NAPA	NAMA	JNAP
Cook Islands	Yes (2)	No	No	Yes
Federated States of Micronesia	Yes(1)	No	No	-
Papua New Guinea	Yes (1)	No	Yes	-
Independent State of Samoa	Yes (2)	Yes	No	-
Kingdom of Tonga	Yes (2)	No	No	Yes
Republic of Fiji	Yes (1)	No	No	-
Republic of Kiribati	Yes (2)	Yes	No	-
Republic of Nauru	Yes (1)	No	No	-
Republic of Palau	Yes (1)	No	No	-
Republic of the Marshall Islands	Yes (1)	No	Yes	Yes (Note: Summary version)
Republic of Vanuatu	Yes (1)	Yes	No	-
Solomon Islands	Yes (1)	Yes	No	-
Tuvalu	Yes (1)	Yes	No	-

Legend: Yes Has been prepared No Not prepared - Status not confirmed
In NC column, number in parentheses indicates as follows: 1 - Initial NC, 2 - Second NC

SPREP is engaged in capacity building, education, and information exchange for both adaptation and mitigation, based on the implementation of concrete projects based on the Pacific Islands Framework for Action on Climate Change (PIFACC) and the Pacific Climate Change Roundtable (PCCR), and is also implementing concrete projects based on the Pacific Adaptation to Climate Change (PACC) Project and the Pacific islands Greenhouse Gas Abatement through Renewable Energy Project (PIGGAREP).

These examples show that South Pacific island countries, besides having already been engaged for some time in climate change adaptation, have also been working on mitigation, having set clear numerical targets, and are implementing practical initiatives such as projects for the use of renewable energy. Regarding adaptation, observers can see that in recent years, they have also been emphasizing approaches that promote disaster risk management and climate adaptation in an integrated way, with the aim of implementing measures efficiently.

3. Identifying the Adaptation Needs of Island Countries

3.1. Summary of Needs, based on Existing Literature

Below, we summarize the adaptation needs of South Pacific island countries based on reports from international organizations, including UNDP, ADB, SPREP, APAN and others, as well as from each country's NAPA or JNAP.

For South Pacific island countries, there are predictions of a wide range of impacts and damage, including flooding and groundwater salinization due to rising sea levels, higher tides and storm surges due to extreme weather events, threats to agriculture, fisheries, food security and water supplies, damage to housing and infrastructure, impacts on coral reefs, health hazards from infectious diseases, and more. Many of these phenomena are already appearing. For example, impacts already being reported include economic damage and the loss of life due to cyclones, droughts, and other extreme events, as well as crop impacts.

Needs are already evident, reflecting each country's natural and social characteristics (see Section 3.4 for details).

3.2. Summary of Needs based on Interviews with Related Organizations

Here we summarize the adaptation needs of South Pacific island countries based on interviews with SPREP and JICA, and on documentation they provided. Some of the important challenges in Pacific Island countries include the development of early warning systems and the integration of disaster risk management and climate change adaptation. Meanwhile, pilot projects of adaptation and mitigation are already being implemented in some countries. Positive examples of integrated adaptation-mitigation models include a combination of photovoltaic power generation and water supply pump in Tonga, and a seawater desalination project in Nauru combined with photovoltaic power generation. The challenge is the up-scaling of examples like this, throughout the South Pacific islands.

3.3. Summary of Needs from the Perspective of Japanese Assistance

Below we summarize the adaptation needs of South Pacific island countries, from the perspective of criteria relating to assistance from Japan.

In recent years, climate change and waste-related cooperation projects of the Japan International Cooperation Agency (JICA) and Official Development Assistance and Overseas Economic Cooperation Projects from Japan's Ministry of Foreign Affairs have included assistance for the Oceania region as a whole, and for individual countries, including Samoa, Tonga, Fiji, Palau, and Tuvalu, etc. They have covered such topics as water resources conservation (water purification technology, leakage prevention); disaster prevention "soft" (institutional/systems) approaches such as improving weather observation and disaster-response planning; enhancing capacity for weather forecasting and warning; "hard" (physical infrastructure) approaches such as ecosystem repair and restoration, beach nourishment, coastal protection and restoration; and ecosystem conservation (integrated ecosystem conservation and management, coral reef monitoring). From that selection, one could infer that they are important topics and needs at the local level.

3.4. Consideration of Adaptation Needs

Based on the summaries of Sections 3.1 to 3.3, we have prepared a comprehensive summary of the adaptation needs of South Pacific island countries.

These countries have adaptation needs in a wide range of categories, as indicated below, including water resources, disasters, natural ecosystems, aquatic environment, food, and health, etc. Meanwhile, some initiatives may not proceed as desired due to a range of constraints, such as the lack of human resources, financing, and technology; the small economic base of South Pacific island countries; their difficulty of geographical access; and the inadequacy of information and communications systems.

- Water resources: Needs exist for improvements/enhancements in water supply infrastructure, for installation of rainwater harvesting facilities, installation of seawater desalination plants, the installation of water storage facilities, and for measures to prevent water leakage, etc. In some countries, there are also needs for installation of seawater desalination plants and water supply facilities that operate on solar power.
- Disasters: In many countries, importance is given to "soft" measures such as the introduction of early warning systems, the development/revision of building codes and urban plans, the creation of hazard maps, and improvement of evacuation plans. There is also a need to reflect the circumstances of island countries that are vulnerable to sea-level rise and extreme events, with improvements in evacuation facilities, strengthening of critical infrastructure in coastal areas, construction of disaster-resistant coastal models, and relocation of housing, etc. Challenges in some countries include such things as the proper handling and effective utilization of disaster waste, and the development of all-weather road networks (raising roadbeds, installing drainage facilities), etc. Meanwhile, in the categories of disasters, water resources, and food, there is a growing and shared need for early-warning systems.
- Natural ecosystems: Various needs exist, including the development of upstream watershed protection programs that are integrated with coral reef conservation and coastal management programs; the monitoring of coral reefs; awareness-raising about coral reefs, conservation of mangrove forests; sustainable forest management; and proper management of marine and freshwater resources.
- Water environment: There is a need to improve and enhance sewerage system infrastructure, and to install advanced domestic wastewater treatment tanks (for example, “Johkasou”) that are appropriate for local conditions.
- Food: The various needs include the development and introduction of crops that are resistant to

drought, increased salinity, and saltwater intrusion; the introduction of early warning systems, the development of drainage systems for low-lying agricultural land, and embankments to prevent saltwater intrusion; the management of marine resources, and sustainable animal husbandry, etc.

- Health: There is a need for epidemic control measures and health education, with an emphasis on prevention, and for training and evaluation of measures against infectious diseases, etc.

4. Identifying the Mitigation Needs of Island Countries Related to Adaptation

4.1. National CO_2 Emission Trends

In this section we analyze national trends in CO_2 emissions, using data from the Carbon Dioxide Information Analysis Center (CDIAC). In terms of the total emissions by country, Papua New Guinea emits the most, followed by Fiji, Palau, the Solomon Islands, and Samoa, with emissions from the top two countries being particularly large. In terms of per capita emissions, Palau is the largest, followed by Nauru, the Cook Islands, the Marshall Islands, and Tonga, and Palau's figures are considerably higher than the others.

4.2. Summary of Needs based on Mitigation-related Initiatives of Each Country

In this section, we summarize the mitigation needs of South Pacific island countries, based on mitigation-related initiatives of each country.

All countries in this study have set specific numerical targets for renewable energy, and one can see that they are quite ambitious in their desire to use renewable energy. Regarding feed-in tariffs (FIT), the Cook Islands, Marshall Islands, and Tonga are discussing the preparation of technical guidelines as a step toward introduction, and they recognize the need for them. One can also observe efforts toward Clean Development Mechanism (CDM) initiatives in South Pacific island countries, with ten projects in Papua New Guinea and three in Fiji already approved (of the total, eight are for the reuse of palm oil mill effluent (POME).

4.3. Summary of Needs based on Interviews with Related Organizations

Here we summarize the adaptation needs of South Pacific island countries based on interviews with SPREP and JICA, and on documentation they provided.

Pacific Ocean island countries need to promote renewable energy technologies, improve energy efficiency, and promote integrated waste management, and some of the important challenges include improvement of sustainable project management, funding, and improvement of standards. Meanwhile, pilot projects of adaptation and mitigation are already being implemented in some countries. Positive examples of integrated adaptation-mitigation models include a combination of photovoltaic power generation and water supply pump in Tonga, and a seawater desalination project in Nauru combined with photovoltaic power generation. The challenge is the up-scaling of examples like this, throughout the South Pacific islands.

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4.5. Consideration of Mitigation needs Relating to Adaptation

Based on the summaries of Sections 4.1 to 4.5, we have prepared a comprehensive summary of the mitigation needs relating to adaptation in South Pacific island countries.

South Pacific island countries have the following types of needs for mitigation in areas such as renewable energy, energy supply and energy conservation, and waste. Total greenhouse gas emissions from these countries are small compared to developed countries, but island countries are inevitably vulnerable in terms of energy security, and they face challenges with environmental pollution due to inadequate waste disposal facilities. Thus, they see these as pressing mitigation issues, and efforts to address them are actively being promoted. Meanwhile, some initiatives may not proceed as desired due to a range of constraints, such as the lack of human resources, financing, and technology, the small economic base of South Pacific island countries, their difficulty of geographical access, and the inadequacy of information and communications systems.

- Renewable energy: The introduction of renewable energy is a major emphasis, particularly photovoltaic power generation. A major background factor is that many island countries currently depend heavily on imported fossil fuels for nearly all of their electricity generation, so increasing their ability to meet their own energy needs is seen as a way to increase energy security and reduce the costs of power generation and transportation. It should be noted that aid agencies have already supported specific projects to introduce renewable energy, but due to inadequate systems of after-care/maintenance and a shortage personnel who can provide proper maintenance, the hoped-for results have not always materialized.
- Energy supply and energy saving: For the supply of electricity, the countries have a need to deal with aging power plants and to develop cost-sensitive maintenance plans. They also have needs relating to the promotion of energy conservation, such as consumer education programs about energy conservation, and improvements in energy performance standards.
- Waste: Needs include the introduction of proper waste treatment technologies (upgrades to semi-aerobic landfills) to address environmental pollution and public health impacts; the promotion of 3R+Return activities; and mechanisms for the collection and export of valuable

resources. It has been pointed out that South Pacific island countries sometimes tend to be interested in the expensive "cutting edge" technologies of developed countries, but it is important to consider the circumstances of each country (e.g., the volume of waste generation) and costs versus benefits, and to carefully select the most applicable technologies.

Furthermore, when considering the "mitigation needs relating to adaptation," some of the approaches indicated below are worth considering.

- Incorporate mitigation into new adaptation initiatives

For example, use renewable energy to provide the required electricity, when constructing new facilities to deal with disasters (e.g., evacuation facilities, drainage facilities, and early warning information systems), and construction of facilities to secure water resources (e.g., groundwater purification facilities, desalination plants).

- Incorporate mitigation into existing adaptation

For example, use renewable energy to obtain the required electricity in conjunction with upgrading of facilities to deal with rising temperatures in livestock barns, or reuse as resources the materials (e.g., make woodchips) from the processing of disaster waste (fallen trees, etc.).

- Incorporate adaptation into new mitigation initiatives

For example, when constructing semi-aerobic landfill disposal facilities, design and build the facilities with some consideration of the effects of future sea-level rise, or extreme events such as storm surges and high waves.

5. Listing of Japanese Adaptation Technologies that Respond to Needs

Here we summarize examples of Japanese adaptation technologies that respond to adaptation needs identified in Section 3. Major items are listed below.

5.1. Water Resources

- Leakage Control Technology

The average water leakage rate in the large cities of the world is around 10%. Tokyo boasts a leakage rate of only 3.6%, and leakage control technology is an area where Japan has some strength. On islands in particular need to use their finite water resources effectively, so it is important to reduce leakage rates in water supply processes. Japan has already been using official development assistance to support human resources development to control water leakage in developing countries.

- Rainwater Utilization Technology

Rainwater utilization technology is designed to store rainwater or general use. In Sumida Ward in Tokyo and many other Japanese local governments have subsidy programs to support the introduction of these technologies. South Pacific island countries have already been using these technologies for some time, so they are not entirely new there, but it is important to rediscover their significance and make a further effort to introduce and promote more effective and efficient technologies.

- Seawater Desalinization Technology

The three main methods to desalinate seawater are evaporation, reverse osmosis, and electrodialysis (this one is still at the experimental research stage). In recent years there has been a rapid increase in the installation of desalination equipment using the reverse osmosis method. Current challenges include finding ways to reduce costs, stabilize plant performance, and simplify operations and maintenance.

5.2. Disasters

- Real-Time Information Provision, Forecasting, Warning and Early Warning Systems

These technologies measure meteorological, marine, and river conditions in real time, and provide the information in a timely way. They also provide short-term projections of conditions. Furthermore, advisories and warnings can be issued in the event concerns about weather-related disasters, and disaster-prevention actions by the relevant bodies and local residents can be encouraged. In recent years, in the face of more frequent localized and extreme rainfall events in urban areas, Japan has been introducing technologies for radar observation, real-time information provision, and evacuation notices.

- Provision of Hazard Maps

Hazard maps indicate the potential water depths and areas that could be damaged by inundation due to storm surges, tsunamis, and flooding, etc., and provide additional information about disaster prevention (evacuation sites and routes, etc.). There is a need for capacity building and collection of basic data for creating hazard maps. There is also a need for education and training, to make local residents aware of hazard maps and how to actually use them to take action when necessary. Since the Great East Japan Earthquake in 2011, in Japan there has been an emphasis on the creation of hazard maps based on community participation, and on more practical disaster-preparedness training.

- Architectural Changes, Reinforcing and Raising Structures

To reduce damage due to storm surges, tropical cyclones, and inundation, etc., buildings can be reinforced and raised, and architectural practices can be changed Specific approaches include designing buildings with raised floors (pilloti), using reinforced concrete, and making building foundations higher, etc. It is important to use technologies that are suited to local engineering and architectural techniques, and types of buildings in the area, but even in areas where large-scale physical ("hard") solutions cannot be used immediately due to time and cost constraints, these measures do have the potential to reduce damage.

5.3. Natural Ecosystems

- Coral Reef Conservation, Transplanting and Restoration Technologies

The conservation of corals benefits not only the conservation of biological diversity, but also brings many other benefits, including the prevention of coastal erosion, the supply of material for beach nourishment, maintaining and activating fisheries through habitat conservation for a variety of fishery resources, and attracting more tourists. Japan has been engaged in research and trial projects with technologies for the transplanting and restoration of coral, but scientific opinion is still divided as to their effectiveness.

5.4. Aquatic Environment

- Johkasou-type Combined Wastewater Treatment Tanks

The Japanese "johkasou" design of wastewater treatment tanks can handle household wastewater and toilet flush water, and can be installed at lower cost and more quickly than a centralized sewage treatment system. In particular, this technology is being promoted for permanent installation in areas with low population density, and considered to be equally permanent to regular sewage treatment systems. Although conventional septic tanks have been broadly deployed in developing countries, many problems have been pointed out in terms of design, operation, and maintenance. Also, in areas where soil is not suitable for septic tanks, problems arise with the effectiveness of treatment. In contrast, johkasou technology solves many of the problems of septic tanks, although cleaning and maintenance inside the tanks is still required a few times per year.

In addition, the johkasou design has been proven to be disaster-resistant. A study found that only 3.8% of 1,099 units surveyed were totally destroyed in the area affected by the tsunami and magnitude 6-plus earthquake at the time of the Great East Japan Earthquake in 2011.

6. Listing of Japanese Low-Carbon Technologies that Respond to Needs

Here we summarize examples of Japanese low-carbon technologies that respond to mitigation needs identified in Section 4. Major items are listed below.

6.1. Renewable Energy

- Photovoltaic Power Generation Incorporated into Evacuation Facilities

As a part of disaster-preparedness, local governments in Japan designate schools, community centers, and meeting places as emergency shelters, and in recent years, renewable energy has been introduced for use at some such facilities. In most cases, photovoltaic power generation is installed to provide a back-up source of electricity in the event of a disaster. In some cases the installation is designed to be used in combination with electric vehicles.

- Case study: Kuzumaki, Iwate Prefecture

  In 2012, this town installed photovoltaic power generation systems (2 to 9 kilowatts per location, totaling 182.84 kilowatts) and storage batteries at a total of 25 community centers and other designated emergency shelters. The purpose was to ensure the safety and security of town residents, who had learned from the experience of long power outages after the Great East Japan Earthquake in 2011.

- Case Study: Ikusaka, Nagano Prefecture

  In 2012, photovoltaic power generation equipment (22.9 kilowatts) and storage batteries were installed at Yamanamisou, the welfare center in this village. The purpose was to improve the capacity of the regional evacuation facility to provide accommodation and cooking facilities for 200 people in the event of a disaster, and to revitalize the community through the creation and sale of eco-brand specialty products that run on solar power.

6.2. Energy Conservation

- Electric Vehicles, Hybrid Vehicles

Japan was the first market in the world for the introduction of electric vehicles and plug-in hybrid vehicles. In Nagasaki Prefecture, in 2009, a "futuristic driving tourism" demonstration project in the Goto Islands region introduced 100 electric rental cars equipped with an "intelligent transportation system" (ITS) next-generation car navigation system. In 2009, Kyoto Prefecture enacted an ordinance for the promotion of electric vehicles, and it is also promoting "Kyoto ECO tourism," taking advantages of the prefecture's strengths as a tourist destination.

- Shore Power Systems for Ships

These systems allow moored ships to turn off their shipboard power generators and boiler heat sources, etc., and instead use electricity from land-based sources. This can reduce the emissions of environmentally hazardous substances from ships and protect the port environment. In the event of an earthquake disaster, the system can be used in the reverse direction, to supply electricity from ship to shore. Besides incorporating reverse power flow to transmit electricity to the power grid from photovoltaic power generators and electric vehicles, this design can also maintain the power supply to disaster-affected areas.

6.3. Waste

- Semi-Aerobic Waste Treatment Facilities (Fukuoka Method)

This technology involves the installation of leachate collection drainage pipes made of cobble and perforated tube at the bottom of a waste landfill, to quickly remove leachate from the landfill system and prevent ponding of leachate in the landfill waste layer. The benefits include reduced generation of methane, and the prevention of groundwater pollution. With this design, air (oxygen) flows naturally into the landfill in the opposite direction of the water flow in the collection drainage pipe. It is based on thermal convection, caused by the difference between the outside temperature and the landfill's internal temperature, which is heated by the microbial biodegradation of waste. With this design, special ventilation facilities are not required, making construction and maintenance simple.

Fukuoka University and Fukuoka City worked together to develop practical applications for this technology. Technology transfer to South Pacific island countries has already occurred through JICA's J-PRISM waste management improvement project. The results were evaluated positively.

- Case Study: Samoa

  In 2005 a circulating semi-aerobic landfill design, with a leachate circulation function, was introduced at the existing Tafaigata landfill site. This was the first case of transfer of this technology to that island region. By the combination of simple water treatment equipment with the circulating semi-aerobic landfill design, the COD concentration in leachate was reduced to a value of 20 to 100 milligrams per liter after one month of operation. This was a validation of the cleaning effects of the technology.

- Case Study: Palau

  A semi-aerobic landfill treatment facility was introduced at the M-dock disposal site in Koror State in 2005. At the same time, aid was also provided for formulation of a waste management plan.

7. Adaptation and Mitigation in Palau: Issues and Needs

7.1. Overview of Palau

Palau is a country among the islands of Micronesia, with a population of about 20,000 people living on a land area of 488 square kilometers (similar in size to the island of Yakushima in Japan). The country has nine inhabited islands, with Kayangeru and Babeldaob (location of Palau's capital city, Melekeok) in the north, Koror and Peleliu in the middle, and Angaur in the south, plus four Southwest Islands, and the total number is said to be 300 islands.

- Natural Features
  - With the exception of Kayangeru and the four Southwest Islands, which are atolls, the islands consist of volcanic islands and coral reefs.
  - The country has abundant natural resources, including coral reefs and mangrove forests (80% of its coasts are lined by mangroves).
- Socioeconomic Features
  - The gross domestic product (GDP) growth of Palau has been maintaining an upward trend.
  - Tourism is the main industry (tourists number about 90,000 per year), and it relies heavily on the coral reefs and other abundant natural resources.
  - Palau has strong ties with the United States, Japan, and Taiwan, and the nation's finances and economy are both highly dependent on aid.
  - Two organizations relevant for this project, though not governmental organizations, are the Palau Public Utilities Corporation (PPUC), which is responsible for power and water industries, and the National Development Bank of Palau (NDBP).
- Status of the Adaptation-related Sector
  - Water resources: Surface water is the most common source of water used on the islands, but rainwater and groundwater are also used. Outlying islands, such as Peleliu, Angaur, and Kayangeru, have a high dependency on groundwater (thanks to the freshwater lens phenomenon). The largest water purification plant in Palau is the Ngeruobel Water Treatment Plant in Airai State. It supplies clean water to Airai and Koror states, about 75% of Palau's population. Some issues with the water supply system that have been identified include aging and inefficient pumps and piping, as well as the complexity of operations and challenges in capacity development of personnel.
  - Disasters: Palau faces risks from storm surges, drought, typhoons, and sea-level rise. In recent years, flood damage from typhoons and storm surges has been reported, and Kayangeru Island was severely damaged by typhoon No. 30 (Haiyan) in November 2013. The National Emergency Management Office (NEMO) formulated the National Disaster Risk Management Framework 2010, of which Phase 1 (2010–2013) placed an emphasis on awareness-raising, and Phase II

(2013–2015) has been promoting activities to integrate risk reduction into the activities of private sector businesses.

- Natural ecosystems: One feature of Palau is that coastal tourism is sustained by its coral reefs and mangrove forests. The country has 33 protected areas today. Challenges involving them include building capacity for biodiversity conservation, revising laws and regulations, and building scientific knowledge. In this context, the lack of adequate human resources is a constraint.
- Aquatic environment: Centralized sewer systems have been installed in Koror and Melekeok states, but some issues with the sewerage system that have been pointed out include the aging and inefficient pumps and piping, as well as complexity of operations and challenges in capacity development of personnel. Sewage from homes and businesses is treated in individually-owned septic tanks and so on, but the potential for serious health impacts has been pointed out, from the lack of proper maintenance and from installation in inappropriate locations.
- Food: The main agricultural crops include foods like taro and cassava. Poultry farming is the main pillar of the livestock industry. In recent years, flooding caused by storm surges has damaged taro production, and there are concerns about high temperatures affecting the poultry industry. Yellowfin tuna are among the major exports from the fisheries industry. The National Aquaculture Strategy and Development Plan (NASDP) calls for initiatives for environmental management in aquaculture, the development of monitoring guidelines, as well as the conservation of native species and ecosystems.

- Status of the Mitigation-related Sector
  - Renewable energy: Palau has established the "20:30:30 policy target" as its energy policy for the next 10 years, and it includes the objective of having renewable energy account for 20% of the energy supply by 2020. The ratio still remains low at present, however.
  - Energy supply: PPUC owns grid-connected power plants in two locations (the 26-MW Malakal and 2-MW Aimeliik power plants), and on remote islands, three independent power plants not connected to the grid: Peleliu (50kW), Kayangel (100kW), and Angaur (200 kW). Palau relies almost entirely on imports of diesel fuel for its electricity consumption, so the country's vulnerability in terms of energy security is an issue.
  - Energy conservation: One part of the "20:30:30 policy target" is to achieve an energy-saving rate of 30%. Meanwhile, the country faces challenges with the aging and inefficiency of pumps and piping in the water supply and sewerage systems, and with a lack of incentives to encourage consumers to buy energy-efficient facilities and equipment.
  - Waste: From 2005 through 2008 JICA provided technical cooperation to introduce semi-aerobic treatment facilities at M-dock and assistance to develop a waste management plan, and these helped make significant progress as measures against environmental pollution. M-dock is getting close to running out of space, however, so the construction of a new landfill site and selection of technology are becoming pressing issues. In addition, based on the "3Rs + return" approach being advocated by JICA, Palau has introduced a container deposit legislation (CDL) program.

- Assistance from Japan related to Adaptation and Mitigation
  - For adaptation, Japan is providing assistance for various initiatives, including improvements to the Palau International Coral Reef Center, capacity building for research and maintenance of coral reef island ecosystems, and capacity building for coral reef monitoring, etc.
  - For mitigation, Japan is providing assistance for various initiatives, including capacity building of the national government and Koror State through the formulation of waste management plans, the introduction of simple composting systems, and the introduction of photovoltaic power generation at the Palau International Airport.

7.2. Adaptation and Mitigation in Palau: Summary of Issues and Needs

Based on the overview in Section 7.1 and interviews with government officials, etc., we have summarized Palau's challenges, needs, and critical measures relating to adaptation and mitigation. The results are presented below.

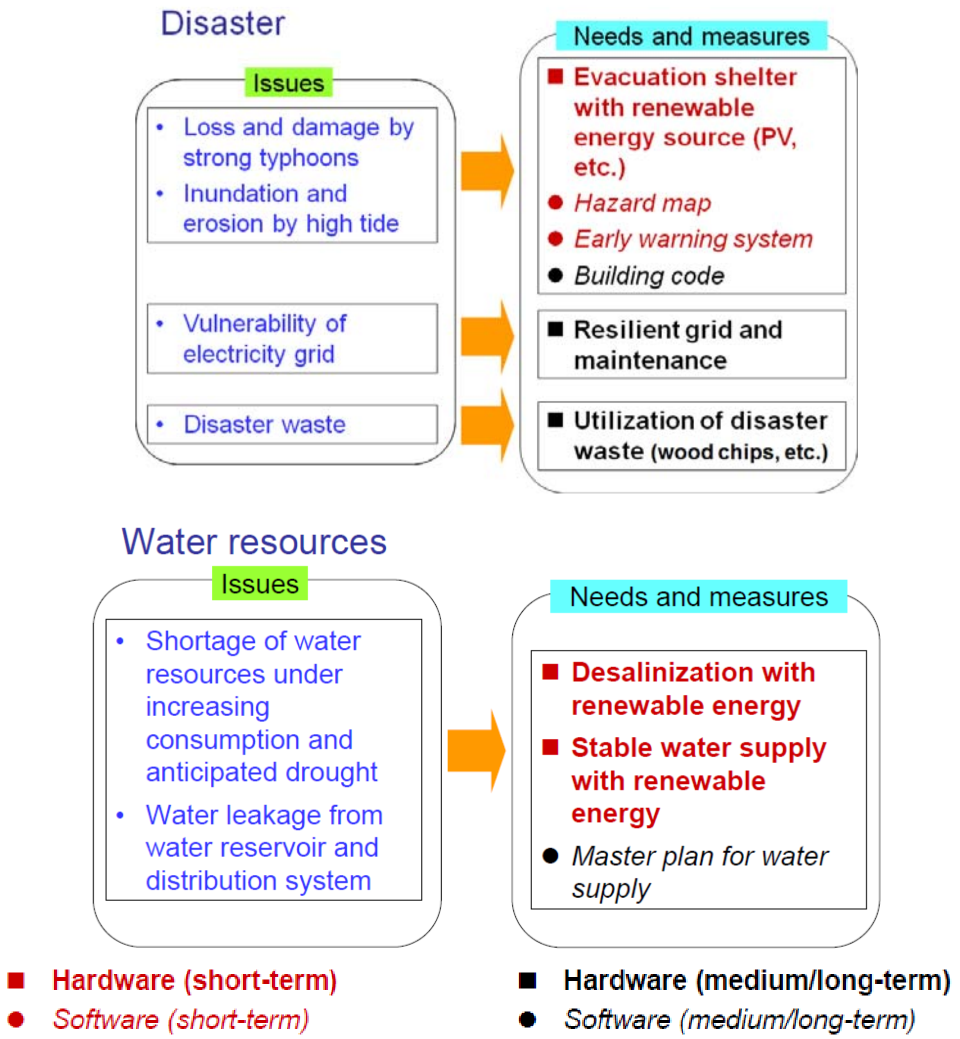


Figure 7.2-1. Adaptation and Mitigation Issues and Needs in Palau, and Essential Measures to Address Them (1)

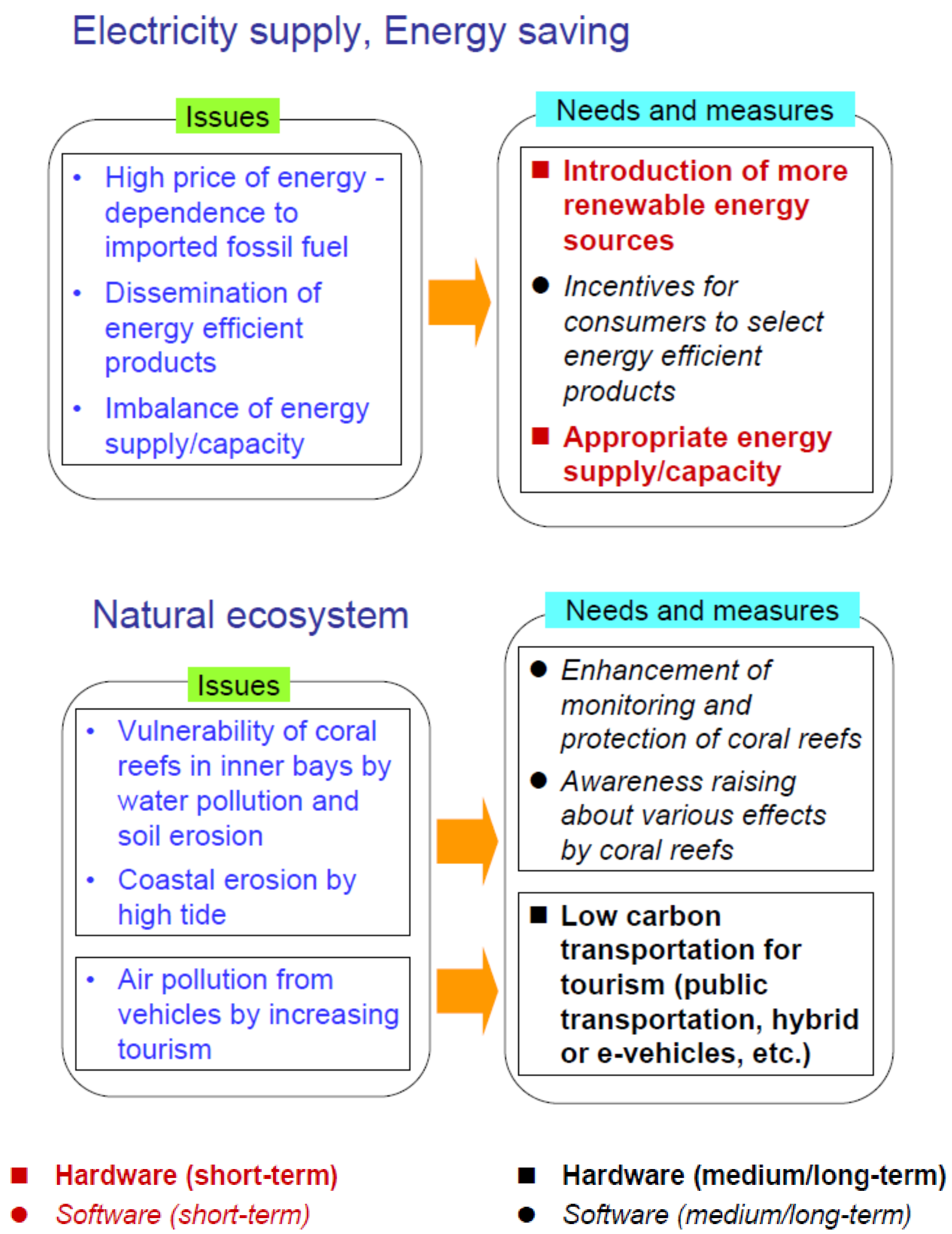


Figure 7.2-2. Adaptation and Mitigation Issues and Needs in Palau, and Essential Measures to Address Them (2)

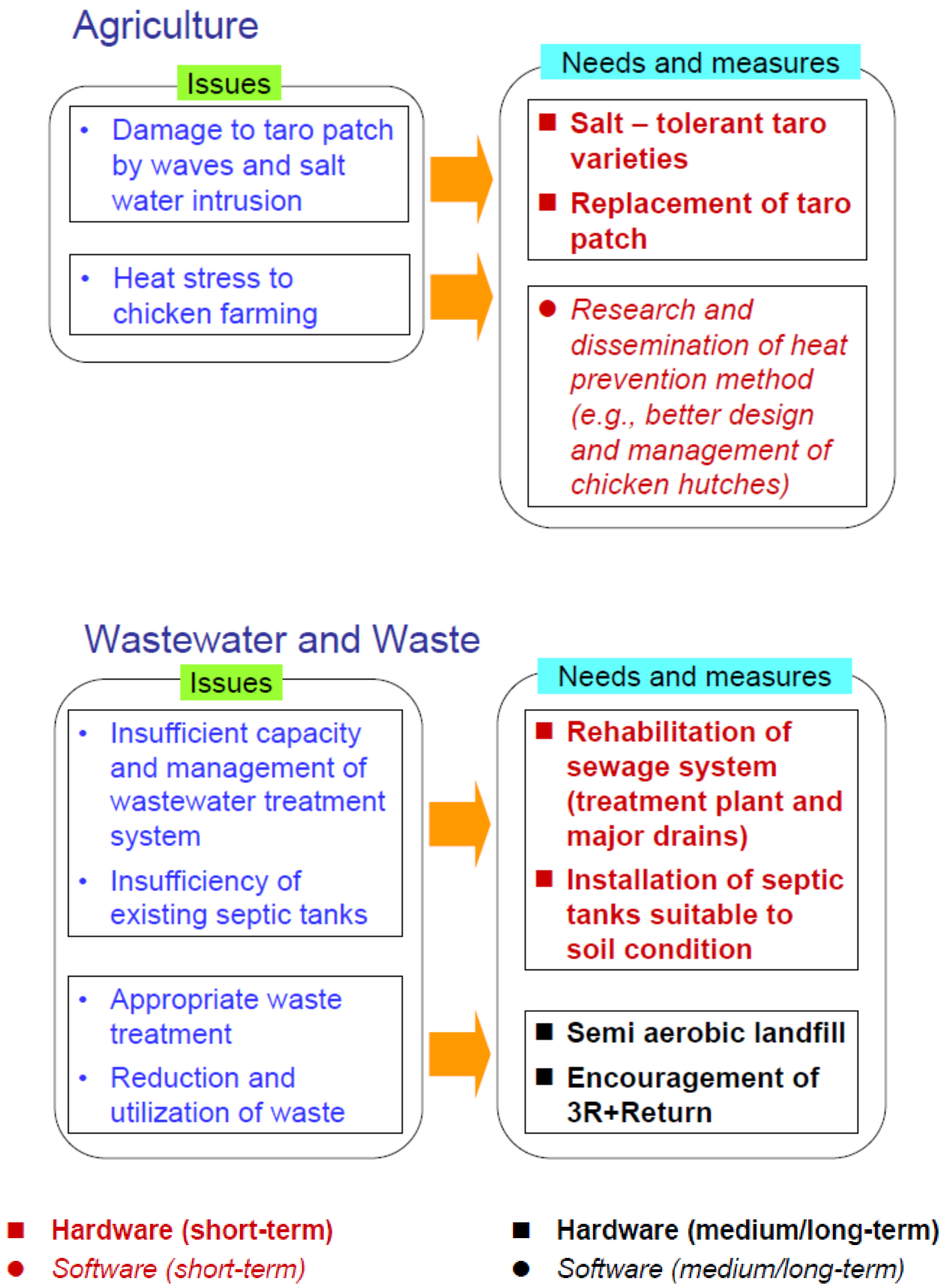


Figure 7.2-3. Adaptation and Mitigation Issues and Needs in Palau, and Essential Measures to Address Them (3)

8. Design of a Low-Carbon/Resilient Model for Small Island Countries, for Broad Application and as a Package

8.1. The Significance of a Low-Carbon/Resilient Model for Small Island Countries

The Intergovernmental Panel on Climate Change (IPCC) released the Working Group I Report of its Fifth Assessment Report (AR5) in September 2013, clarifying the status of climate change being observed around the world, and future projections of temperature increases, sea-level rise, and extreme events, etc. The importance of adaptation to climate change is becoming clearer than ever before, and greater efforts at mitigation are also being demanded as the most effective adaptation policy. The time has come for countries and regions of the world to see adaptation and mitigation not separately, but as a part of integrated climate policy, and to take action now. Meanwhile, even though the concept of integration of adaptation and mitigation has been suggested, there are still relatively few major concrete examples of actual implementation. Thus, it is worthwhile for projects like this project one to create the path forward, take action and produce results, by asking how island countries, as policy-making entities, can best integrate adaptation and mitigation.

South Pacific island countries are taking sustainable development as an important challenge, but their vulnerability to climate change threatens to interfere with those objectives. Also, the greenhouse gas emissions of these countries are not high, but the introduction of mitigation actions such as the use of renewable energy would have great potential to increase the climate tolerance of those countries and to make their societies and economies more wealthy and resilient. It is also important that as these island states are most vulnerable to climate change, they are able to demonstrate their own efforts, while calling for further mitigation efforts by the rest of the world. Japan has a close relationship with South Pacific island countries, and now is a good time to support the creation and promotion of models for integrated adaptation and mitigation efforts.

8.2. Status of Adaptation and Mitigation in South Pacific Island Countries

South Pacific island countries are in a region of the world where adaptation to climate change is most urgent, due to the region's natural and societal features (low-lying land, the concentration of industry and infrastructure in coastal areas, etc.). Projected impacts of climate change include sea-level rise and extreme events like cyclones and droughts, as well as the resulting damage to the natural environment, society and economies. Against this, a variety of efforts are underway, such as the formulation of NAPAs, and development of action plans with support from the UNDP and SPREP. JICA and other aid agencies are engaged in individual projects (e.g., coastal disaster prevention, coral reef conservation, etc.). However, all of these efforts are still limited to just a small subset of countries, regions and sectors.

Meanwhile, in terms of mitigation efforts, while the GHG emissions from these countries are small, they have a strong awareness of their need to reduce dependence on imported fuels and to reduce energy costs, and a strong awareness of energy conservation and renewable energy. They are undertaking a variety of efforts, including the preparation of NAMAs, the setting of numerical targets for the use of renewable energy, and individual projects including some assisted by aid agencies (examples include the introduction of photovoltaic power generation, improvement of waste management, etc.). However, as with adaptation, efforts are still limited to a subset of countries and regions.

In addition, regarding support for individual countries' efforts for adaptation and mitigation in the region, based on local interviews, the various projects are not necessarily being run effectively and efficiently as a whole. There are issues with redundancy of aid, a mismatch between need and the size of facilities, a lack of consideration of sustainable after-care systems once a project has been completed, and a failure to design aid that incorporates all the stages up to private sector involvement.

8.3. Status of Adaptation and Mitigation in Palau

Palau is the subject of our study this fiscal year on a Low-Carbon/Resilient Model for Small Island Countries, and here too, a variety of specific issues have emerged in terms of both adaptation and mitigation With regard to adaptation, flood damage from typhoons and tidal surges has been reported in recent years, and most recently, the need for both hard and soft disaster prevention measures (prevention, emergency response, recovery and reconstruction, etc.) has become a pressing issue after, for example, the serious damage experienced by Palau's northernmost remote island of Kayangel from Typhoon No. 30 (Haiyan) on November 7, 2013. A variety of impacts are beginning to appear, affecting food production and water resources, as well as coral reefs and other natural ecosystems. In particular, in Palau, where tourism is the main industry, impacts on natural ecosystems such as coral reefs—which are the foundation of important tourism resources and marine resources—could result in significant socioeconomic losses to the country. This makes it essential to develop actions as soon as possible, from the perspective of prevention.

As for mitigation, it is essential to shift away from a dependence on imported diesel fuel and move toward energy self-sufficiency with the use of renewable energy; other challenges include dealing with the aging and inefficient water supply infrastructure, and the need to promote and introduce energy-efficient facilities and equipment. Moreover, proper waste disposal and the efficient use of resources is important in Palau, where landfill sites are reaching their limits—not only to reduce greenhouse gas emissions, but also from the perspective of preventing environmental pollution. Pioneering efforts relating to the 3Rs (reduce, reuse, recycle) can be seen in some areas, such as in Koror State, and they are spreading to other areas, but it is essential to actively promote proper waste disposal and the effective use of resources.

8.4. Basic Approach

8.4.1. Key Directions for the Low-Carbon/Resilient Model for Small Island Countries

Below are the key directions envisioned for the Low-Carbon/Resilient Model for Small Island Countries.

- Greatest Possible Use of Renewable Energy

The concepts that "mitigation is one of the most effective adaptation measures," and "the greatest possible use of renewable energy is the best form of adaptation" aim for the maximum use of renewable energy in ways that suit the characteristics of each island country.

<Use of energy systems consisting of both centralized and distributed, independent power generation>

- Use of distributed/independent power generation using solar, wind, small hydro, biomass, etc.

<Use for new adaptation efforts>

- The use in facilities improvements to deal with disaster (evacuation facilities, drainage facilities, etc.)
- The use in facilities improvements to secure water resources (groundwater purification facilities, desalination plants, etc.)

- Construction of Resilient, Weather-Resistant Power Transmission/Distribution Networks and Communication Systems

Once power transmission/distribution networks and communication systems of island countries have been fragmented by extreme events such as typhoons, the result can be extensive damage to human life, industry, society and the economy. Early warning systems on island countries, with a high need in the areas of disaster prevention, food production, and water supply, depend on resilient power and communication systems. These countries can leverage the technology and experience of Japan, which is also an island country, to build resilient power transmission/distribution networks and communication systems. By proposing highly efficient equipment and systems, countries can achieve the climate change mitigation benefits of saving electricity.

- Mainstreaming Adaptation and Disaster Reduction into Proper Waste Management, 3Rs + Return

Incorporate the perspectives of adaptation and disaster prevention into proper waste management and "the 3Rs + return," which are important to solve the problems of environmental pollution and public hygiene on island countries. For example, when developing a semi-aerobic landfill disposal facility, design the facility by taking into account the effects of sea-level rise and storm surge, and develop a manual for the management and transportation of hazardous waste during a disaster.

- Development of Low-Carbon Vehicles and Boats

Aim to shift from dependence on imported diesel fuel to self-sufficiency of fuel for ships and automobiles. For vehicles, shift to electric and hybrid vehicles that run on electricity that makes use of renewable energy. For boats, upgrade old boats to newer, energy-efficient boats.

- Making the Land and Infrastructure More Resilient by the Protection and Restoration of Coral Reefs and other Natural Resources

By protecting and restoring island nations' abundant natural resources such as coral reefs, and mangrove forests, etc., promote CO2 absorption and expand the potential use of biomass, and achieve protection from storm surges.

- Tourism and Industry Promotion and Collaboration

Tourism is one of the main industries on island countries. Be aware the activation of local tourism and traditional industries, in the context of the various businesses mentioned above. Consider the uptake by tourists and fishers of ideas about low-carbon car rentals for tourists, and coral reef conservation activities.

- Development of Sustainable After-Care Systems and Training of Technical Personnel

Consider the development of after-care systems for ongoing maintenance, training of field technicians for this purpose, and the provision of new support schemes to facilitate these things.

- Attention to Legislation, Systems, Customs, Education, Participation

In the introduction of technologies for adaptation and mitigation, always consider compliance with local legislation, systems, and customs. If Japan has effective legislation and systems that could be arranged to be familiar locally, propose them as a set, together with hard (physical equipment, infrastructure) measures. Further, enhance the benefits of introducing these technologies by also incorporating awareness-raising and community participation.

8.4.2. Approaches to Taking Action

The following three approaches are envisioned for future efforts to implement and spread the Low-Carbon/Resilient Model for Small Island Countries.

- Adoption of the Phased Approach

Problems to be solved relating to both adaptation and mitigation are diverse in nature, and priorities vary depending on the geographical characteristics of the island country in question. Therefore, initiatives should be done in stages with two types of models: high priority models of things that need to be achieved in the near term (1 to 2 years), and models of things that need to be considered and implemented over a longer period of time (3 to 5 years).

For models to be realized in the near term, implementation for the target country of Palau is envisioned for fiscal 2014 (or 2015), with special emphasis given to local importance (the degree or urgency of local need), Japanese importance (advanced nature of Japanese technology and experience, etc.) and effectiveness (sustainability, etc.)

- Development of Individual "Models" and Sustainable/Scalable "Schemes"

This project is not intended for model application in Palau only. Rather, the intention is to consider the potential applications for the entire region of South Pacific island countries, and to make them sustainable in the long term. To do so it would be advisable to support the implementation of individual models (by giving incentives for local government and businesses), and at the same time, as a set, to build a policy scheme that can continue in the medium to long term. For example, while constructing a "regional Joint Crediting Mechanism" (JCM) scheme intended for the whole region of South Pacific island countries, through this scheme one could also promote the introduction of integrated adaptation-mitigation models. Furthermore, by providing a certain amount of guidance on matters requiring attention relating to methodologies and project implementation, it may be possible to reduce inefficiencies and redundancy in various current projects.

In addition, the key to success or failure in designing and maintaining the schemes will be gaining consensus with SPREP, which plays an important regional role in environmental and climate change issues, and to build a collaborative relationship with that international organization.

- Attention to Business Sustainability (Creation of Merits for both Government and Industry)

This project is also emphasizes business sustainability. For adaptation, project implementation by public entities is most appropriate, but for some it might be appropriate to establish a private financing initiative (PFI) or public-private partnership (PPP). In some cases, it might be worth adding a profitable project to a beneficial public project that utilizes renewable energy, combining the project with a business scheme that makes a steady profit as a business. For example, by incorporating water purification equipment into a disaster prevention facility, and by supplying it with electricity generated by solar power, the result is of course the realization of both adaptation and mitigation measures, but with the added business component of supplying the region with safe water of high quality (as well as the potential for self-sufficiency in water resources in the event of a disaster). Thus, by creating geographically decentralized and self-sufficient bases of "mini-infrastructure," climate change mitigation and adaptation is achieved, as well as a contribution to sustainable development of the area. The example here is a project of public nature, but takes advantage of renewable energy in a way that has good potential to bring in an income and profit, and combines this with a facility that provides safety, security and convenience for the community, such as a hospital or convenience store.

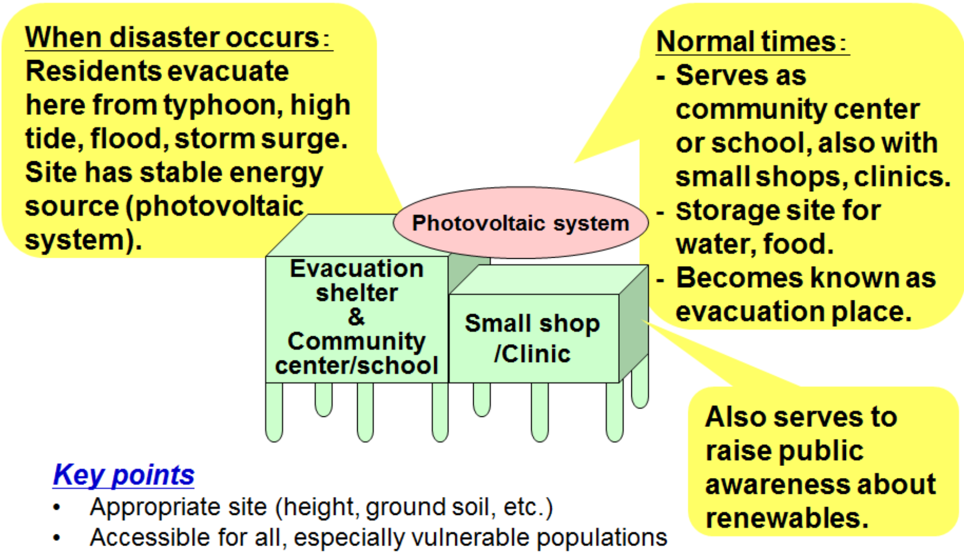
8.5. Low-Carbon/Resilient Model for Small Island Countries Envisioned for Palau

Below, we describe a Low-Carbon/Resilient Model for Small Island Countries as envisioned for Palau. For this fiscal year, based the likelihood of local acceptance and on the level of Japanese technology and experience, for evacuation facilities that utilize renewable energy, we will consider business plans for the items in the following sections.

- Evacuation facilities that utilize renewable energy (consider business plan this fiscal year)

  - Extensive damage has occurred to buildings in Palau due to typhoons in recent years. It is a pressing issue to ensure that there are evacuation facilities able to handle the intensification of extreme events due to climate change.
  - Construct new evacuation facilities (or designate existing facilities to be used for evacuation) to protect residents from disasters (storm surges, flooding, storm damage, etc.), to introduce solar power to the facilities.
  - During normal times, use community facilities and schools as usual, during disasters use them as evacuation facilities with backup power systems.
  - Also, use the facilities as centers for local residents for disaster preparedness education, and to learn about climate adaptation. Support community participation in "soft" (institutional) measures by the government, such as the creation of a hazard map of the region, and the introduction of early warning systems.
  - Also, in the future, by combining water purification facilities and the like with clinics and shops, they can be used as a base for disaster prevention, by supplying electricity and water during normal times, and also carrying everything from food to disaster preparedness supplies. It may also be possible to boost business sustainability by combining these with PFI projects, and so on.

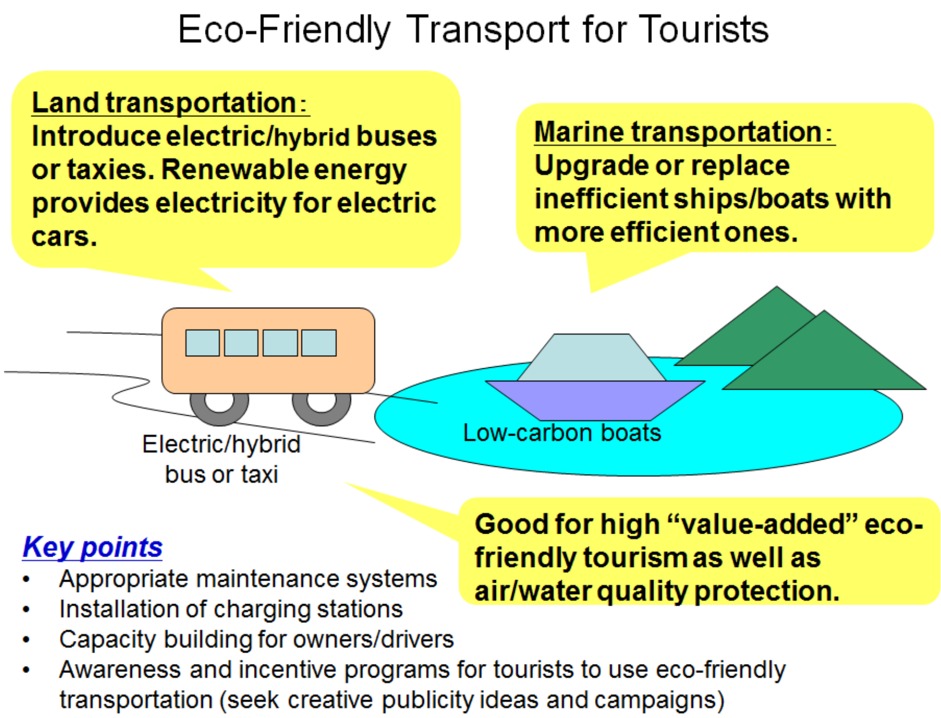
Evacuation Shelter with Renewable Energy



Key points

- Appropriate site (height, ground soil, etc.)
- Accessible for all, especially vulnerable populations
- Secure/stable communication capability in emergency
- Integrate implementation with disaster management education and citizen training

- Eco-Friendly Transportation for Tourists
  - Move Palau toward low-carbon tourism by introducing electric vehicles (using electricity generated from solar power, etc.) and biodiesel for the buses and taxis used by tourists, and introducing energy-efficient boats.
  - Incorporate environmental education about the climate change impacts on coral reefs, and about the diverse roles of coral reefs. Develop these activities to include conservation and monitoring through cooperation with local residents and fishers.
  - From the perspective of comprehensive conservation of the habitats that sustain coral reefs, prevent the intrusion of sediment and domestic wastewater associated with housing construction (by improving laws and regulations, etc.), and support subsidies for the installation of septic tanks and mechanisms for their maintenance.



9. Consideration of Specific Project Schemes

9.1. Ideas for Promotion of Japanese Technology Introduction

In this section, upon review of the project scheme of evacuation facilities that utilize renewable energy as referred to in Section 8.5, we start here by summarizing approaches and ideas for the introduction of Japanese technologies.

In terms of disaster response of evacuation facilities, etc., the National Emergency Management Office (NEMO) in Palau formulated the "National Disaster Risk Management Framework 2010" in 2010, outlining measures that include securing the availability of evacuation shelters, introducing early warning systems, and educating the population on disaster preparedness.

Japan has always been exposed to natural disasters, and also has advanced technology, in terms of both hard (physical) and soft (institutional) solutions. In term of hard solutions, examples include evacuation shelters and evacuation towers, etc., and in terms of soft solutions, Japan has built up expertise in real-time flood prediction based on information systems, and early warning systems, etc. Meanwhile, Japan has not only advanced technology, but also an abundance of activities such as the use of conventional technologies since ages past, and flood fighting teams created through the cooperation of local residents. Japan also has a wealth of soft methodologies, including hazard maps, hazard district zoning, and sets of architectural standards. In the years since the Great East Japan Earthquake (March 2011), considerable further progress has been made in Japan, with even more emphasis on self-help and mutual assistance, and the development of more practical packages of tools for community disaster prevention based on community participation. More recently, Japan has been supporting reconstruction efforts in areas affected by typhoon Haiyan that hit the Philippines in November 2013. In Palau, Japan has supported the reconstruction plans for Ngarchelong Elementary School on Babeldaob Island. It can be tremendously effective to transfer these kinds of experiences and techniques to developing countries in an integrated way.

As for photovoltaic power, in Palau, successful examples of introducing this technology already exist, but they just evident in a limited number of public facilities, not yet ready for broader roll-out. Meanwhile, the potential to introduce photovoltaics would appear to be high, with good basic profitability, considering the high electricity prices in Palau (business owners now pay over 40 yen per kilowatt-hour).

Technologies for photovoltaics and storage batteries need to be able to withstand salt, storm and typhoon damage, especially when being introduced in islands regions like Palau. Japan has examples of equipment manufacturers that sell household/residential photovoltaic generation systems with enhanced capacity to withstand salt damage and typhoons that occur in places with climates like Okinawa. In this respect, as it has been developed and introduced under roughly similar regional conditions—island territories often affected by typhoons—one could say that Japanese technology in this field is superior to that of European countries. Thus, it is important to recognize the excellence of Japanese photovoltaic generation and storage battery technologies.

In addition, many examples already exist in Japan where photovoltaic power generation has been incorporated into evacuation facilities. Japan's experience of combining these two components as a package can offer an effective and multifaceted approach to using these technologies.

9.2. Project Plan

9.2.1. Technical Specifications

The details of technology transfer are based on scenarios of evacuation facilities being equipped with photovoltaic generation equipment. The photovoltaic generation system is combined with a storage battery to function as an emergency power supply at the time of a disaster. Two basic cases are envisioned in the table below: an existing facility (a school that is suitable to also function as a shelter), and a new evacuation facility (built on a piloti design that also incorporates photovoltaic power generation). For existing facilities, two versions of photovoltaic system are presented (4- and 8-kilowatts). In total, three cases are presented.

Table 9.2.1-1. Scenario Cases of Evacuation Facilities with Photovoltaic Power Generation Equipment

Case		Description
Case 1	Install photovoltaic system at an existing facility (4 kW)	Install 4-kilowatt photovoltaic equipment at an existing school
Case 2	Install photovoltaic equipment at an existing facility (8 kW)	Install 8-kilowatt photovoltaic equipment at an existing school (or public facility, church, etc.)
Case 3	Install photovoltaic equipment at a new facility (8 kW)	Construct a new piloti-type evacuation facility (one that can serve as a public facility during non-emergency times) and install 8-kilowatt photovoltaic equipment

Based on the above feasibility study, the following examples are possible scenarios in Palau for large-scale introduction of technology.

Table 9.2.1-2. Number of Cases of Introduction of Large-Scale Expansion in Palau

Case		Number of cases
Case 1	Install photovoltaic equipment at an existing facility (4 kW)	20
Case 2	Install photovoltaic equipment at an existing facility (8 kW)	4
Case 3	Install photovoltaic equipment at a new facility (8 kW)	1
Total		25

9.2.2. Total Cost

The project costs (initial investment) for implementation of feasibility study projects at one location for each case are as follows. The table indicates costs for Cases 1 to 3, where subsidies are available to cover half of the initial investment costs for the photovoltaic generation facilities, and cases with no subsidies. Actual figures indicated may be reduced at the actual time of introduction, depending on the selection of suppliers, and the actual procurement activities. Note that costs can also vary significantly depending on the exact equipment configuration in the actual design. Also, installation costs are included in these numbers, but transportation/delivery costs are not.

Table 9.2.2-1. Scenario Cases of Evacuation Facilities with Photovoltaic Power Generation Equipment

Case		Costs (yen)	
		Not subsidized	50% subsidized
Case 1	Install photovoltaic system at an existing facility (4 kW)	5,800,000	2,900,000
Case 2	Install photovoltaic system at an existing facility (8 kW)	10,600,000	5,300,000
Case 3	Install photovoltaic equipment at a new facility (8 kW)	159,600,000	154,800,000

If the above projects are implemented in Palau, with Case 1 in 20 locations, Case 2 in four locations, and Case 3 in one location, the total costs will be about 320 million yen. If this were to be rolled out on a large scale to other South Pacific island countries (without subsidies), about 1.6 billion yen would be needed for implementation on about the same scale in a total of five countries.

9.2.3. Cost-Benefit Analysis

Below is a basic cost-benefit analysis. Here, we use the values obtained by dividing total project costs (initial investment) by the expected GHG emission reductions. The table indicates costs for cases where subsidies are available to cover half of the initial investment costs for the photovoltaic generation facilities, and cases with no subsidies.

Table 9.2.3-1. Cost-Benefit Analysis for Each Case

Case		Cost versus benefits (yen/t-CO_2)*	
		Not subsidized	50% subsidized
Case 1	Install photovoltaic system at an existing facility (4 kW)	1,379,000	690,000
Case 2	Install photovoltaic system at an existing facility (8 kW)	1,260,000	630,000
Case 3	Install photovoltaic equipment at a new facility (8 kW)	18,978,000	18,408,000

Note: Numbers are rounded.

9.2.4. Project Formulation: Joint Crediting Mechanism (JCM) Scenario

A scenario was developed for project formulation using the Joint Crediting Mechanism (JCM), based on the following assumptions.

(1) Design of evacuation facilities

- For selection of the location of evacuation facilities (or site selection in the case of new facilities to be constructed), review Palau's disaster preparedness planning and systems (in particular, development plans for evacuation facilities, etc.), and articulate assumptions for level of external forcing due to future climate change.
- scenarios of the levels of external forcing, utilize simulations of storm surge damage and wind damage based on Philippine typhoon No. 30 (Haiyan) of 2013.
- Consider the equipment and functions required at the evacuation facility, as well as specifications and costs.

(2) Review of framework for continued support and "soft" disaster prevention measures to be supported in conjunction with (1)

- Consider "soft" measures that can be expected to produce synergistic effects by promoting integration, on a timeline, of evacuation training programs, the introduction of early warning systems, and improvements of evacuation facilities, etc.
- Try to avoid transient efforts, but rather, consider frameworks that can support long-term continuation.

(3) Consideration of photovoltaic power generation equipment

- Consider specifics including procurement methods for photovoltaic equipment and storage batteries, as well as usage, costs, etc. In particular, carefully consider how to procure equipment in ways that allow cost reductions, as well as long-term reliability, and storm-proof durability of products, etc.
- Consider the personnel, organization, and funds needed to operate and maintain the facilities.

(4) Consideration of possibility of additional functions as a future business model

- In addition to the functions of emergency power supply during disasters, consider the future possibility of adding other functions as a business model. For example, consider incorporating the function of water purification equipment for groundwater, as a business operation to supply safe water. It is worth noting that the idea of creating business models that integrate climate adaptation and mitigation in this way are local topics for discussion in Japan as well. Thus, for example, it may be worth creating opportunities for information sharing and exchange with Japanese local governments.

(5) Consideration of schemes for large-scale deployment as integrated adaptation and mitigation measures under the JCM

- Projects implemented in Palau could have special significance as integrated adaptation and mitigation measures in the context of the JCM being advanced by Japan. In order to strongly advocate to the international community the concept from island nations that "**mitigation is one of the most effective adaptation measures**," these approaches should not be limited to just one country (Palau). An effective and efficient scheme should be created to deploy the concepts throughout the South Pacific island countries.
- Develop more details relating to schemes, through coordination and discussion with the Institute for Global Environmental Strategies (IGES), the Asia Pacific Adaptation Network (APAN), etc., organizations that are promoting the efforts of SPREP and LoCARNet, which are expected to play key roles in any schemes.

9.2.5. Future Development Prospects and Schedule

Future prospects and the schedule envisioned for Palau are indicated below.

Table 9.2.5-1. Schedule

Country or Region	FY2014	FY2015	FY2016	FY2017
Palau	Feasibility Study Case 1: Existing, 4kW Case 2: Existing, 8kW Case 3: New, 8kW	Cases 1, 2 Jun. Start project. Complete construction Complete draft JCM methodology Jul. Start operation Start monitoring Jan, JCM registration	Case 3 Jun. Start project Aug. Complete construction Complete draft JCM methodology Setp. Start operation Start monitoring Jul. Report, verify Mar. JCM regist.	Cases 1, 2 Large rollout (24 locations) Sep. Report, verify
All South Pacific Island countries (feasibility studies, project implementation)	Select candidate countries, projects	Feasibility study (Including roll-out of Palau Cases 1-3 in other countries)	Implement Feasibility study	Implement Feasibility study
(Consider large JCM roll-out scheme)	Discussions with related organizations on large JCM roll-out scheme	Design detailed programs Prepare agreements, etc. Discuss with related orgs. Trial operation of actual projects	Full launch of large JCM roll-out scheme	Identify issues, review

9.2.6. Funding Plans

The following three financial support schemes could be considered from Japan's perspective (Ministry of the Environment) to be potentially applicable when developing funding plans:

- Project equipment subsidy programs using bilateral credit mechanisms
- Financial support (fund) enabling " leapfrog" development
- Financial support (ADB loans) enabling "leapfrog" development

Meanwhile, in Palau, the National Development Bank of Palau (NDBP) offers several types of lending programs for energy-efficient buildings as support schemes for mitigation projects. One of them covers projects introducing photovoltaic equipment in commercial sector, so it can be applied for projects like the evacuation facilities with photovoltaic equipment currently being considered.

At present, it may be possible to apply Japan's "Subsidy Program for Project Equipment Using the Bilateral Credit System," which can reduce the sense of burden of local project entities, with prior support funds providing half of the funds at the investment stage.

9.2.7. Project Organization Structure

Elementary schools in Palau consist of private and public schools (both types under the jurisdiction of the Ministry of Education), and the local project entities are assumed to be the bodies responsible for the elementary schools.

9.2.8. MRV Methodologies, Monitoring Arrangements

Regarding monitoring, reporting and verification (MRV) methodologies for the introduction of photovoltaic generation facilities currently being considered, it is assumed that a JCM methodology will be developed with reference to the small-scale CDM methodology AMS-I.F (Renewable electricity generation for captive use and mini-grid). Eligibility requirements envisioned at present are indicated below.

- Eligibility requirements: Projects to construct new grid-connected photovoltaic generation facilities. Currently, grid electricity being used is generated using diesel fuel.
- Method of calculating emission reductions: Multiply amount of electricity generated by the emission factor for grid electricity.
- Monitoring method: Measure amount of electricity generated by photovoltaic generation equipment, after inverter transformer. Measurement frequency shall be once per month.
- Determination of preset values: For the emission factor for grid electricity, use the emission factor for the grid to which the target school facility is connected.

Regarding the monitoring system, to ensure the proper measurement of the amount of electricity generated by the photovoltaic generation equipment, it is important to ensure that local project entities and local consultants submit monitoring plans and report regularly.

9.3. Issues, Aspirations, and Solutions for Project Development

Below are key points regarding issues and solutions toward project development:

- Ensuring funding sustainability: It is important to ensure that the project will be able to continue financially after equipment has been installed, including maintenance and operations.

  → (Solution): Utilize support schemes of the Ministry of the Environment (Japan) to reduce the burden on the project entities at the initial investment stage, and consider the potential for additional functions of the equipment, as future business models.

- Ensuring technology sustainability: It is important to be able to deal with operational stoppages and other problems that may occur due to equipment aging or post-installation failure.

  → (Solution): Consider a routine maintenance and servicing system right at the installation stage of the photovoltaic generation equipment.

10. Consideration of Co-Benefits and Greenhouse Gas Reduction Benefits of the Projects

10.1. Greenhouse Gas Reduction Benefits

The greenhouse gas reductions of this project (large scale roll-out, 25 locations) are presented below.

Table 10.1-1. Greenhouse Gas Reduction Benefits in the Case of Large-Scale Roll-Out in Palau

Case		Emission reductions ($t\text{-}CO_2$/year)
Case 1	Install photovoltaic system at existing facilities (4 kW) x 20 locations	84
Case 2	Install photovoltaic system at existing facilities (8 kW) x 4 locations	34
Case 3	Install photovoltaic system at new facilities (8 kW) x 1 location	8
Total (25 locations)		126

Note: Numbers are rounded.

If the above projects were to be rolled out on about the same scale in a total of five South Pacific island countries, the estimated emission reductions would be approximately 630 $t\text{-}CO_2$.

10.2. Co-Benefits

The co-benefits of this project can be expected to be as follows.

- Benefits in Host Country
  - Enhanced disaster response capability

    Palau and many other South Pacific island countries face an urgent challenge to enhance their preparedness for extreme events, and they are giving particular attention to approaches that promote conventional disaster prevention in ways that are integrated with climate change adaptation. In addition, the use of renewable energy will enhance energy security in many countries, and also help make energy supply and information/communication systems more resilient to disasters, due to decentralized, independent power generation. The construction of evacuation facilities that also incorporate photovoltaic power generation carries a major benefit of simultaneously addressing these types of issues facing island countries.
  - Reduction in environmental impacts

    Besides reducing greenhouse gas emissions, the introduction of photovoltaic power generation can be expected to have the benefit of suppressing the emission of air pollutants from conventional electricity generation from diesel fuel. In addition, in the future, if it is possible to implement water supply projects (incorporating groundwater purification equipment) using electricity from photovoltaic power generation at the evacuation facility, one can also count on the benefits of securing new water resources, which also lead to further reductions in greenhouse gas emissions (reduced emissions from water supply operations).

・ Employment

Besides the work to install photovoltaic generation equipment, a proper system of long-term maintenance and after-care is essential. To prepare for operational stoppages due to equipment aging or failure, it is essential have ongoing maintenance and servicing as well as systems to train technicians; meeting this need leads to the creation of employment for the human resources required for these structures and systems.

・ Community development

By providing a regional center to the local community in case of emergency, the location of evacuation facilities in existing schools during disasters helps to foster a sense of unity in the community. In addition, if a new evacuation facility is constructed and can be given the added function of being a community center for local residents for a variety of local activities, this leads to the further fostering a sense of unity, and to development of the community.

- Benefits in Japan

・ Development of integrated adaptation-mitigation models for Japan (reverse import)

In Japan, the creation of integrated adaptation-mitigation models is a relatively new topic, and there are still relatively few examples of serious and extensive implementation. It is likely that the experience gained from the process of creating integrated adaptation-mitigation models through this project could serve a valuable role in two-way exchanges of information and experience between Japan and South Pacific island countries, including bringing back experience to the frontlines for local governments in Japan.

・ Business development for Japanese companies in developing countries

Japanese companies responsible for technology development, manufacturing and distribution of photovoltaic cells and storage batteries can expect some benefits in the form of business development in developing countries. This scenario could also lead to business development opportunities in regions overseas that are vulnerable to disasters, for businesses involved in design and construction of buildings (evacuation towers, shelters, etc.) for evacuation in disasters.

11. Consideration of a Framework toward a Demonstration Project

11.1. Description

Items requiring further study for a demonstration project in the next fiscal year are listed below.

(1) Feasibility study for introduction of photovoltaic power generation combined with evacuation facilities in Palau

- Review Palau's disaster prevention plans and systems (special emphasis on development plans for evacuation facilities, etc.).
- Make assumptions of external forcing levels due to future climate change (utilize simulations of storm surge damage and wind damage based on Philippine typhoon No. 30 (Haiyan) of 2013).
- Consider location, specifications, and costs for target evacuation facilities.
- Consider procurement methods, specifications, and costs of photovoltaic generation equipment and storage batteries.
- Consider the personnel, organization, and funds needed to operate and maintain the facilities after installation.
- Consider applicable support schemes from Japan, and prepare to make applications.
- In conjunction, also consider "soft" disaster prevention measures that should be supported, and mechanisms for continuation of funding (e.g., evacuation training programs with the idea of time lines, introduction of early warning systems, etc.).
- Consider the possibility of additional functions as a business model for the future (e.g., water supply from water purification equipment incorporated into plans).
- Share information and interact with Japanese local governments that have advanced initiatives for disaster prevention, adaptation, and mitigation.

(2) Consideration of schemes for large-scale roll-out under JCM in South Pacific islands region

- Consider effective and efficient schemes (personnel arrangements, funding sources, etc.).
- Discuss and coordinate with SPREP.
- Discuss and coordinate with IGES (on collaboration with LoCARNet, etc.).
- Discuss and coordinate with APAN.
- Identify candidate countries and projects (as candidates for feasibility studies in FY2015).

11.2. Organizational Matters

In principle, the implementation structure would be the same as this fiscal year, as indicated in the figure below.

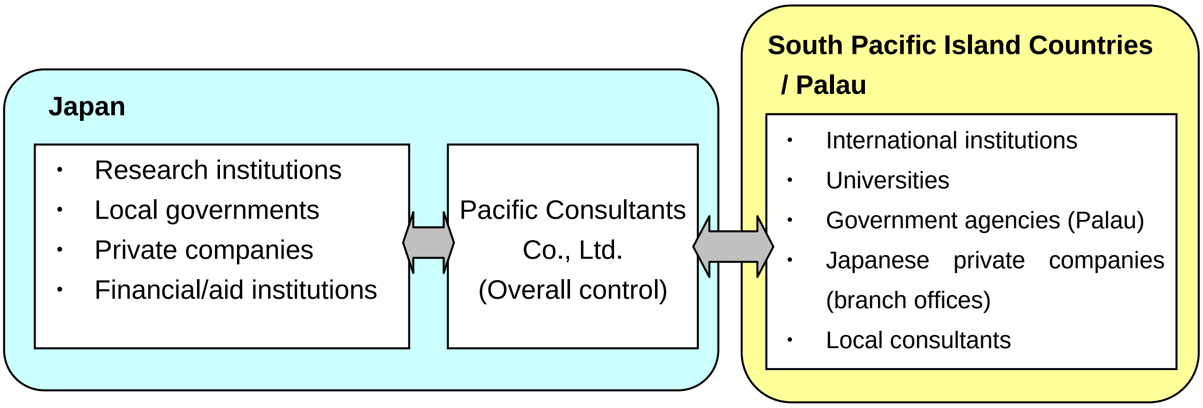


Figure 11.2-1 Organization

11.3. Budget

The budget for implementation of the studies described in Section 11.1 is estimated to be in the range of 40 million to 50 million yen.

12. Site Visits

12.1. Site Visits to Palau

12.1.1. First Mission

Table 12.1.1-1. Summary of First Mission

Timing	October 15 (Tuesday) to October 20 (Sunday), 2013
Actions	・ Interviews with Palau government personnel ・ Interview with JICA branch in Palau ・ Interview with Palau International Coral Reef Center ・ Meetings with local collaborators

12.1.2. Second Mission

Table 12.1.2-1. Summary of Second Mission

Timing	January 11 (Saturday) to January 17 (Friday), 2014
Actions	・ Organization of workshop ・ Meetings with local collaborators (Workshop agenda and participants' list are provided in appendices)

12.2. Site Visits to Samoa

12.2.1. First Mission

Table 12.2.1-1. Summary of First Mission

Timing	September 15 (Sunday) to September 21 (Saturday), 2013
Actions	・ Interview with SPREP ・ Interview with Palau OERC (Ms. Charlene Mersai) ・ Interview with John E. Hey ・ Participation in SPREP annual meeting (as observer)

12.2.2. Second Mission

Table 12.2.2-1. Summary of Second Mission

Timing	December 18 (Wednesday) to December 22 (Sunday), 2013
Actions	・ Interview with SPREP ・ Interview with JICA branch in Samoa