FY2014

JCM Large-Scale Feasibility Study Project for Realization of Low-Carbon Society in Asia

Feasibility Study Project for Evacuation Facilities Using Renewable Energy as a Low-Carbon/Resilient Model for Small Island Countries

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Summary

Purpose of Project

This project aims to conduct research, with Palau as the context for a feasibility study, to develop a working “Low-Carbon/Resilient Model for Small Island Countries” that combines renewable energy (mitigation) with disaster prevention (adaptation), and to consider frameworks to spread the model to the entire region of South Pacific small island states.

Outcome of Project

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

For the purposes of helping with selection of evacuation facilities, we conducted site visits to the facilities to ascertain current siting conditions, building conditions, usage conditions in regular times and when being used for a shelter, management conditions, and issues relating to shelter management.

Based on actual site visits as well as interviews with local persons responsible, we assume the most feasible locations to be the state government building of Koror State, the state government building of Airai State.

Regarding a basic system specification, first of all, we selected 1) Photovoltaic power generation and storage batteries, 2) Photovoltaic power generation and small-scale power generation equipment, 3) Photovoltaic power generation only, based on the purpose of use as evacuation facilities. In addition, we examined concrete spec, cost and CO_2 emission reduction effects.

For implementation as a state government project, the following will also be required: discussion in state legislature for next fiscal year’s budget and approval of the budget amount; followed by bidding procedures as stipulated under Palau legislation.

Regarding facility maintenance/management, it is assumed that after equipment installation, a person in charge of maintenance/management should be decided and will receive a manual with explanations and operational pointers from the manufacturer or installer.

During the next fiscal year, the first action is to prepare for an application to Japan’s Ministry of the Environment for funding under the “Program of Equipment Subsidies for Projects Using the Joint Crediting Mechanism,” and to coordinate details with the relevant organizations to move toward project implementation.

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

It is highly possible that due to their size of government, small island states may find the burden to be excessive for individual countries to sign a JCM agreement with Japan and to discuss and manage projects by Joint Committee. Thus, it may be possible for a group of small island countries to work together with some form of organization or agency acting on behalf of the group, for a joint JCM agreement, discussions, and administrative procedures, etc.

In addition, in the small island stats, it is important that investment for renewable energy should be done from a view point of not only CO_2 emission recduction but also the cobenefit. In order to evaluate from the aspect of sustainable development of islands states, we should develop and improve the model project into the activities which take into account of basic service which residents will need of, for example, ensuring a healthy life and promoting public welfare.

(3) Other issues

We conducted site visits twice to Palau and once to Samoa (where SPREP headquarters are based).

1. Basic information about Project

1.1 Purpose of Project

Countries in the Asia-Pacific region are currently experiencing remarkable economic growth, but the need to reduce greenhouse gas emissions to address climate change is also an important issue, and there is an urgent need to accelerate efforts toward the creation of sustainable, low-carbon society. The South Pacific island countries covered by this study are highly vulnerable to climate change due to their low-lying, flat terrain and other characteristics, including finite energy and freshwater resources, industry and infrastructure. In places such as these, rather than separate mitigation and adaptation strategies, what is needed is their integration as measures to address climate change. Even though the importance of integration of mitigation and adaptation has been pointed out as a concept, there are still relatively few major and specific examples of actual implementation. Thus, it is very worthwhile to examine how island countries can best integrate mitigation and adaptation, create the path to do so, take action and produce results. It is very timely today for Japan, which has a close relationship with South Pacific island countries, to support the creation and promotion of models for integrated mitigation and adaptation efforts.

In Palau, the subject country of the feasibility study in this research, the challenges for both mitigation and adaptation are becoming clear. In terms of mitigation, one of the most important issues is the shift from dependency on imported diesel fuel toward energy self-sufficiency through the use of renewable energy. With regard to adaptation, flood damage from typhoons and tidal surges has been reported in recent years, and recently there has been a more urgent need for both infrastructure and institutional disaster management strategies (prevention, emergency response, recovery and reconstruction, etc.). The serious damage experienced on Palau's northern island of Kayangel from Typhoon No. 30 (Haiyan) on November 7, 2013 illustrates this point. In January 2014, Palau agreed with Japan to introduce the Joint Crediting Mechanism, making it even more important to develop practical CO_2 emission reduction projects.

Based on the context presented above, this project aims to conduct research, with Palau as the context for a feasibility study, to develop a working "Low-Carbon/Resilient Model for Small Island Countries" that combines renewable energy (mitigation) with disaster prevention (adaptation), and to consider frameworks to spread the model to the entire region of South Pacific small island states.

1.2 Description and issues of Project

1.2.1 Feasibility study for introduction of photovoltaic power generation combined with evacuation facilities in Palau

1.2.1.1 Review of Palau's disaster prevention plans and programs

For the selection of locations for evacuation facilities, we reviewed the content and implementation status of existing disaster prevention plans and programs.

1.2.1.2 Assumptions of external forcing levels due to future climate change

As a basis for discussions and plans of evacuation facilities, we developed assumptions about future external forcing levels from climate change, based on previous examples of wind and water damage, etc.

1.2.1.3 Consideration of location, specifications, and costs for target evacuation facilities

Regarding the evacuation facilities being considered, we examined the location, specifications, and costs, while also checking existing studies and discussions as well as local wishes, etc.

1.2.1.4 Consideration of procurement methods, specifications, and costs of photovoltaic generation equipment

Based on the considerations about disasters and usage of photovoltaic power generation systems in the event of wind and water damage, we considered procurement methods for photovoltaic power generation installed in evacuation facilities and factors such as the specifications and costs of facilities. We carefully considered how to procure equipment in ways that allow cost reductions, as well as long-term reliability, and storm-proof durability of products, etc.

1.2.1.5 Consideration of the necessary “soft” disaster prevention strategies and frameworks for continuity of support

We considered options for “soft” disaster prevention strategies desirable to be conducted together with securing and improving evacuation facilities, and considered frameworks for continuity of support of policy implementation by the Palau government and local communities.

1.2.1.6 Consideration of facilities maintenance approaches as a potential business model

We reviewed the maintenance approach (required staffing, organization, costs, etc.), including photovoltaic equipment as evacuation facilities. Looking at the approaches in terms of costs and organization that would enable the permanent operation of the evacuation facilities, we investigated and considered various ideas, including the use of equipment subsidies, a possible arrangement as a private sector activity, turning the site into a supply point for electricity and water, and incorporating a small retail shop into the facility to sell food and emergency supplies.

1.2.1.7 Consideration of applicable financial support schemes

For the next fiscal year we will consider project implementation through financial support schemes that could be applied. We also considered the details and nature of the project, as well as local preferences, etc.

1.2.1.8 Creating/preparing a structure for next fiscal year

Working toward project implementation in the next fiscal year, we proceeded with preparations that included arrangements between government bodies and local communities in the host country and the relevant bodies in Japan; and preparation of proposed methodologies and planning documents to develop into a Joint Crediting Mechanism (JCM) project.

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

1.2.2.1 Consideration of effective and efficient schemes

We considered the potential as an effective and efficient scheme to be promoted in the South Pacific region as a low-carbon/resilient model for small island countries.

1.2.2.2 Discussion and coordination with the relevant bodies

We entered into discussions with SPREP and other major related bodies regarding the potential for a scheme such as mentioned in (1) above. From SPREP we received a report with basic information and recommendations. The report mentioned the latest trends in efforts to integrate disaster risk reduction (DRR) and climate change adaptation in small island countries of the South Pacific region; as well as the need for disaster prevention with evacuation facilities that are combined with photovoltaic power generation; similar cases; and information about where these arrangements could be most applicable. Regarding consideration of possible schemes, we also received advice from organizations including IGES that are promoting LoCARNet initiatives.

1.2.3 Site visits

We conducted site visits twice to Palau and once to Samoa (where SPREP headquarters are based), and engaged in discussions and coordination in order to ensure the feasibility of projects and activities the next fiscal year.

1.2.4 Preparation of report

We prepared a report on findings in the above sections.

1.2.5 Preparation of monthly report

During the project period (from contract signing to end of March 2015) we submitted progress reports by e-mail. The reporting format was as specified through discussion with the Ministry of the Environment.

1.2.6 Domestic cooperation, including participation in discussions and meetings

We participated in progress report meetings at the Ministry of the Environment. There was no other

participation in other discussions and meetings in Japan.

1.2.7 Reporting to meetings specified by the Ministry of the Environment

No other requests were received from the Ministry of the Environment for reporting.

1.2.8 MRV proposals, PDD proposals

Regarding MRV proposals, we proceeded with preparations to be able to make proposals to the JCM Joint Committee if and when directed to do so by the Ministry of the Environment. Regarding PDD proposals, we proceeded with preparations so that third party organizations or the following parties selected by the JCM Joint Committee can “confirm validity” if and when directed to do so by the Ministry of the Environment.

2 Feasibility study for introduction of photovoltaic power generation combined with evacuation facilities in Palau

2.1 Review Palau's disaster prevention plans and programs

2.1.1 National conditions in Palau[1]

(1) Location

The Republic of Palau is an island country in the west Pacific region at about 7 degrees north latitude and 134 degrees east longitude, comprised of over 500 islands of various sizes, including nine that are populated. It is located about 800 kilometers east of the Philippines, and about 800 kilometers north of Papua New Guinea. Among the islands of the Republic of Palau is Babeldaob, which with an area of 330 square kilometers is the largest island, accounting for more than 70% of the national land area. Other major islands include, from the north, Kayangel, Koror, Pelelieu, and Angaur; between Koror and Pelelieu lies the Rock Island group.

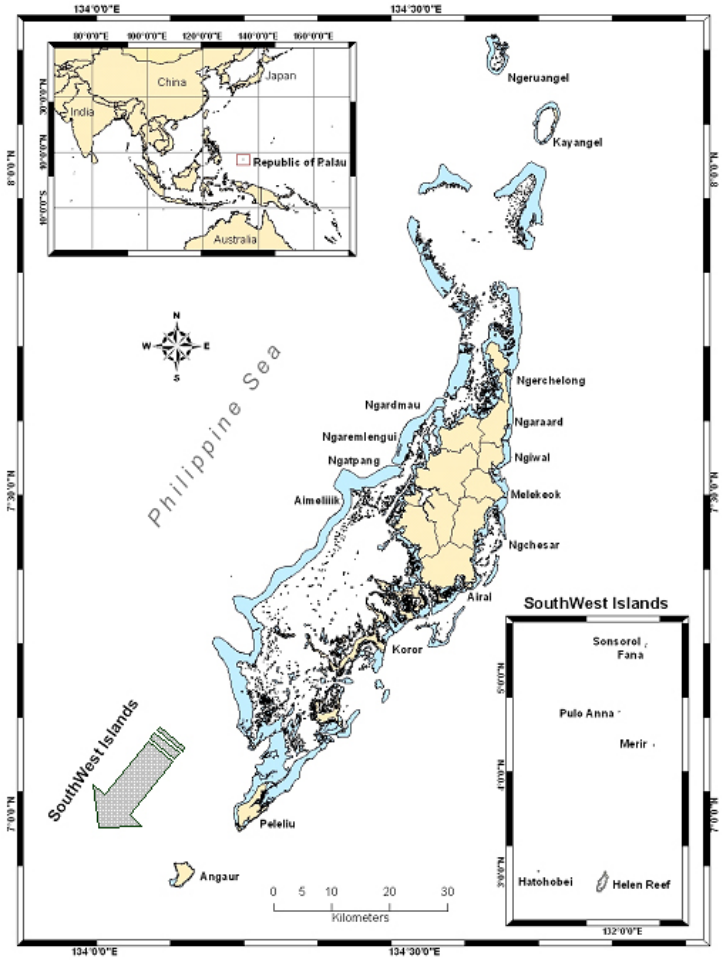

Figure 2.1-1 Map of Palau

[1] Office of Environmental Response and Coordination, Republic of Palau, 2002: First National Communication to the United Nations Framework Convention on Climate Change.

(2) Topography and geology

The Palau archipelago includes islands comprised mainly of igneous rock from volcanic activity; islands comprised mainly of limestone originating from organisms such as coral organisms; atolls; and islands that are a combination of igneous and limestone rock. The highest elevation is Mt. Ngerchechuus with an elevation of 213 meters, and there are number of river systems in which water flows year round.

(3) Climate

The entire territory of the Republic of Palau is within the tropical rainforest climate zone, with an average annual daily temperature of about 28 degrees Celsius, and monthly rainfall of over 200 millimeters. There is virtually no seasonal variation in temperature, and very little daily or annual variation. The annual rainfall on Koror can be as much as 3,800 mm. In the low-rainfall period from January to April, the tropical convergence zone is located south of Palau, and prevailing winds are from the east and northeast. From July to October, the tropical convergence zone shifts north of Palau, and prevailing winds are from the south and west. Palau is at a lower latitude and in the region that generates typhoons, so it is not often that they actually pass over Palau, although there have been instances of significant typhoon damage from time to time, including typhoons Haiyan (2013) and Bopha (2012).

Figure 2.1-2 shows monthly temperature and rainfall on the island of Koror.

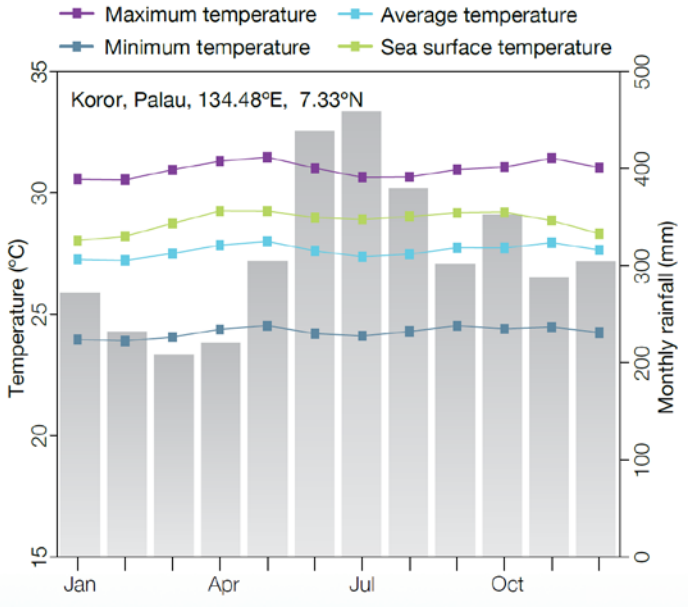

Figure 2.1-2 Koror Island, monthly temperature and rainfall[2]

[2] Palau National Weather Service Office, Australian Bureau of Meteorology and CSIRO, 2011: Current and future climate of Palau.

2.1.2 Social conditions in Palau

(1) Population

Table 2.1-1 shows the population of the Republic of Palau, based on the 2005 national census. The total population was 19,907, of which 5,753 (28.9%) were 18 years or under, and 1,136 (5.7%) were aged 65 or older. Of the total population, 12,676 persons (63.7%) live in Koror State, followed by Babeldaob Island's Airai State with 2,723 (13.7%), and Peleliu State in the southern Palau archipelago with 702 (3.5%), northern Babeldaob Island's Ngaraard State with 581 (3.0%), while Ngarchelong State on the northernmost part of Babeldaob Island, north of Ngaraard State, has 488 (2.5%). Of the total population, 77.4% is concentrated in the two states of Koror and Airai. The average household is 3.86 persons for all states.

Meanwhile, as a nation that depends on tourism, the country receives about 100,000 tourists and visitors from overseas annually.

Table 2.1-1 Population of the Republic of Palau (national census of 2005)[3]

Household and Family Characterstics	Total	Kay-an-gel	Ngarc he-	Ngaraa rd	Ngi-wal	Me-le-	Nge-che-	Airai	Aimelii k	Ngatpa ng	Ngard mau	Ngar-em-	An-gaur	Peleliu	Koror	Son-sor-ol	Hatoh obei
All persons	19,907	188	488	581	223	391	254	2,723	270	464	166	317	320	702	12,676	100	44
In households	18,182	188	488	433	223	391	244	1,999	270	426	153	317	320	702	11,884	100	44
Family householder: Male	2,730	28	96	73	35	70	48	327	42	70	31	56	50	93	1,693	12	6
Female	850	12	20	17	14	14	13	76	13	12	7	11	24	54	550	11	2
Nonfamily householder: Male	765	8	18	21	4	8	8	93	17	10	8	8	8	30	498	14	12
Female	362	–	16	9	3	11	6	33	6	4	1	3	4	14	252	–	–
Spouse	2,596	26	94	69	29	64	48	308	43	60	26	51	44	97	1,625	8	4
Child	5,260	50	102	96	56	95	60	641	73	130	47	95	78	206	3,474	39	18
Parent	157	–	4	6	2	15	1	14	1	–	1	3	4	7	99	–	–
Other relatives	3,449	44	110	88	49	73	44	331	46	100	31	65	82	154	2,216	14	2
Nonrelatives	2,013	20	28	54	31	41	16	176	29	40	1	25	26	47	,1477	2	–
In group quarters	1,725	–	–	148	–	–	10	724	–	38	13	–	–	–	792	–	–
Institutionalized persons	103	–	–	–	–	–	–	–	–	–	–	–	–	–	103	–	–
Correctional institutions	103	–	–	–	–	–	–	–	–	–	–	–	–	–	103	–	–
Noninstitutionalized persons	1,622	–	–	148	–	–	10	724	–	38	13	–	–	–	689	–	–
College dormitories	342	–	–	148	–	–	–	–	–	–	–	–	–	–	194	–	–
Other noninstitutional	1,280	–	–	–	–	–	10	724	–	38	13	–	–	–	495	–	–
Persons per household	3.86	3.92	3.25	3.61	3.98	3.80	3.25	3.78	3.46	4.44	3.26	4.06	3.72	3.68	3.97	2.70	2.20
Persons per family	4.54	4.40	3.84	4.31	4.29	4.29	3.72	4.47	4.20	4.90	3.76	4.57	4.08	4.37	4.69	3.65	4.00
Persons under 18 years	5,753	58	158	252	68	104	79	644	79	182	56	105	98	233	3,597	34	6
Living with both parents	3,142	32	70	68	37	58	46	458	52	92	34	61	44	122	1,944	20	4
Householder or spouse	2	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–
Own child	3,313	32	64	64	31	53	41	442	46	94	32	58	46	136	2,140	28	6
With female hhlder, no husb	405	2	2	10	–	4	2	48	1	6	5	1	4	31	285	4	–
Other relatives	2,205	26	94	62	37	51	38	190	33	74	24	47	52	97	1,674	6	–
Nonrelatives	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Institutionalized persons	2	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–
Other persons in group quarter	231	–	–	126	–	–	–	12	–	14	–	–	–	–	79	–	–
Persons 65 years and over	1,136	20	60	56	26	42	27	123	14	28	9	31	28	56	611	3	2
Family household: Male	343	6	26	16	8	12	10	43	2	10	2	13	8	7	180	–	–
female	256	6	8	8	12	4	7	24	7	6	2	2	10	18	137	3	2
Spouse	169	4	10	14	3	7	5	18	1	2	1	9	2	4	89	–	–
Parent	128	–	4	6	2	11	–	12	1	–	1	3	2	5	81	–	–
Other relatives	116	–	–	4	–	4	1	11	3	6	1	3	6	7	70	–	–
Nonrelatives	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Nonfamily householder: Male・	41	4	2	3	1	–	–	3	–	2	1	–	–	4	21	–	–
Female	75	–	10	5	–	4	4	9	–	2	–	1	–	11	29	–	–
Institutionalized persons	1	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–
Other persons in group quarter	7	–	–	–	–	–	–	3	–	–	1	–	–	–	3	–	–
FAMILY TYPE BY PRESENCE OF OWN CHILDREN																	
Families	3,580	40	116	90	49	84	61	403	55	82	38	67	74	147	2,243	23	8
With own children under 18 yrs	2,660	28	84	62	35	60	43	309	38	72	28	52	56	111	1,661	17	4
With own children under 6 yrs	1,251	18	36	34	16	27	16	125	24	30	12	24	26	57	798	6	2
Married-couple families	2,596	26	94	69	29	64	48	308	43	60	26	51	44	97	1,625	8	4
With own children under 18 yrs	1,979	22	72	51	22	48	33	245	30	54	20	41	30	72	1,199	8	2
With own children under 6 yrs	951	14	28	28	8	19	13	101	17	20	9	21	10	44	611	6	2
Female hhlder, no husb	711	10	14	15	13	11	12	66	12	12	7	10	20	39	461	9	–
With own children under 18 yrs	553	4	10	8	9	8	9	51	8	10	5	8	18	31	369	5	–
With own children under 6 yrs	235	2	6	4	4	6	3	20	7	8	3	2	8	11	151	–	–
Source: 2005 Palau Census of Population and Housing																	

[3] Office of Planning and Statistics, Republic of Palau, 2005: 2005 Census of population and housing of Palau http://palaugov.org/wp-content/uploads/2013/10/2005-Census-of-Population-Housing.pdf

Table2.1-2 Incoming tourists in 2013, by nationality (excluding permanent residents)[4]

	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	TOTAL
AUS / NZ	125	82	96	156	121	59	131	115	104	78	97	113	1,277
GERMANY	49	429	131	163	57	37	24	40	54	69	104	133	1,290
GUAM	92	87	122	94	105	86	153	84	85	217	68	26	1,219
HONG KONG	122	106	213	89	43	23	33	24	21	38	52	92	856
ITALY	20	45	42	35	3	4	4	30	12	23	9	28	255
JAPAN	3,588	3,631	4,394	2,400	1,551	1,632	2,507	3,682	3,124	2,492	2,694	3,947	35,642
KOREA	1,869	1,243	1,419	1,173	1,179	1,183	1,275	1,337	1,756	1,410	1,477	1,550	16,871
MICRONESIA	47	32	43	63	31	95	194	22	109	63	63	23	785
PHILIPPINES	59	72	79	83	82	51	64	33	79	57	79	66	804
PRC CHINA	788	1,659	1,048	659	185	431	654	918	644	467	444	907	8,804
ROC TAIWAN	2,316	2,575	1,697	1,381	1,787	2,429	3,365	2,196	2,611	1,887	1,609	1,690	25,543
RUSSIA	82	37	83	69	76	16	82	34	9	99	163	61	811
SWITZERLAND	32	89	48	60	5	6	15	4	11	41	51	27	389
UNITED KINGDOM	40	37	44	27	19	16	18	18	11	28	30	42	330
US MAINLAND	641	529	786	692	450	656	482	431	402	496	502	551	6,618
OTHER EUROPE	157	213	290	260	100	82	105	92	59	127	276	182	1,943
OTHERS	114	164	122	154	85	103	158	80	87	130	191	241	1,629
TOTAL	**10,141**	**11,030**	**10,657**	**7,558**	**5,879**	**6,909**	**9,264**	**9,140**	**9,178**	**7,722**	**7,909**	**9,679**	**105,066**

(2) Housing conditions[5]

Of the 4,707 residential buildings in the Republic of Palau, 2,993 are in Koror State, 529 in Airai, 191 in Peleliu, 150 in Ngarchelong, and 120 in Ngaraard. Of the total 3,707 residential buildings, 3,196 are detached single-family dwellings, 703 are attached single-family dwellings, and 769 are multi-unit apartment houses. Most of the multi-unit housing is in the states of Koror and Airai, while it is virtually non-existent in other states.

2.1.3 Disaster prevention plans and programs

(1) Palau's disaster prevention plans and programs[6]

In terms of Palau's disaster prevention plans and programs, the National Disaster Risk Management Framework 2010 was adopted in 2010 (abbreviated as NDRMF2010). Its purpose is to reduce disaster risk, create mitigation mechanisms, and establish a comprehensive framework for response and recovery, for the sustainable national development of the Republic of Palau.

According to the NDRMF2010, disaster risk management is comprised of disaster risk reduction and disaster management. "Disaster risk reduction" is conducted prior to a disaster, and includes prevention (e.g., relocation from hazard zones), mitigation (e.g., strengthening of construction standards), and adaptation (e.g., development and implementation of coastal protection plans). "Disaster management" has a role before and after any disaster, and includes preparation (stockpiling of emergency supplies,

[4] Palau Visitors Authority, 2012: Visitor Arrival Report – January 2013. http://www.visit-palau.com/admin/newsletter/images/Visitor%20Arrival%20Statistics%20Report%20-%20January%202013.pdf

[5] Palau Visitors Authority, 2012: Visitor Arrival Report – January 2013.

[6] National Emergency Management Office, 2010: National Disaster Risk Management Framework 2010.

disaster training), response (lifesaving, damage assessment), and recovery/reconstruction (restoring life-line services).

This plan emphasizes the importance of both disaster reduction and management, and under the latter, specifies details of the roles and relationships between the ministries/agencies and related bodies.

(2) Organizations involved in disaster response

Palau's organizational chart of ministries and agencies is shown in Figure 2.1-3 In Palau the National Emergency Management Office (NEMO) reports directly to the Office of the Vice President, and NEMO is the body responsible for proper implementation of the contents stipulated in NDRMF2010.

During (or prior to) a disaster, the President convenes the Disaster Executive Council (DEC). NEMO serves as the secretariat for DEC, and is comprised of the President and head of each Ministry. DEC declares a state of emergency, oversees disaster response, and makes requests for international cooperation.

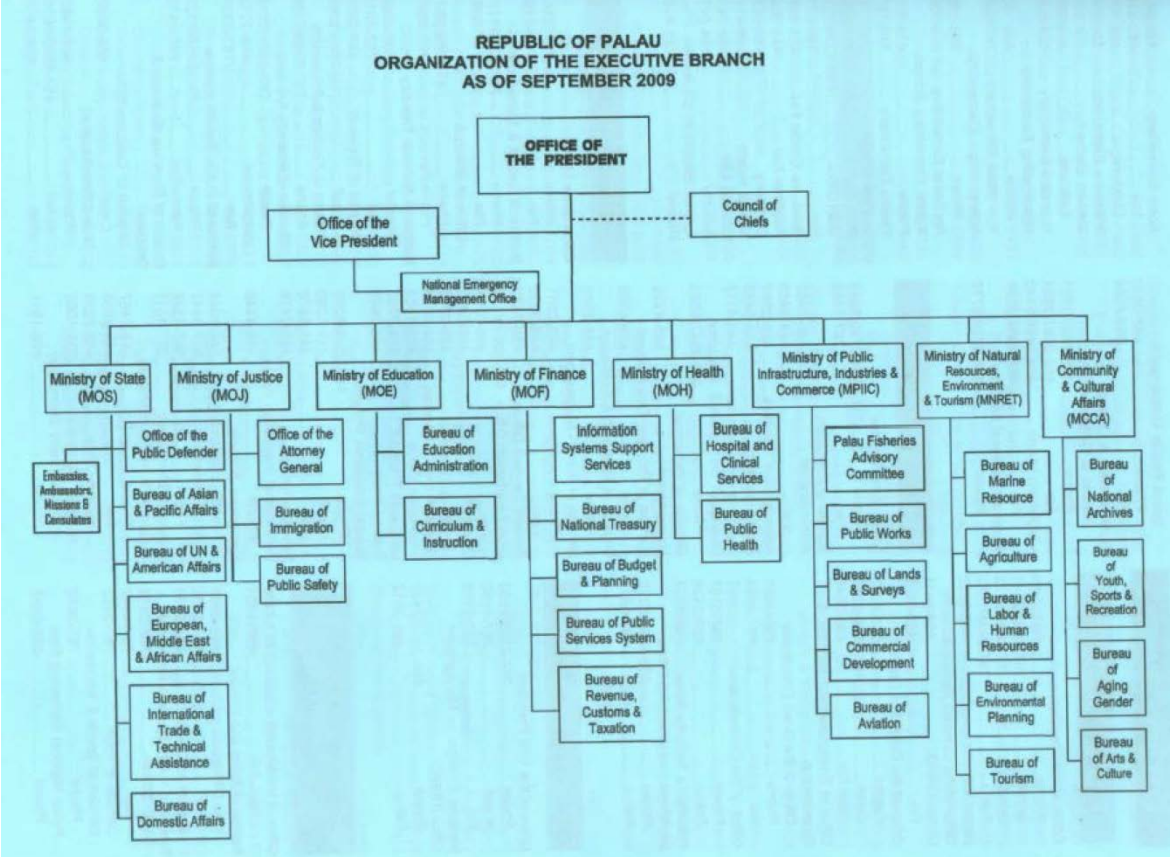

Figure 2.1-3 Organization chart of executive branch of government[7]

Also, to deal with the various essential functions during a disaster, Lead Response Agencies and Support Response Agencies have been designated, as shown in Table 2.1-3 Lead Response Agencies have the

[7] Ministry of Environment (Japan), 2014: Republic of Palau, Organization of the Executive Branch http://www.env.go.jp/earth/coop/lowcarbon-asia/region/data/palau_administrative_20140418.pdf.

responsibility of implementing those functions, while Support Response Agencies assist the Lead Response Agencies, and have specific roles in their implementation.

Table 2.1-3 Emergency functions, Lead Response Agencies, and Support Response Agencies[8]

Emergency Functions	Lead Response Agency	Support Response Agency
Direction	Disaster Executive Council	Leadership Executives
Management & coordination	National Emergency Committee	NEMO
Command and control	National Disaster Coordinator (at national level) or Incident Commander (at incident level)	All other agencies
Public information	President's Press Secretary	Other PIO's, BoPS, BoDA, PNCC
Warning and alerting*	NEMO or BoPS or NWS, depending on the hazard	BoPS, BoDA, PNCC
Law enforcement/fire	Bureau of Public Safety	State Government Rangers
Search and rescue	Bureau of Public Safety, Marine Law Enforcement Division	State Government Rangers, Tour Agencies, Council of Chiefs, BTA
Medical, health and sanitation	Ministry of Health	Private Clinics, Fire, Red Cross
Power	Palau Public Utilities Corporation	Private Sector (MoU)
Water	Bureau of Public Works	State Government/Private sector
Sewer	Bureau of Public Works	State Government/Private sector
Communications	Palau National Communications Corporation	Bureau of Public Safety, Red Cross, Private sector
Engineering and public works	Bureau of Public Works, Capital Improvement Project	Private Sector
Environmental protection (HazMat, oil spills, chemical releases)	Environmental Quality Protection Board, BoPS	BoPS, OERC, private sector, Ministry of Natural Resources, Environment & Tourism
Mass care (food)	Ministry of Education	Red Cross, NGO's
Shelter management	Ministry of Education	Red Cross, BoPS, MoH,
Relief management	Division of Property & Supply, MoF	MoE, State Government, Donors, Red Cross
Initial damage assessment	Depending on emergency (where and who), HazMat	All agencies
Comprehensive damage assessment	All agencies	All agencies Red Cross
Transportation (land & sea)	Bureau of Commercial Development	All other agencies, Require MoUs with NGO/Private Sector
Air transport	Bureau of Aviation	MoU with Local and Regional Agencies
Terrorism	Bureau of Public Safety	All other agencies
Climate change adaptation	Office of Environmental Response & Coordination	National Weather Service, PCC, BoA1, Donor Agencies, EQPB

[8] National Emergency Management Office, 2010: National Disaster Risk Management Framework 2010.

2.1.4 Status of designated shelters

(1) Agencies involved in designating shelters

NDRMF2010 states that NEMO has the responsibility of designating shelters, in cooperation with MoE and the state government, and to notify the affected community of the location of the shelter. Also, when designating a non-governmental facility as a shelter, NEMO has the responsibility of preparing a memorandum of understanding with that facility.

(2) Designated shelters during Typhoon Haiyan in 2013

Table 2.1-4 is a list of designated shelters during Typhoon Haiyan in 2013. Many facilities were also designated as shelters during Typhoon Bopha in 2012, as facilities' strength assessments and memoranda of understanding (in the case of non-governmental facilities) had not yet been concluded, so those facilities continued as before to be designated and used as shelters.

Table 2.1-4 List of designated shelters during Typhoon Haiyan (2013)[9]

STATE:	TYPHOON SHELTER:	CONTACT PERSON:	PHONE NUMBERS:
Kayangel State	1. JFK School 2. State Office	Mr. Billy Graham Mr. Inao Sekiii	876-2766 or 488-2766
Ngarchelong State	1. Mengelang Abai 2. Ngriil (School) 3. State Office	Ms. Sabina Ewatel	855-2967
Ngchesar State Ngiwal State Melkeok State	1. National Capital-Ngurulmud (ROTUNA Area)	Cello Rodney	775-3067/488-3215 775-2450
Ngaraard State	1. Chol Abai 2. Elem. School 3. Ngebuked Abai 4. Alab Abai 5. State Office	Mr. Macario Watsi Ms. Susan Malsol	824-4490
Airai State	1. Oberaod Center 2. Bai Ruluong **(use for Ngeruluobel residence ONLY)** 3. Arai Elem. School 4. Blai Ra Ngermelkii(Ngetkip) 5. Airai State Office	Mr. Clarence Polloi	587-1250(w) 587-3511/2135(state office)
Aimeliik State **NOTE:** Ngchemiangel Abai (POOR Condition) All residence resides in Ngchemiangel will seek shelter @ Medorm Abai/School or Community center.	1. Ngerkeai & Imul Hamlet: Community Center 2. Elem. School 3. Elechui Abai 4. Medorm Abai	Mr. Mark Siksei Ms. Lourigene Samsel Mr. Marino Rechesengel Mr. Paul Dakubong	779-9203(m) 544-1035(h) 778-6857 (m) 544-1007 (h) 775-3952 (m) 775-4200 (m) 544-1445(h)
Ngatpang State	1. Ibobang School 2. Church 3. State Office	Ms. Lise Elobet	535-1882 (w) 535-1009 (h)
Ngeremlengui State	1. State Office 2. School	Ms. Oliau Ibuterang	733-2967 (w) 733-1049 (h)
Ngardmau State	1. School 2. Abai 3. State Office	Mr. Joshua Bukringang	747-2967 (w) 747-1015 (h)
Peleliu State	1. School 2. State Office 3. Japanese Head-Quater 4. Museum 5. Land Com. Buldg.	Ms. Rebecca Nguruios Ms. Elisabeth Mallon	345-1173 (h) 345-1067 (h) 345-2967(w)
Hotohobei State	1. School	Gov. Thomas Patris	488-2218(w)

[9] Based on documents from NEMO.

2.2 Assumptions of external forcing levels due to future climate change

2.2.1 Case studies of past disasters (emphasis on wind and water damage)

According to NDRMF2010, four types of natural disasters are considered as presenting high risk in Palau, including storm surges, typhoons, flooding and erosion from sea-level rise, and drought. Meanwhile, earthquakes, tsunamis, and landslides are classified as presenting low risk. In fact, past records show damage from typhoons, but there are no records of damage from earthquakes and tsunamis.

Major typhoons that have caused damage in Palau include Typhoon Sally in 1967, Typhoon Mike in 1990, Typhoon Bopha in 2012, and Typhoon Haiyan in 2013. The first two caused major damage from strong winds, while the latter two caused damage from both storm surges and strong winds. Here we summarize information about the disasters from Typhoon Bopha in 2012 and Haiyan in 2013.

(1) Typhoon Bopha (2012)

Typhoon Bopha passed about 50 km offshore of Pelelieu Island in the southern Palau archipelago from the night of December 2 to the morning of December 3, 2012. The core air pressure as it passed the region was 935 hPa, and windspeed was about 50 m/s.

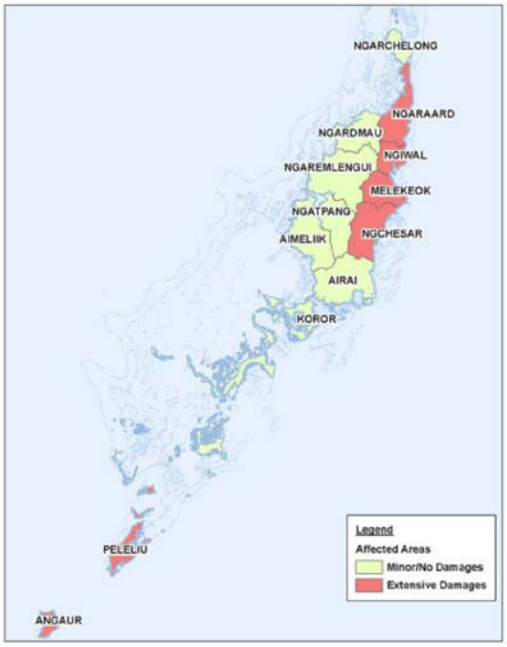

Figure 2.2-1 States with the most damage from Bopha[10]

As shown in Figure 2.2-1, damage was most severe in the states of Angaur and Peleliu in the south, Ngaraard State in eastern Babeldaob, Ngiwal State, Melekeok State, and Ngchesar State, and in these

[10] United Nations Office for the Coordination of Humanitarian Affairs (OCHA), 2012: Palau: Typhoon Bopha Situation Report No. 2 (as of 5 December 2012).

states the damage from storm surges was most significant. In these six states, 92 homes were completely destroyed, and 59 suffered major damage.[11] In addition, Ngaraad Elementary School and Bethania High School were seriously damaged. While these above six states on the east face the open ocean, states facing the western seas and Koror are inside the barrier reef and do not directly face the open ocean, so their damage was low.

The Ngaraad Elementary School that was completely destroyed in Ngaraad State and the elementary schools destroyed in Melekeok and Ngchesar States are located on low-lying land along the eastern coast of Babeldaob Island. The Ngaraad Elementary School building was inundated by the storm surge, while in the case of Melekeok and Ngchesar, the elementary school yards were inundated by the storm surges. Both elementary schools were designated shelters, and many evacuees were present inside as the typhoon passed, but there were no human casualties.

The people were not previously aware about any risk of storm surges from typhoons prior to Typhoon Bopha, because past experience with Typhoon Sally in 1967 and Typhoon Mike in 1990 had only resulted in wind damage. There were no reports of human casualties (death or serious injury) from Bopha, although many local residents had sought refuge in shelters located in low-lying areas and thereby exposed to life-threatening risks.

The estimated damage from Typhoon Bopha was estimated at about 10 million dollars.

(2) Designated shelters during Typhoon Haiyan in 2013

Typhoon Haiyan passed immediately north of Kayangel Island in the northern part of the Palau archipelago from the night of November 6, to the morning of November 7, 2013.[12] The core air pressure as it passed the region was 905 hPa and windspeed was about 60 m/s, making this a violent storm by Meteorological Agency classification. Because Kayangel Island was near the path of the center of the typhoon, damage to buildings from the strong winds was significant, and also on Babeldaob Island, there was damage from strong winds, particularly on the northern part of the island. Kayangel State and the eastern coast of Babeldaob Island felt the impacts of storm surges, but storm-surge damage was limited compared to Typhoon Bopha the previous year.

Figure 2.2-2 shows damage from Typhoon Haiyan. In Kayangel State 22 homes were completely destroyed, while in Palau nationwide the total was 40 homes. In Koror State 23 homes had major damage, while the number was 15 in Kayangel, and 94 nationwide. In terms of school damage, besides the Kayangel Elementary school being destroyed by strong winds, roofs were blown off the Ngarchelong Elementary school, Aimeliik Elementary School, and Palau High School. There were no reports of human casualties (death or serious injury) from this typhoon.

The damage from Typhoon Haiyan was estimated at about six million dollars.[13]

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[11] United Nations Office for the Coordination of Humanitarian Affairs (OCHA), 2012: Palau: Typhoon Bopha Situation Report No. 2 (as of December 5, 2012).

[12] Meteorological Agency Taiphoon No. 30, Haiyan (1130), best track.

[13] United Nations Office for the Coordination of Humanitarian Affairs (OCHA), 2013: Palau: Typhoon Haiyan Information Bulletin No. 2.

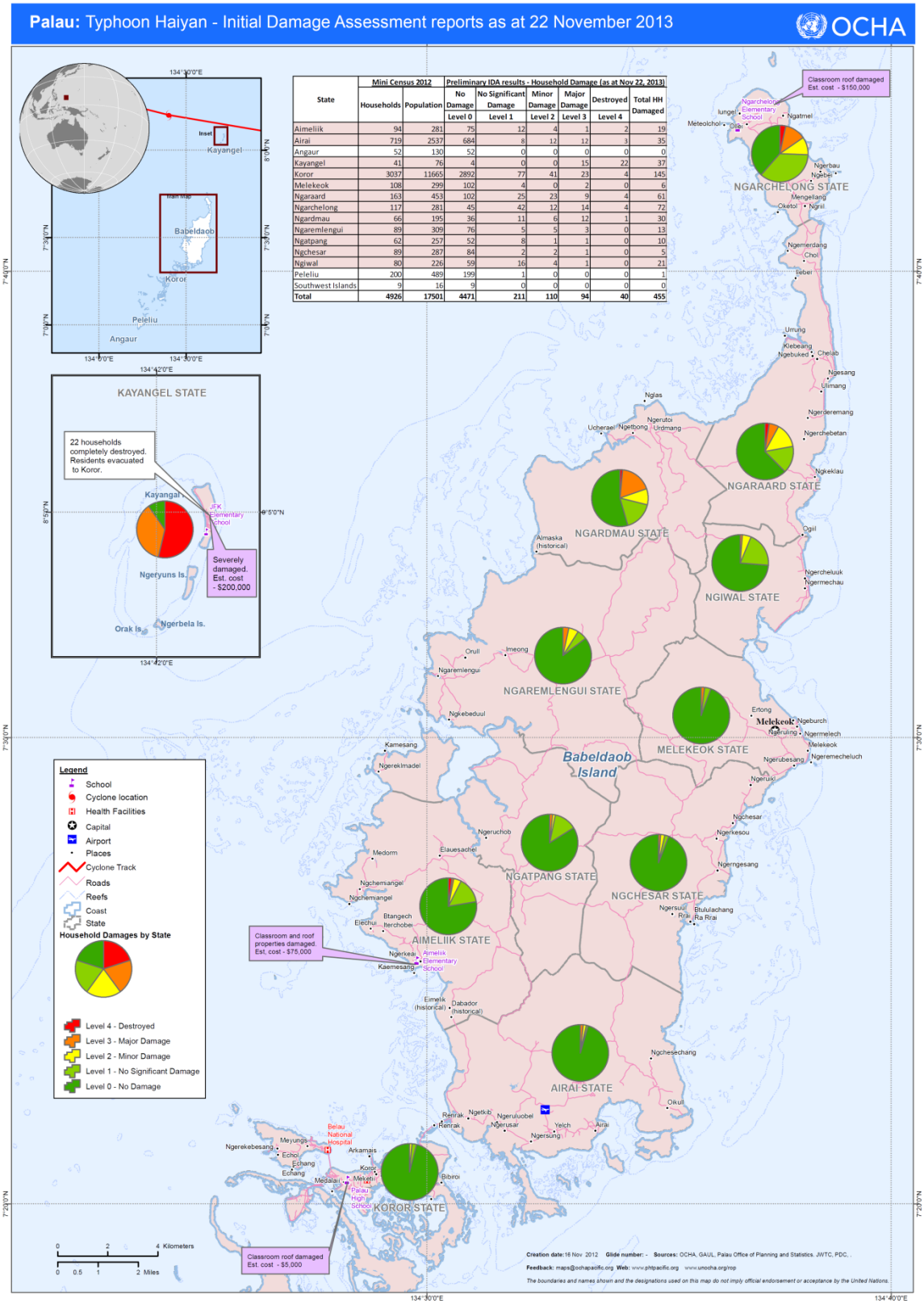


Figure 2.2-2 Damage from Typhoon Haiyan[14]

[14] United Nations Office for the Coordination of Humanitarian Affairs (OCHA), 2013: Palau: Typhoon Haiyan – Initial damage assessment reports as at November 22, 2013.

2.2.2 Existing hazard maps

No hazard maps have been made public detailing any types of hazards in Palau.

2.2.3 Assessment of climate change impacts

(1) Climate change trends for the past fifty years[15] [16]

Figure 2.2-3 shows the trend in annual mean temperatures from 1953 to 2009 in Koror. In Koror, the increases have been 0.11°C per decade for annual mean maximum temperature, 0.08°C per decade for annual mean minimum temperature, and 0.09°C per decade for annual mean temperature. These trends are consistent with the rising temperature trend worldwide due to global warming. In the figure, the light blue bars indicate La Niña years, and dark blue bars are El Niño years.

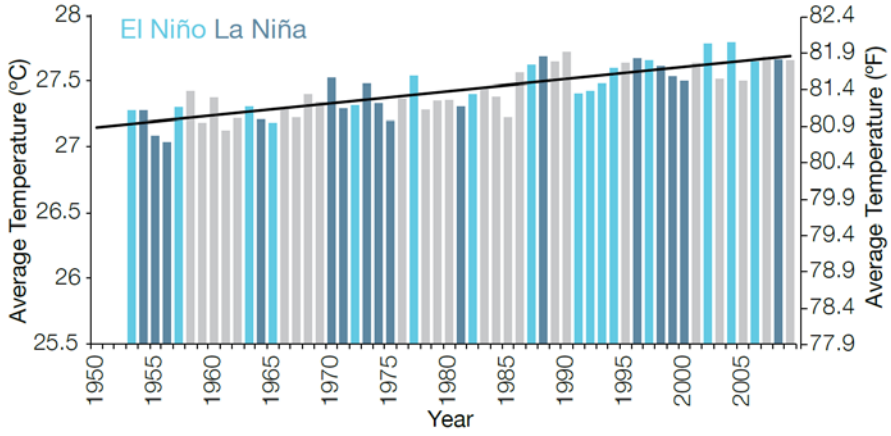


Figure 2.2-3Trend in annual mean temperatures from 1953 onward in Koror[17]

Meanwhile, as shown in Figure 2.2-4, no significant increasing or decreasing trend has been observed in rainfall.

[15] Palau National Weather Service Office, Australian Bureau of Meteorology, CSIRO, 2011: Current and future climate of Palau.

[16] Pacific Climate Change Science, Government of Australia, 2011: Report: Climate Change in the Pacific: Scientific Assessment and New Research, Ch. 10. Palau.
http://www.pacificclimatechangescience.org/publications/reports/report-climate-change-in-the-pacific-scientific-assessment-and-new-research/

[17] Palau National Weather Service Office, Australian Bureau of Meteorology, CSIRO, 2011: Current and future climate of Palau.

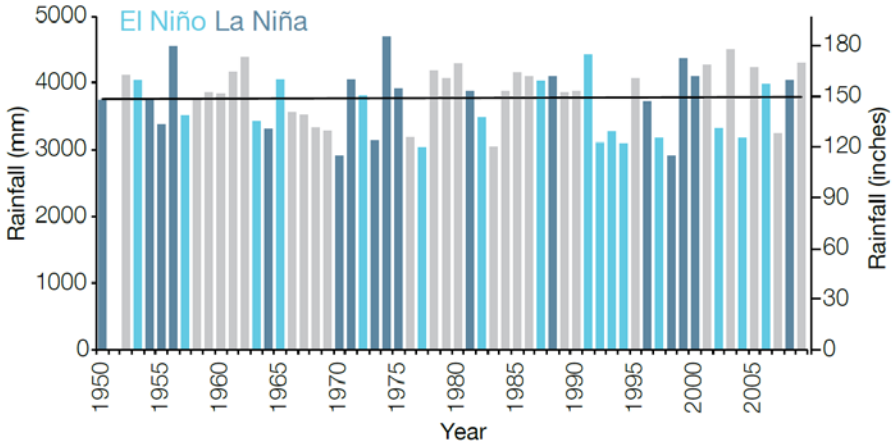


Figure 2.2-4 Trend in annual mean rainfall from 1953 onward[18]

The annual mean sea level rise from 1993 to 2010 was about 9 mm per year in the seas around Palau, based on satellite elevation readings; this is significantly higher than the global average of 3.2 ± 0.4 mm. This trend is partially related to changes in the regional distribution of climate change on an annual to decadal basis.

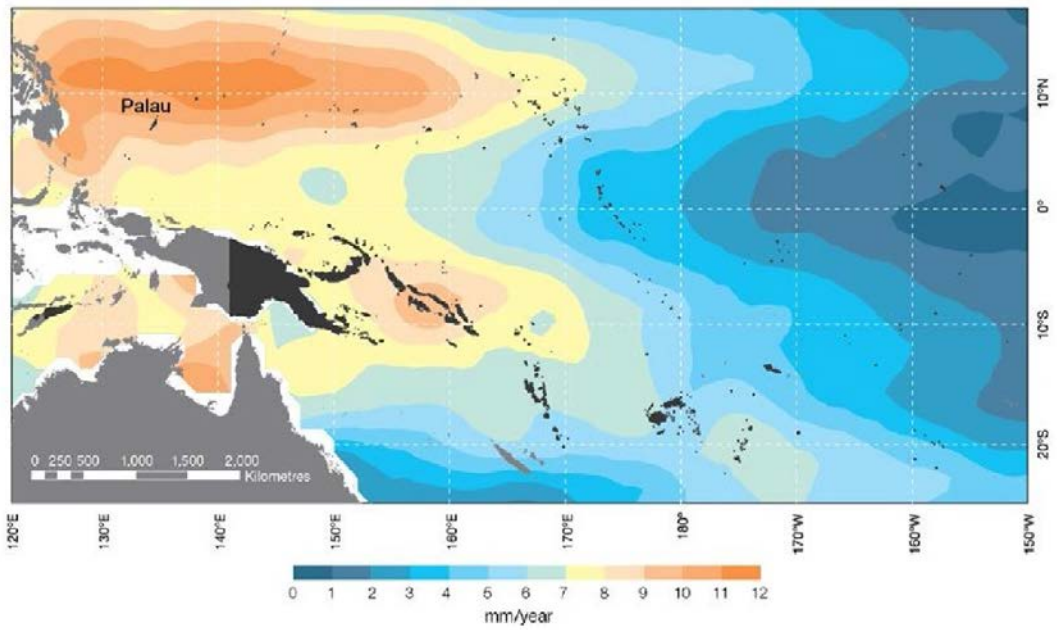


Figure 2.2-5 Distribution of rate of sea level rise based on satellite elevation sensor from January 1993 to December 2010[19]

[18] Palau National Weather Service Office, Australian Bureau of Meteorology, CSIRO, 2011: Current and future climate of Palau.

[19] Pacific Climate Change Science, Government of Australia, 2011: Report: Climate Change in the Pacific: Scientific Assessment and New Research, Ch. 10. Palau.

(2) Future projections of climate change

Air and sea-surface temperatures in the region around Palau are expected to continue rising throughout the twenty-first century, and this upward trend is common in all CMIP3 models. High emissions scenarios indicate a temperature increase between 2.0 and 3.4^{0}C by 2090 compared to the period 1980 to 1990.

Sea-surface temperatures are also expected to increase in line with air temperatures.

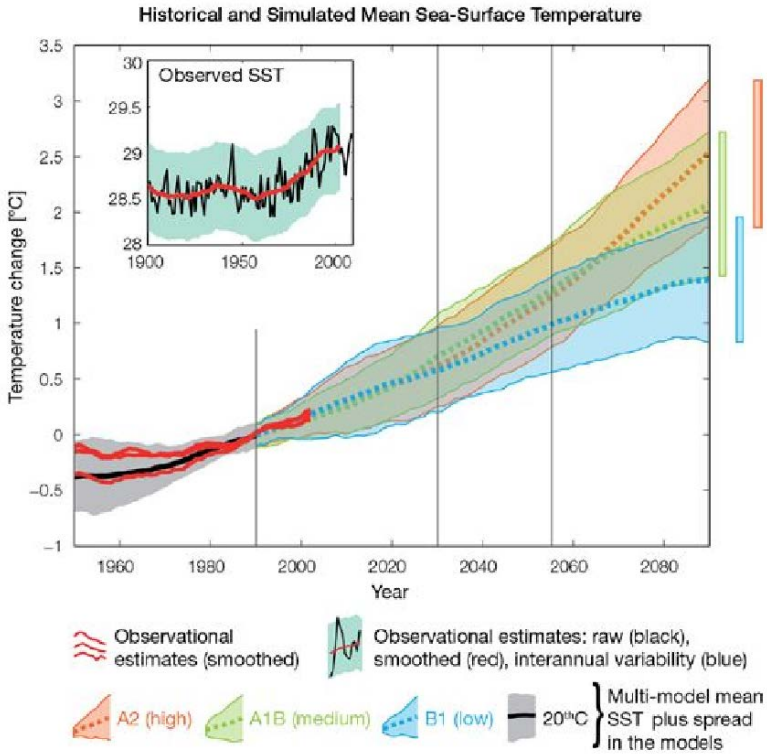


Figure 2.2-6 Past and projected future air temperature changes around Palau[20]

	2030		2055		2090	
	(°F)	(°C)	(°F)	(°C)	(°F)	(°C)
Low emissions scenario	0.4–1.8	0.2–1.0	1.1–2.7	0.6–1.6	1.5–3.9	0.9–2.1
Medium emissions scenario	0.7–2.1	0.4–1.2	1.7–3.5	1.0–2.0	2.6–5.6	1.5–3.1
High emissions scenario	0.7–1.7	0.4–1.0	1.7–3.3	1.0–1.8	3.6–6.2	2.0–3.4

Figure 2.2-7 Projected future temperature increases around Palau, by scenario[21]

[20] Pacific Climate Change Science, Government of Australia, 2011: Report: Climate Change in the Pacific: Scientific Assessment and New Research, Ch. 10. Palau.

[21] Palau National Weather Service Office, Australian Bureau of Meteorology, CSIRO, 2011: Current and future climate of Palau.

Rainfall is also expected to increase throughout the twenty-first century. Simulations for the equatorial Pacific region including Palau, based on CMIP3 models, do not show any significant trends for increases or decreases in rainfall until 2030, but predictions to 2090 show an increase (>5%) or "no major increase" in most models; thus, most models predict no major changes in rainfall amount. Because of this, predictions about increases in rainfall have a certain degree of reliability.

Increases are also expected in the frequency and intensity of extreme rainfall events throughout the twenty-first century. This trend is consistent in all predictions based on CMIP3 models.

Meanwhile, the frequency of tropical cyclones in the tropical north Pacific Ocean region is expected to decrease throughout the twenty-first century.

Figure 2.2-8 shows the observed and future projections of sea-level rise. Sea levels are expected to rise throughout the twenty-first century. Under the high emissions scenarios, predicted sea-level rise ranges from 5 to 15 cm by 2030 and 20 to 60 cm by 2090.

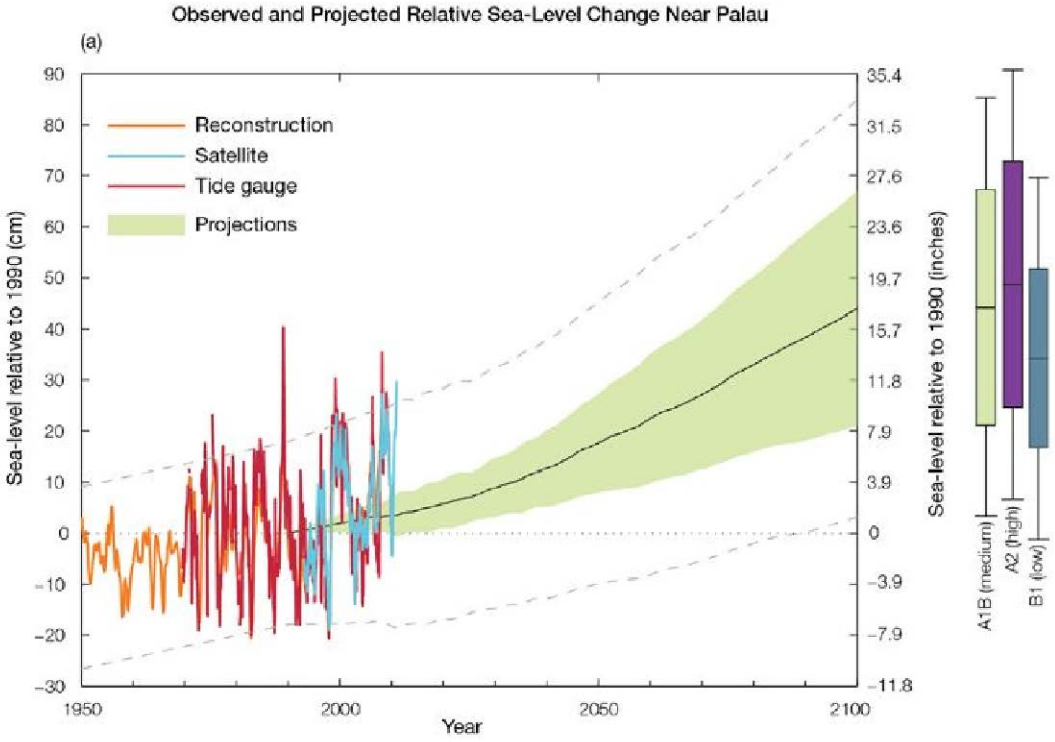


Figure 2.2-8 Observed and future projections of sea-level rise[22]

[22] Pacific Climate Change Science, Government of Australia, 2011: Report: Climate Change in the Pacific: Scientific Assessment and New Research, Ch. 10. Palau.

2.2.4 Assumed hazards and forcing levels in this project

Based on this project's review of past cases of disasters in Palau, we have identified storm surges and strong winds as the assumed hazards, so for the selection of target facilities (shelters), it will be important to ensure that they have safe siting and design, in order to withstand both storm surges and strong winds.

2.3 Consideration of location, specifications, and costs for target evacuation facilities

2.3.1 Actual status on evacuation facilities

For the purposes of helping with selection of evacuation facilities, we conducted site visits to the facilities to ascertain current siting conditions, building conditions, usage conditions in regular times and when being used for a shelter, management conditions, and issues relating to shelter management. The facilities visited for this study are listed in the table.

Table 2.3-1 List of facilities visited for this study

Number	Name of facility	Type	Location
1	Aimeliik Elementary School	Public school (elementary school)	Aimeliik State
2	Ngeremlengui Elementary School	Public school (elementary school)	Ngeremkengui State
3	Ngardmau Elementary School	Public school (elementary school)	Ngardmau State
4	Chol Abai	Community center	Ngaraad State
5	Oberaod Center	Community center	Airai State
6	Airai State Government Building	State government building	Airai State
7	Ngchesar Elementary School	Public school (elementary school)	Ngchesar State
8	Melekeok Elementary School	Public school (elementary school)	Melekeok State
9	Mindszenty High School	Private school (high school)	Koror State
10	Maris Stella Elementary School (Lower campus)	Private school (elementary school)	Koror State
11	Koror Elementary School	Public school (elementary school)	Koror State
12	Palau High school	Public school (high school)	Koror State
13	Koror State Government Building	State government building	Koror State
14	Seventh-Day Adventist Church and School	Private school (elementary school)	Koror State
15	Palau Mission Academy	Private school (high school)	Airai State

Of the 15 facilities listed above, the nine from No. 1 to 8 and No.15 are located on Babeldaob Island, while the remaining six are in Koror State. The location of the nine facilities on Babeldaob are indicated on the map on the following page.

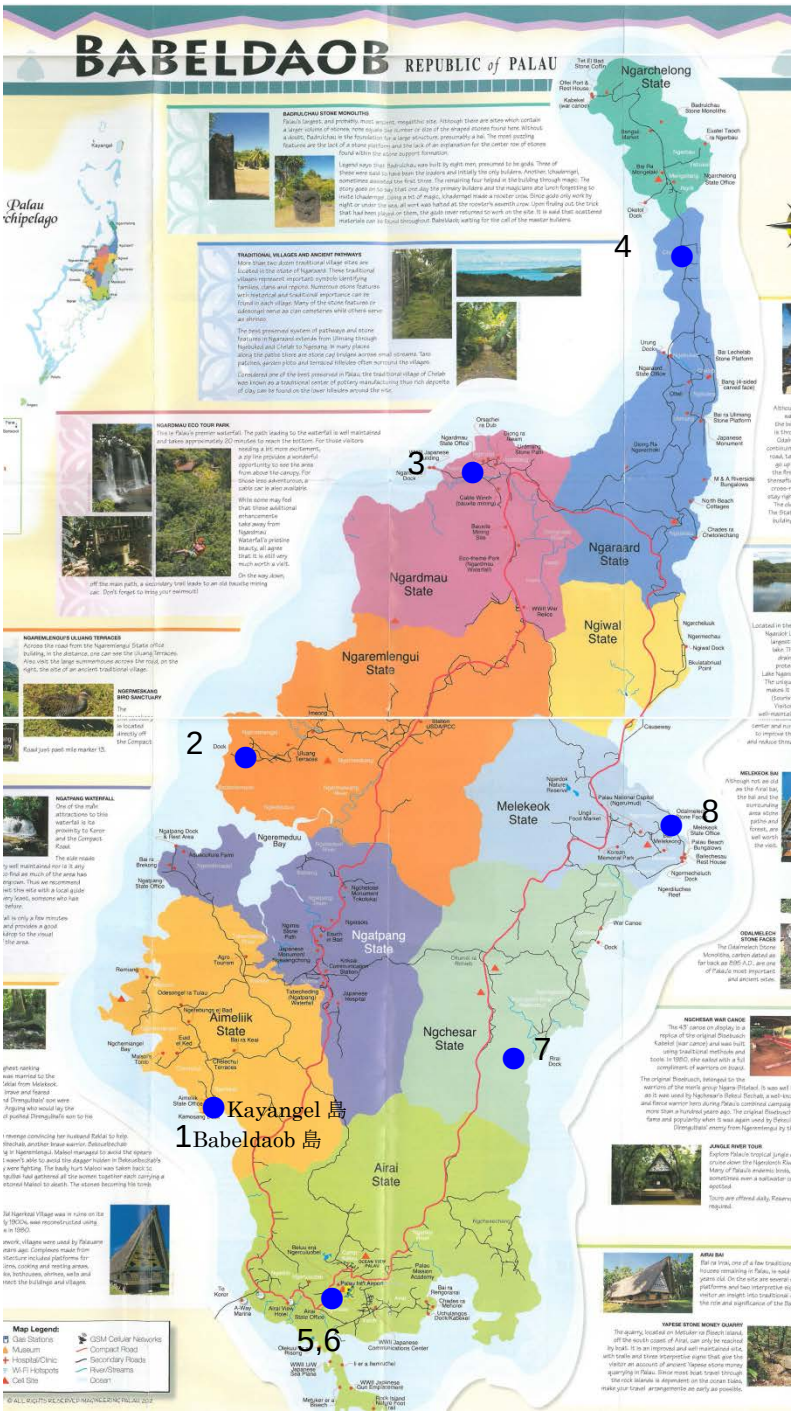


Figure2.3-1 Locations of facilities covered in site visits on Babeldaob Island (blue dots)

2.3.2 Public schools (elementary schools, high schools)

The public schools visited are indicated in the table below.

Table 2.3-2 List of facilities visited for this study (public schools)

Number	Name of facility	Type	Location
1	Aimeliik Elementary School	Public (elementary school)	Aimeliik State
2	Ngeremlengui Elementary School	Public (elementary school)	Ngeremkengui State
3	Ngardmau Elementary School	Public (elementary school)	Ngardmau State
7	Ngchesar Elementary School	Public (elementary school)	Ngchesar State
8	Melekeok Elementary School	Public (elementary school)	Melekeok State
11	Koror Elementary School	Public (elementary school)	Koror State
12	Palau High school	Public (high school)	Koror State

2.3.3 Community centers and state government buildings

The table below lists community centers and state government buildings visited for this study.

Table 2.3-3 List of facilities visited for this study (public schools)

Number	Name of facility	Type	Location
4	Chol Abai	Community center	Ngaraad State
5	Oberaod Center (Ngerusar Community)	Community center	Airai State
6	Airai State Government Building	State government building	Airai State
13	Koror State Government Building	State government building	Koror State

Regarding No.5, 6, 13, detail information are indicated in the table below.

(1) Oberaod Center (Airai State) (Facility No. 5)

Parameter	Oberaod Center
Siting condition	High elevation, no concern about damage from storm surge.
Building condition	One storey, walls and roof made of reinforced concrete. Constructed within the past five years. One large room 10 m x 10 m.
Normal use status	During normal times, the facility is used as a gathering place, for meetings, sewing and dance practices, etc.
Shelter use status	During Typhoons Bopha and Haiyan, 6 or more families (each with 5 - 6 members) used this as an evacuation shelter.
Management status	Ngerusar community leader manages the keys.
Issues for use as shelter	・No auxiliary power supply.

(2) Airai State Government Building (Airai State) (Facility No. 6)

Parameter	Airai State Government Building
Siting conditions	High elevation, no concern about damage from storm surge.
Building condition	There are two storeys above ground and one below ground, but because it is built on a steep slope, when seen from the back it appears to be a three-storey structure. The structure is reinforced concrete, and the second-floor has a metal roof, but the material used for beams is not known.
Normal use status	During normal times, it is used as the state government building, and the office of the governor. The basement level also hosts a server.
Shelter use status	During Typhoon Bopha, 4 families (18 persons) used the basement, and 3 families used the governor’s office as a refuge. The governor’s office is 5.5 by 7.5 meters, and the basement has two rooms measuring about 3 by 6 meters. The second floor was not used for refuge as there were concerns about the roof being blown off. The facilities were used as a shelter for about four days, and people brought their own food and water. Evacuees came to these facilities for shelter not due to concern about storm surge, but about indirect injury from strong winds, such as falling trees and damage to homes.
Management status	Managed by state government.
Issues for use as shelter	・No auxiliary power supply. (It took two weeks to restore electrical power after the typhoon. They used small LEDs for light, and had to minimize use of cell phones.)

(3) Koror State Government Building (Koror State) (Facility No. 13)

Parameter	Koror State Government Building
Siting condition	On a hill, so unlikely to be receive damage from storm surge.
Building condition	This building has three storeys above ground and is made of reinforced concrete. Meeting facilities on the interior are reinforced concrete rooms.
Normal use status	During normal times, it is used as the state government building, and the office of the governor.
Shelter use status	Meeting facilities were used as a shelter during Typhoon Bopha.
Management status	Managed by state government.
Issues for use as shelter	・Auxiliary power supply is on-site, but water supply will be disrupted during a power outage.

2.3.4 Private schools (elementary schools, high schools)

The private schools visited are indicated in the table below.

Table 2.3-4 List of facilities visited for this study (private schools)

Number	Name of facility	Type	Location
9	Mindszenty High School	Private (high school)	Koror State
10	Maris Stella Elementary School (Lower campus)	Private (elementary school)	Koror State
14	Seventh-Day Adventist Church and School	Private (elementary school)	Koror State
15	Palau Mission Academy	Private (high school)	Airai State

2.3.5 Consideration of location, specifications, and costs

(1) Consideration of location

Regarding the location of evacuation facilities, this project envisions installing photovoltaic power generation equipment in facilities already being used as an evacuation facility, or existing schools or state government facilities where such plans exist.

Based on actual site visits as well as interviews with local persons responsible, we assume the most feasible locations to be the state government building of Koror State, the state government building of Airai State or its adjacent community center. Major criteria for the selection are summarized below.

Table 2.3-5 Consideration of selection criteria for target facilities

	Facility		
	Koror	Airai	
Major seslection criteria	State government building	State government building	Community Center*
Fanction of facility at disaster time			
Usage at evacuation time	B	B	B
Urgency for ensuring electric source	A	A	C
Safety			
Structure and Strength of building	B	B	B
Safe location	B	B	B
Financial aspects			
Electricity demands	A	B	D
Ensuring finance	B	B	-**

A: High potential B: Medium potential C: Low potential D: Very low potential

* This refers to Ngerusar Community Center, adjacent to the Airai State Government Building.

** The state government is assumed to be the funding source, as the Airai State Governor has considered installing a system at the State Government Building.

The reasons for selecting the Koror and Airai State Government Buildings are listed below.

- The state government facilities are relatively new buildings, constructed using reinforced concrete, within the past ten years.
- They are located at slightly higher elevations in town, with no risk of direct damage from storm surges.
- There is a track record of using a portion of the facilities during past disasters, for meeting rooms and shelter space, and the facilities also serve as a central point for state government contact and communications in an emergency.
- Power generators are on site, but electricity consumption is high and there is a latent need for photovoltaic power generation, etc.
- Compared to other states in the country, financial resources are likely more available here.

Meanwhile, the following issues may arise if the facilities mentioned are selected.

- It would be necessary for the state government to obtain agreement in the state legislature and secure an adequate budget.
- There is a need to clarify the ownership status of the buildings and land of the community center, as well as management status, etc.
- Power consumption at the community center is usually not very high (and use is not limited to the same time each day).
- The Airai State Government Building and community center have been built with stronger roofs and other components than other public facilities, but the buildings themselves are not that large in size. This limits the size of photovoltaic installation on the roof to a few tens of kilowatts at most, resulting in some issues with costs versus benefits. To deal with this, it will be important to consider other combinations and possibilities, such as the potential to install photovoltaic equipment not only on the roof but also on an adjacent parking lot or open space, or installing the equipment on multiple sites owned by the state government.

(2) Consideration of specifications and costs

In section (1) above, we examined possible installation at the Koror State Government Offices, as well as the Airai State Government Offices and adjacent community center. These are relatively new facilities, and do not currently require any particular upgrading or additions to serve as evacuation facilities. Based on these assumptions and assuming the uses as evacuation facilities, we considered basic combination of technological system for example, the introduction of photovoltaic power generation equipment, storage batteries, and other on-site power generation equipment.

First of all, the electrical source at each of these three facilities is commercial power grid. The Airai State Government Offices and community center do not have on-site power generation equipment; this means that electricity will not be available if power from the grid is disrupted in an emergency. In addition, there have been actual cases in which no electricity was available for several days at the State Government Offices and community center during emergencies, as a result of the grid having no power in disasters.

Based on above, Regarding a basic system specification, we selected 1) Photovoltaic power generation and storage batteries, 2) Photovoltaic power generation and small-scale power generation equipment, 3) Photovoltaic power generation only, based on a usage as evacuation facility. In addition, we examined concrete specification, cost and CO_2 emission reduction effects.

Project 1: Photovoltaic power generation and storage batteries
Project 2: Photovoltaic power generation and small-scale power generation equipment
Project 3: Photovoltaic power generation only

We also compared the following three configurations based on cost-effectiveness as well as CO_2 emission reduction effects. Below table indicates comparison of electric source system with current status, cost-effectiveness, and CO_2 emission reduction effects.

Table 2.3-6 Comparison of three projects for cost-effectiveness and emission reduction effects

Electricity sources for target facilities					Comparison of 3 projects	
	Current status	New system installed			Cost-effectiveness	Emission-reduction effect
Now	Grid			+ on-site power generation*	-	-
Project 1	Grid	PV	Storage batteries		Low	Medium/High
Project 2	Grid	PV		on-site power generation	Medium	Medium
Project 3	Grid	PV			High	Medium

* Only Koror state government building has an on-site power generation.

Also, during our site visits, we discussed various cost factors, including the power demand and electricity consumption of the Koror State Government Building and the Airai State Government Building. We found that because storage batteries would take up a large proportion of the total project costs, so decided to proceed with consideration of photovoltaic power generation systems without storage batteries.

Regarding the Koror State Government Building, an on-site power generation using disel has been installed and there is a plan to introduce oil recycled from waste plastic in the near future. Therefore, it would appear that it's not necessary to install strage battery.

Regarding community center, use frequency of the center is very low according to interview during our site visit. Therefore, it would appear that we should target at only the State Government Building.

2.4 Consideration of procurement methods, specifications, and costs of photovoltaic generation equipment

2.4.1 Procurement

We compared various scenarios for procurement and installation, including procurement of equipment from Japanese manufacturers and installation by local contractors, both procurement and installation by local contractors, and so on; due to cost considerations, we decided to work with a scenario having both procurement and installation done by local contractors. Local contractors have experience procuring

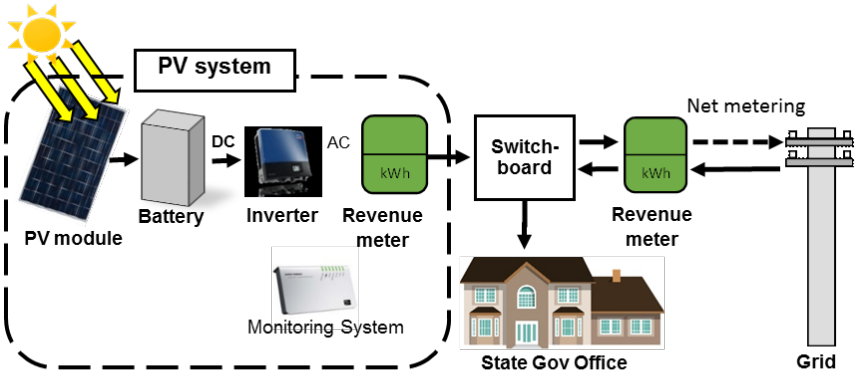
Japanese advanced photovoltaic modules via North American channels, so it is expected that they will procure the equipment overseas for delivery by ship.

2.4.2 Specifications

In this study, we use high-quality photovoltaic modules that are highly durable and can provide a stable supply of electricity for a long period of term. For selection criteria, we assumed that modules would be from manufacturers that have a track record of at least 20 years of production and product use, and that meet IEC standards.[23] Criteria for inverters and storage batteries were that they must be from manufacturers that have a long track record of providing the products as a part of photovoltaic systems. In addition, the introduction of a monitoring system with a data communication device that can monitor in real time the operational status of individual inverters as well as the system's power generation status would enable immediate detection of any problems in the power generation system, even from a remote location. Besides a remote monitoring system, the plan also includes installation of an on-site power meter that meets IEC standards and can record the amount of electricity generated.

Although a contract with PPUC would be required, it would be possible to sell to the power grid any surplus electricity generated by the photovoltaic system.[24] This is referred to as "net metering," and if surplus electricity is to be provided to the grid, PPUC will install a power meter.

Below are schematics of the systems being considered for state government buildings for Projects 1, 2, and 3, as described above.



Project 1

[23] International Electrotechnical Commission

[24] The fees for electricity provided to the grid from the photovoltaic system would offset the consumption of electricity at the target facility.

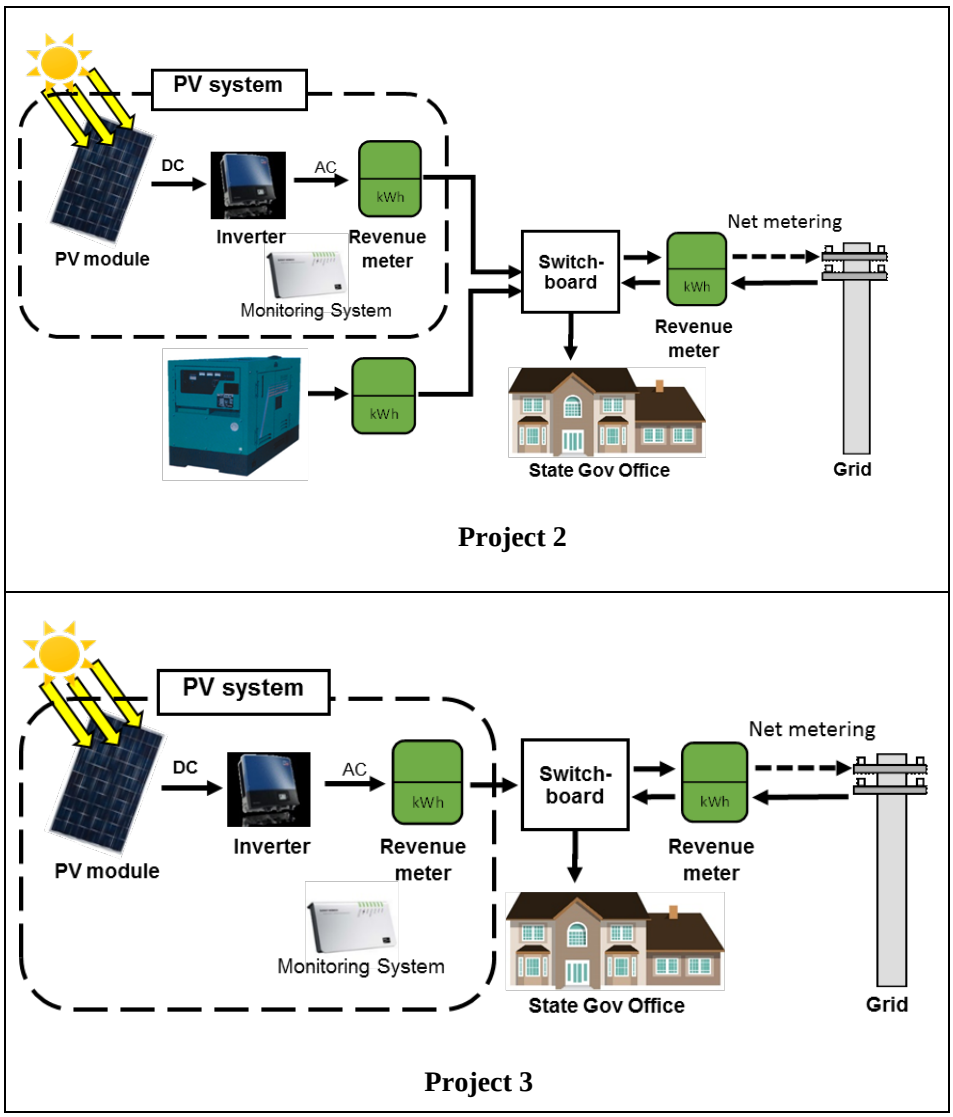


Figure 2.4-1. System schematics of project (proposed)

2.4.3 Costs

While some changes may occur in the number of photovoltaic modules installed, depending on the area and structure of the roof, interviews with persons in chrge and roufgh cost estimate, we calculated the capacity and approximate costs of equipment that could be installed at the state government buildings, as shown below.

(1) Koror State Government Building

For the Koror State Government Building, actual electricity consumption is about from 700 to 800 kWh. Based on the electricity needs and the potencial of introducing energy efficiency measuresas and other renewable energy, the maximum capacity is assumed to be 50 kilowatts. Meanwhile, the minimum capacity would be 20 kilowatts assuming about half of the masimim capacity. This capacity is appropriate from an aspect of roof area, however, we should take into account also plans of introducing other renewable energy.

Table 2.4-1. Equipment capacity for Koror State Government Building (only PV system)

Facility	Capacity	Estimated cost*1 (million yen)	CO2 emission reduction (tCO2/year)	Cost-efficiency (yen/tCO2)
State government building	(1) 20 kW	10.54	15.6	19,914
	(2) 50 kW	22.32	38.9	16,875

(2) Airai State Government Building

Based on the intended use as evacuation facilities, to evaluate the minimum power capacity needed during use as a shelter, the scenario envisions the installation of lights in a several locations, as well as chargers for communications devices such as cell phones, and some electric fans for use during hot weather. Based on this scenario, the minimum capacity required would be 4 kilowatts at the State Government Building,. Meanwhile, the maximum capacity would be 7 kilowatts at the State Government Building based on the roof area.

Table 2.4-2 Equipment capacity for Airai State Government Building (only PV system)

Facility	Capacity	Estimated cost*1 (million yen)	CO2 emission reduction (tCO2/year)	Cost-efficiency (yen/tCO2)
State government building	(1) 4 kW	2.55	3.1	24,076
	(2) 7 kW	2.98	5.4	16,058

2.5 Consideration of the necessary “soft” disaster prevention strategies and frameworks for continuity of support

2.5.1 Current status and issues with evacuation facilities, disaster preparedness systems, etc.

There are a number of issues for disaster preparedness: (1) no hazard map exists, so risk assessment is inadequate in terms of strong winds, storm surges, and other disaster impacts; (2) strength testing has not been done for most evacuation facilities, and many facilities have insufficient strength in roofs, etc.; and (3) the numbers of likely evacuees and the number of persons each facility can accommodate are not clearly known, and there could be an excessive number of evacuees coming to some evacuation facilities.

Regarding (1) it would be difficult to prepare a hazard map quickly, because in the post-war years Palau has not experienced any major disasters other than typhoons, and topographical and other basic data are not available; however, it is probably possible to avoid some disasters from storm surges by avoiding the use of evacuation facilities and routes that were inundated by storm surges during Typhoon Bopha.

Issue (2) above is due to a shortage of engineers who can evaluate structures. Currently most elementary

schools are built with metal roofs and wooden beams, so it is assume that they lack adequate strength against strong winds. Where the structural strength of evacuation facilities is inadequate, it is necessary to upgrade them or to designate alternative facilities. Regarding issue (3), at the stage when it is not possible to evaluate the strength of the facilities, it is also difficult to determine how many people can be safely accommodated.

In terms of non-physical measures for disaster prevention, it is important to first of all provide adequate shelters that, so it is essential to implement (1) and (2) above.

2.5.2 Consideration of frameworks for continuity of support

It will be important to get an early start on "soft" disaster prevention measures such as preparation of hazard maps, and awareness-raising for residents to know how to use them, as these efforts take time. In particular, measure to raise residents' awareness about disaster prevention to not require large budgets, and can be started even on a small scale, but their benefits can be large. It is conceivable that these kinds of "soft" measures for disaster prevention could continue along with support from Japan so that they could be implemented in combination with the installation of photovoltaic power generation equipment in evacuation facilities.

In addition, aid projects are being implemented by international organizations with NEMO as the main implementing agency, and it is possible that assistance for disaster prevention could be provided in collaboration with these existing projects.

Table 2.5-1 Summary of SPC-ACP-EU Projects[25]-

Project name	**Building Safety and Resilience in the Pacific Project**
Donor agency	SPC-ACP-EU
Total amount	600,000 Euro (approx.. 800,000 US dollars)
Lead agency	NEMO
Time frame	2014－2018
Project purpose	To strengthen the capacity of Palau to address existing and emerging challenges with regards to the risk posed by natural hazards and related disasters, while maximizing synergies between Disaster Risk Reduction (DRR) strategies and Climate Change Adaptation (CCA)
Result 1	Effective Preparedness Response and Recovery
	・ Enclosure of National Emergency Operations Center basement to serve as a training venue for DRR and CCA ・ Standardize an Initial Damage Assessment form ・ Relocate Emergency communication VHF repeaters onto Palau National Communication Corporation towers ・ Strengthen inter-operability of emergency services agencies ・ Provide water tanks for typhoon shelters and alternate health centres ・ Develop and implement tsunami support plan
Result 2	Strengthened Institutional Arrangements for DRM and CCA
	・ Development of Joint National Action Plan for DRM and CCA ・ Review the DRM Framework to incorporate lessons learnt from typhoon BOPHA and HAIYAN

[25] African, Caribbean and Pacific countries

	• Update all state Disaster Plans
Result 3	Improved knowledge, information public awareness, training and education
	• Develop and print IEC materials for various hazards in English and Palauan • Conduct Initial Disaster Assessment training for state and hamlet representatives • Conduct Community Risk Reduction training in 4 states and hamlets to develop their DRR and Emergency Response and Recovery Plan • Conduct Emergency Operation Center training for Operation Room Teams • Training in Damage and Loss Assessment • Training of emergency services agencies on Incident Command System • Conduct Introduction to Disaster Management training for State representatives • Conduct training on Emergency Evacuation Planning with the remaining schools • Conduct a national Table Top exercise for all stakeholders
Result 4	Improved understanding of natural hazards and their impacts
	• Strengthen sharing of data with Palau's Geographical Information System technical agency through the development of national Spatial data framework • Complete mapping of sewer and water lines • Socio economic survey for 2 states
Result 5	Enhanced partnership in DRM and CC
	• Support Palau participation at the Regional Steering Committee and Pacific Emergency Management Alliance • Convening of National Steering Committee

Source: Project documents, "Country Implementation Plan for the Republic of Palau" (2014).

2.5.3 Examples of soft measures for disaster prevention in Japan (awareness-raising of residents, resident-centered activities)

For future reference, we have compiled and summarized a number of examples of soft measures for disaster prevention in Japan.

(1) Case 1: Disaster prevention activities starting in normal times (development of disaster prevention/hazard maps, regional disaster training)

Region: Sendai, Miyagi Prefecture

- Residents are creating a regional emergency preparedness map. First, they are considering the characteristics of buildings in the region, characteristics of population distribution, who is living in the area that could help in the event of a disaster (nurses, carpenters, etc.), and which facilities should be noted on the map.
- They are conducting regional disaster prevention trainings with full participation from residents. Trainings have help raise awareness of issues and challenges.

Case 2: Disaster preparedness education

Region: Saiki, Oita Prefecture

- In Oita Prefecture, courses are held under a “Regional Disaster Resilience Improvement Training Program” with the purpose of improving regional disaster resilience. People from that training have created a volunteer corps, which is promoting emergency preparedness activities.
- September 1 each year is designated as “Disaster Prevention Day,” a day for participatory activities such as evacuation drills and trainings to extinguish fires, and on this day families are also encouraged to discuss emergency preparedness at home. Together, family members go through a checklist of emergency preparedness plans and inspections.

Case 3: Resident-directed preparation of shelters and evacuation routes

Region: Tosa, Kochi Prefecture

- Tosa has experienced damage numerous times from tsunamis caused by a Nankai earthquake. To prepare for future tsunamis, based on a survey of all households, it was decided to start first by establishing safe refuge areas where residents could run immediately when in danger of a tsunami.
- For their selection of locations, their main criteria were: (1) easy access from home, (2) easy access for children at home, school children, and passersby, (3) solid ground, (4) elevation 36 meters or more above sea level, (5) location overlooking town (to be able to determine extent of damage).

Case 4: Emergency Shelter Management Game (Hinanjo Unei Game, or “HUG”)

Region: Iwata, Shizuoka Prefecture

- Shizuoka Prefecture's Western Regional Disaster Preparedness Bureau is promoting a card game (translated as "emergency shelter management game") that can simulate the experience of managing an evacuation shelter. The game's use is spreading inside and outside the prefecture.
- This card simulation game is being used in workshops in the prefecture by municipal disaster prevention personnel, as well as in voluntary disaster prevention trainings in the region.

Case 5: Developing participatory mechanisms for managing emergency shelter facilities
Region: Tachikawa City

- Tachikawa City has created a shelter management organization that operates day-to-day. It promotes organizing and role-allocation frameworks that can respond in an emergency.
- Tachikawa City is using the "emergency shelter management game" (HUG) to consider the most important issues for operating a shelter, through this simulation of operations of a shelter.

2.6 Consideration of facility maintenance/management methods, and consideration of feasibility as a business model

2.6.1 Facility maintenance/management

(1) Maintenance/management of photovoltaic power generation facility

After photovoltaic power generation facilities have been installed, they typically do not require maintenance that would require additional expenditures, or any special skills or time. Generally, it is assumed that after equipment installation, the host organization will receive a manual with explanations and operational pointers from the manufacturer or installer.

Based on previous experience, the training of maintenance personnel for the power generation facilities is generally provided when the PV system is installed, by the local contractor that made the installation.

(2) Maintenance/management as evacuation facilities

Maintenance of evacuation facilities would typically involve periodic inspections of the building and surrounding area (including nearby roads that might be used by evacuees to reach the site) to be ready for a possible disaster, as well as periodic inspection of equipment and replenishment of supplies.

The management of state government facilities would be done by personnel from the relevant department, but they would not necessarily be doing the maintenance for the facilities as a shelters, and may not necessarily have a budget for improvements of the evacuation facility. Therefore, in the implementation structure of state government, it is expected that instructions would be given for inspection of equipment and replenishment of supplies within the existing budget.

2.6.2 Consideration of potential as a business model

In order to establish a business model for JCM with evacuation facilities that incorporate photovoltaic power generation as being considered in this study, it will be important to accelerate the investment payback for the photovoltaic equipment installed, to improve cost-effectiveness (initial investment cost per ton of CO_2), and to incorporate ways to further increase expected revenues (profit).

- Reduce the initial investment costs of photovoltaic power generation facilities (procurement methods, etc.).
- Improve cost-effectiveness (ensure installed capacity is above a certain level, reduce usage costs by selling surplus electricity, etc.).[26]
- Obtain other revenues, such as by including a small retail shop to increase value-added as evacuation facilities.

As measures to improve cost-effectiveness, the potential is currently under investigation to develop a proposal with multiple sub-projects, including the sub-projects of photovoltaic system installation for the Airai State Government Building and Koror State Government facilities.

2.7 Consideration of applicable financial support schemes

At present it is assumed that the activities described would be eligible for Japan's "Program of Equipment Subsidies for Projects Using the Joint Crediting Mechanism."

2.8 Consideration of applicable financial support schemes

2.8.1 Organizational arrangements

Based on the above discussion, during the next fiscal year, the first action is to prepare for an application to Japan's Ministry of the Environment for funding under the "Program of Equipment Subsidies for Projects Using the Joint Crediting Mechanism," and to coordinate details with the relevant organizations to move toward project implementation.

Regarding organizational arrangements for implementation of an equipment subsidy project, it is assumed that a consortium of related organizations would be established. In principle, the main entities in the consortium would be Pacific Consultants (on the Japanese side), and the Koror State Government and Airai State Government (on the Palau side), which would be the project implementation agency.

[26] As stated above, this is referred to as "net monitoring," and this differs from electricity sales as a business.

2.8.2 Other preparations

Because this would be a project under the state governments, it is assumed that after first securing the state government budget, an application would be made to the Japanese government under an equipment subsidy program.

For the current study, the following documentation was obtained and prepared as required to apply for an equipment subsidy program.

1) Financial reporting for the past three years
2) Staffing and other organizational matters
3) One year of data: Monthly electricity consumption and nighttime electricity consumption, electricity charges
4) Preparation of a draft memorandum of understanding (MOU) for establishment of a consortium[27]

In addition to the above application documents, for implementation as a state government project, the following will also be required: discussion in state legislature for next fiscal year's budget and approval of the budget amount; followed by bidding procedures as stipulated under Palau legislation; and the preparation of explanatory materials for legislature as well as designs and documentation and for the bidding process. It is expected that local contractors would prepare the designs and documentation.

[27] This applies only to the portion for the Airai State Government. As of mid-February, from the Koror State Government there had been some collection of basic information and debate relating to system design, but no debate about system details or overall costs.

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

3.1 Discussion and coordination with the relevant bodies

3.1.1 Information exchange with SPREP

We travelled to the twenty-fifth annual meeting of SPREP, which started at the end of September 2014, to exchange information with SPREP (mission period was September 28 to October 3, 2014). The annual meeting included reports on the current state of activities relating to climate change, as SPREP has been supporting related policy-making by Pacific island countries. Specifically, SPREP has been helping create climate change adaptation strategies and action plans by each country or at the regional level, and encouraging the inclusion of climate change into national plans. In addition, on a project basis, SPREP is supporting capacity building through implementation of sub-projects such as for wind, solar, and micro-hydro power in target countries, as well as providing support on the institutional dimension by promoting an understanding of renewable energy among related parties. SPREP also distributes information about renewable energy equipment to schools and households.

During discussions, major topics included renewable energy initiatives currently under way in Pacific island countries, and the use of renewable energy in evacuation facilities as a low-carbon/climate change adaptation model for island countries, which is the subject of this project report.

(1) Exchange of information on efforts to integrate climate change adaptation and disaster risk reduction

A joint report of SPREP and the Secretariat of the Pacific Community (SPC),[28] includes sections on Joint National Action Plans (JNAP), which are designed to mainstream disaster risk reduction into regional development plans, to provide information for integrating disaster risk reduction and climate change, as well as the Strategy for Resilient Development for Pacific Islands (SRDP), etc.

In addition, the Pacific Islands Greenhouse Gas Abatement through Renewable Energy Project (PIGGAREP)[29] has been created as an initiative for climate change mitigation through the introduction of renewable energy. PIGGAREP's latest report on initiatives in each participating country is summarized on the next page.

[28] SPC is a forum for regional cooperation that focuses on Pacific island countries. It expanded its coverage from the South Pacific Commission on February 6, 1998.

[29] PIGGAREP had a project implementation period from 2007 to 2014, and it promoted the use of renewable energy, with the support of the UNDP and GEF, and SPREP as the implementation agency. (Confirmed on our mission to Samoa in December 2013.)

(2) Examples of PIGGAREP initiatives

Table 3.1-1 Examples of PIGGAREP initiatives

1. **Cook Islands** With support from PIGGAREP, conducted preparatory work on project formation for a set of renewable energy projects in the northern islands.
- It resulted in support from SIDSDOCK to cover the costs of installation of a photovoltaic system on Palmerston Island.
- It is expected to cut CO2 emissions by about 31,655 tons.

2. Kiribati
- The International Union for Conservation of Nature and Natural Resources (IUCN) conducted a feasibility study for providing a solar-powered water pumps to seven schools.
- PIGGAREP is supporting the installation of these seven pumps.
- From 2010 to 2013, CO2 emissions were reduced by about 108 tons.

3. Samoa
- PIGGAREP conducted a feasibility study on photovoltaic systems linked to the power grid, in order to obtain the $4 million in support from the Pacific Environment Community Fund (PECF).
- This resulted in the PECF approving $4 million in support to procure and install a 546 kW photovoltaic system linked to the grid.
- It cut CO2 emissions by 400 tons starting in 2013.

4. Solomon Islands - Santa Ana Province
- The government of the Solomon Islands requested solar systems for 130 households in Santa Ana Province.
- 65 of the 130 systems were procured by the government, and those 65 were installed by PIGGAREP. For the remainder, Taiwan covered the costs of procurement and installation, through PIGGAREP.
- The 130 systems have already been installed in 130 households.
- As a result, clean energy is available to about 80% of households in Santa Ana Province. (This means a shift from kerosene to sunlight as energy source.)
- Economically, this has meant a reduction in monthly household expenditures from between 15 and 30 US dollars to only four US dollars.
- Since 2011, nine tons of CO2 emissions have been cut.

5. Tonga
- PIGGAREP has provided support for awareness raising and technical training for solar-powered water pumps.
- PIGGAREP provided support for an environmental impact assessment (EIA) on the Ha'apai Islands for the installation of ten solar-powered water pumps.
- Through PIGGAREP, SIDSDOCK provided support for procuring and installing the equipment for these systems.
- The expected CO2 emission reductions will be announced in the future.

6. Tuvalu
- IUCN conducted a feasibility study for installing a 40 kW photovoltaic system connected to the grid for a junior high school on the main island, and procured the equipment.
- PIGGAREP provided support for the equipment installation.
- The system has reduced CO2 emissions by 617 tons since 2011.

Note: The CO_2 reduction amounts came from a direct interview with the person in charge at SPREP.

Source: Interview with SPREP Climate Change Department

(3) Discussion of ideas about initiatives

We exchanged information about the potential to install solar systems at facilities under construction in Samoa.

3.1.2 Advice from IGES

We received guidance from IGES which engaed in the activities of LoCARNet (Low Carbon Asia Research Network) as a secreatariat. The major suggestion and points are as follows.

In the small island stats, it is important that investment for renewable energy should be done from a view point of not only CO_2 emission recduction but also the cobenefit. In order to evaluate from the aspect of sustainable development of islands states, we should develop and improve the model project into the activities which take into account of basic service which residents will need of, for example, ensuring a healthy life and promoting public welfare.

3.2 Consideration of effective and efficient schemes

As indicated above, a number of initiatives are being promoted in the South Pacific islands region under the leadership of SPREP, including Joint National Action Plans (JNAP), which aim to integrate disaster risk reduction and responses to climate change, the Strategy for Resilient Development for Pacific Islands (SRDP), and PIGGAREP, which promotes the installation of renewable energy facilities.

The concepts behind these initiatives are well matched with the orientation of this study, which is investigating the potential in Palau for evacuation facilities combined with photovoltaic power generation facilities.

In the discussions with SPREP personnel, these ideas attracted interest and support for these kinds of projects.

Below are some considerations about possible schemes to benefit from the discussions in Palau and expand examples of these concepts to other parts of the South Pacific islands.

- There is a need to reduce procurement costs and try to reduce shared costs by installing equipment at the sites of multiple evacuation facilities, by organizing the initiatives as one overall project. An alternative approach might be to focus efforts as much as possible on larger, more solidly-built public facilities or private business premises, and aim for a scale of power generation between 100 and 300 kilowatts.
- It is not advisable to include storage batteries as an absolute initial requirement. It is worth giving adequate consideration to the fact that electricity from the grid might be unavailable for days or weeks after a typhoon or other disaster, so just having the benefit of electricity from a photovoltaic system (depending, of course, on the weather) increases the resilience of an evacuation facility.

- Consider actively using JCM equipment subsidies from Japan's Ministry of the Environment, effective use of subsidies and funding programs of the host countries, and effective use of assistance mechanisms of donor agencies. However, even with those options, besides the portion for which financial support is available, funds are also often required from the host national or local government. Thus, for the time being it would be most realistic to focus on governments that have a certain degree of financial capacity for these projects.
- It is highly possible that due to their size of government, small island states may find the burden to be excessive for individual countries to sign a JCM agreement with Japan and to discuss and manage projects by Joint Committee. Thus, it may be possible for a group of small island countries to work together with some form of organization or agency acting on behalf of the group, for a joint JCM agreement, discussions, and administrative procedures, etc.
- In the small island stats, it is important that investment for renewable energy should be done from a view point of not only CO_2 emission recduction but also the cobenefit. In order to evaluate from the aspect of sustainable development of islands states, we should develop and improve the model project into the activities which take into account of basic service which residents will need of, for example, ensuring a healthy life and promoting public welfare.

4 Study missions

4.1 Research relating to evacuation facilities to be supported

Table 4.1-1 Summary of first mission (first trip)

Timing	August 11 to 15, 2014
Actions	・ Interviews with Palau Joint Committee members about support requests ・ Interviews with Ministry of Education and NEMO about the need for support for evacuation facilities ・ Interviews with NEMO about implementation arrangements, policies and initiatives related to disaster preparedness, emergency evacuation areas, and evacuation conditions ・ Study visits to evacuation facilities, including schools, state government buildings, etc. ・ Report to Japanese Embassy and JICA Palau Office

Table 4.1-2 Summary of second mission (third trip)

Timing	November 30 to December 4, 2014
Actions	・ Interviews with Airai State Government and private schools about specific details of support ・ Study visits to evacuation facilities, including private schools ・ Additional interviews with Ministry of Education and NEMO ・ Progress report to Palau Joint Committee members ・ Report to JICA Palau Office

Table 4.1-3 Summary of third mission (fourth trip)

Timing	February 11 to 19, 2015
Actions	・ Discussions with Koror State Government about the specific scale and design of possible projects ・ Discussions with Airai State Government about the specific scale and design of possible projects, and about potential to provide support for adjacent community center ・ Discussions with local contractors regarding scale and design details ・ Discussion with NEMO ・ Progress report to Palau Joint Committee members ・ Implementation of workshop with JCM project parties (candidates) and stakeholders including Palau Joint Committee members ・ Report to Japanese Embassy and JICA Palau Office

4.2 Information exchange with SPREP

We travelled from late September 2014 to early October (specifically, from Sept. 28 to Oct. 3), to attend the 25th annual meeting of SPREP, held in the Marshall Islands, and exchanged information with SPREP regarding the latest developments in initiatives to integrate climate change adaptation, and disaster prevention needs related to the photovoltaic power generation equipment combined with evacuation facilities, as well as any similar initiatives. We also continued exchanging information by e-mail and telephone, and made an effort to gather essential information. Information gathered is reported in Section 3.2 of Chapter 3.

4.3 Workshop for stakeholder organizations

During our final local study mission, in February 2015, we organized a workshop on February 17, for stakeholders in the proposed projects.

Workshop for Stakeholders
of 'Evacuation Facility with Renewable Energy' Project (Proposed)
Joint Crediting Mechanism (JCM) Financing Programme of Japanese Government

- Coordination among Stakeholders in the Project and Financing for the Project -

Date, time and venue
Date and Time: Tuesday 17 February 2014 (14:00 - 17:00)
Venue: Palau International Coral Reef Center (PICRC)

Organizers
Pacific Consultants Co., Ltd. and Melekau Environmental

Objectives
- To discuss financial responsibility in financing solar system between Palauan and Japanese side in the proposed project
- To identify effective ways in maintenance and monitoring activities of solar power generation system and identify the personnel in-charge
- To discuss possible activities for increasing disaster preparedness among the stakeholders' organizations

Agenda
1) Steps of applying for financing support of Japanese government, and roles and responsibilities among the stakeholders including PCKK. Required documents for application
2) Measures to ensure appropriate operations and maintenance and monitoring of solar system, and the role of Joint Committee members in Palau
3) Possible activities to support public government office and community for increasing disaster preparedness in collaboration with National Emergency Management Office (NEMO).

Program

Time	Agenda	Presenter
13:30-14:00	Registration	Melekau Environmental
14:00-14:05	Opening Remarks	Pacific Consultants
14:05-15:00	Agenda 1: - Recent Development of JCM, Overview of PCKK's work on JCM in Palau, Low-carbon/Resilient Model for Small Island Coutries - Steps of applying for Financing Programme of JCM and clarification of responsibility in financing and applying - Discussions	Pacific Consultants All participants
15:00-15:15	Coffee Break	
15:15-16:00	Agenda 2: - Operations and maintenance, and monitoring of the solar system and power generation - Discussions	Pacific Consultants All Participants
16:00-16:50	Agenda 3: - Identification of Possible activities for a public government office and community to increase its disaster preparedness in collaboration with NEMO - Discussions	Pacific Consultants All participants
16:50-17:00	Closing Remarks	Pacific Consultants

5 Participation in local meetings

From the start of this study until the interim report, we made one progress report to the Ministry of the Environment.

Table 5.1-1 Basic information in first report

Timing	December 27, 2014 (Wednesday)
Actions	・ Report of general findings of first local study tour ・ Discussion on details of next research work

Table 5.1-2 Basic information in second report

Timing	Friday, November 28, 2014 (Friday)
Actions	・ Research findings to date (as an interim report meeting), and report of key points in the interim report ・ Discussion on next issues to consider and research directions.

Table5.1-3 Basic information in third report

Timing	December 27, 2014 (Wednesday)
Actions	・ Report of general findings of second local study tour ・ Discussion on next issue to consider, and on specific project proposals

Table5.1-4 Basic information in fourth report

Timing	January 23, 2014 (Friday)
Actions	・ As the final reporting meeting for this study, a report of research conducted to date, and report on the state of discussions regarding specific project proposals. ・ Discussion on next issue to consider, and on specific project proposals