

Chuuk State Government  
Federated States of Micronesia

Verification Survey with the Private  
Sector for Disseminating Japanese  
Technologies for “Resilient Water  
Station” Utilizing Natural Energy

Summary Report

January 2018

Japan International Cooperation Agency

Ichigo Holdings Co., Ltd.

## 1. Background

Federated States of Micronesia (FSM) faces the challenge of a widely dispersed population that is vulnerable to climate change. About 70% of FSM's population and economic infrastructure are located in the coastal area. They are exposed to risks such as coastal erosion due to sea-level rise, and increased incidents of cyclones and droughts. FSM's annual economic losses due to natural disasters amount to approximately 3% of the national GDP.

The Chuuk State, in particular, experienced severe damages by the Typhoon Maysak in April 2015. The Chuuk State is one of the four states of the FSM, and is the most populous state in the FSM, though its land area accounts for less than one sixth of the nation's total. Chuuk State has many small islands within and outside of the Chuuk Lagoon. Public water supply is not available in most of the islands because of lack of budget and infrastructure, thus people are dependent on rainwater for their drinking water. Such conditions make the state highly vulnerable against natural disasters. The Chuuk State Government has been responding to emergency water needs of the state's islands by shipping bottled water to the affected islands, but such operation takes much time and is resource intensive.

Ichigo Holdings Co., Ltd. (hereinafter referred to as "ICHIGO") , a manufacturing company producing various types of mobile RO filtering purification machines, proposes three products (1) Reverse Osmosis (RO) Water Desalination System (Seawater Type), (2) Reverse Osmosis (RO) Water Purification System for Blackish Water (Blackish Water Type) and (3) Manual Reverse Osmosis (RO) Water Purification System for Freshwater (Manual Type) in this verification survey. (1) "seawater type" is a mobile water purification system which can desalinate seawater into potable water. (2) "The blackish water-type" is a mobile water purification system capable of purifying water such as blackish well water. (3) "The manual-type" is also a mobile water purification system that can purify water that has salt concentration (TDS) of less than 1,000ppm. These systems can be used in combination to make up a "Resilient Water Station" for the Chuuk State to provide drinking water for daily uses in Weno and its neighborhood in normal times. In addition, at the times of disasters or emergencies, they can be used together or individually for producing bottled water to be brought to the affected areas, or can be transported to the affected islands to generate drinking water on-site. These products can also be utilized under emergency drills to be conducted during this survey, thereby strengthening the emergency response system of Chuuk State Government.

## 2. Outline of the Survey with the Private Sector for Disseminating Japanese Technologies

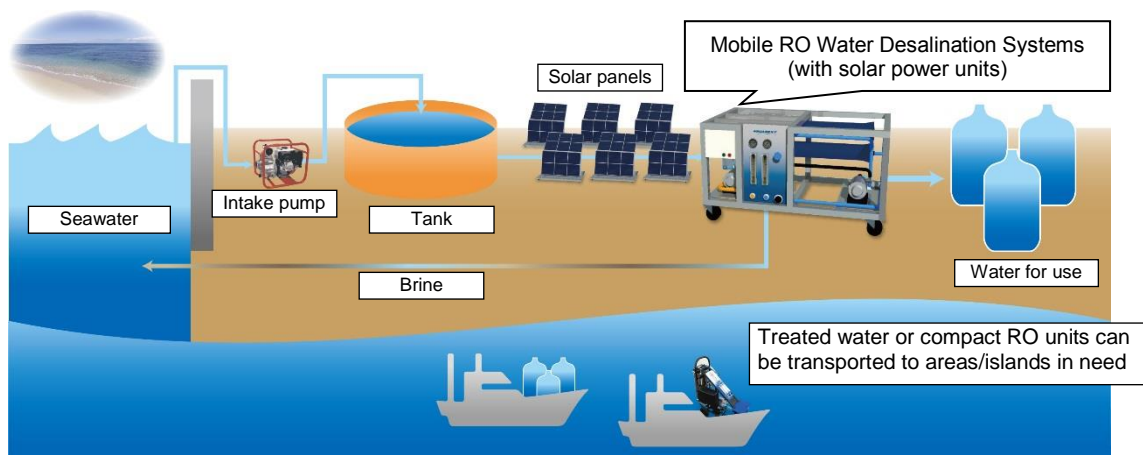
### I. Purpose

The objective of this Survey is to verify the applicability and effectiveness of ICHIGO's mobile water treatment systems for the Chuuk State in providing stable and sustainable safe drinking water supply so as to contribute to the strengthening of the water supply system during the normal times and the response capacity during the emergencies. The Survey also aims to explore ways to disseminate the products in the future and issues concerning it.

### II. Activities

The Survey will introduce and verify the applicability and operability of multiple types of mobile water purification systems, which can be used in combination as the "Resilient Water Station" in Weno. The schematic diagram of the system is shown below.

The systems will be installed on Weno Island and will be operated for day-to-day drinking water provision. The Survey involves installation of the system, training of the Chuuk State Government personnel and the local community for the operation and maintenance of the system, as well as emergency drills for transporting and operating the systems during emergency situations caused by droughts, typhoons, storm-surges, etc.



Schematic Diagram of "Resilient Water Station"

The activities to be conducted in the survey include the following components:

(1) Verification of the technical performance of multiple types of mobile RO water purification systems

1.1 Preparatory meetings and discussions

1.2 Field site selection, manufacturing of the system and transportation

1.3 Installation of the system and related works

1.4 Verification of drinking water production in line with the relevant regulations and standards

1.5 Examine the applicability and appropriate combination of mobile water treatment systems

(2) Operation and maintenance of “Resilient Water Station” during normal times

2.1 Preparation of operation and maintenance manual, and training

2.2 Development and establishment of the operation scheme (including water provision and drainage and pricing for customers)

(3) Operation of “Resilient Water Station” during emergencies

3.1 Preparation of the operation and maintenance scheme, “water supply action plan”, for emergency response

3.2 Implementation of emergency water supply drills according to the action plan in 2 islands in Chuuk Lagoon

3.3 Assessment of the emergency water supply drills to enable feedback into policy making and development of institutional/management framework by Chuuk State Government

(4) Economic analysis of the “Resilient Water Station” and development of business plan

4.1 Economic analysis of the “Resilient Water Station”

4.2 Seminars for dissemination of the products aimed at policy makers and customers

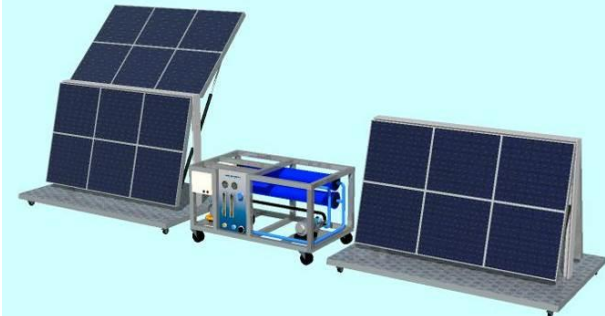
4.3 Development of business plan

### III. Information of Product/Technology to be provided

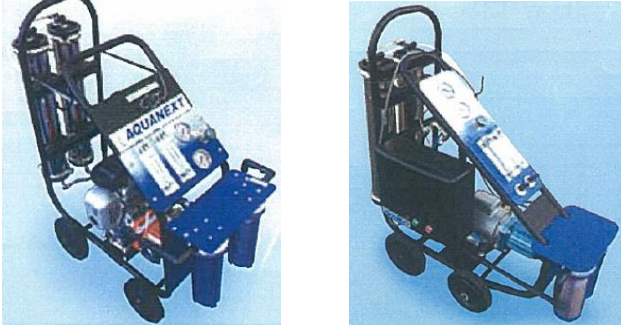
Three types of systems, and 11 units in total, will be used to examine and verify their applicability, as well as to determine the appropriate combination of the systems.

Two of the RO Water Desalination Systems will be installed in Weno as the “Resilient Water Station” for Chuuk State. Others will be tested at multiple sites to verify their applicability. Keeping the systems running during the normal times will ensure that the systems are operable during emergency situations.


(1) RO Water Desalination System (Seawater-Type): SW-NE5 & SW-NE1

Image	 <p style="text-align: right;">SW-NE5 &amp; solar units</p>
Capacity	SW-NE5: Approx. 1,000-1,300 gallons/day (Approx. 4-5m <sup>3</sup> /day) SW-NE1: Approx. 250gallons/day (Approx. 1m <sup>3</sup> /day)
Power Source	Solar power SW-NE5: 6 solar units for one SW-NE5 system SW-NE1: 2 solar units for one SW-NE1 system
Characteristics	<ul style="list-style-type: none"> <li>• Safe drinking water can be produced from various water sources including seawater, river water and non-potable well water.</li> <li>• It is a compact system that can be moved or transported on vehicles or boats. The system is equipped with solar power generation system and a battery, and is capable of operating 24 hours/day.</li> </ul>
Advantages compared to other products	<ul style="list-style-type: none"> <li>• High capacity for the size. Compact.</li> <li>• Easy maintenance and operation</li> </ul>
Size & Weight	SW-NE5: L1,250 x D700 x H800 (mm)    130kg SW-NE1: L1,200 x D710 x H675 (mm)    55kg
Number of units	SW-NE5: 4 units, SW-NE1: 2 units

(2) RO Blackish Water Purification System (Blackish-Type): BW-GS5 & BW-NE5

Images	 <p style="text-align: center;"> <span style="margin-right: 100px;">BW-GS5</span> <span>BW-NE5</span> </p>
Capacity	Approx. 1,300-1,500 gallons/day (Approx. 5-6m <sup>3</sup> /day)
Power Source	Gasoline engine (BW-GS5) Solar power (BW-NE5)
Characteristics	<ul style="list-style-type: none"> <li>• It can produce safe drinking water from river or well water that has salt concentration (TDS) of up to 10,000ppm .</li> <li>• It is very small and compact, and can be moved or transported.</li> </ul>
Advantages compared to other products	<ul style="list-style-type: none"> <li>• Very compact. High capacity for the size.</li> <li>• Easy maintenance and operation</li> </ul>
Size & Weight	BW-GS5: L730 x D490 x H1,090 (mm)    42kg BW-NE5: L1,040 x D460 x H1,050 (mm)    67kg
Number of units	BW-GS5: 2 units, BW-NE5: 1 unit

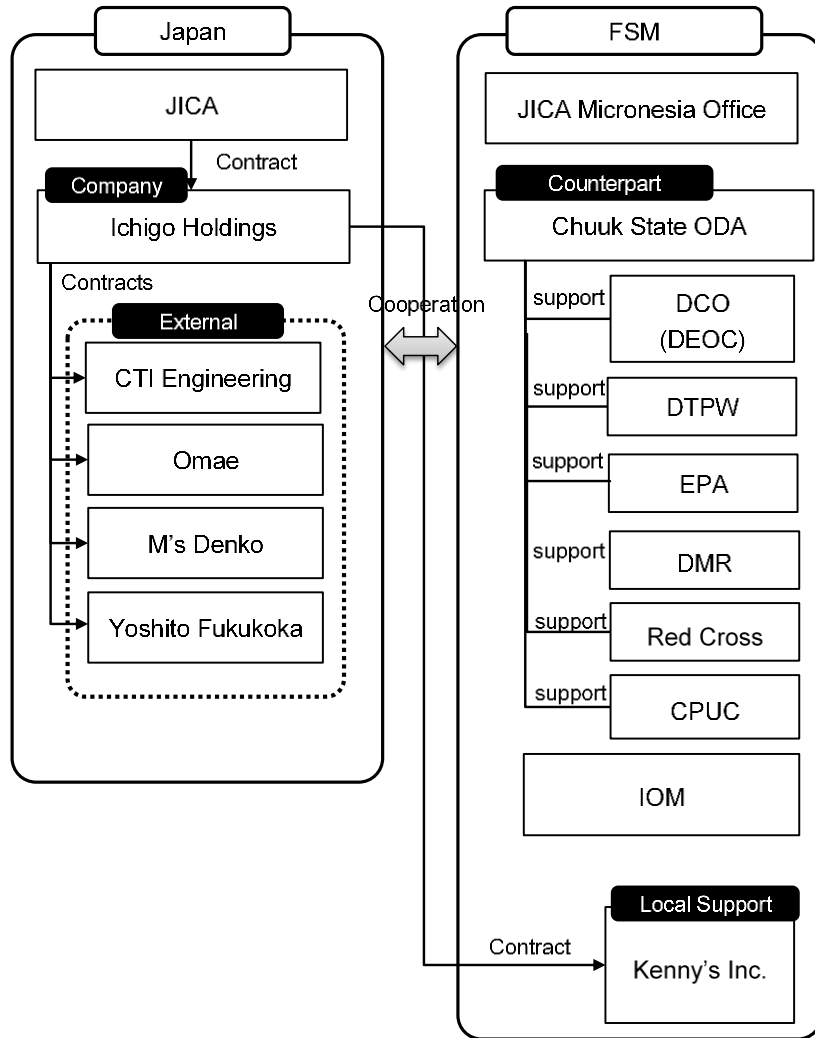
(3) Manual RO Water Purification System for Freshwater (Manual-Type): BW-HP

Image	 <p style="text-align: right;">BW-HP</p>
Capacity	20cc/stroke
Power Source	Manual (hand pump)
Characteristics	<ul style="list-style-type: none"> <li>• It can produce safe drinking water from rainwater, river or well water that has salt concentration (TDS) of up to 1,000ppm .</li> <li>• It is very small and compact, and can be moved or transported.</li> </ul>
Advantages compared to other products	<ul style="list-style-type: none"> <li>• Very compact. High capacity for the size.</li> <li>• Easy maintenance and operation</li> </ul>
Size & Weight	W450 x H800 (mm) 10kg
Number of units	2 units

IV. Implementing Organizations

Japanese side: Ichigo Holdings Co., Ltd. in cooperation with CTI Engineering Co., Ltd., Omae Co., Ltd., and M's Denko

FSM side: Chuuk State Government



V. Target Area and Beneficiaries

Weno Island and the surrounding islands in the Chuuk State

VI. Duration

August 2016 to January 2018 (1 year and 5 months)



## VII. Survey Schedule

Activities	2016					2017												2018
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Output 1																		
1-1 Preparatory meetings and discussions	---																	
1-2 Field site selection, manufacturing of the system and transportation	-----	-----	-----	-----	-----													
1-3 Installation of the system and related works						---			---	---		---	---					
1-4 Verification of drinking water production in line with the relevant regulations and standards						-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
1-5 Examine the applicability and appropriate combination of mobile water treatment systems						-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Output 2																		
2-1 Preparation of operation and maintenance manual, and training			-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
2-2 Development and establishment of the operation scheme						-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Output 3																		
3-1 Preparation of the operation and maintenance scheme, "water supply action plan", for emergency response						-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
3-2 Implementation of emergency water supply drills according to the action plan in 2 islands in Chuuk Lagoon													---	---				
3-3 Assessment of the emergency water supply drills to enable feedback into policy making and development of institutional/management framework by Chuuk State Government													-----	-----	-----	-----	-----	-----
Output 4																		
4-1 Economic analysis of the "Resilient Water Station"						-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
4-2 Seminars for dissemination of the products aimed at policy makers and customers	---												---	---		---	---	---
4-3 Development of business plan													-----	-----	-----	-----	-----	-----

----- In FSM (planned)      ----- In FSM (actual)  
 ----- In Japan (planned)      ----- In Japan (actual)

## VIII. Survey Team

Name	Organization	Responsibility
Masamitsu Miyashita	Ichigo Holdings Co., Ltd.	Project Manager
Hideki Ota	Ichigo Holdings Co., Ltd.	Product Technology Manager
Tomoyuki Ota	Ichigo Holdings Co., Ltd.	Product Technology
Hiroyuki Yamaguchi	Ichigo Holdings Co., Ltd.	Assistant to Project Manager
Hitoshi Negishi	CTI Engineering Co., Ltd.	Chief Advisor
Masato Toyama	CTI Engineering Co., Ltd.	Emergency Operation & Drills
Junko Sagara	CTI Engineering Co., Ltd.	Operation/Maintenance Verification & Economic Analysis
Natsumi Okamine	CTI Engineering Co., Ltd.	Performance Verification & Economic Analysis
Takehiko Konoshima	CTI Engineering Co., Ltd.	Performance Verification
Ryunosuke Omae	Omae Ltd.	Business Development
Masami Taniguchi	M's Denko	Electrical work and solar
Yoshito Fukuoka		Electrical work and solar
Yoshihiro Sakamoto	M's Denko	Electrical work and solar

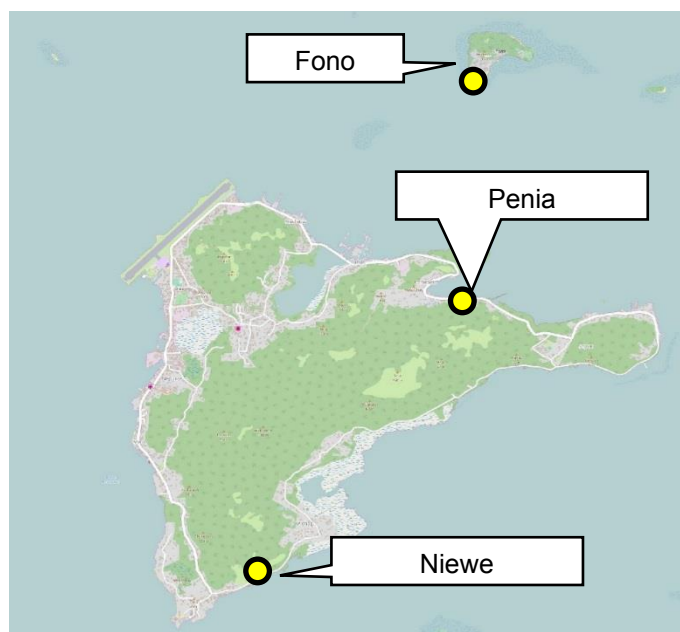
Responsibility	Name	Organization	2016					2017												2018		Total				
			8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	In FSM	In Japan			
Project Manager	Masamitsu Miyashita	Ichigo Holdings	Planned	8														8		8			24	0		
			Actual	4					8												8		8		28	0
Business Development	Kento Takahashi	Ichigo Holdings	Planned					8		8		8		8									32	0		
			Actual																					0	0	
Product Technology Manager	Hideki Ota	Ichigo Holdings	Planned					8		8		8		8									32	0		
			Actual					8		8		8		8		8							8	40	0	
Product Technology	Tomoyuki Ota	Ichigo Holdings	Planned					8															8	0		
			Actual								8													8	0	
Assistant to Project Manager	Hiroyuki Yamaguchi	Ichigo Holdings	Planned	8																		8	16	0		
			Actual	9					8				8		8						8		8	49	0	
Chief Advisor	Hitoshi Negishi	CTI Engineering	Planned	8	3	3			3	8		3		8				3				8	3	32	18	
			Actual	8	3	1			1	2	8	3			1	1	8	1	1		1	1	1	1	1	8
Emergency Operation & Drills	Masato Toyama	CTI Engineering	Planned					3							2	8		3	8	2				16	10	
			Actual						3					1	1		1	1	8	1	1	8	1			16
Operation/Maintenance Verification & Economic Analysis	Junko Sagara	CTI Engineering	Planned	3	8	3		3	3	8		3	8		3			3	8	3		3	8	8	40	38
			Actual	1	3	4	2	1	3	6	3	8	1	1		3	2	8	2	2	1	1	8	2	3	8
Performance Verification & Economic Analysis	Natsumi Okamine	CTI Engineering	Planned	3		3			3		3	8		3				3		3			10	8	34	
			Actual	2		1	2	2	1	3		3		2	2	8	2	3		2	2	1	2	4	1	2
Performance Verification	Takehiko Konoshima	CTI Engineering	Planned		4				4		3		3		3			4						0	24	
			Actual			1	2	2	2	4					3		1		2		1	2	4	1	2	0
Business Development	Ryunosuke Omae	Omae	Planned		1													1	8			8	1	16	3	
			Actual			1															7		1	8	1	15
Electrical Work and Solar Installation	Masami Taniguchi	M's Denko	Planned					8											8				16	0		
			Actual					8																8	0	
Electrical Work and Solar Installation	Hiroshi Ibaraki		Planned					8											8				16	0		
			Actual																					0	0	
Electrical Work and Solar Installation	Yoshito Fukuoka		Planned																				0	0		
			Actual					8															8	16	0	
Electrical Work and Solar Installation	Yoshihiro Sakamoto	M's Denko	Planned																				0	0		
			Actual																				8	8	0	
																					Ichigo M/M Total (planned)		112	0		
																					Ichigo M/M Total (actual)		125	0		
																					External M/M Total (planned)		144	127		
																					External M/M Total (actual)		143	127		
																					M/M Total (planned)		256	127		
																					M/M Total (actual)		268	127		

	In FSM
	In Japan

### 3. Outcome of the Survey

Outcome 1: Verification of the technical performance of multiple types of mobile RO water purification systems

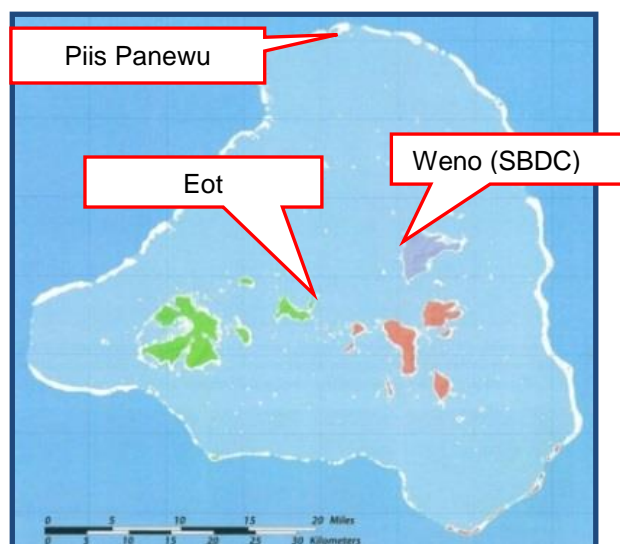
- The multiple types of mobile RO water purification systems were introduced in Weno and were verified for their expected performance and compliance with the drinking water quality standard in Chuuk State.
- Variety of systems were installed in three pilot locations (Penia and Niewe Villages in Weno Island, and Fono Island). Trainings for operation and maintenance of the systems were conducted several times at each location. System usage was monitored and system maintenance was provided at times of site visit. By the end of the survey period, the community representatives in charge of operating the systems were capable of operating the systems and sharing the produced potable water within the community. Based on the applicability of the systems in three locations were evaluated, a proposal was developed regarding the appropriate type of system to be used in each location, and the future installation and usage of the systems.



Outcome 2: Operation and Maintenance of “Resilient Water Station” during normal times

- “Resilient Water Station” which consists of one or multiple RO Water Purification Systems were established in three locations within Chuuk Lagoon, Weno, Eot and Piis Panewu Islands.

- A manual for management and operation of the resilient water stations was developed. Training sessions were provided for 8 persons from Chuuk State Government and persons in charge from three locations (Red Cross, Eot and Piis Panewu) for the operation and maintenance of the water stations.
- It was decided that Disaster and Emergency Operation Center (DEOC) of Chuuk State Government will become the agency in charge of the water stations. The everyday management of the water stations is delegated to the host municipality/organization, and the agreement between the state government and the host municipality/organization will be drafted to define the responsibilities and the roles of the state government as well as the host municipality/organization.



### Outcome 3: Operation of “Resilient Water Station” during emergencies

- Emergency Water Supply Plan was drafted and was presented and discussed with the C/P. The current emergency response plan of the state government is only targeted for large disasters with the issuance of state-wide emergency declaration, and does not provide a clear direction for smaller scale and locally occurring disasters. Furthermore, once the state-wide emergency is declared, assistance is expected from the federal government as well as the international society. Thus, the emergency water supply plan was developed to cover those disasters without the issuance of emergency declaration, where the state government is expected to implement the emergency operation by itself.
- Emergency water supply drills were conducted in Eot and Piis Panewu. The drill was headed by Disaster Coordination Office (DCO, currently DEOC), and was successfully implemented with active participation of the communities as well as

the relevant state government agencies. The drills were participated by 39 community residences in Eot, and 29 in Piis Panewu. The draft emergency water supply plan was revised based on the drill.

#### Outcome 4: Economic Analysis and development of business plan

- A seminar was organized by gathering mayors and representatives of municipalities across Chuuk State, and introduced the products. It was discussed that the resilient water station is needed in all municipalities of Chuuk, and that the state government together with the municipalities will cooperate to secure financial resources needed through FSM Congress, ODA, etc.
- In order to assess the prospects for using the system for commercial purposes, economic analysis was conducted. If the proposed technology is to be used for a bottled water business, it is expected that the initial cost can be recovered within two years. There is not much cost advantage in using the system if the business does not require high quality water and the quality of municipal water is sufficient. However, it could become a cost effective alternative if a business requires higher water quality (potable water), or is purchasing and is currently purchasing bottled water.
- By interviewing representatives of government and private sector, it was found that there is much need for smaller RO desalination systems considering the easiness of handling and lower initial cost. Based on such observation, a smaller carry-case type desalination system was developed and was presented to representatives of the state government, municipalities and congressmen at a seminar. The system attracted a high level of interest.

#### 4. Future Prospects

Prospective business in Chuuk includes further expansion and installation of Resilient Water Stations in other parts of the state, including the outer islands. In addition to public demands, SW-Carry, a smaller and cheaper option of desalination system which was developed as a result of the project, will be promoted not only in Chuuk State but also in other parts of FSM and the Pacific region. It is expected that the price can be reduced by exploiting economies of scale. These systems will be sold through the local agent. Local agent will also provide maintenance services with the support from Ichigo Holdings.

**Verification Survey with the Private Sector for Disseminating Japanese Technologies for  
“Resilient Water Station” utilizing Natural Energy**  
Ichigo Holdings Co., Ltd. (Miyagi, Japan)

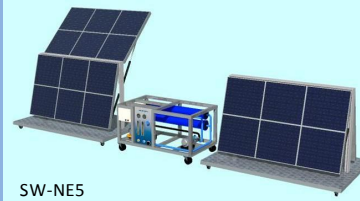
**Concerned Development Issues in FSM**

- Large infrastructure cannot be constructed as the islands are sparsely located across wide area
- Safe and sustainable drinking water supply is needed
- Vulnerable to climate change impacts, and water scarcity is occurring regularly
- Drinking water supply that can be used even during emergencies is needed

**Implemented Activities in the Survey**

- Output 1: Technology and performance of the proposed system is verified under the local conditions and settings
- Output 2: Operation scheme and organizational arrangements for the management of “Resilient Water Station” is established
- Output 3: Emergency water supply drills are conducted and the operation and maintenance scheme for emergency water supply will be developed.
- Output 4: Business development plan will be produced based on the economic feasibility analysis.

**Proposed Products/Technologies**



SW-NE5

**Small and mobile RO water purification systems powered by variety of power sources**

- Mobile RO Water Desalination System: : SW-NE5, SW-NE1
- Mobile RO Blackish Water Purification System: BW-GS5 & BW-NE5
- Manual RO Water Purification System: BW-HP

**Survey Overview**

Name of Counterpart: Chuuk State Government  
Survey duration: 2016.8 - 2018.1  
Survey Area: Weno and surrounding islands

**Impact on the Concerned Development Issues in FSM**

- Provision of safe and sustainable water supply
- Securement of water station resilient to disaster risks such as droughts, high tides and typhoons
- Capacity building and technical transfer for development of personnel capable of operating and maintaining the units

**Outputs and Outcomes of the Survey**

**Present**

- The proposed technology has been used at the affected areas of various disasters including the Great East Japan Earthquake
- They are also used by municipalities for emergency water provision and emergency drills.

**Future**

- Business plan will be produced to promote the technology in Chuuk and FSM
- The proposed technology will be promoted to the surrounding countries
- The experience of promoting the technology will be fed back into the work in Japan