

Survey on the Advantage Resources for International Cooperation in Pacific Region

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I Outline of the Survey

1. Purpose

The purpose of this survey was to collect information on the competitive development experience, knowledge and technology of the Okinawa Prefecture's local government and partners organizations, local community, human resources such as the private companies, NGO's which can be utilized to form the future Pacific cooperation projects.

Survey fields: Water supply, Resource recycling, Electricity and Energy, Tourism

Survey countries: Okinawa Prefecture and Samoa, Tonga, Fiji, Vanuatu

2. Survey results

Okinawa is located in the middle of mainland Japan and Southeast Asia, and consists of 160 island spread in a large ocean area. The islands are an area with a rich natural environment, having a mild climate throughout the year, where various animals and plants inhabit and grow, and the coast is surrounded by coral reefs and white sand beaches. The market of Okinawa is small, and separated by sea and far away from the big cities with the large markets, and there are different limitations to the development of various industries compared to mainland Japan.

But in Okinawa, the economy and society has steadily improved with social infrastructure development and support to the industry by the government. And with the developed infrastructure and the rich natural environment, unique history and culture, it has become one of the top tourist locations. With the development of the tourism industry the awareness of Okinawa has grown, and that has a spreading effect on other industries such as the food industry.

But with the spread of urbanization brought by the various economic activities, the need for water and energy and also the discharge amount of waste has increased, and the water source which is the source of a safe living environment and the tourism resource which is the natural environment was becoming lost.

Now with the implement of technologies and knowledge with consideration to the environment, the natural environment is improving

The local area development in the developing stage of the economy and society of Okinawa, especially the resources (knowledge and technology) which have overcome the weakness of the island area, can be effectively utilized in the development of the Pacific island nations with similar geographical and climate conditions to Okinawa, and the developing countries in other areas.

Also, in the development stage of the Okinawa economy, we have had experienced the same difficulties as the Pacific island nations in water, energy and waste treatment. The social climate and character of the people are also similar to Okinawa. This is an important element in building the relationship and giving support to the Pacific island nations, which is a competitive point that Okinawa has compared to the other parts of mainland Japan.

With this background, we have conducted a survey in the fields of the social infrastructure of water, energy and waste treatment which have greatly contributed to the development of Okinawa, and tourism which has developed based on these social infrastructures.

①Water supply

Regardless of the country or area, water supply is a social infrastructure essential for the improvement of public health and living environment, and it is necessary to build a sustainable water supply system within the natural, social and local conditions of that country or area.

In the Pacific island nations, there is a natural and economical weakness because it is an island. In the field of water supply, with the help of the other nations including Japan, the spread of water supply and improvement of the facilities has been improved, but there are still many issues.

In the development of water supply in Okinawa, the experience and knowledge related to water supply (provision of service) accumulated in the local government, and the technology for design and works, installment and repair of equipment accumulated in the private companies, have a high possibility to effectively contribute as an individual technology to support against the issues of the Oceanic nation states which face a similar geographical and climate condition. Also in the future, there is a possibility for a comprehensive and progressive support and technology transfer from the water source to water supply tap taking into consideration the local characteristics of each Pacific nation state, and by utilizing the experience and knowledge of the facility planning to management for the total water supply system by utilizing the various water sources and purification facilities by both the public and private cooperation of all Okinawa.

Resources of Okinawa (Water Supply)

	Water Resource	Water facility	Management and Society
●Issues facing the Pacific island nations			
	<ul style="list-style-type: none"> ○Scarce water resources <ul style="list-style-type: none"> • Limited water source • Freshwater lens (Salination risk) • Seasonal fluctuation (Water shortage in the dry season) ○Contamination of water source <ul style="list-style-type: none"> • Urban development • Change of life style • Population increase 	<ul style="list-style-type: none"> ○Inadequate water purification management <ul style="list-style-type: none"> • Turbidity management • Chlorine management ○Unprocessed and unsterilized supply of water ○Inadequate intake and supply management ○Many leakage and non revenue water <ul style="list-style-type: none"> • Leakage by the aging of the pipe • Inexperience in installment technology • Low rate of water meter installment • Theft of water • Inadequate meter reading ○Inadequate water supply management <ul style="list-style-type: none"> • Low output in highlands (reduced water pressure, no water output) 	<ul style="list-style-type: none"> ○Inadequate water rate structure ○Flat rate for those without meters ○Increase of water demand due to economical activities and improvement of living standards ○Reduction of trust in the water supply <ul style="list-style-type: none"> • Dissatisfaction with water quality (turbidity, non sterilization, high hardness etc.) • Dissatisfaction with water amount(water stoppage, low water pressure etc) • Dissatisfaction with the rates (unfair rate collection etc) ○Increase of costs <ul style="list-style-type: none"> • Crude oil (fuel costs) increase etc.
●Possible cooperation resources of Okinawa			
1) Short term support ※Support on technical cooperation (training)			
	<ul style="list-style-type: none"> ○Improvement on loss of water (measures against leakage) ○Moving towards a water conservation society (Promotion of the use of rain water for general service water) ○Experience on the conservation restrictions of the water sources (Miyakojima city Ordinance on Underground 	<ul style="list-style-type: none"> ○Experience and knowledge in the management of the Ecological Purification method (slow sand filter method) ○Technology and knowledge of leakage search and leakage repairs ○ Technology and knowledge of water supply control ○ Construction technology of various works ○Management capabilities of 	<ul style="list-style-type: none"> ○Raising the consciousness and development of human resources for water supply business management <ul style="list-style-type: none"> • Measures against non revenue water (proper rate collection) ○ Experience of promotion activities towards the improvement of water conservation consciousness of the residents ○ Experience and knowledge of

Water Conservation, Okinawa Prefectural Ordinance on Prevention of Red Clay Outflow) • Structure building (Data collection, analysis and evaluation, institutional design)	the staff ○ Transfer of water supply technology (Strengthening of the ability of water supply technicians)	water restriction ○ Measures for water source conservation • Educational activities for the residents
2) Middle and Long term (future) support※Support by utilizing fund cooperation		
○ Support for water source development and water operation to effectively utilize the scarce water resource • Water resource development in the small scales rivers (Maximum utilization during high water) • Increase of use of rain water • Increase of freshwater lens • Knowledge of the formulation of the system by source water characteristics (raw water reservoir, water pipe network) ○ Various source water development (Dam, desalination, sewage treatment) and support on management	○ Support on introduction of the water purification system, knowledge on various water treatment facilities (Ecological purification system, rapid sand filter, desalination, hardness reduction) ○ Support on improvement and strengthening of the water pipe system (effective water resource utilization) • Knowledge on water conveyance pipe network and raw water reservoir ○ Support on the improvement and strengthening of the water distribution system (improvement of non revenue water)	○ Support on the review of water rates • Improvement of the management of water business • Promotion towards a water conservation society ○ Support on the strengthening of the water supply operators organization (Development of the management capabilities for the future) ○ Support on the energy saving systems such as building of clean energy • Introduction of the water intake and distribution system utilizing solar power generation ○ Experience on use of rain water • Support on the use of water supply not limited to the framework of the Japanese water supply
3) Potential resources		
○ Experience and knowledge of the planning to management of a water supply system utilizing various water sources and purification facilities ○ Technology, knowledge and experience on the maintenance management of machinery and equipment under the severe conditions of salt damage ○ Experience under a severe water resource environment (Experience on securing water by the knowledge at each household level)		

②Resource recycling

In Okinawa Prefecture, similar to the Pacific island nations, all the consumer goods are brought from outside, and there are many used products. In Okinawa, for things that can be recycled, are recycled in the following three ways, and Okinawa has a special knowledge and technology in these processes.

- 1) Recycled in the prefecture and used as recycled resources
- 2) After the intermediate process of separation, crushing and packaging, transported outside the prefecture
- 3) After a similar intermediate process exported to other countries

The iron scraps contained in used automobiles (ELV) and waste household electrical appliances, and empty cans are recycled inside the prefecture and used as steel resource for the construction material by the prefecture's steel manufacturing companies, and most of the construction material is used within the prefecture.

For used paper, apart from the paper manufacturing factories using as the material for toilet paper, it is compressed and packaged and transported to paper manufacturing factories outside the prefecture or exported to China. For the PET bottles, there are

companies which separate, crush, and clean and make into flakes the compressed and packaged material by the local government facilities, and it is transported to the PET bottle recycling factories outside of the prefecture.

In the remote island the ELV and household electrical appliances were a problem in the past. But with the subsidies of part of the transport cost and the introduction to the remote islands of the technology to efficiently and properly separate and package ELV, it has become possible to transport efficiently and the recycling has greatly developed. Also the used paper and PET bottles are separated, collected and packaged in the remote island areas, and is transported to the recycling companies in the main island by containers.

On the other hand, the needs in the resources recycling field in Pacific found by this overseas survey are,

- 1) the treatment of ELV, batteries and tires
(The private companies do not have the facility and technology)
- 2) the treatment of major appliances such as television, refrigerators (most are dumped without being processed)
- 3) the collection and recycling of the resources such as used paper and PET bottles from households (there is no knowledge on separate collection nor sorting, packaging)
- 4) knowledge on effective transportation outside the island (technology on dismantling, compressing and packaging and knowledge on efficient distribution)

These collections and recycling are the points that the remote islands in Okinawa have worked on for a long time, and because of that they have developed a unique knowledge. Utilizing the knowledge of Okinawa, it is possible to construct a structure appropriate to the local conditions of the Pacific island nations. As the recycled resources are dealt in international market, and wherever the origin is the price is decided by lot and quality, by acquiring the high quality recycling resources using the technology of Okinawa in dismantling, separation and cleaning, there is a possibility that the sales price will go up. Furthermore, by introducing the effective compressing and packaging technology of Okinawa, the reduction of transport cost can be expected, and the profitability of the recycling business may improve.

The equipment of waste disposal and recycling of Okinawa which may be applied to the Pacific island nations are the small scale incinerator, garbage disposal equipment (garbage feeder converter), crushing equipment for glass bottles, equipment to make building material from glass bottles.

These waste disposal and recycling equipment which are used in Okinawa is developed to meet the needs of the remote islands. There is a high possibility for application to the Pacific island nations, but there is a possibility that it will not be efficient without the modification suited to the usage environment of the local area, such as the population size and the suitable equipment size for the amount of waste generated. For this, there are necessary steps to prepare in Okinawa before the actual deployment, such as the collection of the detailed local information and test production of equipment towards the modification. Also the Okinawa companies which have these resources are small scale, and to promote overseas deployment it is necessary to provide backup to this step from the government.

Also, many of the recycling related companies such as the steel manufacturing plants and the ELV dismantling facility are located around the Nakagusukuwan port area in Okinawa Main Island. These companies have received a reply that apart from the restrictions of treaties like the Basel Treaty and laws, they can buy recycled resources such as iron scrap from overseas. For this reason, the promotion of 3R for the Pacific island nations by using the Nakagusukuwan port area has been considered. But to use

the Nakagusukuwan port for the transport of recycled resources from outside the island, apart from the hardware issues of landing facilities and backyard, there is still the software issues of port management and development of shipping routes. At the moment the transport of recycled resources from the Okinawa remote islands are transported into Naha port in the opposite side of the island and then transported by land to the Nakagusuku port. By solving these issues one by one, and effectively using Nakagusuku port as the recycling port, the land transport cost will be reduced, and it is expected to greatly develop the recycling business of Okinawa and overseas including the Pacific island nations.

Finally, in the Pacific island nations recycling is a private business, and to develop the recycling of the island nations it is necessary to support the recycling operators. In recycling, it is necessary for the government, residents and recycling operators to work together. It is important to have a viewpoint as in Okinawa that the recycling companies and NGOs are partners of the government. Further to the support for the facility to the private companies of the Pacific island nations, inviting the recycling companies of the island nations to the prefecture for the training with the Okinawa companies, and the onsite training from the Okinawa companies to the island nations will contribute to the supply of necessary technology and knowledge and development of human resources, and is also expected to promote the cooperation between the private sectors.

③Electricity and Energy

In Okinawa there are not many rivers and it is not suited to hydropower generation, and it has depended on power generation mainly using fossil fuel. Especially in the remote island areas it has depended on diesel power generation, and because the fuel is expensive and the transport costs are high, to reduce the fuel costs in the remote islands solar power generation and wind power generation have been actively introduced.

But because the electricity grid in the remote island is small scale, there is a need to stabilize the unstable renewable energy. Also the maintenance and repair of the various equipments were dependent on the manufacturers outside the island, and there were many issues such as that the procurement of parts took time.

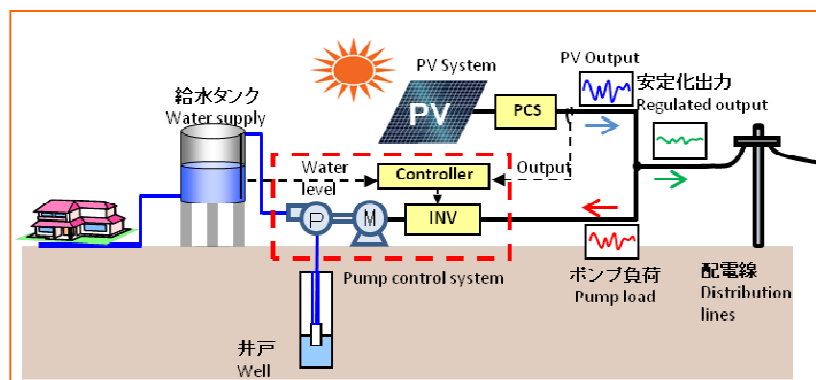
To solve these issues, in Okinawa the development of electricity and energy systems and maintenance technology suited for the remote islands are presently being promoted.

On the other hand, in the Pacific island nations of Samoa and Tonga, many facilities such as lifting pumps use similar small diesel. But similar to the remote islands of Okinawa there are issues with the fuel cost and cost of maintenance.

With this background, we would like introduce an electricity and energy system for the remote islands in a validation phase developed in Okinawa.

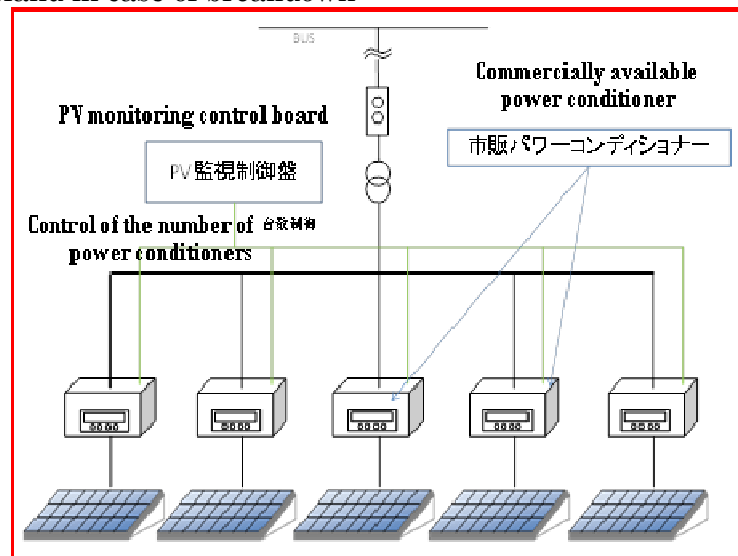
1) Water supply system using new energy (solar power)

A stable water and electricity supply system without using expensive batteries



2) Recyclable energy system by commercially available products

A system which can prevent the total stoppage of the system, and which can be repaired in the island in case of breakdown



The system introduced here is developed according to the nature and usage of a specific remote island of Okinawa. To introduce these to the Pacific nation islands, it is necessary to develop equipment suited to the local usage and to conduct a validation test.

Also, by effectively utilizing the Okinawa Mold Technology Institute and Naha Airport International Logistics Hub developed by the Okinawa Prefecture, there is a possibility that Okinawa can become the hub for providing parts for diesel engines to the Pacific island nations and Asia.

④ Tourism

Okinawa has the tourist and resort resources of a rich natural environment, and many visitors visit from mainland Japan. The background for this is the improvement of infrastructure by government such as airline access, and the building of new hotels and tourist facilities, and the campaigns to attract tourist done together by the government and private sector

The number of tourists has grown steadily from 440,000 in 1972 to over 6 million in 2008. With the development of the tourism industry the awareness of Okinawa has grown, and that has a spreading effect on other industries such as the food industry.

But for the tourism income, the expenditure per person is only growing at a low rate because of the price reduction of travel packages and the diversification of travel styles.

To solve the present situation, municipalities, private companies and NGOs are promoting international conferences and sport camps, high added value travel packages such as resort weddings, and enhancement of the type of experience and long stay tourism is spreading

With this background, Okinawa has accumulated the knowledge of each development stage of the tourism industry.

In this survey, with the results of this overseas field survey, we have classified the competitive knowledge in field of tourism in the Okinawa Prefecture. Because tourism is a service industry, it is necessary think more about the transfer of accumulated knowledge and system according to the present situation and development stage of the Pacific island nations than the visible technology.

On the other hand, the tourist areas of Pacific are international tourist areas, and the

quality of service of foreign operated hotels are relatively high. Therefore there is knowledge which the Okinawa Prefecture can gain from the Pacific countries, but here we will introduce the subjects which can be provided from Okinawa to Pacific.

- 1) Municipalities and private companies (promoted by the local area and each industry)
 - Domestic production of souvenirs (including the establishment of standards by industry groups)
 - Linkage between tourism and other industries such as agriculture (contract farmers system etc)
 - Tourism by the local area(home stay, agriculture and fishery experience, cultural exchange, reduction of local poverty)
 - Introduction and management system of the sport tourism
- 2) Item by Okinawa Prefecture and OCVB (Items to be handles as a general policy and strategy)
 - Development of tourism statistics, the need and method for various surveys related to tourism
 - Knowledge on the planning and implementation of tourism development plans, action plans (annual plan)
 - Improvement of the quality as a tourist area by the introduction of certifications for tourism services such as taxis
 - Knowledge on the hospitality for the Asian market (training)
 - Measures for bad weather such as typhoon
 - Measures against tsunami such as hazard maps
 - Development of flood control infrastructure

【Cooperation organizations】

Okinawa Employers' Associations, Water Business Committee
Okinawa Prefectural Enterprise Bureau
OKINAWA ENETECH CO.,INC
Okinawa Citizens Recycle Movement
Graduate School of Tourism Sciences, University of the Ryukyus
OKINAWA ENVIRONMENT CLUB

II Main Subject

1. Domestic Study of the Prefecture of Okinawa

(1) Brief Overview of Okinawa Prefecture

The prefecture of Okinawa is approximately located in the middle of the mainland of Japan and Southeast Asia. The prefecture consists of 160 islands across territorial waters of 1,000 km from east to west and 400 km from north to south. Okinawa occupies a land area of 2,275 km², which accounts for 0.6% of Japan's total land size. Of the 160 islands that make up the prefecture, 49 islands are inhabited, forming a total population of roughly 130 million people.

The average temperature in Okinawa is 23°C and temperatures rarely fall below 10°C even in winter. With a warm climate throughout the year, Okinawa is home to a large variety of animal and plant life. Its coasts are surrounded by coral reefs and white sandy beaches, making Okinawa a region blessed with rich natural environments.

In spite of this however, commercial markets in Okinawa are small and limited in size. With the added disadvantage of being physically separated from the larger markets of cities such as Tokyo, Okinawa faces restrictions in the development of its industries.



Okinawa's Geographical Location

With government-led initiatives laid out under the Okinawa Economic Development Plan, a long-term proposal designed to fulfill the three objectives of “correcting disparities with the Japanese mainland”, “development of basic infrastructure for autonomous economic development” and the “realization of a peaceful and promising future” that has spanned some 30 years since Okinawa's reversion to Japanese rule in 1972, the vitalization of Okinawa's economy has made steady progress through improvements to social infrastructure such as the boosting of water resources and transport networks.

Infrastructural improvements in Okinawa, together with its bountiful natural environments and unique historical and cultural characteristics, have attracted many visitors, making it one of the leading tourist destinations in Japan. Growth of the tourism industry has increased public awareness of Okinawa, which has in turn brought about spillover effects to other domestic industries such as the food industry.

Meanwhile, economic development has led to rapid urbanization and a growing loss of natural environments that would serve as viable resources for tourism. This is

particularly so for Okinawa's outlying island regions, where limited land resources have led to the relocation of landfills and waste disposal facilities away from city centers to locations close to water sources, a move that endangers the safety of citizens and their lives.

At present, moves towards securing safe living environments and the conservation of natural resources as viable reserves for further economic development have led to initiatives such as recycling, supply of safe potable water and utilization of clean energy. With accumulation of environmentally friendly techniques, the practical application of such technological know-how has gradually brought about changes in citizen awareness and also improvements to natural environments.

Consisting of island archipelagos, the natural environment and geographical attributes of Okinawa are similar to those seen in the countries and territories of the Pacific region. The reserves of know-how and technology cultivated through the development of island communities such as Okinawa, which also encompasses negative consequences brought about by its economic progress, as well as knowledge that has been cultivated by overcoming obstacles posed by the vulnerability of island regions, can be applied effectively to developing countries and territories in the Pacific region to aid their path to progress.

In light of the above, this study focuses on four major elements that have played a major role in Okinawa's economic development, namely water supply, resource recycling, power supply and tourism. In addition, a questionnaire survey aimed at gathering information about the type of products, technology and know-how of business corporations in Okinawa that are targeted at expansion overseas was also conducted.

(2) Present Conditions Surrounding Okinawa's Resources and Overseas Expansion

① Questionnaire Survey

With the cooperation of the Okinawa Business Management Association, 274 business corporations in Okinawa were surveyed on their interest in expanding their business operations overseas and also their inclination towards hosting foreign trainees. The survey also researched different types of business development models and concrete examples of corporations' business operations.

Out of the 45 companies that responded to the survey, 6 are currently exporting their products overseas and accepting trainees from abroad. In addition, 20 companies indicated interest in expanding their business operations overseas.

Of the companies who expressed interest in overseas expansion, 18 were keen to export technology, know-how and products to foreign markets. In addition, 2 companies expressed interest in procuring raw materials from abroad.

Response Rates for Questionnaire Survey		
Business Category	No. of Responses	Interest in Overseas Expansion
Building and Construction	9	4
Manufacturing	7	5
Logistics and Transportation	5	2
Energy	3	1
Wholesale and Retail	6	1
Information and Communication	3	1
Services	10	5
Finance	2	1
	45	20

Business Type	
Business Type	No. of Responses
Export of Technology, Know-How and Services	12
Export of Products	6
Import of Products	2

Most of the companies who responded positively to exporting technology, know-how and services are from industries engaging in services and building and construction. On the other hand, the majority of business corporations keen to export products overseas are from the manufacturing industry.

Examples of technology and products that are being considered for export as follows.

- Development of air routes
- Export of food and beverage products
- Environmental impact surveys and assessments, water quality, analytical testing of products such as food
- Sludge and sewage treatment technology
- Water treatment chemicals and maintenance of dosing equipment
- Maintenance of waterworks systems and techniques for its management and operation

All of the examples listed above (excluding the development of air routes and export of food and beverage products) are related to technology and know-how concerning water

supply, one of the main subjects of research in this survey.

However, the destination markets targeted for expansion of the aforementioned technology and products mostly consist of countries in East and Southeast Asia such as China, Taiwan, Hong Kong and Singapore.

② Water Supply

1) Geographic Features and Climate

The prefecture of Okinawa is located at the southernmost and westernmost point of the archipelago of Japan, spreading across the Pacific Ocean and East China Sea, spanning some 400 km north to south and approximately 1,000 km east to west. The prefecture is divided into four main groups of islands consisting of 49 inhabited and 111 uninhabited islands. Okinawa's total land area is 2,276.15km², of which the main island of Okinawa is the largest (land area approximately 1,201km²). The next largest islands are Iriomote (approximately 289km²), Ishigaki (approximately 222km²) and Miyako (approximately 159km²) respectively.

These islands have distinct topographic features that distinguish islands into those that have high altitudes from those with low altitudes. Islands with high altitudes include the northern region of the main island of Okinawa, Ishigaki and Iriomote. Islands with low altitudes are the southern part of the main island of Okinawa and Miyako.

With regards to the topography of the main islands, a mountain range with an altitude of 400 to 500m found in northern Okinawa forms steep and narrow terrains that extend to the coast. On the other hand, hilly terrains and flat land are found primarily in the central and southern regions of the main island of Okinawa. In addition, the topography of the island of Ishigaki is high in the north and low in the south. The highest mountain in the prefecture is found in the northern region of the main island of Okinawa (*Omoto-dake*, altitude 526 m), while the island of Miyako is composed largely of plateaus and flat land.

Okinawa has an oceanic sub-tropical climate with annual temperatures averaging 22.7 °C, making for mild weather all year round. It has comparatively more rainfall than other parts of Japan and annual precipitation is approximately 2,037mm, which is higher than the national average of 1,718mm. Despite this, a high population density has led to an annual water reserve endowment ratio of 1,837m³ per person, a figure that is 57% lesser than the national average of 3,230m³.

2) Water Supply

Although Okinawa has about 300 rivers both large and small, rivers are perpendicular with short flow channels and total river basin areas are limited compared to rivers and streams in mainland Japan. This is due to Okinawa's limited land area, as even the largest island of mainland Okinawa is long and narrow from north to south. As such, rainfall quickly flows into seas, making it difficult to utilize rivers as an important water resource. In addition, it is difficult to secure a stable supply of water as 50% of Okinawa's annual precipitation is derived from the rainy season from May to June and from August to September, when typhoons frequently occur. Moreover, a number of small outlying islands where inhabitants have no sufficient access to rivers and underground water are scattered across the prefecture. The main island of Okinawa has experienced protracted periods of water rationing almost every year since the reversion of Okinawa to Japanese rule in 1972. In particular, Okinawa exercised water rationing consecutively for 326 days between 1981 and 1982. Such circumstances have led to the development of diverse sources of water supply in Okinawa, such as dams, rivers, groundwater, as well as the desalination of seawater.

There are more than 40 dams of varying sizes in Okinawa, with effective water reservoir capacities ranging from 52 million m³ (Fukuchi Dam) to 5.6 million m³ (Zamami Dam).

Desalination plants in Okinawa have treatment capacities ranging from 210m³ to 40,000m³. A total of 16 facilities deploy reverse osmosis and electro dialysis techniques in the desalination of seawater.

Underground dams have been constructed in Miyako Island and the southern region of the main island of Okinawa to fully tap into groundwater reserves, making Okinawa one of the few places in Japan and the world with such a large number of underground dams.

In addition, steps towards the creation of a water conservation-conscious society have been carried out through initiatives such as the promotion of the active use of sewage treatment water and rainwater for odd chores such as hosing down gardens and cleaning washrooms. In order to ensure the sustainability of limited water resources, the city of Miyako Island enacted the “Miyako City Groundwater Conservation Law” to protect and conserve groundwater reserves, its sole water resource. The “Okinawa Prefectural Ordinance for Prevention of Red Clay Outflow” was also passed to stop pollution of communal waters by red clay dislodged in the process of development. In this way, initiatives have been put in place to care for natural and living environments such as the conservation of seas and rivers, including rivers that serve as sources of water supply.

3) Waterworks Facilities

Public waterworks in Okinawa is derived from a variety of supply sources. Similarly, diverse types of facilities have also been introduced for the purpose of water treatment. Apart from standard treatment procedures such as rapid filtration and biological purification (slow filtration), there are also sophisticated water treatment methods (ozonation treatment, active carbon treatment), processes to reduce the hardness contained in natural Ryukyu limestone (pellet method, electro dialysis) as well as desalination facilities (reverse osmosis technique).

As Okinawa has many outlying islands which include a scattering of small island communities that do not have sufficient water supplies, the prefecture has laid some 60,000 meters worth of undersea aqueducts for water distribution.

Faced with a situation of scarce water supply, the efficiency ratio aimed at abolishing damage to water resources such as leaks is also of a comparatively high level in contrast to prevailing national standards.

Comparison of Efficiency Ratio (Unit: %)

	Waterworks		Basic Waterworks		Total	
	Japan	Okinawa	Japan	Okinawa	Japan	Okinawa
2006	92.5	95.0	78.3	83.1	91.9	94.6
2009	92.8	95.6	78.7	82.3	92.2	95.1

* Source: Okinawa Prefecture Master Plan for Waterworks Maintenance (Proposed)

4) Management of Facilities

In general, the operation of waterworks in Japan are conducted by waterworks companies (local organizations) while support services such as facility maintenance and repair, as well as the introduction of hardware and machinery, are carried out by private-sector corporations. In Okinawa, few waterworks companies are involved in the direct management of the various types of operations related to waterworks. Most companies outsource a number of business operations such as facility security, leakage checks, meter reading and water treatment plant operation management to private-sector firms.

In terms of monitoring water quality, local municipal waterworks companies carry out self assessment checks for a portion of items suited to comparative analysis. All municipal-level waterworks companies commission requests for items that require sophisticated analytical techniques and equipment to testing facilities within the prefecture (3 facilities) that are certified by the Ministry of Health, Welfare and Labor.

③ Resource Recycling

In the 27 years that Okinawa was placed under American rule after the Second World War, industries were established to cope with the barest of needs although core industrial products such as automobiles and electrical appliances were mostly imported from mainland Japan and America. The reversion of Okinawa to Japanese rule in 1972 did little to change the situation.

As Okinawa is an island archipelago surrounding by ocean, people living in outlying islands and in other prefectures had to rely on sea and air transportation for the movement of goods and products. As such, ferry terminals and airports had to be constructed in offshore islands in order for crucial supplies to be transported from other prefectures through the Okinawa mainland.

Meanwhile, automobiles that have been scrapped and brought into Okinawa became an important resource for recycling within the prefecture, such as reusing steel taken from used cars in electric stove meters. In this way, a system of recycling arising from Okinawa's island conditions was established.

Legislations for the recycling of used automobiles and home appliances enacted in outer islands of Okinawa have allowed for recycling-related companies to carry out disassembling and segregation of such disused products. The establishment of a regulated system of reuse allowed for effective transportation of recyclable materials, giving recycling a significant boost.

The law for the recycling of packaging materials established in 1995 made it compulsory for disposed packaging materials collected and segregated by local organizations to be reused as raw materials for the production of new packaging products or sent to other utilizing parties (specific business corporations) for recycling (into new products). With this regulation, businesses would bear the costs of utilizing disposed packaging materials collected by local organizations to manufacture new products. (However, steel cans, aluminum cans, cardboard boxes and paper packaging labels for beverages are subject to price trading and exempted from compulsory reuse by businesses).

With the enactment of this law, local organizations have not only established facilities for the selection, compression and packing of recyclable materials and but also a system of distributing disposed packaging materials to utilizing businesses. Materials collected in outer islands are collected directly by businesses who wish to reuse them in the manufacturing of new products (stipulated by law to be determined by tender). In this way, local organizations are only responsible for bearing the costs of collecting, selecting and compressing disposed packaging materials. While local organizations bear the costs of transporting materials such as empty cans and cardboard boxes that are exempt from compulsory reuse to the main island of Okinawa, recent hikes in the price of recycled resources have allowed some local organizations to generate profit from their operations.

The regulation for the recycling of used automobiles passed in 2005 made it mandatory for automobile manufacturers to recycle ELV (End-of-Life Vehicles). The costs of handling dust and chlorofluorocarbons (CFCs) emitted in the process of recycling are borne by consumers (7,000 to 18,000 yen per vehicle). Before the passage of this legislation, the costs of disposing shredder dust (fragments of plastic and other materials produced in the process of crushing used vehicles) were high and unprofitable for vehicle

disassembling firms. Such costs were passed on directly to the consumer, which led to an over-accumulation of disused ELV. Although the disposal of ELV was a significant problem within the prefecture, the establishment of legal policies resolved the situation by regulating the iron manufacturing and scrapping industry.

In addition, the Japan Center for Promotion of Automobile Recycling, which manages recycling fees collected from consumers, provides support to local organizations by subsidizing the cost of transporting ELV from outer islands to the main island of Okinawa for recycling.

It can be illustrated that the recycling of resources in outer islands has developed tremendously from the installation of legal systems regulating the practice of recycling.

As a further response to this new legal framework, many recycling-related corporations such as iron manufacturing plants, disassembling and segregation facilities for ELV and electrical appliances, as well as plants for the production of PET flakes from used plastic bottles have been established in the industrial estate located at Okinawa's Nakagusuku Port.

In light of the background discussed above, this study aims to look into ways to promote the "3Rs" and provide support to recycling businesses in countries and territories of the Oceanic region through active utilization of Nakagusuku Port. In order to investigate the possibility of alleviating waste-related problems faced by island communities through practical application of Okinawa's environmental technologies, while exploring opportunities for business expansion in island countries by companies in Okinawa, a study on the various recycling and transportation businesses located in the prefecture was conducted. Findings from the study are as follows.

1) Takunan Shoji Co., Ltd

【Recycling of Home Electrical Appliances】

- Transports heat insulating material from refrigerators to Kyushu. Takunan does not have recovery facilities for CFC refrigerators because the collection levels of such items are not large enough to meet costs of installing facilities to recycle them. The company has been able to recover and recycle non-CFC refrigerators at their own facilities following a subsequent increase in the number of such refrigerators. Takunan is also able to recycle all other home electrical appliances.
- Iron is sent to guillotines for processing before being shipped to iron foundries within Okinawa. Non-iron materials are exported to the Japanese mainland.

【Recycling of Automobiles】

- 95% of used cars can be recycled. The remaining 5% are sent to landfills in Miyazaki due to insufficient sites for waste disposal in Okinawa. Takunan pays a disposal fee in order to export car tires to paper mills in Oita prefecture as fuel material. Vehicles are processed using a multi-disassembling machine before being sorted and shredded.
- Techniques for automobile recycling in Ishigaki and Miyako are effective for used car recycling in Pacific. In Ishigaki, scrapped automobiles are first stripped by hand before being compressed in soft-press machines. The entire process is extremely labor-intensive. Compressed automobile scrap is then sent over to the main island of Okinawa.
- Scrap is transported from outer islands to Naha Port in containers and trucked to Takunan's factories. Ships are chartered for large consignments to be delivered directly to Nakagusuku Port.
- Although Japan has a surplus of scrap materials, most scrap from Okinawa is consumed within the prefecture itself. Okinawa also purchases scrap from the Japanese mainland to make up for deficiencies. Scrap may also be purchased from

Pacific although this will depend on purchase amounts and price.

【Licensing of Technology】

- On-site supervision is possible if there are staff members who volunteer to be sent overseas. In addition, Takunan also accepts requests for factory visits.

【Shipping from Pacific to Okinawa】

- Shipping may be difficult if the quantity is not large enough. Assistance may be provided if shipments are conducted under international leadership of the Japanese government, but this must not lead to a deficit in earnings.

【Facilities at Nakagusuku Port】

- Takunan owns a 55-ton movable crane but does not have facilities to accommodate requests to process items that exceed the crane's size and weight handling limits.

2) Nakagusuku Koun K.K.

【Recycle Port Nakagusuku Port】

- Although Nakagusuku Port is a member of the Recycle Ports Promotion Council (RPPC), flow of information remains one-directional. In addition, the port and its hinterland organize a consultative body headed by Professor Sakurai.
- Although designated as a recycle port, it does not have storage facilities.
- Waste disposal is overseen by the Public Health Center of the Environmental Facilities Department and comes under a different jurisdiction from the recycle port.
- Storage facilities are available in Naha Port but not in Nakagusuku Port. Permission has to be obtained from prefecture authorities before consignments can be unloaded, making it inconvenient for use. Time taken to obtain approval from the prefecture causes shipments to be unloaded at Naha Port instead. As such, Nakagusuku Port will benefit from having one-time storage facilities.
- Approximately 1000 chartered ships utilize Nakagusuku Port annually.
- Regular liner services are limited to one route to Shibushi City in Kagoshima prefecture. This route is currently undergoing demonstration tests.
- Securing ocean freight services may be difficult as there are no sea routes in the case of Pacific. Consolidated cargo shipping is difficult but not impossible.
- In order to operate regular liner services, ships must sail at regular intervals and carry a specific amount of cargo.
- There are no merits for investing companies without regular liner services.
- As a recycle port, Nakagusuku Port operates under 24-hour surveillance 365 days a year and has excellent security features.
- The lack of government-managed yards for segregation of waste materials poses an issue to Nakagusuku Port.
- While there have been requests for Nakagusuku Port to receive shipments from abroad, the port is not equipped with facilities to accommodate such requests.
- Prior investment is necessary for the purpose of generating demand.
- Nakagusuku Port will benefit from establishing itself as a model recycle port for islands territories, one that is different from those seen in the Tokyo metropolitan area.
- Nakagusuku Port should establish a system of expansion to include the outer islands of the prefecture and extend the network to the rest of Asia. The establishment of a network with the outer islands within the prefecture is of primary concern. The port will benefit from fully optimizing Okinawa's geographical advantages.

【Waste Disposal Issues Facing Outer Islands】

- Illegal dumping is a problem in outer islands due to the lack of waste disposal sites.

- The islands of Miyako and Ishigaki will benefit from having ocean freight services once a week to transport waste materials. Monthly ocean freight services would suffice for the other outlying islands. Demonstration tests for an initial 3-year period can be supported by subsidies and other forms of funding, after which freight services may be operated on their own without financial assistance.

3) Takunan Steel Co., Ltd

【Nakagusuku Port】

- Further effective optimization of the port is possible, such as developing its role as a transshipment station. The port can serve as a link to outer islands by collecting and consolidating cargo, and serving as a site for the segregation of collected shipments into materials for recycling. Nakagusuku Port collects and consolidates 80-90% of all steel scrap within the prefecture.
- Internal discussions are in process with regards to the effective utilization of Nakagusuku Port as a recycle port.
- Takunan Steel transported reinforcing steel to Ishigaki and brought steel scrap from the island during demonstration tests for a freight service between Ishigaki Island and Nakagusuku.
- Scheduled consolidated cargo collection services will be effortless if a system to routinely collect materials for shipment is established in Pacific. If shipments can be transported directly to Nakagusuku Port, shipments can be sold as value-added products. Collection and consolidation of cargo can be carried out with no difficulty once regular shipping lines become available.
- Demonstration tests for a regular service with Shibushi City of Kagoshima Prefecture are currently underway. Approximately 1000 tons of scrap is received at Nakagusuku Port each month. In return, steel products are exported to Kagoshima. The government is overseeing infrastructural improvements while the prefecture is in charge of overall operations.
- Businesses located on the hinterland of Nakagusuku Port have chosen the location because of the anticipated convenience of being located close to a port. Nakagusuku Port has a recycle port-related consultative body.
- Presently, little effort is geared at attracting new enterprises to the port. It is crucial to develop a high-impact menu of services as attracting new businesses will bring about positive economic effects.
- While the port will be able to support shipments of resource materials from abroad, a number of issues have to be resolved first before the port can be operationally ready to do so.

【Waste Materials】

- Illegal dumping will occur if charges are levied on the disposal of scrap. If scrap is properly sorted, it becomes a value-added raw material for steel production.
- Steel that is manufactured from scrap containing bronze will lead to products of lower quality. If bronze and aluminum are properly separated from scrap, they will fetch higher prices as non-steel materials.
- While scrap is eventually sorted by magnetic energy, initial stages of the sorting process are labor-intensive, making scrap collection and segregation a viable industry for island communities.

4) Faith Okinawa Co., Ltd

【Receiving Recyclable Materials from Pacific】

- As Okinawa imports beverages from abroad, Faith Okinawa collects PET bottles manufactured overseas. Although PET bottles are composed of a single material,

the main demand in Japan is for transparent PET bottles. Prices of colored PET bottles are not as high as those for transparent ones.

- PET bottles may be consolidated with other types of materials for shipment as the costs of transporting PET bottles only are expensive. PET bottles handled by Faith Okinawa are usually packed into square bales measuring 1m on each side, although requests to handle bales of larger sizes may be accepted.
- With regards to handling recyclable materials from Pacific, Faith Okinawa needs to inspect the actual materials first in order to determine if they can be accepted although quantity is not a concern.
- If Oceanic countries step up efforts for waste segregation, the amount of materials collected for recycling will increase. This can then be consolidated and shipped with other items.

【Demand for PET Bottles Overseas】

- China has the highest level of demand although there is also significant demand from South Korea. Sources suggest that China accepts PET bottles even if they are of a slightly inferior quality.

【Recycling of PET Bottles】

- Demand for PET bottles is expected to increase further in future as the production of PET bottles from used PET bottle flakes has been started by major beverage makers. Currently, used PET bottles are mostly processed into fibers or sheets. Bottles have to pass requirements of the Food Sanitation Act in order to be allowed for use. Bottles produced by PET bottle manufacturers have already been approved for use.
- Flakes from used PET bottles are packed into flexible container bags and loaded into trailers during transportation.

【Receiving Recyclable Materials from Outer Islands】

- Once sufficient materials for shipment are accumulated, they are sent by ship from the outer islands directly to Tomari Port or Aja Port in Naha. The shipments are then transported in containers to the factories of Faith Okinawa.

5) Naha Port Authority

【Current Shipping Routes】

- Naha Port is currently conducting demonstration tests for the export of used cars to China while exploring the possibility of bringing in imports from China. The carrying out of demonstration tests to determine the viability of regular shipping services with Taiwan is also being explored.
- While Naha Port handles cargo from the outer islands of Okinawa and overseas, 90% of all exports from Okinawa are transported by air.
- 6-DWT class ships from America call at Naha Port each week.

【Inter-Relationship between Naha Port and Nakagusuku Port】

- While efforts have been made to differentiate services offered by the two ports, outcomes remain unclear.
- Both ports do not engage in operations outside of those stipulated in their port plans.
- There are plans to export water from Kume Island to China. Cargo is slated to be discharged at Nakagusuku Port.

6) Takuryu Kinzoku Inc.

【Receiving Recyclable Materials from Pacific】

- Materials from abroad may be handled but this is dependent on international market rates. As such, it may be better if waste materials were processed close to

the source of origin.

- The opinions of the receiving party have to be taken into consideration when exporting materials for recycling from countries in the Oceanic region.

【Recycling in Pacific】

- If visitors from Pacific are brought to Okinawa, they may take a tour of the company's factories.
- The collection and recycling of home electrical appliances may be difficult given the small population size of most Oceanic countries, although the recycling of PET bottles is viable.
- Rising petroleum costs has led to an increase in demand for waste plastic.
- As automobiles are disassembled by hand, further and more detailed segregation and sorting is possible. Detailed stripping and sorting can be carried out when the number of used vehicles to be processed are small, and the process becomes increasingly difficult as the quantity becomes larger. As close to 100% of used vehicles can be recycled, it is important to find buyers and cater to their requirements.
- With a population of 6 million, there should be suitable processing facilities located in Papua New Guinea.
- The current way of storing disused vehicles in the countries of Pacific is similar to the practices seen in Okinawa in the past. Blazes will be difficult to contain once fires break out.
- Separating machines for the treatment of used tires can be introduced as long as maintenance of the machines is carried out and suitable export destinations are available.
- During training conducted previously for trainees from the Caribbean countries, trainees expressed interest at the concept of small-lot purchase. There was an exchange of opinions on how it is necessary to change people's mindsets from simply disposing their waste to recycling it. It is possible to educate the people of Pacific on the importance of waste segregation.

7) Trim Co., Ltd.

【Practical Application of Trim's Recycling Product "Supersol" in Pacific】

- Supersol can be used as rainwater storage tanks. In order to secure water supply in island countries, individual storage systems are more practical than elaborate large-scale projects such as dam construction.
- Supersol is a porous ceramic that prevents decomposition even without water circulation. Supersol is scientifically proven to prevent the outbreak of large intestinal bacteria, which makes it ideal as a system of effective long-term storage of rainwater.
- It can be applied to the establishment of a constructed wetland system as it is effective for treating and purifying livestock manure and domestic wastewater.
- When mixed into soil, Supersol improves soil quality by boosting water retention and aeration. Supersol significantly influences harvests by aiding plant growth and the prevention of plant diseases.
- Supersol is made from naturally derived glass and does not have any harmful effects on the environment.
- While rigorous color separation is crucial when recycling used glass into new glass, the production of Supersol utilizes a useful technique where different types of glass can be mixed and recycled. As such, the method is widely adopted within Japan.

【Contributions to the Oceanic Region】

- Machines for the shattering and grinding of used glass bottles can be sold.

Machines do not have to undergo maintenance for 3-4 years.

- Techniques for producing glass chips, as well as machines for producing chips of varying fineness (from rough to fine) are available. Glass chips are usually less than 8mm in size. Glass chips of this size would have had most of their sharp edges removed.
- The amount of generated waste will increase as a necessary consequence of economic development. Although combustible waste can be burnt to produce energy, used glass cannot be processed by combustion.

8) Sanwa Kinzoku Corporation

【Recycling in Pacific】

- Most initiatives and plans for development in island countries will entail higher costs.
- American-made balers for processing metals can be used to compress and pack PET bottles and used paper into bales that would fit efficiently into a 40-foot container.
- Recycling businesses in small-island countries will have to engage in the recycling of all types of waste materials.
- Waste collection problems should be tackled even if such processes are costly.
- Even if labor-intensive forms of waste collection are possible at present, collection methods will eventually have to be carried out by machines once economic conditions improve, as workers would begin to seek cleaner and safer working environments.
- Steel and non-steel are subject to international pricing and will experience violent fluctuations. However, materials of a high quality that are free from foreign particles will always be in high demand. It is important to listen to customer requests and produce materials that are reliable and of high quality. Once quality is assured, they will be purchased by manufacturers.

【Contributions to the Oceanic Region】

- Supervision should not only be in the form of providing subsidies and technical support, but also the provision of guidance in the planning and management of businesses.
- Both Naha Port and Nakagusuku Port can be utilized when shipping raw materials to Okinawa. Balers should be used during the packing process if materials are to be shipped in containers from the Pacific region.
- In the event that recycling companies from Oceanic countries visit Okinawa, Sanwa Kinzoku wishes to convey to them that a variety of products may be marketed and sold.

④Electricity and Energy

With its lack of mountains and rivers, Okinawa is unsuited to hydroelectric power generation and has remained dependent on fossil fuel for a large part of its energy needs. In particular, the outer islands of Okinawa have inevitably introduced a system of dispersed small-scale power generation that makes use of diesel-operated power generators. However, high diesel prices and the added costs of transporting diesel to outlying islands make it necessary to reduce fuel expenses. As such, outer islands have also begun to utilize alternative energy sources such as solar and wind power.

Nevertheless, as the instability and variability of renewable energy sources may negatively affect the quality of electricity in small-scale power generation systems such as its voltage and frequency, the development of techniques for power system stabilization has been in progress. One notable example in the area of solar power

generation is the “Year 2009 Off-Grid Renewable Energy Demonstration Project for Remote Islands” led by the Ministry of Economy, Trade and Industry. In addition to evaluating the impact on the normal power grid of introducing solar power systems to off-grid power systems on Miyako Island, Yonaguni Island, Kita-Daito Island and Tarama Island, all of which have power systems of varying sizes, field tests to verify measures aimed at stabilizing power supply such as storage batteries and capacitors are also being conducted. In terms of wind power generation, the “Year 2009 Research Project for the Establishment of Self-Sufficient Energy Systems for Island Regions”, a project jointly supported by the government and Okinawa prefecture, introduced two collapsible-type windmills and also power stabilizing devices in the form of flywheel generators in Hateruma Island. With the introduction of flywheel generators, which are versatile, low-maintenance devices with long equipment lives, fluctuation in power generated by windmills due to changing wind conditions have been minimized, allowing for the establishment of a system that maximizes the usage of power generated by windmills.

In addition, efforts to stabilize power systems without the use of costly storage batteries have prompted the development of techniques to limit the burden borne by utility customers. Also, renewable energy systems have been built using commercial products in a certain offshore island in order to ease the maintenance of such systems. In this way, Okinawa has accumulated technical knowledge and know-how related to renewable energy sources for island regions.

Following this, a study was conducted to survey business companies engaged in three types of systems that are related to renewable energy resources.

【Water Supply System Utilizing New Forms of Energy (Solar Light)】

Due to the small scale of power systems in outer islands, fluctuations in solar light and wind power will significantly affect electricity quality in terms of voltage and frequency. This has prompted the development of strategies to stabilize the output of renewable power sources. Up until recently, techniques were centered on the use of power storage batteries but high costs and the need to replace batteries that have reached the end of their equipment lives limit the implementation of such techniques at present due to economic concerns. In Miyako Island, research on methods to stabilize output from renewable energy resources by controlling the load placed on pumps that pump up water from farm points which store water for agricultural purposes is currently being conducted. Through techniques that seek to minimize the capacity of storage batteries necessary for the introduction of renewable energy, enhancements to the stabilization of output from renewable energy sources and economic viability can be anticipated.

【Renewable Energy Systems Constructed with Commercial Products】

While the introduction of renewable sources of energy such as solar and wind power has been active in the outer islands of Okinawa, response to technical faults and equipment malfunction leads to problems such as lengthy periods of interrupted service, a decreased rate of capacity usage and high costs of sending technicians from the Japanese mainland. The need to resolve such issues has led to the know-how of prioritizing the creation of a system by combining many smaller commercial products over the construction of large-scale customized equipment. The introduction of such a system allows for partial suspension of system services in the event of a technical malfunction and an increase of the capacity usage rate. In addition, the ease of procuring commercial supplies means that merits of reducing high costs of hiring specialist technicians can be anticipated.

【Parts Supply System Inclusive of Software Support】

The Okinawa Mold Technology Institute was established with the aim of vitalizing the prefecture's manufacturing industry by attracting mold manufacturers through the nurturing of talented youth to become mold technicians. In addition, Okinawa is also promoting the transformation of Naha Airport into an international transportation hub and the effective utilization of the special free-trade zone in Uruma City. On the other hand, countries and territories in Pacific are facing problems in procuring replacement parts for diesel engines.

Based on the backgrounds seen in Okinawa and Pacific, seeds in the form of Okinawa's technology and infrastructure can be utilized to fulfill the needs of countries in the Oceanic region. Such international cooperation makes it possible for the development of a future business model that can be extended into the rest of Asia.

- ※ By optimizing its 4-hour geographical proximity to the major Asian cities of Beijing, Hong Kong and Seoul, Okinawa is promoting the establishment of Naha Airport as a logistical hub. In 2009, a new cargo terminal was constructed on 70,000m² of land, paving the way for All Nippon Airways (ANA) to utilize Naha Airport as a transit hub to commence air freight services linking the three domestic airports of Narita, Haneda and Kansai with international airports in cities such as Seoul, Shanghai, Hong Kong, Taipei and Bangkok.

1) Okinawa Mold Technology Institute

【Resource Overview】

- Technology and know-how on the manufacturing of mold and mold parts
- Various types of processing equipment (High-speed machining center, five-axis machining center, injection molder, etching electrical discharge machine, thermal treating equipment)

【Applicable Areas for Resources】

- Mold building
- Environmental energy-related fields (electric vehicles etc.)
- Metal working (metal parts)

【Merits of Application to Oceanic Region】

- Tapping into young talent educated in engineering at universities, technical colleges and high schools in Okinawa and promotion of employment within the prefecture.
- As demand for mold and metal working is limited in Okinawa, new demand can be created by targeting markets overseas.

【Challenges Facing Support and Capitalization】

- Need to nurture skilled and competent global and business talent
- Need for the development of on-site support.
- Need for opportunity to identify needs and ascertain conditions of actual site.

2) Okinawa Kobori Denki Ltd

【Resource Overview】

- Electrical instrumentation equipment work, power generation equipment, expertise and technology of maintenance and inspection of water and wastewater equipment
- Expertise and technology of new energy systems through construction, retail, maintenance and inspection of new energy equipment.

【Applicable Areas for Resources】

- Infrastructure for electrical power such as equipment for power generation
- Water and wastewater management
- New energy systems

【Merits of Application to Oceanic Region】

- Utilization of practical knowledge and technology of building and constructing new energy systems

【Challenges Facing Support and Capitalization】

- Detailed on-site research necessary to develop concrete action plans for market expansion and development.
- National or prefecture-led initiatives for demonstrated development are necessary to further improve the PV pump system.
- Intermediary between actual site and Okinawa is necessary. Presence of interested companies on-site would be ideal.

3) Higa Kogyo Co., Ltd

【Resource Overview】

- Oil refineries, power generation stations, expertise and know-how on plant construction and protection works
- Expertise and know-how related to the laying of aqueducts and water lines as well as other construction work concerning water supply facilities
- Industrial equipment such as welding machines, presses and cutting machines

【Applicable Areas for Resources】

- Energy field such as power generation stations and oil refining plants
- Water supply field

【Merits of Application to Oceanic Region】

- As markets in Okinawa are small and limited in size, international cooperation with Oceanic countries is expected to help in the development of new markets and expansion of sales routes.

【Challenges Facing Support and Capitalization】

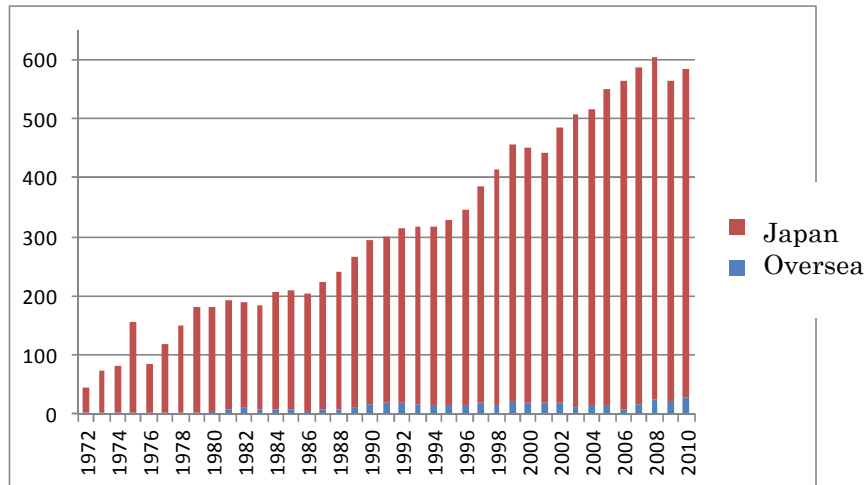
- Need to examine schemes to aid profitability of small and medium enterprises in Okinawa.
- Need for support regarding documentation procedures such as contracts for the export of materials and machinery, as well as agreements concluded on-site.
- Need for linguistic support (English) when carrying out research and marketing activities on-site.
- Need to nurture technical specialists able to communicate with foreign counterparties in English.
- Detailed on-site research required for the development of concrete business expansion plans.

⑤Tourism

Tourism in Okinawa has developed against a backdrop of improved social infrastructure led mainly by the government, its rich natural surroundings centered on the “3S” (sun, sand and sea), as well as resources for tourism and resorts that have been drawn from its unique history and culture.

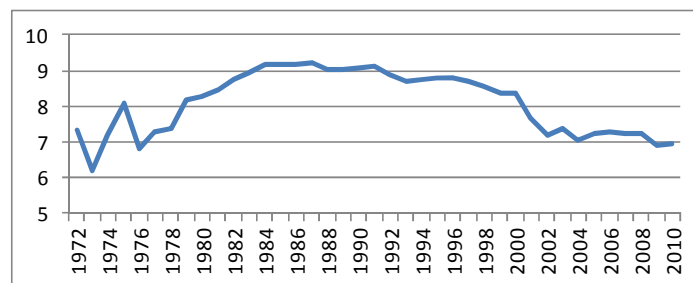
The number of tourists to Okinawa has increased steadily from 440,000 in 1972, the year that maintenance of social infrastructure began, to over 6 million in 2008, making Okinawa one of the leading tourist destinations in Japan.

Enhancements to infrastructure such as improved access by air, construction of new accommodation and tourist facilities, together with tourism promotion efforts led by the combined efforts of the government and the private sector, are factors that account for the increased significance of Okinawa’s tourism industry.



Shifts in Number of Tourists

Based on data from the Tourism Statistical Survey Year 2010



Shifts in Per Capita Consumption within Okinawa

Based on data from the Tourism Statistical Survey Year 2010

Direct tourism revenue through tourist consumption, as well as investments including the construction of accommodation and tourist facilities, has received a boost together with the development of the tourism industry. In addition, public awareness surrounding Okinawa has risen in domestic markets across Japan, leading to strong expansion of the health food and Awamori industries, as well as promotion of the branding of local agricultural and marine products, making tourism one of the core industries of Okinawa's economy.

In terms of tourism revenue however, price reductions of tour products and growing variation in holiday trends have led to a stagnation of per capita tourist spending.

This has spurred moves by groups within the local community and the private sector seeking to boost the diversity of tour products, such as the provision of high value-added tour products, as well as experience and residential-based types of tourism.

In addition, prefecture-wide studies are also being conducted in anticipation of negative effects on tourism resources caused by increased visitor numbers.

1) Various Studies and Tourism Development Plans

The administrative body for tourism in Okinawa has been making improvements to a number of data surveys such as the annual "Tourism Statistical Survey", which are reliable sources of data and statistics about the tourism industry in Okinawa. The statistical survey measures basic indicators such as per capita tourist spending within the prefecture, tourist preferences and characteristics, as well as forecasts of economic spillover effects from tourist consumption and tourist satisfaction rates.

Based on survey findings, the administrative body also sets out the "Master Plan for the Promotion of Tourism in Okinawa Prefecture", a 10-year plan listing mid to long-term

goals for the industry and the 3-year “Okinawa Prefecture Tourism Promotion Plan”. To achieve annual objectives aimed towards the actualization of overall goals, the administrative body drafts a “Visit Okinawa Plan” each year and oversees the deployment of several measures and policies. The “Visit Okinawa Plan” sets out objectives for the tourist promotion plan and targets specific markets for tourist promotion in each particular year. Measures that go towards the achievement of such goals are also listed in concrete terms.

The prefecture of Okinawa has maintained the reliability of tourism-related statistics by conducting research through cooperation with specialist tourism think-tanks, data research firms and private-sector bodies related to tourism.

2) Tourism Promotion

The development of direct air routes between target markets and tourist destinations is an integral factor to increasing tourist figures. Within Japan, direct commercial flights have been established with main domestic airports including Tokyo and Osaka. While there were three direct international routes in 2008 (via Taipei, Seoul and Shanghai), this has since increased to a total of nine direct international flights in recent years by the carriers China Airlines (Taipei, Taiwan), Asiana Airlines (Incheon, South Korea), China Eastern Airlines (Shanghai, China), Hong Kong Express (Hong Kong), Dragonair (Hong Kong), Hainan Airlines (Beijing, China), Air China International (Beijing, China), Continental Airlines (Guam) and Mandarin Airlines (Taichung, Taiwan). The expansion of international air routes is a direct outcome of joint promotional efforts by Okinawa prefecture and the Okinawa Convention and Visitors Bureau (OCVB), as well as top-level sales through personal overseas visits by the prefecture governor.

Tourist promotion activities aimed at both domestic and international markets have also been conducted mutually by the prefecture government and OCVB. In recent years, promotional efforts have been carried out in five cities bound by direct international flights to Okinawa (Taiwan, South Korea, Beijing, Shanghai and Hong Kong) as well as America, one of the new markets targeted for expansion.



Map Showing Direct International Air Routes to Okinawa

3) Strategies to Cope with Diversification of Needs

In response to an increase in demand and a diversification of needs within the tourism industry in Okinawa, efforts geared towards nurturing skilled industry talent and the promotion of international conventions and incentive tours have been carried out. Moreover, there have also been moves towards the development of sports tourism, which includes initiatives centered on local communities such as sport camps for professional baseball and soccer teams, as well as sports events such as marathons and triathlons. Within the private sector, the creation of tourism based on health and recreation, high value-added tour products that include resort weddings and health tourism, of which spa holidays is most representative, and experience-based tours within eco-tourism have grown increasingly significant.

For instance, the number of resort weddings held in Okinawa has increased dramatically from 200 in 1999 to 8189 by the year 2010. Overseas requests for resort weddings from markets such as China have also been accepted in recent years. Particularly, strategies such as technical know-how for wedding photography have been developed in response to the needs of Chinese customers, for whom the creation of beautiful memories in the form of wedding photography is of great significance.

In addition to the development of local gifts and souvenirs, vitalization of local communities through the sale of local agricultural products (joint cooperation between the tourism, fisheries and agricultural industries) has been achieved through the establishment of retail outlets such “Michi-no-Eki Kyoda” (Yanbaru Local Products Center) and “Michi-no-Eki Itoman”.

An example of efforts geared towards the nurturing of highly skilled industry talent is the “Okinawa Tourist Taxi Employee Certification”, a system of certifying taxi drivers who possess comprehensive knowledge of Okinawa’s history and culture and a keen sense of service.

In order to welcome foreign tourists to Okinawa, maintenance and support initiatives for the acceptance of overseas visitors (Tourism Support Center), basic training courses, surveys of foreign tourist satisfaction, as well as the establishment of the “Okinawa 2 Go” project website, which provides tips and recommendations for individuals traveling to Okinawa on their own, have been introduced in progression.

4) Strategies for the Easing of Environmental Burdens

In light of the sharp increase in tour visitors to Okinawa, moves to study the sustainable creation of tourist and sightseeing attractions commenced in the year 2008. The study is aimed at developing tourist destinations based on the optimization of the carrying capacity, which is namely the achievement of a balanced creation of tourist sites by segregating areas designated for tourism development from those that should be conserved in order to protect important natural and historical resources.

More specifically, prefecture-wide surveys of tourist attractions and marine leisure spots utilized by people from both in and outside of Okinawa are conducted annually to chart factors such as yearly visitor numbers, conditions regarding public parking and restrooms, impact on natural environments as well as counter-measures adopted by local administrative bodies.

2. Overseas Study

Overseas studies were carried out in the four countries of the Independent State of Samoa, Kingdom of Tonga, Republic of Vanuatu and Republic of Fiji.

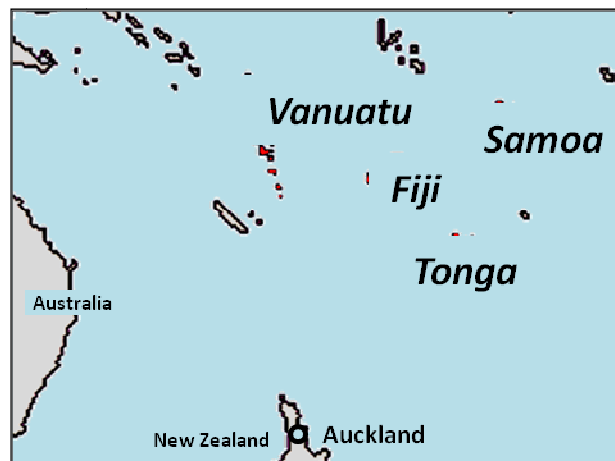
In addition, field research was also carried out in two countries to survey conditions in designated areas of study, namely water supply, resource recycling, power supply and tourism.

Overview of Countries in Survey

Country Name	Independent State of Samoa	Kingdom of Tonga	Republic of Vanuatu	Republic of Fiji
Land Area ¹⁾	2,830km ²	720km ²	12,190km ²	18,270km ²
Population Size ¹⁾	Approximately 180,000	Approximately 100,000	Approximately 240,000	Approximately 850,000
Average Temperature ²⁾	25.7°C	23.3°C	24.1°C	24.7°C
Annual Precipitation ²⁾	2856.3mm	1764.8mm	2664.2mm	2590mm
Core Industries ¹⁾	Agriculture, coastal fishery	Agriculture (copra, coconut oil, pumpkin), fishery	Agriculture, tourism	Tourism, sugar production and apparel manufacturing form 3 main industries

※1 Ministry of Foreign Affairs (<http://www.mofa.go.jp/mofaj/area/index.html>)

※2 Weatherbase (<http://www.weatherbase.com/>)



Geographical Location of Countries in Survey

Time Periods of Study

Area of Study	Target Country	Time Period of Field Research
Water Supply	Samoa	2 nd (Mon) to 5 th (Thu) April 2012
	Tonga	9 th (Mon) to 12 th (Thu) April 2012
Resource Recycling	Samoa	4 th (Wed) to 6 th (Fri) April 2012
	Tonga	9 th (Mon) to 12 th (Thu) April 2012
Power Supply	Samoa	2 nd (Mon) to 5 th (Thu) April 2012
	Tonga	9 th (Mon) to 12 th (Thu) April 2012
Tourism	Fiji	26 th (Mon) March to 2 nd (Mon) April 2012
	Vanuatu	※

※Originally scheduled to take place between 31st (Sat) March and 3rd (Tue) April 2012. However, fieldwork in Vanuatu was called off due to flight cancellation between Fiji and Vanuatu that was caused by tropical storm conditions (which later developed into a typhoon).

2-1. Water Supply

(1) Purpose of Survey

The purpose of this survey was to collect information on the competitive development experience, knowledge and technology of the organizations, local community, human resources in the Okinawa prefecture's local government and private companies, which can be utilized to form the future Pacific cooperation projects.

Regardless of the country or area, water supply is a social infrastructure which is essential for the improvement of the public health and living environment, and it is necessary to build a sustainable water supply system under the various natural, social and local conditions of each country and area.

In Okinawa there are 49 inhabited islands, and with the building of water supply system suited to each island's conditions, for the Pacific island nations with many common points with Okinawa, with the experience and knowledge of the local government and private companies which are engaged in the water supply business in Okinawa, there is a high possibility to effectively contribute to the improvement of water supply in the Pacific area.

With this background, by the collection and documentation of the existing material and inspections on the water supply situation in the survey area, the Independent State of Samoa (Samoa) and the Kingdom of Tonga (Tonga), we intend to understand the issues and needs of both countries, and to organize the possibility of assistance utilizing the experience and knowledge of Okinawa.

(2) Survey schedule and Members

① Survey Period

Total : 29th March 2012 to 14th April 2012
 Samoa : 2nd April 2012 to 5th April 2012
 Tonga : 9th April 2012 to 12th April 2012

② Survey Schedule and Contact

Date	Time	Details and Contact	Country and Place	
29 th March	11:45	Dep. Naha, Okinawa	(transfer)	
	13:35	Arr. Kansai, Osaka		
	18:30	Dep. Kansai Osaka		
30 th March	09:25	Arr. Auckland, New Zealand		
31 st March	20:50	Dep. Auckland, New Zealand		
1 st April	01:40	Arr. Faleolo International Airport, Samoa		
2 nd April	10:00	Samoa survey (01) interview • Specialist on the promotion of yen loans in the field of electricity (SCADA Promotion) Mr. Suezawa	EPC Office	Samoa
	13:30	Samoa survey (02) interview • Mr. Peilini Peilini EPC, Project Management Unit, Acting Manager	EPC Office	
	15:30	Samoa survey (03) inspection	Tanugamanonop Power Generation Plant	
3 rd April	09:00	Samoa survey (04) interview • Mr. Tai'nau M. V. F. T. Titimaea SWA, Managing Director	SWA Managing Director Office	

	09:40	Samoa survey (05) interview • Mr. Tologata G.L.T. Tile Tuimalealifo EPC, General Manager	EPC GM Office	
3 rd April		Samoa survey (06) interview • Mr. Ekiumeni O. Fauolo • Dr. Martin O'Dell • Ms. Levaai Toremana	SWA Office	Samoa
	11:40	Samoa survey (07) interview • Mr. Peilini Peilini EPC, Project Management Unit, Acting Manager	EPC Office	
	15:30	Samoa survey (08) inspection (Hydraulic power plant)	Samasoni	
		Samoa survey (09) inspection (Hydraulic power plant)	Alaoa	
		Samoa survey (10) inspection (Hydraulic power plant)	Fale ole Fe'e	
4 th April	10:00	Samoa survey (11) inspection	SWA Laboratory	
	11:00	Samoa survey (12) inspection	Fulusou Purification Plant	
	12:00	Samoa survey (13) inspection	Pressure Reduction Valve (near Fulusou Purification Plant)	
	13:30	Samoa survey (14) inspection	Vaovai Bore Hole	
	14:30	Samoa survey (15) inspection	Lake Lano	
5 th April		Survey Report	JICA Office	
	15:20	Dep. Faleolo, Samoa	(transfer)	
	18:30	Arr. Auckland, New Zealand		
6 th April		Documentation of material		
7 th April	06:20	Dep. Auckland, New Zealand		
	10:10	Arr. Fua'amotu, Tonga		
8 th April		Documentation of material		
9 th April	10:00	Tonga survey (01) inspection	Mataki'eua Water Supply Facility	Tonga
	14:00	Tonga survey (02) inspection	Atele area survey	
10 th April	10:00	Tonga survey (03) inspection	Fatai Village Water Supply Facility	
	11:00	Tonga survey (03) inspection	Ha'avakatolo Village Water Supply Facility	
	14:00	Tonga survey (05) interview	Ministry of Lands, Survey & Natural Resources	
11 th April	09:00	Tonga survey (06) interview 1. Mr. Pita Moala TWB Project Manager Head Engineering	Tonga Water Board (TWB)	
	10:30	Tonga survey (07) inspection	Mataki'eua Water Supply Facility	
		Tonga survey (08) inspection	Bottle water manufacturing plant	
12 th April	09:30	Tonga survey (06) inspection (Situation of salination)	West of Tongatapu island	
	12:00	Courtesy visit to the Embassy of Japan		
	14:30	Tonga survey (07) survey on electricity distribution lines	West of Tongatapu island	

13th	12:10	Fua'amotu, Tonga	(transfer)
April	14:15	Arr. Auckland, New Zealand	
14th	08:40	Dep. Auckland, New Zealand	
April	16:50	Narita, Tokyo	
	19:25	Narita, Tokyo	
	22:25	Naha, Okinawa	

③ Survey members

Mr. Masao Nakasone (Okinawa Waterworks Control Center)

Mr. Jun Kuwae (Okinawa Prefecture Enterprise Bureau, General Affairs Planning Department)

(3) Survey results

① Samoa

Samoa consists of the 2 main islands of Upolu with the capital Apia and Savai'i, and 7 smaller islands (Total area 2,820km²). 88% of the population of Samoa receive water supply from SWA, of which one third receive properly treated water supply, but in the outskirts of the city and in the countryside, there is still untreated and unsterilized raw water from boreholes and surface water supplied (It does not meet the Samoa drinking water standards based on WHO). And in the remaining 12% which the SWA does not supply water, it is managed by the village and supplied untreated and unsterilized.

In Samoa, the water supply was stated as one of the priority areas, as a vision for the "Improvement of the quality of life of the people" in the "Strategy for the Development of Samoa (SDS), 2008-2012." Also, "Sustainable water source management" and "Increase of access to safe and reliable water supply" was listed as one of the priority targets in the "Water for Life Sector Plan 2008-2012" which supports the SDS, and the Samoa Water Authority (SWA) has made the "Samoa Water Authority Corporate Plan 2009-2011", with the mission to "effectively managing sustainable water services for the water supply customers", and is working on the strategic issues they are facing.

SWA is an organization established in 1993, and is operating both water supply services and sewerage services. Water is supplied in Upolu Island and Savai'i Island, and sewerage has recently started in the center of the commercial area of the capital Apia.

SWA is organized under the Managing Director (MD) with 6 divisions, and there are 180 staff.

In the survey the survey period was limited, and it was limited to the SWA water supply area in Upolu Island. The survey conducted both interviews from SWA staff and site inspections.

1) Samoa Water Authority (SWA) Office

The interview was done after an explanation of the outline of water supply by the SWA staff, with the staff answering our questions. The interview was done on a wide range of issues from general water supply to water rates.

According to the interview, one of the big issues for Samoa is non revenue water. According to the SWA staff, the rate of non revenue water is high, and the reason is not only water leakage but theft of water and illegal meter operations. Regarding water leakage we have witnessed several leakages during our transfer. There are many leakages in the city area where the pipes were installed between 1980s and 2000. And even when it is repaired pipes of different sizes are used and it is only a temporary measure.

SWA survey results

Contact	Samoa Water Authority Mr. Ekiumeni O. Fauolo (Manager, urban operations and maintenance division) Dr. Martin (Larry) O'Dell (Institutional Development Adviser) Ms. Levaai Toremana	
	Question	Answer
	【Intake of water sources】	
	What is the type of water sources?	River water, spring, underground water and lakes.
	What is the intake amount?	30,000 ~ 40,000m ³ /d in the rivers, and double that including underground water.
	What is the intake method?	It is the intake from the river with natural flow.
	Do you know the amount of storage and recharge of underground water?	We manage the underground water level by water gauge.
	【Pipe line】	
	What is the total length of the pipe line?	It is 400~500km including all pipes.
	What is the maximum diameter?	We are using 350mm for the intake of river water.
	How is the storage tank (source water and treated water)	We do not have a storage tank. There are cases where each household has a tank.
	What is the year of installment and the type of pipe?	In the cities it is installed between 1980 to 2000, and in the other areas between 2001 to 2006. The type of the pipe is PVC and ductile cast iron pipe.
	【Measures for non revenue water】	
	What is the percentage of non revenue water?	65% in the cities, 45~60% in Upolu Island, and 70% in Savai'i island.
	What is the survey method of non revenue water?	We calculate the leakage spot by the difference in the branch meter and the meter of each household, and inspect each household after the branch.
	What is the repair method for water leakage?	The staff repairs it directly. In the city area we know where the leakage is but we cannot repair immediately. (Why cannot it be repaired immediately?) We want to repair it but the pipe itself is damaged and there is a need to repair everything. For that we have to dig up all the roads and that will take 10 years.
	What are the measures for non revenue water?	In Savai'i island there was a high rate of non revenue water by leakage, theft of water, illegal meter operation, but in the village of Asau the rate of non revenue water has dropped from 84% to 28%.
	【Water quality and water purification plant management】	
	What is the maximum turbidity of raw water?	It is at maximum during rain at 200NTU.
	What are the measures for high turbidity?	We respond by slowing the processing speed, and there is no problem with the quality of purified water.
	How often is the water quality inspection?	Raw water is once a month, and purified water once a week.
	What is the water quality standard?	It is compliant with the WHO standards.
	Were there contagious diseases (by water) in the past?	We have not heard of it.
	How is the flow of purified	Purification plant is slow sand filter to chlorine sterilization, and

water?	in areas the raw water is supplied directly (wells etc).
What chemicals are used?	Chlorine (powder) imported from Japan.
How are the chemicals injected and managed?	It is injected by machine (pump). The injection amount is adjusted according to the treatment amount.
How is the work shift of the purification plant?	There are 200 staff in SWA, and 8 are operation controllers, and 4 to 5 managers, and there is a resident caretaker for the night time.
Do you have a rapid filter?	In the regions there are rapid filters.
How is the rapid filter handled?	We understand the benefits that with the small size it can increase the amount of treatment. But it is necessary to manage the chemicals such as flocculants.
【Rate and Management】	
What is the original cost of water supply? ?	It is 50 sene (1 tala = 100 sene) for 200L.
What is the water supply rate?	It is 50 sene up to 200L, and over 200L it is 1.4 tala for each 200L
How is the situation of the installment of meters?	(No comment of the installment situation) 10 can be installed in one day, and there are 6 teams handling the installment.
What is the method if there is no meter?	It is fixed at 20 tala.
What is the supply amount per person?	It is 180L per day, and designed for 250L per day.
【The feeling of the residents towards water supply】	
What is the use of water? (Is it used as drinking water)	It is used as drinking water.
How is the residents mainly drinking water?	From the water supply, bottle water, and rain water.
What is the opinion of residents?	We believe that they are generally satisfied. There are complaints but it is mainly about water leakage.
【Projects】	
What are your present projects?	Installment of pipes in the urban area.
What is the evaluation of past projects?	The residents seem to be satisfied.
What is the expected project?	Reduction of underground water by using surface water. Education on the use of water.
【Measures against drought and water salination】	
Do you increase the water intake of boreholes during draughts?	It is increased.
How do you judge the salination of the borehole?	It is managed by electric conductivity. (We asked at what level do they judge as salination but there was no answer)
In case of salination what happens to the borehole?	There was a case of salination in Savai'i island, and at that time it was abandoned.
What are the measures against drought?	During a drought SWA supplies water by a water truck. Each household also uses the rain water tank.
【Relationship with Okinawa Prefecture】	
How is the training in Okinawa?	It is effective. Especially with the support of Miyakojima city, the study of the slow sand filter pond technology was useful.
What type of support do you want from Okinawa Prefecture?	We would like to have technical support from Okinawa on pipe repair (water leakage measures). Also when giving assistance we would like you to understand the present situation of Samoa (big families and communities).

The high rate of non revenue water greatly affects the sustainable management and the estimation of water demand and supply, (Presently there is a plan to build a water purification plant for the untreated system, but there is a shortage of the amount of water in the water source (water flow amount in summer) against the future water amount demand (estimate), and urgent steps toward improvement are needed. SWA is focusing on measures for non revenue water, and hopes that Okinawa provides technical support on the measures on leakage such as the repair of pipes. At the present, on measures for water leakage there is the grass roots technical assistance by Miyakojima city and technical training by the Okinawa Prefecture Enterprise Bureau on water leakage, and it is expected that it will progress. It was not confirmed by materials, but the non revenue water rate of Asau village in Savai'i island was said to have been greatly reduced.

There seems to be no problem with water salination and the underground water level is managed. But the management of the underground water such as the judgment standards of salination could not be confirmed.

On the water quality, the turbidity of rivers seems to rise dramatically during rain. When the turbidity of raw water rises they respond by lowering the treatment speed, and at the high turbidity of 200NTU it is treated by the Ecological Purification System (slow sand filter). On this survey we could not confirm the measure for high turbidity.

Presently, the training provided by Miyakojima city and Okinawa Prefecture Enterprise Bureau has received high opinion from the Chairman and staff of SWA, and it is expected that the transfer of technology will progress by continuing. There were requests from the SWA staff that at the time of technical support (locally?) to understand the community of Samoa people, and it is necessary to take notice when providing support.

1)SWA Laboratory

We conducted a site inspection and interview at the laboratory adjunct to the local SWA office.

Survey result at the Laboratory

Question	Answer
Frequency of inspections	Once a month for raw water, and once a week for purified water, (Once every three years for heavy metal?)
Water supply quality	As a guideline turbidity is 1~5NTU, and electrical conductivity is 80~100 μ S/cm
Maximum turbidity	20NTU at rainfall
Water quality data	It is input in the personal computers and managed
Staff	For water quality 4 staff

Both raw water and purified water are adequately tested, and the measurement results are managed by the personal computer, and data seems to be accumulated. The staff also answered clearly to our questions. For the maximum turbidity of raw water, it was different from the previous day's interview with the manager (Manager 200NTU, staff for water quality 20NTU), and there is a necessity to confirm the sharing of information within the SWA organization.

2)Field Survey

For the site inspection we used the water quality measurement equipment we brought, and together with the inspection and interview we conducted a parallel water

quality survey as much as possible. The inspection of Fuluasou purification plant water intake point was scheduled but the key to the entrance was not found and the inspection of this place was cancelled. For the site inspection we conducted the measurement of the river upstream of Alaoa Purification Plant, Vaovai area bore hole, the water flow and treated water of the Fuluasou purification plant, Lake Lano and the tap water of the hotel. Apart from the Lake Lano the turbidity at the water source was good. At the river upstream of Alaoa purification plant at first sight it was comparable to purified water.

Results of the water quality survey

	Upstream of Alaoa purification plant	Fatai area bore hole	Water flow into Fuluasou Purification Plant	Fuluasou Purification Plant	Lake Lano	Tap Water
Turbidity	0.0	0.0	0.7	0.6	1.5	※2.3~5.7
Chromaticity	1.6	0.2	0.1	0.0	※55 ↑	※0.1~6.7
Electric conductivity	114	85	148	142	35	110
PH	8.18	7.73	8.16	8.20	6.55	8.02
Salt residue	—	—	—	0.8	—	1.8

※For the chromaticity of Lake Lano it was over the measurement range and could not be measured.

※For the tap water, the figures were not stable (maybe an effect of the contamination of the pipe).

【Fatai area bore hole】

The depth is under 100m, the capacity of the pump is 8L/sec (29m³/h) , it is operated 8 hours a day and provide water to the nearby villages. There was a adjunct reservoir tank (250m³), but it was explained that it is used only in the dry season and not in the rainy season. Water quality is similar to a river and good , and as the electrical conductivity is not high the hardness is expected to be low. There is no chlorine injection and the water intake is supplied directly.



Fatai area bore hole
(Water tank at the back)

【Fuluasou Purification Plant】

There are 2 processing systems and the total is 139,000m³/d. The chlorine injection is done by pump, and according to the treatment amount a solution with chlorine dissolved is injected in the injection room. We questioned the concentration of the solution but there was no answer. But it was confirmed from the result of the water quality test that clarifying and chlorine sterilization is done properly. It is believed that the technology transfer by Miyakojima city has contributed to this.



Fuluasou Purification Plant
Chlorine input equipment

【Tap water】

Tap water was taken from the hotel tap. The turbidity and chromaticity could not be properly measured because of the pollution of pipes. Also, the remaining salt is higher than the treatment at the purification plant, but this may be because of the additional sterilization for the swimming pool.

【Lake Lano】

It is a natural lake in the mountains, and according to the SWA staff it does not dry up all year. The intake is by installing pumps at the depth of 4 to 5m and water intake is done by using the diesel engines on the hill. Water intake capacity is 3L/sec x 2 machines (21m³/h x 2 machines), and in an interval of 2 days the operation is repeatedly stopped, and it provides water to 50 to 60 households. It was explained that after the water intake it is treated with sand filter equipment, but we could not confirm those facilities or equipment (the local driver said he thinks that each household has a filter equipment). On the water quality we could not take a direct sample of the intake water, so we took a sample from a household which is receiving the supply of lake water. At first glance the chromaticity is quite high, and the electrical conductivity and pH is low compared to river water. The effect of the reservoir tank cannot be denied, but compared to other water sources the water quality was not in a good condition.



Also, the road to the intake point of Lake Lano is quite difficult even for 4WD vehicles, and from the viewpoint of fuels costs and labor it is better to have a water intake utilizing solar power.

【Pressure reduction valve】

We also inspected the pressure reduction valve near the Fuluasou purification plant as a survey on the water leakage. The pressure reduction valve is operating properly, and for this system the cause of the water leakage is not the problem of reducing pressure. According to SWA staff, the pressure is reduced from 9kg/cm² to 1.5kg/cm². For the secondary pressure there was a pressure gauge, which was at 200kpa (there was no pressure gauge on the primary side).



Pressure Reduction Valve

3)Summary

In the Upolu island, there is the ecological purification system (slow sand filter) (Alaoa purification plant, Fuluasou purification plant, Malololai purification plant) and rapid filter, and in most of Apia the water provided is treated by the ecological purification system, and in parts of the regions, because of restriction on the procuring of a site due to the customs of the village, rapid filter equipment is introduced.

But there are inadequate parts in the management and operation of the purification facilities, and there are cases where there is no adequate water purification treatment it exceeds the drinking water standards of Samoa. For the ecological purification system, the development of human resources of the SWA staff by the transfer of technology of the Miyakojima model through training in the local area and in Japan has been promoted in Miyakojima city from 2010, but there are reports that there are issues with the management of raw water turbidity fluctuation.

In Samoa there are already purification facilities introduced with the assistance of many countries, and it is important to properly manage the existing facilities, and to develop the human resources of the SWA staff the development of that the present technical cooperation with Miyakojima city and Okinawa Prefecture is expected.

In the outskirts of Apia city and the regional area, raw water of boreholes (underground water), surface water and spring water is provided without treatment and sterilization, and there is a high risk to health of diarrhea and water related infectious diseases, and from the standpoint of the improvement of living infrastructure it is necessary to work towards the resolving the untreated and unsterilized supply areas, and Samoa has the objective of “Increase of access to safe water”.

In the urban area of Apia there are 7 areas of raw water supply systems, and in 4 areas there is a project for the improvement of the system including the introduction of a water purification facility. The existing raw water supply facilities are getting old and there are many issues such as leakage of water, and there is a plan to newly build from the water source to the water supply tap (water intake facility, water conveyance facility, water purification facility and water distribution pond, water distribution facility, and water supply facility including water supply meters), so it is necessary to provide a comprehensive support with the future maintenance and management in view. As mentioned above, because of restriction on the procurement of a site due to the customs of the villages, it is necessary to take all the methods of survey, and consideration from a long term view that the local society can tolerate.

As an urgent issue of SWA, there is a “high leakage and non revenue water rate due to inadequate management”, “low rate of installment of water meters (50%)”, “cheap rate structure”, and all these greatly affect the rate income.

In both the urban and regional areas the water leakage rate is high, and because there is a fixed rate applied to those without water meters, the rate collection is lower

than the amount of water used, and this is one of the reasons of the decline of the revenue income, and the revenue income cannot pay for the cost needed for the operation and management of the water supply system.

Also, the installment of meters to all customers and the review of the rate structure and improvement of the collection of rates, and the measures for rising fuel costs are necessary.

Furthermore, with the increase in population and the economic growth the development of the water source area is progressing, and there are worries about the effect to the raw water quality. To achieve a sustainable water supply system, an important factor is to maintain the ecological purification system with its low cost and easy maintenance and to avoid the increase in water production costs and the requirement of high maintenance and management technology because of degradation of raw water quality, it is necessary to work with the conservation of the water source.

Summary of the issues of Samoa

National Strategy	Improvement of the living quality of the people	Water policy (Higher plan)	Increase of access to safe water Building a sustainable water supply system
	Water resources	Water supply facility	Management and Society
Background	<ul style="list-style-type: none"> ○Surface water, spring water, borehole 	<ul style="list-style-type: none"> ○In the urban areas mainly ecological purification system (slow sand filter), in some areas fast filter equipment is introduced ○In other areas raw water is supplied untreated ○In urban areas conveyance and distribution by mainly natural flow ○Pipe type is mainly PVC pipes 	<ul style="list-style-type: none"> ○Low rate of rate collection ○Expected increase of water demand due to development. ○Difficulty of procurement of sites ○Increase in fuel costs
Issues	<ul style="list-style-type: none"> ○Scarce water resources (large seasonal fluctuation, especially difficult in the dry season) ○Contamination of source water quality by development of the source water area 	<ul style="list-style-type: none"> ○Deterioration of treated water due to inadequate management ○Measures for raw water turbidity fluctuation ○Health risk due to supply of untreated water (contamination of water source by sewerage) ○Leakage due to deterioration of pipes and inadequate management (non revenue water over 40%) ○Low installment rate of meters(50%) 	<ul style="list-style-type: none"> ○Low rate structure ○Fixed rate for no meter installment ○High usage of water per person (250L/person/day, including water leakage) ○Introduction of mechanical facilities due to difficulty in site procurement (difficult to properly maintain and manage after introduction)

②Tonga

The Kingdom of Tonga (Tonga) consists of 170 islands, with an area of 720km², and a population of 104,000. Tonga Water Board (TWB) operates the water operation of all the urban areas of the island, and in the regional villages it is operated by the Ministry of Lands, Survey & Natural Resources, and 85% of the households are connected to the water supply. TWB consists of a Board of Directors with 6 directors including the Chairman of TWB appointed by the Cabinet, and with the “Customer Service Department”, “Financial Service Department”, and “Technical Service Department”. In Tonga in 2009 the National Strategic Planning Framework was formulated, and stated with various policies as a national vision “To create a society in which all Tongans enjoy higher living standards and a better quality of life through good governance, equitable

and environmentally sustainable private sector-led economic growth, improved education and health standards, and cultural development”, and as a objective to “improve the access to water and health in the outlying remote islands” and “improve the water quality in Tongatapu island (including the introduction of a purification facility”.

The capital Nuku’alofa city is located in the Tongatapu island , which has the largest area in Tonga, and 95% of the population of the city receive water supply.

All the water sources are underground water, and the water is conveyed to a distribution pond in the hills, and from the top of the distribution pond after the input of chlorine by hand it is distributed using the natural flow of water.

For the other villages and remote islands the main water source is underground water (in Eua island there is a river), and underground water is pumped to a high water tank and distributed by natural flow of water, but in some areas it is supplied with chlorine sterilization.

In the site survey in Tonga, we have focused on understanding the situation of salination by interview to TWB, Ministry of Lands, Survey & Natural Resources staff, and quality inspection of the boreholes.

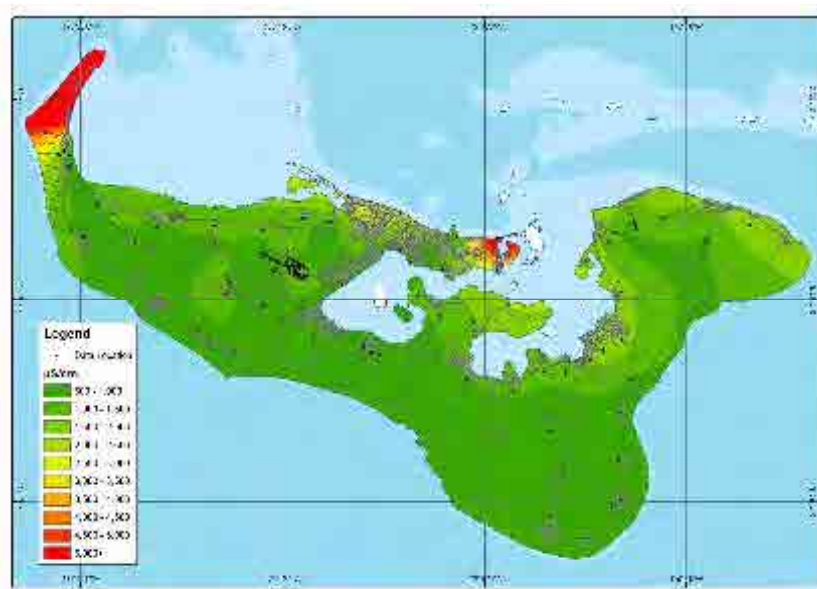
1) Ministry of Lands, Survey & Natural Resources office

After an explanation of the outline by the staff, the staff answered our questions. The interview was done mainly on the water quality as the staff was in charge of water quality.

There is a sense of crisis on salination and there are focusing on the survey and there was a map summarizing the situation of salination. But because of budget restraints inspection items other than salination were not surveyed.

Ministry of Lands, Survey & Natural Resources survey results

What is the area of water quality inspection?	In urban areas it is the TWB, but we have the responsibility for all the supply for the Tonga villages. But in some island the inspection is done locally.
How is the situation of salination?	In the west of Tongatapu the situation is bad. In some places the electric conductivity is 2500~5000 μ S/cm. In the inland area it is 600~900 μ S/cm.
What is the frequency of inspection?	There is a monitoring borehole, and in the Mataki’eua area once a month, and in other areas once every three months.
What are the inspection items?	Temperature, electric conductivity, PH, water level.
Do you measure residual chlorine?	We do not measure but we believe that the Ministry of Health is promoting to put it in.
Do you check rain water?	We do not check rain water. If people drink rain water it is by their own responsibility.
Do you survey the recharge storage of Matakia area?	TWB should have the material.
What are the present issues?	There is a restriction on the budget, and we are importing zero water for the adjustment of measuring gauges but it is expensive. There is also leakage, supply in the villages and salination by excessive pumping.



Togatapu island salination
(provided by the Ministry of Lands, Survey & Natural Resources)
※the red part is the salination area

2) TWB office

The interview was done with the staff answering our questions, on the outline of TWB, water purification management, planning and management.

For the construction plan for the new borehole, there is no detailed survey and it is decided by the monthly monitoring, but we felt that there is a salination risk and a detailed survey of the storage is necessary. For residual chlorine, the monitoring frequency is once a month, so from the viewpoint of “Safe standards for water” it is necessary to increase the frequency of monitoring. As rain water is drunk regularly, the consciousness as using water supply for drinking may be a little thin. Also as a management issue the high water leakage rate has to be improved, and for that the development of both hardware and software to adequately control the intake amount and the supply amount is urgently needed. For the rate system it seems to be calculated by multiplying the amount of water used by the unit price (flat rate).

TWB survey results

Contact Tonga Water Board Mr. Pita Moala (TWB Project Manager, Head Engineering)	
Question	Answer
【Outline of TWB】	
What is the water supply population?	Tongatapu island 40,000, Vava'u island 8,000, Ha'apai island 5,000, Eua island 5,000.
What is the number of water supply?	In Tongatapu island 8,000 households.
Number of water meters installed	Tongatapu island 8,000, Vava'u island 1,000, Ha'apai island 500, Eua island 1,000.
【Water quality and water purification management】	
Water quality measurement items and frequency	The electrical conductivity, bacteria, residual chlorine is measured once a month. For heavy metals it is sent to New Zealand for examination, but there was no problem with the 2009 examination result and it has not been examined after that.

	Chlorine injection	Chlorine injection is fixed by the supply amount. The monitoring of residual chlorine is once a month. It is done at hospitals and several other places but we do not have the exact number of places.
	We went before to the Matakieuva boreholes and the chlorine injection was 3L, and we heard that in case of excess or deficiency the TWB gives instructions, but is it correct?	Yes it is correct. (In this survey we could not confirm the method of checking the excess or deficiency)
【Projects】		
	What is the details of the new project?	By the assistance of ADB we plan to bore 12 new boreholes in the Matakieuva area. Also by changing the present diesel engine pump to an underwater pump, we plan to increase the number of distribution reservoirs.
	What are the expansion plans of the water supply area (village water supply)?	In Fukuvalofa because of the increase in population there is a possibility that the water supply area will expand, but regarding the village water supply presently the jurisdiction is different. In the distant future there may be a possibility.
【Underground water】		
	What is the water supply amount (water intake)?	9,000m ³ per day and in 2015 it is expected to increase to 12,000m ³ .
	Have you done a survey on the underground water residual amount in case of the increase?	We do not know if there is a survey material. But from the monitoring results there should be no problem.
	How is the situation of salination?	Apart from the coastal areas there is no problem. The bigger problem is the hardness, that lime attaches while cooking.
【Non revenue water and rates】		
	What is the rate of non revenue water?	Presently it is 50%. The objective is to reduce to 20%. We believe that most of the non revenue water is leakage, and between the borehole and the reservoir tank.
	What is the leakage amount?	We do not have the exact figure, because the amount used in firefighting is also counted as non revenue water.
	What are the measures for leakage?	As a measure against leakage we form a team and are working on it. The volunteers from Japan have played a large role.
	What is the rate of rate collection?	The collection rate is 98%. Collection is done twice a month. The rate is 2.09 pa'anga per 1m ³ .

3) Site inspectoin

As the water source is only underground water the site inspection was done mainly with boreholes. This survey was only in Tongatapu island due to the schedule. For the survey we used the water quality measurement equipment we brought and measured the situation of salination.

Tonga water quality measurement results

	Matakieuva area No.102	Matakieuva area No.104	Matakieuva area No.106	Matakieuva area No.218	Adele area borehole	Fatai village borehole
Turbidity	0.0	0.0	0.0	0.0	1.9	0.9
Chromaticity	4.7	1.2	0.8	0.6	0.2	0.0
Electric Conductivity	1001	1453	1026	997	996	938

PH	7.04	7.11	7.20	6.96	7.33	6.89
Flow amount (L/h)	2117	1500	1285	—	—	—
	Ha'avakatolo village	※Kolobai village private house	※ Bakalowa beach restaurant	Mataki'eua reservoir	Tap water	Rainwater tank
Turbidity	0.0	3.9	1.6	2.8	0.2	1.0
Chromaticity	0.5	0.0	5.1	0.3	0.7	0.5
Electric Conductivity	1274	1200	631	854	928	43
PH	7.2	7.05	7.77	7.19	7.24	8.62
Salt residue	—	—	—	0.22	※0.28	—

※Kolobai village is supplied from Fatai village borehole

※Bakalowa beach restaurant is a mixed water of Fau'i village water supply and rain water

※the salt residue of tap water may be a bound system from the color condition

【Mataki'eua area】

There are 40 boreholes and 6 reservoir tanks installed in the Mataki'eua area. Out of the 40 boreholes 33 is presently operational. It is 21 underwater pumps and 12 diesel pumps. (the non operating pumps are because of the collapse of the borehole and breakdown, and not the effect of salination).

We inspected 3 underwater pumps and 1 diesel pump in the area (the distance between each borehole is 200m). In the installment area of the underwater pump there was a mechanical flow meter and we measured the intake water amount. As a result, there was a difference in water quality and pumping amount by each borehole, and it is expected that there are different underground water levels and water veins. Also the electric conductivity was high (1000 ~ 1400 μ S/cm, in boreholes of Okinawa 600 ~ 800 μ S/cm) and there is an effect by salination. In the installment area of the diesel engines there was a trace of leakage of oil and it is necessary to improve the management. There is no water level measurement in the intake borehole but there is a monitoring borehole which is measured once a month, and the staff checks the water amount 3 times per day (by the branch valve of the discharge side).



Underwater pump
(installed with EU assistance)



Flow meter in underwater pump



Diesel engine pump

The Ministry of Lands, Survey & Natural Resources surveys the monitoring boreholes once a month, and there are 4 in the Mataki'eua area, and 3 in the nearby areas. The staff wants to add 2 more in the Mataki'eua area. The survey method is by inserting 6 to 7 tubes of different depth into a special tube, and dropping the measurement equipment into the tubes (electric conductivity, temperature, PH, water level). The deepest place we accompanied was 30m and the electric conductivity was 36400 μ S/cm. This result has been sent to a specialist organization and the condition of salination is being analyzed.

In the Mataki'eua area there is a reservoir tank for the intake of water from the borehole.

The following chart is the outline of the reservoir tank.

Outline Mataki'eua reservoir tank

	Capacity	Remarks	Construction site EL
No.1	350~400m ³		EL:25m
No.2	350~400m ³	Not used	
No.3	200m ³		
NO.4	400m ³		
NO.5	1,000m ³	Only half used	
NO.6	1,000m ³		

There are 6 reservoir tanks but only 4.5 are being used. The reason for not using was that "if used the tank water level will go down and we cannot maintain the water pressure." When taking a photograph of the inside of the tank, the walls were white due to the effect of lime. The injection of chlorine was done by hand directly into the tank after the injection equipment has broken down. The injection frequency and amount was 3L per day, and the number of injections was once at 4am. The reason it is 4am is to meet the increase of demand in the morning, and afterwards chlorine injection is done when there is a request from the TWB. When we took water samples and measured at 11am, there was only a minimum amount of residual chlorine and it seems that at the water supply tap there is nearly no sterilization effect.

The flow meter was installed between the flows from the tank, but it was neglected because the inside of the pipe did not become full. The condition of neglect was same in the broken down chlorine injection equipment, and it is necessary to choose the equipment which is hard to break down and develop human resources by the improvement of repair technology of the TWB staff. Especially for the flow amount, in some boreholes there are flow meters installed but the total intake amount is not measured, and with the breakdown in the outward flow meter the supply amount cannot be measured, and these are issues in the management of the intake and distribution amount, so it is necessary to urgently solve the issues for leakage measures and future water supply and demand planning.



Inside of the reservoir tank



Unused electromagnetic flow meter

【Adee area borehole】

It is using solar power generation and the water is pumped to the adjunct elevated tank. The borehole of this area was found during transfer and was not in the inspection schedule.

But there was no fence and only keys in the water intake shed so we went into the facility and did the inspection. The key to the pump shed was open and we could enter into the shed, and we took a sample from the branch tap and measured the water quality. The water quality showed high electrical conductivity similar to the other boreholes.

【Fatai village borehole】

Solar power generation is installed, but it was not used because of the breakdown of the pump, and intake of water was by the backup diesel engine pumps (3600L/h), and pumped into the 2 adjunct tanks. According to the staff, the reason for the breakdown of the pump is because of the breakdown of the valve inside the pump (check valve?). and they have asked the manufacturer for repairs but there is no reply. For the solar panels, in the request form material it is 8, but actually there were only 3 installed, and according to the electricity survey staff (Enetech Okinawa) the direction of the solar panel is not optimal.



Fatai village borehole

Fatai village borehole survey result

Question	Answer
How is the pump operated?	It becomes full with 4 hours in the morning and 4 hours in the daytime.
What is the amount used?	Because there is no meter installed we do not know, but we think that it is same as the capacity of the tank.
What is the capacity of the tank?	It is 5m ³ per tank.
What about chlorine injection?	It is not done.
What about water quality survey?	It is not done.
What is the usage?	Normally it is not used as drinking water, but if there is no rain it is drank.
How many residents and households?	350 people and 62 households.
What about leakage?	There is leakage but a leakage survey is done to each household every month.
When was the pump installed?	The solar system was installed in November 2009, and the pump broke down in January of this year.
What is the water rate?	It is 10 pa'anga per month.

【Ha'avakatolo village】

The interview to the village staff is shown on chart 8. This also uses solar energy. But because of the shortage of the supply amount a diesel engine pump is also used. The solar power generation capacity seemed small, and they want to improve from using it together with diesel engines (use only solar power generation). There was only one staff explaining and he seemed to be in charge of all the water supply.

Ha'avakatolo village interview chart

Question	Answer
How is the pump operated?	When the sun is out 8 hours for solar. That is not enough and the diesel pump is operated for about 2 hours.
What is the amount used?	Because there is no meter installed we do not know, but we think that it is same as the capacity of the tank.
How deep is the borehole?	Solar is 12m, diesel is 10m.
What about chlorine injection?	It is not done.
What about water quality survey?	It is not done.
What is the usage?	Normally it is not used as drinking water, but if there is no rain it is drank.
How many residents and households?	400 people and 56 households.
What about leakage?	There is leakage but the amount is unknown. The repair is done by one staff.
When was the pump installed?	The solar system was installed in December 2011.

【West side of Tongatapu island】

We surveyed the west side of Tongatapu island where salination is advancing. According to the local JICA staff the 3 villages of Hadafu, Kanavakalo, Ahao could not have its own water source because of salination and they receive the water supply from Kolobai village (which is supplied from Fauai village). Also according to Hadafu village residents, the use of water supply was limited to 9pm to 10pm because of the water pressure. For Kolobai village half is its own water source, but the shortage is supplied from Fauai village. In the 4 villages we could not confirm the intake borehole, and we conducted the water quality measurement by samples from a restaurant and private house using water supply. The restaurant was using mixed water of rain water and water supply, and the reason is unknown but the electric conductivity was lower than the other areas.

4)Conclusion

In Tonga the largest issue is for a system to effectively and sustainably use the scarce natural resources, which is that only underground water (freshwater lens) is the water source, and in Tonga there is a sense of crisis for the salination of underground water, and a survey is conducted.

But an increase of water demand is expected with the future increase of population, and an increase in the pumping amount of underground water (increase of intake pump stations) is planned, and there may be a salination of underground water, and underground water conservation by measures against leakage has been done with the assistance of various countries, but the rate of leakage is still high. Presently there are no water purification facilities introduced, and it is supplied only by chlorine sterilization (in the rural areas there is not even chlorine sterilization), and at the moment there is no problem in water quality apart from the high hardness, but with the increase in population and the change of the living environment the increase of the load to the underground water is a concern, and it is necessary to work on both the “amount” and “quality” for water conservation.

Also the cost of power (commercial electricity rate, diesel fuel costs) for underground water intake is a large part of the expenses, and from the viewpoint of healthy management the improvement of the leakage rate is an important factor. As a reduction of cost of power, the change to high efficiency pumps and introduction of solar power generation is needed.

In the regional villages, the supply is unsterilized and there is a health risk. And in the Mataki'eua area which supplies to the capital Nuku'alofa city, the chlorine injection

equipment introduced 10 years ago by grant aid broke down 5 to 6 years ago, and the operation has stopped without repairs, and afterwards the chlorine injection is done once a day by hand, and from the viewpoint of securing stable safe water it is necessary to improve the residual salt control. In Tonga there is less use of supply water as drinking water from the problem of taste (hardness), and that is one of the reasons of unstable chlorine management and supply of unsterilized water.

The use of rain water as drinking water has issues with the access to safe water, but from the viewpoint of diversification of the use of water resource (contribution to the conservation of underground water) and taste it is an item that should be considered, and with regards to the use of rain water it should be considered without being limited to the framework of the Japanese water supply.

One of the solutions may be the possibility like the local restaurant to mix the supply water and rain water. The actual method would be to inject chlorine in the intake water from the borehole so that there will be a certain amount of residual chlorine to mix with the rain water of each household. There is an issue of the management of residual salt in the mixed water, but it will lead to the improvement of the safety of drinking water and to the conservation of underground water.

Also the issue to be improved is the improvement of the technical ability of the TWB staff. With the grant aid from Japan and the assistance from various countries the issues are temporally solved, but with the inadequate management of the facilities after the assistance, in a few years the same issues will occur, so without limiting to the assistance of equipment, it is necessary to improve the technical abilities and human resources of the TWA staff by technical assistance, and to provide the equipment which can be maintained and managed by TWB.

Conclusion of the Tonga survey

National strategy	To create a society in which all Tongans enjoy higher living standards and better quality of life	Water Policy	Improve the access to water and health in the outlying remote islands Improve the water quality in Tongatapu island
	Water resource	Water supply facility	Management and Society
Background	<ul style="list-style-type: none"> ○Water supply water source is underground water only ○Storage of rain water and use as drinking water in each household 	<ul style="list-style-type: none"> ○The underground water is conveyed to the distribution reservoir in top of a hill by underwater pump (commercial electricity) and diesel pump ○There is a plan to increase the borehole (12)(ADB assistance) ○In the regional area, the water is conveyed to the elevated water tank by diesel and PV ○Nuku'alofa city has chlorine sterilization. But it is intermittent input by hand (Once per day) ○The regional area is unsterilized ○Natural flow from the distribution reservoir and elevated water tank 	<ul style="list-style-type: none"> ○The increase of water demand is expected with the increase of population ○The rise of the pump operating costs (Fuel costs and electricity costs) ○Dissatisfaction with the high hardness
Issues	<ul style="list-style-type: none"> ○Inadequate water intake management (no meter installment) 	<ul style="list-style-type: none"> ○Leakage from the conveyance pipe (ACP8.1km)(10%) ○Breakdown of the chlorine 	<ul style="list-style-type: none"> ○Inadequate rate collection (10%) ○Loss of trust of water

	<p>○Risk of salination of freshwater lens by the increase of intake amount</p> <p>○Risk of underground water contamination from the surface (At the moment no problem in water quality)</p>	<p>injection equipment due to inadequate maintenance</p> <p>○Uneven residual salt density by intermittent injection of chlorine</p> <p>○Health risk due to the unsterilized water supply in the regional areas</p> <p>○Inadequate water distribution amount management</p> <p>○Leakage from the distribution pipe (24%)</p> <p>○Low water output in the highlands (low water pressure, no water output)</p>	<p>supply due to low output and hardness</p> <p>○Improvement of the financial situation by reduction of operating costs (fuel costs and electricity costs)</p>
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2-2. Resource recycling

(1) Purpose of survey

The purpose of the overseas survey was to confirm the situation of the resources of Tonga and Samoa including exports and to collect information on the following 3 items.

- 1) Promotion of 3R in the Pacific island nations and the method of recycling business assistance
- 2) Contribution to the problem of waste in the island nations by the use of the environmental technology (waste and recycling) of Okinawa
- 3) The possibility of business development for the companies of the Prefecture in the island nations

(2) Survey schedule and members

① Survey period

Total : 2nd April to 13th April 2012

Samoa : 4th April to 6th April 2012

Tonga : 9th April to 12th April 2012

② Survey schedule and contact

Date	Time	Details and Contact	Country and Place	
2 nd April	12:55	Dep. Naha, Okinawa	(transfer)	
	15:30	Arr. Narita, Tokyo		
	19:00	Dep. Narita, Tokyo		
3 rd April	08:45	Arr. Auckland, New Zealand		
	16:10	Dep. Auckland, New Zealand		
	20:00	Tongatapu, Tonga		
4 th April	09:00	Tonga survey (01) interview • Mr. Asipeli Pakl Director • Ms. Mafile'o Masi SNR Environmentalist	Ministry of Environment and Climate Change (MECC)	Tonga
	11:00	Tonga survey (02) interview • Mrs. Lee Miller	Waste Authority Ltd.	
	14:00	Tonga survey (03) interview • Mr. Sinilau Tou Moua Waste Authority Ltd (WAL) , Operation Manager • Mr. Harvard Tupouniua Waste Authority Ltd (WAL) , Chief Accountant	Waste Management Ltd.	
	16:00	Tonga survey (04) interview and inspectoin • Mr. Mana Takadu Waste Authority Ltd (WAL), Landfill Operation Manager	Tapuhia Landfill	
	17:00	JICA Tonga office courtesy visit and confirmation of the survey plan • JICA Tonga Representative Mr. Makoto Tsujimoto • Researcher Mr. Shigeki Ishigaki • Mr. Alfned Vaka Programme Officer	JICA Tonga office	

5 th April	09:00	Tonga survey (05) interview • Mr. Mosese Lavemai Ports Authority Tonga General Manager • Mr. Alo Maileseni Ports Authority Tonga Chief Financial Officer	Ports Authority Tonga	
	11:00	Tonga survey (06) inspection	Queen Salote International Wharf	
	14:00	Tonga survey (07) interview • Mr. Alani Schaumkel Accountant	Dateline TRANS-AM Shipping Ltd.	
	16:00	Tonga survey (08) interview and inspectoin Small Industry Area • Mr. Kantaro Ooishi Pacific International (TONGA) Ltd., Manager • Tonga Pure Water Ltd. • Kool Tonga Ltd. • Kool Fresh Tonga Ltd.	Pacific International (TONGA) Ltd.	
	16:45	Tonga survey (09) inspection	Ports Authority Tonga (Custom)	
6 th April	09:00	Tonga survey (10) interview and inspectoin • Mr. Filimone Tu'ikolovatu Amiame Manager • Ofa Tu'ikolovatu Managing Director	GIO Recycling (GIO)	
	13:00	Tonga survey (11) inspection Resource collection operator (Korean company)	Korea House (backyard of a restaurant)	
7 th April	20:05	Dep. Tongatapu, Tonga	(transfer)	
	20:35	Arr. Nandi, Fiji		
8 th April	01:45	Dep. Nandi, Fiji		
	04:35	Arr. Apia, Samoa		
9 th April	10:00	Samoa survey (01) meeting • Chief Advisor Mr. Shiro Amano (JICA specialist) • Operatoinal coordination and training planning Mr. Daido Kanou (JICA specialist)	J-PRISM	Samoa
10 th April	09:00	Samoa survey (02) courtesy visit and inerview • JICA Samoa Representative Mr. Katsuhiro Sasaki • Researcher Ms. Naoko Raka	JICA Samoa office	
	10:00	Samoa survey (03) interview • Mr. Felaefua Zoni Zipanaa Assistant CEO • Ms. Fuchwo vileota Hazardous and Chemical waste • Mr. Setoa Apo Solid Waste Unit	Ministry of Natural Resources and Environment Division of Environment and Conservation Principal Office	

	13:00	Samoa survey (04) interview and inspectoin • Mr. Setoa Apo Solid Waste Unit	Tafaigata landfill Ministry of Natural Resources and Environment Division of Environment and Conservation Principal Office	
	14:30	Samoa survey (05) inspectoin • Mr. Silafau Le'afa Loane Sio Director	Pacific Recycles Ltd. (Resource collection operator)	
	15:30	Samoa survey (06) inspectoin	Recycle basket in town	
	16:00	Samoa survey (07) interview • Mr. Aleni Penina Shipping Manager • Mr. Lorenzo Fepuleai Transport & Stevedoring Manager	Betham Brothers Enterprises Ltd.	
11 th April	09:00	Samoa survey (08) interview • Mr. Tomace Port Master • Mr. Steve Schwalger Assistant Maintenance Supervisor	Samoa Port Authority	
	10:30	Samoa survey (09) interview • Mr. Tapaga Colliwa Principal Shipping Officer	Maritime Department, Ministry of Works, Transport and Infrastructure (MWTI)	
	13:00	Samoa survey (10) inspectoin • Mr. Steve Schwalger Assistant Maintenance Supervisor	Samoa Port Authority (Port site)	
	14:30	Samoa survey (11) interview • Ms. Malaeforo Taua Census & Survey Division and others	Samoa Bureau of Statistics	
	15:00	Samoa survey (12) interview • Mr. Samau Etuale Sefo Managing Director	Polynesian Shipping Ltd.	
12 th April	10:30	J-PRISM • JICA Samoa office survey report	J-PRISM • JICA Samoa office	
	15:20	Dep. Apia, Samoa	(transfer)	
	18:30	Arr. Auckland, New Zealand		
	08:25	Dep. Aucklan, New Zealand		
13 th April	16:50	Arr. Narita, Tokyo		
	19:25	Dep. Narita, Tokyo		
	22:25	Arr. Naha, Okinawa		

③ Survey members

Mr. Takeshi Kushima (Okinawa Citizens Recycling Movement)

Mr. Takuro Nukazawa (Okinawa Citizens Recycling Movement)

(3) Survey result

① Tonga

For the result of the interview and inspection of this survey, we have classified the “Main Visits” in the following chart.

<Main Visits>

● Waste and resource recycling	• Ministry of Environment and Climate Change (MECC)
	• Waste Authority Ltd. (WAL) (Tapuhia Landfill inspection)
	• Waste Management Ltd. (Waste collection operator)
	• GIO Recycling Ltd. (Resource collection operator)
● Ports	• Port Authority Ltd. (Nukuhetulu Port inspection)
	(Custom Department)
	• Dateline TRANS-AM Shipping Ltd. (Shipping Agency)
● Private operators (Small Industry Area)	• Pacific International (TONGA) Ltd.
	• Kool fresh Tonga
	• Kool Tonga
	• Tonga Pure Water

● Waste and resource recycling

1) Ministry of Environment and Climate Change (MECC) 【Tonga survey (01)】

[Laws regarding waste management]

Waste management in Tonga is regulated by the “Waste Management Act” enacted in 2005. This law was developed by the “Tonga Solid Waste Management Project” by AusAID from 2004 to 2008. Above this law there is the “Environment Management Act” which regulates the environmental standards and the EIA (Environment Impact Assessment).

[Main body for waste management (Waste Authority Ltd.)]

With the enactment in 2005 of the Waste Management Act, the Waste Authority Ltd. was set up under the Ministry of Environment and Climate Change in 2007 and started operations in 2008. It handles the collection of waste and the management of the final disposal site.

The Waste Authority has a problem of funds. Because the Waste Authority started collection at a low price, the relationship with the private collection operator Waste Management Ltd. worsened, and the Waste Authority itself faced financial difficulties and could not collect according to plan. Now the reform of the organization and management of the Waste Authority is progressing and led by ADB.

[The waste generation amount and composition]

According to the Tonga’s International Waters Programme (IWP) survey in 2004, in the composition survey of the household waste of Nukuhetulu village (survey of 64 households and 391 people) , 92% is organic waste, and plastic and steel is 2% each. The amount of waste per person per day is 1.29kg.

In the Tongatapu Waste Characterization Survey done by the Waste Authority in February 2008, the amount of waste generated per household per day was on average 2.7kg, and the amount of waste generated is estimated at 0.47kg per person per day.

Also according to the Economic costs of waste in Tonga” in the “SPREP’s International Waters Project” by SPREP in 2006, the expense of waste management in Tonga is 6,500,000 pa’anga (325 million yen). A household in Tonga discharges 1 ton of waste annually, and from the 16,194 households of Tonga there is 16,400 tons discharged. 67% is living in Tongatapu, and it is calculated that 11,000 tons of waste is discharged. Of this garden trees and organic waste account for 65%, and the next is diapers. In a survey of the composition and amount of waste of 61 households of the urban and village area (village area 40, urban area 21), 13% is estimated to be resources.

[Management of the final disposal site]

With the “Tonga Solid Waste Management Project” by AusAID from 2004 to 2008, the Tapuhia landfill was improved to a sanitary landfill, and it is constructed with the capacity of landfill designed for 20 years from the start of operations. In the management of the final disposal site, the high cost of heavy equipment repair is an issue.

[Prevention of illegal dumping and improper processing]

Illegal dumping and improper processing is regulated by the Environment Management Act, but the penalties are not enforced. The enforcement of the compulsory execution of the regulation is a further issue, but generally the administration capability of the Tonga ministries are not high, and it is weak in execution.

[Resource collection operations (recycling operations)]

For a private operator to start a waste collection operation or resource collection operation, before registering the start of the business with the Ministry of Labor, Commerce & Industry (MLCI), it is necessary to first explain the description of business to the Ministry of Environment and Climate Change and have a letter of recommendation issued. After that the Ministry of Labor, Commerce & Industry issues the final business license. In 2012 the resource collection (recycling) operators in Tonga listed by the Ministry of Environment are as follows.

List of Recyclers

1. Gio Scrap Metal →GIO Recycling Ltd.
2. Sunshine Enterprise
3. Ata Rd Recycling
4. Sione Scrap Metal
5. Pacific Express Investment Trading Ltd.

[Construction waste]

There was many construction waste around 2006, but now there is none. Normally it is processed at the final disposal site, but part of waste concrete is used as material. Waste wood and bricks are reused in households.

[Food waste]

Garbage discharged from the household is recycled as feed for pigs and dogs, and also as compost. The main source of food waste from business is a small number of food manufacturers (2 drinking water manufacturers, potato chips manufacturer, Noni juice manufacturer, fish processing operator (sea cucumber and fish)), restaurants and hotels. We introduced the Kuimaaru project of Okinawa recycling into pig feed as an example of recycling of food waste.

2) Waste Authority Ltd. (WAL) interview. Tapuhia Landfill inspection.

【Tonga survey (02) & (04)】

Waste Authority Ltd. (WAL) is a public corporation which started operation from 2008, based on the Waste Management Act of the “Tonga Solid Waste Management Project” by AusAID from 2004. It is now financially independently managed, and it does not receive financial support from the government. It operates the management of the final disposal site and the collection of waste.

[Outline of the waste collection operation]

The total number of customers of the waste collection operation of WAL in Tongatapu Island is 2,987, of which 2,541 is households.

Customers of the waste collection service of WAL

Type	Customers
Household	2,541
Schools	78
Church	87
Business	181
Total	2,987

The collection charge for waste discharged from a household is 10T\$ per month. This charge is collected 4 to 5 times per month (once per week). From December 2011, it was newly decided that the waste will not be collected unless it is put in a WAL designated collection bags, and 4 to 5 black bags with the WAL logo are distributed to each household every month. A charge depending on the size of business (17T\$, 25T\$, 64T\$) is collected from December 2011, from the businesses that there was no collection charge before.

[Separate collection and resource recycling]

At present there is no separate collection at the discharge source. Separate collection was tried before, but because of the lack of promotion to the residents, and because at the final stage it was mixed and processed, it did not become familiar with the residents and did not succeed.

For the recycling of resources, GIO Recycling is collecting the cans (aluminum cans, tin (steel) cans) discharged into a cage (recycle basket) installed in each community, and WAL itself is not operating collections.

[Management of the final disposal site/Tapuhia Landfill]

[Landfill area]

With the assistance of AusAID, a sanitary landfill and leachate treatment facility has been constructed. In the bottom part of the landfill area a geomembrane sheet is installed and above it is covered by a clay layer. The capacity of receiving waste is 6,500ton per year. Cover material can be obtained in Tongatapu, but the price is high (in 2009, 70~80T\$ per 5 m³) and not enough amount can be purchased, so same day covering is not being done. Inside the landfill area, the place to process waste is not separated according to material. The management cost of the final disposal site is a burden on the management of WAL.

[Sewage sludge and leachate treatment]

The final disposal site receives sewage sludge and human waste apart from the other waste, and in the site there is a sewage settlement tank constructed. The sewage sludge is natural dried at the sewage sludge treatment pit (planned capacity 3.5 million litres per year), but is not recycled. The sewage and the leachate are processed together in a revolving sprinkling tank, and is recycled (sprinkler) in the disposal site.

[Stockyard of resources]

Inside the grounds of the final disposal site there is a resource stockyard installed, and tin (steel) cans, aluminum cans, PET bottles, waste household electrical appliances are accumulated. But for the reason that "There is no space.", many resources are directly disposed in the landfill area, and there is a scope to expand the recycling of resources in the future.

The accumulated resources are regularly collected by GIO Recycling.

[Medical waste]

Inside the grounds of the final disposal site, there is a small incinerator for the incineration disposal of medical waste. At the time of the survey, there were several plastic containers with used needles beside the incinerator.

[Equipment and vehicles]

The equipment owned by WAL is as follows. All are parked inside the Tapuhia Landfill (there is also a vehicle workshop). It is one and a half year since the landfill compactor has broken down, but it is abandoned without the procurement of spare parts.

Equipment owned by WAL

Collection vehicles	Waste collection vehicle	3 (which 1 is broken)
	Vacuum truck	1
Final disposal site equipment	Landfill compactor	1 (broken)
	Wheel loader	1

3) Waste Management Ltd. (Waste collection operator) 【Tonga survey (03)】

Waste Management Ltd, is a private company operating the collection of waste and sewage sludge and human waste. The operation started in Tongatapu island from 2001, and at that time Waste Management Ltd. was the only company handling waste and human waste collection. They have 12 staff, and 3 compactors (garbage trucks) of which 2 are operational, one open truck and 3 vacuum trucks. The 2 operational compactors are made in Japan.

[Customers, collection charge and collection amount]

They are collecting waste from 300 customers, both private companies and households. The frequency of collection is different by customer (everyday, several times a week, once or twice per month, collection only when requested). The collection charge for waste is 100 T\$ to 300 T\$ per month (collecting one bin once a week is 200 T\$) . They have tried separated collection, but from the point of profitability now the collection is mixed and brought into the disposal site. Glass bottles were collected before, but because it was not profitable they have stopped. Green waste is collected about 2 tons by open truck once a week (every Wednesday) and made into chip, and then into compost in Mr. Millers home.

Electrical and electronic equipment waste (E-waste) is 100kg per month, and it is recognized as a problem at Waste Management Ltd. The collected waste is taken by GIO Recycling Ltd. and there are expectations for the recycling business of the company.

There is also human waste collection (collection from a Septic Tank). Before human waste was distributed to farmers, but after the enactment of the Waste Management Act the treatment and disposal of humane waste at places other than the final disposal site was prohibited, and now it is all treated at the final disposal site.

4) GIO Recycling Ltd. (resource collection operator)

GIO Ltd. started in 1987, when the present CEO Mr. Monet and his father set up “Uiha and Sons Limited”, and started automobile repairs and body sales. In 1989 they started taxi operations, and in 2000 they started sales of automobile parts. In 2002, with the recycling of scrap metal they expanded into GIO Ltd., and started export to New Zealand and Australia. Their mission is stated as “We make Tongan economic development green.” We list below the answers to the questionnaire and the export amount from January to November 2011.

[Answer to the questionnaire to GIO Ltd.]

Question	Answer
Main discharger of resources	People
Waste collector	Waste Authority Ltd.
Intermediate treatment operator	GIO Recycling Ltd.
Exporter to overseas	GIO Recycling Ltd.
Port management	Port Authority Tonga
Intermediate treatment method	Crusher Machine (Steel)、Bailer (Plastic, Cardboard)

Country of resource export	New Zealand
Amount of resources	Steel 28t per month
Costs for export	Domestic : 300 pa'anga* (15,000 yen) per container (Vavau ⇔ Tongatapu) Export procedures : 432 pa'anga (21,600 yen) per container Transport costs : over NZ\$1,800 (108,000 yen) per container
Customs duty	Inland revenue · Export tariff
Domestic export procedures	There is no quarantine, X ray, sterilization until arrival in New Zealand
Days for export	1 day
Domestic license necessary for export	Payment of Export License to customs, other tax
Loading	Packed into a container and transported by truck
Shipping route	Tonga-Fiji(Suva)-New Zealand

*1 pa'anga = 50 yen, 1NZ\$ = 60 yen

Export amount of resources

Type of resource	Amount
Copper	5,649 kg
Aluminum	3,751.5 kg
Stainless Steel	1,836 kg
Radiators	2,014.5 kg
Motors	24,928.8 kg
Brass Mix	499 kg
Aluminum Cans	7,664 kg

[Issues (intermediate treatment)]

- The dismantling of electronic and electrical equipment waste and automobile waste are not strictly separated by material as it is done in Okinawa.
- Of the waste tyres, the reusable ones are sold in Tonga, but the others which cannot be recycled are abandoned.
- There is not enough security in the accumulation area of automobile waste (rented land), and there is arson and theft.
- Training is necessary for the staff of GIO Ltd.

[Issues (transport and export)]

- For the loading of the resources at port there is only the minimum safety measures. If there is a workshop at port the safety can be increased.
- GIO Ltd. does not have container trucks or container loading equipment.
- The payment to the broker is very expensive.
- Used paper and PET bottles were exported before, but there was no buyer and it was treated as waste at the exported country.

[Future business development]

- From 2012 a mobile large bailer for compressing waste automobiles will be leased from a company in New Zealand, and used for the efficient dismantling of the waste automobiles piled up in the accumulation area.
- A workshop will be rented in the Small Industry Area at a rent of T\$511 a month, and will collect paper and plastic. A bailer and scale to make 1 m³ of paper into 750kg, and plastic into 250~300kg is necessary.
- A new metal stamping machine is necessary, and there was a request for an introduction to products from Japan
- They want to consider the possibility of building a paper mill in Tonga.

[Other resource collection operators]

Recently, Korean and Chinese resource operators have begun operation. According to an employee of a Korean company, steel is exported to Fiji every month, and batteries once every three to four months (Because of the difficulty of obtaining

a license for New Zealand and Korea, it it not exported there). For the batteries, GIO Ltd. is preventing the leakage of fluids, but they seem to discard the battery fluid to the ground, and there is concern about pollution of underground water, soil and sea water.

According to this company they are operating with the license from the Ministry of Environment, but it is clear that the treatment is improper, and it seems that the control and monitoring by the Ministry of Environment is not enforced.

- Ports

- 5) Port Authority Tonga interview

Nuku'alofa Port and Custom Department inspection 【Tonga inspection (05),(09)】

[Cargo amount in Nuku'alofa Port]

The container handled at Nuku'alofa Port in one year is 12,000TEU* for both import and export. Of the containers taken out from Tonga, only 11% of the total is with cargo, and the remaining 89% is empty.

*TEU (twenty-foot equivalent units) : Unit for the capacity of one 20ft container (6.1m x 2.4m x 2.6m \div 39m³)

2011 Export and Import amount (tons)

Type	Import	Export	Total
Dry Cargo	110,700	7,995	118,695
Freezer	22,208	5,885	28,093
Break Bulk	2,529	667	3,196
Squash (Pumpkins)	—	1,580	1,580
Cement	16,456	-	16,456
Vehicles	15,979	201	16,179
Timber	4,992	-	4,992
Light Oils	44,592	-	44,592
LPG	1,412	-	1,412
Total	218,869	16,328	235,197

As seen in the above, the structure is that other than pumpkins, all goods such as vehicles, wood, oil and gas are imported. Also only 7% of the total of Dry Cargo are exported, and there are many empty load on the return cargo. The annual amount of cargo is New Zealand 120,000t, Australia 39,000t, Japan 10,000t and Samoa 5,000t.

[Request of procurement of oxygen tanks for the dismantlement of a grounded ship]

There are many grounded ships around the sea of Tonga, and there was a request for an oxygen cylinder equipment for the welder used to dismantle the grounded ship.

- 6) Dateline Transam Shipping Ltd. (Shipping Agency)

Dateline Transam Shipping Ltd. handles in average 10 containers per month. The 4 months from September to November is the peak season for pumpkins, and 40 containers of 40ft are exported. The top 5 countries are as below.

Dateline Transam Shipping Ltd. trading countries (top 5)

Export	Import
NZ	China
Japan	NZ
Australia	USA
Korea	Australia
USA	Others

The maximum load for a 20ft container is 30.4t, and 40ft container is 50t. Tonga has the two shipping routes of New Zealand – Fiji – Samoa – Tonga (14 days) and Yokohama – Fiji – Tonga. The costs necessary for export and import by marine transport is as below (Dateline Transam Shipping Ltd.).

Marine transport costs

Category of costs	Amount(for a 20ft container)	Payee
PSC (Port Service Charge)	163T\$	Ship Owner
Service Fee	30T\$	Ship Agent
Freight Fee	To New Zealand 3,350NZ\$ (2,100 + 59.9% CABAF)	Ship Owner
	To Australia 2,300 \$ (BAF*)	
	To Japan 3,000US\$ + BAF*	
Handling Charge	125T\$	Port Authority
Bond (will be refunded)	200T\$	Ship Agent
Wharfage Fee	166T\$ / Container	Port Authority
Processing Fee	10T\$ / Entry	
Quarantine Fee (Import)	12T\$ / shipment	
Custom Fee (Export)	20T\$ / 1hour	

*BAF (Bunker Adjustment Factor) Extra charge for the adjustment for fuel (heavy oil) price fluctuation. One factor of addition (adjustment) for ocean freight.

[License for import and export]

To export from Tonga an “Export License” and “Business License” is necessary. Both licenses can be obtained from the Ministry of Labor, Commerce & Industry.

● Private operators (in the Small Industry Area) 【Tonga survey (08)】

7) Pacific International (TONGA) Ltd. interview

This company produces Noni juice and also exports to Japan. In 2011 the production was 30t. To Japan it is exported two to three times per year. 5 years ago 20t was exported every month. To manufacture 20t of Noni juice, 40t of raw material is used, of which 25t becomes trash and they take it themselves to the final disposal site. They have a payment contract with WAL for a Tipping Fee of 150T\$ for 3 months. The waste is generated only during the production period, so a large disposal is several times a year. In June 2011, 50t was disposed. The shipping route from Japan to Tonga is once every month and a half, and comes from Yokohama via Fiji. The transport cost is 300,000 yen to Japan for a 20ft container.

○Kool Fresh Tonga Ltd. (Fish processing)

They are processing fish, and exporting after sealing. The head and bones of the fish are disposed, and there is 100 to 150kg of organic waste per week.

Kool Fresh Tonga Ltd. take it themselves to the final disposal site, and pay WAL a Tipping Fee of 180T\$ a month.

○Kool Tonga Ltd. (Refrigerator and cool storage, air conditioning equipment sales)

It is a related company of Fujitsu New Zealand and handles air conditioning equipment. It also does repairs of breakdown equipment. They sell the valuable and tradable aluminum and copper of the unrepairable equipment to GIO Recycling.

○Tonga Pure Water Ltd. (drinking water manufacturer)

They produce PET bottles. Pacific International Ltd. buys the PET bottle at 70¢. One filter costs 600 \$, and they have 3 filters which are changed once in every 3 months, and are producing drinking water at high cost.

●Outline of the waste and resources treatment of Tonga

Type of waste or resource		Present situation	Future measures	Technolody and knowledge of Okinawa
Human waste and sewage sludge		○Waste Management Ltd. collects regurally from the household (once a year) and it is dried in the drying bed in the final disposal site built by AusAID ※ No recycling	Continuation of proper treatment	Batch treatment method purification tank
Household waste		○Collection by Waste Authority Ltd. (25% of Tongatapu island, and 65% of Nuku'alofa area). Private operator (Waste Management Ltd.) also collects and fill in.	Promotion of reduction of garbage	Education on reduction of garbage
Business and industrial waste		○Either the company brings it to the final disposal site, or contracts with a collection operator	Promotion of reduction of waste Promotion of recycling Promotion of proper treatment	Education on waste reduction and recycling
Bulk waste		○Taken to the final disposal site	Dismantling and separation by the collection operator	Bulk waste crushing technology
Organic waste	Garbage (Household)	○Urban area: Filled in the final disposal site ○Rural area: Buried in the garden, or feed for the domestic animals	Promotion of reduction and inhouse treatment	Reduction and composting at the household
	Organic waste (business and industrial waste)	○Fill in the final disposal site	Recycle as compost and fertilizer	Make into compost, fertilizer and feed
	Garden waste and branches (household and business)	○Fill in the final disposal site ※Partly made into compost by Waste Management Ltd.	Recycle as compost	Composting
Construction waste	Construction waste (wood)	○Fill in the final disposal site ※ Small amount generated	Crushed and recycled as material for boards and fuel	Used as wooden chips
	Construction waste (waste concrete, asphalt)	○Fill in the final disposal site ※Small amount generated	Crushed and recycled as building material	Waste concrete and waste asphalt recycling technology
Hazardous waste	Medical waste	○After incineration, fill in the final disposal site ※Inside the grounds of the final disposal site there is a small scale incinerator facility	Proper collection, treatment and disposal	Proper collection and disposal technology of medical waste
	Waste oil	○Unconfirmed	Collection, proper treatment and recycling	Recycling and proper treatment of waste oil
Resources (other than metal)	Used paper (carton boxes, newspapers and magazines)	○GIO Recycling collects (or is brought in) and is accumulated in the company. ※It was exported to New Zealand and Australia twice in the past, but it was not profitable and now it is not exported.	Securing shipping routes and clients to sell at a proper price	Recycling of used paper

Type of waste or resource		Present situation	Future measures	Technolody and knowledge of Okinawa
		※Others are filled in the final disposal site		
	Old textiles (old cloth and clothing)	○Fill in the final disposal site	Promotion of recycling and use of cascade	Reuse at recycling shops, use as waste cloth
	Glass bottles	○Fill in the final disposal site ※Partly recycled as flowerbeds and construction material	Recycling of non reusable bottles	Glass recycling technology
	PET bottles	○GIO Recycling collects (or is brought in) and after compressing by the bailer, it is accumulated in the company. ※It was exported to New Zealand and Australia twice in the past, but it was not profitable and now it is not exported. ※Others are filled in the final disposal site	Securing shipping routes and clients to sell at a proper price	PET Bottle treatment technology and pre treatment technology (cutting, crushing, separating, cleaning, drying, mixing)
	Hard plastic	○GIO Recycling Ltd. compresses by the bailer, and it is accumulated in the company. ※It was exported to New Zealand and Australia twice in the past, but it was not profitable and now it is not exported. ※Others are filled in the final disposal site	Securing shipping routes and clients to sell at a proper price	PET Bottle treatment technology and pre treatment technology (cutting, crushing, separating, cleaning, drying, mixing)
	Soft plastic (packaging and plastic bags)	○Fill in the final disposal site ※Some are open incineration	Promotion of reduction	Same as above
Metal	Steel (Business and industrial)	○Collected by GIO Recycling Ltd and other resource collection operators and exported to New Zealand	Introduction of equipment Thorough dismantlement and separation at the collection operator	Bailer, cutter, electric furnace Knowledge of dismantling and separaton Proper treatment technology
	Non-ferrous metal (Business and industrial) Aluminium, copper, brass and others	○Collected by GIO Recycling Ltd and other resource collection operators and exported to New Zealand	Introduction of equipment Thorough dismantlement and separation at the collection operator	Bailer, cutter Knowledge of dismantling and separaton Proper treatment technology
	Rare metals	○Collected by GIO Recycling Ltd and other resource collection operators and exported to New Zealand	Thorough collection of equipment with rare metals Thorough dismantlement and separation at the collection operator	Knowledge of dismantling and separaton Recycling technology
	Steel cans	○GIO Recycling Ltd. collects from the 150 Cages in the island (built by AusAID), and exports to New Zealand	Thorough separation discharge	Education on separation discharge

Type of waste or resource		Present situation	Future measures	Technolody and knowledge of Okinawa
	Aluminium cans	○GIO Recycling Ltd. collects from the 150 Cages in the island (built by AusAID), and exports to New Zealand	Thorough separation discharge	Education on separation discharge
Composite materials	Automobiles and motorcycles	○Collected by GIO Recycling Ltd. and some are dismantled and exported to New Zealand ※Some of the items difficult to dispose such as tyres are sold in the country. Others are left in the yard, reused in flowerbeds, and filled in the final disposal site ※Batteries are packed and exported to New Zealand	Securing shipping routes and clients to sell at a proper price Thorough dismantlement and separation at the collection operator Proper treatment of hazardous material such as batteries	Bailer and cutters Knowledge of dismantling and separation Proper treatment technology
	Electrical and electronic equipment waste (E-Waste) ※Refrigerators, air conditioners, personal computers and peripherals, CRT television and liquid crystal television, video cassette recorders, radio cassettes, audio peripherals, small household electrical appliances, mobile phones	○Collected (or brought in) by GIO Recycling Ltd and other resource collection operators, and some are exported to New Zealand (the circuit board has heavy metal and a license and insurance is needed for export to New Zealand) ○Items difficult to dispose such as plastic are compressed by a bailer and accumulated in the company, or filed in the final disposal site.	Securing shipping routes and clients to sell at a proper price Thorough dismantlement and separation at the collection operator Proper treatment of hazardous material such as heavy metal	Collection route for electrical and electronic equipment waste Knowledge of dismantling and separation Proper treatment technology

②Samoa

< Main visits >

●Waste and resources recycling	• Division of Environment and Conservation Principal Office, Ministry of Natural Resource and Environment (and survey of Tafaigata Landfill)
	• Pacific Recycles Ltd. (Resource collection operator)
	• J-PRISM
●Ports	• Samoa Port Authority (and Apia Port inspection)
	• Betham Brothers Enterprises Ltd. (Marine cargo operators) (Japan shipping route)
	• Polynesian Shipping Ltd. (Shipping company) (New Zealand, Australia shipping routes)
●Other ministries	• Maritime Department, Ministry of Works, Transport and Infrastructure (MWTI)
	• Samoa Bureau of Statistics

●Waste and resources recycling

8) Division of Environment and Conservation Principal Office, Ministry of Natural Resource and Environment interview and inspection of Tafaigata Landfill

【Samoa survey (03),(04)】

[Situation of waste collection]

Out of the two main islands of Samoa, the Ministry divides Upolu Island into 15 zones, and the operation is delegated to 8 private waste collection operators. Savai'i Island is divided into 2 zones of east and west, and similarly delegated to 2 private operators for collection. The collected waste is filled in the final disposal site.

[Collection of the resources]

Cans (aluminium and steel) and PET bottles are discharged into recycle baskets installed in the island, and collected by Pacific Recycles Ltd. The collection operator collects bulk waste such as household electrical appliances, automobiles and furniture once every three months, but of the bulk waste, depending on the collection operator, some are recycled (recyclable household electrical appliances and automobiles) and some are dumped in the final disposal site.

[Final disposal site]

The total area is 100 acres, and the disposal area used at the present is 10 acres. The number of collection vehicles per day is 50 in total. The remaining years is 6 years, and after that it will be expanded. There seems to be no daily covering.

J-PRISM has operated an improvement project from 2000, and semiaerobic landfill has been introduced. Now it is operated and managed by the local staff. In the site there are 4 staff, and one excavator, one bulldozer, 2 trucks. With the improvement project a leachate treatment facility has been introduced. The leachate treatment facility consists of aeration and vegetation purification (coral, coconuts, shells, grass) of the reservoir. The reservoir has a pump which circulates the leachate into the disposal site. There is not much spread of waste or bad smell, and the site is relatively well managed.

[Small scale incinerator]

As a Grass roots and human safety grant aid, a medical waste incinerator (treatment capacity under one ton per day) is provided, and the medical waste is incinerated before the final disposal.

[Valuables]

Basically, the valuables such as metal are taken into the site of Pacific Recycles Ltd. adjacent to the final disposal site. After the improvement some of the local residents who were Waste Pickers before were employed for the waste delivery operation (vehicles guidance etc.), but we confirmed that there was people collecting valuables from the waste brought into the final disposal site. On the other hand, many cardboard boxes were disposed, and we assume that the market price for cardboard boxes as recycled goods are low, and that it is not collected.

[Amount and quality of waste]

According to a survey in 2008 by Mr. Fafetai of the Ministry of Natural Resource and Environment, Division of Environment and Conservation Principal Office, Waste Management Unit (at that time) of the waste generated amount and composition survey of 80 households of Upolu Island and Savai'i Island, the amount of waste per day per person was 0.5kg in Apia and 0.4kg in Savai'i.

The result of the waste composition analysis by Mr. Fafetai

- 50% is trees and grass and garbage.
- Plastic and steel is the next highest content
- From this figures with proper recycling 70 to 80% of the waste can be recycled.
- If recycling is possible in Samoa, only 20 to 30% of the waste will be delivered to the site.

9) Pacific Recycles Ltd. (resource collection operator) interview 【Samoa survey (05)】

Pacific Recycles Ltd. is a resource collection operator operating in a land adjacent to the Tafaigata final disposal site. They collect resource by delivery from the general public and with their own collection, and after intermediate treatment export the valuables.

In 2005, when the cooperation project between the government and private sector where the Ministry of Natural Resource and Environment lend the land and the private operators recycle started, Pacific Recycle Ltd. applied and was accepted. From 2006 they have started operations, and apart from the lease of land there receive no financial support from the government.

[Equipment]

2 forklifts (Toyota and Mitsubishi), 2 bailers (made in China), 2 trucks (Toyota and Isuzu)

[Resources handled]

The resources they handle is steel, non-ferrous steel, cans, batteries, PET bottles, electrical and electronic equipment waste. The collected waste is crushed and separated by machine and hand, and then compressed and packaged by a bailer. Electrical and electronic equipment waste is dismantled and separated into steel and circuit boards. Plastic has no market price and is not separated.

[Export]

The selected valuables are loaded into a container and sold to operators in New Zealand (Auckland) and Australia (Brisbane) . Steel is shipped 5 containers (20ft) every month, and the sales is 11,880 SAT(Samoa tara), non-ferrous steel is shipped one container (20ft) every month and the sales is 22,500SAT. Of the sales 75% is variable expenses, and the present net profit is 25%.

Last year, one container (20ft) of PET bottles was shipped to New Zealand, but because of the bad quality (uneven colors, the film not removed) the New Zealand operator refused to buy. In the end, Pacific Recycles Ltd. paid 6,000NZ\$ and had it disposed in New Zealand.

The export of batteries are regulated by law, and Pacific Recycles Ltd. has a “Waste and recycling operation license” and the “Battery handling license” (2 to 4 pallets are shipped every month).

10) J-PRISM 【Samoa survey (01)】

We confirmed the situation of waste management by J-PRISM and Samoa with the J-PRISM JICA specialists.

[Trend on regulation, planning and operations]

- In Samoa, the Solid Waste Management Strategy has been formulated (unconfirmed whether it is the final version). The Waste Management Act was enacted in 2010.
- SREP is formulating a guideline on E-waste (and medical waste, asbestos) with the assistance of EU. It is necessary to watch the outcome of the guideline.
- For batteries, the Basel Convention and Waigai Convention is ratified, and SREP is the promotion center for the Basel Convention.
- For incinerators, there is an incinerator developed by J-PIPS (Vaccination project). It is a hybrid type which can use recyclable energy. It is manufactured by Stella Environmental Science Corporation of Japan (Nagasaki). Over 20 machines are introduced in Cambodia. Also Konan Facility Management of Okinawa has come for the sales of an Okinawa incinerator.

[Business development]

- There is a question on changing the transportation of goods from the the Southern shipping route (New Zealand and Australia) in the South Pacific to Okinawa. If it is the Northern Pacific it is understandable to take to Okinawa. If it is too much centered in Okinawa, it may not be sustainable. It may be better to strengthen the relation with New Zealand and Australia. It is necessary to be careful in changing the present way. Itochu Enex Co., Ltd. is preparing a BOP business survey for the arteriovenous distribution business model in Palau.
- Fiji is the economical and political hub of Pacific. There is a paper mill in Fiji, and there are more possibilities in the field of resources in Fiji.
- In a technical cooperation project “Waste reduction and recycling project” in Fiji, the valuable waste was collected using the trucks provided by the project.
- The deposit charge collection system for drink containers is introduced in Palau, Kiribati and Micronesia. It will be introduced in Fiji from next year.
- The World Bank is starting a waste business survey in cooperation with the private sector by the “International Finance Cooperation”. The idea is to bring an operator from outside. From the point of sustainability, it is necessary to take care that the local operators are not excluded.

[Proposal for Okinawa]

- For the transport of resources, a further strengthening within Okinawa including the remote islands.
- Emphasis on the development of human resources and technical cooperation by using the experience of Okinawa. The knowledge of protecting the island environment (Miyakojima).
- The private sector and NGOs can complement the resolution of the issues of government. JICA mainly gives assistance to the government, and cannot directly give assistance to the private sector or NGOs. We would like to give the technology to the government to develop the private sector and NGOs.

●Ports

11) Samoa Port Authority interview and Apia Port inspection

【Samoa survey (08)】

Samoa Ports Authority is the government public corporation controlling all the ports (commercial ports) of Samoa. It is under the Ministry of Works, Transportation and Infrastructure, but it is an independent organization, and independent in accounting. There is also a government public corporation Samoa Shipping Corporation (SSC), which is in charge of operating the marine transport between the islands.

After the explanation of the purpose of survey from the survey members, they commented that “the idea of a recycle port is wonderful and welcome”.

[Apia Port]

Apia Port is the only international port in Samoa. The operation of Apia port is managed by the four operating companies, Apia Haulage, ASL, Peter & Brothers, Pacific Forum Line. These are the private companies which actually handle the loading and unloading of cargo in Apia port.

[Facilities]

The length of the main pier at Apia port is 182m and the depth is 9 to 11m. There is also a 160m long pier on the northern angle of the main pier. On the south side of the middle of the main pier there is a place for tug boats and pilot ships. Behind is a container yard. Behind the container yard there are 2 warehouses. The warehouses are 1,890m² (30m×60m) . Both warehouses are owned by the Samoa Port Authority (the warehouse was empty and there was only several automobiles). There are two light oil

tanks in the container yard, and these are used to store the imported light fuel, and for civil use.

[Equipment]

All the cargo handling equipment such as the 4 Reach Stackers, a large forklift, small forklift are owned by the operator. There are several operators (Betham Brothers, Transam Samoa etc.). The two tugboats are owned by the Authority. They own the pilot boat and there are 6 pilots. The boarding point is one mile away.

[Port call of ships]

The monthly average number of port calls are 7 containers ships (multi purpose vessel), 1 tanker, 1 gas transporter. The container ships are operated by Kyowa Shipping Co., Ltd. (2), Pacific Direct Line, Reef Shipping, Polynesian Line, Pacific Forum Line (each one). The shipping agents are 5 companies, Transam, PFL/FSA, Betham Brothers, Polynesian Shipping, Tokelau. The regular shipping route is Auckland (NZ) → Lautoka/Suva (Fiji) → Apia (Samoa) → Pagopago (American Samoa) → Nuku'alofu (Tonga) → Auckland (NZ). Two cruise ships also call every month.

[Export of recycle resources]

The amount of waste or recycle resources handled at the port is very small. Before, there was loading of metal for recycling as export cargo to China. It is mainly container cargo, and if the contents are waste or E-waste it comes under the jurisdiction of the Ministry of Natural Resources & Environment.

12) Betham Brothers Enterprises Ltd. (Japan shipping route) and

Polynesian Shipping (New Zealand, Australia shipping route) interview
【Samoa survey (07),(12)】

We visited two companies of the Asia shipping route (including Japan) and the New Zealand and Australia shipping route, and confirmed the transport items and the amount of containers.

Betham Brothers Enterprise Ltd. is the sole agent for the ships operated by Kyowa Shipping group. Polynesian Shipping is a shipping company mainly between New Zealand and the South Pacific countries. The former does not own vessels, but the latter owns vessels

[Shipping route and vessels]

(Betham Brothers Enterprise Ltd.)

They have four vessels and mainly operate the shipping route between East Asia and the South Pacific islands. The vessel is a multi purpose vessel of RORO type carrying both containers and automobiles at the same time, and it calls port at Samoa twice a month. In Japan they call on Yokohama and Nagoya, and Busan and Gaoxiong are also ports of call. All the ships are regular ships and there is no tramp ship calling port.

(Polynesian Shipping Ltd.)

Auckland is their base and they rotate two vessels on the Suva/Lautoka → Apia → American Samoa (Pago Pago) → Nuku'alofu → Auckland shipping route. One rotation is 14 to 16 days, and they call port on Apia once a week. The ship is a container ship loading 600 to 700 TEU, and has ship gear and can handle heavy load. The length is 120m.

[Cargo (general)]

According to the Trade Report by the Central Bank, the largest export of Samoa is coconut oil, followed by fresh fish, noni juice and beer.

(Betham Brothers Enterprise Ltd.)

The cargo handled are mainly cars (new and used cars), but they also transport automobile parts and food (instant noodles). These are all imported cargo from Japan

and East Asia. The auto parts (wire harness) is the raw material of Yazaki group from Indonesia transshipped at Noumea port in New Caledonia and Suba port in Fiji (the transshipment of the South Pacific). There are many imports, but the export from Samoa is coconut oil, noni juice, and nickel is exported from Noumea port.

(Polynesian Shipping)

The main cargo is houseware and construction material, food including refrigerated containers.

(Betham Brothers Enterprise Ltd.)

For recycle cargo they have imported scrap from Malaysia. Before the Beijing Olympics the price of steel rose steeply, and they exported 5 to 6 containers of scrap from American Samoa to Korea and China, but now there is no such transport. The reason is that the price of scrap is not high. They know that a New Zealand shipping company is exporting scrap from Samoa or the South Pacific islands to increase the return cargo, and that it is reexported to China, but that is because there is a broker in New Zealand, and at the moment they are not considering such export of cargo from Samoa.

(Polynesian Shipping)

They are carrying scrap from Samoa and American Samoa by container to New Zealand. The container freight is one to two every time. The owner is Pacific Recycling. The scrap is cut so it can be transported by container. The use of recycling systems and introduction of venous distribution is a good idea, and they are interested. Whether it will lead to marine transport is a matter of cost. They do not transport waste oil at the moment, but they are interested.

[Transport freight]

(Betham Brothers Enterprise Ltd.)

Information on marine transport freight is confidential information and could not be provide.

(Polynesian Shipping)

Marine freight from Auckland to Samoa is 3,200~3,500US\$/20ft container, and from Samoa to Auckland is 1,900US\$/20ft container. The difference in price is because from the Samoa side there is an excess of import. On the outward route 90% is cargo, but the cargo from Samoa is more than 90% empty and transports only 10% of cargo. It is considered that that is better than transporting empty containers.

●Other Ministries

13) Maritime Department, Ministry of Works, Transport and Infrastructure

(MWTD) interview 【Samoa survey (09)】

[Handling of the waste oil of vessels]

Apia port is not a Reception Facility according to the Marpol Convention, and no treatment of waste oil of vessels is conducted, and the private operators take them in a small tank out of port, and it is treated at Auckland and other ports. The person in charge is hoping for an improvement.

※MARPOL 73/78: The 1978 Convention on the international treaty for the prevention of pollution by ship of 1973 : It is designed to prevent pollution of the sea by ships and accidents, and it the international treaty and its protocol states the interdiction of dumping and discharge, duty of notification and procedures for restricted substances (oil from ships, chemical substances, hazardous material in containers, polluted water, exhaust).

14) Samoa Bureau of Statistics 【Samoa survey (11)】

We visited the Bureau of Statistic and obtained the Economic Statistics of Shipping (2010, 2011), which lists the cargo amount of export and import. The latest National Survey was conducted in 2011, and the result are to be announded around August 2012

(the previous survey was 2006). Together with the population, the number of household appliances owned (telephones and mobile telephones, faxes, computers, radio, television, microwave oven, washing machine etc.) are surveyed.

●Outline of waste and resource treatment in Samoa

Type of waste and resource		Present situation	Future measures	Technology and knowledge of Okinawa
Human waste and sewage sludge		○Dried in the drying bed constructed by EU. ※No recycling	Proper treatment	Batch treatment method purification tank
Household waste		○Upolu Island : Divided in 15 zones and collected by 8 private operators, and filled in the final disposal site ○Savai'i Island : Divided in two zones of east and west and collected by private operators, and filled in the final disposal site	Promotion of reduction of waste	Education on reduction of waste
Business and industrial waste		○Either the company bring it to the final disposal site, or contracts with the collection operator	Promotion of reduction of waste Promotion of recycling Promotion of proper treatment	Education on reduction of waste and recycling
Bulk waste		○Collected once in 3 months, and brought in to Pacific Recycles, or filled in the final disposal site	Thorough dismantling and separation by the collection operator	Bulk waste crushing technology
Organic waste	Garbage (Household)	○Urban area : Filled in the final disposal site. ○Rural area : Buried in the garden, or feed for domestic animals.	Promotion of reduction of waste and inhouse treatment	Reduction and composting of waste at the household
	Organic waste (Business and industrial waste)	○Filled in the final disposal site.	Recycle as compost and fertilizer	Make into compost, fertilizer and feed
	Garden waste and branches (household and business)	○Filled in the final disposal site. ※some communities make into compost	Recycle as compost	Composting
Construction Waste	Construction waste (wood)	○Filled in the final disposal site. ※Small amount generated.	Crushed and recycled as material for boards and fuel	Use as wooden chips
	Construction waste (waste concrete, asphalt)	○Filled in the final disposal site. ※Small amount generated.	Crushed and recycled as building material	Waste concrete and waste asphalt recycling technology
Hazardous Waste	Medical waste	○After incineration, filed in the final disposal site	Proper collection , proper treatment and proper	Proper collection and treatment disposal technology of medical

Type of waste and resource		Present situation	Future measures	Technology and knowledge of Okinawa
		※Insid the grounds of the final disposal site there is a small scale incinerator constructed (with assistance from Japan)	disposal	waste Small scale incinerator
	Waste Oil	○Unconfirmed	Collection and proper treatment	Recycling and proper treatment technology of waste oil
Resources (other than metal)	Used paper (carton boxes, newspaper and magazine)	○Filled in the final disposal site.	Securing shipping routes and clients to sell at a proper price	Recycling of old paper
	Old textiles(old cloth and clothing)	○Filled in the final disposal site.	Promotion of recycling and use of cascade	Reuse at recycling shops, use as waste cloth
	Glass bottles	○Filled in the final disposal site. ※The bottles of local beer (Vailima Beer) is collected by the dealers (or brought in) and reused in the local factory ※Some are recycled as flowerbeds and construction material.	Recycling of non reusable bottles	Glass recycling technology
	PET bottles	○Collected by Pacific Recycles Ltd. (or brought in), and after compressing by the bailer, accumulated in the site (provided by the government). ※Pacific Recycles collected and exported to New Zealand but there was no buyer and it was used as landfill. ※Others are filled in the final disposal site.	Securing shipping routes and clients to sell at a proper price Promotion of reduction	PET Bottle treatment technology and pre treatment technology (cutting, crushing, separating, cleaning, drying, mixing)
	Hard plastic	○Filled in the final disposal site. ○Collected by Pacific Recycles Ltd. (or brought in), and after compressing by the bailer, accumulated in the site (provided by the government). ※Pacific Recycles collected and exported to New Zealand but	Securing shipping routes and clients to sell at a proper price	Plastic treatment technology and pre treatment technology (cutting, crushing, separating, cleaning, drying, mixing)

Type of waste and resource		Present situation	Future measures	Technology and knowledge of Okinawa
		there was no buyer and it was used as landfill.		
	Soft plastic (packaging and plastic bags)	○Filled in the final disposal site. ※There is a duty to use biodegradable plastic.	Promotion of reduction	Same as above
Metal	Steel (Business and industrial waste)	○Collected by Pacific Recycles and other resource operators (or brought in), and exported to New Zealand	Introduction of equipment Thorough dismantlement and separation at the collection operators	Bailer, cutter, electric furnace Knowledge of dismantling and separation Recycling technology
	Non-ferrous metal (Business and industrial waste) Aluminium, copper, brass and others	○Collected by Pacific Recycles and other resource operators (or brought in), and exported to New Zealand	Introduction of equipment Thorough dismantlement and separation at the collection operators	Bailer, cutter Knowledge of dismantling and separation Recycling technology
	Rare metals	○Collected by Pacific Recycles and other resource operators (or brought in), and exported to New Zealand	Thorough collection of equipment with rare metals Thorough dismantlement and separation at the collection operator	Knowledge of dismantling and separation Recycling technology
	Steel cans	○Collected by Pacific Recycle and other resource operators from collection points (recycling basket) in the island, and exported to New Zealand.	Thorough separation discharge	Education on separation discharge
	Aluminium cans	○Collected by Pacific Recycle and other resource operators from collection points (recycling basket) in the island, and exported to New Zealand.	Thorough separation discharge	Education on separation discharge
Composite material	Automobiles and motorcycles	○Collected by Pacific Recycle and other collection operators (or brought in), and some are dismantled and exported to New Zealand ※Some of the items difficult to dispose such as tyres are left in the yard and filled in final	Securing shipping routes and clients to sell at a proper price Thorough dismantlement and separation at the collection operator Proper treatment of hazardous	Dismantling technology Bailer Cutters Knowledge of dismantling and separation Recycling technology

Type of waste and resource		Present situation	Future measures	Technology and knowledge of Okinawa
		disposal site ※Batteries are packed and exported to New Zealand (a license is necessary)	material such as batteries	
	Electrical and electronic equipment waste (E-Waste) ※Refrigerators, air conditioners, personal computers and peripherals, CRT television and liquid crystal television, video cassette recorders, radio cassettes, audio peripherals, small household electrical appliances, mobile phones	<ul style="list-style-type: none"> ○Collected by Pacific Recycle and other collection operators (or brought in), and some are dismantled and exported to New Zealand (The circuit board has heavy metals and a license and insurance is necessary to export to New Zealand) ○Items difficult to dispose such as plastic are filled in final disposal site. 	Securing shipping routes and clients to sell at a proper price Thorough dismantlement and separation at the collection operator Proper treatment of hazardous material such as heavy metal	Collection route for electrical and electronic equipment waste Knowledge of dismantling and separation Proper treatment technology

2-3. Electricity and Energy

(1) Purpose of Survey

The purpose of this survey was to collect information on the competitive development experience, knowledge and technology of the organizations, local community, human resources in the Okinawa prefecture's local government, private companies and NGOs, which can be utilized to form the future Pacific cooperation projects.

(2) Survey schedule and Members

① Survey Period

Total : 29th March 2012 to 14th April 2012

Samoa : 2nd April 2012 to 5th April 2012

Tonga : 9th April 2012 to 12th April 2012

② Survey Schedule and Contact

Date	Time	Details and Contact	Country and Place	
29 th March	11:45	Dep. Naha, Okinawa	(transfer)	
	13:35	Arr. Kansai, Osaka		
	18:30	Dep. Kansai Osaka		
30 th March	09:25	Arr. Auckland, New Zealand		
31 st March	20:50	Dep. Auckland, New Zealand		
1 st April	01:40	Arr. Faleolo International Airport, Samoa		
2 nd April	10:00	Samoa survey (01) interview • Specialist on the promotion of yen loans in the field of electricity (SCADA Promotion) Mr. Yosuke Suezawa	EPC Office	Samoa
	13:30	Samoa survey (02) interview • Mr. Peilini Peilini EPC, Project Management Unit, Acting Manager	EPC Office	
	15:30	Samoa survey (03) inspection	Tanugamanono Power Generation Plant	
3 rd April	09:00	Samoa survey (04) interview • Mr. Tai'nau M. V. F. T. Titimaea SWA, Managing Director	SWA Managing Director Office	
	09:40	Samoa survey (05) interview • Mr. Tologata G.L.T. Tile Tuimalealifo EPC, General Manager	EPC GM Office	
	10:10	Samoa survey (06) interview • Mr. Ekiumeni O. Fauolo • Dr. Martin O'Dell • Ms. Levaai Toremana	SWA Office	
	11:40	Samoa survey (07) interview • Mr. Peilini Peilini EPC, Project Management Unit, Acting Manager	EPC Office	
	15:30	Samoa survey (08) inspection (Hydraulic power plant)	Samasoni	
	16:00	Samoa survey (09) inspection (Hydraulic power plant)	Alaoa	
	16:30	Samoa survey (10) inspection (Hydraulic power plant)	Fale ole Fe'e	

4 th April	10:00	Samoa survey (11) inspection	Tanugamanono Power Generation Plant	
	13:30	Samoa survey (12) inspection	Vaovai Bore Hole	
	14:30	Samoa survey (13) inspection	Lake Lano	
5 th April	09:00	Survey Report • JICA Samoa Office Representative Mr. Katsuhiro Sasaki	JICA Office	(transfer)
	15:20	Dep. Faleolo, Samoa		
	18:30	Arr. Auckland, New Zealand		
6 th April		Documentation of material		
7 th April	06:20	Dep. Auckland, New Zealand		
	10:10	Arr. Fua'amotu, Tonga		
8 th April		Documentation of material		
9 th April	10:00	Tonga survey (01) inspection	Mataki'eua Water Supply Facility	Tonga
	14:00	Tonga survey (02) inspection	Atele area syrvet	
10 th April	10:00	Tonga survey (03) inspection	Fatai Village Water Supply Facility	
	11:00	Tonga survey (04) inspection	Ha'avakatolo Village Water Supply Facility	
11 th April	09:00	Tonga survey (05) inspection • TPL CEO Mr. John van Brink	Tonga Power Limited (TPL)	
	10:30	Tonga survey (06) interview • TPL Manager Mr. Lani	Popua Power Generation Plant	
12 th April	09:30	Tonga survey (07) survey on electricity distribution lines	East of Tongatapu island	
	12:00	Courtesy visit to the Embassy of Japan		
	14:30	Tonga survey (07) survey on electricity distribution lines	West of Tongatapu island	
13 th April	12:10	Fua'amotu, Tonga		(transfer)
	14:15	Arr. Auckland, New Zealand		
	14 th April	08:40	Dep. Auckland, New Zealand	
	16:50	Narita, Tokyo		
	19:25	Narita, Tokyo		
	22:25	Naha, Okinawa		

③ Survey members

Mr. Sadao Azato (Okinawa Enetec Co.ltd)
Mr. Louis Kakefuku (Okinawa Enetec Co.ltd)
Mr. Yusuke Kokuba (Okinawa Enetec Co.ltd)

(3) Survey result

① Samoa survey

The interviews in this survey is listed below (refer to the survey schedule). The key word in 【 】 after the reply is the knowledge or the applicable technology which may be gained from Okinawa.

1) Interview with the Specialist on the promotion of yen loans in the field of electricity (SCADA Promotion) Mr. Yosuke Suezawa 【Samoa Survey (01)】

- The government of Samoa has set the objective to provide 50% of the energy by recyclable energy (RE) by 2030. To achieve this objective the best way would be to increase the percentage of hydraulic power.
- But in Samoa the land is owned by each village and the attachment towards the land is strong, and it is very difficult to acquire the necessary land for hydraulic

development.

- Presently there is the construction of the Fiaga Power Generation Plant. Four Mitsubishi diesel power generators of 5MW (5.77MW) will be introduced here. Also from the problem of environment of noise and smell, the existing three power generator of Tanugamanono Power Generation Plant will be moved to Fiaga Power Generation Plant.
- Presently a plan is proceeding to introduce the SCADA system to the National Control Center. The plan is to connect the power generation plants by a communication network and control each power generation plant by remote control from the National Control Center. It is not fully automatic, and the remote control is expected to be by hand.
- The existing SCADA system is not functioning. The operators of each power generation plant communicate by radio and coordinate the output of each plant. Therefore it is difficult to coordinate the voltage and frequency. The operator of the plant sets the voltage of the power generator at a high level, and the voltage of the grid tends to be high.
- There is no Automatic Frequency Control (AFC). The operator monitors the frequency and adjusts by operating the governor by hand.
- The consciousness of the operator towards the control of electricity quality is low. The highest priority is to provide electricity continuously without a power failure.
- China and other countries are actively providing assistance to Samoa. There is a plan to introduce a 400kW battery. But from the viewpoint of waste such as lead, to introduce a battery to this country does not make sense.
- The water depth around the island is deep, and personally Ocean Thermal Energy Conversion (OTEC) is promising.



SCADA system JICA specialist Mr. Suezawa (right side)

2) EPC, Project Management Unit, Acting Manager, Mr. Peilini Peilini 【Samoa survey(02)】

- With the assistance of JICA, ADB, the Power Section Expansion Project is progressing on schedule from 2008 to 2016.
- Of the electricity generated by EPC, 40% is provided by hydraulic and 60% is by diesel.
- The survey of 5 small hydraulic sites is done, and it will soon be finished. The size of 500kW to 2MW is expected.
- There is a plan to introduce RE within 5 years by IPP. The first is to introduce a PV of total 4MW in 4 places, and the second is a 4MW Biogas power generation.

Also by Japanese assistance a 400kW PV is expected to be introduced next year.

- There is no battery installed in each PV, so there is concern of the adverse effect to the grid frequency when the PV output suddenly changes. EPC recognizes the need to ensure the reserve power by diesel. Also, it is necessary to contain the rate of the introduction rate of the PV to less than 20% of the grid load. The maximum load is 16MW, so it is necessary to contain the PV to 3MW.
- With regards to wind power a survey is being conducted at the moment. Observation of wind conditions is conducted in the center and eastern part of Upol Island and north of Savaii Island, but the wind speed is only 1 to 3m/s.
- In ten households of Apolima Island, electricity is provided by a 12kW PV.
- In south of Savaii Island the possibility of hydraulic is being considered. If there is a large amount of power generation, it is considered to transmit it to Upol Island by underwater cable. Between Manono Island and Upol Island the water is not deep, and an underwater cable is installed. 【underwater cable】
- In the fields of the inland area of Upol Island, there is an Independent Water Scheme. In those areas the water supply system using PV will be very helpful.
- When the diesel breaks down the parts are ordered to each manufacturer, but it takes two to four months for procurement. 【metal processing】
- We introduced a solar power generation system using commercial inverters, and they showed interested. 【Recyclable energy system using commercial products】



EPC Mr. Peilini (right side)

3) SWA, Managing Director , Mr. Tai'nau M. V. F. T. Titimaea 【Samoa survey(04)】

- The depth of boreholes managed by SWA are 36 to 190m. The boreholes of Upol island are relatively shallow, and the boreholes of Savaii island are deep.
- In Upol island an electric pump connected to the grid is mainly used to pump up water from the borehole. But at a place more than 50km away from the source of electricity the supply of electricity is unstable, and the pump is operated by diesel. 【Use of new energy】
- The pump used is made by "Grand Horse" Ltd., and the quality is good, and when a change of parts is necessary it can be immediately procured from New Zealand, so there is no problem with maintenance. At the moment, they are not using pipes made in Japan.

4) EPC, General Manager, Mr. Tologata G.L.T. Tile Tuimalealifo 【Samoa survey(05)】

- In Samoa the demand for electricity is growing fast, and diesel power generation which can be constructed in a short time is being introduced. In the future, they would like to change the diesel to PV, biomass and other recyclable energy.

- We introduced the PV, wind power and other recyclable energy of Okinawa Enetec. In Samoa there is a concern that with the introduction of PV the grid becomes unstable, and there was a strong interest in grid stabilization technology utilizing batteries and seawater pumped storage power generation. 【grid stabilization measures】
- One of the major problems in Samoa is the system loss. System loss is more than 18%. To improve the technical loss of system loss, they are upgrading the electric wires, and have bought a simulation software to model the electrical grid. By reducing these losses the electricity rate should be reduced. They would like cooperation in this area.
- They are interested in asset management, and considering buying software for effective maintenance and asset management.

5) SWA, Mr. Ekiumeni O. Fauolo, Dr. Martin O' Dell, and Ms. Levaai Toremana

【Samoa surbey(06)】

- Okinawa Enetec made a proposal on a pump operating system using PV, in the remote villages far from the electrical grid. Most of the pumps of Upol island are using the underwater electrical pump connected to the grid, but in areas not connected to the grid diesel is used. They commented that it would be very convenient to use the PV pump system there. 【Utilization of new energy】
- For tomorrow (4th April) site inspection, we asked to be taken to a site where the pump is operated by diesel.



SWA from right Ms. Toremana, Dr.O'Dell, Mr.Fauolo

6) EPC, Project Management Unit, Acting Manager, Mr. Peilini Peilini 【Samoa survey(07)】

- Okinawa Enetec explained the purpose of this survey. Okinawa Enetec has heard in the past from a technician of an electricity company in Pacific, that it is difficult to procure replacement parts quickly when the diesel facilities break down, and that causes a problem of stable supply of electricity. One of the purposes of this survey is to understand such problems, and to survey the possibility of a system to supply those replacement parts quickly from Okinawa.
- The real problem in Samoa is not the shortage of replacement parts, but because the maintenance plan and the accompanying budget planning is not being done properly. Because the maintenance plan is not drawn up properly, the procurement of replacement parts are haphazard, and the shortage of replacement parts occur.
- There are genuine parts and non-genuine parts. Because there are not many

companies making genuine parts and old parts, when buying parts EPC buys the OEM parts (Original Engine Manufacturer parts). OEM parts are manufactured by a different manufacturer than the engine manufacturer, and approved by the engine manufacturer. When buying parts from a different manufacturer than the engine manufacturer, it is important that the parts fit the engine so they are using OEM parts.

- When manufacturing parts in Okinawa it will also be necessary to get the approval from the engine manufacturer by acquiring a license. From the point of quality and reliability, the electricity companies strongly request that the parts are bought from an OEM company.
- We explained that Okinawa has an international airport which is a logistics hub, and if a parts supply facility is established the replacement parts can be supplied quickly. They commented that if the parts can be bought quickly and at low cost it will be very good.

7) Tanugamanono power generation plant 【Samoa survey(03),(11)】

- From the shut off to the startup of the diesel 15 minutes is necessary. Startup is all by hand. After startup, to have a 100% load it takes another 5 minutes.
- The operator is monitoring the monitor for the grid frequency and operating the governor by hand to control the grid frequency.
- For maintenance, it is difficult to obtain parts in case of a breakdown, and there is a problem of lack of knowledge of machine and electricity.
- The genuine parts are procured overseas from Europe, Australia and New Zealand. When procuring from New Zealand and Australia, when it is quick it comes in 1 to 2 weeks, but normally it takes 1 to 2 months, and it is also very expensive.
- The parts necessary to replace are cylinder liners, piston rings etc.
- They commented that if there is a facility that produces and supplies immediately after receiving the order, and supplies at a low cost it would be very helpful.



Tanugamanono power generation plant



Diesel power generator



Power generator operation board



Interview of the power generation plant staff

Tanugamanono power generation plant



Vaovai Bore Hole



Power panel hut



Power panel



Reservoir tank

Vaovai Bore Hole

8) Vaovai Bore Hole (survey on a candidate site for a water supply system utilizing PV)
【Samoa survey(12)】

- From the borehole the water is pumped up to the tank by an underwater pump. According to the accompanying SWA staff, the depth of the borehole is less than 100m. From the tank to the nearby villages it is distributed using gravity
- The underwater pump is an electrical pump and connected to the electricity distribution line. The flow amount during operation is 8L/s and it is operated 10 to 12 hours per day.
- The tank is a cube 22m×22m wide and long, and the height is 2m and made of concrete, and the upper part is flat, and there is enough space to install a 20~30kW PV.

9) Lake Lano (survey on a candidate site for a water supply system utilizing PV)
【Samoa survey(13)】

- There is a total of six tanks of 10,000L each on the hill, and it is pumping up water using two underwater pumps from an adjacent village to the hill. The distribution of water from the tank to the nearby villages is by gravity. As it is far from the electricity distribution line, the pump is operated by a diesel power generator. The height from the lake surface to the tank is 30 to 50m.
- The tank is operated for 48 hours, and after that it is shut for 48 hours, and this process is repeated. The startup of the diesel power generator is done by hand by SWA staff.

- 700~800m³ of water is supplied to 50 to 60 households every day.
- The fuel cost for the diesel power generator is 600 tara/drum x 2 drum/week = 1,200 tara /week.
- Near the hut of the diesel power generator there is a wooded area, and if that is cut down a site for PV can be secured.



Lake Lano



Diesel power generator hut



Diesel power generator



Reservoir tank

Lake Lano

② Tonga survey

1) Tonga Power Limited(TPL), CEO, Mr. John van Brink interview【Tonga survey(05)】

- First we introduced our company and explained about the purpose of this survey, followed by the interview.
- A 1.3 MW PV is being built with the assistance of New Zealand. The installed capacity of the PV was decided with the result of a preliminary survey that if the maximum grid load is under 15%, there is no effect to the grid even without batteries. The present load is 8MW, and 15% of that is 1.2MW. If the load to the grid is over 20%, it is thought that a battery will be necessary.
- TPL considers that in the future the recyclable energy of wind power, small scale distributed PV system, biomass of wood waste should be actively introduced.
- TPL as a first step wants to build a micro grid, and optimize the diesel and recyclable energy power generation facilities and batteries. As a next step, they want to build a smart grid to control both the power generation and load including the control of the air conditioning facility of the load side.
- When we explained experimental study to stabilize the output of the PV by a pump system in Miyakojima, Mr. Brink was very interested. He mentioned that at the moment there are 26 7kW pumps in Tongatapu island, and it may be applied to these pumps. He was also interested in the seawater pumped storage power generation which our company and Hawaii is considering together. He mentioned that in Tonga he thinks that there is land which can be used for seawater pumped storage power generation. 【grid stabilization measures】
- For the spare parts for the diesel power generator, when ordered it is quickly

delivered and there is no problem at the moment.

2) TPL, Power Generation Manager, Mr. Lani interview and Popua power generation plant survey **【Tonga survey(06)】**

- A 1.3MW PV system is under construction. The DC output is 1.3MW, and the AC output is 1.0MW. There are detailed data and documents, but it is necessary to have authorization from New Zealand, and they could not provide it at the moment.
- The 1MW inverter is composed of 8 rated capacity 125kW inverters. It is made by Emerson Ltd. of U.S. and the type is SPV2400.
- The diesel No. 1 to 6 startup and shutdown automatically. No. 7 is startup and shutdown by hand, but it is operated at a fixed load as a base load machine.
- For No. 1 to 6 the load is loaded equally by PLC. There is also a priority for the startup of those units. When the grid load continuously increases, and the load of the operating unit is more than 85% for 2 minutes, the shutdown unit with the highest priority starts up. When the grid load continuously reduces, and the load of the operating unit is less than 65% for more than 5 minutes, the operating unit with the lowest priority shuts down.
- The cooling water grid is No. 1 to 6 and one grid. The shutdown unit automatically circulates the lubricant for 5 minutes every hour. Therefore the No.1 to 6 units complete 30 seconds from startup. No.7 unit requires 30 minutes for startup.
- The SCADA system presently employed was completed in April 2011. It is a GE product called “GE Cimplicity”, and the function is the monitoring and data storage and it has no control function.



Popua power generation plant



Diesel power generator



Central control room



Interview from Mr. Lani

Popua power generation plant

- For the spare parts the genuine parts of Caterpillar are used. It is bought from an US dealer and it arrives one week after ordering. The parts are cheaper from

the US dealer than New Zealand, so they always buy from US.

- We explained the idea of building a spare parts supply center in Okinawa, and to build a system where the parts can be supplied quickly and at low cost. They commented that if there is such a system it will be very helpful. 【Metal processing】

3) Mataki'eua Water Supply Facility survey 【Tonga survey(01)】

- In this area there are 33 boreholes, and of that 23 boreholes supply water to the reservoir tank in this facility.
- There are six reservoir tanks. The capacity of the reservoir tank is as follows.
No.1 350~400m³
No.2 350~400m³
No.3 200m³
No.4 400m³
No.5 1,000m³
No.6 1,000m³
- The depth of the borehole is 20m. Each borehole pumps up water by pump, but several of the pumps are broken and cannot be used.
- There are 14 pumps operating on diesel of which 12 are operational.
- The electric pumps are underwater pumps and all are connected to the grid. In the pump building, an inverter is installed, and it seems to control the rotation frequency of the pump.
- The flow rate of water pumped up by the pump was estimated by an integrating flow meter installed in the site. In No.102 pump it was 2,120L/h, and at No.104 pump it was estimated to be 1,500L/h.
- There are 7 monitoring boreholes, and once a month there is a survey of water quality.
- The inspection of the borehole and pump is three times a day, AM, PM and early morning. When the water level of the borehole is lower than the position of the pump the water cannot be pumped up, and when this is sighted during the inspection the pump is shut down by hand.
- The leakage of fuel oil was confirmed in a wide area on the surface of the ground around the building of the diesel pump. If this leaks deeply into the soil, there is a concern about the effect of the water quality of the borehole. There was a tussock opposite the road of this site where it is thought to be possible to install a PV. We asked MR. Nafe about the owner of the land, and the answer was that it was owned by the government or the royal family. 【Utilization of new energy】
- The chlorine injection system introduced by the assistance of JICA in the past has broken down and cannot be used. The chlorine is injected by hand into the reservoir tank. The reason seems to be that the equipment introduced was highly technical and was difficult for the technicians of Tonga to maintain and manage.

4) Atele area PV pump system survey 【Tonga survey(02)】

- 8 PV modules of 160W/panel manufactured by BP Solar Ltd. are connected to the 1,500W rated inverter. This operates the underwater pump. At the time of survey there was a vibration from the pipe, and the pump seems to be operating properly.
- A cylindrical shaped tank with a capacity of 5,000L is installed above a mount 10m high made of L shaped angles.
- The PV pump system is a product of Mono-Pumps Ltd of Australia, Series 3000 Sun-Sub SMC Solar Pumping System.



Water reservoir



Pump room



Underwater pump pipe



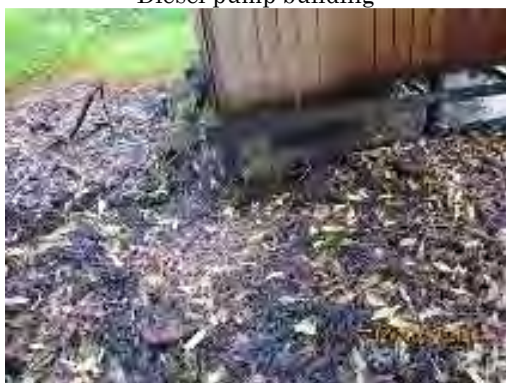
Inverter



Diesel pump building



Diesel pump



Leakage of fuel



Leakage of fuel

Mataki'eua Water Supply Facility



Reservoir tank



PV array and borehole



Inverter



Diesel pump

Atele area pump system

5) Fatai Village Water Supply Facility survey 【Tonga survey(03)】

- The PV pump system was installed in November 2009.
- 3 PV modules of 175W/panel manufactured by Soanar Ltd. (it seems to be an OEM production by Taizhou Sopray LTd.) was connected to a Mono-Pumps Ltd manufactured inverter (rated capacity unknown), and operated the underwater pump. The number of panels of the PV module of the PV pump system in other places are 8 panels, but in this site it is only 3 panels, and it has to be confirmed whether this is the appropriate number of module panels. The PV module should be facing the north, but it is installed facing west. This will affect the obtainable amount of solar radiation of the PV module, and it should be changed to facing north.
- At the time of the site survey the pump was shut down. We asked the local operator the reason, and he told us that it is shut down since the valve of the pump broke down in January of this year (2012). They have asked the contractor for repairs but they have not responded yet.
- At the time of the site survey the backup diesel pump was operating. The diesel operates 4 hours in the morning and 4 hours in the afternoon with a total of 8 hours operation. The fuel of the diesel is supplied 10L once every two days.



PV array and water reservoir tank



PV array



Inverter



Diesel engine

Fatai Village Water Supply Facility

6) Ha'avakatolo Village Water Supply Facility survey 【Tonga survey(04)】

- The PV pump system was installed in December 2011.
- 8 PV module panels of 175W/panel manufactured by Soanar Ltd. (it seems to be an OEM production by Taizhou Sopray LTD.) are connected to a Mono-Pumps Ltd manufactured inverter (rated capacity 1,500W), and operates the underwater pump. At the time of survey there was a vibration from the pipe, and the pump seems to be operating properly.
- The PV module is facing north, but the angle is nearly 0° . If dust and fallen leaves accumulates on top of the module it is difficult to fall off even if it rains, so it is better to have a slight angle of inclination.
- The reservoir tank has a two systems, a PV pump system and a diesel pump system, and each has a capacity of 5,000L.
- The depth of the borehole is 12m (40 feet).
- The village has a population of 400, with 56 households.
- The PV pump system fills the reservoir tank with 8 hours of operation. The diesel pump system fills the tank in 2 hours. The diesel operates for two hours from 5pm. The fuel consumption of the diesel is 1L/h.
- Before the introduction of the PV pump system, a motor pump connected to the grid was used. The electricity bill at that time was 200TOP per month, but now the fuel cost of diesel is 50TOP per month and it is more economical.
- There are no problems as breakdown or troubles with the PV pump system. But if an issue should be raised, the comment was that the capacity is not enough to

service all the water demand of the village.

- During the site survey the backup diesel pump was operating. The diesel operates 4 hours in the morning and 4 hours in the afternoon with a total of 8 hours operation. The fuel of the diesel is supplied 10L once every two days.

③ Conclusion

1) Samoa

With this survey the first thing we felt is that Samoa has the geographical condition, climate, and furthermore, the sociality for the respect of the family and the relationship of the local community, which has many common aspects with Okinawa, and compared to the other areas it is a very big advantage in making an environment of fundamentally understanding each other.

For the electricity infrastructure, we felt that the increase in fuel costs and the issues for the maintenance of a supply of stable electricity is a problem specific to the island area, and the response to these issues are very important for this country.

Okinawa has established the present technology toward the issues specific to these island areas with the effort of many years. We believe that if this technology is utilized together with the development of the electricity infrastructure of this country, there is a large role to be played by Okinawa.

For recyclable energy, there was a great interest from SWA towards the introduction of a system utilizing solar as a water supply system for the regional area. The SWA staff is scheduled to visit Okinawa for the training of JICA, and there was a request to visit the experimental facility of Miyakojima. We are positively responding. Also, for the future development of recyclable energy in Samoa, as there is abundant hydraulic resources, development of hydraulic power generation should be promoted. Unfortunately Okinawa is scarce in hydraulic resources, and in actuality does not have enough hydraulic power generation technology, but there are many promising development sites in Savaii island, and as an effective utilization of hydraulic resources the electric transmission to Upolu island by an underwater cable can be considered. In that case, there is the possibility that Okinawa can make a great contribution with the underground cable technology.

This survey was a short period of 4 days but we conducted an effective survey. We found the possibility to utilize the technology of Okinawa for the maintenance and management of the introduction of recyclable energy and the building of a system suited for the island area.

※Okinawa has 37 inhabited remote islands, and electricity is provided to all those islands. In the small remote islands rather than building a diesel power generation plant and supplying electricity, it is more economical to provide electricity by an underwater cable from a neighboring island, and in Okinawa there are many cases of electricity being supplied by an underwater cable. The installment, maintenance and management of the underwater cable is done with the cooperation of the local companies of the Okinawa Prefecture, and in the prefecture there are companies which have a long experience and technology related to underwater cables.



PV array and reservoir tank



PV array and borehole



PV array



Inverter



Reservoir tank



Diesel pump

Ha'avakatolo Village Water Supply Facility

2) Tonga

With this survey of Tonga, we strongly felt that the people of Tonga have trust and affinity towards the Japanese. Also, most of the people knew the name of JICA, and the activity of JICA is receiving a high estimate. Same as Samoa, the geographical condition, climate, and furthermore the sociality for the respect of the family and the relationship of the local community, has many common aspects with Okinawa, and compared to the other areas it is a very big advantage in making an environment of fundamentally understanding each other.

For the electricity infrastructure, the facility of the power generation plant is well maintained, and the system is a good system. But with the facility expansion for the

future growth of demand, the future issue is how to create a total system consistent with the existing facility. The rapidness of parts supply is one of the reasons for the good condition of the facility maintenance in the power generation plant. We felt that because all the power generators were made by the same US manufacturer and could be procured within one week, this made it possible to maintain the good condition of the facility.

With regards to recyclable energy, there is a 1MW solar power generation plan under construction, and there are plans for wind power and other solar power generation. These are an effective way to solve the issues related to the rise of fuel costs, which is a concern specific to the island area. But because the output of solar and wind is not stable, it may lower the electricity quality of voltage and frequency, and there is concern that it might bring the instability of the electricity grid. From the point of the improvement of quality and maintenance of stable supply of electricity, in the future it is necessary to consider the measures of grid stabilization using batteries for the electricity storage system and controlling the load of the consumer.

For those measures, there is an advanced power generation control system already built in the generator of the Popua power generation plant, and we believe that potentially there is a high capability towards the fluctuation of recyclable energy.

When we introduced the recyclable energy system developed in Okinawa, there was strong interest in the system using commercial inverters and the stabilization system combining the lifting pump and solar energy

With regards to the use of recyclable energy in the water supply facilities, we felt that the combination of the solar power generation system and the pump system was promising. It was actually installed in some places, but there were facilities where the capacity of solar power generation was not enough, or facilities broken down and not operating.

With regards to breakdowns, it seems to be easily repairable if there are replacement parts, and it was very regrettable that a simple problem could not be solved, and they could not receive the benefits of the system. This was completely opposite to the case of the power generation plant, and we strongly felt that the supply of parts is important to maintain the system. In the future, for the people of Tonga to maintain the facilities themselves, it is necessary to provide assistance from both the aspect of hardware and software, the parts supply system of quickly obtaining the necessary replacement parts (hardware), and the technical training for a sustainable and effective operation for the facility (software).

2-4. Tourism

(1) Purpose of the Survey

The survey plan has been drawn up with the recognition that the first priority is to understand the present situation of the tourism in Pacific. Tourism and the related industries in this area are changing dynamically with the effect of globalization, and it is necessary to understand the situation of recent years. In particular, the interview of tourism related governmental organizations and affiliated organizations, and also academic institutions, and inspection of tourism related facilities

(2) Survey schedule and members

① Survey Period

Total : 25th March 2012 to 5th April 2012

Fiji : 26th March 2012 to 2nd April 2012

Vanuatsu: It was originally scheduled from Saturday 31st March 2012 to Tuesday 3rd April 2012. Because of the effect of the tropical cyclone (which developed into a typhoon), the flight to Vanuatsu was cancelled and we gave up the survey.

② Survey Schedule

Date	Time	Details and Contact	Place/Country	
25 th March	12:40	Dep. Naha, Okinawa	(transfer)	
	15:00	Arr. Incheon, Korea		
	19:25	Dep. Incheon, Korea		
26 th March	08:10	Arr. Nadi, Fiji	Nadi Airport Sri Siva Subramaniya Temple Kula Eco Park Baravi Handicrafts JICA Fiji Office	
	09:00	Fiji survey (01) inspection		
	09:30	Fiji survey (02) inspection		
	11:00	Fiji survey (03) inspection		
	12:00	Fiji survey (04) inspection		
	16:00	JICA Office courtesy visit Fiji survey(05) interview • JICA Fiji Office Deputy Director Mr.Yutaka Fukase		
27 th March	08:45	Fiji survey plan confirmation and exchange of information • JICA Fiji Office Mr. Masaaki Ito • Mr. Nawin Dewan, Program Officer, JICA Fiji Office	JICA Fiji Office	
	10:30	Fiji survey (06) collection of material (Collectoin of tourism brochures)	Government Information Center	
	12:00	Fiji survey (07) interview • Ms. Nanise Masau Product Development and Ownership, Ministry of Public Enterprise, Communications, Civil Aviation and Tourism	JICA Fiji Office	
	14:30	Fiji survey (08) interview • Mr. Michael Wong, Chief Executive Officer	Fiji Hotel and Tourism Association	
	15:30	Fiji survey (09) inspection	Fiji National Museum	
	16:00	Fiji survey (10) inspection	Fiji Government House	
	16:15	Fiji survey (11) collection of material (Collection of Fiji Tourism Master Plan(2006~17))	Ministry of Public Enterprise, Com-munications, Civil	

			Aviation and Tourism	
28 th March	09:30	Fiji survey (12) interview • Mr. Petro Manufolau Marketing Manager • Mr. Tarataake Teannaki Capacity & Communications Manager • Mr. Sai Too Go Planning Manger and Webmaster	South Pacific Tourism Organization (SPT)	Fiji
	11:30	Fiji survey (13) interview • Ms. Alrina Ali Senior Public Relations & Investment promotions Officer • Ms. Nilesh Wati Prasad Investment Promotions Officer	Investment Fiji	
	14:30	Fiji survey (14) interview • Professor David Harrison Head of Tourism and Hospitality Management, USP	JICA Fiji Office	
	16:00	Fiji survey (15) inspection	Curio and Handicraft Center	
	16:30	Fiji survey (16) inspection	Jack's	
29 th March	09:30	Suva survey report • JICA Fiji Office Mr. Masaaki Ito • Mr. Nawin Dewan Program Officer, JICA Fiji Office	JICA Fiji Office	
	10:15	Fiji survey (17) inspection	Suva Municipal Market	
	11:00	Fiji survey (18) inspection	Naboro Landfill	
	11:30	Fiji survey (19) inspection	Pacific Harbor	
	14:00	Fiji survey (20) inspection	Inter Continental Fiji Golf & Spa	
	15:30	Fiji survey (21) inspection	Tanoa International Hotel	
30 th March	09:30	With the approach of the tropical cyclone, flood in Nadi city JICA Fiji Office informs us that 2 inspections have been cancelled	Tanoa International Hotel	
	11:00	Fiji survey (22) inspection	Hotel and around Nadi Airport	
	12:30	Discussion with JICA Vanuatu Office	Tanoa International Hotel	
	14:00	Documentation of survey material		
31 st March	04:15	Confirmation of the cancellation of the flight to Port Vila	Nadi Airport	
	10:00	Fiji survey (23) inspection	Hotel and around Nadi Airport	
	13:00	Documentation of survey material Arrangement with contact of Vanuatu and Fiji	Tanoa International Hotel	
1 st April	10:00	Fiji survey (24) inspection	Nadi	
	13:00	Documentation of survey material Arrangement with contact of Vanuatu and Fiji	Tanoa International Hotel	
2 nd April	10:00	Information collection and discussion on the schedule at the hotel	Tanoa International Hotel	
	12:00	Information collection at Nadi Airport	Nadi Airport	
	15:00	Arrangement of schedule with contacts	Tanoa International Hotel	

3 rd April	10:30	Dep. Nadi, Fiji	(transfer)
	17:55	Arr. Incheon, Korea	
4 th April	19:20	Dep. Incheon Korea	
	20:50	Arr. Kansai, Osaka	
5 th April	10:05	Dep. Kansai, Osaka	
	12:10	Arr. Naha, Okinawa	

③ Survey members

Mr. Tetsuo Umemura (University of the Ryukyus)

Mr. Touru Yoshida (Okinawa Environmental Club)

(3) Survey results

The interviews of this survey are listed according to the time line (refer to the survey schedule). The key word in 【 】 after the reply is the knowledge which may be gained from the tourism in Okinawa.

1) JICA Fiji Office courtesy visit and interview

JICA Fiji office is in the forefront of providing assistance in this country. According to Deputy Director Mr. Fukase, at the moment there is no direct assistance project related to tourism, and there was no information on the actual situation of tourism, but there was an explanation that with the change of the political situation, the friction between the Fijian and Indian people which has continued from the past has eased with the present government. On this point, the driver during the transfer from Nandi to Suva also stated that now there is no difference between the Fijian and Indian people, and stressed that everyone born in Fiji is a Fijian. In Fiji there was always a friction between the descendants of the native Fijians and the Indians brought in the English colonial times to grow sugarcane, and there is a history of several coup d'états, and each time there was worries about the effect on tourism, but the reconciliation policy is very important as a foundation for Fiji tourism.

2) Ministry of Public Enterprises, Communications, Civil Aviation & Tourism

This ministry controls the tourism industry in Fiji. In this survey, we interviewed Ms. Nanise Masau (Principal Tourism Officer, Product Development and Ownership).

- Tourism Fiji is under the control of this ministry and the promotion department for Fiji tourism. The annual budget is 3 million Fijian dollars, and the main purpose is to increase the number of tourists.
- The major tourist markets which they are recently focusing are China, India, United Arab Emirates (Dubai), Russia, Brazil.
- Viti Levu Island is prospering with tourism, but tourists do not go much to Vanua Levu island, and there is a gap in the tourism in the country. Therefore to promote Community Based Tourism (CBT) they are considering measures. 【Home stay】
- The domestic food self sufficiency is limited to 3 months. To increase the rate of self sufficiency, they are considering by priority agriculture, fishery, forestry. 【Local products and local consumption】
- The minimum wage in the hotel and food service industry in Fiji is, depending on the job category, F\$2.75/hour to F\$2.97/hour, and higher than other industries.
- They have a rating for the improvement of service for taxis. 【Churashima Okinawa Sightseeing Taxi (Okinawa Sightseeing Taxi Driver Certification)】
- To protect the environment, there was the Green Fiji Standard (Environmental Protection Standard in Fiji) , but after the political change it has been cancelled.

- There is a "Code of Conduct for all of Tour Operators", but they are making a new code.
- Many Fijians are working in the tourism industry, but there is no regulation to give priority to hiring Fijians.
- Management is Australian, New Zealander and American.
- There is a master plan for zoning, and in the old tourism master plan there were 3 zones, but in the new plan the country is divided into 15 zones, with each zone promoting tourism by its characteristics, and the policy is to make the whole country a tourism area. For example Levuka will promote the old city.
- The new tourism master plan (Fiji Tourism Development Plan 2007-2016 -Tourism Fiji's Opportunity) can be bought for F\$50.
- In the Denarau area, there are Hilton, Sofitel, Westin, Sheraton Denarau Villas, Sheraton Fiji Resort, Radisson, Trendwest, and there is a plan to build a new casino. The license has been granted, and when the law passes in the parliament it will become legal.
- The rent in the Denarau resort area is paid every 6 months to the landlord.

3) Fiji Hotel and Tourism Association

This association is a private organization of the hotel and tourism industry. This time we interviewed Mr. Michael Wong (Chief Executive Officer). He has contributed to the establishment of a direct flight with Japan

- The tourism industry is 34% of the GDP of Fiji, and is a F\$1 trillion industry.
- 5,000 people are directly employed in the tourism industry, and indirectly it produces an employment for 230,000 people.
- The positive point of tourism is the westernization of the life style. A woman working in a hotel will see the clean toilet of the hotel and bring the idea into her village. Also the culture shows in the hotels help to continue the culture.
- The negative point of tourism is that of the tourists 50% is Australian, and 15% New Zealanders, and the young people copy the actions and become westernized. Also in the past natural materials were used for living, but it has changed to plastic products which are difficult to decompose naturally.
- There are not many tourists who visit the Pacific Harbor Culture Center. The tourists are concentrated in Nandi, and there are not many tourists who visit Suva and the Coral Coast.
- Not all the souvenirs are made in Fiji, and it includes souvenirs made in Philippines and Indonesia. The shop "Jacks" sells woodcraft made in Fiji.
- The influence of Qantas is becoming strong on Air Pacific (the former national airline), and the reason of the reduction of direct flights to Japan is the reduction in the number of Japanese visitors.
- The market for the tourism in Fiji is Hong Kong, China, Korea, India, and in the future Shanghai and Beijing. In March 2013, three Airbus A330 of Air Pacific is planned to fly from Russia via Europe.
- For the introduction of foreign capital in the tourism industry, there are various taxes such as corporate tax and alcohol tax which are under the control of the Ministry of Finance, and the government is promoting the introduction of foreign capital, and there is a 7 year tax free period for investments over 20 million US\$.
- There is no resort hotel with local capital.
- In 2012 a casino, in 2013 a time share apartment is to be opened.
- The number of rooms in Denarau area is 1,000 rooms and is 20% of the rooms in Fiji, and 50% are hotels of the four star level.
- The main target customers are families, and when the children grow up and

become parents themselves they will become regular customers. 20% are regular customers, and effort is put on services for families with children, such as installment of toilets for children.

- The ranking of the source of foreign exchange in 2011 was tourism, overseas remittance, sugarcane, mineral water, gold.

4) South-Pacific.Travel、(hereunder SPT)

This organization is established by the South Pacific area nations to promote the tourism in this area, and the members are Cook Islands, Fiji, Kiribati, New Caledonia, Niue, Samoa, Solomon Islands, Tahiti (French Polynesia), Tonga, Tuvalu, Banuatu, Papua New Guinea, Nauru, Marshall Islands. China is also an external member.

- Up to 2010, four Japan Overseas Cooperation Volunteers were working in SPT, and the Japanese website was made at that time
- EU and the 14 members contribute the funds for SPT.
- The characteristic of the organization is an independent organization limited to the area.
- Their main business is to support the SME (Small Medium Enterprise) in tourism. They only have a weak link with JICA.
- Activities are ① Capacity building = training, ② Marketing (Presentation at various international travel expositions) , ③ Planning of tourism ICT and development of statistics
- The problem of Pacific tourism is that the statistics are not well developed. **【Development of tourism statistics】**
- Within the island nations, the smaller countries are at the stage of the development of a tourism plan and tourism development, while the larger countries are focused on marketing. Therefore there is a disparity of the development stage of tourism development between the members.
- CBT (Community Based Tourism) can be applied in Vanuatu and Samoa.
- In tourism related investment, generally there is taxation and employment conditions as restrictions for foreign capital.
- In Pacific, in tourism there is a competition between the island nations.
- More focus is on Green Tourism by recyclable energy (solar power generation) than waste management.
- There is not many local products of souvenirs.
- In the development stage of tourism, Fiji and Vanuatu are developed, followed by Tonga and Samoa, and after that Kiribati and Tuvalu.
- Spa is the main health tourism.
- Recently there is a home stay program, and in Nandi they have a Youth Camp, and there are also camps for professional sports **【Sports Tourism】**
- There is no triathlon or marathon, but there is a Music festival.
- Internship of tourism is 3 to 6 months. [The regulation on internship is specified in the minimum wages law]

5) Investment Fiji





This organization was the former FTIB (Fiji Trade and Investment Board), but to promote the introduction of foreign capital the name was changed. The organization is positioned under the Ministry of Public Enterprises, Communications, Civil Aviation & Tourism, and it is an organization to provide a one stop support for all the investment to Fiji.

- This is a department dealing in all the foreign investment to Fiji.






- The incentive for the tourism sector is changed every year. [With regards to the industry structure, by changing the incentive the investment is controlled.]
 - Recently, the main focus has changed from tourism to agriculture.
 - There are similar departments in Vanuatu, PNG, Samoa and Tonga.
 - Foreign investment to tourism (hotel) in 2010 was 14 registered and 8 operating, in 2011 was 28 registered and 5 operating.
 - The condition for investment by the hotels is that 90% of the employees are from residents. 10% can be management and other nationals.
 - Reserve Bank of Fiji monitors the flow of funds.
 - The negative point of introduction of foreign capital is the spread of western culture. [The distinct culture of Fiji has to change.]
 - Basically there is no local rate in the hotel prices, and the price fluctuation is by the seasonality.
 - There is no regulation on nature protection, but there is the Eco Base Project.
 - The license for a casino has been issued by the Cabinet Office.
- 6) Professor David Harrison, Head of School, Faculty of Business and Economics, School of Tourism and Hospitality Management, The University of the South Pacific
- We met with Professor Harrison with the introduction of Professor Ueno of the University of Hawaii, Hawaii Community College. The professor specializes in cultural anthropology, and is knowledgeable in Fiji tourism, but it was memorable that he has a different opinion from the opinion of the tourism related organizations.
- There are still agreed prices and local prices in the hotels of Fiji.
 - The tourism related foreign investment is by the white people for the white people.
 - The white people immigrated in the 70s and the tourism of Fiji began. Afterwards the promotion by the Fiji Visitors Bureau started.
 - 50% of the hotels in Fiji are multinational companies. Only the Tanoa Hotel Group is managed by a Fiji Indian.
 - In the hospitality education in universities, they teach the culture and life style of Australia and New Zealand. It is a 4 year course and in the 3rd year there is an internship of one year. There are 280 students, and the enrollment for the each year is 100 students. 6 students are taking the master degree, and 1 student is in the doctor course.
 - CBT also thinks that Pro-poor Tourism has not succeeded.
 - In Fiji, 45,000 people are employed in the tourism industry.
 - The village on the Coral Coast is dependant on the employment by the hotels.
 - The statistics are unreliable. 90% of the beef in the hotels are made domestically, and wine and spirits are imported.
 - The culture of Kele Kele hampers the accumulation of capital in Fiji.
 - In the island resort, the rent is paid to the village, and in the world currency crisis of 2009, the number of tourists declined but there were cases where the same rent was demanded.
 - There is a need for the localization of tourism. Because the present structure is that 4 to 5 people of the management take 70% to 80% of the profit, and the rest is distributed to the local staff.




7) Tourism facility survey results

Date	Time	Place of inspectoin	Observations
26 th March	09:00	Nandi International Airpot 	The airport is small scale but there is the minimum necessary facility. Effective immigration, baggage handling, several foreign exchange and rent-a-car, airline counters are properly placed, and there is the same scale and facility as the exit of Naha Airport domestic arrivals. http://www.airportsfiji.com/
	09:30	Sri Siva Subramaniya Temple 	This is a Hindu temple on the south of Nandi, and shows the characteristics of the multiethnic nation Fiji. We heard that the river flowing next to the temple flooded in January. Also in late March, this river flooded and Nandi could not be entered from the south. (photo from the internet)
	11:00	Kula Eco Park 	This is a small foreign capital zoo in the middle of Nandi and Suva. Entrance fee is F\$20. It is not a large facility but well maintained. There were some Australian tourist groups, but not many people visit here. According to the interview, in the high season there are 700 to 840 visitors per month, and in the low season 300 to 400 visitors per month. Estimating a monthly average of 600 visitors. There is 7,200 visitors per year. http://www.fijiwild.com/index.html
	12:00	Baravi Handicrafts 	Souvenir shop on Queens Road from Sigatoka to Suva. It sells local handicraft. The size of the shop is small, and most of the products are relatively cheap using shells and tapa cloth.

27 th March	10:30	Government Information Center 	In the center of the town of the capital Suva, before it was the tourist information, but now it has lost that function and there are only several tourism brochures. We did not see tourists visiting.
	15:30	Fiji National Museum 	National museum in Suva. Entrance fee for adults is F\$7. It is not big, and there were not many tourists. The culture and history of Fiji is introduced and you can buy souvenirs related to Fiji culture. http://www.fijimuseum.org.fj/
	15:45	Fiji Government House 	The guards at the Government House are also famous as tourist resources. It is little away from the center of Suva, but there were some people stopping by their cars. They not only perform guard duty, but are service minded towards the tourists, and gave the permission to take photos not in silence but good naturedly. This unique uniform is a heritage of the British colonial times, and it is one symbol of the history of Fiji, and can be a cultural and tourist resource.
28 th March	16:00	Curio and Handicraft Center 	It is a building with many handicraft shops in the seaside of Suva, but because of the rain there were no tourists. Also the products displayed in the storefront were not all made in Fiji. The entrance is free, but it was quiet, and although open not doing business.

28 th March	16:30	Jack's of Fiji 	<p>Jack's is a long established souvenir shop in Fiji. The exterior is modern and many local people were there for shopping, and we were able to interview the staff of the souvenir sales. There are both Fijian products and foreign made products. Fijian products were cosmetics and soap made from coconut oil, coffee, traditional weapons made of wood, and the traditional drink Yangona and the vessels made from tanoa and palm for making Yangona.</p>
29 th March	10:15	Suva Municipal Market 	<p>On the morning of the day moving from Suva to Nandi, we inspected the Suva market. Many vegetables and tropical fruits, potatoes such as taro, cassava, coconuts, carrots were sold in heaps. In the fish corner, freshwater shells, refrigerated and fresh fish were sold.</p>
	11:00	Naboro Landfill 	<p>In Nanboro between Suva and Pacific Corner there is a prison, and a new waste treatment plant has been built. Before there was a large waste disposal site near the coast of the suburbs of Suva, and there was a hygiene problem, but it seem to have relocated. According to the signs, it seems that there was assistance from the EU. There was also a pond to purify the filthy water.</p>
		Art Village, Pacific Harbor 	<p>In Pacific Harbor which is famous for it's golf course, there was a cultural village and accommodation facilities. In actuality it was souvenir shops, but we heard that a culture show is held here. There were not many tourists here.</p>

29 th March		Inter Continental Fiji Golf & Spa 	It is a newly built Inter Continental hotel near Natandora Beach (sand dunes) from Sigatoka towards Nandi. It is not a building and is composed of cottages. It is a very new resort hotel, but there were not many guests.
		Flood site near Queens Road 	With the heavy rain of the day before, we saw the signs of the damage from the flood after passing Sigatoka. The road is built on an embankment and was not flooded, but the low lying houses which were not high floor structure were flooded up to near the roof. Part of the residents were taking refugee in the tents built on the road side.
	15:00	Tanoa International Hotel 	Tanoa International Hotel which we stayed is the sole local (Indian) capital hotel group in Fiji. It is 5 minutes from Nandi Airport, and seems to be used as a transit hotel, with cabin attendants and pilots. They have all the facilities, but there was not enough staff at the reception, and we had to wait many times. http://www.tanoahotels.com/
30 th March	11:00	Around the Hotel and Airport 	There were signs announcing delays and cancellations at Nandi Airpot due to the disruption of flights. Also the road from the airport to the town of Nandi was flooded and a car could not pass. The road to go to the south of the town of Nandi was blocked by police. The road network was completely disrupted by the flood.
	11:10	Supermarket in Nabua (MH) 	Between Nandi International Airpot and the town of Nandi, in the small town of Nabua, there is the Morris Hedstrom (MH) supermarket. Many people were shopping, and this time there were abundant goods, and it did not seem like a shortage. But because the roads are disrupted, it is a sign that there will be a shortage.
31 st	04:15	Nandi International Airpot	At Nandi International Airport, we

March			confirmend that the flight to Port Vila, Vanuatu was cancelled.
1 st April	10:00	<p>Nandi International Airport and the road to Nandi</p> 	At the airport the cancellations and delays of the flights of the major airlines increased, and there were young people sleeping inside the airport. The photo is a road to the south the Nandi called the backroad, but as in the photo it was flooded and cars could not pass.
2 nd April	12:00	<p>Nandi Airport inspection and the response of the hotel</p> 	We confirmed the cancellation of the flight to Vanuatu. The hotel put shutters on all rooms preparing for the typhoon. The hotel explained that there was 4 days food stored, but with the stop of logistics the food shortage worsened, and the hotel meals were buffet only. The price was same as usual at F\$30 per adult, but because of the food shortage there was many potato and cassava, and meat was limited. This situation was same in the restaurant of the airport, and there was no sausage or meat was sold, and fried potatoes were the only menu.

3. Outline of the possible projects towards Pacific assistance

Here, the survey on Okinawa and Pacific Island Countries, "2012 Okinawa Eco Island Symposium - A New Challenge to Protect the Life and the Island." (Symposium of 2010)* Taking into account of its results, we organize the support project for Okinawa and Pacific Island Countries.

* The symposium is sponsored by JICA and Okinawa Prefecture, held in Okinawa on May 23. It attended by the government and the local businesses of Micronesia, Fiji, Palau, Samoa, Solomon Islands and Tonga. It also attended by Japan's government, local businesses, non-profit organizations, and universities.

(1) Water supply

For the water supply of both Samoa and Tonga, stopgap assistance such as leakage measures and purification plant operation management has been provided, and a certain result can be confirmed, but for those other that the subject of assistance the issues still remain without improvement, and also for the assistance subject the same issues happen after a certain period by the lack of follow up after the assistance, and it has not fundamentally improved both countries water supply, and at the moment it is still dependant on the assistance from other countries including Japan.

To supply safe tap water and comfortable water supply, it is necessary to maintain the facility appropriate to the local situation, and to achieve the proper management of the facility totally from the water source to the water tap, and by comprehensively supporting and transferring the technology, it will more effectively contribute to the achievement of sustainable water supply.

As mentioned above, Okinawa has the same issue on water as the Pacific island nations from the scarce water resource environment by the geographical and climate conditions, and in the past has experienced very difficult times such as 326 days consecutive water rationing, and with the assistance of the post war Government of the Ryukyu Islands, and the United States Civil Administration, and after the return to Japan by receiving the assistance from the government, Okinawa has moved step by step towards the development of the water supply system, and now it has achieved a 100% penetration rate of water supply as the water supply system was built in the islands of the prefecture, and has developed to achieve the provision of safe and stable water supply.

In the development of the water supply in Okinawa, in the local government the experience and knowledge related to water supply (provision of service), and in the private companies the technology related to design and construction of facility maintenance, and the installment and repairs of the equipment have been accumulated, and within that, in both the hardware and software there is the unique experience and knowledge of Okinawa, such as the maintenance of water supply facility and approach to water source conservation, and effectively and sustainably utilizing the scarce water resources, and there is a high possibility that this can effectively contribute to the issues faced by the Pacific island nations which have many common points with Okinawa.

In Samoa, there are the issues of the management of the purification treatment facility (ecological purification system (slow sand filter, rapid sand filter)) introduced in some areas, the problem of the non revenue water such as leakage, the problem of water resources such as the shortage of amount of water in the dry season and the rise in raw water turbidity after rainfall, and also the plan to resolve the areas where raw surface water is supplied untreated and unsterilized (securing access to safe water by the introduction of purification facilities). It is expected that by the technical cooperation of "management technology and knowledge of the ecological purification system and fast

sand filter equipment”, “technology for leakage”, “knowledge on securing water sources in small scale rivers and operation of the water source” those issues will be solved.

In Tonga, geographically the water source is limited to underground water, and there are issues of the risk of salination by the increase of pumping amount, loss of limited water resources by the leakage in the pipeline, everyday occurrence of output fault such as water stoppage and water reduction for water supply users, and the concern for the reduction of trust towards water supply, and the technical cooperation using the “experience of working on the advanced underwater conservation”, “technology for leakage”, “experience of water supply restriction” is expected.

Furthermore, in the future, by building a system of “All Okinawa” including the cooperation between the public and private sectors on the technology and knowledge of Okinawa, there is a possibility to support and transfer the technology of “from water source to water tap”, “planning to management”, “management to service” comprehensively and according to the stage, to the Pacific island nations including Samoa and Tonga.

On the other hand the issue for the Okinawa side is the past lack of international contribution and experience of exchange in the water supply field.

To provide international exchange and assistance, an important element is the building of trust with the subject country of assistance, and within the organization of the local government and private companies of the prefecture, it is important to maintain the system and human resources which can respond to international assistance. Among them, in the “Okinawa 21st Century Vision” made by the Okinawa Prefecture in 2010, the policy to actively engage in international contribution and exchange through technology transfer was stated, and the policies towards its realization is being considered.

In regard to the private companies, to consider the participation of private companies in the promotion of technical assistance to the Pacific island nations, the “Water Business Committee” was established by the private companies in the prefecture composed mainly by the general constructions company and water related equipment handling company, industrial chemical manufacturing company, measurement communication equipment company, water supply facility operation maintenance management company, water quality inspection company (registered inspection agency of the Ministry of Health, Labor and Welfare), leakage survey company related to water supply business in Okinawa, and the overseas development by Okinawa prefecture private companies has started to spread, and both the public and private sector is moving towards becoming “international”, and progress is expected.

In the Symposium of 2012, Dr. David Shepard (SPREP; Secretariat of Pacific Regional Environment Program) stated that in order to sustain the development of Pacific Island Countries, the concept of “Eco Island” is very important. He also pointed out the biggest threat to the local water resources are waste and pollutants. In order to find an effective solution, the partnership between the people and the government is essential.

Also, in the group discussion about the water supplies, it has been summarized that in order to obtain useable water in the islands region, it is necessary to improve both the conservation of water sources and the management of water supply. The conservation of water sources are proper waste disposal, diversification of water sources and, groundwater nourishment (the use of rainwater leaching). The management of water supply is its structure and the maintenance of water meters, it is the responsibility of water utilities.

These are the unique challenges of island areas, it is necessary to efficiently utilize and sustain the limited water resources. The issue of having limited water resources especially occurs in Miyakojima Island and the other Okinawa islands. In addition, Miyakojima Island has had many problems such as the groundwater polluted by waste.

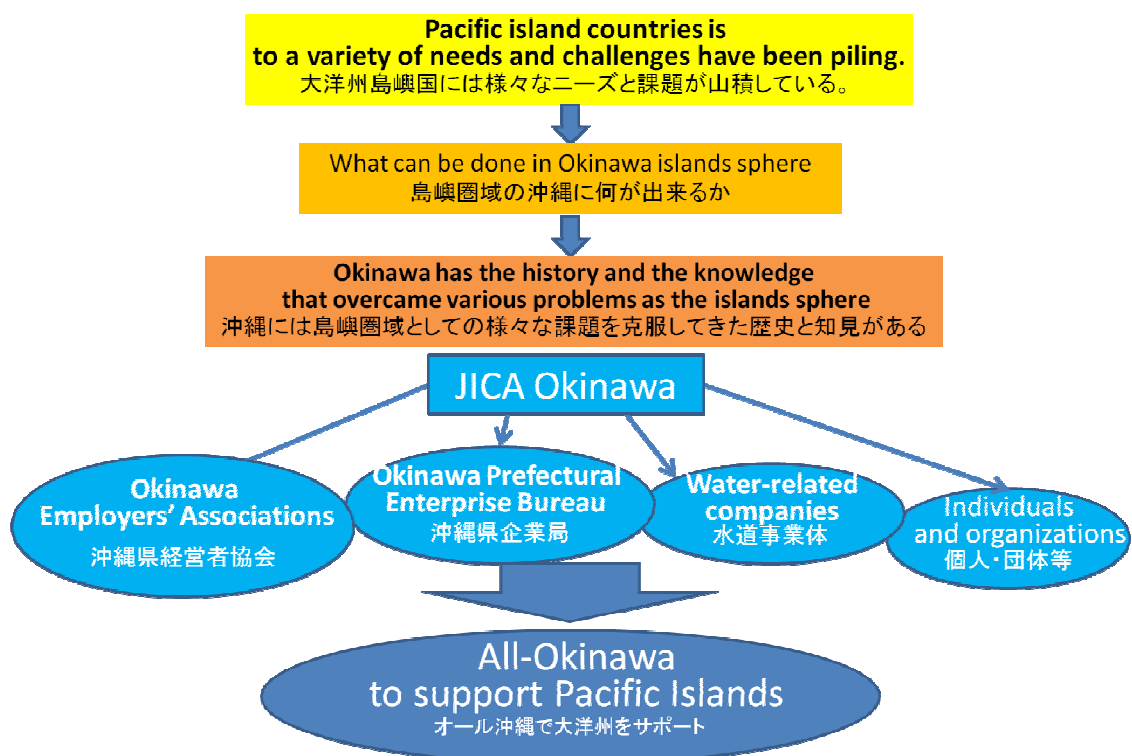
The details are referred to in the recycling of resources (2). Following Miyakojima Island's example for the proper disposal of waste, and using its technology and know-how would likely assist in solving the problem faced by other Pacific island countries.

Meanwhile, Miyakojima Island is currently supporting water supply projects in Samoa. However, in order to help the overall water supply companies in Okinawa, it is essential to introduce the technology, know-how, and the details of the use of the facilities. In addition, the local companies' technology and know-how are indispensable for the water supply project. For this reason, there is a need to build support and cooperation system between the government and the local companies, also there is a need to promote a project prior to starting.

Furthermore, the building of trust with the nation receiving assistance is an important element in assistance, and with the same difficult experience towards water, and similar social climate and character, that there is a common point with the Pacific island nations is a competitive point not found elsewhere, and the building of a network by personal exchange is promoted, and by mutually accumulating and sharing the technology and knowledge of water supply effective for the island nations, it is expected to lead to the sustainable development of the mutual water supply

At "The Sixth Pacific Islands Leaders Meeting" (PALM6), Prime Minister Noda expressed, "I hope Japan and other Pacific Ocean island countries can follow the water system technology model currently in use on Miyakojima Island, in order to overcome their respective water resource challenges."* In order to implement Prime Minister Noda's wishes, the first step will be building the support system in Okinawa as soon as possible.

* May 26, 2012; The Sixth Pacific Islands Leaders Meeting (summary of results); Ministry of Foreign Affairs
(http://www.mofa.go.jp/mofaj/area/ps_summit/palm_06/gaiyo.html)



Possibility of assistance to Samoa

National Strategy	Improvement of the living quality of the people	Water policy (Higher plan)	Increase of access to safe water Building a sustainable water supply system
	Water resources	Water supply facility	Management and Society
Background	<ul style="list-style-type: none"> ○Surface water, spring water, borehole 	<ul style="list-style-type: none"> ○In the urban areas mainly ecological purification system (slow sand filter), in some areas fast filter equipment is introduced ○In other areas raw water is supplied untreated ○In urban areas conveyance and distribution by mainly natural flow ○Pipe type is mainly PVC pipes 	<ul style="list-style-type: none"> ○Low rate of rate collection ○Expected increase of water demand due to development. ○Difficulty of procurement of sites ○Increase in fuel costs
Issues	<ul style="list-style-type: none"> ○Scarce water resources (seasonal fluctuation) ○Contamination of source water quality by development of the source water area 	<ul style="list-style-type: none"> ○Deterioration of treated water due to inadequate management ○Measures for raw water turbidity fluctuation ○Health risk due to supply of untreated water (contamination of water source by sewerage) ○Leakage due to deterioration of pipes and inadequate management (non revenue water over 40%) ○Low installment rate of meters(50%) 	<ul style="list-style-type: none"> ○Low rate structure ○Fixed rate for no meter installment ○High usage of water per person (250L/person/day, including water leakage) ○Introduction of mechanical facilities due to difficulty in site procurement (difficult to properly maintain and manage after introduction)
1) Short term assistance ※Assistance utilizing technical cooperation (training)			
Resources of Okinawa	<ul style="list-style-type: none"> ○Knowledge on the improvement on loss of water (measures against leakage) ○Moving towards a water conservation society (Promotion of the use of rain water for general service water) ○Experience on the conservation restrictions of the water sources (Miyakojima city Ordinance on Underground Water Conservation, Okinawa Prefectural Ordinance on Prevention of Red Clay Outflow) • Structure building (Data collection, analysis and evaluation, institutional design) 	<ul style="list-style-type: none"> ○Experience and knowledge in the management of the Ecological Purification method (slow sand filter method)(measures for turbidity) ○Knowledge on management of the non treated water area (operation of water according to the fluctuation of water quality (turbidity), thorough treatment of chlorine) ○Technology and knowledge of leakage search and leakage repairs ○ Construction technology of various works ○Site management capabilities ○ Strengthening the ability of Samoa water supply technicians 	<ul style="list-style-type: none"> ○Raising the consciousness and development of human resources for water supply business management • Experience on measures against non revenue water ○ Experience of promotion activities towards the improvement of water conservation consciousness ○ Experience and knowledge of water restriction during a draught ○Education activities for the understanding of the people towards public facilities and work

2) Middle and Long term (future) assistance※Assistance utilizing fund cooperation			
	<ul style="list-style-type: none"> ○ Support for water source development and water operation to effectively utilize the scarce water resource <ul style="list-style-type: none"> • Water resource development in the small scales rivers (Maximum utilization during high water) • Knowledge of the formulation of the system by source water characteristics (raw water reservoir, water pipe network) ○ Various source water development (Dam, desalination, sewage treatment) and support on management 	<ul style="list-style-type: none"> ○Support on the introduction of the water purification system most suitable for the conditions of each untreated water supply area <ul style="list-style-type: none"> • Knowledge on various water treatment facilities (Ecological purification system, rapid sand filter, desalination) ○Support on the installment of meter on all taps and proper management (meter check and exchange) 	<ul style="list-style-type: none"> ○ Review of water rate system <ul style="list-style-type: none"> • Improvement on the management of SWA • Promotion towards a water conservation society ○Strengthening of the organization of SWA (Development of the management capabilities for the future) ○ Support on the energy saving systems such as building of clean energy
3) Potential resources			
	<ul style="list-style-type: none"> ○Experience and knowledge of the planning to management of a water supply system utilizing various water sources and purification facilities ○Technology, knowledge and experience on the maintenance management of machinery and equipment under the severe conditions of salt damage ○ Experience under a severe water resource environment (Experience on securing water by the knowledge at each household level) 		

Possibility of assistance to Tonga

National strategy	To create a society in which all Tongans enjoy higher living standards and better quality of life	Water Policy	Improve the access to water and health in the outlying remote islands Improve the water quality in Tongatapu island
	Water resource	Water supply facility	Management and Society
Background	<ul style="list-style-type: none"> ○Water supply water source is underground water only ○Storage of rain water and use as drinking water in each household 	<ul style="list-style-type: none"> ○The underground water is conveyed to the distribution reservoir in top of a hill by underwater pump (commercial electricity) and diesel pump ○There is a plan to increase the borehole (12)(ADB assistance) ○In the regional area, the water is conveyed to the elevated water tank by diesel and PV ○Nuku'alofa city has chlorine sterilization. But it is intermittent input by hand (Once per day) ○The regional area is unsterilized ○Natural flow from the distribution reservoir and elevated water tank 	<ul style="list-style-type: none"> ○The increase of water demand is expected with the increase of population ○The rise of the pump operating costs (Fuel costs and electricity costs) ○Dissatisfaction with the high hardness
Issues	<ul style="list-style-type: none"> ○Inadequate water intake management (no meter installment) ○Risk of salination of freshwater lens by the increase of intake amount ○Risk of underground water contamination from the surface (At the moment no problem in water quality) 	<ul style="list-style-type: none"> ○Leakage from the conveyance pipe (ACP8.1km)(10%) ○Breakdown of the chlorine injection equipment due to inadequate maintenance ○Uneven residual salt density by intermittent injection of chlorine ○Health risk due to the unsterilized water supply in the regional areas ○Inadequate water distribution amount management ○Leakage from the distribution pipe (24%) ○Low water output in the highlands (low water pressure, no water output) 	<ul style="list-style-type: none"> ○Inadequate rate collection (10%) ○Loss of trust of water supply due to low output and hardness ○Improvement of the financial situation by reduction of operating costs (fuel costs and electricity costs)

Resources of Okinawa	Middle and long term (future) assistance		※Assistance utilizing fund cooperation
	<ul style="list-style-type: none"> ○Knowledge on the improvement on loss of water(Leakage measures) ○Experience on underground water conservation (Miyakojima city Ordinance on Underground Water Conservation) <ul style="list-style-type: none"> ・ Structure building (Data collection, analysis and evaluation, institutional design) ○Experience on leading to a water saving society 	<ul style="list-style-type: none"> ○Knowledge of management of intake and distribution amount ○Technology on leakage survey and repairs ○Thorough proper chlorine treatment ○Technology on various works ○Management ability of each site ○Strengthening the ability of the Tonga waster supply technicians 	<ul style="list-style-type: none"> ○Education of raising the consciousness towards water source conservation and saving water ○Raising the consciousness and development of human resources for water supply business management ○Promotion activities towards the improvement of water source conservation and water saving consciousness ○ Experience and knowledge of measures for water restriction during a draught
	Middle and long term (future) assistance		※Assistance utilizing fund cooperation
	<ul style="list-style-type: none"> ○Strengthening the freshwater lens <ul style="list-style-type: none"> ・ Knowledge on water intake methods ・ Underground dam development ○Various source water development (Dam, desalination, sewage treatment) and support on management 	<ul style="list-style-type: none"> ○Improvement and enhancement of the water distribution facility (solving the output failure) ○Support on the installment of meter on all taps and proper management (meter check and exchange) 	<ul style="list-style-type: none"> ○Review of the rate structure <ul style="list-style-type: none"> ・ Improvement of the management of TWA ・ Maintenance of a water saving society (suppression of the increase of water intake) ○Introduction of a water intake system utilizing PV (reduction of operating costs) ○Consideration of the use of water not limited to the Japanese water supply (consideration of use of rain water)
	Potential resources		
	<ul style="list-style-type: none"> ○Experience and knowledge of the planning to management of a water supply system utilizing various water sources and purification facilities ○Technology, knowledge and experience on the maintenance management of machinery and equipment under the severe conditions of salt damage ○ Experience under a severe water resource environment (Experience on securing water by the knowledge at each household level) 		

The competitiveness and issues of Okinawa

Competitiveness of Okinawa	<ul style="list-style-type: none"> ○For the more effective promotion of the achievement of sustainable water supply, what is necessary is not the stopgap assistance of the past, but the comprehensive assistance “from water source to water tap”, “planning to management”, “management to service”. ○Okinawa and the Pacific island nations have many common points in the geographical and climate conditions, social climate and character. ○For the issues on water supply of Samoa and Tonga, there is many experience and knowledge in Okinawa to make possible a comprehensive and gradual assistance. ○In Okinawa the “Okinawa 21st Century Vision” states the policy to actively engage in international contribution and exchange through the transfer of technology for water resources and environment for the Pacific area, and the policies towards its realization is being considered. ○In the private companies of the prefecture, the “Water Business Committee” was established, to consider the participation of private companies in the promotion of technical assistance to the Pacific island nations, and the overseas development by Okinawa prefecture private companies has started to spread. ○With the development of the assistance system by “All Okinawa”, including the cooperation between the public and private sectors, the assistance utilizing the competitiveness of Okinawa for the Pacific island nations, including Samoa and Tonga, becomes possible.
Assistance to Samoa and Tonga	<ul style="list-style-type: none"> ○For both countries, there has been assistance by grant aid by Japan and assistance by other donors, and a certain result can be confirmed, but still there are many issues. ○For both countries, presently there is technical cooperation by JICA operations in Miyakojima city and Okinawa Prefecture, and the transfer of the water supply technology of Okinawa is promoted. ○In the future, when providing grant aid and loan aid, it is important to coordinate with the technical cooperation
Issues on the Okinawa side	<ul style="list-style-type: none"> ○The maintenance of the organization and human resources to respond to international contribution and exchange. ○Lack of record on ODA operation (building of a smooth local work, trust between the local area). <ul style="list-style-type: none"> →Training the private companies in the prefecture, making an environment where the small and medium size companies can easily join in the ODA operations. ○Formulation of an “All Okinawa” support system for comprehensive assistance (risk hedge, risk sharing)

(2) Resource recycling

In Okinawa Prefecture, similar to the Pacific island nations, all the consumer goods are brought from outside, and there are many used products. In Okinawa, for things that can be recycled, they are recycled in the following three ways.

- 1) Recycled in the prefecture and used as recycled resources
- 2) After the intermediate process of separation, crushing and packaging, transported outside the prefecture
- 3) After a similar intermediate process exported to other countries

The iron scraps contained in used automobiles (ELV) and waste household electrical appliances, and empty cans are recycled in Okinawa, and used as a steel resource for construction by the prefecture's steel manufacturing company (Takunan Steel), and almost all of the waste generated in the prefecture is utilized. In the past in the remote areas, the treatment of ELV and waste household electrical appliances was a problem, but with the enactment of the Automobile Recycling Law and the Home Appliance Recycling Law, the system for the cost of recycling was built (part of the transport cost from the remote island is subsidized), and with the steel companies and related companies in the prefecture building a system to dismantle and separate properly and reuse the waste, and the technology being introduced to the remote island area it has become possible to efficiently transport the waste, and recycling has greatly progressed.

For used paper, apart from the paper manufacturing factories in the prefecture using as the material for toilet paper, it is compressed and packaged and transported to paper manufacturing factories outside the prefecture or exported to China. For the PET bottles, local government facilities compress and package the material, and there are companies which separate, crush, and clean and make into flakes, and it is transported to the PET bottle recycling factories outside of the prefecture.

The used paper and PET bottles, are separated and collected in the remote island area and packed locally and transported by container to the main island, and the recycling operator in the main island is providing the intermediate treatment.

In the Nakagusukuwan port industrial park in Okinawa Prefecture, many recycling related companies such as steel plants, ELV dismantling treatment facilities, household electrical appliances dismantling treatment facility, PET bottle flake facility are located.

From this background, we have considered finding a way for the 3R promotion and recycling business support for the Pacific island nations by the utilization of Nakagusukuwan port, and the possibility of contribution to the waste problem of the island nations by utilizing the environmental technology of Okinawa (waste and recycling), and the possibility of business development of the prefecture companies in the island nations.

On the other hand, the demand in Pacific in the field of resource recycling which we have found with this overseas survey is the following.

- 1) Treatment of ELV, batteries and tires (It cannot be handled by the facility capability or technology of the private operators)
- 2) Treatment of large household electrical appliances such as television, refrigerators (it is dumped without being treated)
- 3) The collection and recycling of resources such as used paper and PET bottle generated from the household (there is no knowledge of separate collection, separation and packaging)
- 4) Knowledge to effectively transport outside the island (technology of dismantling, compressing, packaging and knowledge of efficient distribution)

This collection and recycling are an area where Okinawa, especially the remote island areas, have experienced hardship for a long time, and because of that an unique knowledge has been developed. The Pacific countries can utilize this knowledge of

Okinawa, and it is possible to build a system suited to the situation of each local area.

For the metal resources of waste automobile, household electrical appliances, and PET bottles, by introducing the separation and cleaning technology of Okinawa a higher level of recycling is possible, and because the quality as a resource improves, there is a possibility that the sales price will increase. If it is traded at a higher price than the cost of transport to the recycle resource user, the profitability of the recycle operation will increase. From the above viewpoint, in the survey on the recycle companies in the prefecture, apart from the restriction of the treaties and laws such as the Basel Convention, we have received a reply that it is possible to purchase regardless whether it is domestic or from abroad. The issue of the island of transport cost and proper waste management is similar in Okinawa and Pacific. Also in the Pacific island nations the discharge amount of waste is not large and there is no advantage of scale. This is also similar to the Okinawa remote island areas.

With regards to the present situation of the demand of Pacific and resources of Okinawa, on the theme of assistance coordinating with Pacific utilizing recycle port Nakagusuku port, we have outlined the possibility and the issues.

1) The promotion of 3R and recycling business support for the Pacific island nations by the utilization of recycle port Nakagusukuwan port

Recycle port is based on the vision of the “Construction of a total venous distribution system with the port as a core” promoted by the Ministry of Land, Infrastructure, Transport, and the ports to become the hub for the venous distribution is designated as the total venous distribution hub port (recycle port), and as of January 2011, 22 port have been designated in the country.

The ports will not only function as a distribution base, but will become a hub for the production of energy and products, and it may have a waste sea surface disposal site which can dispose the residue generated by recycling, and it has a large potential to complete the life cycle from production to waste. With this potential and by utilizing the low cost and low environment load marine transport, the purpose is to promote as a hub for the venous distribution system with the port as a core, and the flow in a large area of recyclable resources.

Recycle port Nakagusukuwan port is still under development as a port function, but in the industrial park in the backland many recycling related companies are located, and it is possible for many of them to accept the delivery of recycle resources from the island nations. But to transport the recycle resources from the island nations, it has become clear that it is necessary for Nakagusuku port to function more effectively as a recycle port, not only from the point of hardware of the lack of facility of Nakagusuku port, but also by solving one by one the issues of software such as port management and shipping routes.

For Nakagusuku port to function more effectively, there is a high necessity to develop the port facilities gradually, and to develop the effective collection and output of information regarding resource recycling. Also the concept of recycle port represented by Nakagusuku port can be introduced to the Pacific nations, and by developing a recycle distribution hub next to the port of each island, there is an effect of effective distribution and cost reduction.

2) Possibility of contribution to the waste problem of the island nations by utilizing the environmental technology of Okinawa

In the process of forming an island recycle society, in Okinawa the corporate mission of the recycle companies as an environmental company and the improvement of social awareness has greatly contributed to the development of recycling.

In many island nations the capacity of the government is small, and to solve the issues it is necessary to approach other than the government. Especially, recycling is a private operation, and to develop the recycling of the island nations the assistance to recycling operators is essential.

Even if the government and residents collect the resources, if it is not treated in the island or transported out of the island it becomes “waste”. In recycling, the cooperation between the government, residents, recycling operators is necessary. As in Okinawa, it is important to have a perspective that the government makes the recycling companies and NGO their partners.

The recycling companies in the prefecture are active in the contribution by the technical cooperation on the waste problem of the island nations. The island nations do not have the technology and knowledge to effectively recycle, and there is a lack of human resources to effectively separate the discharged waste. Therefore, with the training in a recycle company inviting the recycle operators of the island nation to the prefecture, and operating a local training in the island nations, it can contribute to the provision of necessary technology and knowledge and development of human resources.

Furthermore, together with the strengthening of personal exchange for solving the issues of the island with the development of the human resources of the recycling operator and the provision of knowledge, by establishing an information center to promote the trading of recyclable resources between the island nations, the function of the transmission and mediation of information can be developed.

With the assistance to the recycling operators who are important partners, if it cannot be covered within the framework of the cooperation of JICA, a development of a new scheme such as a NGO familiar with the local situation cooperating with the private company, and expanding the assistance for the recycle operator by involving the government and the residents may be necessary.

In the new scheme, the objective is to build a business between the private sectors, for example the development of the business environment before the BOP survey. And within the JICA cooperation program, positioning this as a new scheme to strengthen the private sector which is essential to the achievement of the objective of the cooperation program within the JICA cooperation program,

3) Possibility of business development of the prefecture companies in the island nations

The population of each Pacific island nation is not large, and there is not enough waste generated to give the advantage of scale. Therefore, the investment in equipment for individual recycling of various items is not realistic. As a business development of the companies in the prefecture, it will be mainly the development of the software such as the technology to safely and efficiently dismantle automobiles, and the knowledge of increasing the values as a resource with the separation by item

It is necessary to provide the technology of software to private operators, and from that point there is a possibility of a “consultant business”, training the knowledge of recycling technology. For hardware, there is a possibility of the utilization of waste treatment and recycling related equipment developed by the companies in Okinawa Prefecture. In particular, including the ones under development, there is the small scale incinerator, garbage treatment equipment (garbage composting equipment), glass bottle crushing equipment, equipment for manufacturing building materials from glass bottles.

The waste treatment and recycling related equipment manufactured by the companies in Okinawa Prefecture have been developed with the demand of the remote islands, and the possibility to utilize the technology for the island nation is high. But the improvement of the equipment to meet the local demand, such as the size of the equipment according to the population size and amount of waste discharged, and easy maintenance, and the

backup for business development such as providing these technical information to the island nations is necessary.

On the other hand, according to Symposium of 2012, in order to sustain the development of islands region, it is important to have a proper waste disposal method. The following two points were raised:

- To address the order of “refuse”, “reduce”, “reuse” and “recycle”
- To facilitate this cycle, the government, local companies, and NGO need to know their role and benefit from each other

The current status of waste disposal in the Pacific island countries has had the same issues as outlying islands of Okinawa. The steel manufacturing companies and other local companies in mainland Okinawa introduce the technique of dismantling and packing waste to outlying island of Okinawa. Not only changing the waste into useable resources, but improve transport efficiency. The government assists transportation, so the waste from outlying islands turn into building materials for mainland Okinawa’s steel manufacturing companies.

The government and local companies have been steadily cooperating with each other. This effort has provided an effective means to resolve the important issues that rose at the symposium.

Present situation and issues of the Pacific island nations and the technology of Okinawa in the field of resource recycling

In the field of Resource Recycling					
Type		Present situation	Issues	Possible solutions	Technology of OKinawa
Automobiles	Collection	Collection by operator, brought in	—	Introduction of a system for collection	Dismantling technology to raise the value as a resource
	Intermediate treatment and storage	Dismantling by cutter, compressing by bailer	No accurate dismantling, small compression amount	Introduction of dismantling technology and press machine	
	Recycling	Export by material (NZ)	—	Purchase centers and recycle centers	
Tire	Collection	Automobile after dismantling	—	Introduction of a system for collection	Technology for cutting for effective transport
	Intermediate treatment and storage	None	There is no equipment for the crushing of the tires.	Intermediate treatment for easy transport	
	Recycling	Some are reused in the country, others final disposal in the country	There is no method for recycling in the country.	Utilization as fuel in the sugar factories and cement factories of Fiji	
Battery	Collection	Collection by operator, automobile after dismantling, brought in	—	Introduction of a system for collection	Mediation for the equipment for packaging safely and transporting to bring out of the island for treatment, knowledge and technology of packaging
	Intermediate treatment and storage	Packing	The battery liquid is illegally dumped.	Safe packaging and export to overseas	
	Recycling	Export (NZ, Fiji)	When exported to Fiji, it is not known if it is treated properly		
Household Electrical Appliances	Collection	Collection by operator, brought in	—	Introduction of a system for collection	The technology of the dismantling and separation of steel and non ferrous metals, and the knowledge and technology of packaging
	Intermediate treatment and storage	Dismantling and separation, compressing and packaging by bailer	No accurate dismantling.	Separation, and easy to transport packaging	
	Recycling	Export by material (NZ), final disposal in the country	Because of rough dismantling the price is low, and there are many parts which cannot be recycled	Recycling by material	
Glass bottles	Collection	Reusable bottles are brought into the dealers	—	Introduction of a system of collection of non reusable	Knowledge of separate collection to raise the

Type		Present situation	Issues	Possible solutions	Technology of OKinawa
				bottles	value as a resource
	Intermediate treatment and storage	Reusable bottles are cleaned in the factory	No technology of recycling		
	Recycling	Some are used in the country, others final disposal in the country	No reuse other than local beer	Reuse of the reused bottles. Recycling of the one way bottles as bottles and other material	Use as road and building material in the island
PET bottles	Collection	Collection by operator, brought in	—	Separate collection	Knowledge of separate collection to raise the value as a resource
	Intermediate treatment and storage	Compressing and packaging by bailer	Compressed with the caps and film remaining	Make into bales and flakes to raise the value as a resource	Technology to make into bails and flakes to raise the value as a resource
	Recycling	Some are disposed overseas, others final disposal in the country	No value trading, because of low quality refused at the quarantine (NZ)	Reused as raw material for chemical fiber and PET bottles	
Paper	Collection	Collection by operator, brought in	—		Knowledge of separate collection to raise the value as a resource
	Intermediate treatment and storage	Compressing and packaging by bailer	Not separated by material	Separation to raise the value as a resource	Technology of separation, pressing to add high value as a resource
	Recycling	Some are disposed overseas, others final disposal in the country	No value trading, because of low quality refused at the quarantine (NZ)	Make into bales by type	

(3) Electricity and Energy

① Samoa

In the Lake Lano site of SWA, there is no electricity distribution line nearby, and the diesel power generator is used as a power source for the underwater pump to pump up water from the lake. Twice a week, it is operated by 2 SWA staff storing the diesel fuel into a drum can and transporting by a pickup truck, and starting up the diesel power generator by hand. The fuel cost of this power generator is 1,200 tala/week (50,000 yen/per week), and it is a large economical burden for SWA. Furthermore, this site is in the mountains one hour from the center of the capital by car, and to arrive at the site it is necessary to climb a unpaved steep hill, and it is a psychological and physical burden on the SWA staff. From this situation, we estimated that the demand on this site for a “water supply system utilizing new energy (solar)” was large.

As a result of the interview of EPC Acting Manager Mr. Peilini and the survey of the Tanugamanono power generation plant, we found that the maintenance and management of the diesel equipment was not being properly done, and the main reason was that in case of breakdown it takes several months to procure the replacement parts, and it is also very expensive.

EPC uses parts called OEM parts (Original Engine Manufacturer parts). OEM parts are parts manufactured by a different manufacturer than the engine manufacturer with the approval of the engine manufacturer. We explained to EPC the idea to build a parts center in Okinawa, and to establish a system to supply the replacement parts quickly, and they commented that if the parts can be bought quickly and at low cost it will be very good. From the operation situation of the power generation plant and the demand of EPC, we estimated that the demand for “parts supply system including the assistance on software” was large.

② Tonga

In the survey of the Matakiki’ eeua Water Supply Facility, there was a pump operated by diesel, and we confirmed a leakage of fuel in a wide area on the soil surface in the surrounding area. If this fuel leaks deeply into the soil, there is a concern about the negative effects on the water quality of the borehole, so it is preferable to change from diesel to an electrical pump. The electricity company TPL is actively promoting the introduction of recyclable energy, and they are considering a plan with the first step to build a micro grid, and as the second step to build a smart grid. When we explained to the CEO of TPL the outline of the experimental study in Miyakojima to reduce the output fluctuation of the PV by the load control of the pump in the farm pond, he showed strong interest. From this situation and from the interest of TPL, we judged that there is a large demand for a “water supply system utilizing new energy (solar)”.

TPL is building a 1MW PV system with the assistance of New Zealand, and the inverter to be installed is made by Emerson Ltd. of U.S and the rated capacity is 1,410kVA. According to the explanation of TPL, the inverter is composed of 8 modules, and to raise the conversion efficiency, the machine is controlled according to the output of the PV. But if the module breaks down and it is necessary to replace, it seems that only the modules manufactured by Emerson Ltd. can be applied. If the PV system is built with combining many commercially available small capacity inverters instead of a large built to order converter, in case of breakdown it can be repaired and replaced by themselves, and there is a possibility that the equipment rate of utilization can be improved by the early recovery. When we explained this idea to TPL, they showed strong interest. With this situation and the interest of TPL, we estimated that the demand for “recyclable energy system using commercial products” is high.

The result of the demands of Samoa and Tonga are listed in the chart below, and for

these 3 systems, we will present by order.

Demand in Samoa and Tonga

Demand	Samoa	Tonga
①Water supply system utilizing new energy (solar)	◎	◎
②Parts supply system including the assistance on software	◎	○
③Recyclable energy system using commercial products	○	◎

(◎ : Large, ○ : Medium, △ : Small)

③Water supply system utilizing new energy (solar)

1) Local demand

- They are using an engine driven lifting pump, and struggling with the rise of fuels cost.
- The supply of fuel takes time and labor.
- There is no electrical transmission line nearby. (Independent type)
- They would like to utilize the smart grid. (grid connected type)

2) System structure and characteristics

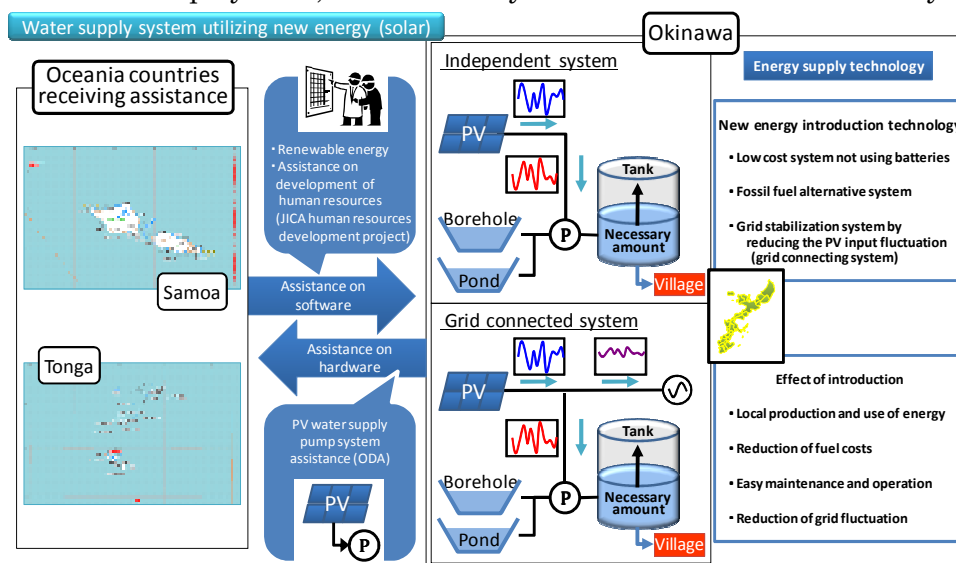
- It can reduce the fuel cost and CO₂.
- It can reduce the cost including the fuel cost and cost for supplying fuel.
- With the role of the reservoir tank water can be supplied stably against the fluctuation of the pump engine by the solar input fluctuation.
- It is suitable for the distributed intake of water for not damaging the freshwater lens.

3) The available technology (seeds) and request of the prefecture

- The manufacture of the system is technically possible.
- For the independent type the experiment in the prefecture is necessary.
- There is a necessity to support the local activities.
- They would like to have an opportunity to confirm the demand and the local situation directly by themselves.

4) Issues and future development

- To make the system better, there is an experimental development necessary as a project of the central government or the prefecture with the purpose to export the system.
- For the actual deployment, it is necessary to have a detailed local survey.



The concept of the water supply system utilizing new energy (solar)

Water supply system utilizing new energy (solar)

2012

First Step

- Planning of the project
- Site survey by each player of the project
- Development and verification experiment of independent system

2014

Second Step

- Development of the introduction of the independent system
- Start of consideration towards the integration of the smart grid and the grid connected system planned by Tonga TPL

Around 2020

Third Step

- Integration of the smart grid and the grid connected system of Tonga TPL

Flowchart of the water supply system utilizing new energy (solar)

③Recyclable energy system made from commercial products

1) Local demand

- Both the electricity companies of Tonga and Samoa have the same idea on having several inverters instead of making the system by one inverter.
- There were many cases where the facility installed by the assistance of various countries was not operational because they could not be repaired.
- It is necessary to build a system to repair by themselves.
- In some facilities with a partial breakdown all of the facility was shut down.

2) System structure and characteristics

- Both the electricity companies of Tonga and Samoa had the recognition on the necessity of having several inverters instead of one inverter, but they did not have the idea of using commercial products.
- By using commercial inverters, it is easy to replace in case of the breakdown of the inverter. Also because there are several installed, even if one inverter breaks down it will only be a partial decrease of output and will not lead to total shutdown.
- It is a commercial product and easy to obtain.
- It can respond flexibly to the increase of facility.
- By controlling the number of the equipment, the operation according to the condition of the grid is possible.

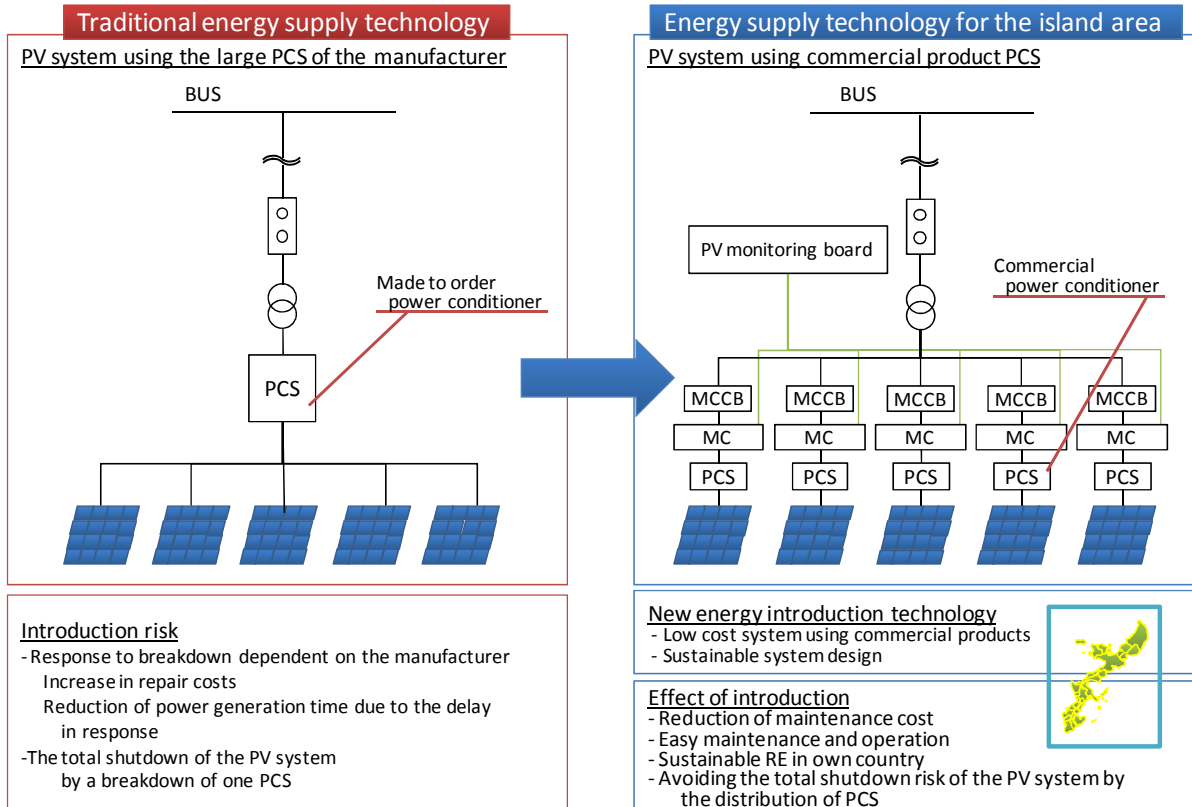
3) The available technology (seeds) and request of the prefecture

- Manufacturing is possible.
- Okinawa has the experience of installing many commercial inverters instead of one large built to order inverter.
- There is a necessity to support the local activities.
- They would like to have an opportunity to confirm the demand and the local situation directly by themselves.

4) Issues and future development

- For the actual deployment, it is necessary to have a detailed local survey.

Renewable energy system made from commercial products



Concept of the recyclable energy system made from commercial products

Renewable energy system made from commercial products

2012

First Step

- Planning of the project
- Consideration of the system structure
- Development and verification experiment of independent system

2013

Second Step

- Introduction to Tonga or Samoa as a model case

Around 2015

Third Step

- Horizontal Development

Flow chart of the recyclable energy system made from commercial products

⑤Parts supply system including the assistance on software

1) Local demand

- They would like to quickly obtain the replacement parts.
- They want the parts manufactured under the authorization of the manufacturer to maintain the performance of the equipment.
- They want to obtain at low cost.
- They want a supply of parts for a long period.
- There were many cases where the facility installed by the assistance of various countries was not operational because they could not be repaired. A building of a support system to repair by themselves in necessary.
- There is a strong mistrust against the Japanese manufacturers whose response for the supply of parts is bad. ※ (information outside this survey)

2) System structure and characteristics

- The parts necessary in the local area can be supplied quickly.
- Even for the parts which have stopped manufacture, it is possible to manufacture if there is a design.
- By the system to rapidly supply the parts, it will lead to the promotion of sales of Japanese products.

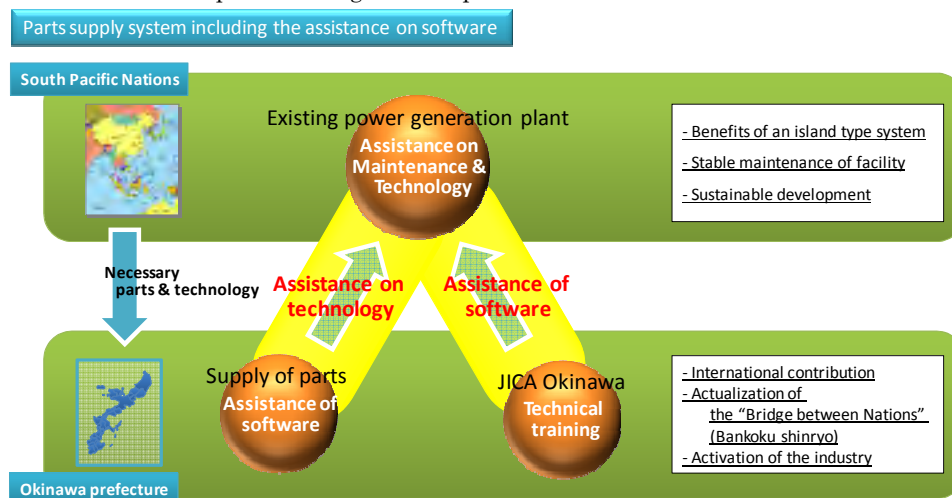
3) The available technology (seeds) and request of the prefecture

- Okinawa has the seeds of the mold processing technology and international distribution hub. By effectively utilizing these it will lead to the promotion of Okinawa industry
- There is a necessity to support the local activities.
- They would like to have an opportunity to confirm the demand and the local situation directly by themselves.
- It is necessary to train human resources who can respond to global business.

4) Issues and future development

- Building of a scheme to manufacture the parts based on the license agreement with the manufacturer.
- Consideration of the logistics from the order of the parts to production and delivery.
- It is necessary to have a system to provide the supply of parts at low cost.

※In the Pacific island nations the size of the business is small and because there is no profit the response of the Japanese manufacturers are not good, and also because the Japanese companies have a general agent agreement and the parts can be procured only through the specific channels the price is being driven up.



The concept of the parts supply system including the assistance on software

Parts supply system including the assistance on software

2012

First Step

- Planning of the project
- Consideration of the system structure

2013

Second Step

- Negotiation towards the license agreement with the manufacturer
- Consideration of logistics and reduction of costs
- Consideration of software assistance

Around 2015

Third Step

- Start of the operation of the parts supply system

Flow chart for the parts supply system including the assistance on software

(4) Tourism

With the interview to the tourism organizations and the inspection of the tourism facilities, there are the following issues in the situation of tourism development in Pacific. The underlined parts are the technology and knowledge which has the possibility to be provided to Pacific from the Okinawa Prefecture government and affiliated organizations, and the tourism industry (In principle, “Okinawa prefecture”).

① Insufficient development of tourism statistics, various surveys related to tourism

Each country cannot be said to have the sufficient development of statistics related to tourism. The number of entry and departure can be found at immigration, but there is no material on the tourism spending per person, the customer base of the tourists, and the demand survey related to tourism services. In Guam, in the customs declaration submitted at the time of entry, there is a questionnaire printed in English and Japanese, and the information is analyzed and disclosed every month. In Okinawa prefecture a highly reliable tourism statistics has been developed, and various surveys have been conducted on tourism with the cooperation of the think tank specialized in tourism such as the public interest incorporated foundation Japan Travel Bureau Foundation (JTBF) and survey companies. These knowledge will be useful for the Pacific island nations.

② The gap in tourism development not only between countries but also domestically

From Fiji which has been recognized in the world as a tourist destination for a long time, and which is expected to develop further with introduction of foreign capital, to the countries such as Kiribati and Tuvalu where the tourism development has just started, there is a gap not only between the countries, but there also exists a gap in income distribution in the country.

For the gap in the tourism development situation between the countries, the (1) development of a national tourism development plan, (2) introduction of foreign capital in the field of tourism, (3) development of tourism human resources, (4) development of tourism infrastructure is necessary. Depending on the degree of development, there is a question of where to put the priorities. For example, it would be divided into countries which put priority in the traffic network and water supply and sewerage for the residents, development of the electrical infrastructure, education, strengthening of the medical services before the development of tourist sites, to countries which should expand the tourism promotion and the development of tourist sites, the policy for the introduction of foreign capital to the field of tourism and the related restrictions on employment and preservation of the natural environment.

The income gap by the effect of the tourism industry in the country depends on how the benefits of tourism income are widely spread. From the point of economics, it is necessary to think not only of a tourism development with wide economical spreading effect, and the economical spreading effect of domestic souvenir sales such as one village one product, but also about policies for home stay, CBT (community based tourism)、locally operated tourism, attracting cruise ships, making the whole island and area an ecological museum.

Either way, from the macro level to the micro level, there are many issues related to the policy for tourism development, but it is necessary to respond by each country. But, not all the Pacific island nations have developed a tourism development plan, and there are still countries which will develop the plan in the future (appendix 2). Okinawa has developed a tourism development plan several times, therefore it is possible to utilize the knowledge of Okinawa on developing a tourism development plan for the Pacific island nations.

③ Limited tourism resource

In every Pacific island nation, there should be no disagreement that the basic tourism resource is the 3S (sea: blue sea, sand: sand beaches, sun: blue sky). Marine sports such as snorkeling and scuba diving, resort islands are a major tourism destination, and island hopping is also popular.

Recently the tourism items have increased, and cultural tourism resources utilizing traditional culture, resort weddings, health tourism mainly by spa, and ecotourism is developed. But, most of these are targeted at the western tourists. On the other hand, in Pacific, China and Asia is thought as a new market, but there is little experience with the services for Asians. On this point Okinawa prefecture can provide support on what is the service for Asian tourists. For example, on the resort weddings for the Asian tourists taking a picture is important. Okinawa prefecture has the competitiveness in this knowledge.

The limited cultural resource is also an issue. There are museums and cultural villages, but there were not many tourists and it was quiet. In the Pacific island nations, the development of resort hotels and golf courses is actively done by the introduction of foreign capital, but the investment to other cultural tourist resources are limited. In Okinawa prefecture, there are various theme parks such as “Churaumi Aquarium” (government operation), “Ryukyumura”, “Okinawa World”. To promote the diversity of the tourism resources of the Pacific island nations, stepping up the support for the museums and cultural villages can be expected.

Furthermore, in the field of sport tourism Okinawa prefecture is an advanced area. (1) receiving the professional baseball and professional football camps, (2) holding beach sports competition such as beach volleyball, (3) holding cycling and marathon, triathlons. These areas are not much developed in Pacific.

For the improvement of services, Okinawa prefecture is working on the taxi certification, which is a measure to improve the quality of service of the taxi drivers, and the introduction of a certification will help in the improvement of tourism service outside the hotel.

④ Opening of direct flights and tourism promotion

To open a direct flight from the tourist market to the destination is a very important element to increase tourists. Recently the direct flights to Okinawa prefecture from overseas are, China Airline (Taipei/Taiwan), Asiana Airlines (Incheon/Korea), China Eastern Airlines (Shanghai/China), Hong Kong Express Airways (Hong Kong), Dragon Air (Hong Kong), Hainan Airlines (Beijing/China), Air China (Beijing/China), Continental Airlines (Guam), Mandarin Airlines (Taichung/Taiwan), and it has increased to nine routes. The Governor of the Prefecture goes directly to the area, and opens the direct international flights by the top sales, but OCVB (Okinawa Convention and Visitors Bureau) has also been working on this strategy. Therefore, it is possible to transfer the knowledge of tourism promotion which the Okinawa prefecture has been working on in the recent years to Pacific.

⑤ Issues on the domestic production of souvenirs

In the souvenirs sold in the souvenir shops of Fiji, many of them were not made in Fiji, but made overseas in Indonesia and China. This would not only limit the economic spreading effect to the country through souvenirs, but also there would be a question of the authenticity as a tourist site. In Okinawa prefecture, regarding souvenirs we have been actively specifying the difference between the products of the prefecture and those that are not so that the consumer (tourist) knows. It is awamori, Ryukyu glass, sea grapes. This measure would also be necessary in the Ocean island nations.

In the present situation, rather than protecting the authenticity of the tourist site, it is more import to spread the economic effects of tourism to the residents through sales of souvenirs, and this is closely related to the “buy local activity” by the Okinawa prefecture.

By using local products for the material of food provided in the tourist facility, it will help in the improvement of domestic self sufficiency rate, and there is a high significance to introduce this measure.

⑥Weakness of the tourist site related to bad weather

In Pacific where it is surrounded by sea, and is spread in an area of tropical and semitropical area, if there is a tropical low pressure or typhoon, not only the domestic transport, but the also the operation of flights which is the key to entry and departure will be effected, and Okinawa prefecture is not an exception. In this survey, we experienced a typhoon by coincidence, and confirmed the response of the tourism industry and government towards tourists. The road around Viti Levu Island was severed by the flood caused by the heavy rain, and the transfer of people and the distribution system was completely paralyzed. We could not go the Nandi city which is near the airport and where many tourists visit, because of the flooding of the roads.

And according to the taxi driver, the road to the Denarau area resort hotels was blocked by flooding. The tourist area became isolated in the island.

1) Response of the government of Fiji

In the local news of the local television, the attitude of the government was emphasizing the point how the tourists will return to their countries, and until the weather recovers the entry is temporally limited. This shows that the government thinks first of the safety of the tourists.

2) JICA Emergency assistance

In Fiji in the same area in end of January this year there was heavy rain and flood, and on the 27th of that month JICA provided an emergency grant aid of goods (100 tents, 100 plastic sheets, 2,400 plastic containers). The tourists of Denarau area could not go to the airport by land, and they moved from Denarau port to a port near the airport by ship. For the damage of this heavy rain and flooding, in 8th April this year, JICA emergency grant aid goods (30 power generators, 30 cord reels, 30 compact water tanks, 30 water purifiers, 240 plastic containers) arrived and were handed over.

3) Response of the hotels

Tanoa international hotel where we stayed informed the hotel guests by signboard that they have 4 days food storage for the hotel guests, to drink water from PET bottles because the water supply system is not functioning, that electricity is operated by a private power generator and asked for the cooperation towards saving electricity. This response should be the same at other hotels, but by clearly explaining the present situation of the hotel and the measures the tourists felt safe.

4) Provision and collection of the information on flights

This time it was difficult to collect information on the flights. Basically the system was that each airline company sends a fax on the information regarding cancellations and delays to the hotels, and that would be displayed at reception. But this information was not complete, and there were airlines which did not send the information. Also there was confusion in the hotel guests, as the fax to announce the cancellation of the morning flight was send during the night of the day before.

The internet environment (hotel wireless LAN) was operating, and by accessing the website of each airline and the Nandi international, it was possible to confirm the flight situation to a certain extent, but these also had time lag for updates, and it was only for reference.

In the end, we were forced to go to the airport 3 hours before departure time, and ask the staff in the check in counter directly. The communication of the flight situation was left to each airline, and the problem was that there was no integrated information offered.

5) Infrastructure on flood control.

Vitu Levu island was a relatively dry area, and grew as a tourist site, but it has been proved by chance that the infrastructure on flood control is very weak. Therefore, from the point of the safety of the tourist site but from securing the distribution, a development of the flood control infrastructure and the natural disaster information system is urgently needed. The government of Japan has already decided to give assistance with the flood in Thailand, but a similar assistance is necessary for the island nations which are fragile against bad weather such as typhoons. This is a field which the Okinawa prefecture has the knowledge with the typhoons coming every year.

⑦ Whether there is enough consideration for the negative sides of tourism development.

In Okinawa prefecture with the rapid increase of the number of tourists, a survey on a sustainable tourist site has been conducted.

The survey was conducted all over the prefecture on the number of annual visitors, parking and toilets, effect to the environment, response of the local government for tourist sites and beaches not only where people from outside the prefecture visit but also people from inside the prefecture visit. The result of this survey has not been fully utilized yet, but it is a project aimed to have a balanced development of the tourist site, by separating the areas to be developed as tourist sites, and areas where nature and culture is reserved and not developed into a tourist site, and it is aiming for a tourist site development with regards to the carrying capacity.

Also, all over the prefecture there is a project for comprehensively surveying the situation of the coral reefs and the change across the ages, and the method and knowledge of the project can be applied to Pacific. This point is mentioned in the “Fiji Tourism Development Plan 2007-2016”.

⑧ Weakness towards natural disasters

Taking lessons from the damage of recent earthquakes as in Indonesia and the resulting tsunami, and the tsunami by the Tohoku earthquake of 11th March 2011, in many areas of Japan the measures against tsunami such as preparation of a hazard map is progressing. In the Okinawa prefecture the reconsideration of the measures against tsunami is done under a more severe condition than before. The recent measures taken by the Okinawa prefecture against the tsunami such as the consideration of an evacuation route, and posting of the height above sea level on telephone poles is a field which can be applied to the Pacific island nations.

⑨ Conclusion

With this site survey, we have developed the competitive knowledge of Okinawa prefecture in the field of tourism. As the field of tourism is a service industry, it is necessary of thinking more about how to transfer the accumulated knowledge and structure to the Pacific island nations according to their situation and development stage rather than the visible technology.

On the other hand, in the international tourist sites in Pacific, the level of service inside the hotels operated by the foreign capital was relatively high. Therefore it should be noted that there is knowledge which Okinawa can gain from the Pacific countries.

This survey report is directly based on the local survey in Fiji, but it also includes the information from previous academic surveys, and the JICA sustainable tourism

development training done by JICA Okinawa from 2005 for 6 years. Also, because of the typhoon in Fiji, the Vanuatu survey was not possible, but at the same time we had a real experience of the effect of typhoon on the island tourism. Following is the points we found.

- Against bad weather in Pacific, we understood that as the infrastructure of roads and flood control is fragile, there is a large effect on tourism such as the roads being blocked. Of course there was the cancellation and delay of the international flights, and the tourists had to stay at the hotel, and there was a limit to the food storage of hotels, and the quality of meals visibly deteriorated.
- The flight information was sent by fax from each airline to be obtained at the hotel, but this information was not 100%, and we understood that in the end the correct information could only be gained at the airline check in counter at the airport.
- In the hotels, as the tourists were westerners, there was an effort to explain quickly and in detail by the signboard about the situation the hotel itself is facing. The photo of face of the hotel manager was also made available. In other words, the active disclosure of information eased the anxiety of the hotel guests, or there was an effort to make accountability certain.

By being involved in the middle of a natural disaster, this survey clarified the disaster prevention, and the effect during the natural disaster to the government and the tourism related industries, and the effect to the local residents, and we conclude that it was meaningful that the information was gained to make a proposal, which can be made only by Japan and tourism prefecture Okinawa which has experienced the great earthquake.

Following is the subjects with the possibility of providing from Okinawa to Pacific.

- 1) Municipalities and private companies (promoted by the local area and each industry)
 - Domestic production of souvenirs (including the establishment of standards by industry groups)
 - Linkage between tourism and other industries such as agriculture (contract farmers system etc)
 - Tourism by the local area(home stay, agriculture and fishery experience, cultural exchange, reduction of local poverty)
 - Introduction and management system of the sport tourism
- 2) Item by Okinawa Prefecture and OCVB (Items to be handled as a general policy and strategy)
 - Development of tourism statistics, the need and method for various surveys related to tourism
 - Knowledge on the planning and implementation of tourism development plans, action plans (annual plan)
 - Improvement of the quality as a tourist area by the introduction of certifications for tourism services such as taxis
 - Transfer of the knowledge on the hospitality for the Asian market (training)
 - Measures for bad weather such as typhoon
 - Measures against tsunami such as hazard maps
 - Development of flood control infrastructure

(5) Issues towards assistance

① From government assistance to private assistance.

In Okinawa, in the process of an island recycle society, the corporate mission of the recycle companies as an environmental company and the improvement of social awareness has greatly contributed to the development of recycling. Also, the local private sector has an important position in the promotion of the tourism industry in Okinawa such as the promotion campaign developed by both the government and private sector working together and the promotion of ecotourism utilizing the environmental resources of the area and development of souvenirs by the private companies and NPOs.

This situation can be seen in all the areas where it is operated publically, such as water supply and electricity and energy, and it has developed by the accumulation of knowledge and the technology by the local private companies, and the government utilizing that technology.

In the regional development of Okinawa the contribution of the private sector (private companies and NPOs) is essential, and they are an import partner of the government.

On the other hand, in the Pacific island nations, most of it is left to the private sector. There is also a limit to the administrative capacity, and it is difficult to solve the issues by approaching only the government.

For example, the recycling is done by private operators, but the company size is small and they do not have enough facilities or knowledge. For example, for the ELV (used automobiles) which is always a problem in the island area, there is a certain amount of treatment done, but because there is no technology of dismantling to add additional value as scrap, or knowledge of hazardous waste treatment such as oil, and there is not enough pressing facilities for transporting outside the island, a large amount of ELV is accumulated without treatment. Also used paper is not recycled because there is no pressing and packaging facility. To promote these recycling the assistance of technology provision and assistance on facilities of the related private operators is essential.

For the assistance to the private sector which is an important partner of the government, if this cannot be covered by the system of cooperation of JICA, it is necessary to develop a new scheme such as the NGO which knows the local situation cooperating with the company, and to develop assistance together with the government and the residents.

For example the assistance for the business environment development stage which is the condition for the BOP business survey, the positioning in the JICA cooperation program of a new scheme to strengthen the private sector which is essential to the achievement of the objective can be considered.

By strengthening the local private sector related to each field in the Pacific island nations, in the future it is possible to build the business between the private sector of both Okinawa and the Pacific island nations, and there is a high possibility that this will lead to the development of the Pacific area.

② Building a system on the Okinawa side

Basically, the equipment and system utilized by the Okinawa companies are based on the equipment and technology of mainland Japan, and improved and developed with the demand of the island area. Therefore, there is a high possibility that it can be utilized as a technology responding to Pacific.

But, the most of the resources of the Okinawa companies are the knowledge and technology of equipment operation and improvement and maintenance, and there is a high possibility that it will only be the provision of knowledge and technology, and the benefit for the Okinawa companies providing the resource is not clear.

Also, each company is utilizing it individually, and for the introduction of the resources of

the companies of Okinawa to the Pacific island nations, it is necessary to first understand the situation and demand of the places to introduce, and try the development and improvement according to the situation of the local area and verification tests.

On the other hand, the Okinawa companies are small and their management base is weak, and they are reluctant to invest their management resources into a development which is not directly linked to business.

For this reason, it is necessary to have the support from the government such as the central government or Okinawa Prefecture for the detailed survey and development and verification test of the Pacific island nations where it will be introduced.

Also, in addition to the private sector and the government, if JICA and the universities work together and conduct the collection of the information of the Pacific island nations and the development and verification test of equipment in Okinawa, and also provide training not only for the government but also for the private sector of the Pacific island nations, it will greatly contribute to the promotion of the “international cooperation and exchange through technology transfer” set in the “Okinawa 21st Century Vision” .

③ Development of the infrastructure on transfer and transport

To provide sustainable cooperation from Okinawa to the Pacific island nations, it is necessary to develop the infrastructure related to the transfer of people and goods to make the development on a business basis by the private sector in Okinawa.

As one example, in the recycling field, there are the recycling companies which use the separated waste as raw material, such as the steel plants who collect the scraps of iron and use them as the raw material to manufacture products, and PET intermediate treatment operators. These companies have the ability to respond to receiving raw material from overseas, and regard receiving good quality resources as a business opportunity.

These recycling companies are located around the Nakagusukuwan port of Okinawa main island which is designated as a recycle port. By utilizing this port and receiving resources from overseas, the business development of the Okinawa companies are expected.

But with Nakagusuku port, it is not only the problem of hardware that there is a lack of facility, but there are issues remaining in the software such as the management of the port and the shipping routes. By solving these issues one by one, and making Nakagusuku port function effectively as a recycling port, it will be possible to accelerate the future business based development, and have sustainable cooperation with overseas.

Also, with this overseas survey, we moved through Tokyo, Osaka and Korea to the Pacific island nations. In the future, to deepen the cooperation with the Pacific island nations on a business basis, it will be necessary to have a shipping route to make possible it go directly to Pacific without going through mainland Japan.

III. Proposal

Okinawa and the Pacific island nations both have a rich natural environment. But they also have common restrictions resulting from the geography to economic development, such as that it is separated by sea and far away from the large markets of the big cities. Also, in the development process of the economy and society, Okinawa has experienced the same hardships as the present Pacific island nations in securing and providing water and energy, and treatment of waste. Furthermore the social climate and the character is similar to Okinawa. This is an important element in building a trusting relationship and supporting the Pacific island nations, and a competitive part of Okinawa not seen in mainland Japan.

In this survey we have looked for effective resources for the cooperation for the Pacific island nations mainly in water, energy, recycling and tourism which have contributed to the economic development of Okinawa.

The resource of Okinawa is mainly the knowledge and technology of improvement and operation unique to the island area. But these resources are contributing to the economic development and improvement of the environment of the island area Okinawa, and should be effective in the assistance towards the development of the Pacific island nations.

Also, a resource developed by the technology of Okinawa and accompanied by the hardware close to the development of the business basis was confirmed. The direction towards the overseas development of the private sector is also spreading, such as the establishment of the “Committee to consider the water business by the Okinawa Management Association” which is exploring the overseas development of the resources of Okinawa.

But, to effectively utilize the resources of Okinawa as a cooperation resource for the Pacific island nations, there are difficult issues which cannot be solved by the private sector of the individual private companies and NPOs of Okinawa which have an effective resource, such as collecting the detailed information on the utilization of each country, and the development and verification test of the equipment suited to the environment of each country.

To conduct an actual cooperation project for the Pacific island nations using the resources of Okinawa, it is necessary to build a system where the private sector which has the resources of Okinawa, and the government, Okinawa Prefecture, JICA and universities to get together, and prepare the collection of the various information of the Pacific island nations and the verification test towards the formulation of the project.

From this preparation stage, by providing training and the sending specialists for the Pacific island nations, with the system of the government and private sector of Okinawa working together, it will be one measure towards the realization of the “international cooperation and exchange through technology transfer” set in the “Okinawa 21st Century Vision” .

On the other hand, in the Pacific island nations, most of the activities in the field which was the subject of this survey is done mainly by the private sector. To promote the future development of the Pacific island nations, it is necessary to develop the training and sending of specialist not only for the government but also for the private sector.

By having an exchange including the government and the private sector both in Okinawa and in the Pacific island nations, it will build a wide personal network, and by both sides accumulating and sharing the technology and knowledge effective for the island area, it is expected to lead to the sustainable development of the Pacific island nations and Okinawa.

Furthermore, by the further development of infrastructure related to the transfer of people and goods of the airports and ports of Okinawa, it will be easier for the overseas development of the private sector of Okinawa on a business basis, and not only with the Pacific island nations, but it is expected to greatly progress the wide cooperation with overseas.